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A New Era: Towards a New World of Green Prosperity

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Preface

Established with the approval of the Chinese government in 1992, the China Council for International Cooperation on Environment and Development (CCICED) is a high-level international advisory body. Its core tasks are to conduct policy research on environment and sustainable development problems of domestic, regional or global significance and provide policy recommendations to the Chinese government.

Over the past 28 years, CCICED has witnessed and taken part in China's historic shifts in development philosophy and model. It has opened the door to international experience on sustainable development and built a bridge to promote exchanges between China and the international community on environment and development. It has also provided a valuable platform for two-way dialogues, enabling the international community to improve understanding of Chinese approaches and support the country's engagement with the world.

The year 2019 marks the 70th anniversary of the founding of the People's Republic of China. It is a crucial year for winning the tough battle of pollution prevention and control and securing a decisive victory in building a moderately prosperous society in all respects. It also witnessed the start of drafting the 14th Five-Year Plan for Economic and Social Development. Faced with sluggish global economic growth and mounting downward pressure in the domestic market, China needs to find a new way out to implement its new development concepts, promote ecological civilization construction, enhance ecological and environmental protection and achieve high-quality development.

Against such background, CCICED held its 2019 Annual General Meeting with the theme of "A New Era: Towards a New World of Green Prosperity" to discuss issues on green transition and high-quality development during the 14th Five-Year Plan Period. Han Zheng, Vice Premier of the State Council and CCICED Chairperson, pointed out at the Closing Ceremony of the Annual General Meeting, that China will continue to embrace green development to pursue modernization characterized by harmonious coexistence between man and nature, and contribute to global ecological security.

It is agreed by Chinese and international CCICED Council Members that China's economy has been transitioning from a phase of rapid growth to a stage of high-quality development. Such a transition will effectively address the contradiction between unbalanced

and inadequate development and the people's ever-growing needs for a better life, and promote ecological and environmental protection and sustainable development. Green development is a major component of high-quality development. Forming consensus on green development is the base for the construction of ecological civilization.

As an annual publication, the Policy Report is based on the research outputs of CCICED in 2019. It presents the policy recommendations proposed by Chinese and international CCICED Council Members, Special Advisors, and experts, for the reference of decision makers of all levels, scholars and the public.

Acknowledgement

China Council for International Cooperation on Environment and Development (CCICED) conducted a series of research projects in 2019 with the support of Chinese and international experts (including Council Members) and partners, including: Global Climate Governance and China's Role, Post-2020 Global Biodiversity Conservation, Global Ocean Governance and Ecological Civilization, Green Urbanization Strategy and Pathways towards Regional Integrated Development, Ecological Compensation and Green Development Institutional Reform in the Yangtze River Economic Belt (YREB), Goals and Pathways for Environmental Improvement by 2035, Green Transition and Sustainable Social Governance, and Green Belt and Road and 2030 Agenda for Sustainable Development. The book is based on the outputs of these research projects. Acknowledgement is given to the following experts engaged in these projects:

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Implementing the New Idea of Green Development Towards a New World of Green Prosperity* (Excerpts)

(Preface One)

HAN Zheng

China Council for International Cooperation on Environment and Development (CCICED) 2019 Annual General Meeting has completed its agenda and is now drawing to a successful close. Here, on behalf of the Chinese government, I wish to express warm congratulations on the complete success of the meeting.

The theme of this Annual General Meeting—“A New Era: Towards a New World of Green Prosperity”—is most fitting under the current circumstances. The color green is the symbol of life and the color of nature. Green development has become a trend of today’s world, which represents people’s aspirations to live a better life and the direction of human civilizations going forward.

China attaches great importance to the construction of ecological civilization. Since the 18th CPC National Congress, under the leadership of the CPC Central Committee with Comrade Xi Jinping at its core, China’s efforts to promote ecological progress and environmental protection, from practices to theories, have gone through a historic turnaround with wide-ranging implications. As China’s building of an ecological civilization has entered a fast track, a beautiful China with more blue skies, lush mountains and lucid waters is unfolding.

—We have deepened the supply-side structural reforms and accelerated the transition to green development.

In 2018, the crude steel production capacity was reduced by more than 35 million tons and the backward coal production capacity was pulled out by 270 million tons, completing

* Extract from the Closing Remarks by Han Zheng Vice Premier of the State Council of the People’s Republic of China, Chairperson of China Council for International Cooperation on Environment and Development (CCICED) At the Closing Ceremony of 2019 Annual General Meeting of CCICED June 4, 2019.

the “13th Five-Year Plan” target ahead of schedule. The proportion of clean energy consumption rose to 22.1%, making China the world’s largest country in the use of new and renewable energy. Constant endeavors were made in energy resources conservation, with energy consumption per unit of GDP falling by 3.1% year-on-year.

—We have given top priority to tackling environmental issues that are of the greatest public concern and continued to improve the ecological quality.

In 2018, the average concentration of PM_{2.5} in 338 cities at and above prefecture-level went down 9.3% year-on-year, in which the Beijing-Tianjin-Hebei Region and its surrounding areas, Yangtze River Delta and the Fenwei Plain all dropped by over 10%. As for water quality, the volume of the surface water bodies with water quality to or above Grade III national standard in China improved from 67.9% to 71%, and surface water below Grade V, the lowest ranking, declined from 8.3% to 6.7%. We also stepped up to improve rural living environments, accomplishing integrated treatment to 25 thousand administrative villages.

—We have comprehensively intensified the protection of ecosystems and improved national shields for ecological security.

The number of national nature reserves increased to 474, effectively protecting the natural ecosystem and most of the key wildlife species. We have promoted large-scale afforestation, in 2018, more than 100 million mu of land was afforested nationwide and the forest coverage rate increased to nearly 23%. Data shows during the past two decades, about a quarter of the new greening areas on the surface of the Earth came from China.

—We have launched rigorous supervision and compliance inspection and initially shaped an environmental governance system with the engagement of multiple parties.

The first round of follow-up ecological and environmental protection inspections was carried out by the central government, addressing a total of 140 thousand environmental problems occurred on the people’s doorsteps. We issued the *Code of Conduct for Environmental Protection* and promoted the opening of 124 environmental protection facilities and municipal wastewater and waste treatment facilities to the public, involving more and more public efforts in protecting the ecology and environment.

—We have actively participated in global ecological and environmental governance and played an increasingly important role in building a clean and beautiful world.

China has worked together with the international community to put the *Paris Agreement* to conclude and enter into force. In 2018, we promoted a full success of the UN climate conference (COP24) in Katowice. China has earnestly implemented the national strategy to actively tackle climate change. The carbon dioxide emissions per unit of GDP in 2018 dropped by 45.8% compared to that of 2005, already surpassing the 2020 target.

On April 28, 2019, President Xi Jinping attended the opening ceremony of the International Horticultural Exhibition in Beijing and delivered important remarks. He clearly articulated five proposals to preserve what gives our planet life and embrace green development. China will unswervingly implement the new mentality of green development to achieve a new state of modernization in which man and nature live in harmony and make new contributions to global ecological security.

First, guided by green development, we need to actively establish a modern economic system.

We will continue to pursue supply-side structural reform as our main task, properly implement the innovation-driven development strategy, promote a smart and clean upgrade of traditional industries, accelerate the development of energy-saving and environment protection sectors, and foster new industries, businesses and patterns. We will strive to develop clean energy, and improve the level of clean utilization. We must promote all-round conservation and recycling of resources, and ensure that the systems of production and everyday life overlap in their circular use of resources.

Second, taking improving ecological and environmental quality as the core, we need to secure a victory in the fight against pollution.

We will maintain a strategic focus on enhancing ecological civilization, to fulfill ecological environment protection targets by 2020. By making it a priority to win a decisive victory in the campaign to defend our blue skies, we need to step up structure adjustments to industry, energy, transportation and land use and strengthen joint efforts to prevent and control pollution to further improve the air quality. We must thoroughly implement our action plan for preventing and controlling water pollution, to guarantee the safety of drinking water, and to deal with dark and fetid water bodies in urban areas. We must also fight against soil pollution, boosting the management and restoration of areas affected by soil pollution.

Third, following the harmonious coexistence between man and nature, we need to strengthen ecological system protection.

We will define and rigorously enforce red lines for environmental protection, optimizing the distribution of territorial space available for development. Throughout the process of development, we must prioritize environmental protection and put the restoration of nature first, protecting and restoring the ecology from an overall perspective. We need to develop a nature reserves system composed mainly of national parks, providing the strictest protection for important natural ecosystems. We will promote afforestation, take comprehensive steps to control desertification, stony deserts, and soil erosion.

Fourth, taking modernizing China's system and capacity for governance in the field

of ecology and environment as the goal, we need to deepen the reform of the system for developing an ecological civilization.

We will enhance conservation of the ecological system, improve the ecological environment supervision system and better govern ecological environment in a market-oriented and legal-based manner. We should build a system of social actions, to realize a multipartite governance that features government leadership and participation from enterprises, social organizations and the public.

Fifth, agreeing on a common path of global green prosperity, we need to join hands to meet global environmental challenges.

We are willing to get deeply involved into global environmental governance and jointly tackle global environmental issues like climate change, marine pollution and biodiversity protection. China will fulfill its obligations as the host country in hosting the 15th meeting of the Conference of the Parties to the *Convention on Biological Diversity* in 2020 and making positive efforts for protecting the global biodiversity. We will promote the development of the International Coalition for Green Development on the Belt and Road and the ecological and environmental protection big data platform, and jointly implement the UN 2030 Agenda for Sustainable Development.

Interaction among civilizations spurs diversity, which in turn promotes mutual learning and their further development. The Chinese government highly recognized the great efforts of CCICED in promoting China's sustainable development and would continue to support the CCICED in playing its important roles. Hope fellow members and experts would put forward more prospective and operational policy recommendations for China's ecological and environmental protection and green and low-carbon development.

I congratulate again the CCICED 2019 Annual General Meeting a complete success, and wish all fellow members, experts and friends a pleasant stay in Hangzhou.

Thank you.

Maintaining a Strategic Focus on Strengthening Ecological Preservation to Promote a High-quality Development*

(Preface Two)

LI Ganjie

Themed with “A New Era: Towards a New World of Green Prosperity”, the annual general meeting 2019 will propose policy advice for China’s “14th Five-Year Plan”, which manifests the CCICED’s foresight and strategic mindset. Meanwhile, this year’s annual meeting will act in concert with the home events of World Environment Day, centering on tackling air pollution, to share China’s confidence and determination in improving air quality and winning the battle to defend the blue sky with all countries. Here, I’d like to exchange ideas with you under the theme of “Maintaining a Strategic Focus on Strengthening Ecological Preservation, to Promote a High-quality Development”.

The Chinese government has always attached great importance to ecological progress and environmental protection. President Xi Jinping came up with the philosophy “Lucid waters and lush mountains are invaluable assets” in his visit to Yu Village, Anji county in 2005, when he was Party chief of Zhejiang Province. Tomorrow, you may walk around and take a look at Anji on site. I believe you would have direct and deep impressions on China’s practicing the concept of green development and exploring ecological conservation.

Since the 18th CPC National Congress, the Chinese government has integrated the construction of ecological civilization into the grand blueprint of the country’s governance. Ecological conservation is included as one part of the “five-sphere integrated plan”. Adhering to the harmonious coexistence of human beings and nature is one of the basic strategies for upholding and developing socialism with Chinese characteristics in the new era. “Green” is one of the major concepts in the new development philosophy, and the tough war against pollution is one of the three critical battles. Chinese President Xi Jinping has put forward

* Extract from the Remarks by Li Ganjie Former Minister of Ecology and Environment Executive Vice-chairperson of China Council for International Cooperation on Environment and Development (CCICED) At the Closing Ceremony of 2019 Annual General Meeting of CCICED June 4, 2019.

a series of new concepts, new ideas, new strategies and new requirements on ecological conservation and ecological environment protection, stressing on the close ties between civilization and nature, the harmonious coexistence between man and nature, that lucid waters and lush mountains are invaluable assets, that no welfare more universally beneficial than a sound natural environment, that our mountains, rivers, forests, fields, lakes and grasslands together form a biotic community, that the strictest regulations and laws must be applied in protecting the environment, the national action for building a beautiful China, and that joint efforts must be made in building a global ecological civilization, etc.. These new ideas in all formed up the Xi Jinping Thought on Ecological Civilization, mapping out the course for China's ecological conservation and environmental protection.

Guided by the Xi Jinping Thought on Ecological Civilization, since 2018, China's ecological and environmental protection has made positive progress. The world will see a China with more blue skies, lush mountains and lucid waters.

First, we have basically completed the reform of ecological and environmental institutions. China's institutional reform in the field of ecology and environment has attracted wide attention home and abroad. Over the past year or so, we have successfully completed the establishment of the Ministry of Ecology and Environment, and set up ecology and environment bureaus (departments) in 31 provinces (autonomous regions and municipalities) to perform monitoring and law enforcement duties for ecological affairs and urban and rural pollution discharging. Meanwhile, a comprehensive law enforcement team for ecological environment protection has been established to enhance the unity, independence, authority and effectiveness of law enforcement. 7 bureaus for monitoring and managing river basins and sea areas ecological environment were set up to improve the system, which recently completed inauguration in succession.

Second, we have continued taking actions in air, water and soil pollution prevention and control and constantly improved ecological and environmental quality. In 2018, a year-on-year increase of 1.3 percentage points occurred in the proportion of days with good or excellent air quality for cities at or above prefectural level (APL cities), while the annual average PM_{2.5} concentrations dropped by 9.3%. As for water quality, the volume of the surface water bodies with water quality to or above Grade III national standard rose by 3.1 percentage points, and surface water inferior to Grade V deceased by 1.6 percentage points. From January to May, 2019, the proportion of days with good or excellent air quality for APL cities was up by 0.6 percentage points; the year-on-year average PM_{2.5} concentrations level was even, while that of Beijing fell by 14.3%. The proportion of surface water sections with excellent and good water quality rose by 5.4 percentage points year-on-year, and that inferior

to Grade V dropping by 2.8 percentage points.

Third, we have vigorously promoted high-quality economic development. We have adopted 15 key measures to reform management of environmental protection to better facilitate high-quality development. Some of the measures are expected to make the examination and approval processes of environmental impact assessments more efficient. We compiled “Three Lines and One List” (ecological protection red lines, environmental quality bottom lines, resource utilization upper limits, and environmental access negative list) for the 11 provinces or cities along the Yangtze River Economic Belt and Qinghai Province, to guide and optimize the industrial distribution. We have strengthened efforts of inspection law enforcement, and brought scattered, non-compliant, and polluting industries and aggregates under control, effectively tackling the issue of “Bad money drives out good”, and constantly improving the productivity and efficiency of compliant enterprises. The ministry will carry out measures to promote green development in the private sector to improve the market access system, promoting a long-acting mechanism to support the green development of private enterprises.

It has been proved that China’s intensified efforts in environmental governance is an efficient impetus for the country’s high-quality development in the new era. In 2018, a total of 114.38 billion yuan was invested to treat black and odorous water bodies in key urban areas in China. The shift from bulk coal to natural gas and electricity as heating sources in northern China also promotes consumption and investment. China saw investment in ecological protection and environmental rehabilitation increase 43 percent year-on-year in 2018, an annual growth of 19.1 percentage points. From this point, the contribution from the environmental protection sector to economic development has been increasing, becoming a new highlight in China’s economic growth.

Fourth, we have extensively engaged in global environmental governance. China played a constructive role in the 2018 UN climate conference (COP24) in Katowice, delivering comprehensive, balanced and robust outcomes of the Climate Package. We held the Thematic Forum on Green Silk Road of the Second Belt and Road Forum (BRF) for International Cooperation, initiated the International Coalition for Green Development on the Belt and Road and the ecological and environmental protection big data service platform to build the Green Silk Road, and jointly implement the UN 2030 Agenda for Sustainable Development.

Fellow members and experts,

President Xi Jinping pointed out, in the Chinese economy’s transition from the phase of rapid growth to a stage of high-quality development, pollution control and environmental

governance are two major tasks that must be accomplished. He emphasized that we must unwaveringly maintain a strategic resolve in enhancing the building of an ecological civilization and never slacken our efforts, to explore a new path of high-quality development that prioritizes ecology and highlights green development. He called for intensified protection of the ecological system, urging people to fight resolutely against pollution.

2019 marks the 70th anniversary of the founding of the People's Republic of China. It is a decisive year in finishing the building of a moderately prosperous society in all respects and winning the battle against pollution. We will remain the efforts and trends to combat pollution, consolidate our achievements, and stay determined in the direction we have chosen. In promoting high-quality development of economy in concert with high-level protection of ecology and environment, China's environmental quality will keep improving and a bright future for sustaining the development of the Chinese nation is on the way.

First, we need to unswervingly implement the concept of green development. We need to consciously integrate economic and social development with ecological conservation, and make overall plans, in a way that helps reduce pollutants and improve the ecological and environmental quality, that helps advance structural adjustments and promote high-quality economic growth; and that helps solve the prominent environmental problems in the living environment and promote social harmony and stability. Ultimately, we will deliver a win-win outcome for environment, economy and society, making green the constant color for development.

Second, we need to secure a winning of the tough battle against pollution. We must secure the victory to defend the blue sky, to conduct comprehensive management of atmospheric pollution in autumn and winter in key areas. We must thoroughly implement our action plan for preventing and controlling water pollution, which includes the protection of the source water, the treatment of dark and odorous waters in the urban areas, the protection and restoration of the Yangtze River, the integrated management of the Bohai Sea, and the control of pollution in the agricultural sector and rural areas. We must make solid progress in battling soil pollution, continuing the reform to enhance solid waste import management system by prohibiting the entry of foreign waste and launching the pilot of building "zero-waste cities". We will summarize and extend Zhejiang's experience in building the Green Rural Revival Program, actively promoting the living environments in rural areas.

Third, we need to strengthen environmental protection inspection. The second round of the Central Ecological and Environmental Inspection shall be kicked off. We will organize mobile and targeted inspections aiming at localities, departments and enterprises with prominent environmental problems. We need to take an overall consideration on the

prevention and control of air pollution in key areas, and strengthen supervision on the environmental protection of centralized drinking water source areas. We should stress both supervision and support, in a way that helps to tackle prominent issues. We need to pay equal attention to strict supervision and service optimization, value enterprises' proper demands, enhance our awareness and skills to serve, and support enterprises to formulate their solutions for tackling environmental problems.

Fourth, we need to join hands to meet global environmental challenges. We will actively prepare for the 15th meeting of the Conference of the Parties to the *Convention on Biological Diversity* in 2020, fulfill our obligations as the host country, and jointly negotiate with all parties on establishing the Post-2020 Global Biodiversity Framework. China will firmly carry out positive measures to tackle climate change, continue to play its constructive role in international negotiations concerning to climate change, and push forward South-South Cooperation on climate change, jointly safeguard the *Paris Agreement* along with all parties, and give impetus to the success of the 2019 UN COP25. We will take feasible actions to implement the consensus reached at the Second BRF for International Cooperation, continuously push forward the construction of the International Coalition for Green Development on the Belt and Road and the ecological and environmental protection big data service platform and put the Green Silk Road Envoys Program into practice.

Fellow members and experts,

“Towards a New World of Green Prosperity” is our common wish. I hope all of you will share with us your knowledge, experience and wisdom, focusing on the “14th Five-Year Plan” and offering ideas and recommendations for building a beautiful China. Also, I hope the CCICED will continue to serve as a bridge and bond for sharing China's ecological conservation theories and practices and the Council's policy advice, making greater contributions for driving the global cause of sustainable development and constructing a clean and beautiful world.

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Review: The Shift to High-Quality, Green Development

0.1 China's Five-Year Plan

The 2019 Annual General Meeting of CCICED is an important opportunity to share recommendations from the Council about the preparation of China's 14th Five-Year Plan, which will cover the years 2021 to 2025.

China's system of Five-Year Plans is of strategic importance for its domestic as well as regional and multilateral objectives. Five-Year Plans identify key development and social objectives, market condition assumptions, strategic sectors, priority geographic areas, quantitative targets and other themes, pathways and directions.

In late 2018, the National Development and Reform Commission (NDRC) of the State Council¹ reviewed progress in implementing the current, 13th Five-Year Plan (which covers the years 2016–2020). The NDRC review underscored the preeminence of high-quality development as an overarching goal. It also noted a number of crosscutting priorities, notably social well-being, innovation-led development, supply-led structural reforms, the expansion of the services sector, and environment and sustainable development. Several areas of ongoing environmental progress were highlighted in the late 2018 review, including in freshwater management, the decoupling of energy consumption per unit of Gross Domestic Product (GDP), the reduction of carbon dioxide emissions per unit of GDP, and forestry. It also noted challenges, including air quality, urban water quality and soil contamination.

0.2 Shifting Lanes: High-Speed to High-Quality Development

As noted, China has initiated a strategic shift away from high-speed (or rapid) economic development towards high-quality development. High-quality development encompasses green development, which goes beyond environmental protection and pollution abatement to include drivers like innovation, factor productivity enhancements through efficiency

¹ The State Council is responsible for preparing the draft Five-Year Plan, with its National Development and Reform Commission (NDRC) coordinating input from all levels of government, ministries and agencies. The final draft of the 14th Five-Year Plan will be debated and adopted by the National People's Congress.

advances, well-being and the expansion of cleaner systems—from energy and mobility to green finance—and the expansion of the services sector more broadly.

China's record of high-speed development has been remarkable. In the last four decades, the Chinese economy has expanded 30-fold. The structure of growth continues to shift towards higher-value-added economic activities, reinforcing the prominence of innovation and productivity advances. In 2014, China surpassed Japan and the European Union to become the world's second-largest research and development performer (Organisation for Economic Co-operation and Development [OECD], 2018). Today, China is the world's largest producer of computers, robots, high-speed trains, cell-phones, appliances and other high-value goods produced within global supply chains, as well as lower-value-added outputs like crude steel, cement and coal.

0.2.1 Rapid growth, high environmental externalities

China's high-speed development has lifted millions from poverty and into the middle class. Yet the environmental costs have been exceptionally high when measured by rates air pollution, freshwater pollution, soil contamination, the depletion of natural resources, the loss of habitats like coastal wetlands and the extent of greenhouse gas (GHG) emissions. Today, China is the largest net GHG emitter and is among the highest per-capita emitters.

0.2.2 The war against pollution

China's response to its environmental challenges has been comprehensive, ambitious, sustained and innovative. Environmental protection is one of three national “tough battles” (together with preventing and diffusing financial risk and alleviating poverty). Its “war on pollution” continues to be strengthened. Recently, Premier Li Keqiang reported that China spent approximately RMB 255.5 billion (approximately USD 38.1 billion) in 2018 on pollution abatement programs, an increase of 14 percent from the previous year. Four recent initiatives underscore China's increasingly ambitious domestic environmental commitments:

- The 2018 introduction of a national environmental tax covers some 260,000 enterprises;
- The ongoing phase-out of inefficient coal-fired electric utilities and application of emission-based performance standards for new facilities;
- The ongoing strengthening of regulatory enforcement: in the first 10 months of 2018, 30,000 violations were reported; some RMB 11.8 billion (USD 1.71 billion) in fines were levied; and 6,500 alleged violators were detained; and
- Work towards the launch in 2020 of the world's largest carbon market based on an emissions-trading system (ETS), with initial coverage of the electricity sector.

More attention is being placed on aligning stringent domestic environmental action with regional and multilateral action. The Paris Agreement and subsequent steps forward would not have happened without China's global leadership. China has noted the importance of aligning a green Belt and Road Initiative (BRI) with the Sustainable Development Goals (SDGs): in late April 2019, the Belt and Road Green Coalition itself included welcome action with BRI green platforms for cooling, lighting and big data. Looking forward, China will host the 2020 UN Convention on Biodiversity Conference of the Parties—an important juncture given the end of the Aichi Targets, the release of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) report, and the importance of leading an urgent, ambitious global agenda to protect nature.

0.2.3 Divergence: Economic slow-down and environmental action

China's commitment to environmental protection—remarkable in its own right—is all the more noteworthy given slowing rates of economic growth. The International Monetary Fund (IMF)¹ forecasts an annual growth rate of 6.2 percent in 2019 and again in 2020 (IMF, 2019b), down from a 6.9 percent growth rate in 2017 and 2018, and well below the remarkable double-digit growth rates of previous years. Yet, in the face of a decelerating rate of economic growth, China's environmental actions are increasing: during the 13th People's National Congress in March 2019, senior leaders announced that both sulphur dioxide and nitrogen dioxide pollution emission targets would be tightened by an additional 3 percent. Actions to further cut the concentration of particulate matter (PM_{2.5}) are ongoing.

This strengthening of environmental action marks the divergence from past cycles, in which economic slow-downs have tended to prompt an easing of environmental commitment, usually the result of misplaced concerns about job or competitiveness losses associated with green actions. It also points to progress around the green development agenda—for example, the OECD and others have shown a neutral or marginally positive correlation between jurisdictions with ambitious climate mitigation policies and rates of economic development (OECD, 2017).

Yet China's actions are reshaping the green development agenda itself, not least because of its leadership in framing green development and high-quality development within a broader, value-based vision of ecological civilization.

¹ The IMF explains slowing rates of growth as a combination of domestic reforms, notably the tightening of banking regulations, and external uncertainty and volatility due to the rise of unilateral trade protectionism of the Trump Administration, which is having a dampening effect on global trade and investment. A recent report on financing sustainable development cautions of risks to the global economic system and the projected “peaking” of global economic growth in 2019 at around 3 percent per year (United Nations, 2019).

0.3 Ecological Civilization and High-Quality Development

In a March 2019 meeting with Delegates of the Inner Mongolia Autonomous Region, President Xi Jinping described the region's forests, grasslands, wetlands, rivers, lakes and deserts as comprising a "comprehensive ecological system that should not be sacrificed to economic growth." Protecting those assets required "strategic resolve." The vision of ecological civilization, which continues to evolve, encompasses avoiding environmental destruction and, in so doing, realizing the prosperity associated with key ecosystems. The dual emphasis of ecological civilization was further articulated in a 2018 speech by President Xi: "Ecological advancement leads to civilization prosperity whereas ecological deterioration leads to civilization decline."

(1) Ecological loss and wider decline. This connection between ecological destruction and the decline of past civilizations recalls work by Diamond (2005), Harper (2019) and others. Yet today's rate of ecological decline has no predecessor in history; it is being framed within the context of planetary boundaries exceeded and the Anthropocene taking root, characterized by the loss of nature and accelerating climate change.

(2) Biodiversity. The IPBES released its assessment of the global state of biodiversity on 6 May 2019. The findings of that report are profoundly alarming and include the following conclusions from the Summary for Policymakers (IPBES, 2019):

- Current rates of ecological decline and destruction have never been witnessed before;
- An average of around 25 percent of species in assessed animal and plant groups are threatened, suggesting that one million species already face extinction, many within decades;
- Between 1980 and 2000, some 100 million hectares of tropical forests have been lost, mainly from cattle production in South America and palm oil in Southeast Asia;
- Wetlands have declined by 87 percent since the 1970s;
- Natural ecosystems have declined by 47 percent on average, and biomass and species abundance has fallen by 88 percent.
- Land degradation has reduced productivity in 23 percent of the global terrestrial area, and as much as USD 577 billion in annual crop output is at risk because of pollinator loss;
- These rates of loss are not inevitable, but the time for new, urgent, transformative action is now.

The 2020 UN Convention on Biodiversity Conference of the Parties will be one opportunity for the international community to act. Many of the current Aichi Targets will not be met. Some new approaches under consideration by the scientific community include a new

deal for nature, including proposals calling for 30 percent of the planet be protected by 2030 and an additional 20 percent of land be designated as climate-stabilization areas, including not only forest areas but also peatlands, tundra, mangroves, grasslands and wetlands as both important habitat areas and effective systems for carbon storage. Some leading proponents of the new deal for nature warn that the time for talking is over, that the current suite of targets have been inadequate and that humanity is facing a “point of no return”.

(3) Climate Change. The 2019 IPBES report notes that climate change is exacerbating the global biodiversity crisis, affecting species distribution, population dynamics, community structure and ecosystem function.

Since the CCICED’s last Annual General Meeting in November 2018, climate records have been smashed in Australia, Argentina, Chile and elsewhere. In 2019, Mozambique was hit by unprecedented cyclones and flooding events. The World Meteorological Organization (WMO, 2019) reports that the average ocean-heat content is at record-high levels; that the average global temperature in 2018 tipped 1°C above pre-industrial levels; that the years 2015 to 2018 were the four hottest ever recorded; and that, in 2018, some 35 million people were affected by flooding and 125 million exposed to deadly heat waves.

Actions to counter GHG emissions is increasing. Markets for clean, low-carbon and zero-carbon energy are growing. Some 1,300 models of electric vehicles are now available in the United States. Annual climate finance reached USD 463 billion last year, with most focused on mitigation and far less on adaptation. More cities—including Atlanta, San Francisco and Chicago—are on track to be powered by 100 percent renewable energy between 2030 and 2035. Wales has committed to making the public sector carbon neutral by 2030, with green procurement playing a central role in buildings, transport and other activities.

Despite these and a growing number of other initiatives, the world is not on track to meet the Paris Agreement. The International Energy Agency reported in early 2019 that global energy-related GHG emissions increased in 2018 by 1.7 percent. Current levels of GHGs are at an all-time-high of 33.1 Gt CO₂ (IEA 2019).¹ It is no wonder a new generation of activists like Greta Thunberg are expressing impatience with promises and demanding action now.

0.4 Green Development, Prosperity and Quality Development

The current sense of urgency to act is why the second aspect of ecological civilization as a new means to achieve prosperity is so welcome. Decades of warnings from scientists about the state and fate of global ecosystems has led to change, but clearly not enough and not

¹ A useful overview of China’s comprehensive climate mitigation actions is the December 2018 edition of Mapping China’s Climate and Energy Policies, published by the Swiss, German and U.K. embassies in Beijing.

fast enough. Therefore, describing ecological civilization as a positive means to prosperity is so immensely welcome. Part of this prosperity agenda is to show that green development delivers, in traditional economic indicators, starting with jobs and income. In its most recent annual report, the International Labour Organization notes that 1.2 billion jobs depend on a stable and healthy environment, noting that more jobs are being created in the shift to low-carbon, clean energy systems than jobs being lost as dependence on coal declines. Indeed, 24 million new jobs have been created in highly innovative emerging industries like electric vehicles, clean energy and green financial services, compared to 6 million jobs lost in carbon-intensive sectors. However, those gains are at risk from climate impacts that threaten domestic production and global supply chains, putting at risk 72 million full-time jobs in the next 11 years.

Beyond GDP: quality matters

The above estimate of the job effects of climate change point to a profoundly welcome reassessment of traditional economic indicators underway that takes into account ecological destruction. Certainly, no indicator has held more sway on economic planning than GDP. GDP has been a pillar of the 70-year Bretton Woods system, reflecting the Keynesian emphasis on the need to measure aggregate income and expenditure flows. Ancillary accounts have been developed to measure other indicators, such as savings and balance of payments, but ultimately GDP has focused on measuring income flows.

Complaints about GDP have been long-standing. In 1968, Robert Kennedy famously said that GDP “measures everything except...that which makes life worthwhile.”¹ Over the years, many initiatives have been launched to complement GDP, including for instance the 1990 launch by UN Development of the annual Index of Well-Being report. More recently, the IMF, World Economic Forum and others have pointed to the limits of GDP. In late 2018, for instance, the OECD released the Beyond GDP Report with various recommendations to complement GDP as a means to reconnect the economy with people and nature.

The questioning of GDP gained urgency following the 2008 global financial crisis, as many wondered why seemingly healthy GDP indicators showing growth moments before the crash missed entirely the fragility of the system. The answer is simple enough: GDP was never intended to predict the future, but rather to measure the performance of the last

1 In that speech, Kennedy noted that “Gross National Product counts air pollution and cigarette advertising, and ambulances to clear our highways of carnage...[It] does not allow for the health of our children, the quality of their education or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country, it measures everything in short, except that which makes life worthwhile.” More recently, a Nobel-prize economist argued that “GDP is not a good measure of economic performance, it’s not a good measure of well-being” (Chainey, 2016).

quarter. More problematically, since GDP was designed to measure mostly income flows—that is, the quantity of economic activity—it has little insight into the structural quality of that economic activity, let alone whether levels of debt and deficit spending—be they financial or ecological—are sustainable.

One of the architects of GDP, Nobel-prize economist Samuel Kuznets, warned of the dangers in GDP gaining prominence beyond its founding purpose and of the risk in confusing quantity with quality. In the 1930s, Kuznets landed on a production-driven model as the basis of national income accounting and GDP. His reasoning was understandable: Kuznets focused on production flows in the midst of the Great Depression, when U.S. national income had shrunk from USD 89 billion in 1929 to USD 49 billion in 1932. Focusing then on quantity of manufacturing output and related income flows was understandable then, given the context of sharp economic decline. Yet three decades after writing the seminal paper that launched our love affair with GDP, Kuznets cautioned of the fundamental importance of distinguishing between “between the quantity and quality of growth, between its costs and returns, and between the short and long term” (Kuznets, 1962, emphasis added).

0.5 Natural Capital

China’s articulation of an ecological civilization that emphasizes high-quality development is therefore of critical importance from both an economic theory and an applied policy perspective. China is a leading proponent of work to complement GDP, including work in ecological accounting, integrated wealth and comprehensive wealth measurement.

Much of this work draws upon the methods and framework championed by Cambridge economist Sir Partha Dasgupta. Of note is UN Environment’s 2018 Inclusive Wealth Report (IWR), in which Dasgupta chairs the science panel. It concludes that the world’s economic growth has been largely fuelled by a kind of ecological deficit spending. The report demonstrates through the use of existing official national statistics that between 1990 and 2018, while GDP growth appeared positive, the natural capital shrank on average by 0.7 percent per year. Put another way, one fifth of the planet’s natural capital base has been lost in less than three decades, as the world economy is driven by rapid development.

Climate smart natural infrastructure. Work in natural capital is undergoing a renaissance. This work is intended not only to describe unsustainable rates of loss, but to show new areas of action working with natural capital. For example, the Natural Capital Lab of the Inter-American Development Bank was created to bridge links between the environmental and financial sectors, with a focus on practical, scalable deals to accelerate projects that

deliver sustainability solutions (IADB). In early 2019, Thomas Lovejoy emphasized practical links between biodiversity and climate action through the scaling-up nature-based climate solutions. Work by WRI and others has shown the key role of forests and forestry management in sequestering carbon, as well as the importance of REDD+, in that regard. Work by Pattison-Williams et al, (2017) has also demonstrated the importance of maintaining or restoring wetlands as being more cost-effective in flood-control responses than traditional built infrastructure. The 2019 IPBES summary report notes the importance of nature-based solutions, including green and blue infrastructure.

The Natural Capital Project—a partnership between Stanford University, the Nature Conservancy, World Wildlife Fund and the University of Minnesota—is using natural capital information to integrate ecosystem values into economic and societal decisions. Tools include large-scale spatial planning to identify rich areas of ecosystem importance as a means to improve the siting and design of megaprojects including infrastructure, as well as analytic data tools to record ecological values like sequestered carbon within standing forests (Natural Capital Project, Stanford University).¹

0.6 Looking Ahead: Challenges and Opportunities

Given the pace of change, uncertainty and risk, it is hard to predict what issues China and the world will face as its 14th Five-Year Plan comes to an end in 2025. What is clear is that action to tackle the global climate and biodiversity crises must be well advanced then, in order to be on track for the 2030 timeline. China's leadership in high-quality development suggests that a new course of economic development can occur, one in which natural capital, social well-being and innovation-led development are values needed to realize the SDGs and ecological civilization. The following provides some issues to consider in these important steps ahead.

(1) Governance, policy coherence and institutional coordination. A recurring theme of the 13th Five-Year Plan is the importance of effective and coordinated governance systems, to align action at state, provincial, city and rural levels. China has identified large-scale geographic regions—of note is the wider Yangtze River Basin—in order to align and coordinate policy actions across multiple levels of government jurisdiction.

Policy coherence is important. It is also immensely difficult. Among the lessons of the UN 2030 Agenda and the SDGs is the importance of integrated action across key sectors,

¹ The next phase of the CCICED Special Policy Study on the Yangtze River Economic Belt will examine the role of natural capital in supporting comprehensive protection, in partnership with the Natural Capital Project.

policy instruments and communities. Unlike the environmental agenda's remit around pollution abatement and conservation, the SDGs have prompted several governments—Germany, Finland, France, Mexico and others—to coordinate all-of-government action across ministers and sectors, and to promote public participation from communities as a source of innovative, transformative ideas.

(2) Gender mainstreaming is a CCICED priority, and work continues within the Special Policy Studies to highlight this issue. While work has identified labour market gaps and comparable pay gaps, recent analysis has pointed to higher-than-expected economic gains associated with greater gender parity, from boosting the economy-wide benefits of more women in the workforce to gains in women on corporate boards: for example, banks with more women on their boards tend to have better capital buffers and fewer nonperforming loans.

(3) Green development within economic sectors is increasingly related not only to downstream and end-of-pipe measures, but also to integrating innovation, efficiency and resilience planning upstream. The transition to clean energy systems is a priority in nearly all countries, and pathways after coal are gaining support, including among green consumers. Two additional sectors—both noted in the 13th Five-Year Plan, are agriculture and natural resources. Agriculture is or should be at the front lines of sustainability. A 2019 U.S. National Academies report underscores the strategic importance of making food systems more efficient, resilient and sustainable, and states that progress in light of climate and other challenges requires “radically different” approaches. In the metals, minerals and mining sector, London Metal Exchange announced in April 2019 that it would only trade in responsibly sourced metals by 2022. Since much of the Fourth Industrial Revolution and clean energy sector relies on key metals (cobalt and lithium), initiatives like the World Bank's Climate Smart Mining are a welcome example of integrated sustainability management.

(4) Greening financial instruments are well underway, from climate finance and green bonds to the uptake of market-based fiscal instruments like carbon pricing and emissions-trading systems. Two additional tools are green procurement and debt finance. Given that public procurement represents a large proportion of total economic activity in most countries (typically between 20 and 30 percent), green procurement based on high-quality green standards can be a powerful driver to de-risk newer, low-carbon and clean goods and services. In the area of debt, President Xi noted the importance of debt sustainability. A positive example of how debt is linked with conservation is the 2015 partnership between The Nature Conservancy and the Seychelles, with other partners like the Global Environment Facility and UN Development, to use a new debt-for-conservation arrangement to protect

and conserve the coastal marine area of the Seychelles. The Nature Conservancy is now working with others on a broader, 20-country initiative to leverage debt for conservation and biodiversity protection.

(5) **Building Climate Resilience.** The Global Commission on Adaptation is taking stock of the current rate of climate adaptation efforts, as well as the urgent need to accelerate climate adaptation action in the face of more frequent and extreme climate impacts affecting all countries, communities, sectors and ecosystems. The commission is co-convened by the World Resources Institute and the Global Center on Adaptation, with six of its commissioners affiliated with CCICED, including Minister of Ecology and the Environment Li Ganjie. The commission will release its report during the September 2019 UN Climate Week in New York. Given the accelerating severity of climate impacts, CCICED may consider integrating its findings and recommendations into ongoing work and might consider new research moving forward.

(6) **Adopting High-Quality Green Standards.** In his address to the Second Belt and Road Forum, President Xi referenced the importance of high standards as well as the role of green, high-quality infrastructure. High levels of environmental standards are important both at the domestic and BRI levels. One dimension involves safeguards: the World Bank, which updated its safeguards in 2016, has provided a useful mapping of safeguards across lending organizations. A second is aligning standards with multilateral environmental agreements, such as the Kigali Amendments to the Montreal Protocol and the need to phase out HFCs—a highly-potent GHG—as well as adopt best-in-class efficiency standards for new industrial and cooling systems.

Chapter 1 China's Contribution to Global Climate Governance

1.1 Introduction

1.1.1 The challenge of global climate change is more severe than ever

From the perspective of natural threats, the IPCC's fifth assessment report and numerous research reports have pointed out that climate change is the most serious and urgent global challenge of our times. In October 2018, an IPCC special report – Global Warming of 1.5°C – has given a clearer signal. If the global temperature rises more than 2°C, the climate impact on survival and development of human being will be more significant, and yield worse consequences.

Since tackling the challenges of climate change requires to address both energy use and energy transition, solutions will require efforts and impacts in all the sectors of the economy. On one hand, in the current conditions, developing countries in general may deal with conflicting priorities between low-carbon transition and other development goals such as poverty alleviation. On the other hand, we must combine education; employment and income increase to reducing emissions. The sustainable emission reduction can hardly be achieved without economic growth, social progress and transformation of a country's development path, which adds both complexity and integration to the solutions to climate change. Therefore, it requires systematic and integrated solutions, timeline, and roadmap, priority and policy directions for the different development goals to address climate change.

In the global context, some major countries are trying to withdraw from the Paris Agreement and other international environmental agreements, this will bring new challenges to the global climate and environmental governance system. Trade wars will also directly affect the global climate change action and transition process. Unilateralism will further damage the process of international cooperation and transition, and the loss of biodiversity will also counteract poverty reduction efforts. In September 2019, the Climate Summit of the United Nations Secretary-General will be held at the United Nations Headquarters in New York. Heads of state will come together to discuss how to tackle climate change challenges more ambitiously and accelerate global low-carbon transition. The results of this summit are

expected to take the pulse of near future climate governance.

The international community has reached a consensus on the necessity, in order to achieve the global climate targets, to transform production mode, lifestyle, and finance and to accelerate technology innovation. All countries should deepen cooperation and take action together to accelerate transition process, initiate an innovative global climate governance system, integrate climate change in economic development, poverty alleviation, living-condition improvement, environment preservation, health protection and security, enhance mutual trust, build a community with a shared future for mankind, and lead a green, low-carbon and sustainable development globally.

1.1.2 China firmly implements the Paris Agreement and actively participates in global climate governance

The 19th National People's Congress of the Communist Party of China put forward a series of new concepts, new ideas and new strategies, aimed at achieving a moderately prosperous society in all respects by 2020, socialist modernization by 2035, and a modern powerful socialist country by the middle of the century. It also pointed out that China has become a participant, contributor and leader of global ecological civilization by actively guiding and taking part in international cooperation on climate change, and China will continue to closely participate in global environmental governance and meet emission reduction commitments in the future. The new strategic targets for development require urgent actions on rationalized institutional structure and functional allocation, comprehensive organizational preparation, institutional mechanism improvement, and integrated promotion of economic construction, political construction, cultural construction, social construction and establishment of an ecological civilization. Under these circumstances, China has promoted a new round of governmental institutional reform. On March 21, 2018, the full text of "Deepening the Reform of Party and Government Institutions Plan" (hereinafter referred to as the Plan) was published. Prior to that, the contents concerning the institutional reform of the State Council had been deliberated and adopted by the People's Congress, and the "Decision of the CPC Central Committee on Deepening the Reform of Party and Government Institutions" (hereinafter referred to as the Decision) had also been published. In line with the insights of the 19th National People's Congress of the CPC, this is a profound transformation aiming to promote the modernization of China's governance systems and governance capacity, aiming at "one matter or one type of matter being dealt with by one department, and enhancing collaboration between relevant institutions in an effort to prevent one policy from being formulated by multiple institutions, ensuring responsibilities of each institutions are

clearly defined, and preventing institutions from shirking their duties.”

The environment management system reform is one of the key elements of the Decision and the Plan. The Decision specifically mentions, “Reforming the systems for managing environment. We need to implement the strictest environmental protection system, establish an environmental governance system led by government, subjected businesses, and involving civil society organizations and the general public, so as to provide systematic guarantees for the ecological civilization.” The Plan specifies the functions of the newly established Ministry of Ecology and Environment, especially points out that “Protecting the environment is a basic national policy. We should treat the ecological environment as we treat life, implement the strictest environment protection system, form green development way and lifestyle, and focus on solving outstanding environmental issues. In order to integrate the deconcentrated responsibilities of ecological environmental protection, exercise responsibilities of supervision and administration on various pollution emissions from natural and urban/rural areas, strengthen environmental pollution control, ensure national ecological security, develop a Beautiful China. The Ministry of Ecology and Environment is composed as a part of State council, and it integrates the roles of former Ministry of Environmental Protection, and climate change and emission reduction responsibilities of the National Development and Reform Commission, the functions of the former Ministry of Land and Resources in monitoring and preventing groundwater pollution, the functions of the Ministry of Water Resources in compiling water function zoning, sewage outlet setting and management, and basin water environmental protection, the functions of the Ministry of Agriculture and Rural Affairs in monitoring and guiding the agricultural surface source pollution control, the marine environmental protection responsibilities of the State Oceanic Administration, the South-to-North Water Diversion Project areas’ environmental protection responsibilities of the South-to-North Water Diversion Project Commission Office of the State Council. The Ministry of Ecology and Environment retains the function of National Nuclear Safety Authority. The major functions of the ministry include formulating and organizing the implementation of ecological environment policies, plans and standards, monitoring the overall ecological environment and being in charge of law enforcement, supervising and controlling pollution, ensuring nuclear and radiation safety, and organizing the central supervision of environmental protection. We also set up an integrated law enforcement team for ecological environment protection, which takes law enforcement responsibilities with regards to pollution control and ecological protection related in departments of land, agriculture, water resources and ocean management, guided by the Ministry of Ecology and Environment.” In which it proclaims to integrate the reform of “the functions of the National Development and Reform Commission

on climate change and emission reduction” explicitly. The Department of Climate Change of the National Development and Reform Commission, and the National Center for Climate Change Strategy and International Cooperation were transferred to the newly established Ministry of Ecology and Environment. Since then, the era of a “comprehensive government department” of ecology and environment has begun.

According to Li Ganjie, Minister of the Ministry of Ecology and Environment, at the press conference of the two sessions, the reform has solved two outstanding issues in China’s system of ecological environmental protection: “First, overlapping responsibilities bring confusion in accountability; second, administrators and owners are not well distinguished, they are both athletes and referees. Some referees are independent, but the authority and effectiveness are not very convincing.” The reform integrates previous deconcentrated responsibilities of pollution control and ecological protection through “five links”. “First, we link the overground and underground, second the shore and water, third the land and ocean, fourth urban and rural, fifth CO and CO₂, that is integration of air pollution control and climate change.” The last link talks about the new tone of work after the transfer of climate change functions.

Global climate change has become the most important environment and development challenge around the world in the 21st century. It challenges human nature, social system, economic development mode, international politics and civilization. Facing current complex situation of “reversal of globalization” and rising protectionism in the world, global climate governance, as one of the few issues concerning international politics, economy and non-traditional security sectors after the cold war, is a “mirror” and “banner” of global governance reform, which will have profound impact on the existing international architecture and governance system. China has been actively promoting domestic green and low-carbon growth, innovating development paths, participating in the process of global climate governance constructively and guiding international cooperation in addressing climate change. Especially China played an important historic role in the process of the arrangement, signing, enactment and implementation of the Paris Agreement, which has been widely recognized by the international community, including the United Nations Secretary-General. China has become “an important participant, contributor and leader in the global ecological civilization”. Around the announcement of the United States’ decision to withdraw from the Paris Agreement, President Xi Jinping and other government leaders on many occasions reiterated China’s strong determination to work together with all parties, adhere

to the achievements of the Paris Agreement, jointly promote the implementation of the Paris Agreement and build a clean and beautiful world. They also released positive signals to the world that China will firmly stick to the path of green and low-carbon development and shoulder 100% of its own responsibilities, and to lead the global ecological civilization. These signals have promptly consolidated the confidence and determination of the global climate change community, fully demonstrated China's strong sense of duty to build a community with a shared future for mankind, and laid a defining feature of the joint efforts of all parties to fully implement the Paris Agreement and the commitment of Nationally Determined Contributions.

1.1.3 Climate governance challenges in the new era

After The 19th National People's Congress of the CPC, on one hand, the international community has new expectations regarding China's climate policies and actions, hoping in particular that China could fill the "gap" of leadership in global climate governance after the withdrawal of the United States from the Paris Agreement. On the other hand, international public opinion also sits on the fence on the impact of transferring the climate change portfolio from the National Development and Reform Commission to the Ministry of Ecology and Environment. International public opinion even believes that addressing climate change in China will fall into the "end-of-pipe" pollution control without "strong" macroeconomic and energy industry management functions, and questions whether the management system for tackling climate change been "weakened" by the institutional adjustment.

How to better promote and strengthen the fight against climate change and better fulfil the role of "the leader of global ecological civilization" under the new system of ecological environment protection? How to provide strong institutional safeguard for the Chinese government to integrate the management of air pollution control and fight against climate change through the system reform, and create new opportunities for China to contribute and lead the multilateral process of global climate change? How to make the work of fighting against climate change more practical and efficient? How can China leave its mark in the establishment of a new era of global ecological civilization, follow the principle of achieving shared growth through dialogue and collaboration in engaging in global governance, and commit to build a community with a shared future for mankind? This report aims to make a preliminary discussion on the above issues and provide some suggestions.

1.2 International Experience and Lessons Learnt- Major Types and Characteristics of Climate Governance Structure

1.2.1 Diversity in climate governance structure between countries

This report studies the governmental organization of 13 countries and the EU for policies regarding climate change, energy and the environment, more specifically air quality. Based on their ministerial organization, the countries can be divided within three categories, see Table 1-1.

Table 1-1 Organization of air quality, climate change and energy portfolios

Policies	Air Quality	Climate change	Energy
Integrated ministry for environment, energy and climate change			
France	Ministry for the Ecological and Inclusive Transition Directorate General for Energy and Climate		
Ministry of the Environment and Energy			
Sweden	Natural Environment Division	Climate Division	Energy Division
Department of the Environment and Energy			
Australia	Deputy Secretary for Climate Change and Energy innovation		Deputy Secretary for Energy
Integration of environment and climate change			
Germany	Federal Ministry of the Environment, Nature Conservation and Nuclear Safety (BMU)		Federal Ministry for Economic Affairs and Energy (BMWi)
	“IG” Directorate	“KI” Directorate	
Poland	Ministry of Environment Department of Air Protection and Climate		Ministry of Energy (current form 2015)
Canada	Environment and Climate Change Canada		Natural Resources Canada
United States	Environmental Protection Agency		Department of Energy
India	Ministry of Environment, Forest and Climate Change		Ministry of Power and Ministry of New and Renewable Energy
Brazil	Ministry of the Environment		Ministry of Mines and Energy
South Africa	Department of Environmental Affairs Air Quality and Climate Change		Department of Energy
Integration of energy and climate change			
United Kingdom	Department for Environment, Food and Rural Affairs (DEFRA)	Department for Business, Energy and Industrial Strategy (BEIS) Minister of State for Energy and Clean Growth	
Netherlands	Ministry of Infrastructure and Water Management	Ministry of Economic Affairs and Climate Policy	
	DG for the Environment and International Affairs	DG for Energy, Telecommunications and Competition	

Policies	Air Quality	Climate change	Energy
European Union	Commissioner for Environment, Maritime Affairs and Fisheries	Commissioner for Climate Action and Energy	
	Directorate-General for Environment	Directorate-General for Climate Action	Directorate-General for Energy
Japan	Ministry of the Environment	Both Ministry of the Environment and Ministry of Economy, Trade and Industry	Ministry of Economy, Trade and Industry Agency for Natural Resources and Energy

(1) A single ministry is in charge of climate change, energy and environment. This is the case in France, Sweden and Australia.

(2) There is one ministry in charge of affairs related to climate change and environment, and another one for energy issues. This is the most common case encountered among the countries covered by this study: e.g. Germany, Poland, Canada, the United States, India, Brazil and South Africa.

(3) Finally, in some cases, climate change is under the responsibility of a ministry in charge of energy and climate change but environmental issues are dealt with in a separate ministry. This is the case in the United Kingdom, the Netherlands, the EU and in some extent Japan where both the METI and the MOE seem in charge of climate change.

This organizational consideration will have an impact on the decision making and on the ability for the department or agency in charge of climate change mitigation to coordinate energy and climate change policies and to make them mutually supportive.

On the contrary, when climate change and energy are managed by separate ministries, there have been cases where the Ministries in charge of climate change and energy would express diverging views regarding the GHG emission reduction targets or the means of achieving a national target, showing internal disagreements and struggles.

Eventually, regardless of the structural organization, some cross-governmental coordination is bound to take place for national positions, such as the NDC submission under the Paris Agreement.

1.2.2 Case study: detailed organization and climate action for France and Germany

1.2.2.1 National climate governance in France

In France, the Directorate General for energy and climate is in charge of all climate, energy and air quality related matters and is part of a large ministry in charge of environment

and energy (Ministère de la transition écologique et solidaire), taking different names under recent governments, but constantly in charge of all energy and climate matters since 2008.

(1) Co-implementation and co-management at local level

In some countries, climate change regulations and air quality or pollution regulations at local level are co-implemented and co-managed by local offices of the ministry of environment. For instance, they would be in charge of the validating the monitoring, reporting and verification of GHG emissions, as well as the authorizations, control and reporting of pollutants emissions.

In France, the regional offices for the environment, planning and housing are in charge of monitoring and delivering the operation permits for large industrial installations and polluting installations in accordance with the regulation on installations classified for environmental protection. Since the beginning of the EU ETS, they are also in charge of following and validating the MRV process for GHG emissions. As they are responsible for delivering operation permits, they will monitor every significant change in the physical machinery and operations of the plants. This will in turn help check the quality of GHG emissions data and its consistency with other information gathered at the local level.

(2) Benefits of cross-governmental coordination in France

France provides a good example of cross-department and cross-ministry coordination. For all European negotiations, including issues concerning climate and energy, the lead ministry in charge of the file prepares all national positions. For climate and energy issues, this task falls under the DG for energy and climate in the ministry for the ecological and inclusive transition. Once this leading ministry has prepared a draft position for the French government, it is sent to the General Secretariat for European Affairs (SGAE) which conducts a cross-governmental consultation with all concerned DGs, including the DG for the Treasury, DG for businesses, the Ministry of Foreign Affairs, and Ministry of Agriculture. The consultation by the SGAE is the place where possible diverging views between ministries will be expressed, discussed and consolidated into the formal French national position for the negotiation. A few specificities are key to the French system that will allow a single consistent French position to be expressed and relatively good cooperation between ministries:

- The consultation toward building a consensus is done by a neutral party. The SGAE holds neither expertise nor position on the subjects. It will only requests comments to each concerned DGs and try to build a consensual position. Only if it fails to find a compromise, will the SGAE relay the problem to the Prime Minister's cabinet (from which the SGAE depends directly) to take a final decision.
- The consultation and discussions between ministries happen at technical level. It's

directly the experts on each subject that are consulted, draft comments and find compromises toward a national position built bottom-up. This way, cooperation and mutual understanding of positions start from the expert level. This will also allow for very regular consultations that limit the possibility for long-standing divergence between ministerial positions. For instance, in a normal EU negotiation process, the SGAE will be conducting consultations for each round of working parties, which typically happens every two to four weeks.

- When speaking for the French authorities in public meetings and negotiation working groups, agents regardless of their ministry of origin are required to express the official national position.

In practice, this also provides the opportunity to discuss contentious issues between ministries on a regular and systematic platform. Also, as the SGAE deals systematically with day-to-day negotiation, it's not a high level arbitration and the experts in charge of the files are fully involved in the cross-cutting consolidation and will seek compromise. If on the contrary the arbitration process was only to happen for political issues at high stakes, then ministries could develop quite different positions before a national consolidated position is eventually arbitrated (see chapter for Germany).

1.2.2.2 National climate governance in Germany

In Germany, the ministry in charge of environment and climate change (Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit - BMU) is separated from the ministry for energy and economy (Bundesministerium für Wirtschaft und Energie, BMWi).

The BMU has a Directorate General in charge of climate policies and a separate DG in charge of risk prevention, including pollution. The BMWi is in charge of energy policies and the economy. It contains a DG in charge of electricity policies: the energy transition (Energiewende), renewable energies policies, the effect of the EU ETS and carbon price on the energy system, and the grid. A second DG is in charge of "energy efficiency" in terms of heating, industry energy efficiency, renewable heat, etc.

During the European carbon market reform negotiations, due to differentiated ministry for energy and climate matters, Germany had difficulties emerging with a unified position. Due to the lack of cooperation and arbitration at technical level between the ministries in charge of climate and energy, there might be some circumstances where the two ministries will publicly show different positions. This duality will only be solved when the divergence is big enough for the higher political level (Chancellor level) to arbitrate. It also means that most technical issues that are not politically relevant enough are often not arbitrated before a

larger issue comes up.

Unfortunately, this would often lead to a longer needed time to find a national position, and a weaker standing point in the international negotiations. Also, this may sometimes lead to German ministries for energy and climate only being able to agree on the less political issues and on the “lowest common denominator”, which can be less ambitious from a climate point of view.

More examples of co-actions and illustrations of international experience are presented in the Annex. In Annex Table 1-1, a summary of advantages and challenges of establishing the climate change portfolio under the Ministry of Environment, and ways to tackle the challenges and fulfil the opportunities, is presented based on solutions learnt.

1.2.3 Lessons learnt from international experience

Governance is essential to be able to tackle the challenges of climate change efficiently. The ministerial structure in charge of climate change in relation to those in charge of air quality and energy is important. Depending on the proximity between these parts of the administration, organic cooperation and deep interaction can occur naturally. In turn, this integration can help exploit the co-benefits of measures and prevent incoherencies between policies.

However, different functioning systems of ministerial governance in the world demonstrate that the range of subjects impacting climate change requires cross-cutting linkages regardless of ministerial portfolios. The challenge of climate change is so systemic and it needs such a transformation of the whole economy that no ministry can do it alone. The international experience shows multiple solutions from different countries in terms of governance to facilitate and catalyse climate action.

In light of the analysis done on multiple countries around the world, a check-list of issues and measures concerning the governance of climate change that could support ambitious and efficient action is suggested in the Annex 1-1.

1.3 Opportunities and Challenges of Climate Governance in China after the Institutional Reform

1.3.1 The 2018 reform of climate change institutions

In 2018, the functions of climate change and emission reduction of NDRC were transferred to the newly established Ministry of Ecology and Environment. Since then, the Ministry of Ecology and Environment has undertaken the daily operation of the Leading

Group in dealing with climate change and emission reduction.

On September 11, 2018, the Plan of setup and functions, internal institutions, and auxiliary staffing (duties, institutions, and personnel) of the Ministry of Ecology and Environment was officially released. Part Ten, Article Three of the Plan describes the main responsibilities: the Ministry of Ecology and Environment is “responsible for addressing climate change, will organize and formulate major strategies, plans and policies for tackling climate change and reducing GHG emissions. [The MEE] leads the relevant departments to organize and participate in international negotiations on climate change. [The MEE is] Responsible for the implementation of United Nations Framework Convention on Climate Change (UNFCCC).” The Plan clarifies the functions of the Ministry of Ecology and Environment in addressing climate change, and sets up a Department of Climate Change ranking 11th in the Ministry under Article Four, right after the Department of Atmospheric Environment (Atmospheric Environment Administration of the Beijing-Tianjin-Hebei Region and Surrounding Areas). The description of duties, institutions, and personnel for Department of Climate Change is very simple. The Department will “Analyze the impact of climate change on the economic and social development; carry out China’s role in the United Nations Framework Convention on Climate Change and work with relevant governmental departments to participate in international negotiations and conferences; implement clean development mechanisms; carry out the daily operations of the National Leading Group on Climate Change, Energy Conservation, and Emission Reduction”, which is inconsistent with the climate change related responsibilities of the Ministry of Ecology and Environment mentioned in the Plan. Indeed, the Department lacks functions such as “formulating major strategies, plans and policies for tackling climate change and reducing GHG emissions” and “leading the relevant departments to organize and participate in international negotiations on climate change”, etc.. Except for Department of Climate Change, the Department of Ecological and Environmental Monitoring undertakes the role of “Organize monitoring of GHG emission reductions”. To some extent, this has also aroused public concerns about the “spin-off and weakening” of the Department of Climate Change.

Unlike the Plan of duties, institutions, and personnel, the implementing measures of internal structures of the Ministry of Ecology and Environment subsequently issued have greatly retained the original duties, institutions and personnel of the Department of Climate Change. The specific institutions and functions, and comparison of functions before and after the reform are as shown in Table 1-2. For the Department of Climate Change itself, its own functions and internal institutions setup have remained basically unchanged. Only the “GHG emission reduction monitoring” related functions have been incorporated into the Department

of Ecological and Environmental Monitoring, while “taking the leading role in implementing international conventions on the protection of the ozone layer” has been added to its responsibilities. In addition, the Department of Climate Change is responsible for “Developing and administering the national greenhouse gases emission trading scheme”.

Table 1-2 Comparison of climate change functions before and after the reform

Pre-reform (National Development and Reform Commission)	After the Reform (Ministry of Ecology and Environment)
1. Study the international situation and major national trends of climate change comprehensively; Analyze the impact of climate change on China’s economic and social development, and put forward general measures and suggestions	Comprehensively analyze the impact of climate change on the economic and social development
2. To organize the formulation of key strategies, plans and policies for addressing climate change; Implement specific measures and actions on climate change mitigation and adaptation; Carry out communication campaigns on climate change, and study and put forward legislative proposals for relevant laws and regulations	Implement proactive national strategies on climate change; Initiate the formulation and the implementation of China’s major objectives, policies, programs and plans, and institutions on the control of greenhouse gas emissions, on the promotion of green and low-carbon development, and on the adaptation to climate change; Provide guidance to other governmental departments, industries, and local governments in such implementation
3. Initiate the formulation and the implementation of national scheme on climate change; Provide guidance to other governmental departments, industries, and local governments in formulation and implementation of local plans	Carry out China’s role in the United Nations Framework Convention on Climate Change and work with relevant governmental departments to participate in international negotiations and conferences; Organize and formulate a national report on climate change implementation; Compile national GHG emission inventories
4. Carry out China’s role in the United Nations Framework Convention on Climate Change and work with relevant governmental departments to participate in international negotiations and conferences; Organize and formulate a national report on climate change implementation; Compile national GHG emission inventories	Work with relevant governmental departments to take the lead and participate in international negotiations and conferences
5. Study and put forward proposals of general policies and measures for China’s participation in international negotiations on climate change; Take the leading role in formulating and organizing specific negotiation proposals; Work with relevant governmental departments to take the lead and participate in international negotiations and conferences	Build the capability to face the challenge of climate change, and conduct research and publicity campaigns on climate change
6. Formulate plans for capacity-building to face the challenge of climate change; Carry out scientific research and systematic observation on climate change	Promote the bilateral, multilateral, and South-South cooperation and exchanges on climate change
7. Formulate guidelines on international cooperation on climate change; Coordinate major international cooperation activities on climate change; Undertake bilateral, multilateral cooperation activities on climate change; Review sensitive data and information involved in international cooperation activities	

Pre-reform (National Development and Reform Commission)	After the Reform (Ministry of Ecology and Environment)
8. Carry out the clean development mechanisms; Take the lead in project audits of clean development mechanisms; Work with relevant governmental departments to supervise the activities of the clean development mechanisms fund; Study the mechanism of GHG emission trading markets	Implement clean development mechanisms; Develop and administer the national emission trading scheme
9. Carry out the daily operations of the National Leading Group on Climate Change, Energy Conservation, and Emission Reduction; Responsible for centralized management of climate change affairs; Guide and coordinate local governments in addressing climate change	Carry out the daily operations of the National Leading Group on Climate Change, Energy Conservation, and Emission Reduction
10. To undertake other tasks assigned by the NDRC leadership	—

At the same time, along with the new leadership elected, the advancement of the institutional reform and the transfer of climate change-related affairs during 18th National Congress, the members of the National Leading Group on Climate Change, Energy Conservation and Emission Reduction have also changed, as shown in Table 1-3. Except changes of related department heads, the major changes include: a) The changes caused by merger, cancellation and reorganization of departments, such as the Ministry of Land and Resources and the State Oceanic Administration transferred to the Ministry of Natural Resources, the Ministry of Environmental Protection transferred to the Ministry of Ecology and Environment, the Ministry of Agriculture transferred to the Ministry of Agriculture and Rural Affairs, the National Health and Family Planning Commission transferred to the National Health Commission, the General Administration of Quality Supervision, Inspection and Quarantine transferred to the State Administration of Market Regulation, the State Forestry Administration transferred to National Forestry and Grassland Administration, and Legislative Affairs Office of the State Council transferred to the Ministry of Justice, etc.. b) The Minister of Foreign Affairs and the Head of the National Development and Reform Commission are no longer members of the Leading Group, left only the Vice Minister of Foreign Affairs and the Deputy Director of the National Development and Reform Commission; c) The Minister of Culture and Tourism, the Governor of the People's Bank of China and the Chairman of China International Development Cooperation Agency are added as members of the Leading Group; d) The Vice Minister in charge of climate change, energy conservation and emission reduction affairs (formerly is Deputy Director Xie Zhenhua) is no longer a member of the Leading Group. Generally speaking, the departments covered by the National Leading Group on Climate Change, Energy Conservation and Emission Reduction have increased, especially those related to culture, tourism, finance and international

development and cooperation, which provides an institutional foundation for collaboration on climate change issues such as investment and financing, carbon finance, South-South cooperation and other related issues. But at the same time, the Minister of Ecology and Environment ranking 11th among the group members only (NDRC ranks 3rd before), with the fact that the Vice Minister in charge of climate change, energy conservation and emission reduction is no longer retained as a member in the leading group may affect the coordination ability of the climate change departments and further increase the difficulty of reaching an agreement on climate change issues within the Leading Group.

Table 1-3 Comparisons of group members of National Leading Group on Climate Change, Energy Conservation and Emission Reduction before and after the institutional reform

	On July 9 th , 2013	On July 19 th , 2018
Group Head	Li Keqiang, Premier	Li Keqiang, Premier
Deputy Director	<ul style="list-style-type: none"> • Zhang Gaoli, Vice Premier • Yang Jiechi, State Councilor 	<ul style="list-style-type: none"> • Han Zheng, Vice Premier • Wang Yi, State Councilor
Members	<ul style="list-style-type: none"> • Xiao Jie, Deputy Secretary-General • Wang Yi, Minister of Foreign Affairs • Xu Shaoshi, Director of NDRC • Yuan Guiren, Minister of Education • Wan Gang, Minister of Science and Technology • Miao Wei, Minister of Industry and Information Technology • Li Liguang, Minister of Civil Affairs • Lou Jiwei, Minister of Finance • Jiang Daming, Minister of Land and Resources • Zhou Shengxian, Minister of Environmental Protection • Jiang Weixin, Minister of Housing and Urban-Rural Development • Yang Chuantang, Minister of Transport • Chen Lei, Minister of Water Resources • Han Changfu, Minister of Agriculture • Gao Hucheng, Minister of Commerce • Li Bin, Director of National Health and Family Planning Commission • Jiang Jiemin, Director of State-owned Assets Supervision and Administration Commission • Wang Jun, Director of State Taxation Administration • Zhi Shuping, Director of General Administration of Quality Supervision, Inspection and Quarantine 	<ul style="list-style-type: none"> • Ding Xuedong, Deputy Secretary-General • Kong Xuanyou, Vice Minister of Foreign Affairs • Zhang Yong, Deputy Director of NDRC • Chen Baosheng, Minister of Education • Wang Zhigang, Minister of Science and Technology • Miao Wei, Minister of Industry and Information Technology • Huang Shuxian, Minister of Civil Affairs • Fu Zhenghua, Minister of Justice • Liu Kun, Minister of Finance • Lu Hao, Minister of Natural Resources • Li Ganjie, Minister of Ecology and Environment • Wang Menghui, Minister of Housing and Urban-Rural Development • Li Xiaopeng, Minister of Transport • E Jingping, Minister of Water Resources • Han Changfu, Minister of Agriculture and Rural Affairs • Zhong Shan, Minister of Commerce • Luo Shugang, Minister of Culture and Tourism • Ma Xiaowei, Director of National Health Commission • Yi Gang, Governor of the People's Bank of China • Xiao Yaqing, Director of State-owned Assets Supervision and Administration Commission • Wang Jun, Director of State Taxation Administration

	On July 9 th , 2013	On July 19 th , 2018
Members	<ul style="list-style-type: none"> • Ma Jiantang, Director of National Bureau of Statistics • Zhao Shucong, State Forestry Administration • Jiao Huancheng, Deputy Secretary-General, Director of National Government Offices Administration • Xiao Yong, Deputy Director of Legislative Affairs Office • Bai Chunli, President of Chinese Academy of Sciences • Zheng Guoguang, Director of China Meteorological Administration • Wu Xinxiong, Deputy Director of NDRC, Director of National Energy Administration • Liu Cigui, Director of State Oceanic Administration • Lu Dongfu, Vice Minister of Transport, Director of National Railway Administration • Li Jiaxiang, Vice Minister of Transport, Director of Civil Aviation Administration of China • Xie Zhenhua, Deputy Director of NDRC 	<ul style="list-style-type: none"> • Zhang Mao, Director of State Administration of Market Regulation • Ning Jizhe, Deputy Director of NDRC, Director of National Bureau of Statistics • Wang Xiaotao, Chairman of China International Development Cooperation Agency • Li Baorong, Deputy Secretary-General, Director of National Government Offices Administration • Bai Chunli, President of Chinese Academy of Sciences • Liu Yaming, Director of China Meteorological Administration • Nuer Baikeli, Deputy Director of NDRC, Director of National Energy Administration • Zhang Jianlong, Director of National Forestry and Grassland Administration • Yang Yudong, Vice Minister of Transport, Director of National Railway Administration • Feng Zhenglin, Vice Minister of Transport, Director of Civil Aviation Administration of China
Notes	The daily operations of the National Leading Group on Climate Change, Energy Conservation, and Emission Reduction is undertaken by the NDRC	The daily operations of the National Leading Group on Climate Change, Energy Conservation, and Emission Reduction is undertaken by the Ministry of Ecology and Environment and the NDRC in line with their own responsibilities

1.3.2 The impact of institutional reform on climate change administration capability

In addition to the adjustment of the dominant institutional functions and the composition of the leadership group, the recessive factors such as different function definitions, ways of working, and resource allocation capacity of the National Development and Reform Commission and the Ministry of Ecology and Environment will also impact on the practices of addressing climate change. Table 1-4 summarizes the respective characteristics of NDRC and the Ministry of Ecology and Environment, as well as the advantages and disadvantages they may bring to the implementation of their climate change responsibilities. As a macro-control department, the National Development and Reform Commission is in charge of studying, formulating and implementing strategies of national economic and social development, annual plans, medium and long-term development plans, coordinating economic and social development, directing and promoting the restructuring of economic system and strategic adjustment of economic structures, which make it having more

advantages in promoting the leading position of climate change in overall national strategies and strengthening the top-level planning of climate change policies, and can coordinate the relationship between climate change and economic and social development, energy, environment and other aspects at a higher level. It also has stronger capability to allocate and mobilize resources to promote agreement between all departments. At the same time, since the NDRC is also responsible for the coordination of energy, sustainable development, energy conservation and emission reduction, it is also helpful for the integrated consideration and coordinated implementation of goals and policies on climate change, society-wise energy resources conservation, and low-carbon energy development. In addition, through the past 20 years of capacity building in leading and coordinating climate change affairs, the NDRC has gradually established a local team with knowledge, experience and capability to deal with climate change, especially in the policy sectors of GHG reporting, monitoring, and verification, carbon intensity target assessment and carbon market which require stronger industry background knowledge. The change of local teams caused by the portfolio transfer may result in greater costs of retraining and grinding-in. Nevertheless, it is undeniable that the Department of Climate Change, being a relatively weak department in an all-encompassing and macro-level National Development and Reform Commission, has been detrimental to the Department's work to some extent. For one thing, NDRC has always paid more attention to the economy and development aspects, resulting in some NDRC leaders considering climate change in opposition to development without a thorough understanding of it, paying more attention to the costs of the fight against climate change, which hinders more ambitious climate change targets and policies. For another, the influence of the NDRC over most ministries limits the openness on the climate issue, resulting in more reliance on internal policies and department regulations for climate change, and climate change legislation is relatively lagging behind. The planning and formulation of related policies on carbon market, South-South Cooperation Fund did not fully take the roles of other departments into account, such as "The People's Bank of China, China Banking Regulatory Commission, China Securities Regulatory Commission, China Insurance Regulatory Commission" and the Ministry of Finance, which ultimately affects the policy performance.

Unlike NDRC, the Ministry of Ecology and Environment, which was upgraded to the former Ministry of Environmental Protection in 2008, still has a lower ranking among the relevant ministries, although its organization has changed several times with higher level and stronger functions. With ecology and the environment getting worse, the Ministry of Environmental Protection enters public view more than ever before. And it has made some achievements in improving ecological civilization and environmental protection. It

has also become a key task for building a moderately prosperous society in all respects to win the battle against pollution and make “our skies blue” again. On the whole, the above-mentioned progress of environmental protection mainly depends on strict environmental law enforcement and administrative management measures, and a lot of forces have been put on environmental protection supervision. On the one hand, we pay attention to the establishment and improvement of the legal system, promulgates and amends the Environmental Protection Law, the Law on the Prevention and Control of Air Pollution, the Law on the Prevention and Control of Water Pollution, the Law on the Prevention and Control of Soil Pollution (Draft) and the Environmental Protection Tax Law, etc, which play a good legal guarantee for the effective implementation of environmental protection. On the other hand, it has a strong administrative law enforcement team relying more on administrative measures and end-of-pipe regulation. For example, the central government inspections on environmental protection has achieved remarkable results, being implemented from the central level with Chinese characteristics, and is an important initiative closely related to China’s political structures. However, it lacks long-term or marked-based mechanisms, as well as basic measures to fight against climate change and pollution such as the link to the economic development model, industrial structure and energy structure. Its capability to formulate relevant policies is weak. After the establishment of a “large government department” of ecology and environment, the coordination of various elements within the department, such as climate change and regional environmental protection, is expected to be better addressed. Just as the “five links” mentioned by Minister Li Ganjie, the implementation of the Environmental Protection Tax Law and the establishment of the public supervision system will also help to improve the implementation of market principles and public participation. Yet at the same time, the relationship between ecology and environment and administration of natural resources and economic development is still not being effectively addressed. Establish a cross-department coordination mechanism, to make overall plans on major strategic issues such as building an ecological civilization, implementing the concept of green development, and building a community with a shared future for mankind, are important challenges that the Ministry of Ecology and Environment will be facing. In addition, other key factors of the effectiveness of climate policies will depend on the ability of the existing local environmental protection team to quickly implement the transfer, re-structure and capacity-building of local institutions, and to take existing advantages of the Ministry of Environmental Protection to do legislate climate change law and carbon market regulations. It will also depend on their ability and willingness to make better use of market principles to promote environmental protection and address climate change based on emission trading.

Table 1-4 Advantages and disadvantages of implementing climate change functions before and after institutional reform

	Before National Development and Reform Commission	After Ministry of Ecology and Environment
Advantages	<ul style="list-style-type: none"> • Climate change plays a leading role in the overall national strategies; • Top-level planning of climate change policies; • Coordinate the relationship between climate change and economic and social development, energy and environment; • Stronger capability to allocate and mobilize resources to promote agreement between all departments; • Integrated consideration and coordinated implementation of goals and policies on climate change, conservation and utilization of social energy resources, and low-carbon energy development; • Foster a good local team with knowledge, experience and capability to deal with climate change, especially in the policy sectors of GHG statistics/monitoring/verification, carbon intensity target assessment and carbon market which require stronger industry background knowledge 	<ul style="list-style-type: none"> • Attention to the establishment and improvement of the legal system, which provides legal protection for related operations; • Strong administrative law enforcement team, such as the central government inspections on environmental protection which has achieved remarkable results; • The coordination of various elements within the department, such as the climate change and regional environmental protection, is expected to be better resolved; • Department of Climate Change has higher hierarchy in Ministry of Ecology and Environment than in NDRC; • Coordination of Environmental Protection Tax Law and national emission trading scheme; • The political background and strategic orientation of building ecological civilization, implementing the concept of green development, and building a community with a shared future for mankind
Disadvantages	<ul style="list-style-type: none"> • Always paid more attention to economy and development and the costs of climate change mitigation; • The lack of openness. For example the planning and formulation on carbon market, South-South Cooperation Fund did not fully take the roles of other departments into account, such as “The People’s Bank of China, China Banking Regulatory Commission, China Securities Regulatory Commission, China Insurance Regulatory Commission” and Ministry of Finance, which ultimately affects policy performance; • Relies on internal policies and department regulations on climate change, and climate change legislation is relatively lagging behind; • Department of Climate Change is a relatively vulnerable sector and lacks fund and implementing mechanism 	<ul style="list-style-type: none"> • Lack of capability in coordinating the relationship between climate change and natural resources and economic development; • Relies too much on administrative measures and lack the application of long-term mechanisms and market principles, as well as fundamental measures for climate change and pollution control such as the adjustment of economic development models, industrial structure and energy structure. • Lack of capability to allocate resources and formulate comprehensive policies with other departments; • The extra cost of re-training and grinding-in for local teams

With the gradual completion of government institutional reform, climate change policies enter a new starting point and faces new opportunities and challenges. On the one hand, the national planning of the central Party leadership shows strategic, long-term and in-depth considerations, which establishes a more unified and powerful institutional framework for the ecological civilization, forms a supervision and administration mechanism for the ecological and environmental protection adapted to the new era, integrates climate change to fore short and long term, national and international synergies, and is capable of timely adjustment from lesson learnt. At the same time, despite the backlash against global climate governance and international cooperation, the overall landscape is still in a cycle of progress and reshaping. Climate change is still on the diplomatic agenda of major countries. Events with international influence are keeping the momentum up, and the attention of markets, society and public is growing. Innovations in policies, business and technologies emerge endlessly. The moral stand of global climate governance and international cooperation cannot be erased, and its efficiency is evidenced by recent successes. On the other hand, it is generally believed that the initial system of climate governance was built on the ways of working and characteristics of the NDRC, and is more closely integrated with macroeconomic management, energy conservation, renewable energy planning, special major projects, financial resources and local support. In the initial system, climate change issues were often regarded as “a development issue”. Now, as part of the Ministry of Ecology and Environment role, the work methods, allocation of resources and local teams may face new changes. At the same time, the current international climate equilibrium has changed, the isolationism trend is undermining multilateral rules and existing international order, and the initial close climate cooperation between China and the United States has ceased. Trade disputes, technological blockade, and focus on costs conversely affect the decision-making of domestic governments and enterprises. It is also argued that the task of tackling climate change is important but long-term and world-wide, while the task of preventing and controlling air pollution is urgent and domestic. Therefore, the Ministry of Ecology and Environment would prioritize on winning the battle against pollution, rather than addressing climate change. These concepts, external environment, team grinding-in and other issues are also challenges to be tackled after this institutional reform.

1.4 New Expectations for the Governance of Climate Change in China and its Requirement on Strengthening Government Leadership

The report to the 19th National Congress of CPC sets ambitious goals for China's development till 2050, and divides the goals into two stages. Promoting ecological civilization and green and low-carbon development is an indispensable part of these goals. This requires China to uphold the principles of innovative, coordinated, green, open, and shared development, put in place the most stringent environmental protection regime, firmly pursue a model of sustainable development featuring increased production, higher living standards, and healthy ecosystems, establish and move the economic system towards green, low carbon, and sustainable growth, revolutionize the way that energy is produced and consumed, build an energy system that is clean, low-carbon, efficient and secure, promote a simple, moderate, green and low-carbon way of life, develop a Beautiful China and create sound working and living environments for the people. At the same time, China should contribute to building a community with a shared future for all mankind. China will play an active part in global environmental governance, honor the commitment on emission reduction, and cooperate to tackle climate change. Close coordination is significant to address climate change and develop the economy, eradicate poverty, improve people's lives, protect the environment and ensure health. China will continue to play the role of global participant, contributor and leader in addressing climate change, and achieve green, low-carbon, climate-resilient and sustainable development globally.

The new era, new vision and new goals have put forward new requirements for accelerating ecological civilization and strengthening climate governance in China.

1.4.1 Climate change actions in China should be adapted to economic and social high-quality growth

The 19th National Congress of CPC puts forward two stages arrangement of “work hard for a further 15 years”, establishing a modern economic system towards green and low carbon, and sums up “Xi Jinping's thinking on promoting ecological progress” with primary principle of “harmony between human and nature”. At the same time China will deepen its involvement in global environmental governance, formulate solutions for world environmental protection and sustainable development, and guide international cooperation on climate change. Therefore, as a new development vision, on the one hand, China regards green, low-carbon and circular development as the basic characteristic of modern economic

system, and environmental and sustainable development goals are referenced under the connotation of “high-quality growth”. On the other hand, the strategies of the 14th Five-Year Plan (2021—2025) should be integrated with developing a Beautiful China in 2035 and the 2050 emission reduction target, unifying the short, medium and long-term plans and identifying a consistent road map.

1.4.2 Climate change actions in China should be in line with the goal of developing a Beautiful China

The 19th National Congress of CPC regards “To attain a fundamental improvement in the environment and the goal of building a Beautiful China” as important aspects. Addressing climate change should give full play to forging synergy and become the main path to coordinate and lead green development, resolve outstanding environmental issues and strengthen ecosystem protection. 2035 and 2050 are the pivotal points for climate change and green and low-carbon development. The new direction of development towards low-carbon and climate adaptation is an important strategic measure to propel economic and social transition and properly resolve the problems of unbalanced and inadequate development.

1.4.3 Climate change actions in China should come down to social and economic structural changes

When the Central Finance and Economics Commission held a meeting last year to lay out strategies for winning the battle against pollution, it was clearly proposed to persist in preventing and governing from sources, adjust the “four structures” and achieve “four reductions and four increases”. First is to adjust the industrial structure, reduce excessive and outdated industries and increase new engines of growth. Second is to adjust the energy structure, reduce coal consumption and increase the use of clean energy. Third is to adjust the transport structure, reduce road transport and increase railway transport and the development of electric vehicles. Fourth is to adjust the structure of agricultural input (land use), reduce the use of chemical fertilizers and pesticides and increase the use of organic fertilizers. As a result, in 2018, the proportion of China coal consumption in primary energy dropped below 60% for the first time, with 59%.

1.4.4 Climate change actions in China should be in line with its role of key participant, contributor and leader of the global ecological civilization

Compared with the late 20th century, the main difficulties and characteristics of global climate governance in the new era have undergone profound changes. China is confronted

with a series of more complex challenges of recognizing scientific facts and historic responsibilities, assuming corresponding responsibilities and obligations, expanding the amount of funds, accelerating transition and technology innovation, and carrying out international cooperation, etc.. The international and domestic environment and conditions for China's participation in global climate governance have changed. The idea of "zero-sum games" in tackling climate change needs to be abandoned, all parties should work together, do their best, learn from each other and establish a fair, reasonable and win-win global climate governance system. Dialogue should be promoted, contributing to a community with a shared future for low-carbon development, sharing the benefits of the low-carbon transition. A positive narrative for China's role in fighting climate change should be put in place, promoting good practices illustrated in China's low carbon development, providing transition experience for developing countries, and contributing its wisdom and plans to tackle climate change worldwide. Climate change mitigation and adaptation should also proactively be added to the main agenda of the Belt and Road Initiative and South-South Cooperation, further developing international low carbon production capacity and capital cooperation, striving to build a new platform for global climate governance and injecting fresh impetus into common sustainable development.

As General Secretary Xi Jinping especially mentioned in his speech at the National Conference on Ecological and Environmental Protection held after institutional transfer: "China should implement the national program to actively tackle climate change, foster a global climate governance system that is fair, reasonable and focus on win-win cooperation, demonstrate China's strong sense of duty, and build a community with a shared future for mankind. China should work together to build a sound global eco-environment, deepen its involvement in global governance, formulate solutions for world environmental protection and sustainable development, and guide international cooperation on climate change." These are new expectations for tackling climate change in the new era, giving the strategic direction for a well-functioning climate change department in the Ministry of Ecology and Environment after the structural transfer.

1.4.5 Climate change actions should seize the benefits of institutional reform and strengthen co-management and co-control in China

The main goal of transferring climate change functions to the Ministry of Ecology and Environment is to provide institutional guarantee for achieving high-quality growth, developing ecological civilization and a Beautiful China, and building a community with a shared future for mankind. The core is to maximize the synergies of controlling conventional

pollutants and greenhouse gas emissions and promoting green and low-carbon development, that is, to help change models, adjust structures, improve the quality of growth, create new engines of growth, and promote green employment. Whether to reap the core benefits is the most important criterion to judge the performance of this institutional reform. To implement the reform plans is to integrate climate change management with the improvement of local environmental quality organically, and to achieve co-management and co-control. The allocation of existing political, legal, administrative, economic and technological resources for environmental management shall be optimized. The integrated application of different policy measures, such as administrative regulation, economic methods and communication and education, is needed. Climate change management should be integrated into existing policy infrastructure, such as statistics, monitoring, verification and law enforcement systems.

1.5 Suggestions on Climate Policy Adjustment under China's Institutional Reform

To accurately identify the role of Ministry of Ecology and Environment in climate change, to give full play to the political advantages of the Party's leadership and the socialist system in China, to make full use of the solid material foundations accumulated over the four decades since the launch of reform and opening-up, and to take climate change in China to a new high under the national institutional reform, we need to readjust from the concept, responsibility, operation and cooperation, and to reconstruct a new system of climate governance in China according to the new characteristics of the Ministry of Ecology and Environment.

1.5.1 Strategic positioning and change of the fight against climate change

1.5.1.1 The primary is political position

Climate change is an environmental issue as well as a development issue, but it comes down to a political issue, which need to be considered from both the international and domestic perspectives and achieve win-win on the national interests and international image. From the political view, the Ministry of Ecology and Environment can only do a better job in tackling climate change after the institutional reform. The "story" of China fighting climate change should be told abroad and at home, while serving the overall diplomatic work and demonstrating China's strong sense of duty abroad, and form a unified understanding and joint efforts at home. The "large environmental protection" concept of the Ministry of Ecology and Environment expresses that ecological and environmental protection is not a single department's role, but a major reform measure of the whole Party and country. The

same is true for climate issues. The climate issues are not staying in a single department or ministry, but having a higher position and a broader working architecture. National Leading Group on Climate Change, Energy Conservation and Emission Reduction shall fully coordinate and promote joint actions in all sectors, departments, industries and regions. For example, the launch of national carbon trading market can only perform well when the responsibilities are divided reasonably to financial, industrial, local and market departments, and to truly fulfill the solemn commitment of the General Secretary. Similar with the South-South Cooperation Fund for climate change, which should be regarded as a national platform to promote global ecological civilization, and broader support from the external sectors are needed to make it better.

1.5.1.2 The core is strategic leadership

Addressing climate change is a long-term and important task, therefore more attention should be paid to long-term planning. The 19th National Congress of CPC has put forward the long-term strategies of “two centenary goals” and “work hard for another two 15 years”, of which the pivotal points are 2020, 2035 and the middle of this century. These are in line with the strategic milestones of the update of the Nationally Determined Contribution under the Paris Agreement and the submission of a long-term strategy for low GHG emission, with both submission time in 2020. These targets and strategies are the core tasks in the next two years of climate change, which require continued attention and discussion outside the climate sector. Climate change should be integrated to economic and social development to put forward new ideas, visions, policies and strengths to the Millennium Plan for the sustainable development of the Chinese nation, the development of ecological civilization and Beautiful China, and building a community with a shared future for mankind. One should make best use of the advantages and bypass the disadvantages, focus on the long-term and global characteristics of climate change, mobilize all aspects of resources, emancipate the mind and seek truth from the facts, prioritize major issue and situation while thinking ahead to lead high-quality growth and global governance. Among them, the investigation of major developments and issues still need higher political level decision, including but not limited to whether to improve Nationally Determined Contribution in 2030 (such as implementation of total GHG cap control, early peaking), whether to gradually assume funding obligations (such as contributing to the Green Climate Fund), how to propose an updated Nationally Determined Contribution for 2025, and how to identify strategic objectives by the middle of the century, etc.. For these long-term and global issues, we should introduce “climate milestones” and “Historical views” and strategic thinking in global climate governance.

1.5.1.3 The breakthrough lies in synergy

Integration of climate change and air pollution control is an old topic, and arguing who is in a dominating position, of climate change or pollution control, would be vain. Now the focus should be put on optimizing existing resources to cooperate and achieve “1 + 1 > 2”. The prevention and control of air pollution has a good foundation in emission monitoring, supervision and law enforcement, and has a strong enforcement force in key areas such as Beijing-Tianjin-Hebei Region, for example the compulsory reduction of coal consumption. While climate change has more experience coordinating domestic and international efforts (such as “external drives internal”, policies and actions are generally announced on international occasions), formulating comprehensive objectives (such as integration of energy conservation/energy intensity, renewable energies and carbon sink targets) and applying market mechanism. Although emissions of GHG and air pollutants share the same root causes, their targets did not been completely match in the past. Based on the institutional reform, initiative should be taken to integrate efforts to tackle climate change, make full use of existing infrastructure and teams, form a coordinated monitoring, statistics, reporting and verification system, formulate policies and measures of source emission reduction and end-of-pipe governance, establish a unified platform and market mechanism for cost reduction of transaction and regulatory, develop an assessment method based on integrated ecological performance, and serve green Belt and Road through international public products. In addition, in the areas of environmental legislation and environmental law, climate change should be integrated gradually and through revisions of the laws. And the integration of the two in the sectors of green planning, supervision, finance, technology, production and consumption is easier to achieve when the barriers and boundaries from the past are gradually broken.

1.5.1.4 The concretization lies in team building

The talent pool is essential for the aforementioned goals. An ecological and environmental protection team, politically strong, highly competent, rigorous, and brave enough to assume the responsibilities is needed to tackle climate change. After the institutional reform, the building of local institutions, teams and capacities is the major challenges. It may take three to five years to form a solid and effective union between the higher and lower levels. Generally speaking, the teams of existing environmental protection system can tackle climate change more pragmatically and professionally. In terms of intellectual support, compared to the NCSC's focus on domestic emission reduction policies and international negotiation, other research institutes under the Ministry of Ecology and Environment will be more likely to play a greater role in climate change science, impact and

adaptation than before, including wider and more diverse support in the sectors of bilateral and multilateral cooperation.

1.5.2 Policy adjustment to address climate change in the near and medium terms

1.5.2.1 Improving ambition in early decarbonization of China economy

The 14th Five-Year Plan period is when the theory of “high-quality growth” to be tested in practice, is also a key period to answer to General Secretary Xi’s call for ecological civilization. Early peaking and accelerating the speed of carbon emission reduction are crucial for China to fulfil its climate and emission reduction commitment to the world and its low-carbon economic transition. China should promote the establishment and operation of its national carbon market and realize carbon reduction target through the control of both total carbon cap and carbon intensity, of which the targets and systems to be determined during the 14th Five-Year Plan period as a replacement of the existing total energy consumption control. In addition, to achieve sustainable economic and social development, carbon emissions must be decoupled from economic development as soon as possible. The 14th Five-Year Plan should integrate medium and long-term strategies, focus on three topics: to avoid investment in fossil fuel powered infrastructure, to accelerate the development and application of low-carbon technologies, and to forge a national policy reform on low-carbon future.

1.5.2.2 Comprehensively deepen the co-management of economic development, energy reform, environmental quality and climate protection

The National Leading Group on Climate Change, Energy Conservation and Emission Reduction shall function well in the battle against pollution, then promptly promote the structural transition in industrial, energy, transport and land use sectors, and comprehensively coordinate the policies and measures on objectives, planning, technology, investment and financing of development, energy, environment and climate change. Binding indicators for climate change needs to be incorporated into the system of central government inspections on ecological and environmental protection and be used as legal indicators resulting in punishment if not respected. The establishment of local climate change institutions should be regarded as a key inspection task in 2019 and 2020, and the existing system of inspections on ecological and environmental protection should be put to use to effectively promote the implementation of climate change policies. To improve GHG monitoring, reporting and verification systems, GHG should be integrated into existing environmental monitoring, statistics and control systems for building a common inventory list of GHG and other pollutants.

1.5.2.3 Emphasizing the structural change of energy consumption

Incorporate energy consumption related indicators into the 14th Five-Year Plan will help achieve the goal of total carbon cap control and economic green transition. By the end of the 14th Five-Year Plan (2025), coal shall account for less than 50% of primary energy consumption, non-fossil energy consumption reach 20% of primary energy consumption, and non-fossil power generation account for more than 40%.

(1) Further control of coal consumption. To continuously improve the quality of environment and air, the use of coal should be further controlled, energy efficiency increased, and China should strive to earlier achieve its emission reduction targets. Transition from coal in key areas such as the Beijing-Tianjin-Hebei Plain should be accelerated and set as examples. The use of alternative energies, including natural gas as a possible transitional energy and renewables as the long-term solution should be facilitated. Non-fossil power generation should be prioritized, coal-fired power should be restricted and its share in the energy supply limited. New investments in coal power plant will create lock-in effect, increase the risk of stranded assets and should be eliminated. Achieving a large share of renewables require a more comprehensive and integrated policy support. The up-scaling of renewables can be facilitated by easier access to financial markets, financing schemes, priority granting of land, grid connectivity. Support should be increased for the economic transition of coal-dependent provinces and municipalities.

(2) Actively promote the use of renewable energy. China must update the Renewable Energy Law as well as Energy Conservation Law and develop new renewable energy policies to facilitate the deployment of renewables. Favorable market conditions should be put in place, including support policies for smart grids, energy storage, and the acceleration of the reform of the energy market. Cross-department coordination is needed to improve renewable competitiveness via facilitating market financing, land use, and financial market access for renewable technologies.

1.5.2.4 Strengthen system, infrastructure and capacity building for carbon market

A binding absolute cap for the sectors covered by the carbon market via top-level design should be implemented. Full allocation via auctioning for the power sector should be the rule, allowing for the use of revenues in further climate action, and other industrial sectors should be included as soon as possible in order to complete the carbon pricing mechanism. A stronger carbon pricing mechanism enabled by a permit-buying power sector and a stringent cap will support low carbon power production technologies and help avoid investments in foreseeably climate-incompatible energy infrastructure, preventing associated sunk costs.

1.5.2.5 Strengthen research and capacity-building of climate change adaptation and nature based solutions

An integrated comprehensive masterplan should be developed to link mitigation based on carbon sinks and adaptation to negative climate impacts of climate change on water resources, biodiversity, ocean management, human health and infrastructure. China needs to build up the database and information to support the linkage about the above-mentioned areas. China should develop thematic and strategic plans targeting at land use, including agriculture, forestry, wetland, grassland and land use change; agriculture use: tangible reduction of chemical fertilizers and pesticide use, and limiting methane emission; protection of ecological land.

1.5.2.6 Clearly identify “Green and Low-Carbon Development” as a fundamental principle to promote “Belt and Road” and South-South Cooperation

“Greening and low carbon” is key to deal with the negative controversies of China’s Belt and Road Initiative (such as coal-fired power investment, transfer of high carbon and pollution overcapacity). By applying the “Green and Low-carbon Development” principle to all “Belt and Road Initiative” practices, China would help Belt and Road Initiative partner countries to deliver their pledges under the Paris Agreement and the United Nations’ Sustainable Development Goals (SDGs).

Various investment and financing tools should be used to expand climate financing channels and provide funding for the construction of the Belt and Road Initiative. Criteria such as ecological and environmental impact, carbon intensity and climate-related risk should be incorporated to the negative list system of overseas investment of the NDRC to guide green and low-carbon investments.

The role of non-state actors represented by cities in global climate governance should be enhanced and a “Belt and Road” low-carbon city alliance should be set.

Policy dialogues needs to be strengthened between the “Belt and Road” countries on environmental protection legislation and climate change targets, and the docking of green and low carbon standards should be promoted.

Annex Table 1-1 Advantages and challenges of a ministry for environment and climate change separated from the energy portfolio

Subject	Opportunities and challenges	Ways to fulfil opportunities and to address the challenge
Taking decisions efficiently	× Slower decision making on energy related issues. Might hinder energy and climate decisions. × If uncoordinated, the national voice in international negotiations might be weaker. ✓ Possibly faster on issues relating to other sectors in the scope of the MEE (transport, waste, housing...).	<ul style="list-style-type: none"> • Put in place regular and ad hoc, informal and mandatory cross-cutting collaboration environment for energy and climate issues. • Create a cross-governmental committee with the power to arbitrate decisions when energy and climate are involved, and which systematically has the final word on international negotiations. • Put in place regular work collaboration with other environment related issues. Build a common culture in the MEE.
Legislating power	× Less efficient in defining energy taxes if carbon tax uses this medium × Less easy way to access data on energy consumption	<ul style="list-style-type: none"> • More communication and regular update to assess the cross-cutting effects of energy and climate policies • Access to common database on energy consumption and emissions MRV
Control and enforcement power	✓ More data on environmental control, less prone to lobbying when separated from energy and industry ✓ Better local control and enforcement	<ul style="list-style-type: none"> • Full integration with other subjects of the ministry of environment. • Benefit from the use of local existing network with on-the-ground experience
Climate ambition	✓ Easier to advance climate policies without constant concern for conservative security of supply ✓ Co-benefits with environmental issues and additional motivation	<ul style="list-style-type: none"> • Keep constant collaboration with ministry of energy • Explicit the co-benefits and quantify them for better visibility and political strength
Integration of related subjects	× When climate is under the ministry in charge of economy, easier to involve green finance questions	<ul style="list-style-type: none"> • Keep collaboration with other aspects of climate issues. Set up a cross-ministerial climate team.

Annex 1-1 Check-list for an Efficient governance of climate change

Are the full potentials of co-benefits exploited?

Is GHG classified as air pollutant to fully benefit from existing environmental legislation?

Are the steps taken to improve data availability on all pollutants between agencies and ministries?

Are there positive feedback mechanisms in place that helps incentivise for higher ambition and review?

Are inter-dependent policies on energy, climate change and air quality consistent?

The dependency between energy plans and climate targets require deep cooperation to ensure consistency. The roles of energy consumption and low-carbon electricity are essential and a common strategy is needed. Will energy and climate plans be built together and be mutually-consistent? How much do energy plans involve climate change experts? Are those consultations legally binding?

Are the necessary coordination and institutional framework ready for technical dialogue between energy and climate experts?

Is the Ministry in charge of climate change powerful enough to tackle the climate challenge?

Implementing ambitious climate change policies needs a strong administration and a high political priority. Administrations size, budget and power are key parameter for their ability to make policy choices efficiently. Does climate change benefit from a high enough priority on the political agenda?

Policies on environment are often end-of-pipe oriented, while real solutions to climate change will come from systemic, process-wide, economy-wide approach. Air quality issues are localized, climate issues do not care for geography, “pollution delocalization” is ineffective. Is fighting climate change a primary objective in itself, are there additional climate targets that go further than the co-benefits from air quality measures?

The eventual accountability for achieving the climate targets and the possible feedbacks should fall on all the ministries involved in GHG emissions, not only the ministry of environment. Who is responsible for steering the climate ship? Are all ministries across the economy accountable?

How is climate change taken into account in other public decisions? Is there a reference carbon price to guide public and private investments?

If the ministry is not strong enough, is there leeway for regional initiatives and leadership?

Is China ready to fulfil its role as a global leader on climate change?

Are the foreign investments that will deeply change neighbouring economies, such as the Belt and road initiative, climate-aware and future-proof?

Is China involved in high level coalitions to build political momentum and influence key economic partners toward a common approach on climate change issues? Is China involved in platforms for technical discussions with international partners to allow lesson learning and foster international cooperation?

Chapter 2 Post-2020 Global Biodiversity Conservation

2.1 Introduction

World attention is focusing on the emerging and worsening global “environmental emergency” that will affect present and future generations. The 2015 Paris Agreement on Climate Change is designed to address one key driver of the emergency. In addition, scientists have made a strong case that ecosystem destruction, with loss of biodiversity and ecological services threaten planetary and human health and well being in unprecedented ways (see IPBES Summary Report for Decision Makers released in May 2019).

Accelerated actions under the Global Convention on Biological Diversity (CBD) require levels of public attention comparable to those of the Paris Agreement on Climate Change. Furthermore, there is great need for seeking synergy in implementation action under the various global environmental regimes. The UN 2030 Sustainable Development Goals (UN SDGs) incorporate clear goals and target action on environmental matters, and a timeline to 2030 for meeting the most urgent needs. One important area of progress during the first years of the UN SDGs has been the increased attention regarding the plight of global ocean environment, ecosystems and biodiversity; and the important role of the oceans in climate change.

2020 to 2030 is a critical period for “turning the curve” towards sustainable resource use, conservation, and ecological restoration. Full return to a healthy planet and living within “Planetary Boundaries”, and an acceptable “Ecological Footprint” for all people and nations will take longer. Milestones are needed for the two decades after 2030, and also for the longer term to 2100. For Climate Change, limiting global temperature rise to no more than 1.5 to 2 degrees C is commonly cited as a single target. Setting a single target for biodiversity conservation is very difficult. One approach is to consider a target global number for protected land, freshwater and ocean protected areas. More broadly, is the building momentum in many circles for “A New Global Deal for Nature” (NGDN). Such initiatives will require comprehensive action to respect, protect and enhance biodiversity and ecosystems. It is an idea that is compatible with Chinese concept of “People Living in Harmony with Nature” and new concepts such as “Ecological Civilization”.

The CCICED Task Force on Global Governance addresses climate change, biodiversity conservation, and ocean sustainable use via three Special Policy Studies. The Task Force has highlighted cross-impacts and synergies among the three topics and their links to the UN SDGs. 2020 is a particularly important milestone globally and within China for this Task Force since major assessments will take place for each topic, reviewing progress, and in the case of the CBD, setting new targets for 2020—2030 and possibly beyond to at least 2050.

China will host the 15th Conference of Parties to the CBD (COP 15) in Kunming in October 2020. COP 15 is an important opportunity for China to engage and accelerate global progress on protecting nature, and to showcase its own progress. It is also an opportunity to consider how synergies can be improved among the key subject areas, and with other topics such as the Belt and Road Initiative (BRI), green supply chains and China's War on Pollution.

The Post-2020 Global Biodiversity Conservation SPS began its work in 2018, focusing on three main topics:

- Analysis and proposals for the Post 2020 Framework;
- Political mobilization for global leadership and green diplomacy as the host to ensure agreement of ambitious, practical post-2020 framework in Kunming; and
- Showcasing via case studies China's own progress and needs including Ecological Civilization, institutional reform, performance management / implementation, ecological redlining, the new National Park System as the basis for its expanded conservation system, and perhaps other examples such as eco-compensation.

This CCICED SPS will continue to work closely with the international community as the approach to COP 15 evolves and gains momentum, and with the organizing body and others within China. Initial recommendations from the SPS were provided in its initial report to the CCICED Annual General Meeting in November 2018. The current progress report provides further recommendations, including some initial suggestions on the role of Biodiversity conservation in the 14th Five-Year Plan. It is anticipated that work will need to continue over the coming year leading to COP 15, and perhaps beyond. Participation in various international forums will take place.

The first of these was a well-attended Side Event sponsored by the SPS seeking advice from stakeholders at the November 2018 CBD COP 14 in Sharm El-Sheikh in Egypt. The COP 14 theme was “Investing in Biodiversity for People and Planet”.

A second initiative was attendance by our SPS member Harvey Locke and SPS Team Leader Li Lin at an April 2019 international meeting held in Montreal to catalyze formation of a “Coalition of Champions” for protection of Nature. As Canadian Minister of Environment and Climate Change, Catherine McKenna arranged this international gathering.

It followed directly from the CCICED Open Forum on Post-2020 Biodiversity Conservation held at the 2018 Annual General Meeting (AGM).

In addition, there has been extensive contact of SPS team leaders with the CBD Secretariat, various stakeholder bodies such as WWF, IUCN, World Economic Forum, and various countries including Germany, Canada, France, Norway, plus several developing countries and civil society bodies within and outside China. It will be important to provide further inputs to decision-makers inside China, and possibly to international bodies as well, at various points later in 2019 and 2020. Our work must take into account real time decision-making in the lead-up to COP 15.

From our experience in the months since COP 14, we have learned there is still a great gap between high expectations on the part of scientists and others alarmed at the rapid global ecological damage and biodiversity loss, and existing political will nationally and globally to take sufficient action to guarantee a sustainable future. It is a question of global political will to ensure that COP 15 is highly successful. Also, increasing the level of public interest throughout the world, commitments of enterprises and the financial sector, will make difference. In 2015 this happened for climate change, and over the last two years also for attention on oceans, particularly on reduction of plastic wastes.

This SPS recommendation document places emphasis on building momentum towards political commitment for CBD COP 15, consideration of China's efforts to adopt best practices, and raising understanding of the need for societal commitment to protecting and conserving nature. We use the term *nature* intentionally, as that is the term people and decision makers understand and value intuitively, even though many scientists and policy makers are comfortable with terms such as *biodiversity and ecosystems*.

2.2 Building Momentum

Over the past 20 years, global targets for Biodiversity have not been fully achieved. The latest global Strategic Plan for Biodiversity (2011—2020), set 20 targets (“Aichi Biodiversity Targets”). The Strategic Plan provided a roadmap and schedule for global biodiversity sustainable use and benefit sharing. It provided a flexible framework for setting national targets and a 2050 long-range target: that “by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people.” Most of these Aichi Targets will be missed, even though there are encouraging results in various countries and regions.

Leading up to COP 14, there were various assessments of progress on the individual

20 goals so that reasons for slow progress are reasonably well understood. At CBD COP 14 an Inter-sessional Working Group was approved to help in the formulation of a suitable framework for the COP 15 meeting. The idea is this effort might serve as the basis for a new action plan covering 2021—2030 targets and for options that extend well beyond the next decade, perhaps to 2050.

Directly related to future practical needs, Egypt and China, in collaboration with the CBD, launched the “*Sharm El-Sheikh to Beijing Action Agenda for Nature and People*” at COP 14. As noted by IISD coverage of the conference, “the action agenda has three main objectives: to raise public awareness about the urgent need to stem biodiversity loss and restore biodiversity health for both humanity and the global ecosystem; to inspire and implement nature-based solutions to meet key global challenges; and to catalyze cooperative initiatives in support of global biodiversity goals. The action agenda will be hosted on an online platform that will receive and showcase commitments and contributions to biodiversity from stakeholders across all sectors in advance of COP 15……This platform will enable the mapping of global biodiversity efforts, and help to identify key gaps and estimate impact.” By early April 2019 the platform was launched on the CBD website, and will allow for the “the full commitment and engagement” of the global community.

More recently still, at the May 2019 meeting of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), the Summary Report for Policymakers of the 2019 Assessment was released. This document sent shockwaves as it noted that as many as a million species could be lost in coming times. The summary report is based on finding from a very comprehensive IPBES report to be released in late 2019.

2.3 Political Engagement

2.3.1 Addressing Key Challenges

Many challenges have held back progress on CBD goals and targets, including those noted below.

- Despite some inspiring progress at national and local levels of various countries, global efforts to reverse nature loss still lack sufficient political urgency, commitment and effective delivery. Implementation of individual multilateral environmental agreements is sub-optimal, and together the efforts lack alignment and accountability. Climate change, ecologically sustainable land and water use, ocean sustainability, and biodiversity loss present what should be *one integrated challenge that requires unified responses*. Yet such an approach generally has not happened.

- Loss of natural capital and ecosystem services remains relatively low on political, public and private sector agendas. Companies and financial institutions are not yet playing significant enough roles in safeguarding nature; and space for civil society interventions is shrinking in some parts of the world.
- Scientists addressing biodiversity often have significant differences in how they feel issues should be presented and addressed. The extent to which economy and ecology should be co-promoted in addressing ecological goods and services is a frequently mentioned example.

Driving transformational change in order to reverse trends in nature loss by 2030 and setting a path towards restoration by 2050 will require a much more urgent, coherent and integrated response at local, national and global levels during the coming decade. Effective political champions are needed, especially in the preparations for COP 15 and in the immediate years after.

Momentum on climate change and the UN SDGs before and since 2015 suggests progress on ecosystem restoration is possible—as long as the two key ingredients that made the Paris climate negotiations successful are replicated: that non-state actors and business take significant and meaningful action in advance of COP 15 and shape key UN negotiations; and that countries hosting COPs and other summits conduct professional and inclusive diplomacy designed to deliver flexible and accessible high quality policy frameworks.

No single organization, sector or even country can face these challenges alone. The political mobilization should reach out as widely as possible, and across all the countries. The time from now to the 2020 CBD COP 15 in China is critical for building needed political engagement and mobilization.

2.3.2 Realizing opportunities

Among countries demonstrating a degree of elevated political willingness and leadership are Canada, Costa Rica, Egypt, France, Germany, Kenya, Norway and others are emerging. In addition, UN leadership is emerging via bodies such as United Nations Environment Programme(UNEP), United Nations Development Programme(UNDP) and Food and Agriculture Organization of the United Nations(FAO). IUCN, WWF, the World Economic Forum and other independent organizations are prepared to take on leadership roles. The opportunity for China is to mobilize support from these and additional leaders for building ambition and action on protecting Nature at national and global levels. This can be done in a staged fashion taking advantage of forums and initiatives already being planned.

For example, with the success of the Paris Agreement, the French government has

continued to show leadership on Nature by tabling the Global Pact for Environment at the UN High Level Political Forum in July 2017 and will host the IUCN World Conservation Congress in mid-2020. The French Development Agency is working with the financial community worldwide to enhance green growth investment, with implications for both Climate Change and Biodiversity Conservation. The recent G7 Environment Ministers Meeting in Metz, France, which emphasized “Natural Solutions”, for example in addressing some aspects of Climate Change.

In late April 2019, Canada hosted a Nature Champions meeting in Montreal attended by Environment Ministers and leaders from various organizations to begin global mobilization for “placing nature’s needs at the heart of all global agendas.” This *call to action* includes an emphasis on “Nature-based Solutions” and other matters noted below:

- Recognizing the fundamental link between nature, a stable climate, human wellbeing, and sustainable development for all;
- Uniting nature conservation objectives with addressing climate change and developing nature-based solutions that are effective for both;
- Promoting an ambitious set of new targets for the UN Convention on Biodiversity Diversity(CBD) that has clear and measurable objectives for 2030 and effectively enables the world to reach the 2050 Vision of Living in Harmony with Nature;
- Widening the participation in the Convention on Biological Diversity Strategic Plan beyond governments to include commitments and actions by a wide range of actors;
- Addressing nature’s needs by increasing the proportion of land and ocean that we protect and conserve around the world and improve the way we manage and restore it;
- Addressing the key drivers of nature loss across the world by enhancing concrete action on:
 - Reducing habitat-loss and deforestation;
 - Curbing terrestrial and marine pollution; and
 - Developing and strengthening sustainable supply and value chain management;
- Embracing nature-based decision-making in all key political, economic, cultural, and social decisions;
- Increasing investment in nature conservation and leveraging existing commitments to mobilize new resources; and
- Recognizing and enhancing the role of subnational governments, cities and other local authorities as well as of Indigenous peoples, local communities, women and youth in the protection of nature.

The Canadian political call to action meeting have been followed by other such

gatherings, for example, the Conference on Biodiversity in Trondheim, Norway, 35 July 2019. That meeting focused on establishing dialogue on how to achieve an “ambitious outcome” from COP 15. It also focused on green supply chains to address matters such as deforestation. The UN General Assembly high-level segment this September, COP 25 on Climate Change in December 2019, the June 2020 Oceans Conference, and the June 2020 IUCN World Conservation Conference are examples of other venues where Nature Champions can meet and their numbers expanded.

What is most important, however, is not to focus only on those who are already engaged. If nature conservation and biodiversity are to become mainstreamed to the extent already achieved for Climate Change, it is necessary to broaden support within the major business drivers of the economy, in the decisions of consumers, and in the value systems of society. This implies the need for a much broader outreach across many sectors, and into investment and trade practices for example. It will be necessary to deepen dialogues established in recent years at Davos forums, and in many other meetings and mechanisms. The big opportunity is to make the CBD COP15 a turning point for Nature in the same way that the Paris Agreement was for Climate Change. All these created a space where China can play a convening and leadership role.

2.3.3 Potential Chinese responses and political engagement possibilities

China can be at the center of the game to ensure momentum builds for COP 15. Also, China can liaise with various countries to build on the strength of each other. Similarly, via cooperation with international organizations, enterprises, and others, China can amplify their impact. China also can lead by showcasing the progress it is making towards mainstreaming its approach to Ecological Civilization and specific efforts to conserve and protect Nature. Below are several important ways for China to engage with others in the drive for a robust outcome to COP 15.

(1) Only being a good host for the CBD COP 15 is not enough. With all the warning signs that Nature is in a state of emergency throughout our planet, 2020 becomes the historical moment when China can and should take the most meaningful actions possible. Three outcomes are possible: a) agreement on an ambitious framework for 2020—2030 that the world will hail, such as that of the Paris Agreement, that the world will put all its efforts to achieve, and that will be remembered in history; b) agreement on a mediocre agreement based on lowest common denominator with perhaps more than half of the world not satisfied and perhaps with criticism targeted towards China for not playing a sufficient leadership role; or c) facing immediate failure by reaching no agreement, with long-term negative implications.

Outcome c) is a no-go. Clearly, Plan b) should clearly be avoided. China should strive vigorously for Plan a). But China acting alone will not bring success. Mobilizing support for Nature Champions—who collectively can form a formidable force for desired action—should be the approach China takes.

(2) Mobilize and enable action by Champions for Nature. The entire government of China and other organizations should tackle the nature agenda with determination and high political will. All related ministries, and others should proactively engage with like-minded peers and stakeholders inside and outside of China, to create a movement in the lead up to 2020. All mechanisms need and can be explored: official diplomatic channels, track 1.5 and track 2 diplomacy, bilateral dialogues, multilateral discussions, multi-stakeholder exchanges, and public education and communications, academic connections, business engagements. This is a tall order but necessary and China is not alone on this as more and more champions for nature are emerging.

(3) Utilize green diplomacy to break through geopolitical uncertainties. It is an opportune time for China to use green diplomacy to open new ground—a common high moral ground—to discuss global common issues, particularly reversing the loss of nature, and the economic gains from enhancing ecological services to gain new allies. This is also the time for China to explain to the world the essence of concepts nurtured by China, including *Ecological Civilization* and *A Community with a Shared Future for Humanity*.

(4) Take leadership roles in promoting a “New Deal for Nature and People”. The movement now taking shape for a New Deal for Nature and People, (“By 2020 a strong endorsement and commitment by Heads of State to substantially strengthen global targets and mechanisms of the CBD, in order to reverse the loss of Nature and to protect and restore Nature by 2030, in support of and underpinned by the SDGs and the Paris Agreement.”) The essence of the New Deal for Nature and People is to have highest commitment in countries and, at the global level, by the UN Secretary General and, for Heads of States to reverse the loss and restore Nature throughout agendas of the government as a whole, beyond the ministries of environment. This will be supported by the mobilization of other ministries that are critical to the economic development, health, and wellbeing of the citizen, as well as business, finances and general public all over the globe.

China’s ecological effort domestically is already becoming a path consistent with a New Deal. Examples include President Xi’s 2005 thoughts that “clear water and green mountain are as valuable as mountain of gold and silver”; Ecological Civilization, initiated in 2007 and now recognized in China’s Constitution; the 5-in-1 approach that promotes economic, political, cultural, social, and ecological progress—proposed in 2012 and now a

key policy goal; championing of environmental protection along the Yangtze River Economic Belt (YREB) in 2017; the ban of all ivory trade in 2017; the elevation of Ecological and Environment Ministry in 2018; a newly established natural resources and ecological environment department under the Ministry of Finance in 2018; plus many more pilots and experiments on natural resource asset audits, enhanced environmental protection, including a focus on ecosystems, and particularly on the War on Pollution.

The top level design on environmental and ecological issues with the highest political will is critical to making a new deal with Nature. It is the right time for China to expand its green initiatives to all walks of life in China, and to China's overseas operations. It is also time for China to work with like-minded countries and players to have the whole world involved in formulation of a robust new deal with Nature. The CBD COP15 in China, in the year of realizing China's goal of a moderately well off society, provides China a great opportunity to make this a new deal for Nature and its own people.

(5) China should become a beacon for the world through its march towards Ecological Civilization. It is time for China to reflect on the progress and development of thinking and practices, domestically and internationally, regarding Ecological Civilization. China is valuable to the world's sustainable development efforts, especially to those countries that may be entering a development stage similar to China's efforts in past decades. This approach could be tied to the efforts for a Green Belt and Road Initiative.

One more issue needs China's attention. Ecological Civilization is far reaching into the future, and explicitly addresses the relationship between development and ecological constraints. However, due to culture, ideology and language barriers, the world is not able to fully understand China's thoughts and practices in the way Chinese understand them. It is important for China to enlist and engage like-minded allies to build understanding and join force with others outside of China in support of this endeavor.

With countries such as France, China can join force to engage at the Heads of State level (HoS) to jointly call for other HoS to be champions for Nature, to work with the UN Secretary General to champion an ecological agenda together. China can also engage closely with French teams of diplomacy and organization that have made Paris a success for United Nations Framework Convention on Climate Change (UNFCCC), to learn from their successes and failures.

With countries such as Germany, China can join force to mobilize resources, to turn "Merkle Millions" (From 2006 to 2017, Germany's contribution to international biodiversity financing has increased from 75 million euros per year to 537 million euros). Such investments levels per year must shift on the part of others to become equivalent to "Billions

for Nature”.

With countries such as Kenya and many other African countries, China can build on some China-Africa efforts in the past two decades to elevate sustainable development practices towards ecological civilization joint initiatives, especially in the context of the UN SDGs.

By cooperating with many other countries, China can explore and be the glue for a common agenda, in order to secure systems of “Natural Solutions” for our collective thriving future. Starting with France and bringing in EU, Germany, the UK, Canada, Rwanda, Uganda, Egypt, Chile, Mexico, Costa Rica, Colombia, Peru, Seychelles, Norway and others, there can be a gradual build up of interest in high quality outcomes from COP 15. The General Assembly of the United Nations(UNGA) Climate Summit in 2019 is an important opportunity to bring out new ideas especially to address synergies among global agreements. In general, China can and should build on the domestic drive of Champion countries to generate political mobilization in national capitols. Also, to enlist support from these governments to help build popular, national and commercial action, and the political space to agree and deliver a “New deal for Nature and People” through UN and international forums in 2020.

Demonstrating the essential role of Nature in peace and security, key forums such as the G7 and G20 also can be utilized to seek to introduce a Nature agenda and make Nature loss relevant to financial, peace, security and international justice. These bodies and some others are essential bodies for follow-up after 2020.

There are many other opportunities that can be taken on the part of Chinese organizations in the time leading up to COP 15. Obviously, these should be undertaken in a coordinated fashion and generally involve a number of partners, for example in the following three suggestions:

- Utilizing the opportunity presented with New Zealand and China co-leading the Nature-based Solutions work stream for the UNGA 2019 Climate Summit, the climate department and ecological units within China’s MEE in should closely liaise with each other, so that the maximum gain for both biodiversity and climate change action can be achieved already at the 2019 UNGA Climate Summit;
- Accelerating learning from the success of the Paris Agreement on Climate Change. This should focus on two fronts: a) within China: the biodiversity community should learn from the climate change community to gain the insights on engaging at global context, playing a more active and proactive role; and b) with France: get more intensive and detailed exchanges with prominent leaders who have made Paris a success, by having open and honest dialogues to deep dive on how to play a leading role as a host country;

- Actively joining the newly emerged initiatives that aiming to generate collation of nature champions, such as the April 2019 Montreal Nature Summit that was inspired via the CCICED AGM in 2018. China should consider organizing such a gathering of Nature Champions soon, either later in 2019 or in early 2020. This way, China can utilize the spring-board effect created by other similar initiatives, and at the same time push for greater momentum leading to Kunming.

2.4 Good Practices for Biodiversity Conservation Related to China

The Post-2020 Biodiversity Conservation SPS is interested in practices and case studies related to China's domestic situation and to activities relevant to China's relationships outside of the country, for example in the BRI countries. Showcasing China's experience is important as part of the global dialogue about what is feasible, pitfalls to be avoided, and what constitutes cost-effective Natural Solutions. As one of the most significant cases among the world's mega-biodiversity countries, the struggle to improve and restore Nature in China is a story of global significance. Good practices have emerged, and will be of particular value to other developing nations.

This section of our SPS 2019 Summary Report covers key points from draft material on Good Practices for Biodiversity Conservation in China. We will be publishing a more complete document later in 2019 as input to preparations for the CBD COP 15. The summarized points noted here form the basis for some SPS current recommendations, including considerations about higher quality development and also as preliminary ideas that might inform thinking regarding the 14th Five-Year Plan (2021—2025) formulation.

Annex 1 is a brief regarding bamboo as an example of emerging Natural Solutions for sustainable development—bridging several important needs including poverty reduction, ecological services, low carbon economy, and biodiversity enhancement. This brief was prepared by a CCICED research partner, the China-based International Bamboo and Rattan Organization (INBAR). The case demonstrates the remarkably high potential value of bamboo both within China and in many other countries.

Over coming months we anticipate highlighting various other China-related cases which may be valuable to other countries and which might be considered at the time of the COP 15 (i.e., “showcasing Chinese experience”.) There is particular value for ecological and conservation experience for the greening of China's signature partnerships under the BRI. An example is Pakistan's interest in extensive reforestation (“10 billion trees program”) and ecologically based water management. Pakistan wishes to draw upon China's experience.

2.4.1 Institutional Reform

2.4.1.1 Implementing institutional reform for ecology and biodiversity

China's State Council has a long-standing role in establishing and monitoring the "China Biodiversity Conservation Strategy and Action Plan (2011—2030)" and the National Committee for Biodiversity Conservation is chaired by the Vice Premier in charge of environmental matters. At the most recent meeting of the National Committee in February 2019, Vice Premier Han Zheng emphasized that strengthening biodiversity conservation is an important part of ecological civilization construction and an important starting point for promoting high-quality development. Certainly over this past decade, and even before, the topic has received high-level attention from Chinese leaders, especially President Xi Jinping.

In 2018, the Chinese government issued the "Deepening Party and State Institutional Reform Plan", in which the re-organized Ministry of Ecology and Environment is responsible for establishing and improving the basic system of ecological environment, supervising and managing environmental pollution prevention, guiding coordination and supervision of ecological protection and restoration, carrying out ecological environment monitoring, implementing ecological environmental supervision and law enforcement. The newly established Ministry of Natural Resources is responsible for conducting unified management of the development, utilization and protection of natural resources, and establishing a system for compensated use of natural resources. The National Forestry and Grassland Administration integrates the management responsibilities of nature reserves, scenic spots, natural heritage, and geological parks previously managed by various departments, and attaches the National Park Administration brand to establish a protected area system with national parks as the main body. The reform of the above-mentioned institutional functions has laid an important foundation for strengthening the protection of biodiversity.

2.4.1.2 Implementing a balance sheet system for natural resources

The scope for natural resources balance sheets should include both natural resources that can be used for economic systems in the accounting area, as well as those related to the ecological environment and ecological services of vital significance to survival of life on the planet. As an important part of ecological environmental protection, biodiversity is reflected in the protection of ecosystem diversity in the natural resources balance sheet mainly through the establishment of land, forest resources and water resources accounts. The basis of biodiversity conservation is the protection of the living environment of animals and plants. For the improvement of habitat quality, there are mainly natural forests, lakes and rivers accounting in the natural resources balance sheet. This accounting system is very much a

work in progress and incomplete, for example in addressing the oceans. In 2015, the General Office of the State Council launched pilot work in several locations. The next step will include establishment of a unified framework and standards for a unified natural resources balance sheet. This information will also be used in a performance appraisal mechanism, for reasonably establishing the reward and punishment performance appraisal mechanism, and for construction of eco-civilization and green development.

2.4.1.3 Implementing the Departure Audit System for the Natural Resource Assets of Leading Cadres

The departure audit of leading cadres' natural resources assets refers to the accounting of the land, water, forests and other natural resource assets in the jurisdiction of the auditing department after the departure of leading party and government leading cadres. This system is to prevent leading cadres from paying attention to economic development but not taking into account environmental protection. The purpose is to promote leading cadres to better fulfill their natural resource asset management responsibilities and ecological environmental protection responsibilities. At an institutional level, it is a means to ensure leading cadres approach their ecological construction work with enthusiasm and initiative. Therefore, it is often referred to as "ecological audit." This is part of a lifelong accountability system regarding ecological environmental damage liability on the part of officials.

2.4.2 Guiding principles of eco-civilization and green development

At the 19th National Congress of the Communist Party in 2017, the grand goal of "accelerating the reform of the eco-civilization system and building a beautiful China" was put forward. The main tasks to achieve this goal include: implementing major projects of important ecosystem protection and restoration, optimizing the ecological security barrier system, building the ecological corridor and biodiversity conservation networks to improve the quality and stability of ecosystems and establish the natural protected area system with national parks as the main body.

Xi Jinping's eco-civilization thoughts are rich in content and systematic, and deeply demonstrate the reasons, goals and pathways in eco-civilization construction. They are concentrated in the "eight adherences", that is, adhere to the theory of "civilization will flourish when ecology prospers", adhere to the harmonious coexistence between man and nature, "lucid waters and lush mountains are invaluable assets", adhere to a good ecological environment is the most inclusive benefit of people's livelihood, "mountains, rivers, forests, farmlands, lakes and grass forming a community of life", adhere to protecting the ecological environment with the strictest system and law, adhere to the national actions of constructing

“Beautiful China”, and persist in collaborating on the construction of global eco-civilization.

In 2016, the Chinese government issued the “Notice on Promoting the Ecological Protection and Restoration of mountains, rivers, forests, farmlands, lakes”, This Notice pointed out that, “Accelerate the ecological protection and restoration of rare and endangered animal and plant habitat areas, restore the damaged trans-regional ecological corridors to ensure connectivity and integrity, build a biodiversity conservation network, promote the overall restoration of ecological space, and promoting ecosystem function improvement.”

2.4.3 Mainstreaming China’s strategy for biodiversity conservation

In order to implement the CBD and effectively address new problems and challenges in biodiversity conservation in China, the Chinese government has continuously improved the organization and institutional construction of biodiversity conservation, integrated biodiversity conservation into ecological civilization construction, promoted the implementation of the mainstreaming strategy for biodiversity conservation, innovated and delineated the Ecological Conservation Redline (ECR), undertaken reform of the natural protected area system, with national parks as the centerpiece, and conservation and utilization of biological resources through ecological compensation and the creation of various economic benefits. These measures are starting to produce good results and accumulate successful experiences, which is of great significance for national and international biodiversity conservation and sustainable use of biological resources. In addition, China is seeking to introduce ecological and conservation concerns into its relationships with neighboring countries as well as other interested countries, especially via the BRI.

2.4.3.1 Formulating China’s Biodiversity Conservation Strategy and Action Plan

The 2011—2030 Biodiversity Conservation Strategy and Action Plan defined the strategic objectives, strategic tasks, and priority action plans. At the same time, the action plans proposed priority areas for biodiversity conservation with well-defined boundaries for the first time in China, which have identified 32 inland and 3 marine biodiversity conservation priority areas in China, of which the 32 inland biodiversity conservation priority areas involve 885 areas in 27 provinces, accounting for about 24% of China’s land area.

2.4.3.2 Integrating biodiversity conservation into the Five-Year Plans

In 2015, China issued the “13th Five-Year Plan” and clearly stated that “insisting on giving priority to conservation and natural restoration, promoting the protection and restoration of natural ecosystems, building ecological corridors and biodiversity conservation networks, and comprehensively improving the stability and ecosystem services of all types of natural ecosystems, in order to build an ecological security barrier.”

During the “14th Five-Year Plan” (2021—2025), it is anticipated that China might further increase the importance and protection of biodiversity, re-formulate and implement the 2020—2030 Biodiversity Conservation Action Plan, accelerate the development of national legislation on biodiversity conservation, conduct regular biodiversity surveys and assessments, and continue to implement ecological protection and restoration in accordance with the concept of “mountains, rivers, forests, farmlands, lakes and grass form a community of life”. By promoting the sustainable use of biological resources and improving the ecological compensation mechanism, it will be important to consolidate and enhance the production and living standards of people in poverty-stricken areas, while maintaining and improving the level of biodiversity conservation.

2.4.3.3 Implementing the National Plan for Major Functional Zones

In 2010, the State Council issued the “National Plan for Major Functional Zones”. It is a strategic, basic and binding plan for the development of national land space. It divides the national land space into four categories: optimized development zones, key development zones, restricted development zones and forbidden development zones. The forbidden development zones refer to representative natural ecosystems, natural concentrated distribution of rare and endangered wildlife species, and natural heritage sites or cultural sites with special values. The plan determines a total of 1,443 national forbidden development zones with a total area of about 1.2 million square kilometers, accounting for 12.5% of the China’s land area. Among them, the national nature reserve accounts for 9.67% of China’s land area, where biodiversity conservation are given priority.

The “National Plan for Major Functional Zones” has identified 25 key ecological functional areas with a total area of 3.86 million square kilometers, accounting for 40.2% of the national land area. The national key ecological functions are divided into four types: water conservation, soil and water conservation, wind and sand fixation, and biodiversity conservation. Among them, there are 7 biodiversity conservation zones.

2.4.3.4 National Land Planning Outline (2016—2030)

In 2017, the State Council issued the “National Land Planning Outline (2016—2030)”. The Outline adheres to the principle of giving priority to conservation and natural restoration, and focuses on improving environmental quality. According to the control requirements of land development intensity in different regions, the comprehensive land protection should be promoted by classification and level.

2.4.3.5 Nature in the development plan for the Yangtze River Economic Belt (YREB)

In 2016, the state issued the outline of the development plan for the YREB. It put forward improving the ecological environment as the top of the development strategy of the YREB.

The outline emphasizes the restoration of the ecological environment of the Yangtze River, respects the laws of nature and river evolution, and protects and improves the ecosystem services function of the river basin. It requires that the water environment and water ecology quality must achieve overall improvement in 2030, and put forward the specific objectives of ecological environment construction such as excellent water quality (reach or exceed III) proportion (more than 75% in 2020), and the forest coverage rate (43% in 2020). Based on the principle of eco-priority, the outline stresses that the relationship between rivers and lakes should be properly handled, the protection of aquatic biodiversity should be strengthened, and forest protection and ecological restoration along the river should be reinforced.

2.4.4 Eco-compensation

The implementation of eco-compensation is an important means to mobilize the enthusiasm of all parties and protect the ecological environment. Over the past decade, the central government and local governments have actively promoted eco-compensation, and pushed forward the construction of a compensation mechanism for ecological protection orderly. However, on the whole, the scope of eco-compensation is still relatively too small and the standard is relatively too low, and the mechanisms between the protector and the beneficiary are not perfect, which affects the effect of ecological environmental protection measures. In order to further improve the eco-compensation mechanism, in 2016, the Chinese government put forward that “by 2020, a complete coverage of important regional eco-compensation such as forest, grassland, wetland, desert, sea, river, farmland and other key areas and prohibited development areas, key ecological function areas, will be implemented. Compensation level will adapt to economic and social development, and cross-regional and cross river compensation pilot demonstration will achieve significant progress”.

The compensation system related to biodiversity protection includes: public welfare forest compensation; rewards for stopping commercial logging of natural forests; rewards for returning grazing land to grassland; subsidies for grazing prohibition and rewards for balancing grazing and livestock; important wetland eco-compensation; pilot project of land closure protection and compensation for desertification; subsidies for the breeding, releasing and ecological environment restoration of aquaculture; compensation of aquatic germplasm resources reserve; compensation for ecological protection in national marine nature reserves and marine special reserves. Various compensatory measures have been promoted in an orderly manner by different authorities and have played an important role in the protection of biodiversity.

The establishment of upstream and downstream eco-compensation mechanisms not

only ensure the water environment quality of the downstream regions, but also promote the protection of vegetation and habitat environment in the upstream regions. In 2012, the Ministry of Finance and the Ministry of Environmental Protection coordinated Anhui and Zhejiang Provinces to jointly implement the cross-provincial eco-compensation mechanism for the Xinan River. On the basis of the success of the first three-year pilot program, the second pilot program was launched in 2015, with a total investment of 700 million RMB for the ecological and environmental protection of the Xinan River. In 2018, the provincial finance department, the provincial environmental protection department, the provincial development and reform commission and the provincial water resources department jointly issued the implementation opinions on the establishment of a horizontal (“same level”) ecological protection compensation mechanism for upstream and downstream river basins in Zhejiang Province, making Zhejiang the first province to implement a horizontal ecological protection compensation mechanism for river basins in China.

Eco-compensation, also could be used to strengthen the breeding research of wild resources, innovate the technology of biological resources development and utilization, and reduce the utilization of wild resources according to the principle of “protection first and sustainable utilization”. Through the sustainable utilization of biological resources, the development and utilization of biological diversity resources will become a new growth point of economic development and a new means for residents to get rid of poverty.

2.4.5 Ecological Conservation Redline

Delineating ECR is a major decision of the Chinese government. Compared with existing protected areas at home and abroad, the ECR system is based on ecological service supply, disaster mitigation control, and biodiversity conservation. It integrates existing types of protected areas and supplements the regions where the function of ecological services is extremely important or the ecological environment is extremely sensitive and fragile, so the composition is more comprehensive, the distribution pattern is more scientific, the regional functions are more prominent, and the control constraints are more rigid. It is a major improvement and innovation in the construction of the protected areas system. By delineating and strictly managing the ECR, it not only effectively protects biodiversity and important natural landscapes, but also plays an important role in purifying the atmosphere and expanding the water environment capacity. At the same time, the ECR is also the control line for the development of land space, which maintain the green water and green mountains on which the sustainable development of the Chinese nation depends, it also provide a strong guarantee for safeguarding national ecological security and promoting sustainable economic

and social development. Therefore, the ECR is sometimes called China's "another lifeline after the farmland redline".

In February 2017, the General Office of the CPC Central Committee and the General Office of the State Council issued "Several opinions on delineating and strictly managing the ecological conservation redline", which clarified the overall requirements and specific tasks of ECR. In June 2018, the "Opinions of the Central Committee of the Communist Party of China on Strengthening Ecological Environment Protection and Resolutely Doing a Good Job in Pollution Prevention and Control" further proposed that the goal of the area of ECR should account for 25% of China's total land area.

Currently, China has made the following progress in delimiting ECR:

- Establishing a coordination mechanism. MEE has taken the lead in setting up a leading group for inter-ministerial coordination of ECR.
- Developing guidance documents. Documents such as the guidelines for the ECR delimitation, opinions and suggestions on the distribution of ECR in provinces (districts and cities), and technical regulations on ECR demarcation (pilot) have been issued to guide the orderly ECR delimitation in various regions.
- Building a regulatory system. The integrated monitoring network has been improved, an ECR regulatory platform has been launched and organized for operation. The platform is expected to be complete by the end of 2020.
- Intensifying efforts to publicize ECR. An ECR logo has been released. The ECR publicity video has been planned and produced. The useful experience of ECR demarcation has been summarized, the media has been invited to follow up the publicity, and the publicity of popular science knowledge of ECR has been strengthened. An ECR demarcation toolkit has been developed by cooperation with IUCN, and Chinese experience in ecological protection has been promoted to the international community.
- Positive progress has been made in ECR delineation. In February 2018, the State Council approved the plan of ECR delimitation in 15 provinces, including the Beijing-Tianjin-Hebei Region, the YREB and Ningxia Autonomous Region, covering about 25% of the area. ECR delimitation of all the 15 provinces have been issued and implemented by provincial governments. At present, the 15 provinces are carrying out the pilot work of ECR demarcating. The other 16 provinces have formed preliminary plans for ECR delimitating, which will be revised and improved according to the opinions of the ministry and submitted to the State Council for approval.

In the next step, all localities will carry out ECR demarcation in accordance with the delimitation plan approved by the State Council. Combined with land space planning,

protection land system construction and other work, the precise implementation of ECR will be promoted, and the more refined ecological supervision will be implemented. At the same time, the Chinese government will formulate and promulgate measures for ECR management, which will clarify the management principles, management and control of human activities, conservation and restoration, ecological compensation, regulatory assessment and other requirements. And ECR legislation will be promoted on the basis of local management practices.

2.4.6 National Park as the core of a Protected Area System in China

After several years of consultation of discussion and planning, in September 2017, the General Office of the CPC Central Committee and the General Office of the State Council together issued the “Overall Plan for Establishing a National Park System”, which, based on a clear definition of the concept of national park, provides explicit description regarding how to build China’s national parks from seven aspects. These are: overall requirements, scientific definition of the content of national parks, establishing a unified administrative power and tiered management system, establishing a system of funding guarantee, improving the system of natural ecosystem protection, building a coordinated community-development system and implementation support. The National Parks System will be the core for a broader network of protected areas, including many areas now designated as nature reserves or with other designations such as geo parks.

In less than five years, China has taken the opportunity of the national park system development and made significant milestone progress in comprehensively deepening the reform of the protected natural area system, laying a solid foundation for the realization of ecological civilization and the national strategy of building a beautiful China.

National parks will be state approved and managed—specific terrestrial or marine areas that have clear boundaries with an aim primarily to protect nationally representative, natural ecosystems, and to achieve scientific conservation and rational use of natural resources. The primary aim is to protect large-area ecosystems and large-scale ecological processes, underlining the need for preservation of the authenticity and integrity of ecosystems. They are clearly categorized as development prohibited zones in the national main functional area planning to achieve ecological red line management and the strictest protection. National parks adhere to the features of national representation and inheritance from generation to generation, inspiring national pride and leaving a precious natural legacy for future generations. They adhere to public welfare of the whole people, provide environmental education and recreation opportunities for the citizens and encourage the sense of

identification for the protection of nature among the people.

Ten national park system pilot areas have been established in 12 provinces so far including Sanjiangyuan, giant panda, Siberian tiger and leopard and Qilian Mountain, to explore the protection of large-scale ecosystems and ecological processes in representative areas and promote deep institutional and system reform for protected natural area management.

In order to better implement the guidelines of “establishing a system of protected natural areas with national parks as the core”, we put forward six recommendations as follows:

(1) Solidifying the three cornerstones of “ecological protection first, national representation, and public welfare for the people” to achieve the core status of national parks in the system of protected natural areas by having the central government exercise the administrative power of national parks, while strictly controlling the access threshold and the total number of national parks.

“Ecological protection first, national representation, and public welfare for the people” are the overall requirement for the development of China’s national park system in the new era of ecological civilization, and a distinctive feature of China’s national park development, thus solidifying these three cornerstones of the development of China’s national park system is the top priority.

To this end, we recommend classifying all national terrestrial and marine areas into different biogeographic units based on the characteristics of ecosystems and ecological processes. Within each unit, the most representative, authentic and complete areas should be selected as potential sites for national park construction to be included in the tentative list of national parks. When determining the national park sites and areas, attention should be paid to the function of the national park as an ecological corridor, establishing a spatial relationship between the existing protected natural areas with the national park as the core. In order to realize “administrative power by central government” and “the strictest protection” for all national parks, it is recommended that the central government strictly control the access threshold and number of national parks. The central government may organize multi-disciplinary experts who will develop China’s national park development planning according to the requirements of authenticity, integrity and suitability; and formulate management implementation rules for individual national parks according their characteristics, management objectives and existing issues.

The national parks established in accordance with this highest standard and the most stringent procedures will become the highlight of Beautiful China, an outstanding representative and a model of conservation management of China’s protected natural areas in

the new era of ecological civilization, best reflecting the core position of national parks in the system of protected natural areas.

(2) Establishing a wilderness conservation system in China and demarcating wilderness conservation areas within various protected natural areas such as national parks to carry out rescue protection of the national heritage of the country with the highest authenticity.

Wilderness refers to wild natural areas that is free from human interference and has no human inhabitation, without development land use and man-made visual obstacles such as artificial infrastructure and animal husbandry. The purpose of wilderness protection is to preserve its authentic natural state. Since wilderness is the natural heritage of the country with the highest authenticity, ecologically valuable essence of protected natural areas such including national parks, etc., the background of Chinese civilization, and the most beautiful part of homeland that is being lost rapidly in economic development, it is necessary to study and establish China's wilderness protection system and implement rescue protection.

Wilderness is a unit of management policy, instead of a unit of administration. Currently, in most of the ten national park system pilot projects, tens of thousands of people live within the boundaries. Therefore, it is impossible to implement the "strictest protection" for the entire area for a long period of time. We recommend demarcating wilderness protection areas as large as possible within protected natural areas such as national parks, etc., where "the strictest protection" and "running wild" policies are implemented to truly give wilderness to the nature and incorporate wilderness into ecological civilization.

(3) Building a faceted and multi-level protected natural area system according to the characteristics of the target of protection and the difference in the level of protection, establishing the legal framework the "system of protected natural areas with national parks as the core", and formulating management policies for different types of protected natural areas.

China's protected natural areas currently account for 18% of the country's land and may grow further in the future. Different individual nature reserves have different resource characteristics (mountain, water, forest, sea, lake, grass, sand, etc.), protection targets (ecosystem protection, ecological process protection, species diversity protection, cultural landscape protection, etc.), sizes (from hundreds of thousands of square kilometers to hundreds of square kilometers), complex land ownership (state-owned land, collective land with contracting rights confirmation), and different financial administrative powers. Therefore, such a large-scale protected natural area cannot adopt a simple, extensive and one-size-fits-all management policy. Instead, it should build a multi-faceted and multi-level protected natural area system according to the characteristics of the target of protection, and formulate management policies for different types of protected natural areas, for a

differentiated, detailed and scientific management.

Considering the history of China's protected natural area development and the requirements of a new era of ecological civilization, it is recommended that China's protected natural areas be divided into four major categories: a) National Parks, equivalent to IUCN Category II protected area type, aim at protecting large-area ecosystems and large-scale ecological processes, where the strictest protection in a scientific sense is implemented, and environmental education activities for national welfare are allowed to be carried out; b) Nature Reserves, equivalent to IUCN Category I protected area type, aim at protecting typical ecosystems and rare and endangered species of flora and fauna and their habitats, implementing strict protection and differentiated management; c) Scenic Areas, equivalent to IUCN Category III and V protected area types, aim at protecting mixed heritage of nature and culture and unique landscape characteristic of China, including current scenic spots, geological parks, forest parks, wetland parks, etc., which can be subdivided into scenic areas, geological scenic areas, forest scenic areas, wetland scenic areas, etc.; d) Ecology e) Management Areas, equivalent to IUCN category VI protected area type, protects important ecological function areas and habitats together associated with ecosystem services such as cultural values and community livelihood, etc., whose aim is to sustainably using natural resources under the precondition of scientific conservation. Negative lists of human behavior, artificial facilities and land use are to be developed according to the sensitivity of protected targets of different types protected natural areas.

We recommend establishing a 1+4+X pyramid-shaped legal framework for the "system of protected natural areas with national parks as the core", where "1" refers to the Law of the People's Republic of China on Nature Protected Areas, which shall be the basic law for "establishing a system of protected natural areas with national parks as the core", "4" refers to four State Council regulations: National Park Management Regulations, Nature Reserves Management Regulations (formed by revising the existing Nature Reserve Regulations), Scenic Areas Management Regulations (formed by revising the existing Scenic Areas and Places of Interest Regulations), and the Ecological Management Zones Administration Regulations, and the "X" refers to the management regulations for each national park, in accordance with the National Park Management Regulations, such as Sanjiangyuan National Park Management Implementation Rules.

We recommend developing a national park functional division based on the level of strength and the goal of conservation management. Three types should be considered: core conservation area (wilderness zone), ecological conservation area, and restricted use area. The core conservation area (wilderness zone) shall strictly prohibit the construction

of artificial facilities and interference from human activities; the ecological conservation area shall only allow ecological conservation measures such as scientific research activities and habitat management; and the restricted use area shall strictly limit the construction of artificial facilities required for non-protection management, and may be further divided into conventional use zones and science education and recreation zones, for which the capacity for community population and environmental education shall be scientifically developed.

(4) Paying full attention to the complexity of land ownership and the arduousness of community management by developing special management policies based on the characteristics, problems, difficulties and root causes of land, population and community in the development of national parks in different regions to prevent possible long-term hidden dangers caused by one-size-fits-all policies.

The most challenging issue in the institutional development of China's national parks is the land and community population. Although China's land system is based on public ownership, the mixture of state-owned land and collectively-owned land and different types and duration of land contracting systems has resulted in a land ownership for potential national park regions so complex that it is rarely seen around the world. Meanwhile, most of the proposed national parks and nature reserves have a large population of farmers and herdsmen, forestry workers and even urban dwellers living on both sides of the boundary. If the characteristics, problems, difficulties and root causes concerning land, population and community are not thoroughly investigated, and if a realistic and innovative package solution cannot be proposed based on such investigation for different regions and scenarios, there will be long-term hidden dangers in the development of China's national parks and nature reserves.

We recommend engaging experts from multiple disciplines to conduct special research and subject studies on land, community and population issues. Studies should examine issues such as the existing status of land ownership, administrative authority and right to use in national parks; the impact of confirmation of land right on national park management, and the implementation of easements; the feasibility of implementing a national park conservation and management system with community engagement such as easement, co-management agreements, etc., on the basis of which the competent authority for national parks is to develop, respectively, land administration policy, and community and population management policies for national parks.

In the process of formulating national park management policies, the opinions of stakeholders such as community residents should be thoroughly solicited, thus providing a path for community engagement in the decision-making and management of national parks,

with special attention to the participation of women in this process. The contradiction between protection and community development in national parks needs to be balanced. Through functional division of national parks, visitor activities and the production and day-to-day life of the residents in the national park area will need to be defined within a clearly controllable boundary. Under the premise of ensuring the strictest protection for core protected areas and ecological conservation areas, it is necessary to have good visitor planning and community development planning, giving full play to the comprehensive functions of national park research, education, recreation and community development.

(5) Giving full play to the unique role of scientific research and the community of scientists in the development of national parks, and use science as the criteria to achieve “the strictest protection”.

“Science” is one of the indispensable elements in the development of the national park system, and it is also the shortcoming of various types of existing nature protection areas in China. As the main body of the natural protection area system, national parks should play an exemplary role in the scientific legislation, planning, protection, management, and monitoring to achieve the science-based “strictest protection” for national parks.

We recommend setting up the “China National Park Science Steering Committee” comprised of multi-disciplinary experts with ideals, ethics, ability and ideas, to undertake top-level scientific consultation in national park development; implementing the national park chief scientist system where the chief scientist for each national park is appointed by the competent authority of national parks; establishing a ecological conservation science department responsible for the planning, conservation, management and monitoring for the national park concerned; developing the “National Park Talent Training Base” based on top-ranking universities or disciplines to coordinate with competent authority for education in allocating postgraduate places for the training of high caliber talents for national parks.

(6) Selecting one province or autonomous region each in the eastern, central, western, northwestern and autonomous regions for ethnic minorities, for prompt kick-off of province-level pilot activity to establish a “System of Nature Protected Areas with National Parks as the Core”, and exploring the ways and means and feasible paths for a “five in one” development of ecological civilization, economy, politics, culture and society in different regions taking advantage of the development of national parks, activating holistic natural conservation.

Compared to “establishing a national park system”, “establishing a system of protected natural areas with national parks as the core” is a more ambitious, arduous and complicated task. It not only affects the overall situation of China’s natural ecological protection, but also

is inextricably linked with poverty alleviation, urban and population distribution, industrial transformation, national stability, national defense security, ecological red line, main functional areas, etc.. It is indeed a serious matter, and should not be taken lightly during the implementation process. We recommend that lessons learned be summed up on the basis of the existing national park system pilot programs and that provincial pilot programs for “establishing a system of protected natural areas with national parks as the core” be carried out as soon as possible.

China has a vast territory, a large population, and a rich and diverse ecological environment. In the process of “establishing a system of protected natural areas with national parks as the core”, the eastern, central, western, and northeastern regions face different challenges and contradictions, especially different land and community population management issues. We recommend selecting one province or autonomous region each in the eastern, central, western, northwestern China and autonomous regions for ethnic minorities, for prompt kick-off of province-level pilot activity to establish the “System of Nature Protected Areas with National Parks as the Core” based on a comprehensive consideration of geographical characteristics, difference in protected targets, economic development level, ethnic population composition, etc.. exploring the ways and means and feasible paths for “five in one” development of ecological civilization, economy, politics, culture and society in different regions taking advantage of the development of national parks.

2.4.7 Promoting the “Belt and Road Initiative” Green Internationalization Strategy

In 2013, Chinese President Xi Jinping proposed the “Belt and Road Initiative” (“Silk Road Economic Belt” and “21st Century Maritime Silk Road”) as a national top-level cooperation initiative. In 2017, the Ministry of Environmental Protection issued the “Belt and Road Initiative” Ecological Environmental Protection Cooperation Plan. In 2019 at the Second BRI Summit, an international Coalition for a Green BRI was established.

The “planning” aims to disseminate the concept of eco-civilization, promote cooperation among countries along the “Belt and Road” in the field of ecological and environmental protection, and strengthen cooperation mechanisms for environmental protection and environmental protection information sharing. It will encourage relevant countries to jointly formulate and implement ecological and environmental protection strategies and action plans at the bilateral, multilateral, sub-regional and regional levels. The platform construction will promote the implementation cooperation of relevant countries in multilateral environmental conventions such as the CBD and the Stockholm Convention on Persistent Organic Pollutants, which will establish a cooperation mechanism for the implementation of

environmental conventions and promote technical exchanges and South-South Cooperation.

2.4.8 China's bamboo sector and INBAR (See Annex 1)

China hosts or supports various international organizations within China related to the conservation and utilization of biological diversity and ecosystems. One that has made major contributions since it is founded in 1997 is the INBAR, headquartered in Beijing but with outreach to numerous other countries. Bamboo has been associated with China's landscapes and culture, since ancient times and particularly since the 1980s, government and private sector investments in the bamboo sector have resulted in significant socio-economic and environmental benefits.

From 1981 to 2016, the annual value of the bamboo sector increased from just USD 160 million to USD 32 billion. This has led to the generation of millions of formal jobs in the bamboo sector across the south of the country, bringing many people out of poverty. For example, in Anji County, in Zhejiang Province, bamboo accounts for 35 percent of the county GDP and provides average per capita income of USD 1,000 per year.

Development of the bamboo market during this time has also had a major impact on reforestation and efforts to reverse land degradation, with bamboo forest cover increasing from 3 million to 6 million hectares during this same period. This has had tangible impacts for conserving soil and water. INBAR research has shown that areas restored from marginal agriculture to bamboo can have 25 percent less water runoff and a reduction in soil erosion by over 70 percent.

Restoring land with bamboo also has climate change benefits. It is estimated that bamboo forests in China currently store over 700 million tonnes of carbon, which will grow to 1.18 billion tonnes by 2050. At a conservative estimate, improving management practices in China's bamboo forests could mitigate carbon emissions of up to 50 million tonnes and generate additional income of RMB 4 billion [USD 580 million]. Furthermore, climate change vulnerability analysis, coupled with observations from recent climate shocks, such as the 2008 snow storm in southern China, indicate that bamboo resources are resilient to climate change and can support smallholder farmer adaptation.

The future for bamboo looks bright in China. In 2013, China became one of the first countries to publish a national bamboo strategy. China's National Plan for Bamboo Industry 2013 to 2020 predicts that by 2020, the bamboo sector will reach a trade value of USD 48 billion and will employ 10 million people. Bamboo could form an important part of the Chinese government's "eco-civilization" drive.

One very practical way in which bamboo can be used is as part of China's international

cooperation with other countries, particularly the Belt and Road Initiative, which is building trade and infrastructure links across a large number of countries. In 2018, bamboo was mentioned by President Xi Jinping in his speech at the Forum on China-Africa Cooperation, as part of a key push for cooperation on “green development and ecological and environmental protection in Africa.” A Sino-Africa bamboo center has since been established to develop the bamboo sector in African countries, with Chinese support. INBAR is also a member of the new International Coalition for Green Development on the Belt and Road Initiative.

2.5 Policy Recommendations

The environmental emergency facing people and planet has continued to worsen globally since this CCICED SPS on Post-2020 Biodiversity Conservation first provided inputs to China’s State Council in November 2018. In the half year since then, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), has released the first global assessment since 2005. Without transformative change towards sustainability, it is suggested that perhaps a million species are at risk. The Secretary General of the UN in his opening speech at the May 2019 Belt and Road Forum remarked that the planet’s ecosystems are degrading at an alarming rate. He noted “for the first time in human history, the world has at its disposal sufficient resources and advanced technologies to end extreme poverty, to reduce inequalities and to place the planet on a sustainable trajectory.” Also, that “a multipolar world needs multilateral cooperation to face common threats and seize shared opportunities.” Furthermore that “China is a central pillar of multilateralism.”

Over the past decade, China has certainly earned this acknowledgement through its vigorous efforts to eliminate poverty, and more recently to tackle the problems of climate change domestically and globally. Now there is an opportunity to do so for planetary ecology and biodiversity. China has taken a major step in this direction by hosting the Convention on Biodiversity Conference of Parties (COP 15) in October 2020. This timing is perfect for China domestically since it will be a turning point in terms of its own prosperity and ecological reform.

Globally, 2020 will be the pivotal point for setting out longer term and decadal goals for protecting the planet’s natural wealth—following the precedent set by the 2015 Paris Agreement on Climate Change and the ambitious UN 2030 Sustainable Development Goals. However time is short to build a coalition of “Champions for Nature” among world governmental leaders, and others from international bodies, business and financial

organizations, and individuals. Fortunately, in recent months we see momentum building on many fronts. China will need to be the catalyst and leader to secure success for COP 15. And this will require a vigorous and expansive effort in the months ahead.

In Annex 2 to this 2019 SPS Executive Summary Report, we have included the Biodiversity recommendations from the November 2018 CCICED Annual General Meeting as a reminder of some baseline needs to make COP 15 successful. Within the main body Chapters 3 and 4 of our current report, we have included some specific recommendations embedded in the general discussions on Political Engagement (section 3) and on topics China might wish to showcase at COP 15 regarding its own Best Practices (section 4).

In the recommendations below we provide several overarching suggestions on how opportunities for China to take in further developing its proactive role internationally, and also advice on how China can further mainstream Nature, ecology and biodiversity into its domestic efforts for high quality development, especially for the coming 14th Five-Year Plan.

The following three new recommendations are forwarded for consideration.

2.5.1 Recommendation 1

China should pull out all stops to ensure full commitment of the world community, including world leaders, to a high quality COP 15 outcome

Only in this way can Nature receive the global policy attention required if we are to formulate and adhere to ambitious and practical goals to guide 2020 to 2030 action on conservation, and on synergies among global environmental conventions, including those inherently part of the UN SDGs. China can take advantage of various already scheduled international major gatherings. In addition, China should consider one or more major preparatory meetings during late 2019 and the first 8 months of 2020. Such meetings can be used to take the measure of momentum and therefore additional efforts needed on the part of China and other Champions. The meetings should draw not only on governments but also other stakeholders from business circles, and non-state actors.

2.5.2 Recommendation 2

(1) Accelerate the pace of efforts for a “Green BRI” both within and outside China, including strong financial support and a 2019 action plan for the International Green BRI Coalition announced at the 2019 BRI Forum

The BRI represents the largest infrastructural development project in human history, and as such has a huge potential for wide scale environmental damage without careful planning attention and mitigation efforts. However, with caution and diligent planning the BRI has

the potential to be a tool for conservation. “Greening” the BRI takes two main forms. One is to reduce environmental impacts through rigorous planning, assessments, preventive and restorative measures, and post-project monitoring and capacity building. Second is to incorporate specific conservation policies and objectives such as enhancement of ecological services, sustainable development for example related to eco-tourism, wetland restoration etc.. Both types of measures could be implemented and enforced through project financiers.

Taken together, these efforts may help to avoid problems such as excessive and poorly secondary development, associated unsustainable land development, illegal trade and disease risks. It is important to note that these efforts should be considered on the supply side of goods and services from within China, and, of course, impacts in the BRI country partner locations. Other efforts could involve sharing of green technologies and experience of value to partner countries. Prime examples are systematic efforts to introduce renewable energy; eco-efficient, low carbon and green manufacturing, and green supply chains for commodities exported to China.

(2) Improve preventive measures through integrated assessments and planning

In reducing the BRI's footprint there are several facets to consider. First, in the physical placement of roads, railways and other transport corridors, wherever possible these should seek to avoid important areas for biodiversity, especially Protected Areas, Key Biodiversity areas, frontier and primary forests, and other areas with high diversity and endemism based on site-level assessment (noting in particular habitats with high levels of endemism such as karst). When passing through such regions is unavoidable then care should be taken to either elevate the route (to prevent road kill, reduce fragmentation of native habitat, and reduce access which could drive the extraction of wildlife or natural products) or at a minimum to provide overpasses/underpasses for wildlife and not place stops in such areas. At the interface between the maritime and land routes this also includes ports, and their locations relative to key wetlands and breeding areas for migratory wading birds. Considerable effort in many BRI countries is needed to create effective networks of marine protected areas.

(3) Take full advantage of conservation opportunities to support relevant UN 2030 Sustainable Goals in BRI countries

As no initiative on this time and space scale has ever occurred before, the BRI has the opportunity to set new standards for sustainable development. Again, this comes in a number of forms:

- Standard setting in the avoidance of harm, and the implementation of practicable Eco-civilization measures along the route.
- As a mechanism to reforest and reconnect fragmented landscapes along the route, and

to offset atmospheric carbon emissions and other ecological benefits. Afforestation and sustainable agriculture can reduce landslide and erosion thereby protecting corridors in addition to maintaining biodiversity. Roadside protection from land opening alongside roads, and properly maintained rail lines, pipelines and electrical grids can reduce spread of invasive plant and insect species and risk. For mines and other disruptive features to landscapes will require specialized measures to ensure environmental restoration is feasible and actually implemented.

- By connecting fragmented forest along the course of the route it would better enable species to move adaptively with a changing climate, and thus fulfill many important conservation roles.

These and other sensible policies for a Green BRI will help China to become a world leader in sustainable development, and to take an integrated approach regarding the UN SDGs within China and in BRI nations. Some countries are already seeking new types of initiatives under the next phase of BRI to better meet their socio-economic and environmental objectives—and a move away from strict emphasis on infrastructure development.

(4) Ensure the new International Coalition for a Green BRI is financially supported and with access to capacity building, research and knowledge sharing, including wider access to the use of big data

The Coalition should become active quickly if it is to keep pace with infrastructure development and various other BRI decisions. Substantive initiatives should begin within 3 to 6 months.

2.5.3 Recommendation 3

(1) Integrate biodiversity conservation more effectively into China's efforts towards high quality development, especially into the 14th Five-Year Plan

During the 14th Five-Year Plan (2021—2025), China should further increase the importance and protection of biodiversity, re-formulate and implement a strengthened 2020—2030 Biodiversity Conservation Action Plan; accelerate the development of national legislation on biodiversity conservation; conduct regular biodiversity surveys and assessments, and continue to implement ecological protection and restoration in accordance with the concept of “mountains, rivers, forests, farmlands, lakes and grass forming a community of life”. This approach should take into account the ecological and environmental impact linkages between land, rivers and sea. By promoting the sustainable use of biological resources and improving the ecological compensation mechanism, China should further consolidate efforts to enhance the production and living standards of people in poverty-

stricken areas, while maintaining and improving the level of biodiversity conservation.

(2) Strengthen Biodiversity Conservation as an element for high quality development involving China and for the 14th Five-Year Plan

First, enhance the status and role of biodiversity conservation, as well as the coordination among key agencies in national strategies. In terms of national top-level design, biodiversity conservation should be placed in a more important position and implemented in local governments at all levels by promoting legislation and policy formulation. The coordination between key ministries and department on the elements related to nature, climate and SDGs should be enhanced.

Second, the protection subject of local government should be transferred to broader participation of society. Local governments are the mainstay of biodiversity conservation, but it is not enough for the government alone to carry out biodiversity conservation. It is necessary to promote the broad participation of the society, especially the participation of enterprises in biodiversity conservation.

Third, promote a virtuous circle of coordination between protection and development. In accordance with the principle of “protection priority and sustainable use”, selectively strengthen research on breeding of wild resources, innovate the development and utilization of biological resources, and reduce the utilization of wild resources. Through the sustainable use of biological resources, the development and utilization of biodiversity resources, for example bamboo, is a new growth point for economic development and a new means for residents to be rid of poverty. At the same time, improve the vertical and horizontal ecological compensation mechanisms to truly environment and ecological benefits reach protectors and minimize the damage to important species and ecosystem resources.

In the 14th Five-Year Plan, in the field of biodiversity conservation, the government should signal to all sectors and stakeholders its concern that China will strive to be a responsible biodiversity leader country, will continue to strengthen cooperation with the international community, strengthen the implementation of “Green Belt and Road” policy, and actively participate in the resolution of global challenges such as biodiversity conservation, forest and land degradation and marine pollution.

In terms of system design, the Chinese government might wish to promote the following specific actions.

- Formulate and implement an updated Chinese “Biodiversity Conservation Action Plan for 2020—2030”.
- Promote national biodiversity conservation legislation and improve other sectoral policies from a biodiversity-friendly perspective when under revision.
- Conduct biodiversity investigation and evaluation regularly.
- Continue implementing ecological conservation and restoration in accordance with the idea of mountains, rivers, forests, farmlands, lakes, and grasslands life community.
- Construct and improve the natural reserve system with the national park as the core part.
- Delineate ecological conservation redline and construct the strictest possible system for environmental protection.
- By promoting the sustainable use of biological resources and improving the ecological compensation mechanism, the production and living standards of people in poverty-alleviation areas will be consolidated and enhanced, the ecological environment quality will get maintained and improved.
- In terms of technological innovation, a series of important technical means will promote biodiversity conservation. These specifically include:
 - Ecological conservation redline delineation technology;
 - Natural protected area system with national park as main part construction technology;
 - Ecological corridor and biodiversity network planning and design technology;
 - Biodiversity big data and artificial intelligence technology;
 - Sky-land-universe integration biodiversity monitoring technology;
 - Biodiversity conservation effectiveness evaluation technology;
 - Ecological function restoration and promotion for damaged ecosystem technology;
 - Natural resource asset accounting method and ecological compensation method.

Over the 14th Five-Year Plan the role of China as a biodiversity leader country will become stronger in the international community. The actions of the central and local governments in fields like legislation adoption and system construction for biodiversity, ecological conservation redline delineation, systemic conservation and restoration guided by the idea of integrated strategies involving mountains, rivers, forests, farmlands, lakes, and grasslands; community improvements and poverty alleviation based on the sustainable use of biodiversity resources, may become valuable experience for many other countries to learn from.

Annex 2-1 Standing Tall: Bamboo and Sustainable Development

A briefing note produced by the International Bamboo and Rattan Organization (INBAR) for the Post-2020 Global Biodiversity Conservation Special Policy Study (SPS) of the China Council for International Cooperation on Environment and Development (CCICED) The note will be available in both Chinese and English for the CCICED 2019 Annual Meeting in Hangzhou 2-5 June 2019.

1.1 Introduction: the growing importance of nature-based solutions

Nature-based solutions can play a crucial role in creating a more sustainable world. If properly managed and conserved, ecosystems and the services they provide can be used to address a large range of societal challenges, including climate change, poverty, food security and natural disasters.

Ecological approaches to development are gaining ground. Sixty-five percent of all signatories to the UN Paris Agreement on climate change have already committed to restoring or conserving ecosystems. In early 2019, a prominent group of international researchers called on politicians to sign up to a Global Deal for Nature, to accompany the Paris Agreement. Within China, the government is pursuing a more sustainable course of growth under the goal of “ecological civilization”.

Bamboo could be an important part of nature-based development. Known in some parts of the world as “green gold”, this fast-growing grass plant covers over 30 million hectares of land across the tropics and subtropics, and has proven potential to help combat a number of global challenges, including rural poverty, land degradation, deforestation, unsustainable resource use and climate change.

As this briefing note shows, China is a shining example of what countries could do with bamboo. For several decades, China has used bamboo as an ecological approach to support sustainable socio-economic development, with startling results. China’s bamboo sector is now valued at some USD 30 billion a year and employs almost ten million people.

Other countries could follow China’s lead. Bamboo is a shared resource across many places in the Global South, including a large number of countries along the Belt and Road. With appropriate support, technology and training, any bamboo-producing country can integrate bamboo as a nature-based solution for their development and green growth

strategies.

This report has two parts. The first section provides an overview of China's bamboo sector, including a case study from Guizhou province. The second summarizes bamboo's global opportunities: for livelihood support, as a source of energy, in construction and infrastructure, as part of sustainable consumption and production patterns, for climate change mitigation and adaptation, terrestrial ecosystem management, and women's empowerment.

1.2 Overview of China's bamboo sector

In China, since the 1980s, government and private sector investments in the bamboo sector have resulted in significant socio-economic and environmental benefits.

From 1981 to 2016, the annual value of the bamboo sector increased from just USD 160 million to USD 32 billion. This has led to the generation of millions of formal jobs in the bamboo sector across the south of the country, bringing many people out of poverty. For example, in Anji County, in Zhejiang Province, bamboo accounts for 35 percent of the county GDP and provides average per capita income of USD 1,000 per year.

Development of the bamboo market during this time has also had a major impact on reforestation and efforts to reverse land degradation, with bamboo forest cover increasing from 3 million to 6 million hectares during this same period. This has had tangible impacts for conserving soil and water. INBAR research has shown that areas restored from marginal agriculture to bamboo can have 25 percent less water runoff and a reduction in soil erosion by over 70 percent.

Restoring land with bamboo also has climate change benefits. It is estimated that bamboo forests in China currently store over 700 million tonnes of carbon, which will grow to 1.18 billion tonnes by 2050. At a conservative estimate, improving management practices in China's bamboo forests could mitigate carbon emissions of up to 50 million tonnes and generate additional income of RMB 4 billion [USD 580 million]. Furthermore, climate change vulnerability analysis, coupled with observations from recent climate shocks, such as the 2008 snow storm in southern China, indicate that bamboo resources are resilient to climate change and can support smallholder farmer adaptation.

The future for bamboo looks bright in China. In 2013, China became one of the first countries to publish a national bamboo strategy. "China's National Plan for Bamboo Industry 2013 to 2020" predicts that by 2020, the bamboo sector will reach a trade value of USD 48 billion and will employ 10 million people. Bamboo could form an important part of the Chinese government's "eco-civilization" drive.

One very practical way in which bamboo can be used is as part of China's international

cooperation with other countries, particularly the Belt and Road Initiative, which is building trade and infrastructure links across a large number of countries. In 2018, bamboo was mentioned by China's President Xi Jinping in his speech at the Forum on China-Africa Cooperation, as part of a key push for cooperation on "green development and ecological and environmental protection in Africa." A Sino-Africa bamboo center has since been established to develop the bamboo sector in African countries, with Chinese support. INBAR is also a member of the new International Coalition for Green Development on the Belt and Road, which is led by UN Environment and the Chinese Ministry of Ecology and Environment.

Case Study: Bamboo Promoting Livelihoods Growth in Chishui, China

In Guizhou province, several million people live below the poverty line. This is particularly true of those living in the remote mountainous Chishui municipality, in northwest Guizhou. Located in the upper reaches of the Yangtze River, Chishui is a focus area for China's national poverty alleviation program and a site of real ecological importance: it is one of the ecological protection demonstration project areas in China. Chishui's ecosystems are particularly vulnerable to climate change, and in recent decades the area has suffered from long-term land degradation and subsequent reductions in productivity and farmer income. Following heavy soil erosion and flooding in Chishui, since 2001 various programs have worked to restore unproductive land with bamboo. By 2018, Chishui's local bamboo forest had increased by over 50,000 hectares, to 87,000 hectares: the highest bamboo forest per capita in China.

Research shows that Chishui's afforestation effort has had an important impact on reducing soil erosion, conserving water resources and increasing carbon sequestration.

- Compared to sweet potato farming lands, the average water runoff for bamboo plantations is 25 percent less, and the average soil erosion quantity is reduced by 80 percent.
- One 13,000-hectare bamboo plantation in Chishui was shown to reduce over 350,000 tons of soil erosion that used to flow into the Chishui River annually and conserved some 6,000 cubic metres per hectare of water resources annually.
- The increased bamboo stocks sequesters almost 200,000 tons of carbon annually.

As well as its environmental benefits, bamboo has played a key role in supporting the economy of Chishui.

- Farmers' annual per capita income from bamboo increased from RMB 600 to RMB 2,900 [USD 87 to USD 419] between 2000 and 2015.
- The number of farmers involved in the bamboo supply chain has risen tenfold, from 10,000 to almost 100,000 between 2000 and 2015. There are now three times the number

of small and micro-sized bamboo processing enterprises.

- By 2015, the total value of the sector was RMB 6 billion [USD 860 million]: almost 20 times its value in 2000.

An eco-tourism industry is also emerging and is attracting more and more investment in infrastructure and capacity building for service provision. Five out of six famous tourist spots in Chishui feature bamboo; together these spots have a value of RMB 10 billion [USD 1.4 billion].

One fascinating result of the project is the return of migrant workers to Chishui. Since the project began, about 40 percent of migrant workers have returned home from Guangdong, 30 percent of whom are dealing with bamboo supply chain. This result is testament to the increase in opportunities afforded by a robust bamboo supply chain.

1.3 Global opportunities for bamboo development

This section provides a brief overview of the global potential of bamboo, and in particular the plant's potential to contribute to the UN's 2030 Sustainable Development Agenda.

Bamboo has huge global potential. Given that China has created an industry of USD 30 billion from 6 million hectares of bamboo, the world could conceivably have a USD 150 billion bamboo industry if its existing 30 million hectares of bamboo are developed and utilised to their full potential. If 200 million hectares of available land is planted with bamboo, this could create a global industry worth USD 1 trillion.

1.3.1 Livelihoods

Bamboos are now considered one of the world's most valuable non-timber forest products, and can be an excellent resource for the poor, especially in remote areas with limited off-farm income communities. Several things make bamboo a particularly important way to create or improve livelihoods, and reduce poverty:

- Bamboo has a multiple array of end uses as commodities, from shoots, baskets and furniture to laminated plywood and activated charcoal. The huge variety of potential products gives producers a wide range of options, and increases their flexibility in times of market stress.
- Bamboo has a long history of use in many societies. This means that take-up of new, value-added products builds on existing skills and is more likely to be chosen by stakeholders than an entirely new technology.
- Bamboo can be grown on peripheral soil, or as part of intercropping farm systems, requires few inputs, and regrows quickly after harvesting, without the need to replant.

It an essentially “renewable” resource and one that does not compete with productive agricultural land.

(1) Energy. Bamboo can provide a renewable, legally harvestable source of bioenergy to some of the world’s most energy-poor rural communities, as fuelwood, charcoal or gas. The potential of bamboo bioenergy is particularly large in Africa, where a large number of people still rely on solid biomass on a daily basis. Creating bamboo charcoal briquettes is a particularly efficient way to create bamboo energy, and can be done with little investment or technology.

Because of its fast growth and annual regeneration, using bamboo as a source of bioenergy can take pressure off other forest resources, reducing deforestation. This could be critical in areas such as sub-Saharan Africa, where deforestation for wood fuel remains a primary driver of deforestation. One study estimates that sub-Saharan Africa has strong potential to produce about 9 million tons of bamboo charcoal on a sustainable basis; this could potentially replace over 60 percent of the region’s wood consumption for charcoal production.

(2) Construction and infrastructure. Bamboo boasts a tensile strength greater than that of mild steel, and withstands compression twice as well as concrete. Given its unique properties and wide global spread, is not surprising that bamboo is being developed for use in heavy infrastructure and construction.

Bamboo can be a resilient source of green infrastructure. In China, companies are exploring the use of bamboo as the main material for use in wind turbine blades, storm drainage pipes, and even shock-resistant exteriors for bullet-train carriages. And in India and the Netherlands, noise- and pollution-reducing “green corridors” have been built along national highways, using bamboo. These new products make bamboo a feasible low-carbon material to use in infrastructure development.

The flexibility and lightness of bamboo makes it an excellent construction material for earthquake-resistant buildings in areas vulnerable to natural disasters, including Colombia, Ecuador and Nepal. Bamboo bends but rarely breaks, earning it the nickname “vegetal steel” among architects around the world. After natural disasters hit, modular bamboo homes can be erected quickly and at a low cost: the UN and Yale University are currently working on a 3D-printed modular bamboo house for this purpose.

(3) Sustainable consumption and production. In recent decades, industry developments have vastly increased the potential of bamboo and rattan to contribute to durable, low-carbon and sustainably sourced products. Bamboo can be a recyclable replacement for single-use plastic products, including cutlery, cups, paper and packaging.

All parts of a bamboo plant can be used to create products: culms, leaves, roots and rhizomes. And at the end of a bamboo product's life cycle, it can be recycled, repurposed, or burned to produce heat or electricity. These factors mean that bamboo products can have a low or even negative eco-cost over the course of their lifecycle, compared to other materials.

1.3.2 Climate change

Bamboo is particularly suitable as a tool for carbon sequestration. Over a period of 30 years, bamboo plants and products can store more carbon than certain species of trees. This is mainly because bamboo can be harvested regularly, creating a large number of durable products which store carbon over several years, in addition to the carbon stored in the plant itself.

Bamboo also helps communities and individuals adapt to the negative impacts of climate change, as a sustainable source of income in a changing climate.

1.3.3 Terrestrial ecosystem management

Several aspects of bamboo's biology make it very useful for stabilizing loose soil to prevent soil erosion. Bamboo has extensive root systems, which bind soil and make the plant capable of surviving and regenerating when the biomass above ground is destroyed by fire. More and more countries are integrating bamboo into their watershed and land restoration programs. In Allahabad, India, an INBAR-supported bamboo project has helped raise the water table by over 15 meters in ten years, and return a blasted brick-mining area, prone to frequent dust storms, to productive agricultural land. And in Ethiopia, bamboo is one priority species in a large World Bank-funded project to restore the country's degraded water catchment areas.

Bamboo is also a key element for biodiverse ecosystems. A number of the world's most iconic and endangered species rely on bamboo for their survival, including the giant panda, the red panda, the mountain gorilla and certain types of lemur.

1.3.4 Women's empowerment

Bamboo's light weight and linear-splitting nature makes it easier to process than timber. This provides farmers, many of whom are women, with opportunities to engage in initial processing, and so increases their share in value addition. INBAR has worked on a number of projects to train women in value-added processing and product selling techniques, and many trainees have subsequently reported an increase not only in income, but also in social standing and decision-making authority in the household and community.

Bamboo can also reduce the risks associated with collecting timber for fuelwood, a job typically done by women in certain parts of the world. Because bamboo grows locally to many rural communities across the tropics and subtropics, and is often excluded from local

forest protection laws, it can be harvested legally, within close proximity to a community. Converting bamboo to charcoal requires few set-up costs—some technologies even use converted oil barrels as kilns—and the resulting charcoal has a similar calorific density to other commonly used forms of biomass.

1.3.5 Conclusion

Bamboo can play a key role in a changing world. Fast growing, quick to mature and easily replenishing, without the need to replant after harvesting, bamboo provides a versatile and sustainable source of income for many countries. It can also contribute to national green development strategies, climate change mitigation plans and environmental protection policies. If more countries can harness the potential of bamboo and rattan, the world will be closer to achieving its ambitious development, climate and environmental aims, including the UN's Sustainable Development Goals, REDD+ objectives, the Paris Agreement commitments, and the Aichi Biodiversity Targets.

1.4 About the International Bamboo and Rattan Organization

The report was compiled by the INBAR. INBAR has been a partner of CCICED since 2017, where it works to raise awareness about the importance of nature-based solutions for a number of global challenges.

Established in 1997, INBAR is an intergovernmental development organization that promotes environmentally sustainable development using bamboo and rattan. It is currently made up of 45 Member States. In addition to its Secretariat Headquarters in China, INBAR has Regional Offices in Cameroon, Ecuador, Ethiopia, Ghana and India. INBAR's mission is to improve the well-being of producers and users of bamboo and rattan within the context of a sustainable bamboo and rattan resource base, by consolidating, coordinating and supporting strategic and adaptive research and development.

www.inbar.int

Annex 2-2 SPS 2018 Recommendations

1.1 Play a strong leadership role in developing effective post-2020 global biodiversity conservation goals under the CBD

The Global Convention on Biological Diversity has failed to meet conservation targets set in 2002 and 2010. As in the case of climate change, the window of opportunity to stem major biodiversity and ecological service losses is rapidly closing. The COP 15 will be hosted by China in 2020. By joining efforts with like-minded countries and organizations/partners, China can help to set revised goals covering the period to 2030 and beyond. This event is a major opportunity to set a new course in global green governance, and a platform to demonstrate China's commitments and achievements towards becoming an ecological civilization.

To fulfill its international obligations under the CBD, China must not only protect its biodiversity and related ecosystem service, but also actively participate in biodiversity and ecosystem global governance. By joining efforts with like-minded countries and organizations/partners, the desired outcome would be to dramatically reduce biodiversity losses in all parts of the world. COP 15 is a unique opportunity to accomplish four objectives noted below. These recommendations are preliminary and will be followed up by CCICED at various times in 2019 and early 2020.

(1) Make a positive contribution to the development of a robust post-2020 global biodiversity conservation framework by creating an enhanced enabling framework for the implementation of the new targets building on a joint understanding why past CBD goals have not been met. Parties will need to agree on a post 2020 global biodiversity framework with ambitious and measurable targets, enabling conditions and implementation mechanisms, periodic review and ratcheting instruments to continuously increase ambitions, and with Nationally Determined Contributions for nature. Consultations with stakeholders, including those not traditionally involved with conservation, for example digital economy business leaders, and others involved in the development and implementation of market mechanisms for ecological services and biodiversity conservation, must be carried out.

(2) Establish an effective mechanism to ensure that the CBD strategic goals can be achieved on schedule. Focus should be on state-set goals (e.g. something like NDCs) rather than the power of the convention itself as the key for the successful implementation of

conservation goals. The active participation of the whole society is very important. Also, a need to communicate and set up synergy with relevant international agendas.

(3) Showcase China's experience in biodiversity conservation for reference of the international community and engaged Parties. Focus on China's domestic and global initiatives in dialogue and engagement with other governments, including but not limited to Eco-Civilization, Redlining, the Greening of the BRI, Green Finance, Natural Resource Assets Accounting and Auditing, National Park-centric Nature Conservation Systems. Better cross-sectoral relations between these initiatives should be established to foster synergies.

(4) Build successful and on-going engagement involving heads of state. There is a need for proactive outreach linked to a proposed Heads of State Summit at the UNGA in 2020; and to build a momentum of support for the significance of the COP15 event similar to what occurred in the Paris Climate Change COP held in 2015. Steps could involve the following elements:

- Engage with the CBD Secretariat to provide a positive signal and to begin the preparations of the Summit at UNGA 2020.
- Respond or proactively reach out to various heads of state of countries that could potentially form a “Coalition of Champions for Nature” together with China.
- Prepare a series of nature, environment and biodiversity related events in China and at the global stage in and leading up to 2020 to set up springboards and milestones leading up to the COP15.
- Pay special attention to the links between the CBD and the SDG2030 objectives, especially those related to social development and various aspects of gender mainstreaming.
- Recognize that leadership actions abroad will come from many different players, including international bodies, non-state, non-party actors such as business, financial institutions, civil society, and the general public. Increase efforts in the communication and exchange with international communities.

1.2 Recommendations on “Establishing a National-Park-Centric Protected Area System in China”

In November 2013, the 3rd Plenum of the 18th CPC Central Committee proposed for the first time “the establishment of a national park system”, making pilot of the national park system an important part of China's ecological civilization system development. In November 2017, the report delivered at the 19th National Congress of the Communist Party of China put forward “the establishment of a national-park-centric protected area system”. In less than five

years, China has taken the opportunity of the national park system development and made significant milestone progress in comprehensively deepening the reform of the protected area system, laying a solid foundation for the realization of ecological civilization and the national strategy of building a Beautiful China.

In September 2017, the General Office of the CPC Central Committee and the General Office of the State Council issued the “Overall Plan for Establishing a National Park System”, which, based on a clear definition of the concept of national park, provides explicit description on how to build China’s national parks from seven aspects, namely, overall requirements, scientific definition of the content of national parks, establishing a unified administrative power and tiered management system, establishing a system of funding guarantee, improving the system of natural ecosystem protection, building a coordinated community-development system and implementation support. National parks refer to state approved and managed specific terrestrial or marine areas that have clear boundaries with an aim primarily to protect nationally representative, large-area natural ecosystems and to achieve scientific conservation and rational use of natural resources. National parks’ primary aim is to protect large-area ecosystems and large-scale ecological processes, underlining the preservation of the authenticity and integrity of ecosystems. They are clearly categorized as development prohibited zones in the national main functional area planning to achieve ecological red line management and the strictest protection. National parks adhere to the features of national representation and inheritance from generation to generation, inspire national pride, and leave precious natural legacy for future generations; they adhere to public welfare of the whole people, provide environmental education and recreation opportunities for the citizens, and encourage the sense of identification for the protection of nature among the people.

As academics from home and abroad who have long been engaged in nature protection, we feel profoundly inspired by these initiatives. In order to better implement the guidelines of “Establishing a National-Park-Centric Protected Area System”, we sincerely put forward six recommendations as follows:

(1) Solidifying the three cornerstones of “ecological protection first, national representation, and public welfare for the people” to achieve the core status of national parks in the system of protected areas by having the central government exercise the administrative power of national parks, while strictly controlling the access threshold and the total number of national parks.

(2) Establishing a wilderness conservation system in China and demarcating wilderness conservation areas within various protected areas such as national parks to carry out rescue

protection of the national heritage of the country with the highest authenticity.

(3) Building a faceted and multi-level protected area system according to the characteristics of the target of protection and the difference in the level of protection, establishing the legal framework of the “National-Park-Centric Protected Area System”, and formulating management policies for different types of protected areas.

(4) Paying full attention to the complexity of land ownership and the arduousness of community management. Developing special management policies based on the characteristics, problems, difficulties and root causes of land, population and community in the development of national parks in different regions to prevent possible long-term hidden dangers caused by one-size-fits-all policies;

(5) Giving full play to the unique role of scientific research and the community of scientists in the development of national parks, and use science as the criteria to achieve “the strictest protection”;

(6) Selecting one province or autonomous region each in the eastern, central, western, northwestern and autonomous regions for ethnic minorities, for prompt kick-off of province-level pilot activity to establish “A National-Park-Centric Protected Area System”, and exploring the ways and means and feasible paths for a “five in one” development of ecological civilization, economy, politics, culture and society in different regions taking advantage of the development of national parks, to activate holistic natural conservation.

Chapter 3 Global Ocean Governance and Ecological Civilization

3.1 Introduction

Marine pollution is a problem and challenge all countries face, and a priority for China, a series of measures have been taken to tackle marine pollution: according to the new cabinet restructuring plan, marine pollution, previously overseen by the State Oceanic Administration is now under the mandate of the Ministry of Ecology and Environment, and in November 2018, China and Canada released the Joint Statement between Canada and China on Marine Litter and Plastics, China is also taking active parts in global and regional efforts, such as the global negotiation process on marine litter, the COBSEA and the NOWPAP.

Chinese President XI Jinping reiterated the importance of marine environment. During his visit to Africa in July 2018, he pointed out that the blue economy is incorporated into African Agenda 2063 for socioeconomic transformation. China has taken the lead in pushing for marine-friendly cooperation and can offer Africa the support it needs to exploit its blue world. In a signed article in a Portuguese newspaper, published during his state visit to the country, President XI Jinping mentioned that the two countries need to lead the way in growing the blue economy by promoting maritime cooperation. Portugal, known for its tradition of maritime expedition, has a time-honoured maritime culture and rich experience in the exploitation of marine resources. The Blue Partnership between China and other coastal states needs to be strengthened to facilitate cooperation in marine research, ocean development and protection, port logistics and other areas, and grow blue economy together to better harness the vast ocean to the benefit of future generations.

Oceans flow over nearly three-quarters of our planet and hold 97 % of the planet's water. The ocean is vital to all life on Earth, providing many provisioning, regulating and supporting services. They provide living and non-living resources, facilitate shipping and other maritime uses, and play a key role in the global climate and weather system. Oceans and coasts are the very basis of much of the world's economy. 350 million jobs around the world are linked to the oceans¹.

¹ Why does addressing land-based pollution matter? UN Environment website, <https://www.unenvironment.org/explore-topics/oceans-seas/what-we-do/addressing-land-based-pollution/why-does-addressing-land>.

The marine environment, its resources and its biodiversity are under increasing threat from sewage, garbage, spilled oil and industrial waste which we collectively allow into the ocean every day. Pollution from both maritime and terrestrial sources has therefore drawn growing attention, it is roughly estimated that 80 % of marine plastic debris comes from land, though there is not sufficient evidence to corroborate that, what can be said with certainty is there are very significant regional differences in the degree to which waste is subject to collection and management, either as wastewater or solid waste¹. A study estimated the total number of floating macro and microplastic pieces in the open ocean to be 5.25 trillion, weighing 269,000 tonnes². 8,300 million metric tons (Mt) of virgin plastics have been produced to date; 6,300 Mt of plastic waste has been generated as of 2015; of this waste, 9% has been recycled, 12% incinerated, and 79% has accumulated in landfills or the natural environment; 12,000 Mt of plastic waste will be in landfills or in the natural environment by 2050 under current production and waste management trends³. Globally, over 80% of all wastewater (over 95% in some developing countries) is discharged without treatment⁴. Long-term solutions including improved governance at all levels as well as behavioural and system changes will support the transition to a circular economy and sustained oceans.

This report aims to review the current statuses and policies on marine pollution in China, take stock of ongoing global and national ocean initiatives, and then recommend how China can contribute to these efforts, and how CCICED and China could work further with regard to marine pollution, in short- and long-term perspectives as well as at national, regional and global levels. The report will first look at marine pollution in China, specifically on nutrients, marine litter, Short-Chain Chlorinated Paraffins (SCCPs), Polybrominated Diphenyl Ethers (PBDEs), Organochlorine Pesticides (OCPs), Polychlorinated Biphenyls (PCBs), Polycyclic Aromatic Hydrocarbons (PAHs) and antibiotics, identify status and sources of marine pollution in China, impact on the ecosystems, and existing coastal and ocean pollution policies, then it turns to a global view, and map ongoing international ocean governance structures, emerging concepts for marine pollution, and national measures. Recommendations are then provided at the end of chapter 3.

1 UNEP. 2016. Marine plastic debris and microplastics - Global lessons and research to inspire action and guide policy change. United Nations Environment Programme, Nairobi.

2 ERIKSEN M, LEBRETON L C M, CARSON H S, et al. Plastic pollution in the world's oceans: more than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. PloS one, 2014.

3 GEYER R, JAMBECK J R, LAW K L. Production, use, and fate of all plastics ever made. Science. Advances, 2017, 3(7), e1700782.

4 https://www.un.org/waterforlifedecade/water_and_sustainable_development.shtml.

3.2 Marine Pollution in China

Driven by rapid exploitation and utilization process, Chinese ecosystem has undergone profound changes over the past four decades. Currently, China has entered a new era. We should recognize that the marine eco-civilization construction puts forward new requirements for marine environment protection, and therefore marine environment status and the source of marine pollution along Chinese coast should be identified.

According to the “China Marine Environmental Quality Bulletin” annually issued by the former State Oceanic Administration over the years, due to the excessive input of land-based nutrients into the sea, the main pollutants are inorganic nitrogen, active phosphate, etc., and these resulted in eutrophication in China’s coastal waters. The adverse impacts of emerging pollutants (such as marine debris and microplastics, antibiotics, short-chain chlorinated paraffins, new flame retardants, etc.) are gradually arising in China’s coastal waters. Thus, the aim of this section is to comprehensively overview of the current status of major pollutants, including nutrients, marine debris and microplastics, SCCPs, PBDEs, OCPs, PCBs, PAHs, antibiotics.

3.2.1 Nutrients and eutrophication

Chinese strategic objective on eutrophication is to maintain a healthy marine environment. Eutrophication is the result of excessive enrichment of water by nutrients¹. Chinese coastal waters receive increasing amount of nutrients from rivers due to rapid economic development and population growth. Between 2001 and 2017, the maximum of sea areas that do not meet the clean water standard is 177,720 km² in 2010. The mean of sea areas with water quality worse than the SQSC (Seawater Quality Standard Category) IV were 36,102 km². During period from 2012 to 2017, the sea areas with water quality meeting the SQSC I showed a significant increase in the Bohai Sea. DIN (Dissolved inorganic nitrogen) and DIP (Dissolved inorganic phosphate) are the major pollutants. In summer and winter of 2017, the sea areas with inorganic nitrogen concentrations SQSC IV were mainly located at the inshore areas of Liaodong Bay, Bohai Bay, Laizhou Bay, Jiangsu Coast, Yangtze River Estuary, Hangzhou Bay, Zhejiang Sea Coast, and Pearl River Estuary. The sea areas with DIP

1 STROKAL M, YANG H, ZHANG Y, et al. Increasing eutrophication in the coastal seas of China from 1970 to 2050. *Marine Pollution Bulletin*, 2014, 85, 123-140.

2 The State Oceanic Administration of China. *Bulletin of Marine Environmental Quality in China 2017*. Beijing SOA: 2018.

concentrations worse than the SQSC IV were mainly located at the inshore areas of Yangtze River Estuary, Hangzhou Bay, Zhejiang Coast, and Pearl River Estuary.

Severe eutrophication areas were mainly located at the inshore areas. Nutrients related to anthropogenic activities are transported into the marine environment through the freshwater, atmospheric deposition and mariculture activities. Wastewater and sewage directly discharged into the sea is an important source. The main pollutants discharged from sewage outlets to the sea were TP (total phosphorus), CODCr, SS (suspended solids), and ammonia. Furthermore, atmospheric deposition is another pathway brings nutrients into the sea through wet or dry deposition in different forms, such as gas or aerosol.

In the recent decade, China has made significant efforts in reduction of discharges, emissions, and contaminants, both air and water. The effect of these efforts is clearly visible in improve of seawater quality of the Bohai Sea and the eutrophic sea areas in the national jurisdictional sea area. However, eutrophication is still a problem in some areas, concerns about riverine inputs and atmospheric of nutrients should still remain.

3.2.2 Marine litter

Marine litter is a global issue, with increasing quantities of litter documented in recent decades. It includes any persistent, manufactured or processed solid material. Originating from sources both on land and at sea, marine litter comprises a wide range of materials, including plastic, metal, wood, rubber, glass and paper.

3.2.2.1 Macro litter in marine environment

The mean abundance of litter items on the seabed was 1,400 items/km². Of all the seabed litter, plastic was the largest, accounting for 74%, followed by glass and wood, accounting for 13% and 5%, respectively. Seabed litters were mainly plastic bags and bottles, glass bottles, and wood blocks¹. The abundance of floating litter in China's coast was two orders of magnitude less than those found in the North Pacific Gyre, and was of the same order of magnitude as those reported in samples from the North Atlantic coast and South Pacific subtropical coast, including the Caribbean Sea, the Maine Bay, and the Australia Coast. The maximum difference in mean abundance of litter in beaches among the studies was in the range of three orders of magnitude, which was much less than that of seawater. Compared to other reported in the worldwide, a relative low level of litter contamination was found on China's beaches.

3.2.2.2 Microplastics in marine environment

Plastic particles with diameters < 5 mm, which are called microplastics, are ubiquitously

¹ The State Oceanic Administration of China(SOA). Bulletin of Marine Environmental Quality in China 2017. Beijing: SOA, 2018.

distributed in the marine environment, accounting for 13.2% of the global marine plastic debris mass and 92.4% of the number of global plastic pieces¹. There is growing concern over marine microplastics because of the increased bioavailability. Microplastics in marine environment is currently considered one of the most important global pollution problems of our time. China has been considered as one of the three biggest producers of plastic waste². Understanding the properties and distribution of plastics is useful in considering how microplastics impacts the social economy, what influence the items have on the marine ecosystem and how to target management.

(1) Microplastics in seawater

According to the Bulletin of Marine Environmental Quality in China³, in 2017, the average abundance of floating microplastics was 0.08 items/m³, and the highest abundance was 1.26 items/m³ in monitoring sections of China seas. The average abundances of floating microplastics in the Bohai Sea, Yellow Sea, East China Sea, and South China Sea were 0.04, 0.33, 0.07, and 0.01 items/m³, respectively. The main types of floating microplastics were granules, fibers, and fragments, and the main components were polystyrene and polypropylene.

(2) Microplastics in beach and sediment

According to the Bulletin of Marine Environmental Quality in China⁴, in 2017, the average abundance of beach microplastics was 245 items/m², and the highest abundance was 504 items/m². The main types were lines, granules, and fibers, and the main components were polystyrene and polypropylene. The mean abundance of microplastics in sediments was in the range of 25 ~ 47,897 items/m² for beaches and 15 ~ 3,320 items/kg for subtidal sediments. The maximum difference in mean abundance of microplastics in sediments among the studies was in the range of three orders of magnitude, which was much less than that of seawater. According to the previous reported studies, the microplastics abundance in beaches in Asia was significantly higher than those in America and Europe. Relatively high abundances were recorded in East Asia, including China, Japan, Hong Kong SAR(China), and Korea.

(3) Microplastics in marine organism

Some studies have reported the presence of microplastics in commercial seafood for human consumption, indicating a direct connection between the microplastics and seafood,

1 ERIKSEN M, LEBRETON L C M, CARSON H S, et al. Plastic pollution in the world's oceans: more than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. *PloS one*, 2014.

2 ROCHMAN C M, BROWNE M A, HALPERN B S, et al., Policy: Classify plastic waste as hazardous[J]. *Nature*, 2013, 494, 169-171.

3 Same with 1.

4 The State Oceanic Administration of China(SOA). Bulletin of Marine Environmental Quality in China 2017. Beijing: SOA, 2018.

especially the bivalve and fish.

In total of 21 species of sea fish collected from a fishery of China were found to uptake microplastics in abundance of 0.2 ~ 26.9 items/g. Demersal species showed significantly higher abundance of microplastics than pelagic fishes. Microplastics were dominated by fiber in shape, transparent in color and cellophane in composition¹. Fibers were also the most common morphotypes of microplastics in fishes from the North Sea². However, abundance of microplastics in pelagic fishes was higher than demersal fishes from the North Sea, Baltic Sea and English Channel³.

Li et al., (2015)⁴ investigated 9 commercial bivalves in China with microplastics ranged from 2.1 to 10.5 items/g. Multiple types of microplastics, including fibers, fragments and pellets, occurred in the tissue of all bivalves, and the most common size class was less than 250 μm.

According to Sun et al., (2017)⁵, microplastics were widely present in zooplankton of China coast. The average sizes of microplastics in the zooplankton were smaller than 200 μm in the Yellow Sea, the East China Sea and the South China Sea. Fibers were the dominant type of the microplastics

3.2.3 Short-chain Chlorinated Paraffins (SCCPs)

As the most complex halogenated contaminants, chlorinated paraffins (CPs) can be subdivided into short-chain (C_{10-13} , SCCPs), medium-chain (C_{14-17} , MCCPs), and long-chain chlorinated paraffins (C_{18-30} , LCCPs) according to the carbon atom number of chlorinated derivatives. China is one of the largest producer of CPs in the world. The CPs production in China was up to 600,000 tons by 2007. According to the recent literatures, the overall concentrations of CPs around the coastal area were higher than those from other countries and regions, for example a 6600 ng/g⁻¹ (dw) in sediment from the PRD coastal estuary has always been the highest concentration reported in literature all around the world⁶.

1 JABEEN K, SU L, LI J, et al. Microplastics and mesoplastics in fish from coastal and fresh waters of China[J]. Environmental Pollution. 2017, 221, 141-149.

2 LUSHER A L, MCHUGH M, THOMPSON R C, Occurrence of microplastics in the gastrointestinal tract of pelagic and demersal fish from the English Channel[J]. Marine Pollution Bulletin, 2013, 67, 94-99.

3 RUMMEL C D, LÖDER M G J, FRICKE N F, et al. Plastic ingestion by pelagic and demersal fish from the North Sea and Baltic Sea[J]. Marine Pollution Bulletin, 2017, 102, 134-141.

4 LI J, YANG D, LI L, et al. Microplastics in commercial bivalves from China. Environmental pollution (Barking, Essex : 1987), 2015, 207, 190-195.

5 SUN X, LI Q, ZHU M, et al. Ingestion of microplastics by natural zooplankton groups in the northern South China Sea[J]. Marine Pollution Bulletin, 2017, 115, 217-224.

6 CHEN M Y, LUO X J, ZHANG X L, et al. Chlorinated Paraffins in Sediments from the Pearl River Delta, South China: Spatial and Temporal Distributions and Implication for Processes[J]. Environmental Science and Technology, 2011, 45, 9936-9943.

Until now, most studies in China were conducted around the Bohai Sea and the concentrations were higher than those from Japan and west European areas. Furthermore, the riverine was reported to be the main source of SCCPs input and thereafter influenced the spatial distribution of SCCPs in Liaodong Bay. Further studies in Bohai demonstrate that the treated or untreated wastewater was an important direct or indirect input of SCCPs to the seawater.

Considerable amounts of SCCPs were detected in sediments from the nearshore regions of the Bohai Sea (97.6 ~ 1,760 ng/g, dw)¹, the Liaohe Estuary (64.9 ~ 1,680 ng/g, dw), Liaodong Bay (65.0 ~ 541 ng/g, dw)², the mouth of the Daliao River (64.9 ~ 407 ng/g, dw) (Gao et al., 2010), and the PRD coastal estuaries of China (320 ~ 6,600 ng/g; mean: 2,800 ng/g, dw)³. Besides, the levels of SCCPs in the Liaohe River also exhibited a strong decreasing trend with increasing distance from the cities, implicating local industrial activities as the major emission source⁴.

Ma et al., 2014⁵ have studied the influence of SCCPs on food web. The indicators of bioaccumulation and biomagnification of SCCPs in the marine organisms and marine food web hinted an ecological and health risks to organisms and humans, however to date, there is very limited data on CPs available for the risk managements in terrestrial wildlife and humans over the world.

3.2.4 Polybrominated Diphenyl Ethers (PBDEs)

As one type of brominated flame retardants (BFRs), PBDEs are extensively used in electronic appliances, plastics, furniture, and textiles as additives to prevent fire, and have received increased attention over the last two decades for their potential environmental risks. Since 2000, the extensive investigations on the occurrence and distribution of PBDEs in coastal environment have been conducted in South and East China^{6 7}. Totally,

1 MA X, CHEN C, ZHANG H, et al. Congener-specific distribution and bioaccumulation of short-chain chlorinated paraffins in sediments and bivalves of the Bohai Sea, China[J]. *Marine Pollution Bulletin*, 2014, 79, 299-304.

2 MA X, ZHANG H, WANG Z, et al. Bioaccumulation and Trophic Transfer of Short Chain Chlorinated Paraffins in a Marine Food Web from Liaodong Bay, North China[J]. *Environmental Science and Technology*, 2014, 48, 5964-5971.

3 MA X, ZHANG H, WANG Z, et al. Bioaccumulation and Trophic Transfer of Short Chain Chlorinated Paraffins in a Marine Food Web from Liaodong Bay, North China[J]. *Environmental Science and Technology*, 2014, 48, 5964-5971.

4 GAO Y, ZHANG H, SU F, et al. Environmental Occurrence and Distribution of Short Chain Chlorinated Paraffins in Sediments and Soils from the Liaohe River Basin, P. R. China[J]. *Environmental Science and Technology*, 2012, 46, 3771-3778.

5 Same with 3.

6 CHEN S J, FENG A H, HE M J, et al. Current levels and composition profiles of PBDEs and alternative flame retardants in surface sediments from the Pearl River Delta, southern China: Comparison with historical data[J]. *Science of The Total Environment*, 2013, 444, 205-211.

7 MAI ChenChen, LUO ChenChen, YANG Sheng, et al. Distribution of Polybrominated Diphenyl Ethers in Sediments of the Pearl River Delta and Adjacent South China Sea[J]. *Environmental Science and Technology*, 2005, 39, 3521-3527.

the concentrations of PBDEs in different marine matrixes were higher compared with other reports around the world, even with the developed countries. For example, the highest residual level of PBDEs reported in literature was found in the Pearl River Delta and several e-waste recycling areas in China. Obviously, the electronic manufacturing and e-waste dismantling industries was the main source of PBDEs around the coastal areas.

The concentrations of PBDEs around the coast of China also presented a typical regional characteristic and the overall concentrations were higher than those from other countries and regions. The highest concentration, with the value of 68 ng L^{-1} , was detected from the Pearl River Delta¹. Because a lot of electronic manufacturing industries and e-waste dismantling areas exist in China coastal areas, the rainfall and the surface runoff are likely to take the atmospheric particulate and the soil into the coastal environment.

The concentrations of PBDEs displayed significant difference among the different sampling sites. PBDE distribution in the coastal Eastern China Sea (ECS) was related to the land-based inputs rather than the sediment characters. They were mainly from the coastal electronic waste dismantling/recycling and Yangtze River, and the coastal ECS is an important sink of the PBDEs in the world.

PBDEs residual levels in most coastal areas of China were also relatively lower than those of other countries. However, the concentrations of PBDEs from the polluted areas were comparable to/or even higher than those of developed regions (Table 2). According to the report by Shi et al.(2009)², the average concentration of PBDEs in fish samples collected from the electronic waste recycling plant in Qingyuan (Guangdong Province) was 153.0 ng/g (lw), and the mean value in waterfowls was up to $1,165.2 \text{ ng/g}$ (lw). Because of the high potential of bioaccumulation and biomagnification, the risk managements about PBDEs in terms of ecosystem and human health, especially in heavily polluted areas, should not be ignored.

3.2.5 Organochlorine Pesticides (OCPs)

OCPs accounted for 80% of the total pesticides before 1982 in China. According to the core sediment records of the Yangtze River Estuary, it was estimated that the total burdens of HCHs and DDTs in the inner shelf of the East China Sea were 35 tons and 110 tons, respectively. After 1983 (year of the official ban in China), those values were 13 tons and 50

1 GUAN Y F, WANG J Z, NI H G, et al. Riverine Inputs of Polybrominated Diphenyl Ethers from the Pearl River Delta (China) to the Coastal Ocean[J]. *Environmental Science and Technology*, 2017, 41, 6007-6013.

2 SHI T, CHEN S J, LUO X J, et al. Occurrence of brominated flame retardants other than polybrominated diphenyl ethers in environmental and biota samples from southern China[J]. *Chemosphere*, 2009, 74, 910-916.

tons, respectively¹.

The OCPs concentration in seawater and organisms presented an identical trend that the HCHs concentrations were higher than those of DDTs; whereas, the DDTs in sediment presented the opposite tendency. In the coastal areas of Fujian and Guangdong Province (locating in the South China Sea), the OCPs concentrations in water were relatively higher.

In the fishery along the throughout coastal line, from Tianjin in north to Wanning (Hainan Province) in south, the concentrations of DDTs and HCHs in bass muscle from southern fisheries were in general much lower than those from the northern. The ratios of OCP congeners suggested that technical DDT was not the main input and a recent usage of lindane or aged technical HCH residuals could be the source of HCHs. Expect for Quanzhou and Wanning, the consumption of bass were quite safe on the base of the maximum allowable fish assumption rate².

Comparing to open sea and ocean areas in the world such as Arctic Ocean, Pacific, and Berling Sea, the OCPs residual levels in the seawater of Chinese marginal seas were relatively higher because the usage in agriculture and disease control. However, The HCHs and DDTs concentrations in surface sediments are much lower than those in some other Asian area, such as Vietnam, India and Singapore³. The Asian Mussel Watch initiative revealed that China, along with Vietnam, is one of the three countries having the highest DDT concentrations among 12 Asia-Pacific countries. Furthermore, the coastal region of central China is likely one of the most DDT- and HCH-polluted areas in the world in the context of the levels detected in mollusks.

3.2.6 Polychlorinated Biphenyls (PCBs)

Polychlorinated biphenyls (PCBs) are one class of traditional Persistent Organic Pollutants targeted by the Stockholm Convention on Persistent Organic Pollutants. The emissions from Chinese coking industry were 115 kg, less than 0.1% of the total UP-PCB emissions.

The concentrations of PCBs in the seawater and sediment sampling from some coastal areas of Dalian, Bohai Bay (Tianjin inshore) and Fujian Province (such as Minjiang River

1 LIN T, NIZZETTO L, GUO Z, et al. DDTs and HCHs in sediment cores from the coastal East China Sea[J]. *Science of The Total Environment*, 2016, 539, 388-394.

2 PAN H, GENG J, QIN Y, et al. PCBs and OCPs in fish along coastal fisheries in China: Distribution and health risk assessment[J]. *Marine Pollution Bulletin*, 2016, 111, 483-487.

3 WU Y, WANG X, YA M, et al. Distributions of organochlorine compounds in sediments from Jiulong River Estuary and adjacent Western Taiwan Strait: Implications of transport, sources and inventories[J]. *Environmental Pollution*, 2016, 219, 519-527.

Estuary and Xiamen) were relatively higher than those in other coastal areas. Similarly, the higher-leveled PCBs in fish and shell fish samples were detected collected from Dalian Bay, Bohai Bay and Pearl River Estuary, as Table 1 shown. The PCBs concentrations in the bass muscles of 9 Chinese fisheries (Tianjin, Qingdao, Lianyungang, Zhoushan, Ningbo, Wenling, Ningde, Quanzhou, Shantou, Shenzhen, Fangchenggang, Sanjiang and Wanning) were approximately 10 times lower than those fish taken from UK, USA and Japan.

PCBs may pose a health risk of a lifetime cancer to the coastal residents who consumed more seafood, so the carcinogenic risk factors was used to assess the health risk level derived from PCBs contamination. The PCBs concentrations in sediment sampling from Dalian Bay, West Harbor (Xiamen) and Pearl River Estuary exceeded the ERL value, suggesting that PCBs would have slight negative effects¹. The bioaccumulation in marine organisms in Hangzhou Bay and Yangtze River Estuary did not pose a significant health risk and the PCBs concentrations in air would not cause cancer via inhalation as well.

Generally, the residual of PCBs in the marine environmental matrixes were relatively low to medium in the world, so that the adverse effects derived from PCBs were rarely reported in China. Some areas in high industrialization levels, such as Bohai Bay, Yangtze River Estuary and Pearl River Estuary were less contaminated in terms of PCBs concentrations in sediments, than Korean coasts, Singapore coasts, Sea lots of Trinidad, Cantabrian Sea (Spain), Bay of Biscay (France) and Guánica Bay (Puerto Rico, USA).

3.2.7 Polycyclic aromatic hydrocarbons (PAHs)

PAHs are a class of hydrophobic semi-volatile organic compounds in the environment, and originated mainly from incomplete combustion of fossil fuels and biomass. With the increase of fossil fuels consumption, the levels of PAHs in coastal environments are increasing. The overall concentrations of PAHs in different matrixes are comparable to some developed countries, especially in some harbour areas. For example the PAHs in sediments from the Dalian and Hong Kong harbour are similar to those from San Francisco Bay, USA.

The difference of PAH concentrations in seawater among different regions are significant. In general, the PAH concentrations in the Bohai Sea are higher than those of the Yellow Sea, East Sea and South China Sea. The levels of PAHs along the marginal seas of China are comparable or slightly higher than those of other regions in the world depending on the different sea areas.

On a larger scale in China, PAH levels in sediments of the Bohai Sea were not

¹ MENG J, HONG S J, WANG T Y, et al. Traditional and new POPs in environments along the Bohai and Yellow Seas: An overview of China and South Korea[J]. *Chemosphere*, 2017, 169: 503-515.

statistically higher than those in the Yellow Sea and South China Sea sediments, which was probably influenced by the location of sampling sites, contents of organic matters in sediments, and local industrial structure of target areas, etc..

The results of vertical distribution in core sediments showed that, in general, PAH levels increased from the bottom to the surface, indicating the obvious influencing of human activities on the vertical distribution of PAHs. Most studies suggested that the concentrations of PAHs in core sediments began to increase gradually from 1960's. However, the different core profiles of PAHs among different sites indicated that regional characteristics (e.g. fuel consumption intensity, fuel types, economic development) also influenced the PAH levels and distribution.

3.2.8 Antibiotics

Antibiotics have been widely used as human and veterinary medicines to treat diseases and to promote growth in livestock and aquaculture, and increasingly released in to the aqueous environment. The occurrence, transformation and risks of antibiotics in aquatic systems are well-acknowledged environmental issues and have raised particular concerns. Importantly, these pollutants are pseudopersistent and have been proved to induce antibiotic resistance genes (ARGs), which have been recognized as a new emerging contaminant in environment. China is the largest producer and user of antibiotics in the world based on the market sales data. The total antibiotic usage in China for 2013 was estimated to be approximately 162,000 tons. China consumed 150 and 9 times more antibiotics than the UK and USA, respectively. The large usage in China, as well as their incomplete elimination by metabolism and wastewater treatment have been resulted in the high emission into the environment. For instance, the total emission for 36 frequently detected antibiotics in China was estimated to be 53,800 tons. Furthermore, the Yellow River, Huaihe River, and Yangtze River downstream basins received the discharge of the target antibiotics of more than 3,000 tons¹.

As emerging contaminants, Antibiotics have been increasingly detected in environmental waters. Their presence in surface waters (including seawaters) has been reported in many countries including the United States, Europe, and Vietnam. This is particularly relevant in China with their widespread occurrence in coastal areas. For example, sulfonamide antibiotics exist quite widely, with mean concentrations observed to range from 0.1 to 150.8 ng/L in the coastal waters of China through a variety of recent monitoring studies.

¹ ZHANG Q Q, YING G G, PAN C G, et al. Comprehensive Evaluation of Antibiotics Emission and Fate in the River Basins of China: Source Analysis, Multimedia Modeling, and Linkage to Bacterial Resistance[J]. *Environmental Science and Technology*, 2015, 49, 6772-6782.

In general, the aquatic environment in China has relatively higher antibiotic contamination levels when compared with other countries around the world¹. The environmental concentrations for sulfonamides and tetracyclines in China are higher than in some European countries such as Italy and France. For the macrolides, roxithromycin had a mean concentration range of ND-150 ng/L in German rivers, while it was 0.05 ~ 378 ng/L in China. The measured environmental concentrations of fluoroquinolones (ciprofloxacin, norfloxacin, ofloxacin, and norfloxacin) in Italy (9 ng/L), USA (up to 120 ng/L), and Germany (20 ng/L) are much lower than those in China with concentrations up to 7,560 ng/L, with the average for all fluoroquinolones being 303 ng/L.

3.2.9 Summary

Overall, China's rapid economic and social development has led to an acceleration in nutrient inputs to coastal waters. More than 80 percent of pollutants originates from terrestrial sources via point and non-point sources. Changes in the nutrients in coastal water were closely related to China's GDP growth rate, development pattern, population growth, as well as environmental protection policies and measures. The nutrient inputted to the sea increased rapidly during the end of the 1980s to the beginning of the 21st century, with a high rate of growth in real GDP. In the last decade, the increasing trend in nutrient inputs to the sea has been shifted, a steadily decreasing trend has been observed, and the status of coastal areas on eutrophication has improved over the last five years. Other than the nutrients, emerging contaminants and emerging issues about waters, sediment, and organism contamination have caused great concerns in China. The abundances of floating litter and microplastics in China's coast were the same order of magnitude as those reported in samples from the North Atlantic coast and South Pacific subtropical coast. Relatively high abundances of microplastics in water and sediment were recorded in the Estuaries and fishing harbors. More "true or really new" emerging contaminants would of course include many more types of contaminants such as pesticides, pharmaceuticals and personal care products, fragrances, plasticizers, hormones, flame retardants, nanoparticles, perfluoroalkyl compounds, chlorinated paraffins, siloxanes, algal toxins, various trace elements including rare earths and radionuclides, etc.. Of these, SCCPs, PBDEs, OCPs, PCBs, PAHs, and antibiotics have been ubiquitous in China's coast, especially in the Bohai Sea. More work is still needed to elucidate the sources, status, fate, and potential threat to ecosystem and human health.

¹ ZHANG R, TANG J, LI J, et al. Antibiotics in the offshore waters of the Bohai Sea and the Yellow Sea in China: Occurrence, distribution and ecological risks[J]. *Environmental Pollution*, 2013, 174, 71-77.

3.3 Pathways of the Land-based Pollutants into the Ocean

With the development of economic activities and marine undertakings in coastal areas, a large amount of sewage and various harmful substances have entered the offshore sea of China, causing a certain degree of pollution. In recent years, the decline of aquatic resources in some sea areas, the ruin of beaches, and the decline of seashore aesthetics have all been related to sea area pollution. This section analyzes the main pathways of the pollutants interface with ocean, coastal and river based on recent data.

3.3.1 Rivers and ocean outlets

3.3.1.1 Main Riverine Sources of Pollutants

Of the 55 rivers monitored for several years, 44%, 42% and 36% rivers failed to meet Surface Water Quality Standard Category V during dry, wet and normal seasons, respectively (Table 3-1). The main pollutants were chemical oxygen demand (COD_{Cr}), total phosphorus, ammonia nitrogen and petroleums.

Table 3-1 The statistics for water quality categories of monitored riverine sections

Monitoring period	Water quality				Total
	I ~ III	IV	V	> V	
Dry season	6	18	7	24	55
Wet season	4	16	12	23	55
Average water season	6	15	14	20	55

The pollutant loads carried by 55 seagoing rivers monitored for several years were as follows: 13.3 million tons of COD_{Cr}, 150,000 tons of ammonia nitrogen (measured based on nitrogen), 2.1 million tons of nitrate nitrogen (measured based on nitrogen), 50,000 tons of nitrite nitrogen (measured based on nitrogen), 230,000 tons of total phosphorus (measured based on phosphorus), 50,000 tons of petroleums, 10,000 tons of heavy metals (including 2,826 tons of copper, 445 tons of lead, 6,974 tons of zinc, 105 tons of cadmium, and 49 tons of mercury) and 2,761 tons of arsenic.

The monitoring results from 2013 to 2017 indicated that, the total amount of nitrogen (ammonia nitrogen, nitrate nitrogen and nitrite nitrogen) input to the sea via rivers was 2.3 ~ 2.7 million tons each year, while the total amount of phosphorus was 0.18 ~ 0.27

million tons¹. The Yangtze River is the largest nutrient-transporting river among all of the Chinese rivers, followed by the Zhujiang River. Wastewater and sewage directly discharged into the sea is an important source of nutrients entering the coastal waters. The main pollutants discharged from sewage outlets to the sea were total phosphorus, COD_{Cr}, suspended solids, and ammonia.

3.3.1.2 Environmental quality of the pollutant discharge outlets into the sea and the Adjacent Sea Areas

Results showed that, of the various types of emission outlets, the integrated source had the largest sewage load, followed by industrial source, and the least is the source of life (Table 3-2). Among the coastal provinces, Zhejiang has the largest sewage load, followed by Fujian and Guangdong, and Zhejiang has the largest COD load, followed by Liaoning and Shandong (Table 3-3).

Among the 371 monitored land-based sewage outlets, 29% were industrial outlets, 43% were municipal outlets, 24% were sewage discharge rivers, and the remaining 4% were other types of sewage outlets. The percentage of standardized discharge for the monitored outlets in March, May, July, August, October, and November were 49%, 52%, 59%, 59%, 61%, and 62%, respectively. Throughout the year, standardized discharges occurred 57% of all monitored operations, which increased 2% compared with that in the previous year. The discharge levels of 119 sewage outlets were all compliant at each monitoring operations, and 76 sewage outlets discharged wastes at levels that were noncompliant with the standards at all monitoring operations. The main pollutants discharged from sewage outlets to the sea were total phosphorus, COD_{Cr}, suspended solids, and ammonia.

Of the various types of sewage outlets into the sea, the percentage of standardized discharge was 68% for industrial outlets, which was similar with previous year. The percentage of standardized discharge for municipal outlets and discharge rivers were 52% and 53%, which increased 2% and 9% compared with that of the previous year. The percentage of standardized discharge for other types of outlets was 62%, which decreased 3% compared with that of the previous year.

The environmental qualities of the adjacent sea areas of sewage outlets were generally poor. The adjacent sea areas of over 90% of sewage outlets could not meet the environmental protection requirements for their respective marine functional zones.

¹ The State Oceanic Administration of China(SOA). Bulletin of Marine Environmental Quality in China 2017. Beijing: SOA, 2018.

Table 3-2 The pollutant load for various types of emission outlets in 2017

Outlet source	Number of outlets	Sewage load/10 ⁴ t	COD/t	Petroleum/t	NH ₄ -N/t	TN/t	TP/t	Cr/kg	Pb/kg	Hg/kg	Cd/kg
Industrial source	150	162,033	21,168	153.0	711	3,594	120	361.0	469.5	1.8	9.0
Source of life	59	73,385	24,081	290.0	1,946	7,058	385	130.3	422.9	5.9	18.1
Integrated source	195	400,624	127,165	463.3	8,102	45,973	1,664	1,843.5	2,965.3	235.7	516.3

Table 3-3 The pollutant load of emission outlets in different coastal provinces in 2017

Province	Number of outlets	Sewage load/10 ⁴ t	COD/t	Petroleum/t	NH ₄ -N/t	TN/t	TP/t	Cr/kg	Pb/kg	Hg/kg	Cd/kg
Liaoning	34	52,534	19,742	278.4	3,282	6,209	264	138.4	30.3	31.1	—
Hebei	5	7,123	1,884	—	619	903	133	71.9	3.6	—	0.2
Tianjin	18	7,037	2,213	3.5	201	577	26	—	11.3	1.7	4.2
Shandong	47	64,771	19,637	36.5	860	6,106	203	157.6	389.3	64.9	66.1
Jiangsu	15	4,752	1,989	8.9	111	460	32	119.2	111.8	13.2	30.3
Shanghai	10	24,598	6,269	72.7	322	2,513	131	—	126.1	26.5	14.5
Zhejiang	85	206,877	74,702	271.1	2,585	23,480	524	1,589.8	1,139.1	28.3	289.1
Fujian	59	156,516	18,870	86.9	936	5,981	229	167.5	135.7	51.9	16.7
Guangdong	66	71,487	14,529	70.9	1,014	6,008	328	22.9	201.6	14.5	4.0
Guangxi	38	11,901	5,043	12.9	289	1,630	205	67.6	1,664.8	9.7	117.7
Hainan	27	28,446	7,537	64.3	541	2,757	93	—	44.2	1.6	0.5

(1) Water quality

The water qualities of the adjacent areas to 79 sewage outlets in May and 80 in August were monitored. In May, the water bodies adjacent to 53 sewage outlets exceeded the Category IV standard,. In August, the water bodies adjacent to 56 sewage outlets (accounted for 70%) exceeded the Category IV standard, which accounted for 70% of the total monitored sewage outlets. The main pollutants were dissolved inorganic nitrogen, active phosphate, petroleum, and COD in the adjacent sea areas of sewage outlets. In some adjacent sea areas, water contained standard excessive concentrations of heavy metals and fecal coliform bacteria. The water bodies adjacent to 88% of sewage outlets could not meet the water quality standard for their respective marine functional zones.

(2) Sediment quality status

The sediments quality in sea areas adjacent to 80 sewage outlets were monitored in August, among which 31 stations did not satisfy the sediment quality requirements of marine functional zones. The main pollutants were petroleum, copper, chromium, mercury, and sulfide.

(3) Organism quality status

The organism quality monitoring results of shellfish collected from the adjacent areas of sewage outlets indicated that 67% of samples could not meet the organism quality standard for their respective marine functional zones. The main pollutants were fecal coliform bacteria, Cd, Hg, Zn, and As. In some adjacent sea areas, Cu, Pb, and petroleum hydrocarbons exceeded the standard.

(4) Trends of environment quality of adjacent sea areas

The monitoring results from 2013 to 2017 indicated that over 75% of seawater adjacent to sewage outlets were classified as Category IV or worse than IV each year. The main pollutants were inorganic nitrogen and active phosphate. The percentage of the adjacent sea areas with sediment qualities that met the requirements of the Marine Sediment Quality Standard Category I increased during these years.

3.3.2 Atmospheric deposition

3.3.2.1 Pollutant contents in marine atmospheric aerosols

Atmospheric deposition is another pathway bring nutrients into the sea through wet or dry deposition in different forms, such gas or aerosol. Monitoring of pollutants in marine aerosols was carried out at 15 stations, namely, Laohutan in Dalian, Daheishi in Dalian, Yingkou, Panjin, Huludao, Qinhuangdao, Tanggu, Dongying, Penglai, Beihuangcheng, Xiaomaidao in Qingdao, Lianyungang, Shengshan in Zhoushan, Beishuang in Fujian, and

Dawanshan in Zhuhai. The highest concentration of $\text{NO}_3\text{-N}$ in aerosols was observed at the Qinhuangdao Station at $6.3 \mu\text{g}/\text{m}^3$, and the lowest was at the Dawanshan Station at $0.9 \mu\text{g}/\text{m}^3$. The highest concentration of $\text{NH}_4^+\text{-N}$ in aerosols was found at the Yingkou Station at $6.0 \mu\text{g}/\text{m}^3$, and the lowest was at the Dawanshan Station at $1.4 \mu\text{g}/\text{m}^3$. The highest Cu concentration ($72.5 \text{ ng}/\text{m}^3$) was found at the Huludao Station, and the lowest ($6.5 \text{ ng}/\text{m}^3$) was at the Beihuangcheng Station. The highest Pb concentration ($116.0 \text{ ng}/\text{m}^3$) was detected at the Huludao Station, and the lowest ($11.5 \text{ ng}/\text{m}^3$) was at the Zhoushan Shengshan Station.

During 2013 and 2017, the total amount of nitrogen (ammonia nitrogen, nitrate nitrogen and nitrite nitrogen) input to the sea via wet deposition of atmosphere was declined generally, while the total amount of heavy metal (copper and lead) showed fluctuation changes.

3.3.2.2 Wet deposition of atmospheric pollutants in the Bohai Sea

Wet deposition of atmospheric pollutants is one of the important channels for the natural and man-made chemical elements transporting to the ocean, and the dissolved elements in the rain are easy to absorb and enrich by marine plants and animals, which have a direct effect on the marine ecological environment. Studies have shown that plankton in the ocean have a rapid response to nutrients in rainwater, and primary productivity increases rapidly after wet deposition events. In the yellow sea, 65% of the dissolved inorganic nitrogen and 70% of the dissolved inorganic phosphorus are transported by atmospheric wet deposition.

Monitoring of the wet deposition fluxes of atmospheric pollutants was conducted at Daheishi in Dalian, Yingkou, Panjin, Qinhuangdao, Tanggu, Dongying, Penglai, and Beihuangcheng. The highest wet deposition fluxes of nitrate-N and ammonia-N were observed at the Daheishi Station at 1.3 and 0.7 $\text{t}/(\text{km}^2 \cdot \text{a})$, respectively. The lowest wet deposition fluxes of nitrate-N and ammonia-N were observed at the Penglai Station at 0.2 and 0.4 $\text{t}/(\text{km}^2 \cdot \text{a})$, respectively. The highest wet deposition flux [$3.7 \text{ kg}/(\text{km}^2 \cdot \text{a})$] of Cu was found at the Dongying Station, and the lowest [$0.7 \text{ kg}/(\text{km}^2 \cdot \text{a})$] was at the Tanggu Station. The highest wet deposition flux of Pb [$0.8 \text{ kg}/(\text{km}^2 \cdot \text{a})$] was found at the Beihuangcheng Station, and the lowest [$0.1 \text{ kg}/(\text{km}^2 \cdot \text{a})$] was at the Dongying Station.

The monitoring results indicated that, during 2013 and 2017, the total amount of nitrogen (ammonia nitrogen and nitrate nitrogen) input to the sea via wet deposition of atmosphere was $5.4 \sim 35.4 \text{ tons}/(\text{km}^2 \cdot \text{a})$, while the total amount of copper was $5.9 \sim 17.4 \text{ kg}/(\text{km}^2 \cdot \text{a})$, and the total amount of lead was $2.3 \sim 13.2 \text{ kg}/(\text{km}^2 \cdot \text{a})$. The Tanggu station is the largest nutrient (ammonia nitrogen and nitrate nitrogen) transporting station among the stations in the Bohai Sea. The Yingkou station is the largest heavy metal (copper and lead) transporting station among the stations in the Bohai Sea (Figure 3-1, Figure 3-2).

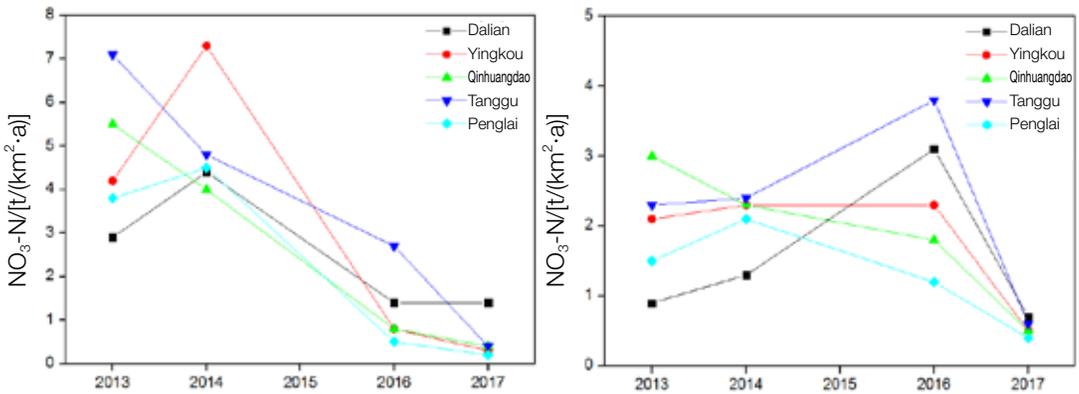


Figure 3-1 Wet deposition flux of inorganic nitrogen at various monitoring stations in the Bohai Sea from 2013 to 2017

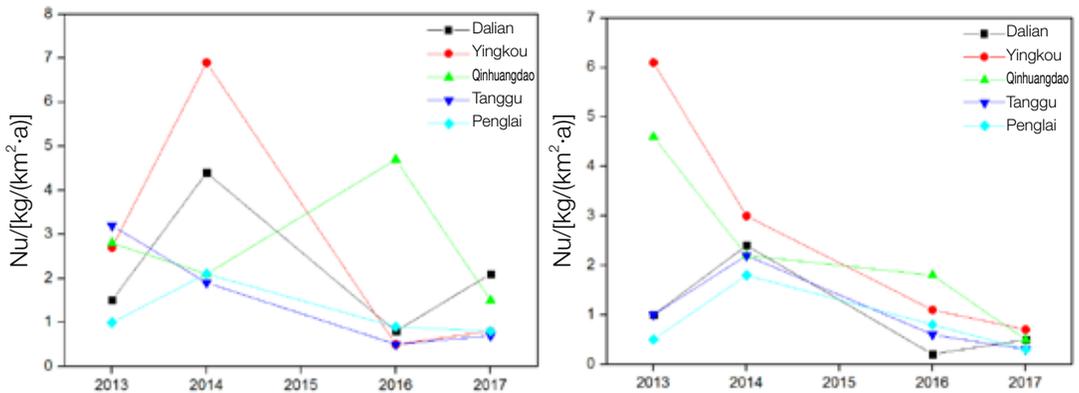


Figure 3-2 Wet deposition flux of copper and lead at various monitoring stations in the Bohai Sea from 2013 to 2017

3.3.3 Ground water

Submarine Groundwater Discharge (SGD) is increasingly considered to be one of the important pathways for terrestrial chemicals, such as nutrients, trace elements and pollutants, to enter the ocean. China’s research on SGD started late, but a lot of work has been carried out so far. China’s SGD research is mainly concentrated in the estuaries of the Yellow River, the Yangtze River and the Pearl River. It belongs to the delta coast type. The loose sediments are widely distributed and thick. The coastal aquifers have better water-rich conditions and

the groundwater input is more obvious^{1 2 3}. Jiaozhou Bay, Xiakou Bay and Hong Kong Tulu Bay, both are bedrock coasts, sandy coasts, and small river deltas, the input of groundwater is very uneven^{4 5 6}. On the east coast of Hainan Island, with varying degrees of mangroves and corals, groundwater input has special significance for mangroves and corals^{7 8}. The delta of the Minjiang River estuary is not obvious, belonging to the coast of the triangular port, and the input of groundwater is very limited⁹.

The researchers used the radium isotope tracing technique to study the groundwater discharge from the seabed, and analyzed the transport flux of the source elements they carried, and then evaluated the possible environmental effects¹⁰. The study areas include semi-closed aquaculture bay—the easternmost Sanggou Bay in the Shandong Peninsula, the relatively closed aquaculture lagoon—the Laoye Sea and the Little Sea in the eastern part of Hainan Island, and shelf edge sea under the influence of the great river. The SGD fluxes of the three types of study areas are listed in Table 3-4. Results showed that the SGD flux as a whole is Sanggou Bay > lagoon > East China Sea. The comparison shows that the effect of tidal dynamics is more pronounced in the semi-enclosed bay than in the relatively closed

1 PETERSON R N, BURNETT W C, MAKOTO T, et al. Radon and radium isotope assessment of submarine groundwater discharge in the Yellow River Delta[J]. *Journal of Geophysical Research Oceans*, 2008, 113(C9).

2 GU H, MOORE W S, LEI Z, et al. Using radium isotopes to estimate the residence time and the contribution of submarine groundwater discharge (SGD) in the Changjiang effluent plume, East China Sea[J]. *Continental Shelf Research*, 2012, 35(1) : 95-107.

3 LIU Q, DAI M, CHEN W, et al. How significant is submarine groundwater discharge and its associated dissolved inorganic carbon in a river-dominated shelf system—the northern South China Sea?[J]. *Biogeosciences*, 2012, 9: 1777-1795.

4 GUO Z, HUANG L, YUAN X, et al. Estimating submarine groundwater discharge to the Jiulong River estuary using Radium isotopes [J]. *Advances in Water Science*, 2011, 22(1) : 118-125 (in Chinese, with English abstract).

5 LIU H, GUO Z, GAO A, et al. Distribution Characteristics of Radium and Determination of Transport Rate in the Min River Estuary Mixing Zone[J]. *Journal of Jilin University (Earth Science Edition)*, 2013, 43(6) :1966-1971 (in Chinese, with English abstract).

6 TSE K C, JIAO J J. Estimation of submarine groundwater discharge in Plover Cove, Tolo Harbour, Hong Kong by ²²²Rn[J]. *Marine Chemistry*, 2008, 111(3) :160-170.

7 SU N, DU J, MOORE W S, et al. An examination of groundwater discharge and the associated nutrient fluxes into the estuaries of eastern Hainan Island, China using ²²⁶Ra[J]. *Science of the Total Environment*, 2011, 409(19) : 3909-3918.

8 WANG X, LI H, JIAO J J, et al. Submarine fresh groundwater discharge into Laizhou Bay comparable to the Yellow River flux.[J]. *Scientific Reports*, 2015, 5: 8814.

9 ZHANG B, GUO Z, GAO A, et al. Estimating groundwater discharge into Minjiang River estuary based on stable isotopes deuterium and oxygen-18*[J]. *Advances in Water Science*, 2012, 23(4) : 539-548 (in Chinese, with English abstract).

10 WANG X L. Study on submarine groundwater discharge (SGD) and its driven nutrient fluxes from typical area in coastal sea of China East China Normal University[D], 2017 (in Chinese, with English abstract).

lagoon system, so in the relatively closed water environment of the Grand Sea and the Small Sea, the amount of seawater circulation caused by a single ocean drive is limited. Whether in semi-enclosed bays, relatively closed lagoons or open shelf systems, SGD plays a very important role in its biogeochemical cycle: in research areas with small river flow, small area, relatively closed and semi-closed, SGD is the main input source, and the nutrient flux input from it can reach more than 40% of the total input of nutrients, even up to 98%, in the area where the river flow is large, the area is large and open, the nutrient flux input by SGD is equivalent to the nutrient flux delivered by the river, and it is also an important input source that cannot be ignored.

Table 3-4 A comparison of SGD and its driven DIN, DIP and DSI fluxes in different study areas of this word

Study area	Regional characteristics	River flow	SGD	Tidal-driven SGD	SGD/River		
		$10^7 \text{ m}^3/\text{a}$	$10^7 \text{ m}^3/\text{d}$	$10^5 \text{ m}^3/\text{d}$	DIN	DIP	DSi
Sanggou Bay	Semi-closed aquaculture bay	17 ~ 23	2.59 ~ 3.07	75 ~ 100	21.0	1.5	5.8
Laoye Sea	Relatively closed aquaculture lagoon	1.26	0.17	1.5 ~ 1.9	2.6	0.1	79.7
Little Sea		83.6	0.18	0.6 ~ 2.2	0.9	3.5	0.9
East China Sea Shelf	Shelf edge sea under the influence of the great river	1.14×10^5	$(1.14 \sim 5.42) \times 10^5$	—	0.8	2.2	1.2

3.4 Impact on Marine Ecosystems from Marine Pollution

Marine ecosystem is the largest ecosystem on the earth, and plays important roles in regulating the climate system, supporting rich biodiversity, and sustaining the development of human-beings. Marine ecosystem has a rich diversity of habitats, such as estuaries, sea grass beds, salt marshes, tidal flats, mangroves, coral reefs and shelves, and provides multiple beneficial services to human society. The health of marine ecosystem is crucial for the sustainable development of global economy. The fisheries and aquaculture industry generate US\$252 billion annually, and support the livelihoods of between 58 million and 120 million people. Fish from the sea provide 3.1 billion people with over 20 percent of their dietary protein¹.

Marine ecosystem has been considered as a vast and resilient system to pressures, but is now subject to significant changes under multiple stressors. The principal drivers of the changes are ocean warming, acidification, pollution, increasing use of oceans for

¹ United Nations Environment. Global Environment Outlook-GEO-6: Healthy Planet, Healthy People, 2019. Nairobi. DOI 10.1017/9781108627146.

food production and transportation, increased nutrient and sediment run-off, and marine litter etc.. The impacts of these driving factors will produce significant negative impacts on marine ecosystems and their services. In the First World Ocean Assessment, the detrimental impacts on the health of marine ecosystems have been clearly addressed¹. The “Conserve and sustainably use the oceans, seas and marine resources for sustainable development” has been listed as the 14th Sustainable Development Goals (SDG14) to protect marine ecosystems and resources².

China is an important coastal country with a continental coastline of more than 18,000 km, and the claimed jurisdictional sea area is 3.0 million km². Marine ecosystem supports a wide variety of habitats for marine organisms, and different resources for peoples' livelihoods. The wealth of natural marine resources and the enormous value of marine ecosystem services are important contributor to the nation's socio-economic development. With the continuing development of social economy and rapid urbanization along the coast, marine ecosystem is facing increasing threats of pollution. Apparent changes of marine ecosystem, such as the occurrence of harmful algal blooms, hypoxia, alteration of food web structure, degraded habitat conditions, loss of biodiversity, have been reported.

3.4.1 Nutrient pollution and eutrophication

Excessive land-based nutrient input into the sea will lead to serious problems of nutrient pollution and eutrophication, and subsequently affect different marine ecosystems. Many coastal regions around the world, particularly the coastal waters of East Asia and Western Europe, have series problems of eutrophication.

Coastal eutrophication is mainly caused by the increased use of fertilizer from agriculture. In the regions with intensive fertilizer use, such as Asia, Europe and the USA, huge amounts of dissolved inorganic nitrogen (DIN) will export to aquatic systems via rivers. It has been estimated that approximately 60 Tg nitrogen (N) flows to the world's oceans through rivers every year. Compared to phosphorus (P) fertilizers, N fertilizers have a rapid increase due to the capacity for anthropogenic N synthesis. In China, the production of N fertilizer increased nearly 5 fold in the last four decades. Another important source of nutrients is the animal waste. The animal production facilities are estimated to produce huge amounts of N pollution in the reduced forms of N, such as ammonia, urine and other dissolved organic N. Mariculture is an important source of nutrients in the sea, especially for the reduced forms of N. Atmospheric deposition is also increasing due to many sources, like

1 <https://www.un.org/regularprocess/content/first-world-ocean-assessment>.

2 SDG14, 2018. <https://sustainabledevelopment.un.org/sdg14>.

volatilization of NH_3 from agricultural lands and animal operations.

In China, nutrient pollution is mainly confined in the estuaries and embayment, such as the Liaodong Bay, Bohai Bay, Yangtze River Estuary, Hangzhou Bay and Pearl River estuary. Increasing nutrient input into the sea lead to significant changes of the concentrations and structure of nutrients in seawater. In the river mouth of the Changjiang River, concentration of N increased about 4 times compared to the 1960s¹, while the concentration of P had little change, and silicate exhibited a decreasing trend. As a result, the stoichiometry of nutrients in seawater also changed significantly. In the Changjiang River Estuary, the N/P ratio increased significantly while the Si/N ratio dropped from 4 to 1. In the Bohai Sea, the N/P ratio was about 3 in the middle 1980s, but increased drastically to over 25 by the 21st century. Over the same period, Si/N ratio showed a dramatic decrease². In the Yellow Sea, the N/P ratio also rose rapidly from around 5 in the middle 1980s to around 20 in the middle 2000s, while the Si/N ratio dropped from around 2 to 1 over the same period. In the Pearl River estuary of the South China Sea, however, the N/P ratio exhibited a decreasing trend from the end of the 1990s. The forms of N exported to the sea also changed significantly. More than half of the N fertilizer used throughout the world now is urea. The increasing use of organic forms of nitrogen are likely to promote the growth of small flagellates and lead to different ecological consequences compared to the DIN.

The occurrence of harmful algal blooms (HABs) is the most significant consequence of coastal eutrophication³. The direct responses to nutrient enrichment in marine ecosystems are the increasing level of chl-a and algal blooms that sometimes are harmful or noxious. An increasing number of HAB events have been recorded in the coastal waters of China during the last 2 decades⁴. Before the 1990s, the recorded number of HABs is quite limited. Most of the HABs were caused by non-toxic diatoms, and affected a relatively small sea area. Since the year 2000, the recorded number of HAB events has reached 50 ~ 80 every year. Large scale HABs have been recorded in many different regions of the China Seas. In the East China Sea, for examples, intensive blooms of different dinoflagellate species (red tides) have been recorded from the beginning of the 21st century. The blooms of dinoflagellates can last

1 ZHOU M J, SHEN Z L, YU R C. Responses of a coastal phytoplankton community to increased nutrient input from the Changjiang (Yangtze) River[J]. *Continental and Shelf Research*, 2008, 28: 1483er di.

2 WANG B D, XIN M, WEI Q S, et al. A historical overview of coastal eutrophication in the China Seas[J]. *Marine Pollution Bulletin*, 2018, 136: 394-400.

3 GLIBERT P M. Eutrophication, harmful algae and biodiversity-Challenging paradigms in a world of complex nutrient changes[J]. *Marine Pollution Bulletin*, 2017, 124: 591-606.

4 YU Rencheng, LV Songhui, LIANG Yubo. Ecology and Oceanography of Harmful Harmful algal blooms in the coastal waters of China[M]//GLIBERT P, BERDALET E, BURFORD M A, et al. *Ecology and Oceanography of Harmful Algal Blooms*[J]. Springer, 2018, 309-316.

from early May to the middle June each year, and affect a large sea area up to 10,000 km². The HABs of dinoflagellates, such as *Prorocentrum donghaiense* and *Karenia mikimotoi*, are harmful to both aquaculture industry and marine ecosystems. For instance, the red tide of *K. mikimotoi* in 2005 led to mass mortality of cultured fish in the sea area around Nanji Island, and the economic loss was estimated to be 30 million RMB. Another red tide of *K. mikimotoi* in 2012 destroyed the aquaculture industry of abalones along the coast of Fujian Province, and led to the economic loss around 2 billion RMB (nearly \$300,000,000). Dinoflagellate *P. donghaiense*, although non-toxic, has strong inhibition effects on reproduction of the keystone zooplankton species *Calanus sinicus* in the East China Sea. In the Bohai Sea, a tiny pelagophyte *Aureococcus anophagefferens* formed large-scale brown tides from the year 2009, and became a recurrent phenomenon in this region later on. In 2010, the bloom affected a sea area over 3,000 km² and destroyed the scallop culture industry in this region, which led to economic loss of 200 million RMB (about \$30,000,000). In the South China Sea, large-scale red tides of haptophyte *Phaeocystis globosa* started to appear from the late 1990s in Zhelin Bay, Guangdong Province. The red tide caused mass mortality of cultured fish, and the economic loss was estimated to be 70 million RMB (about \$10,000,000). From the year 2010, intensive red tides of *P. globosa* started to appear in Beibu Gulf, an isolated sea area previously pristine to HABs in the northwestern part of the South China Sea. Red tides of *P. globosa* occurred in northern Beibu Gulf in 2014 and 2015 and posed potential threats to the operation of cooling systems of a nuclear power plant. Besides the HABs of microalgae, the harmful algal blooms of macroalgae, such as the green tides of *Ulva prolifera*, have been recorded in the southern Yellow Sea from the year 2007, and led to negative impacts on the west coastline along the Yellow Sea. Many studies have suggested that the occurrence of HABs in the China Seas is closely related with coastal eutrophication caused by nutrient pollution¹. Huge amounts of N and P discharged into the sea in different forms aggravated the status of coastal eutrophication, with different features in different regions. For example, the Yangtze River Estuary and its adjacent waters is characterized by high concentration of nitrate and high N/P ratio and N/Si ratio. In the coastal water of Qinhuangdao of the Bohai Sea, however, the organic forms of nitrogen are more prominent. This will lead to the proliferation of different types of HABs.

Hypoxia is another significant consequence of coastal eutrophication, which could cause the collapse of marine ecosystems and fishery resources². Coastal eutrophication will promote

1 GLIBERT P M. Eutrophication, harmful algae and biodiversity-Challenging paradigms in a world of complex nutrient changes[J]. *Marine Pollution Bulletin*, 2017, 124: 591-606.

2 RABALAIS N N, DIAZ R J, LEVIN L A, et al. Dynamics and distribution of natural and human-caused hypoxia[J]. *Biogeosciences*, 2010, 7 (2) 585-619.

the growth of algae in the sea and cause increasing deposition of organic matter into the bottom. The degradation of organic materials lead to consumption of dissolved oxygen (DO) in seawater at the bottom and result in adverse effects on benthic animals. Under the extreme condition, “dead zone” will form at the bottom. It has been estimated that a total sea area of more than 245,000 km² is affected by dead zone around the world. The Gulf of Mexico and the northwestern shelf areas of Black Sea are the two most well-known hypoxic areas. Studies have shown that status of hypoxia gradually deteriorated in the sea area adjacent to the Yangtze River Estuary over the past several decades^{1 2}, and the probability of hypoxia in summer has increased by 90% from 1990 onwards. DO level at the bottom of the Pearl River estuary also followed a decreasing trend related to the excessive input of N, leading to a marked increase of hypoxia-tolerant foraminifera from 1970. Recently, intensive oxygen deficit has been observed at the bottom of the Bohai Sea. Besides bottom water hypoxia, acidification of the bottom water is another consequence of coastal eutrophication, which could have adverse effects on benthic communities.

Increased nutrient loading also results in losses of biodiversity and habitat, changes of ecosystem structure, and degradation of ecosystem services. Nutrient over-enrichment is regarded as a major cause for the decline of seagrasses, coral reefs, mangroves and salt marshes. In the Bohai Sea, in association with the increase of phytoplankton standing stock (as indicated by chl-a concentration) from the 1980s to the beginning of the 21st century, the proportion of large net-collected phytoplankton dropped dramatically over the same period. Besides, the dominancy of dinoflagellates, such as *Ceratium* spp., gradually increased from the 1990s to the 2000s. In the sea area adjacent to the Yangtze River Estuary, the number of benthic animal species decreased evidently together with the increasing proportion of polychaetes, which have short life cycle and high tolerance to environmental stresses. The massive occurrence of jellyfish in the Yellow Sea and Bohai Sea are also partially attributed to coastal eutrophication.

3.4.2 Microplastics

Marine plastics and microplastics (MPs), which has been found in nearly all oceans at all depths, received increasing attention recently³. It has been estimated that the total input

1 WANG B D. Hydromorphological mechanisms leading to hypoxia off the Changjiang estuary[J]. Marine Environmental Research, 2009, 67 (1) : 53-58.

2 WEI H, HE Y, LIA Q, et al. Summer hypoxia adjacent to the Changjiang Estuary[J]. Journal of Marine System, 2007, 67 (3-4): 292-303.

3 EGBEOCHA C O, MALEK S, EMENIKE C U, et al. Feasting on microplastics: ingestion by and effects on marine organisms[J]. Aquatic Biology, 2018, 27: 93-106.

of plastic litter into the sea amounts to some 8 million tonnes annually, and 80 percent of which originates from land-based sources. Plastics are synthetic organic polymers, such as polypropylene (PP), polyethylene (PE), polystyrene (PS), polyvinylchloride (PVC) and polyethylene terephthalate (PET), with different properties. MPs are commonly defined as small particles with a diameter between 1~5 μm , in the forms of particles, fibres or granules. MPs in the sea could be divided into primary microplastics that are products for domestic and industrial use, and secondary microplastics generated by breaking of larger plastic items in the sea.

It has been believed that marine plastic litter can result in significant ecological impacts from entanglement and ingestion. A large number of filter feeding organisms, such as copepods, bivalves, fish and whales, could actively or passively ingest MPs in seawater¹. Besides, MPs can act as a vector for the transport of other pollutants and pathogens, and lead to more risks of the organisms ingesting on MPs. Due to the unique features of MPs, they could actively absorb and concentrate other pollutants, particularly persistent organic pollutants (POPs) in seawater and transfer them through food chains. This process could lead to potential impacts on marine ecosystems.

The growing presence and abundance of MPs in the sea has potential adverse effects on the health of both marine organisms and human-beings. Researches have revealed some negative impacts of MPs on marine organisms. The chronic exposure to MPs, for examples, can lead to decreases of food ingestion, growth, and fecundity of copepods. The ingestions of MPs by economic fish species also pose potential risks to human health.

MPs have been widely detected in seawater and sediment of the China Seas, including the sea area adjacent to the Yangtze River Estuary in the East China Sea, the Bohai Sea, coastal waters of the South China Sea, and northern Yellow Sea etc². The investigations MPs and polycyclic aromatic hydrocarbon (PAHs) in the Bohai Sea and the Yellow Sea indicated a high risk of transferring PAHs by MPs³. Besides, MPs were also detected in zooplankton, shellfish and fish samples. The demersal species generally has relatively higher abundance of MPs compared to the pelagic species. However, little studies revealed any direct impacts of MPs on marine animals or ecosystems in the China Seas so far.

1 GUZZETTI E, SUREDA A, TEJADA S, et al. Microplastic in marine organism: Environmental and toxicological effects[J]. *Environmental Toxicology and Pharmacology*, 2018, 64: 164-171.

2 ZHU L, BAI H Y, CHEN B J, et al. Microplastic pollution in North Yellow Sea, China: Observations on occurrence, distribution and identification[J]. *Science of the Total Environment*, 2018, 636: 20-29.

3 MAI L, BAO L J, SHI L, et al. Polycyclic aromatic hydrocarbons affiliated with microplastics in surface waters of Bohai and Huanghai Seas, China[J]. *Environmental Pollution*, 2018, 241: 834-840.

3.4.3 Persistent organic pollutants (POPs) and endocrine disrupting chemicals (EDCs)

Some halogenated organic chemicals, such as organochlorine pesticides (OCPs), polychlorinated biphenyls (PCBs), polybromodiphenyl ethers (PBDEs), hexabromocyclododecanes (HBCDs), dechlorane plus (DP) and perfluoroalkyl substances (PFASs), have been listed as POPs in the Stockholm Convention¹. High levels of POPs are usually found in the sea areas near populated, urbanized and industrialized regions, and land-based activities have been considered as the major source of POPs in the coastal seas.

POPs have negative impacts on different marine organisms in various ways. Some POPs, like lindane, PBDEs or PFOA, could inhibit the growth of algae through their acute toxic effects. The POPs could also inhibit the enzyme activity and interfere the immune system of marine organisms. PBDEs has been reported to affect the gene expression of fish. Field investigations also revealed potential toxic effects of DDE on the eggs produced by brown pelicans (*Pelecanus occidentalis*) off the southern California. Some studies also illustrated the bioaccumulation and biomagnification of POPs via marine food web, which will lead to significant risks to animals at the high trophic levels.

Some organic pollutants, including butyltins, natural (estrone [E1], 17 β - estradiol [E2]) and synthetic (nonylphenol [NP]) estrogens, atrazine, dichlorodiphenyltrichloroethane (DDT)-related compounds, polychlorinated dibenzo-p-dioxin/dibenzofurans (PCDD/F), and coplanar polychlorinated biphenyls (co-PCBs), have special toxic effects of endocrine disruption, and are considered collectively as endocrine disrupting chemicals (EDCs). Butyltins, for example, will cause imposex of marine gastropods, thus lead to sterility and extinctions of gastropod populations under the severe contamination condition.

To protect the coastal ecosystems and human health, some selected marine animals, like mussels, have been used as indicator to reflect the long-term variation and accumulation in marine organisms. The monitoring programs such as “Mussel Watch” of the US, and documented the long term changes of POP pollution status in the sea.

China plays an important role in implementation of the Stockholm Convention to Reduce And Eliminate Pollution of POPs. Monitoring of POPs has been systematically conducted in the coastal waters of China. According to the review of past investigations on POPs in the Bohai Sea and the Yellow Sea², it was found that high hydrophobic compound like OCPs,

1 LIU L Y, MA W L, JIA H L, et al. Research on persistent organic pollutants in China on a national scale: 10 years after the enforcement of the Stockholm Convention[J]. Environmental Pollution, 2016, 217: 70-81.

2 MENG J, HONG S, WANG T, et al. Traditional and new POPs in environments along the Bohai and Yellow Seas: An overview of China and South Korea[J]. Chemosphere, 2017, 169, 503-515.

PCBs, PBDEs and HBCDs were mainly present in sediment, while the relatively hydrophilic PFASs were mainly detected in seawater. High concentration of POPs were detected mainly in the coastal waters of the Bohai Sea and northern Yellow Sea. Potential risks of POPs were evaluated. At the Pearl River estuary in the South China Sea, biomagnification of PCBs, PBDEs and DDE were found in Bombay duck and Tapertail anchovy. In Jiulongjiang River of Fujian province, the ecological risk of POPs were generally low, and only PAH may pose some ecological risks¹.

For EDCs, the butyltin compounds have been widely detected along the coast of China, and imposex of gastropods have been reported. High proportion of sterile individuals (10% ~ 27%) were predicted in the sea areas near Dalian, Lianyungang, Xiamen, Shenzhen, Beihai, Haikou, et al. The highest incidences of female sterility were found along the coast between Shantou and Shenzhen in the South China Sea. The incidences of intersex have been documented in wild population of clams *Macraa veneriformis* collected from Bohai Sea, reflecting the potential impacts of EDCs. According to an investigation in the Bohai Sea, EDCs had relatively high ecological risks to estuarine animals compared to PAHs.

3.4.4 Antibiotics

Antibiotics have been widely used to treat infectious disease in humans, and in livestock and aquaculture operations as well. Aquatic environments are major pools for antibiotics, which have been widely detected in the coastal waters. Antibiotics released into marine environment may pose potential risks to the health of marine ecosystem². So far studies on the impacts of antibiotics mainly focused on their acute or chronic toxic effects, and the ecosystem risk assessment methodologies for antibiotics have been developed using different organisms. The knowledge on their impacts on microorganism communities, however, are still quite limited. A growing body of evidence indicates that the selection of antibiotic-resistant bacteria may occur in the environment. The rapid and widespread increase of antibiotic resistance genes (ARGs), which is considered as an emerging pollutant, has been accelerated in recent years.

Many investigations have been performed in the coastal regions of China Seas, including Bohai Bay, Beibu Gulf, Jiaozhou Bay, Laizhou Bay, Yantai Bay, Liaodong Bay,

1 WU Y L, WANG X H, LI Y Y, et al. Polybrominated diphenyl ethers, organochlorine pesticides, and polycyclic aromatic hydrocarbons in water from the Jiulong River Estuary, China: levels, distributions, influencing factors, and risk assessment[J]. Environmental Science and Pollution Research, 2017, 24: 8933-8945.

2 BRANDT K K, AMÉZQUITA A, BACKHAUS T, et al. Ecotoxicological assessment of antibiotics: A call for improved consideration of microorganisms[J]. Environment International, 2015, 85: 189-205.

and Shenzhen Bay, to detect targeted antibiotics (Figure 3-3). In an investigation in 2017¹, 7 out of 13 target antibiotics were detected in coastal water samples. Detected norfloxacin (NFC) and sulfamethoxazole (SMX) had high ecological risks, while non of the antibiotics exerted apparent risks on the health of human-beings. Strains of *Vibrio vulnificus* and *V. parahaemolyticus* isolated from seafood in China have been tested for their resistance to antibiotics, and some strains showed resistance or intermediate resistance to various antibiotics, which could pose risks to the health of human-beings².

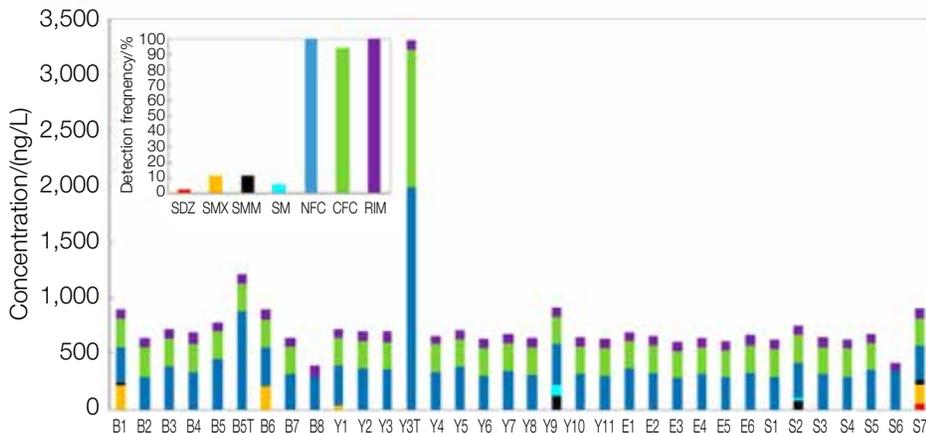


Figure 3-3 Distribution, concentrations and detection frequencies of target antibiotics in coastal waters³

3.4.5 Heavy metals

The naturally occurring heavy metals, including zinc (Zn), copper (Cu), chromium (Cr), lead (Pb), nickel (Ni), arsenic (As), mercury (Hg), and cadmium (Cd), are increasingly present in marine environment as a result of anthropogenic activities. The heavy metals in marine environment are potentially bioavailable and toxic to aquatic biota at high concentrations.

Many laboratory studies revealed potential acute or chronic toxic effects of heavy metals to phytoplankton, zooplankton, fish and benthos. In some coastal regions, the concentration of heavy metals could reach the level of causing toxic effects. The toxic effects of heavy

1 LU J, WU J, ZHANG C, et al. Occurrence, distribution, and ecological-health risks of selected antibiotics in coastal waters along the coastline of China[J]. Science of the Total Environment, 2018, 644: 1469-1476.

2 JIANG Y H, CHU Y B, XIE G S, et al. Antimicrobial resistance, virulence and genetic relationship of *Vibrio parahaemolyticus* in seafood from coasts of Bohai Sea and Yellow Sea, China[J]. International Journal of Food Microbiology, 2019, 290: 116-124.

3 LU J, WU J, ZHANG C, et al. Occurrence, distribution, and ecological-health risks of selected antibiotics in coastal waters along the coastline of China[J]. Science of the Total Environment, 2018, 644: 1469-1476.

metals in marine environment could be modulated by many factors, such as seawater salinity, or content of organic compounds in sediment. For marine animals at high trophic levels of the food web, metals from bioaccumulation and bio-magnification processes are somehow more important than those uptaken from seawater.

In China, prevention and management of heavy metal pollution has been set as one of the key goals of government. The production and consumption of heavy metals however, are still increasing, and metal pollution in the sea will remain an important issue. Using coral skeleton as an indicator, it was found that concentrations of metals Cr, Cu, Cd, Ba, Pb and U in Hainan Island have risen in the recent 140 years. Another study in Liaodong Bay indicated rapid increase of Cd, Hg, Zn and Pb concentrations after the late 1970s. Concentrations of heavy metals in seawater and sediment are generally higher in southern part of the China Seas compared to the northern part, particularly for Pb and As. The coastal regions in the Bohai Sea like Jinzhou Bay, however, have high concentrations of Cd and Hg. In Jinzhou Bay, high concentration of heavy metals may pose potential ecological risks to the marine ecosystem.

3.4.6 Interactions between marine pollution and climate change

Marine pollution mainly occur in the coastal region, with complex interactions with other stressors, such as climate change (including warming and acidification due to increasing level of CO₂), overfishing and habitat losses (Alava et al, 2017; Lu et al, 2018). These stressors could affect food webs, marine ecosystems, and the ecological services simultaneously. Moreover, the processes of climate change are likely to affect the exposure and bioaccumulation of marine pollutants. Studies indicated that, with global warming, exposure of apex predators in arctic to PCBs and mercury may increase due to the retreating of sea ice. The climate change will also affect status of marine nutrient pollution in many different ways. Nutrient input into the sea, for example, is tightly coupled with freshwater discharge, which is driven by regional climate variability and global climate change. Therefore, it's necessary to have a comprehensive understandings on the complex interactions between marine pollution and other stressors like climate change.

3.4.7 Summary

Marine environment are facing increasing impacts from pollution, including nutrients, heavy metals, oil spill, POPs, EDCs, antibiotics, marine litters and MPs. The coastal eutrophication resulted from nutrient pollution is undoubtedly the most severe marine pollution issue in China, and lead to significant ecosystem changes like HABs, hypoxia and other ecosystem changes. EDCs, oil spill and heavy metal pollution will lead to apparent negative

impacts in confined sea area. Consequences of some emerging marine pollution issues, such as MPs or ARGs, only have limited studies so far.

To have a better understanding on the consequences of marine pollution, a holistic, integrated monitoring and assessment of the marine environment needs to be fostered to achieve “Good Environmental Status”. Besides, the complex interactions between marine pollution and other stressors, particularly climate change, required for an integrated approach to evaluate the health status of marine ecosystems, to guide the implementation of marine pollution controlling activities.

3.5 Existing Governance Measure in China on Coastal and Ocean Pollution

The People’s Republic of China, as a contracting party of the relative international conventions, including: UNCLOS, London Conventions, 1996 Protocol, MARPOL Conventions, CBD, FAO Code of Conduct for Responsible Fisheries, Basel Convention, Stockholm Convention, Rotterdam Convention and Minamata Convention, has been working to improve national laws, regulations and policies to fulfil the obligations under those conventions. After 20 to 30 years of construction, China has set up a basic legal and regulatory framework for the conservation of the marine environment and sustainable use of living resources.

The domestic legal sources of China on marine pollution heavily rely on its administrative laws and regulations while some other important provisions are reflected in its civil law, criminal law, procedural law and their judicial interpretations. Policies in particular formulated by the Central Committee of CPC or the State Council despite of their non-legally binding nature may play critical role for marine environmental stake-holders as well, which should not be underestimated.

3.5.1 National Laws

The fundamental legislation in the marine environmental protection area is the Marine Environment Protection Law of PR China (hereinafter referred to as “The Marine Environment Protection Law”). The Marine Environment Protection Law has undergone four amendments (1999, 2013, 2016 and 2017) since its promulgation on August 23, 1982. The law currently has 10 chapters, including General Provisions, Supervision and Control over the Marine Environment; Marine Ecological Protection; Prevention and Control of Pollution Damage to the Marine Environment Caused by Land-based Pollutants; Prevention

and Control of Pollution Damage to the Marine Environment Caused by Coastal Construction Projects; Prevention and Control of Pollution Damage to the Marine Environment Caused by Marine Construction Projects; Prevention and Control of Pollution Damage to the Marine Environment Caused by Dumping of Wastes; Prevention and Control of Pollution Damage to the Marine Environment Caused by Vessels and Their Related Operations; Legal Liabilities and Supplementary Provisions, for a total of 98 articles. The law is PR China's basic law for the protection of marine environment, which provides an overall regulation on pollution control, ecosystem protection and resources conservation. It provides that the administrative department in charge of environment protection under the State Council, shall guide, coordinate and supervise the nation-wide marine environment protection work and be responsible for preventing and controlling marine pollution damages caused by land-based pollutants and coastal construction projects.

The law established many legal systems on the protection of the marine environment. On pollution control, the law set up the marine environmental quality standard system, total quantity control system and regional limits system. For the key sea areas where the State has established and put into practice the system of controlling the total sea-disposed pollution discharge. In key sea areas where the indicators for the control of the total quantity of key pollutants discharged into the sea are exceeded, the environment protection administrative departments shall suspend the approval of the environmental impact reports (forms) for the construction projects which will newly increase the total quantity of corresponding types of pollutants discharged into the sea. Prevention and control of pollution is the core part of the Marine Environment Protection Law, which is stipulated in five chapters separately as: a) Prevention and Control of Pollution Damage to the Marine Environment Caused by Land-based Pollutants; b) Prevention and Control of Pollution Damage to the Marine Environment Caused by Coastal Construction Projects; c) Prevention and Control of Pollution Damage to the Marine Environment Caused by Marine Construction Projects; d) Prevention and Control of Pollution Damage to the Marine Environment Caused by Dumping of Wastes; and e) Prevention and Control of Pollution Damage to the Marine Environment Caused by Vessels and Their Related Operations. The 2016 revision of the law specifically requires that Vessels and their relevant operations shall take effective measures to prevent marine environment pollution, while increasing the provisions "An administrative department of maritime affairs and other relevant departments shall strengthen the supervision and administration of vessels and their relevant operations."

For maritime pollution incidents, the law requires the State to draw up State contingency schemes to cope with major marine pollution accidents.

Besides the laws analysed above, there are some other laws that are closely related to the conservation of the marine environment. The Law on Prevention and Control of Air Pollution regulates the pollution from atmospheric deposition. The Law on Prevention and Control of Water Pollution regulates the land-based pollution by carrying out the discharge standard system, total quantity control system and discharge permit system. And the Law on Environmental Impact Assessment provides the EIA as a useful tool to control the environmental impact of coastal and sea projects etc..

3.5.2 National Regulations

In order to implement the laws issued by the National People's Congress and its Standing Committee, or to regulate the issues which have not been addressed in the current laws, the State Council, administrative departments of central government, local people's congress and local people's government issued about 80 regulations and rules of all levels, which to a large extent enriched the legal system on marine environmental protection.

3.5.2.1 Regulations issued by the State Council

In order to implement the laws issued by the National People's Congress and its Standing Committee or to regulate the issues which have not been addressed in the current laws, the State Council issued about 15 national regulations since the 1980s. Of these 15 regulations, 6 regulate marine pollution from different sources, such as vessel, ship breaking, coastal and marine engineering projects, dumping, oil exploitation. This shows that pollution is the areas that attract more attention of the State Councils.

- Administrative Regulation on the Prevention and Control of Pollution Damages to the Marine Environment by Vessels.
- Administrative Regulation on the Prevention and Control of Pollution Damages to the Marine Environment by Coastal Engineering Construction Projects.
- Administrative Regulation on the Prevention and Treatment of the Pollution and Damage to the Marine Environment by Marine Engineering Construction Projects.
- Regulations of the People's Republic of China on the Control over Dumping Wastes into the Sea Waters.
- Regulations of the People's Republic of China Concerning Environmental Protection in Offshore Oil Exploration and Exploitation.
- Regulations on Prevention of Environmental Pollution by Ship Breaking.

3.5.2.2 Department rules issued by the administrative departments under the State Council

To fulfil the obligations in laws and regulations and carry out the management duties set down by the State Council, the administrative departments which have authorities over the

sea issued about 28 department rules within the last 30 years. Of these 28 department rules, 7 of them are related to pollution control regarding pollution from vessels and related activities, exploitation of offshore oil, and dumping (Table 3-5).

Table 3-5 Department rules issued by the administrative departments under the State Council

No.	Name	Issuing Authority	Date Issued	Effective Date
1	Provisions of the People's Republic of China on the Administration of Prevention and Control of Marine Environmental Pollution by Vessels and Their Operations (2017 Amendment)	Order No. 15 [2017] of the Ministry of Transport	2017.05.23	2017.05.23
2	Provisions of the People's Republic of China on the Administration of Emergency Preparedness for and Emergency Response to Vessel-Induced Pollution to the Marine Environment (2018 Amendment)	Order No. 21 [2018] of the Ministry of Transport	2018.09.27	2018.09.27
3	Measures for the Implementation of the Regulations of the People's Republic of China on the Dumping of Wastes at Sea (2016 Amendment)	Order No. 64 of the Ministry of Land and Resources	2016.01.05	2016.01.05
4	Measures for the Implementation of the Regulation of the People's Republic of China on the Administration of Environmental Protection for Offshore Oil Exploration and Exploitation (2016 Amendment)	Order No. 64 of the Ministry of Land and Resources	2016.01.05	2016.01.05
5	Measures for the Administration of Entrusted Issuance of Licenses for Dumping Wastes into the Sea	Order No. 25 of the Ministry of Land and Resources	2004.10.08	2005.01.01
6	Measures for the Administration of Fishery Pollution Accident Investigation Qualification	Ministry of Agriculture	2004.04.12	2004.04.12
7	Provisions on the Procedures of Fishery Water Pollution Accident Investigation and Handling	Order No. 13 of the Ministry of Agriculture	1997.03.26	1997.03.26

Besides the national laws and regulations, the local coastal provinces and cities have also issued local laws and local regulations on marine environment protection. These laws and regulations have further improved the marine environment protection legal system.

3.5.3 Policy issued by the National and Local People's Governments

The Government of PR China has issued a variety of national policies and launched a number of projects to protect the marine environment, implement laws and regulations and comply with its obligations under the international conventions. Many of the policies and projects can be found in plans developed by national and local governments. The general plan developed by the National Development and Reform Commission (NDRC) under the State Council is the Five-Year Plan for Economic and Social Development of the People's

Republic of China. There are also plans focused on a specific area, for example, the National 13th Five-Year Plan for Protection of Ecological Environment developed by the MEE. The National 13th Five-Year Plan for Marine Economy Development by the NDRC and State Oceanic Administration. Local government, according to the national plan and based on their own situations, may develop specific plans, for example, the 13th Five-Year Plan for Marine Development of Jiangsu Province, Marine Ecological Red Line Protection Plan of Jiangsu Province (2016—2020).

Governments at various levels strictly control the land-based pollutants discharged into the sea, only if they meet both the discharge standards and the total amount of pollutants that can be discharged. Governments are working on the establishment of an early warning mechanism to prevent the pollutants discharged from exceeding the carrying capacity of the marine environment.

The Nearshore Pollution Control Plan is implemented to improve the quality of ecological environment in estuary and nearshore areas. The target of the plan is to eliminate the land-based discharge from rivers whose water quality fall below Grade 5 in coastal provinces before the year 2020.

Thirteenth Five-Year Plan for National Economic and Social Development of the People's Republic of China clearly proposes the implementation of the “Blue Bay” remediation project, the “South Mangrove and North Tamarix” wetland rehabilitation project and the “Ecological Island” restoration project. The implementation of the “Blue Bay” remediation project will optimize the production, ecological and living space layout of the bay and coastal wetlands, control the discharge of land-based pollution, strengthen the ecological improvement and restoration of the bay, and create beautiful seascape of the bay. The project will accelerate the restoration of coastal wetlands and beaches, and to stop the degradation and loss of coastal wetlands in China. The ecosystem services of the bay and coastal wetlands will be enhanced.

The Action Plan for the Comprehensive Management of the Bohai Sea requires the improvement of the ecological environment quality of the Bohai Sea as the core target. For major actions including land-based pollution control action, sea-based pollution control action, ecological protection and restoration action, and environmental risk prevention actions will be implemented and the Bohai Sea ecological environment will be ensured to be no longer degraded. By the end of 2020, 73% of the coastal waters in Bohai Sea will attain the good sea-water quality (Class 1 and Class 2 sea-water quality) requirements, the natural shoreline retention rate will remain at around 35%, the coastal wetland remediation and restoration area will be no less than 6,900 hectares, and the coastline remediation is about 70

kilometres.

3.5.4 Institutional development

(1) Ecological civilization

Ecological civilization was listed along with economic, political, cultural and social progress as one of the five goals in the country's overall development plan at the 18th National Congress of the Communist Party of China in 2012. Respect, protect, and stay in tune with nature. Ecological conservation is vital not only to sustained, healthy economic development, but also to political and social progress, and must therefore be given a position of prominence and incorporated into every aspect and the whole process of economic, political, cultural, and social development. See that mountains, waters, forests, and farmlands are a community of life. Based on the integrity and systemic nature of ecosystems and the way they work, it is necessary to take into consideration all the elements of the natural ecosystem – both hills and their surrounding areas, both above and under the ground, both land and sea, both upper and lower river basins—and work to protect them in their entirety, restore them systematically, and take a comprehensive approach to their governance in order to preserve ecological balance by strengthening the ability of ecosystems to circulate. The 13th Five-Year Plan period is crucial for China to accelerate eco-civilization construction and to complete the construction of the moderately prosperous society. The key tasks include developing green economy to promote economic transformation and upgrading, improving efficiency of energy and resource to build environment-friendly and resource-efficient society, implementing ecological construction projects to promote ecosystem services capability, solving outstanding environmental problems that threaten people's health, setting and strictly observe ecological red line, promoting new-type urbanization to coordinating urban and rural development, carrying out national ecological assets accounting and building up monitoring platform for ecological assets. China set up several goals for marine eco-civilization to be achieved during its 13th Five-Year plan (2016—2020). During the 13th Five-Year period, more than 2,000 km shoreline and 66 bays will be remediated, more than 85km² coastal wetland will be restored. Expansion of the MPA coverage in the sea areas under national jurisdiction is to 5%.

(2) Gulf chiefs

China has been launching new mechanism to protect marine ecology. China has initiated a pilot mechanism of appointing “gulf chiefs” to tackle pollution on coastlines and offshore areas. The protection mechanism for maritime pollution control outlined by the State Oceanic Administration(SOA) is similar to the approaches of “river chiefs” and “lake chiefs” which have been widely adopted nationwide since 2016 and have achieved visible

results in combatting pollution. Under the mechanism, top officials at provincial, city, county, and township levels are appointed as chiefs, accountable for the effects of water pollution control. The SOA selected the province of Zhejiang and cities of Qinhuangdao, Qingdao, Lianyungang, and Haikou to pilot the gulf-chief mechanism at the start of 2017. The pilot should be extended and expanded in the near future, and a national standard system to evaluate the work of gulf chiefs should be established based on the pilot results.

(3) Ecological redlines

In 2017, China issued “Several Opinions on Delineating and Strictly Protecting the Red Line of Ecological Protection”, pointing out that the improvement of the quality of the ecological environment and the conservation of the ecological function is the core targets. Given the need for systematic governance of mountains, forests, farmland, rivers, and lakes, the ecological protection red line will be delimited and strictly guarded. The red lines will governance the important ecological space and ensure the ecological service not degrading, area not reducing, nature not changed. By the end of 2020, the national red line of ecological protection will be fully defined, and the red line system of ecological protection will be generally established. The ecological space of the country will be optimized and effectively protected, the ecological function will remain stable, and the national ecological security pattern will be more perfect. By 2030, the layout of the ecological protection red line will be further optimized, the ecological protection red line system will be effectively implemented, the ecological function will be significantly improved, and the national ecological security will be fully guaranteed. The marine ecological red line system refers to the institutional arrangements for the maintenance of marine ecological health and ecological security, defining important marine ecological functional areas, ecologically sensitive areas and ecologically vulnerable areas as key control areas and implementing strict classification and control. The Nearshore Coastal Pollution Prevention and Control Program requires that the ecological protection red line area of the coastal waters be no less than 30%.

3.5.5 Gaps in the current laws and policies

Although laws and policies have been much improved in the last ten years, there are still some existing gaps which prohibit China from fully implementing its obligations in the international conventions and protect its marine environment and resources.

(1) Lack an integrated ecosystem-based view. The ecological character of a marine ecosystem determines that the ultimate goal of conservation and management is to maintain its ecological integrity. This requests that any of the conservation and management activities must be designed based on or derived from an ecosystem-based point of view. Although the

principles of “determine the land-based discharge amount based on the carrying capacity of the sea” and “promote land and marine development in a coordinated way” have been raised frequently as the guiding principles for major national policies, due to the limitation of the administrative system, these principles have not been implemented well. The current laws, regulations, policies and plans are enacted based on administrative sectors with inadequate communication and coordination among each other.

(2) Lack of laws in protection of resources and ecosystem. After the examination of current environmental laws and policies, it was found that in China, laws and policies in pollution control were relatively well developed, while laws and policies in the protection of resources and ecosystem are relatively weak. For example, lack of a national wetland law or regulation remains a challenge for China’s wetland conservation, especially for establishing the institution of specific mechanisms for wetland management, including those related to conservation concession, ecological compensation, supplementing water supply, and water pollution treatment. The prevention and control of marine debris has been focused on more frequently by the international community in recent years. As to the Marine Environment Protection Law, the articles relative to marine ecosystem protection which occupied only 10% is rather limited comparing with the articles concerning the control and prevention of marine pollution. The limited ratio is inconsistent with the requirements of ecological civilization progress. Although China has a set of legal systems in prevention and control of all kinds of marine pollution and a national law regulating solid waste which is the major pollutant source for marine debris, the regulation of marine debris hasn’t been well established, because the current solid waste legislation hasn’t been integrated with the coastal zone management laws and policies. The legal system to prevent and control marine debris needs to be strengthened in the coastal zone management laws.

(3) Lack of detailed implementation rules. After more than 30 years of legal construction since the issuance of the Marine Environmental Protection Law in 1982, the legal framework offering a rough line to protect the marine environment, and utilization of natural resources has been established. But many legal systems are very general with no implementation rules followed, which to a large extent influenced the implementation effect. This left the law a big room for improvement.

(4) Lack of a cross-sector implementation mechanism. As the “global” feature of environmental problems gets more and more apparent and the interaction among these problems goes deeper within an ecosystem, the issues discussed recently by the international environmental conventions intersect with each other, especially climate change, wetland degradation, biodiversity loss, fishery resources depletion, etc.. Yet in China, the

responsibilities to implement international conventions are assigned to different administrative sectors based on their duties with no or not enough coordination in implementations. Different implementing bodies separately carry out the rights and obligations for China as a participating country under international conventions. The disadvantage of this system is that the resources spent by the implementation bodies can't generate synthetic effects, therefore, lots of duplication in efforts and activities existed, causing a waste of limited administrative resources.

3.6 Ongoing National and International Ocean Initiatives to Combat Ocean Pollution

By 2050, the planet will need to provide food, health, jobs and energy to sustain a population of 9 billion people. A healthy ocean is essential to life on Earth, from the smallest plankton to the largest marine mammals, and is the underpinning of ecosystems and human well-being. It is estimated that some 40 percent of the global population live within coastal communities and 3 billion people rely on the ocean for their livelihoods. As our dependency on ocean increase, so have political engagement and various policies and initiatives have been and are under development to combat marine pollution.

3.6.1 International measures

3.6.1.1 Global ocean governance framework and international legal instruments

Multiple international institutions, legal frameworks exist at global level for ocean governance, including mechanisms to target marine pollution. In table 3-6 an overall overview of legal and institutional frameworks can be found.

Table 3-6 Legal and institutional framework

International Institutions
International Maritime Organization
The International Seabed Authority
The World Trade Organisation
The Food and Agriculture Organization
The World Bank/Global Environment Facility
UN Development Programme
Legal framework at the global level
United Nations Convention on the Law of the Sea (UNCLOS)
Agreement relating to the Implementation of Part XI of UNCLOS
The United Nations Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea of 10 December 1982 relating to the Conservation and Management of Straddling

Legal framework at the global level

Fish Stocks and Highly Migratory Fish Stocks (the Straddling Stocks Agreement)
 The Convention on Biological Diversity
 The United Nations Framework Convention on Climate Change (UNFCCC)
 The Kyoto Protocol
 The Paris Agreement
 FAO instruments
 The 1993 FAO Agreement to promote Compliance with International Conservation and Management Measures by Fishing Vessels on the High Seas
 The 1995 FAO Code of Conduct for Responsible Fisheries
 IMO treaties
 The Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972
 The 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter
 The Convention on Migratory Species
 The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
 The Stockholm Convention on Persistent Organic Pollutants
 The Minamata Convention on Mercury
 Proposed international legally binding instrument (on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction)
 The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities

Many of those instruments are relevant to marine pollution. UNCLOS is the global legal framework for ocean governance, there are two implementing agreements, on deep seabed mining and highly migratory fish stocks respectively under UNCLOS. A third Implementing Agreement on the conservation and sustainable use of marine biological diversity of areas beyond national jurisdiction (BBNJ) is currently under negotiation and is expected to be finalized in 2020.

Part XII of UNCLOS deals with “Protection and preservation of the marine environment” and requires states to take all measures necessary to prevent, reduce and control pollution of the marine environment from any source. These measures aim to minimize to the fullest possible extent the release of toxic, harmful or noxious substances.

Furthermore, part XII includes detailed provisions on land-based sources of pollution, pollution from vessels, seabed activities, dumping, and pollution from or through the atmosphere.

The other central global governance mechanisms relevant to marine pollution include the target 14.1 under the UN Sustainable Development Goals (SDGs) 14: By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution.

The UN Environment Assembly (UNEA) has adopted several resolutions that relate to marine pollution¹.

International Maritime Organization (IMO) and the International Convention for the Prevention of Pollution from Ships also provide stipulations for marine pollution from the shipping industry.

The Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) was adopted in 1995. The Program is currently under review but its mandate focuses on marine pollution in relation to three sources: nutrient, litter, and wastewater. Details of these framework at global levels can be found in the Annex.

3.6.1.2 Emerging global concepts for tackling marine pollution

Many concepts for ocean governance have emerged and been accepted at global or regional levels, notably, blue economy, circular economy, and the source to sea approach.

(1) Blue economy

The concept of “Sustainable Blue Economy” provides a useful approach to examine and address the relationship between ocean-based economic activity and the impact of a changing marine environment. The key opportunity is ensuring that economic activities in the ocean are undertaken without undermining the very ecological assets from which ocean wealth is derived. To further enhance an effective and comprehensive ocean and coastal management, there is a need for each actor to define their role in the ocean space. Other than President Xi Jinping’s reiteration of the concept of blue economy, some of the progress in this regard are:

- The Kenya government held the first sustainable blue economy conference in Nairobi from 26 to 28 November 2018, attracting 18,000 participants from 184 countries around the world.
- A group of Heads of State and government have created a High-Level Panel for a Sustainable Ocean Economy² to “catalyse bold, pragmatic solutions for the ocean”.
- In September 2018, the World Bank announced the creation of “PROBLUE” a multi-donor trust fund to support SDG14, addressing marine pollution, overfishing, coastal

1 General Assembly Resolution 71/312: Our ocean, our future; United Nations Environment Assembly resolution 2.12 on Sustainable coral reefs management; UNEA resolution 2/11 Combating marine plastic litter and microplastics, an assessment of the effectiveness of relevant international, and resolution 3/7, on marine litter and microplastics, resolution 4/L7 on marine plastic litter and microplastics and resolution, 4/L12 on protection of the marine environment from land-based activities.

2 IISD. Heads of State and Government Form Panel to Support Sustainable Ocean Economy, 2018. http://sdg.iisd.org/news/heads-of-state-and-government-form-panel-to-support-sustainable-ocean-economy/?utm_medium=email&utm_campaign=2018-09-27%20-%20SDG%20Update%20AE&utm_content=2018-09-27%20-%20SDG%20Update%20AE+CID_01f07018f6597500dc479b31b110422a&utm_source=cmandutm_term=Heads%20of%20State%20and%20Government%20Form%20Panel%20to%20Support%20Sustainable%20Ocean%20Economy.

erosion and sustainable growth of coastal economies.

- The UN Global Compact’s “Action Platform for Sustainable Ocean Business” (UN Global Compact)¹ includes 35 of the world’s largest companies, banks and investment funds, all of whom are leaders in the sectors in which they operate.

(2) Circular economy

Targeting marine pollution needs to be done from both an upstream and downstream approach. Focusing on the upstream approach, includes stopping pollution at its source. As more and more governments are taking action on marine litter and single-use plastic, the concept of “circular economy” has gained increasing attention. The approach aims to redefine growth, focusing on positive society-wide benefits. It entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. Underpinned by a transition to renewable energy sources, the circular model builds economic, natural, and social capital. It is based on three principles: Design out waste and pollution; Keep products and materials in use; Regenerate natural systems². The European Commission adopted a new set of measures in January 2018 as part of its effort to transform Europe’s economy into a more sustainable one. Hence EU took action to implement a Circular Economy Action Plan. The measures include EU Strategy for plastics in the Circular Economy, options to address the interface between chemical, product and waste legislation, a monitoring framework on progress towards a circular economy and a report on critical raw materials and the circular economy³.

(3) Source to Sea approach

A “Source to Sea Approach” will be crucial to addressing land-based activities and pollution. The concept links the land-based with the marine and coastal pollution. Several factors that can affect ecosystems downstream, in the coastal zones and in marine environments, originate from upstream developments on land and along rivers. These include direct sources from production on land such as agriculture, industrial activities, forestry and energy production and through indirect sources such as consumption. In addition, there are several pressures at sea derived from fisheries, transports, extraction of non-living-resources (mining, sand, oil and gas) that affect the marine environment. It may also have effects on coastal zones and upstream in deltas and rivers.

1 United Nations Global Compact (UN Global Compact), Action Platform for Sustainable Ocean Business, <https://www.unglobalcompact.org/take-action/action-platforms/ocean>.

2 Ellen Macarthur Foundation, Concept of circular economy. <https://www.ellenmacarthurfoundation.org/circular-economy/concept>.

3 European Commission, Environment, Implementation of the Circular Economy Action Plan http://ec.europa.eu/environment/circular-economy/index_en.htm.

The above challenges, together with climate change and increasing needs of water, food and energy, call for new forms of holistic and integrated management approaches that take the whole continuum from source to sea into consideration. Policies and management systems need to allocate water between sectors and downstream/upstream users, secure reliable delivery and adequate water quality, and protect people and the environment from hazards and degradation of ecosystems. Hence integrating complex economic, social and environmental aspects and dimensions with a source to sea approach is a necessity to achieve sustainable development (Swedish Agency for Marine and Water Management).

3.6.1.3 Global actions targeting different types of pollutants

(1) Nutrients

There are great varieties of nutrient used globally. In some places there is an excessive use of nutrients, and in other regions, there is insufficient use. The main point is that the efficiency of nutrient use is very low on a global scale¹. Livestock manure is one of the major contributors to nutrient pollution. The United States has a zero-discharge system, if applied properly, treating manure can result in zero nutrient emissions into surrounding freshwater systems. As China is among the world's largest producers and consumers of beef, mutton and dairy, and due to the lack of systematic nutrient management planning, most manure generated by large operations is released to the environment without treatment.

A project titled “the GEF-Global foundations for reducing nutrient enrichment and oxygen depletion from land-based pollution”, in support of Global Nutrient Cycle, has contributed to the development and application of global-level quantitative modelling approaches, to estimate and map present day contributions of different watershed-based nutrient sources to coastal nutrient loading and their effects, to estimate the magnitude of impact of further nutrient loading on coastal systems under a range of scenarios.

(2) Wastewater

On average, high-income countries treat about 70% of the wastewater they generate, but globally, over 80% of all wastewater (over 95% in some developing countries) is discharged without treatment.

The Global Wastewater Initiative is a voluntary multi-stakeholder partnership working to address wastewater-related issues, prompt coordination and encourage investments in wastewater management.

Through the Global Coral Reef Partnership and the Global Wastewater Initiative, a Policy Brief titled “Wastewater Pollution on Coral Reefs”, with focus on the impact of

¹ Olha Krushelnytska, Solving Marine Pollution, Successful models to reduce wastewater, agricultural runoff, and marine litter, September 2018.

wastewater on coral reefs to support the health and resilience of coral reefs has recently been developed.

Moreover, UN Environment and The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden (PERSGA), one of the Regional Seas Programmes, developed a Manual for Monitoring Indicators of the Impact of Wastewater Discharge on Coral Reefs with the goal of collecting objective information on the value of coral reefs to provide evidence for advocacy of action leading to more effective management. It is also organizing a series of webinars, the overall objective of which is to enhance the understanding and recognition of wastewater as a resource as well as to expand knowledge generation, awareness raising and outreach on crucial issues related to sustainable wastewater management.

The Guidelines on Municipal Wastewater management propose sustainable wastewater management, and ten key mechanisms were pointed out, including securing domestic financial resources, developing integrated urban water supply and sanitation managing systems also addressing environmental impacts, adopting a long-term perspective and taking action step-by-step, and selecting appropriate technology for efficient and cost-effective use of water resources and consider ecological sanitation alternatives.

(3) Marine litter

Today, nothing has captured public in the way that plastic pollution has done. It is therefore unsurprising that many initiatives to address the problem have been launched to address it. The main mechanism that captures the interest of public and government officials are campaigns and various outreach activities to raise awareness. This have laid the foundation to build up a global momentum and encourage various stakeholders to take action on their own:

- Global Partnership on Marine Litter (under UN Environment);
- UN Environment’s Clean Seas campaign;
- Charlevoix Ocean Plastics Charter;
- G7 Marine Plastic Litter Innovation Challenge;
- Commonwealth Blue Charter Action Group on Marine Plastics (also known as “Commonwealth Clean Oceans Alliance”);
- Communities of Ocean Action, implementation of SDG14.1 (marine pollution);
- Ad Hoc Open-Ended Expert Group on Marine Litter.

The following additional initiatives have a broader scope than marine litter and consider the need for a circular economy approach to plastics, they are worth mentioning here as they provide a key solution to marine litter:

- Global Plastics Platform (European Union and UN Environment);
- The New Plastics Economy Global Commitment (IISD, Plastics Economy);
- European Strategy for Plastics in a Circular Economy (EU Plastics Strategy).

Working in partnership with key stakeholders to drive the action on pollution, support member states to take concrete action will be crucial to be able to address the urgency of the issue.

In accordance with UNEA resolution 3/7, on marine litter and microplastics, the first meeting of the ad hoc open-ended expert group was convened in May 2018, three options were proposed:

- maintain the status quo and continue current efforts;
- revise existing frameworks to better address marine plastic litter and microplastics;
- develop a new international architecture with a multi-layered governance approach.

Due to the failure of the current fragmented and uncoordinated regime to combat marine plastic litter and microplastics, the focus has been on options of a revised and strengthened framework (option 2) or a new framework (option 3).

The second ad-hoc meeting was held in December, the outcome of the discussions among government experts are:

- the need for a holistic and evidence-based approach for circular management of plastic;
- prevention as the priority, and the usefulness of exploring the potential of existing framework (Multilateral Agreements);
- need for strengthened science-policy interface and a source to sea approach;
- extended producer responsibility;
- information exchange;
- circular economy and full life-cycle approach;
- consider the possibility of a global legally binding instrument;
- setting up interim coordinating structure were also discussed at the meeting.

A resolution on marine litter was adopted at the fourth UNEA held in March 2019, in addition, the national source inventory and monitoring methodologies are being developed for marine litter.

In February of 2017, UN Environment's ambitious Clean Seas campaign was launched. Through the campaign, they are driving forward a global movement to take an active role in reducing ocean bound plastic pollution. To do so, Clean Seas connects individuals, civil society groups, industry and governments to transform habits, practices, standards and policies around the globe to dramatically reduce marine litter and the harm it causes. By December 2018, 54 countries have committed to the campaign.

A systemic approach to address marine plastics requires a fundamental system shift from a linear plastics economy to a circular economy by taking actions across the whole value chain, at the design, production, consumption, waste management, as well as mitigation phases. There have been such initiatives focusing on solutions across the whole life cycle of plastics, with the objective of reaching a circular plastics economy. The Global Plastics Platform, launched by UN Environment with the European Commission and other governments, is a partnership between UN Environment, national governments and regional organizations. It aims to facilitate dialogue and exchange among governments at the highest level, on their experiences, successes and lessons learned in addressing plastics pollution through a sustainable consumption and production approach. The work of the Global Plastics Platform is organized in five streams: a) policy, around which the other streams are articulated; b) circularity, innovation and technologies, c) education and advocacy, d) finance, and e) research. All stakeholders can be involved through these five streams. These streams build on the extensive experience of UN Environment in the area of sustainable consumption and production, e.g. the GEF-Funded project “Addressing Marine Plastics. A systemic approach” and its reports (GEF Marine Plastics publications). The activities of the platform contribute to ongoing discussions among G20 countries on marine litter and resource efficiency. The New Plastics Economy Global Commitment, led by Ellen MacArthur Foundation in collaboration with UN Environment), unites businesses, governments, and other organisations sharing the common vision of a circular economy for plastics and targets to address plastic pollution at its source. As of March 2019, over 350 institutions (New Plastics Economy Global Commitment) have signed the New Plastics Economy Global Commitment, including 16 governments from around the world, more than 150 businesses of the plastic packaging value chain (jointly representing over 20% of all plastic packaging used globally), and 26 financial institutions with a combined USD 4.2 trillion worth of assets under management¹.

(4) Antibiotics

Antibiotics and pharmaceutical residues in general in the oceans are causing concern as the full impact for the marine environment is still unknown, it is a new emerging area with much work to be done at both national and regional levels. So far, the Baltic Region has made more progress on that topic.

In the Baltic Sea region, a Pharma platform has been initiated in November 2017, it brings together projects and stakeholders from the whole regional to assist knowledge-

¹ IISD, Over 290 Companies Sign Global Commitment on New Plastics Economy, <http://sdg.iisd.org/news/over-290-companies-sign-global-commitment-on-new-plastics-economy/>.

sharing, increase effectiveness, streamlining activities and support regional policy development. It will mainly focus on non-regulatory solutions, such as new technical and management options, and encompass three inter-linked columns: projects, supporting activities such as extended stakeholder networks and regional status reports, and policy development¹.

3.6.1.4 Regional Seas Programmes

More than 143 countries have joined 18 Regional Seas Conventions and Action Plans for the sustainable management and use of the marine and coastal environment. In most cases, the Action Plan is underpinned by a strong legal framework in the form of a regional Convention and associated Protocols on specific problems.

The Regional Seas Framework provides an ideal setting for:

- Applying ecosystem-based management approaches towards governance of our common ocean;
- Ensuring regional strategies are designed to implement and enhance conservation and sustainable use (the blue economy);
- Developing innovative partnerships or governance mechanisms to realize sustainable regional blue economies; and
- Developing regional strategies for ocean governance, based on the sustainable blue economy principles and existing framework(s).

3.6.2 National measures

3.6.2.1 Examples of national measures

Realising the negative impact of marine pollution, countries all over the world have taken action to curb marine pollution, some examples:

Singapore utilises both legislative controls and administrative measures to control marine pollution from land-based sources. For example, the National Environment Agency (NEA) administers the Environmental Protection and Management Act (EPMA), which provides for the protection and management of the environment through controlling the discharge of trade effluent, oil, chemical, sewage or other polluting matters into the environment. The EPMA also ensures proper management of hazardous substances in an environmentally sound manner. Another example is the control of soil pollution, since pollutants in the soil are likely to make their way into the water system as run-off or groundwater. Other upstream controls

¹ Swedish EPA, A regional cooperation platform to reduce pharmaceuticals in the Baltic Sea, <http://www.swedishepa.se/Environmental-objectives-and-cooperation/Cooperation-internationally-and-in-the-EU/International-cooperation/Multilateral-cooperation/Baltic-Sea-Region-EUSBSR/Policy-Area-Hazards/A-cooperation-to-reduce-pharmaceuticals-in-the-Baltic-Sea/>.

implemented by NEA include a) integrated solid waste management system; and b) anti-littering as well as waterways clean-up measures ensuring that land-based litter, including plastic waste, that might otherwise wash into the ocean is prevented from doing so.

NEA also works with partners from the People, Private and Public (3P) sectors on initiatives that contribute to reduce the generation of land-based solid waste, such as the Singapore Packaging Agreement. This voluntary Agreement is an initiative undertaken by the government, industry and non-governmental organisations, to reduce packaging waste.

South Africa has set up a permanent Oceans Economy Ministerial Management Committee which reports to the Vice-President and coordinates with ocean-related departments, so that more effective cross-sectoral ocean governance can be achieved.

The Kenyan government organized the first Sustainable Blue Economy Conference from 26 to 28 November 2018. Over 18,000 participants from around the world are coming together to learn how to build a blue economy that: Harnesses the potential of our oceans, seas, lakes and rivers to improve the lives of all, particularly people in developing states, women, youth and Indigenous peoples, and leverages the latest innovations, scientific advances and best practices to build prosperity while conserving our waters for future generations.

In Sweden, the 2020 interim targets of the protection of land, freshwater and marine areas include at least 20% of Sweden's land and fresh water areas and 10% of Sweden's marine areas by 2020¹. This will be achieved through protection or other conservation measures in areas of particular importance for biodiversity and ecosystem services. The formal protection of lakes and rivers will be increased by at least 12,000 hectares and the formal protection of marine areas will be increased by at least 570,000 hectares. Through the development and strengthening of green infrastructure, the ecological relationships are strengthened so that sheltered and preserved areas and habitats are connected and integrated into the landscape, including the marine environment (RAMSAR Convention, National report)². The EU Marine Strategy Framework Directive is being implemented in Sweden. The directive was transposed into Swedish legislation through the Marine Environmental Regulation in 2010.

Canada has an Oceans Strategy is the Government of Canada's policy statement for the management of estuarine coastal and marine ecosystems³. It commits to promoting institutional governance mechanisms, implementing integrated management planning to

1 Swedish Agency for Marine and Water Management, the concept of Source to Sea, <https://www.havochvatten.se/en/swam/eu-international/international-cooperation/the-concept-of-source-to-sea.html>.

2 National Report on the Implementation of the RAMSAR Convention on Wetlands, Sweden, 2015. <http://archive.ramsar.org/pdf/cop12/nr/COP12NRFSweden.pdf>.

3 Canada's Oceans Strategy. <http://www.dfo-mpo.gc.ca/oceans/publications/cos-soc/index-eng.html>.

engage partners in the planning and managing of ocean activities and promoting stewardship and public awareness (Canada's Oceans Strategy).

3.6.2.2 Ban and other policies on plastics

The State of Plastics released for 2018 world environment day looked at measures on plastics, including levies, voluntary agreements, total bans, and combined bans and levies, in this report UN Environment has drawn up a 10-step roadmap for governments to follow should they seek to adopt similar measures or improve on current ones. Governments need to curb the amount of plastic waste dumped into the environment and create an incentive to promote the use of bags, enforcement of regulation needs to be strengthened, and alternatives be promoted. As of July 2018, one hundred and twenty-seven out of 192 countries have adopted some form of legislation to regulate plastic bags¹. Special measures have been taken by countries have made a direct impact on actions against marine pollution.

The European Parliament has approved a ban on single-use plastics such as straws, plates, cutlery and cotton-swab sticks in Europe by 2021. The use of other plastics such as single-use burger and sandwich boxes that do not have practical alternatives at this point will be reduced by at least 25 percent by 2025, and 90 percent of beverage bottles will be recycled, under the proposal.

The United Kingdom has implemented a surcharge for getting plastic bags while shopping, while Kenya has gone so far as to punish plastic bag users with penalties up to a \$40,000 fine or a four-year jail sentence.

Indonesia plans on reducing plastic litter 70% by 2025.

Uruguay announced it will initiate a tax on single-use plastic bags later in 2018.

Costa Rica will make efforts to reduce plastic waste by increasing proper waste management measures (legislation) and education.

3.6.3 Summary

Several challenges are facing global oceans: inadequate knowledge; ineffective sector/cross-sector policies, cooperation and governance systems; inadequate solutions and incentives to enable and encourage resource efficiency and circular economy approaches; and insufficient public and private financing. Multiple global legal and institutional framework for ocean governance exist but is fragmented, and mostly sector-specific. To achieve integrated ocean governance, some concepts such as Blue Economy, Circular Economy, and Source to Sea Approach, are emerging and applied by countries.

¹ UNEP Legal Limits on Single-Use Plastics and Microplastics: A Global Review of National Laws and Regulations. https://wedocs.unep.org/bitstream/handle/20.500.11822/27113/plastics_limits.pdf?sequence=1&disAllowed=y.

Actions have been taken at the global level to target marine pollution such as nutrients, wastewater, marine litter and antibiotics. It is worth noting that two sessions of Ad Hoc Open-Ended Expert Group on Marine Litter and Microplastics have been held, and it was decided that the process will continue at the fourth UNEA; under UNCLOS, the Intergovernmental Conference on Marine Biodiversity of Areas Beyond National Jurisdiction is underway to discuss a possible third Implementing Agreement under UNCLOS. Initiatives aiming to promote a circular economy for plastics at global level such as the Global Plastics Platform and the New Plastics Economy Global Commitment, will also contribute to addressing marine plastic pollution from its root. At the regional level, the Regional Seas Programmes are playing key roles to curb marine pollution; and mandated by the African Ministerial Conference on the Environment, an African Ocean Governance Strategy is under development. At national levels, initiatives are taken to tackle marine pollution, including marine plastics. Marine pollution and Ocean governance are now high on the agenda at global, regional and national levels.

3.7 Policy Recommendations

The agricultural and industrial achievements of the past two centuries in feeding, clothing and housing the world's population have come with the price of seriously degrading important parts of the planet, including much of the marine environment, especially near the coast. Often, while production and emission to a large degree is land-based, the marine environment is in fact the end recipient. In addition to the well-known eutrophication effects from terrestrial nutrient input, the globally growing plastic pollution challenge is another prime example of such interactions.

That is the same case in China. In the 40 years following the Chinese economic reform and opening policy, China has formed a coastal ribbon of high economic development, which has brought with it population density and urbanization. Coastal and marine ecosystems are subject to tremendous ecological damage and land-based pollution pressures while supporting coastal economic development. The ability to sustain development has declined significantly. More than 70% of nutrients discharged into the sea are from land-based origins, and these and other sources of pollution being leached into the marine environment have led directly to a decline in marine water, sediment and biological quality. Beyond the obvious direct link to marine water quality, the volume of pollutants discharged into the sea has a direct connection to huge economic costs tied to marine fisheries, marine tourism, and human health and safety. Marine pollution also causes environmental degradation, the decline in biological diversity,

and the loss of ecosystem services, each of which may be difficult to account for in monetary terms but is significant nonetheless.

Recently, China has made full use of the substantial foundation accumulated over the past 40 years of economic reform, and step up efforts to promote ecological civilization construction. Pollution control is one of the three tough battles which Chinese government must win. At present, the China's environmental quality has been going to improve. In order to further pursue a path of harmony between people and the ocean, promote conservation and green development of the oceans, enhancing ocean-based prosperity, the policy recommendations are proposed to address marine pollution control and prevention.

3.7.1 Establishing a holistic mechanism of land-sea coordination in joint marine pollution prevention and control

(1) Significantly enhance the land-sea ecological environment monitoring unity. In accordance with the principle of land-sea coordination and the unified plans, optimize the construction of a fully covered and refined marine ecological environment monitoring network, strengthen gridded and real-time monitoring, and develop the online monitoring for the primary rivers and outlets discharging and atmospheric deposition of pollutants into the sea. Establish a baseline survey/census system for marine pollution.

(2) Enhance management and prevent land-based pollution from the agricultural, pharmaceutical sectors. Full consideration should be given to improving overall agricultural production capacity and to preventing and controlling rural pollution. Development of environmental protection facilities, such as those for handling rural wastewater and refuse, should be bolstered by subsidies from governments and village collectives, fee payments from residents, and the participation of non-government capital. A variety of assistive measures should be adopted to foster and develop market entities for the control of all types of agricultural pollution from non-point sources and for the handling of rural wastewater and refuse. Green production way in agriculture should be pursued to promote making full use of agricultural wastes. According to the market-based rules, a green finance system is encouraged to support the pilot of disposal and harmless treatment of livestock and poultry breeding. Comprehensive utilization of livestock and poultry manure might be gradually achieved on the spot. Subsidies for the production of organic fertilizers from the comprehensive utilization of livestock and poultry manure need to be increased, and simultaneously subsidies for chemical fertilizer to be reduced. The management of antibacterial drugs used for human and animals should be strengthened. Proper procedures should be introduced to restrict the use of chemicals such as antibiotics in accordance with

the law, and prohibit the abuse of antibiotics.

(3) Further improve China's marine environmental quality target system. China's marine environmental quality target system is mainly based on water quality targets, which are often expressed by the under-criteria rate of marine functional zoning or clean water (below the criteria of grade I, II). Suggest to further enrich the content of China's marine environmental quality target system, in addition to the water quality target, the spatial and temporal distribution characteristics of marine ecosystems need to be combined, further increase marine ecological protection target, such as the biodiversity, habitat suitability, ecosystem structure and function, etc., lay the foundation and direction for the marine ecological protection work. Strengthen the connection of sorting, indices selecting, and valuing of water quality standards between surface water and seawater, and introduce new indices such as total phosphorus, total nitrogen, and emerging pollutants. Advance seawater quality standards revision. Take a holistic approach for emissions control and water quality target management in the river basins and offshore areas.

(4) Construct an integrated governance mechanism for the River Chief and Bay (Beach) Chief systems. In accordance with the holistic approach to conserving our mountains, rivers, forests, farmlands, lakes, and grasslands, strengthen coordination of the comprehensive management of rivers discharging into sea, bay and estuarine. Establish a joint-action mechanism between the River Chief System and Bay Chief System, set a regular consultation mechanism and emergency response mechanism, and enhance the capability of pollution prevention and control in a holistic approach for land and sea.

3.7.2 Strength lifecycle management for plastics, and formulates a national action plan for marine debris pollution prevention and control

(1) Strengthen the source control of plastics debris. Explore the waste reduction and harmless management pattern in line with national conditions, and effectively prevent the entry into marine environment of microplastics and plastic waste resulting from the manufacturing production and individual consumption process, severe weather events and natural disasters in coastal regions. Strengthen the management of plastic nurdle, and put on file and supervise of the process of "resin nurdles - plastic products - usage and circulating of commodity". Encourage extended producer responsibility (EPR) and related mechanisms. Promote EPR mechanisms to involve producers, importers and retailers in the establishment of resource-efficient product value chains from the design to the end-of-life treatment and in financing waste collection and treatment. Forbid to produce and sell personal care products containing plastic micro-beads. Introduce technologies in washing machines to better capture

fibres from wash-loads in both domestic and commercial/industrial uses.

(2) Support integrated sustainable waste management. Improve and developing national waste regulatory frameworks, including legal framework for EPR, and taking care for enforcement and governance. Support capacity development and infrastructure investments for improved waste management systems in cities and rural areas through existing instruments, and promote access to regular waste collection services and facilitate investments in waste management infrastructure in order to prevent plastic waste leakage into the sea. Establish sufficient waste reception facilities at harbors in coastal cities in order to allow ships to dispose of their waste in an environmentally sound manner.

(3) Formulate a national action plan for marine debris pollution prevention and control. Promote the establishment of sound national regulatory frameworks on waste management. Construct an integrated coordination mechanism for marine debris prevention and control across sectors, regions and river basins. Encourage green development, speed up the research and application of innovative approach for substitute for plastic products and waste treatment, and urge the manufacturing and use of degradable plastic products and substitutes for plastic. Strengthen researches on sources, transport and fate of microplastics as well as the impact on marine ecological environment, and improve the scientific understanding of microplastics. Call on all relevant stakeholders to engage and encourage social organizations, communities and the public to reduce plastic waste generation, hold clean-up activities, significantly reduce the unnecessary use of single-use plastics, and live green-consumption lifestyle, with the aim to prevent and significantly reduce marine microplastic pollution.

3.7.3 Develop a market system which allows economic levers to play a greater role in marine environmental governance and ecological conservation

(1) Accelerate industrial innovative and green development and transformation in coastal areas. Promote industrial upgrading toward to emerging industries and modern service industries. Strengthen the construction of industrial zones, promote circular economy and green production, build ecological industrial zones, and enhance the integrated and recycling utilization of resources. Set the binding requirements including industrial structure and layout, resource and environmental capacity loads, and ecological red lines. Strengthen the management of project approval, enhance the market entry, compel industrial transformation and upgrading, and progressively fall into disuse lagged behind production capacity.

(2) Improve the system for compensating marine ecology conservation efforts. Persist to the principle of “who benefits, who compensates”, comprehensively use fiscal, taxation and market measures, adopt the form of incentive instead of subsidies, and establish a

compensation mechanism for marine ecological conservation.

(3) Strictly implement compensation systems for ecological and environmental damage. Tighten manufacturers' legal responsibilities for environmental protection, and significantly increase the cost of illegal activities. Improve legal provisions concerning marine environmental damage compensation, methods for appraising damage, and mechanisms for enforcing compensation. In accordance with the law, mete out penalties to those who violate environmental laws and regulations, determine compensation for ecological and environmental damage by the extent of damage and other factors, and pursue criminal liability when violations result in serious adverse consequences.

(4) Establish a diversified funding mechanism. Integrate various types of marine environmental protection funds by central budget, increase financial support, and keep supporting the rural environmental governance and Blue Bay restoration actions. Bring into full play the initiative of local budget, enhance local financial support, make full use of market investment and financing mechanisms, and encourage and attract private, social, venture capital and other funds to gather in the area of marine environment protection.

3.7.4 Strengthen protection and remediation of coastal wetlands, and restore the ecological functions of wetlands including water purification

(1) Improve coastal wetland grading management system. Establish important coastal wetlands grading management systems at national and local levels, release in batches the national important coastal wetlands list, and identify the control proportion target of coastal wetlands at local level. Innovate the protection pattern, and establish the coastal wetland pilot national park.

(2) Establish degraded coastal wetlands restoration system. In accordance with the natural attributes of marine ecosystems and the characteristics of coastal biota, carry out the coastal wetland restoration. Implement the restoration projects, including restoring the coastal aquaculture farms back to wetlands, culturing densely vegetation, conserving habitat, improve the community structure of wetland vegetation, and raise the biodiversity of wetland habitats. Expand the coastal wetland area and recover the ecological services of wetland, such as water purification, carbon sequestration. By 2020, the restored area of coastal wetland will be more than 20,000 hectares.

3.7.5 Strengthen cooperation and exchanges, and jointly address global marine pollution

(1) Strengthen research on emerging marine environmental issues of global concerns.

Conduct survey and research on ocean acidification, plastics and microplastics, oxygen deficiency in hotspot areas, and comprehensively analyze the emerging marine environment issues of global concerns, particularly in the high seas and Polar Regions. Deeply participate in the designation of high seas protected areas, environmental impacts assessment of seabed development activities, and research on marine environmental protection in Polar Regions, and play our part in global marine environmental governance.

(2) Establish Maritime Community with a Shared Future to jointly address marine pollution. With the aid of the 21st Century Maritime Silk Road, carry out pragmatic and efficient cooperation and exchange under the framework of the Asian Infrastructure Investment Bank, China-Pacific Island Economic Development Cooperation Forum, China-ASEAN Maritime Cooperation, and Global Blue Economy Partnership Forum etc.. Strengthen research on marine environmental issues of global concerns, build a broad blue partnership, jointly improve the ability to address and control marine pollution. Establish China-ASEAN Marine Environmental Protection Cooperation Mechanism, and promote international cooperation. Enhance capacity on pollution monitoring and governance through sharing knowledge making best use of other relevant efforts in the region such as PEMSEA, APEC, NOWPAP and COBSEA, GPML, GPNM, GWI and work together to build a community of shared future for mankind.

Chapter 4 Green Urbanization Strategy and Pathways Towards Regional Integrated Development¹

4.1 Introduction

The city in the modern sense is based on the industrialization model formed after the Industrial Revolution. The agglomeration process of population and economic activities in the urban, i.e., urbanization, has greatly accelerated the process of industrialization. Human society has thus formed a modern social structure based on industrial civilization and the basic urban-rural economic geograph of “urban-industry and rural-agriculture”. The existing urbanization model, in terms of economic content carried by the city and the specific organizational form of the city itself, is largely based on the logic of traditional industrialization. Though this development model has brought tremendous progress to mankind, it has also brought about serious unsustainable problems.

Since modern economic activities mainly occur in cities, most of the environmental problems originate from cities. People naturally treat green urbanization as a city issue rather than a development issue, and the discussions thus focus on how to green the existing cities. However, the logical starting point to think about the issue of green urbanization shall start from why the city emerge, rather than discussing in the given cities. The urban environmental problem is fundamentally an issue of development model, not just a city issue. When the content and methods of economic development, as the basis of urbanization, face profound transformation because they are not sustainable, the corresponding urbanization model will inevitably undergo a profound transformation.

This means that the existing urbanization pattern formed in the traditional industrialization model needs to be reshaped on the basis of ecological civilization, so as to promote China’s economic transformation and high-quality development through green urbanization. This SPS aims to fundamentally investigate the internal mechanism behind the urbanization, and proposes a strategy and pathway based on ecological civilization to reshaping China’s urbanization.

¹ This chapter is the interim executive summary of the CCICED Special Policy Study on "Green Urbanization Strategy and Pathways towards Regional Integrated Development". The final report will be completed in 2020.

4.2 Why Redefine Urbanization?

4.2.1 Two basic tasks of green urbanization in China

An important driving force for the rapid development of China's economy is the rapid urbanization. In 1949, only 10.6% of China's population lived in cities. In 2017, China's urbanization level reached 58.5%¹. According to the experience of industrialized countries, it is estimated that by 2035, about 70% of China's population will live in urban areas. In 2050, this proportion will rise to around 80%(Figure 4-1). This means that China's urbanization level still has more than 20 percentage points to increase, and the newly added urban population is about 200 million people.

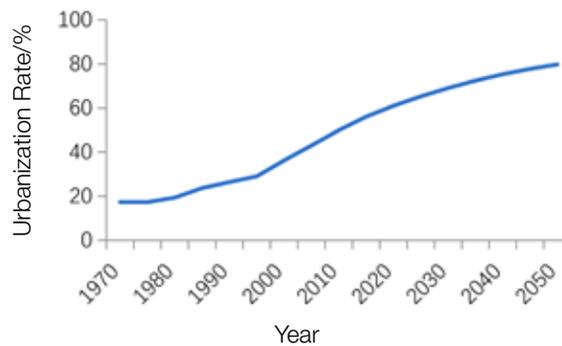


Figure 4-1 Rapid Growth of Urbanization in China 1970—2050

Date Sources: DRC Green Team.

Therefore, China's green urbanization faces two basic tasks: first, how will the 200 million people be urbanized in a green way; second, how the existing cities formed in the era of traditional industrialization become sustainable through green transformation that injects vigor into the economy.

4.2.2 China's urbanization has entered a new stage

First, the actual level of urbanization in China is higher than that of statistics. The urban area is defined as an area with a population density of more than 1,000 people per square kilometer. According to a study of DRC Big Data Lab for Macroeconomy with Baidu HUIYAN Population Big Data, China's actual urbanization level in 2015 was 62.2%, 6.1 percentage points higher than the traditional statistics².

1 国家统计局. 中国统计年鉴 [M]. 北京: 中国统计出版社, 2017.

2 陈昌盛, 石光. 大数据视角下的我国城镇人口比重 [M]// 陈昌盛. 迁徙的人、变动的城: 大数据视角下的中国城镇化. 北京: 中国发展出版社, 2019.

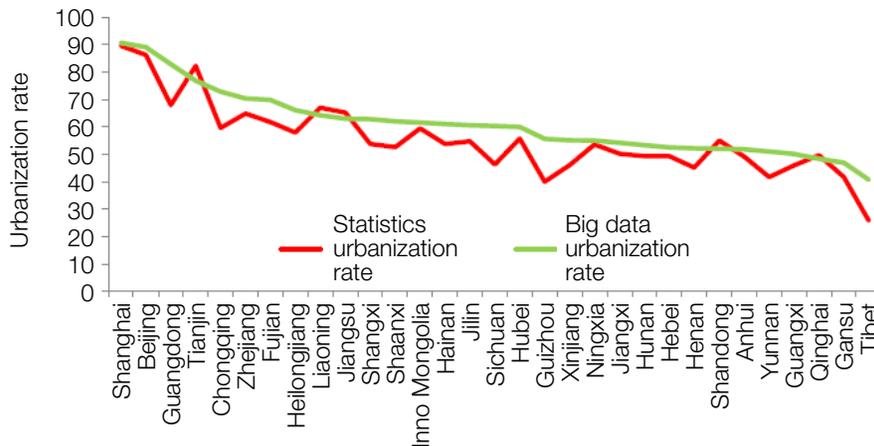


Figure 4-2 Comparison of Provincial Urbanization Level: Big Data-based and Statistics

Source: Chen and Shi, 2019.

Note: Red line represents statistics urbanization level of each province, green line represents level measured with big data.

Second, overall, China's cities have entered a high-quality development stage from quantity expansion. The economic development and population in some cities started to show an inverted U-shaped relationship¹. Over the past two years, the net inflow of daily migrants in some of China's most attractive cities has not changed significantly. The resident population in a few megacities has declined. As the regional economy becomes more balanced, an increasing number of people tend to return to their hometown to work or start a business.

Third, the spatial pattern of the city is undergoing major changes: the rise of urban clusters and metropolitan areas will dominate the future economic development in China. According to the calculations of the SPS team, the proportion of GDP, population and land area in 2017 in China's 20 urban clusters accounted for 90.87%, 73.63% and 32.67% of the nation, respectively. Lan Zongmin (2019)'s research, based on Baidu migration data, mobile phone density data and nighttime lighting data showed that the divergence of urban clusters is obvious, and the spatial scope of the planned urban clusters is generally smaller than that measured with big data².

This means that in the future, the main spatial scope of green urbanization will occur mainly in the existing urban clusters and county level. At the same time, the content and form of urbanization are undergoing profound changes.

1 陈昌盛, 魏冬. 从人口互动大数据看中国城市的发展与潜力 [M]// 陈昌盛. 迁徙的人、变动的城: 大数据视角下的中国城镇化. 北京: 中国发展出版社, 2019.

2 兰宗敏. 基于大数据的城市群识别与空间特征 [M]// 陈昌盛. 迁徙的人、变动的城: 大数据视角下的中国城镇化. 北京: 中国发展出版社, 2019.

4.2.3 The basic characteristics and consequences of traditional urbanization

The urbanization established in the traditional industrial era has two basic characteristics:

First, from the perspective of economic development, the function of the city is mainly to promote the production and consumption of industrial wealth, i.e. to promote the process of industrialization. Correspondingly, the function of urban infrastructure is also largely for facilitating the production of industrial products. More generally speaking, the economic development process based on traditional industrialization is a process of urbanization that transfers a large amount of agricultural labor to urban manufacturing, forming a pattern of urban-rural economic geography of “urban-industry; rural-agriculture”.

Second, from the perspective of the organization of the city itself, it is mainly based on the centralized way of traditional industrialization logic. The city’s design philosophy relies too much on industrial technology, rather than relying on ecological ideas to make nature work for the benefit of mankind. For example, the centralized model of heating, energy, construction and water treatment relies too much on industrial technologies, which is always costly. If the natural forces are fully released, it will reduce the cost of the city and increase the efficiency of the city (see TNC, “Valuing Nature’s Role”).

This urbanization model, while greatly promoted industrialization, inevitably brings unsustainable consequences to the environment and the regional economy.

First, serious environmental consequences, including air pollution, water pollution, noise pollution, solid waste pollution, etc.. The cause behind this is that the traditional industrialization model centered on the production and consumption of material wealth must be based on material consumerism (e.g. encouraging overconsumption, planned obsolescence, instant products, etc.), resulting in “excessive resource use, severe environmental damage, high carbon emissions”. If the economic growth still heavily depends on the material wealth, the urbanization based on this will inevitably become a major source of environmental problems.

Second, transforming agriculture into industrialized and chemical agriculture with the logic of urban industrialization has brought about serious rural ecological and environmental consequences, including environmental pollution (industrial pollution, chemical agriculture, aquaculture pollution, domestic pollution), ecological consequences triggered by pollution, excessive exploitation, and destruction of ecological chain. The monoculture and chemical agriculture is a major contributor to the agricultural biodiversity loss.

Third, the consequences of urban-rural and regional imbalance. In the process of industrialization and urbanization, the population will migrate from rural areas or inland areas

with no industrial advantages to urban or coastal areas, which will bring irreversible impact to the former and inevitably lead to urban-rural and regional disparities.

Fourth, social and cultural costs. On one hand, it is difficult for big cities to provide people affordable housing, education, and medical care. High income and low wellbeing has become a prominent problem. At the same time, it is difficult for migrant workers to be truly integrated into the city. On the other hand, urban and rural problems have become two sides of one coin. The original rural social fabric has been impacted by large-scale urbanization. The problem of “agriculture, rural areas and farmers” has become a serious problem, and a large number of hollow villages, left-behind children and etc.. have appeared. To this end, the 19th National Congress of the Communist Party of China has made “rural revitalization” a major strategy.

As the basis of the traditional urbanization model, the traditional growth model has significantly enhanced human well-being, while also affecting people’s well-being through two channels. First, ecological damage and environmental pollution will reduce people’s quality of life and well-being. Environmental problems such as air pollution, food safety, water contamination, noise, extreme weather, and biodiversity loss have penetrated into all aspects of people’s lives, seriously affecting people’s quality of life, health and safety^{1, 2}. Second, economic growth centered on production and consumption of material wealth has failed to simultaneously improve people’s quality of life and happiness. Numerous studies have shown that in many countries, including China, the economic development under the traditional industrialization model does not continue to improve the level of happiness as people think^{3, 4, 5}. When the basic material needs are met, the further expansion of material wealth, although it will bring bright GDP figures, will have little effect on improving people’s wellbeing.

In short, the traditional industrialization model, which is the basis of the existing urbanization, has brought about high material productivity, but it is unsustainable with high-cost. Since the high cost is not reflected in the internal cost of enterprises, but reflected as social costs, hidden costs, long-term costs and opportunity costs, it is easy to be ignored. At the same time, the wellbeing this growth model brings is also relatively low, while improving well-being is the ultimate purpose of economic growth. With the transformation of this

1 YANG J D, ZHANG Y R, 2015. Happiness and Air Pollution[J]. *China Economist*, 2015, 10(5) .

2 EASTERLIN R A, MORGAN R, SWITEK M, et al. China’s life satisfaction, 1990—2010[N]. *Proceedings of the National Academy of Sciences of the United States of America*, 2012, 109(25): 9775-9780.

3 NG Y K. From preference to happiness: Towards a more complete welfare economics[J]. *Social Choice and Welfare*, 2003, 20, 307-350.

4 JACKSON T. *Prosperity Without Growth: Foundations for the Economy of Tomorrow*[J]. Taylor and Francis, 2016.

5 SKIDELSKY E, SKIDELSKY R. *How much is enough? money and the good life*[M]. Penguin UK, 2012.

unsustainable growth model to sustainability, the corresponding urbanization model must also be redefined on the basis of ecological civilization.

4.3 Green Urbanization: An Analytical Framework

4.3.1 Why city

Thinking about green transformation of urbanization must begin with the logic why there is a city. Before answering this question, we must first understand the mechanism of economic growth and how urbanization promote economic growth.

The spring of economic growth is the improvement of the division of labor, and the division of labor is limited by the extent of market¹. There is a trade-off here, that is, a higher specialization and division of labor mean higher productivity, but the division of labor necessarily requires trade, which incurs transaction costs. If the transaction costs are too high to exceed the benefits of specialization and the division of labor, it would be difficult for the division of labor to occur and for the economy to grow^{2,3}.

Therefore, how to increase transaction efficiency becomes the key to promoting economic growth. Urbanization is crucial for increasing transaction efficiency. In addition to the improvement of (i) hardware infrastructure such as road transportation and communication and (ii) the soft aspects of institution and mechanism design (including effective government, property rights system, enterprise system, patent system, etc.), the geographic agglomeration of economic activities in urban areas, i.e. urbanization, plays crucial role in increasing transaction efficiency.

As an industrial chain is concentrated in the city, it is easier to develop division of labor and collaboration than being scattered in the rural area, thus driving economic growth. The other benefits of the city include: First, the agglomeration of the population in the city can expand the market, which creates conditions for the increase of the division of labor. Second, the centralization of urban facilitates the provision of infrastructure and government public services. The concentration of public facilities such as water, electricity, gas, and communications would, compared to decentralized provisions, greatly improve the efficiency of use and reduce construction costs. Third, the concentration of population in cities facilitates the exchange of ideas and is conducive to the creation and diffusion of innovation

1 SMITH A. An inquiry into the nature and causes of the wealth of nations[Z]. London: W. Strahan and T. Cadell, 1776.

2 YANG X K. Economics: New classical versus neoclassical frameworks. New York, NY: Blackwell, 2011.

3 BETTENCOURT. Impact of Changing Technology on the Evolution of Complex Informational Networks[C]. Proceedings of the IEEE. 2014, 102(12). No. 12, December 2014.

and new knowledge. In addition to the perspective of division of labor, there are many other lines in urban research^{1,2,3,4,5}.

Therefore, there are three key factors determining the urbanization model: The first is the change in transaction efficiency; the second is the change in the provision of public facilities and public services; the third is the change in the content of development, i.e. the content of production, consumption, and trading. Among them, the economic foundation of green urbanization is the transition of the development content from the industrial wealth characterized by “high resource consumption, high environmental damage, high carbon emissions” to the high-quality emerging economies that rely more on intangible resources such as knowledge, ecological services and culture. When the three defining factors undergo profound changes, the requirements for spatial agglomeration of economic development will change, and the content and forms of urbanization will also change accordingly. A core objective of this research is to investigate the changes of these defining factors in the digital and green development era and its implications on China’s urbanization, and how the government should formulate corresponding green urbanization strategies(Figure 4-3).

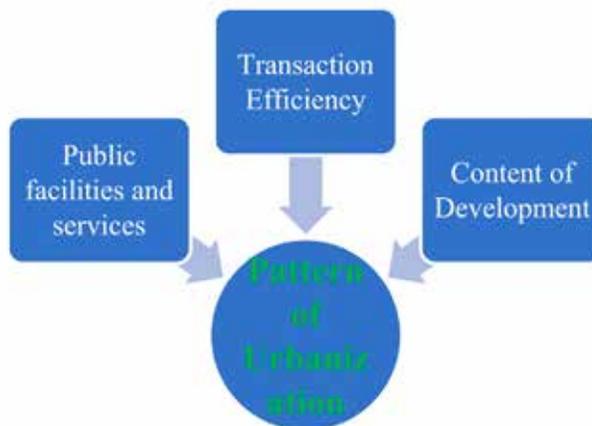


Figure 4-3 Three Defining Factors of Urbanization:An Analytical Framework

Source: made by author.

- 1 YANG X. Development, Structure Change, and Urbanization[J]. Journal of Development Economics, 1991,34: 199-222.
- 2 YANG X, RICE R. An Equilibrium Model Endogenizing the Emergence of a Dual Structure between the Urban and Rural Sectors[J]. Journal of Urban Economics, 1994, 25:346-368.
- 3 HENDERSON J V. The Sizes and Types of Cities[J]. American Economic Review, 1974, 64: 640-657.
- 4 FUJITA M. Urban Economic Theory: Land Use and City Size[N], New York: Cambridge University Press, 1989.
- 5 FUJITA M, KRUGMAN P. When is the economy monocentric? von Thunen and Chamberlin unified. Regional[J]. Science and Urban Economics, 1995, 25: 505-528.

4.3.2 The emergence of urban clusters

Now that the agglomeration of population and economic activity is so important to the economic growth, according to this logic, shall all the population gather in a super-large city? The answer is no. Driven by market forces, a hierarchical structure of large, medium and small cities will be formed, and then several central cities will be formed in different regions, which together constitute several urban clusters and metropolitan areas.

Why is there a hierarchy of large, medium and small cities? Although big cities can improve productivity, they also have disadvantages, including high prices and various “urban diseases” in terms of urban pollution, traffic congestion, high housing prices, crime, high mental stress, etc.. Therefore, the real utility in big cities is not as high as their nominal income suggests. For example, a 10,000 yuan income in a big city does not mean that its real utility is twice that of a small city of 5,000 yuan, because a large part of the income is used to pay for various costs including transport, high rents and so on. If taking non-monetary factors such as pollution and mental pressure into account, the real utility of big cities and small cities should be quite similar. This is why, under the market force, different people will choose different cities to work and live, thus forming a hierarchical structure of large, medium and small cities¹.

How does the urban clusters appear then? The reason is that different regions forming their center cities can minimize the spatial cost of the overall economy. In particular, a vast country with dense population like China will certainly form a number of regional center cities and metropolitan areas, and within each of them will form a hierarchical structure of the city. The phenomenon that a large part of a country’s population is concentrated in a mega city is more likely to occur in territorially small countries. The total transaction costs of population to agglomerate in different central cities are often lower than that of all population to agglomerate in a single large city. In addition to cost, how cities are geographically distributed also depends on the benefits of agglomeration to production, which is affected by land area, population size and initial distribution, industrial structure, natural endowments, transportation, climate, culture, institution, and etc.. Such factors affect the cost and benefits of agglomeration, and thus affect the geographical pattern of urbanization.

¹ YANG X, RICE R. An Equilibrium Model Endogenizing the Emergence of a Dual Structure between the Urban and Rural Sectors[J]. *Journal of Urban Economics*, 1994, 25: 346-368.

4.4 The Future Urbanization Model in China

4.4.1 The defining factors of urbanization pattern are profoundly changing

As human society enters the digital and green era from the traditional industrial era, the three key factors that determine the urbanization model are undergoing dramatic changes. These changes are particularly dramatic in China. This means that China's future urbanization model will undergo profound changes.

First, the dramatic increase in transaction efficiency. With the advents of Internet, the digital age and the rapid transportation system, the traditional concept of space and time is undergoing major changes. Many economic activities do not necessarily have to rely on the large-scale physical concentration of production factors and markets as in the industrial era, and no longer have to be undertaken in the city or at a fixed location.

Second, changes in technologies have made it possible for some of the public facilities and services that originally relied on concentration to be provided in a decentralized manner. For example, heating, sewage treatment, distributed energy, garbage disposal, etc., can be transferred from centralized supply to distributed supply in many cases. This means that in some small towns and villages, high-quality living can be achieved at low cost. In the digital age, many government services are also accessible through digital platforms.

Third, and more importantly, the development content changes. As discussed above, the traditional industrialization model will inevitably lead to an unsustainable environment. One of the important tasks of green urbanization is to change the content of supply. Among them, an increasing demand for the emerging services that meet people's expectation for a better life is the direction of green development and is the new economic foundation of green urbanization. Although urban agglomeration is still very important, much of the new content doesn't necessarily require physical concentration as it once did. In particular, countryside and small towns excel in good environment and culture. As a result, many new economic activities may emerge in the countryside, and the urban-rural relationship will be redefined.

4.4.2 The implications of green urbanization

It is important to point out that although the above changes of three key factors have made many economic activities less dependent on the physical concentration of production factors as in the past, this does not necessarily mean "the decline of the city", nor does it

mean that a large number of economic activities will leave the city. It means the traditional urban and rural concepts need to be redefined through which new sources of economic growth would be emerging.

—The profound change of economic activities carried by the city. People's demands for good life is not just for material wealth. As demands upgrade, the content of economic development expands from traditional material wealth to emerging services. Many economic activities that did not exist under the traditional development will appear. For example, the big population of the existing cities could be an advantage for developing cultural creative and experience economy, thus transforming the development content; in addition to produce agricultural products, the rural area could also be a new type of geospatial space that can accommodate many new economic activities, including economies of experience, ecological tourism, education, health, etc..

—The change of city's own organization and geospatial layout. For example, the way of urban life will change a lot; the centralized energy supply may be partially replaced by distributed supply, and urban infrastructure will be based more on ecological principles.

The above changes have double effects of increasing agglomeration or decentralization of economic activities. Whether the urban will become more agglomerated or decentralized depends on which effect of the above three defining factors become dominant.

As for the trend of spatial distribution of urbanization in the future, it seems that a consensus is yet to be reached in the academic community. There are two different foresights about future urban forms. One is support for the decentralization trend. Henderson et al. shows evidence that Chinese cities are experiencing a decentralization trend with the emergence of high-speed rails¹. One is that the Internet and convenient transportation will accelerate the concentration of population to large cities². These two different conclusions may be derived from different understanding of the inherent law of the city, or different definitions about city. Therefore, it would be more effective to measure the real situation of urbanization through big data on population and economic activities distribution than traditional statistical data.

For China's future urbanization strategy, it is very important to clarify the relationship between city size and economic development. Though city scale is emphasized in many literature, in the theory of economic growth, population size is not always conducive to economic growth. For example, in Solow's growth theory, endogenous growth theory, and

1 BAUM-SNOW N, BRANDT L, HENDERSON J V, et al. Roads, railroads and decentralization of Chinese cities[J]. *Review of Economics and Statistics*, 2012(0).

2 GLAESER E. *Triumph of the city: How our greatest invention makes us richer, smarter, greener, healthier and happier*[M]. Penguin, 2011.

Lewis' surplus labor theory, population size has a negative, positive, or neutral effect on economic growth. The new economic geography, represented by Krugman, Krugman and Fujita¹, emphasizes the benefits of population size for economic growth. However, as Young² pointed out, the “extent of market” emphasized in Smith's theorem is not “mass production” and population size. The research from Zhang and Zhao³ shows that the economies of scale in the Fujita-Krugman urbanization model are not in line with reality. Some empirical studies that emphasized the size of the city show there is a strong correlation between the size and per capita GDP. However, the conclusion may not be so simple, because large cities have large market size and higher level of division of labor, and their nominal GDP is usually higher than that of small and medium-sized cities, but the GDP of large cities contains more transaction costs including commuting costs, high house prices, congestion, etc., the net utility is not necessarily higher. In reality, we can find a large number of examples of “small but advanced cities”, and “large scale but poor cities”. In Europe, more than half of the population lives in small and medium-sized cities with a population of 5,000 ~ 100,000. At the same time, the size of the urban population is not equal to prosperity. 22 out of the 29 megacities in the world with more than 10 million people are in Africa, Asia and Latin America, and these super-large cities have not prospered. In China, the development of many cities no longer depends on population growth, and there is an inverted U-shaped relationship between population and urban economic growth.

4.5 The Strategic Choice of China's Green Urbanization

The overall idea: reshaping China's urbanization based on ecological civilization and no longer relying on quantitative urban expansion, and making green urbanization a driver for green transformation of Chinese economy towards high-quality development. Green urbanization strategy should be an important part of the 14th Five-Year Plan.

4.5.1 Three major components of green urbanization

Component 1: Reshaping the existing cities, that is, transforming cities according to the requirements of new production and lifestyle in the digital green era

The first is to promote green new economy. The advantages of the existing cities for

1 FUJITA M, KRUGMAN P. When is the economy monocentric? von Thunen and Chamberlin unified[J]. *Regional, Science & Urban Economics*, 1995, 25: 505-528.

2 YOUNG A. Increasing returns and economic progress[J]. *The Economic Journal*, 1928, 38: 527-542.

3 ZHANG, ZHAO. Testing the scale effect predicted by the Fujita-Krugman urbanization model[J]. *Journal of Economic Behavior and Organization*, 2004, 55 (2004): 207-222.

green transformation lie in demand and supply. In terms of market demand, the existing population size provides huge market for the new service economy; on the supply side, relying on its intangible endowments such as high-quality talents, urban culture and history, a large number of experience economy and creative economy could be formed. At the same time, it is of great potential to upgrade the traditional sectors by applying new business model and Internet technologies, and China has lots of successful cases, including transformation of old neighborhoods, old industrial parks and old malls into creative and experience economic zones, and successful transformation of resource-exhausted cities.

The second is the green transformation of urban infrastructure. Renovating existing urban infrastructure based on the concept of ecological civilization will reduce urban costs and improve efficiency. For example, research by The Natural Conservancy shows that by valuing the role of nature, it can bring better results, “when ecosystem functions and services are included in a cost-benefit analysis, hybrid infrastructure-combining nature and nature-based infrastructure with gray infrastructure-can provide the most cost-effective protection from sea-level rise, storm surges, and coastal flooding. All-gray flood protection can cost more and miss opportunities for generating additional economic benefits and ecosystem services, such as recreation, carbon capture, and habitat” (TNC, “Urban Coastal Resilience: Valuing Nature’s Role”).

Component 2: New urbanization, that is, urbanizing new population in a green way

There will be 300 million new urban dwellers in the future and a new green concept and model is required to realize urbanization. A large number of these people will be transferred to existing towns, while some will be urbanized locally in the county area to form new characteristic towns. The future between cities and villages is more of a difference in physical form than the difference between modernity and economic development level. Due to the new opportunities in the countryside and the substantial improvement in the quality of rural life, a large number of new “urban and rural amphibious population” is likely to emerge. The traditional statistical definition of urbanization also need to be changed accordingly.

There are many good cases and studies on this regard in China. For example, the Rocky Mountain Institute are promoting “near-zero emission demonstration zone” in some parts of China. It is based on the concept of integrated governance, while promoting economic growth, minimizing pollution, garbage and carbon dioxide emissions. The demonstration takes an integrated concept to solve environmental problems, through considering the protection of air, water, soil and ecosystem as a whole. It provides an integrated solution from the ecosystem, production process, full value chain, etc..

Component 3: A new definition of the countryside

The city and the countryside are two aspects of the same issue. When the content and mode of economic development change, the definition of the village and the urban-rural relationship will change accordingly. Under the traditional concept of development, development is taken as a process in which agricultural labor is massively transferred to cities for manufacturing on a large scale, namely industrialization and urbanization, while agriculture and rural areas are restructured from the perspective of industrialization, becoming a base of labor, food and raw materials for urban industries. The mode of agriculture production is also transformed into monoculture and chemical agriculture in accordance with the logic of industrialization, which brings serious ecological and environmental consequences. This traditional rural definition from the perspective of industrialization not only limits the economic development potential of the rural areas, but also sacrifices many valuable rural culture and ecological resources. In fact, the countryside is a versatile new geospatial space that can accommodate a large number of new economic activities. In this regard, China also has many successful cases. For example, the DRC Green Team helps underdeveloped regions achieve leapfrog development through green transformation under the framework of “redefining countryside”.

4.5.2 Two strategic focuses of green urbanization: green urban clusters and county level urbanization

The two strategic focuses of China’s green urbanization are: First, the green transformation of urban clusters and metropolitan areas. Second, the county level urbanization. The reasons are following.

First, the economy and population of the 20 urban clusters currently accounts for an absolute proportion in the country. In 2017, China’s 20 urban clusters accounted for 90.87%, 73.63% and 32.67% of the national GDP, population and land area, respectively. It can be said that the achievement of green transformation of urban clusters basically means the achievement of green urban across the country (Table 4-1).

Table 4-1 Share of GDP, Population and Land Area of 20 Urban Clusters in China

	GDP/100 million	Population/10 ⁴	Land Area/km ²
20 Urban clusters (A)	743,771	102,351	3,147,710
National 2017 (B)	818,461	139,008	9,634,057
Share (A/B)	90.87%	73.63%	32.67%

Source: made by author according to statistics.

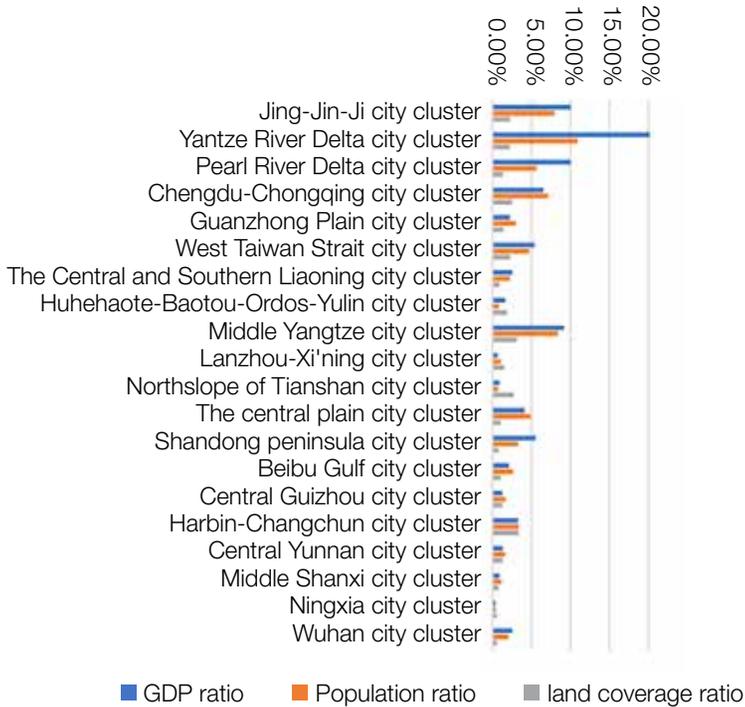


Figure 4-4 Share of GDP, Population and Land Area of Each Urban Cluster in China

Source: made by author according to statistics.

Second, since the urban clusters include three major components of green urbanization, namely existing cities, population to be urbanized, and rural areas, it can take both advantages of the urban and rural areas. Focusing on the city clusters and metropolitan areas, it can activate both advantages of urban and rural areas and potential market. Based on their ecological resources, villages located in urban clusters and metropolitan areas could provide new green supplies to the surrounding cities.

Third, revitalizing the county-level economy is a major task of rural revitalization in China. In addition to moving to the capital city of the county, a large number of people will be urbanized in the form of characteristic towns, so as to take both advantages of the urban and rural areas.

Chapter 5 Ecological Compensation and Green Development Institutional Reform in the Yangtze River Economic Belt (YREB)

5.1 Introduction

As stretching over 6000 km, the Yangtze River Valley has a unique ecosystem, which has a precious ecosystem in China. The Yangtze River Economic Belt (hereinafter referred to as YREB) covers 11 provinces and municipalities with a population and GDP accounting for over 40% of total amounts in China. It is the economic center in China with great vitality, and also an important support for the sustainable development of Chinese nation. It is of great significance to promote the YREB to step a path of ecology priority and green development, and build it into a green demonstration belt with great influence throughout the country. With reference to the successful experiences in both domestic and international watershed management, this project is to study how to promote the green development of the whole Yangtze River basin, especially the upper reaches of the Yangtze River Basin through the innovative institutional reform of watershed management among the provinces within the YREB, so as to ensure that the clear water of Yangtze River will last for future generations.

5.2 Basis, Issues and Needs

Based on the national development strategy of the YREB, 11 provinces and municipalities concerned have made joint efforts to firmly uphold the concept of green development, optimize the industrial structure, strengthen environmental management, and coordinate efforts, which positive results have been achieved in aspect of the green development. However, some challenges still exist when breaking through the barriers of regional administrative divisions, innovating the mechanism for regional coordinated development, and promoting the construction of integrated market system.

5.2.1 River Basin Management Experience of the YREB

Traversing the West, Middle and East China, the Yangtze River Economic Belt

(hereinafter referred to as “YREB”) is one of our country’s areas with the most powerful comprehensive strength and the largest strategic support, accounting for 40% of the national overall economic output. It has formed a development momentum of the lower reaches of Yangtze River Delta as the lead, and cities groups in the middle reaches, Chengdu-Chongqing cities groups in the upper reaches as the supports. Integrating mountains, water, forests, fields and lakes, the Yangtze River basin possesses a lot of enormous ecological service value, such as flood adjustment, water sources preservation, water and soil conservation, biological variety maintenance and environment purification, and it is our country’s essential treasure house as well. In addition, eight concentrated exceptional poverty areas, such as Qinba mountain region, Wuling mountain region in the middle and upper reaches, are regarded as the national key ecological function zones, and the mineral and water resources concentrated distribution area, so an acute contradiction stands out between the resource exploitation and ecological protection.

5.2.1.1 Basic Advantages

(1) Nature Resource Value of the YREB

Spanning across the tropical, the subtropical and the warm temperate zone, Yangtze River basin has a complex geomorphological type and a diverse ecological system. Many ecosystems here, such as the river, valley and forest ecosystem in western Sichuan, the subtropical evergreen broad-leaved forest ecosystem in the southern subtropical zone, and the wetland ecosystem in the middle and lower reaches of the Yangtze River, are the priority biodiversity protection area with the global great significance. The forest coverage in Yangtze River basin can reach 41.3% with an abundant biological species, where the river, lake, reservoir and wetland area accounts for 20% of the whole country, the rare and endangered plants, 39.7% and the freshwater fish, 33%. It is also the concentrated distributed area for the national rare and endangered wild animals and plants, such as Chinese sturgeon, finless porpoise, Chinese alligator, giant panda, golden monkey, and silver fir, metasequoia, davidia. The eight concentrated exceptional poverty areas, such as Qinba mountain region, Wuling mountain region, are regarded as the national key ecological function zone, and the mineral and water resources concentrated distribution area. Nearly half of the national key heavy metal prevention and control regions are located in the YREB.

(2) Water resource value of the YREB

Extremely abundant in the water resources, the Yangtze River basin is the strategic place of water resources for the Chinese nation. According to the national ecological function zone division, 8 important water conservation and ecological service functional areas are distributed in the YREB, among the national 17 total, which accounts for 47.1%, including

Qinba Mountain, Dabie Mountain, Huaihe Source, Nanling Mountain, Dongjiang Source, Zoige, Three Gorges Reservoir Area and Danjiangkou Reservoir Area, etc.. The high value area of water conservation quantity per unit area in the Yangtze River Basin is primarily located in Hunan, Jiangxi, Zhejiang, Yunnan, etc.. The Yangtze River is deemed as the life river of the Chinese nation. For many years, the average annual water resources amount to about 995.8 billion cubic meters, accounting for about 35% of the national total. The annual water supply of the Yangtze River exceeds 200 billion cubic meters, which sufficiently meets the demand of living and production water for 400 million people along the Yangtze River. Moreover, the people in North China, Northern Jiangsu, Shandong Peninsula and other large areas can also get the benefit through the south to north Water Diversion Project.

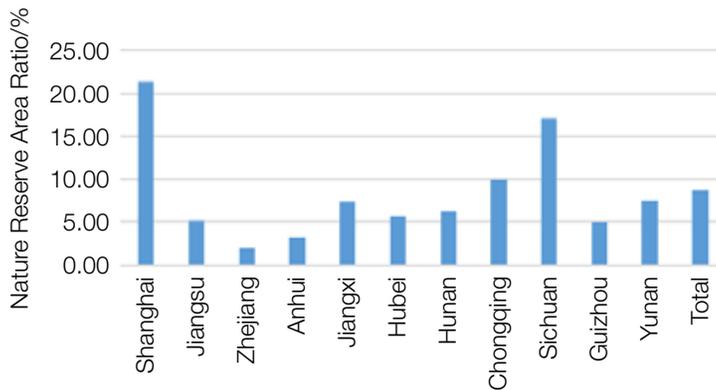


Figure 5-1 Illustration to the area ratio of nature reserves in different provinces along the YREB

(3) Ecological service value of the YREB

The upper reaches of Jinsha River and Minjiang River and Three Parallel Rivers, the Danjiangkou Reservoir Area, the upper reaches of Jialing River, Wuling Mountain, the upper reaches of Xin'an River, Xiangjiang River, Zijiang River, and Yuanjiang River, and others, are the national key soil erosion prevention areas. The lower reaches of Jinsha River, Jialing River and the middle and lower reaches of Tuojiang River, Three Gorges Reservoir Area, the middle reaches of Xiangjiang River, Zijiang River, and Yuanjiang River, and the upper and middle reaches of Wujiang River and Chishui River and others are the national key soil erosion governance areas. Guizhou and other southwest Karst areas are one of the three largest rocky desertification areas in the world. Some areas in the Yangtze River Basin, such as the hilly areas around Sichuan Basin, Nanling Mountains, Wuyi Mountains and southern Anhui Mountains, have the strong ecosystem soil conservation function. There are totally

140 nation-level nature reserves and 297 national forest parks in the YREB. According to the latest regulated red line of ecological protection issued by the different provinces, the total area of the red line of ecological protection in the YREB is about 518, 500 square kilometers, accounting for 25.34% of the land area of 11 provinces and cities in the YREB.

(4) Outstanding contradiction between protection and development

There is a strong geographical distribution coupling between the important ecological function zones and the poverty areas in the YREB. The YREB has eight national key ecological function zones, including Sichuan-Yunnan Ecological Function Zone for Forest and Biodiversity, Three Gorges Reservoir Ecological Function Zone for Soil and Water Conservation, Qinba Biodiversity Ecological Function Zone, Wuling Mountain Ecological Function Zone for Biodiversity and Soil and Water Conservation, Dabie Mountain Ecological Function Zone for Soil and Water Conservation, Zoige Ecological Function Zone for Grassland and Wetland, accounting for 1/3 of the national key ecological function districts and counties (676 county-level administrative districts), this area covers 254 counties, among which 154 counties belong to the state-level poverty-stricken counties. With the protection areas highly overlapping with the poverty areas, this area not only plays the role of “ecological security” and “resource reserve”, but also undertakes the task of poverty alleviation and development. For a long time, China’s ecological compensation policies in these zones have been primarily project-based, and a huge amount of financial transfer payment fund has provided a good basis for the ecological compensation, and has given a certain compensation for the loss of development opportunity cost in ecological protection area. However, at the same time, these policies have brought great risks to the implementation effect, due to a clear time limit without sustainability. Once the funds are cancelled, it is easy to cause a vicious circle of “poverty-destruction-poverty”. Therefore, in order to keep a long-term mechanism of ecological compensation, it is necessary to combine the state’s precision-poverty relief and alleviation program to promote the coordination between the ecological protection and poverty-alleviation development in the ecological protection area.

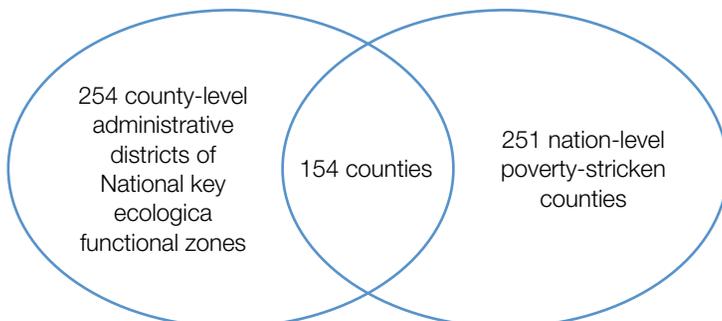


Figure 5-2 Illustration to the key ecological function zones and nation-level poverty-stricken counties in YREB

Table 5-1 List of the key ecological function zones in YREB

No.	Name of the key ecological function zones
1	Sichuan-Yunnan Ecological Function Zone for Forest and Biodiversity
2	Three Gorges Reservoir Ecological Function Zone for Soil and Water Conservation
3	Qinba Biodiversity Ecological Function Zone
4	Wuling Mountain Ecological Function Zone for Biodiversity and Soil and Water Conservation
5	Dabie Mountain Ecological Function Zone for Soil and Water Conservation
6	Zoige Ecological Function Zone for Grassland and Wetland
7	Nanling Mountain Ecological Function Zone for Forest and Biodiversity
8	Guangxi, Guizhou and Yunnan Ecological Function Zone for Karst Rocky Desertification Control

5.2.1.2 All-basin management experience

(1) Ecological compensation experience of the YREB

The single factor ecological compensation projects have been tamped continuously. The ecological compensation mechanism has been established in the key river basin of all the provinces (cities) along the Yangtze River, and there are six provinces (cities) that have covered the whole province with the ecological compensation mechanism, so the basin ecological compensation mechanism has become an important means to carry out the comprehensive governance for the upper and lower reaches of the YREB. The forest and wetland ecological compensation mechanism has been continuously improved, and the restoration project for the mountain, water, forest, field, lake and grass system has been accelerated. The comprehensive ecological compensation has been further promoted, the transfer payment method for the key ecological functional zones have been kept optimizing, and the scope of subsidies has been continuously expanded. The ecological compensation is also expanding from intra-province to trans-province, and gradually realizing the share of cost and benefit, and co-governance between trans-zone ecological protection and environmental governance.

1) All provinces (cities) along the YREB have established the ecological compensation mechanism in the provincial key river basins or even throughout whole province.

Shanghai and Jiangxi provinces have established a vertical ecological compensation transfer payment mechanism covering the whole province.

In 2017, on the basis of Opinions on Establishing and Improving Ecological Compensation Mechanism in Shanghai and Ecological Compensation Transfer Payment Measures in 2009, Shanghai issued the City-to-District Ecological Compensation Transfer Payment Measure to further detail the original payment method, so the transfer payment

funds for ecological compensation have always maintained a significant growth momentum. Take the ecological compensation of water source areas for example, which is in the charge of Municipal Environmental Protection Bureau, the accumulative compensation funds during 2009 to 2018 exceeded RMB 5.9 billion, and the compensation funds in 2018 was up to RMB 1.15 billion.

Jiangxi Province has formally issued Jiangxi Province Basin Ecological Compensation Measures, which basically retains the content of Jiangxi Province Basin Ecological Compensation Measures (Trial) issued in 2015, and continues to include the five major rivers of Poyang Lake and Ganjiang River, Fuhe River, Xinjiang River, Raohe River, and Xiuhe River, as well as the Jiujiang River section of the Yangtze River and Dongjiang River basin into the scope of implementation, covering all the 100 counties (cities and districts) over the whole province. In 2018, the scale of ecological compensation funds will exceed RMB 2.89 billion. In order to promote the establishment of trans-provincial and intra-provincial horizontal ecological compensation mechanism, an investigation on the provincial river basin ecological compensation will be carried out in the counties (cities) with the all-provincial representative maturity.

According to the principle of “Anyone who exceeds the standard should compensate, anyone who reaches the standard should benefit”, Jiangsu and Anhui provinces have established a “two-way compensation” mechanism for basin water environmental quality covering the whole province.

There are 112 compensation sections throughout Jiangsu Province, including 76 compensation sections in 8 cities along the Yangtze River. Up to now, the total amount of compensation funds for water environment area in Jiangsu Province has accumulatively reached nearly RMB 2 billion, which, together with provincial reward funds, has been returned to the local governments for dedicated use in water pollution prevention and control, thus effectively promoting the improvement of regional water environmental quality. The regional compensation program of Jiangsu Province is also developing extensively and further, and referring to the provincial compensation practices, Wuxi, Xuzhou, Changzhou, Suzhou, Nantong, Huai’an and other cities also carry out trans-county (city, district) river regional compensation within their jurisdictions. On December 30, 2017, the General Office of Anhui Provincial Government issued Provisional Measures of Ecological Compensation for Surface Water Section in Anhui Province, and established an ecological compensation mechanism for surface water section mainly based on municipal-level horizontal compensation and supplemented by provincial-level vertical compensation, which includes 121 sections within the whole province and covers the Yangtze River, Huaihe River and

major tributaries, and important lakes throughout Anhui Province. During January to March, 2018, the ecological compensation fund of Anhui Province amounted to RMB117 million. In addition, five municipalities in the upper and lower reaches of the Yangtze River were organized to sign Ecological Compensation Agreement on Surface Water Section in the Yangtze River Basin within Anhui Province.

Zhejiang and Chongqing provinces promote the establishment of a horizontal ecological compensation mechanism in the upper and lower reaches of the Yangtze River throughout the whole province.

On the basis of previously issued Opinions on Establishing a horizontal Ecological Protection Compensation Mechanism in the Upper and Lower Reaches of Yangtze River Basin within Province (No. 184 of Zhejiang Finance Construction [2017]), and in accordance with the requirement of “Early Signing, Early and More Gaining”, Zhejiang Province has timely distributed and arranged the reward funds for protection and governance of the YREB, so by the end of March, six pairs of regions in upper and lower reaches of the Qiantang River and Puyang River basins have all signed horizontal ecological protection compensation agreements, which are included in the first batch (required to be completed by the end of March). Chongqing Municipal Government has promulgated Implementation Plan of Establishing a Horizontal Ecological Protection Compensation Mechanism for Yangtze River Basin in Chongqing (Trial) (No.53 of Chongqing Municipality [2018]). By 2020, the district and county horizontal ecological protection compensation mechanism will totally have covered the river basin area of more than 500 square kilometers within the city’s administrative area, and 19 secondary rivers flowing through two or more districts and counties. At present, three districts and counties in Bi’an River basin have signed the horizontal compensation agreement, and the other districts and counties related to 18 secondary rivers have all showed their willingness to sign it this year.

Hunan Province, Guizhou Province and Sichuan Province have established the ecological compensation mechanism based on water environmental quality in the key river basins throughout the whole province.

On the basis of the ecological compensation program for water quality and quantity assessment in the Xiangjiang River basin that has been implemented for three years, Hunan Province plans to carry out the ecological compensation for water environment in an overall way throughout the whole province, actively study and construct the horizontal ecological compensation mechanism for the four river basins of Xiang River, Zi River, Yuan River and Li River within the province, and explore the implementation of the ecological compensation awards for atmospheric environment throughout the whole province. Since 2009, Guizhou

Province has successively carried out the river basin ecological compensation in Qingshui River, Chishui River, Wujiang River and Hongfeng Lake of the Yangtze River basin. Through a Valuation Adjustment Mechanism (VAM) on water environmental quality between the relevant cities (prefectures) of the river basin, RMB 330 million of ecological compensation dedicated funds have been invested in improving the environmental quality of the river basin, and the ecological compensation mechanism of main river basins in different cities and counties along Guizhou section of the Yangtze River has been initially established. In 2011, Sichuan Province firstly attempted to carry out the river basin horizontal ecological compensation for the Minjiang River and Tuojiang River, the important first-level tributaries of the upper reaches of the Yangtze River within the province. In 2017, Sichuan Province issued Ecological Compensation Measures for Water Environment at Provincial Boundary Sections of Three Rivers Basin (Trial), and established a closed-cycle assessment mechanism for the “Three Rivers” Basin within the province. At present, Implementation Plan of Ecological Protection Compensation in Tuojiang River Basin is being drafted.

2) The substantial progress of trans-provincial river basin ecological companion needs to be perfectly made.

The pilot project of the ecological compensation in the trans-provincial Xin’An River basin has been steadily advancing.

Based on the previous two rounds pilot projects of the ecological compensation in Xin’anjiang River basin, we firstly, together with the provincial financial departments, will evaluate the performance of the two rounds of pilot projects, and joining Anhui Province, apply to the Ministry of Finance and the Ministry of Environmental Protection for the continuous guidance and support on the ecological compensation in Xin’anjiang River basin. At present, the two provinces are conducting an in-depth consultation and communication on the new round of compensation benchmarks, compensation methods, compensation standards, joint prevention and co-governance mechanism and others in Xin’anjiang River basin. Meanwhile, we will actively explore the way to strengthen the cooperation in industry, talent, tourism and other aspects, and the way to establish a diversified compensation mechanism.

The pilot progress of the ecological compensation in trans-provincial Chishui River basin needs to be speeded up.

March 21 to 23, 2018, the environmental protection departments and financial departments from three provinces of Yunnan, Guizhou and Sichuan held a project promotion meeting in Renhuai city, Guizhou Province on the trans-provincial ecological compensation in Chishui River basin. The meeting adjusted and updated the list of members of the Coordinating Group on the pilot project of the ecological compensation mechanism in the

Chishui River basin of Yunnan-Guizhou-Sichuan area, and discussed the compilation of Implementation Plan of the Horizontal Ecological Protection and Compensation in Chishui River Basin. At present, its exposure draft has been completed and is soliciting the opinions of the relative departments from Yunnan Province, Guizhou and Sichuan provinces.

Other trans-provincial river basin projects are still under negotiation.

Guizhou Province has initiated a pilot study on the horizontal ecological compensation in Xijiang River basin and reached a preliminary consensus with Yunnan Province. Moreover and it is planning to jointly initiate a proposal to establish a horizontal ecological compensation mechanism for Xijiang River in the near future, to negotiate with Guangxi and Guangdong provinces located in the lower reaches of Yangtze River. The related departments from Hubei, Hunan, Anhui, Chongqing and other provinces and municipalities have carried out an early communication to promote the trans-provincial horizontal ecological compensation mechanism in Yangtze River basin, and to sign the compensation agreements, etc.. Hubei and Hunan provinces are negotiating on launching the horizontal ecological compensation of the trans-provincial river basin for Huanggai Lake that is located at the border of the two provinces. Chongqing Environmental Protection Bureau, together with the Municipal Finance Bureau, has completed the drafting of compensation agreement (draft) of trans-provincial river basin in Chongqing, pending a discussion with the neighboring provinces and cities.

(2) Experiences of green development institution and mechanism in YREB

A multi-level mechanism for consultation and cooperation has been formed. The Yangtze River Valley spans three major economic zones in the eastern, central and western China, totaling 19 provinces, municipalities and autonomous regions. In recent years, in order to protect the trans-boundary environment and promote the healthy economic and social development in river basin, the local governments along the Yangtze River have also made certain innovations and practices in the administrative supervision system in aspect of environmental protection. In Sichuan, Guizhou and Yunnan Provinces, the provincial departments of environmental supervision, in accordance with the working ideas of “striving for breakthrough by means of reform, governance-oriented, mechanism guarantee and heavily punishment”, vigorously carry out comprehensive environmental improvement through establishing long-term mechanism, building infrastructure and carrying out joint law enforcement, and severely crack down on illegal and criminal activities in river basin. The ecosystem and water quality in Chishui River basin have been improved significantly. Some provinces have issued opinions on fully implementing the river-chief system, and established a river-chief system in an all-round way in the YREB. Some administrative regions of the

YREB spontaneously signed relevant agreements on inter-basin joint prevention and control. Through establishing the joint watershed prevention and control organization, joint working meeting system and signing joint agreement, the mode of “information exchange, data sharing, joint prevention and control, and joint emergency response” is gradually realized in the river basin.

A green, orderly, coordinated and standardized pattern has been preliminarily established. The key to promoting the development of the YREB under the new situation is to deal with the relationship between self-development and coordinated development well. The coordinated green development is essential component of the coordinated development of the YREB, it is particularly important to scientifically and rationally plan the green industry system which links up and coordinates each other within the river basin. Therefore, the relevant provinces and municipalities shall implement a strict negative list system for industrial access in the river basin. The local and coastal areas are actively promoting industrial upgrading, optimization, transformation and so on, and focusing on how to combine the green development with planting and tourism, etc, so as to truly achieve the coordinated development among the primary, secondary and tertiary industries during the ecological construction within the YREB. In order to promote the ecologic agriculture and industry, some villages are merged and restructured in the YREB to build some special bases, and gradually realize large-scale, intensive and standardized production.

A supervisory mechanism from the central to the local level has been formed. In the Yangtze River basin, the natural resources assets allocation is decentralized, so the determination of the ownership, distribution and structure of natural resources are the prerequisites for implementing this form of supervision. Many provinces have carried out a pilot audit of the responsibility of natural resources assets, and hold leading cadres accountable accordingly. People’s Congress at all levels have established a system for people’s governments to report to People’s Congress and their Standing Committee of the National People’s Congress at the corresponding levels on environmental protection. Central Environmental Protection Inspectors inspect the administrative areas in the YREB on environmental protection related issues. The local provincial party committee and the provincial government environmental protection inspection team shall, every two years, make rectification suggestions and demands on the implementation of the environmental protection responsibilities of local party committees and governments and their relevant departments. And Monitors will publish the main situation and the whole rectification situation through the media to the public. In December 2016, the General Office of CCCPC and the office of State Council published The Measures for Evaluating the Objectives of Ecological Civilization

Construction. The YREB, covering 11 provinces and cities including Jiangsu, Zhejiang, Hubei, Shanghai, Yunnan, Sichuan and Guizhou, has also issued corresponding assessment measures.

An enterprise involvement mechanism has been initially established. According to the decision and deployment of the CPC central committee, under the energetic support of the relevant ministries and commissions of the state, China Three Gorges Corp. is integrating the internal and external resources and tries to: first, establish China Yangtze River Ecological and Environmental Protection Group Co. as a subject to implement the comprehensive environmental protection in an effort to cultivate ecological environment protection industries, develop the environment protection industries in the YREB in both size and strength through market-oriented, professional and corporate operations; second, launch the establishment of China Yangtze River Green Development Investment Fund and Special Fund for Comprehensive Protection of the Yangtze River, encourage various types of capital to increase investment in green development, and guide social capital to focus on ecological environmental protection and clean energy development; third, establish the Yangtze River Eco-environmental Protection Industry Alliance, give play to the industrial synergistic advantages of eco-environmental enterprises, and create a large regional cooperation platform with integrity, professionalism and coordination; fourth, plan to build the national engineering research center for the ecological environment of the YREB to provide technical support for the comprehensive protection. By using the above 4 platforms, basing on the center of continuously improving the water quality of the Yangtze River, urban sewage treatment pilot projects have been implemented in Yichang of Hubei, Yueyang of Hunan, Jiujiang of Jiangxi, Wuhu of Anhui and other provinces and cities presently in a bid to actively explore sustainable, c and propagable new mechanisms and new models in technology, policy, management and commerce etc.. On this basis, the models of plant-network-river (lake) integration and equal emphasis on sludge-water will be comprehensively popularized in 11 provinces and cities along the river, so as to promote water pollution control, water ecological restoration and water resource protection in an all-around manner.

5.2.1.3 Problems in river basin management

Lack of unified and comprehensive river basin legal system¹. The coordinated development of green industries in the YREB not only involves the protection and utilization of resources in the river basin, pollution prevention and control etc., but also involves the development coordination of 11 provinces and municipalities as well as industry,

¹ LI Mengyuan. Research on the Legal Guarantee Issues of Green Development of the Yangtze River Belt[D]. Huazhong Agricultural University, 2017.

transportation, agriculture, animal husbandry, water conservancy, urban construction and other industrial sectors. The current laws and regulations such as *Water Law*, *Law on Prevention and Control of Water Pollution*, *Law on Water and Soil Conservation* etc.. have laid down some regulations on the ecological protection and pollution prevention of the river basin, but some common rules will not solve the problems of the YREB in aspects of ecological civilization construction and coordinated development; second, local government and relevant functional departments have laid down some related provisions for strengthening the river basin management, but there is possibility that local government and some departments maintain the interests, what is more important is lack of communication and negotiation among different departments in formulating rules, resulting that the rules and resolutions formed are inevitable to avoid overlap or conflict and make no material contribution to the coordinated development of the YREB. Therefore, unified and comprehensive river basin laws and regulations are required to provide action guidance for the coordinated development of green industries in the entire river basin and even the YREB.

The green development of the whole river basin calls for further effective coordination. The industrial layout in some areas along the river is seriously homogeneous. There are tens of thousands of chemical enterprises along the Yangtze River, and the total emission of major pollutants exceeds the bearing capacity of the environment. Some polluting enterprises are too close to residential areas and riverside. The environmental protection measures taken by some enterprises remained inadequate. Besides, the sewage discharge outlets, ports, docks and water intakes in some areas is not reasonably arranged, and there exist a lot of risks and hidden dangers¹. Green development of the YREB is closely related to factors such as capital, technology, manpower and market, especially in some cities which develop by relying on the planned economy system, for realizing the transformation and upgrading, such cities must face the market and reasonably arrange their own industries in a market-oriented manner. However, in the practice, the coordinated development process of industry in the YREB process remains dominated by government as the key player and the market mechanism is still playing a relatively weak role therein. The green basic public service level of the YREB varies greatly from area to area. For example, in 2015, the urban green space in the YREB was 1.042 million hectares, of which the urban green space in the Yangtze River Delta accounted for 51.7% of the total in the YREB, while the proportion of the central and western provinces and municipalities was only 28.6% and 21.7% respectively².

1 CHENG Changchun. Promote Yangtze River Economic Belt Green Development by Green Industrial Change[N]. Economic Daily, 2018.

2 HUANG Juan. Thoughts on Green Development of Yangtze River Economic Belt Under the Concept of Coordinated Development-Using Experience on the Green Coordinated Development of the Rhine River[J]. Enterprise Economy, 2018.

Box 5-1 The industry of the YREB has a distinct characteristics of “heavy” and shows a serious homogeneity

From the perspective of the industry layout in the YREB, three industrial clusters have taken shape in the region: the first is heavy chemical industry cluster, except Chongqing and Sichuan, the output value of enterprises above designated size of enterprises engaging in chemical raw material and chemical product manufacturing in the provinces is among the top five. Among others, the industries of iron and steel, petrochemical, energy, building materials has a large scale, with lot of domestically well-known leading enterprises gathering in the region. The second is mechanical and electrical industry cluster, represented by automobile manufacturing industry in Shanghai, Hubei and Chongqing. The third is new and hi-tech industry cluster, which are mainly distributed in large and medium-sized cities in the lower reaches and nodes of the river basin. Since the 12th Five-year Plan period, the industrial structure of the YREB has been constantly adjusted, and the proportion of primary industry has been decreasing; the secondary industry first rose and then fell, reaching a peak of 49.92% in 2011; the tertiary industry fell and then rose; it has grown by an average of 2 percentage points a year since 2011. On the whole, the industrial structure of the YREB is constantly being optimized, but the homogenization of the industrial structure remain serious. One fifth of the industrial output value of the Yangtze River Delta region comes from petrochemical and chemical industries. More than 80 chemical industrial parks or concentration areas have been built, mainly distributed in 8 cities along the Yangtze River in Jiangsu and Zhejiang, 5 cities along the Hangzhou Bay and the coastal areas such as Nantong, Yancheng and Lianyungang in northern Jiangsu. Among the 12 manufacturing sectors in Shanghai, Jiangsu and Zhejiang, the three most developed provinces (municipalities) in the YREB, there are 11 same industries in Jiangsu, 10 same industries in Zhejiang and Shanghai, and 10 same industries in Shanghai, Zhejiang and Jiangsu respectively. In addition, the convergence of industrial structures in various provinces and municipalities along the Yangtze River is also obvious. For example, there are more than 20 chemical industrial parks in 8 cities along the river in Jiangsu, 60% of which are along the two sides of the river. Among the 16 cities in the Yangtze River Delta, 11 cities choose automobile as the key development industry, 8 choose petrochemical industry and 12 choose electronic information industry. The serious homogenization of industrial structure makes it difficult to give play to the comparative advantages and characteristics of different regions, weakens the ability of regional division of labor and cooperation, and is not conducive to the integration process of the YREB.

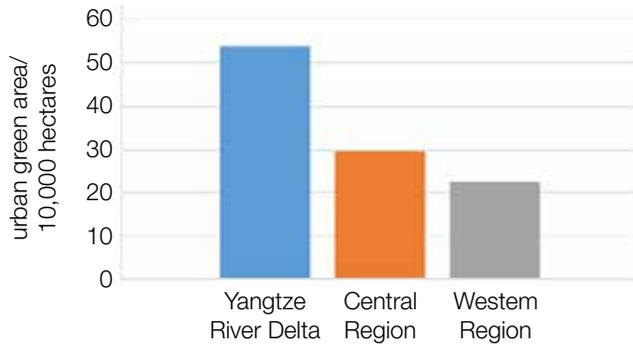


Figure 5-3 Regional difference in urban green area of the YREB

The role of market mechanism in the green development of the YREB needs to be further improved. Judging from the current sources of funds for ecological compensation and green development in the YREB, the central government and local governments are still the key provider of funds, and the most of funds are financial funds from general public budgets of the central government and local governments, including general transfer payments, special transfer payments and horizontal transfer payments. On the whole, the degree of marketization of capital source is very low. At present, it has not been connected with relevant projects such as ecological economy and green economy development, and the path to compensate for ecological losses by economic development has not been fully opened up. The less-developed regions are usually located in the upper reaches of the river basin, facing the dual problems of economic development and ecological constraints. The financial mechanism with the government as the subject cannot meet the demand for green development, and the degree of marketization for financial support is low and the financial support is insufficient. In the developed regions, the sources of funds such as policy-based finance, green finance, and PPP model and enterprise compensation are more diversified, and the degree of marketization of financial support is higher than that of upstream less-developed regions.

The ecological compensation mechanism lacks laws and regulations, and scientific and long-acting ecological compensation mechanism still needs to be improved. As for some river basin ecological compensation problems in the YREB, through active practice of local governments, an effective mechanism has taken shape and relevant laws have been enacted, however, lower level of effectiveness and weak rigid constraint make it difficult to be implemented smoothly, with inadequate power in solving the problem of cross-river basin ecological compensation due to the administrative barriers and other constraints. The mode of ecological compensation is single and the compensation fund is insufficient. Though Guizhou

Province, for example, has actively explored the horizontal transfer payment mechanism between the upstream and downstream in terms of river basin ecological compensation, the compensation funds are simply sourced from government financial allocation. The success of ecological compensation after basin water pollution occurs depends on the financial ability of local governments. For the regions in which the economic strength is relatively weak, the limited compensation is an utterly inadequate measure. Meanwhile, such an ecological compensation advanced by the superior government can not mobilize the enthusiasm of the inferior government to exploit the market compensation, thus restricting the sources of compensation funds, making the compensation mechanism to be weak in adaptability, flexibility and effectiveness. In addition, public involvement in ecological compensation is insufficient, and the participation of non-governmental organizations and citizens is weak, especially in economically under-developed areas, where there are few non-governmental organizations or citizens getting involved in.

“River-chief system” as an important means to solve the environmental problems of the river basin, the executive ability of the executive body is relatively weak. Although local authorities have repeatedly stressed that the river chief office is the river chief office of the Party committee and the government, but the river chief office is set in the water conservancy department, less powerful compared with other power departments, resulting in less driving force in the relevant work and less authority and deterrent in the supervision and inspection notification. Many departments regard the River-chief system as the work of water conservancy department and fail to actively participate in it. The professional competence of local river chiefs remains insufficient. The river chief office undertakes the daily work of comprehensively implementing the River-chief system, which is very strenuous and involves many departments. However, Due to the limit of staffing level, the staff of river chief office at county and township level cannot be fulfilled, with most of them being part-timers, making it difficult to ensure the smooth implementation of the relevant affairs. In addition, the assessment system of “River-chief system” is not perfect, and the assessment subject is not reasonable. The existing assessment is simply a “self-assessment” in the top-down system, without introducing third-party independent evaluation and seeking opinions from the public, thus, the assessment results lack fairness and credibility.

5.2.1.4 Experience of Xin'an River basin management

In order to accelerate the establishment and improvement of the ecological compensation mechanism, the Ministry of Finance, the former Ministry of Environmental Protection and the two provinces of Anhui and Zhejiang have actively negotiated for promotion, jointly signing the Agreement for Xin'an River Basin Water Environmental Compensation in 2012.

By the end of 2017, the two rounds of pilot projects were successfully concluded, and the water environment quality in the river basin was stable and improved further. Economic development has been maintained at a relatively high speed and quality. Public awareness of ecological civilization and participation in ecological and environmental protection have been significantly improved. The linkage mechanism of upstream and downstream of the river basin has been improved continuously and the pilot target has been basically achieved.

The upstream and downstream of the river basin have adhered to the most rigorous ecological and environmental protection system, forced the continuous improvement of the quality of development, strengthened the publicity and guidance to the public, and achieved multiple wins in ecological, economic and social benefits, realizing the goal of promoting the overall protection and coordinated development of the upstream and downstream of the river basin through ecological compensation. After two round of pilots in a row, with the joint efforts of various parties, the comprehensive governance effect of Xin'an River has been continuously amplified with remarkable results. (i) Ecological benefit: Since the pilots, the overall water quality of Xin'an River basin is good and stably positive, the water quality of Jiekou section across the provincial boundary has kept at class II stably and reached the compensation condition for years. Thousand island lake synchronization to improve water quality, nutrition state index decline gradually. The water quality in Thousand-islet Lake has also achieved an improvement in the meantime, with the trophic status index declining gradually. The proportion of natural ecological landscape area in the river basin has hit more than 85%, presenting an excellent ecological landscape pattern. According to the estimation, the carbon fixation and oxygen release of the ecosystem in the Xin'an River basin are 5.743 million tons and 4.93 million tons respectively, and the ecosystem service value of carbon fixation and oxygen release is RMB 7.58 billion and RMB1.68 billion respectively. (ii) Economic benefit: Huangshan City has, by drawing up a plan of ecological economic demonstration zone in Xin'an River in a scientific way and combining with the pilot of ecological compensation mechanism, forced the industry transformation, built a green industrial system. While maintaining a rapid development of economy, the structure proportion of three industries has changed from 12.7, 44.1, 43.2 to 9.8, 39.0, 51.2, achieving a change of industrial structure from "231" to "321". The energy consumption per unit GDP has been reduced gradually and the pollutants emission intensity of main industries has declined obviously. (iii) Social benefit: The pilot of the Xin'an River basin was selected as one of the National Top 10 Reform Cases by the Central Reform Office in 2015. It has obtained the in-depth reporting and high evaluation of mainstream media such as CCTV, People's Daily and Xinhua News Agency. The awareness of ecological and environmental

protection for the public has been strengthened.

Under the current system and mechanism in China, the central government coordinates the relevant provinces and promotes them together through the combination of vertical and horizontal ways, which is a feasible path to establish the cross-provincial ecological compensation mechanism. During the two rounds of pilot, Xi'an River have actively explored the "Xi'an River model" of river basin compensation mechanism. The "Xi'an River model" mainly includes the following three aspects. First, top-level design is launched on the level of nation. Under the current condition that lacks laws and regulations, related to ecological compensation, by issuing the printing of the Pilot Implementation Plan for Water Environment Compensation of Xin'an River Basin and the Pilot Implementation Plan for Horizontal Ecological Compensation of Xin'an River Basin Upstream and Downstream (2015—2017), specifying the water quality objectives, the division of the responsibilities for the two provinces, and clear sources and use of the funds and other key issues, launching an overall design of the compensation frame and ensuring the implementation of the compensation system by national administrative means. Second, in the early stage of the establishment of the compensation mechanism, the appropriate support of central financial funds has played a leading and amplifying role of "seed fund", which is conducive to inspiring the willingness of upstream and downstream of the river basin to actively cooperate and strengthening the guidance and supervision of the central government on local areas. Third, the related provinces in the river basin, by means of agreement, further clarify their respective environmental responsibilities, strengthen the provinces' horizontal communication, establish a long-acting working mechanism of joint monitoring by upstream and downstream, joint law enforcement, emergency linkage etc., which is helpful to push forward the joint prevention and control throughout the whole basin, form a joint effort in water environmental protection gradually, lay a foundation for the horizontal compensation between related provinces next step. At present, the horizontal ecological protection compensation mechanism established in trans-provincial basins such as Water Diversion Project from Luanhe River to Tianjin City, Dongjiang River, Ting River (Han River), Jiuzhou River and Yangtze River has generally followed the framework of the Xin'an River pilot, which has proven that the "Xin'an River model" is a successful model that can be copied and referenced.

Established a perfect linkage mechanism for trans-regional water environment protection, pushed forward the coordinated governance of the river basin's upstream and downstream, enhanced the joint efforts in river basin environmental regulation and administrative law enforcement, realized the unified planning, unified monitoring, unified law enforcement, which has provided a useful exploration to perfect the system of

environmental governance and promote the reform of ecological civilization system. As for the prevention and control of the river basin's water pollution, "Xin'an River model" has effectively promoted the communication and collaboration between governments of the upstream and downstream of the river basin. Anhui and Zhejiang Provinces have broken the administrative boundary, established a river basin upstream and downstream visit and consultation mechanism, actively built a linkage mechanism of cross-regional water pollution prevention and control, pushed forward the joint prevention and control of the whole basin, clearly established the mechanisms such as joint monitoring, joint salvage at flood season, joint law enforcement by polluting enterprises along the river, emergency linkage between Huangshan and Hangzhou and the system like holding a joint meeting on regular basis. In respect of a joint control of trans-boundary water pollution, prevention and treatment of trans-boundary pollution disputes, the upstream and downstream make joint efforts in improving the ability and efficiency of pollution treatment, promoting the benign interaction of trans-regional environmental protection, pushing forward the collaborative control between the basin's upstream and downstream, enhancing the efforts in basin's environmental regulation and administrative law enforcement, realizing the unified planning, unified monitoring and unified law enforcement, and effectively solving the problems of trans-boundary water environmental protection so as to ensure the safety of the river basin water environment.

The "Xin'an River model" has proved through practice that the "Lucid waters and lush mountains are invaluable assets", pushing forward the development on the premise of protecting the ecosystem of the river basin, transforming the "green welfare" of the ecosystem into the "economic dividend" that will benefit the people for a long time. The upstream of Xin'an River basin has carried out the exploration and practice of "Lucid waters and lush mountains are invaluable assets". Huangshan municipal Party committee and municipal government have profoundly realized that green is the biggest advantage for the sustainable development of Huangshan, which must give full play to the comparative advantage of ecological environment, establish an ecological economic system of green, low carbon and sustainable development, based on the working idea of "being fine in primary industry, being strong in secondary industry and being superior in tertiary industry" and propose such two main lines of economic development as "speeding up the new industrialization process and actively pushing forward the tourism plus". In the aspect of agriculture, Huangshan City develops intensive agriculture and increases the added value of characteristic agricultural products such as tea by means of ecological planting, clean processing and reduction of agricultural residue; make use of local quality water resource to develop spring fish farming, with the market price 3 times higher than that of common grass carp, realizing the

transformation of “grass fish” into “gold fish” and promoting the income increase of the masses, especially the poor ones. In terms of service industry, it has not only paid attention to the building of national-level “large scenic spots” like Mount Qiyun and Taiping Lake etc., actively created exquisite “small scenic spots” in rural areas, developed 298 Anhui Province star agritainment hotels, nearly 1,000 farmhouse inns, nearly 200 administrative villages which engage in rural tourism. More than 100,000 farmers engage in tertiary industry based on tourism, with annual per-capita income exceeding RMB 8,000. In respect of industry, Huangshan City firmly upholds the concept of “ecological city”, actively optimizes its industrial structure, and develops leading industries that are adapted to the environment, such as green food, green flexible packaging, automobile electronics and new materials. By virtue of abundant water resources and excellent water quality, a batch of “aquaculture”, such as Master Kong, Liugujian and Wujixue, have been cultivated and introduced. While strengthening the three industries, it also endeavors to cultivate brand competitions and sports economy by relying on natural geographical advantages, the cultural resources such as the hometown of Huizhou merchants and the birthplace of Huizhou culture, and taking the ways of photography and painting etc.. to drive the traveling craze so as to make the protection of local ancient dwellings be a project to enrich the people.

There are still some problems with the ecological compensation of Xin’an River basin, such as single compensation method, low compensation level and high pressure of water quality protection. It is recommended that the upper reaches should strengthen the prevention and control of nitrogen and phosphorus pollution, the provinces of Anhui and Zhejiang should actively promote the diversified compensation, the central government should continue to provide appropriate subsidies for a certain period of time, and a long-acting compensation mechanism should be established for completely horizontal and benign operation. In terms of water quality protection for Xin’an River upstream region, in addition to the total nitrogen, other indicators have basically maintained in Class I or II. The space of further optimization and improvement is narrowed, non-point source pollution is serious and water quality is difficult to be continuously kept at a high level. In terms of funds, the upstream region of Xin’an River is relatively weak in financial resources, with rigorous constraints on economic development and difficulty in sustainable investment. The use of the pilot compensation funds is limited to ecological and environmental protection, and there is no direct or indirect compensation for the ecological protection and people’s livelihood that have sacrificed for the environmental protection of Xin’an River. In terms of water quality protection, it is suggested to keep on deepening the systematic protection and control of river basin, with emphasis on the prevention and control of nitrogen and phosphorus pollution and non-point

source pollution. In terms of compensation mechanism, it is recommended that the two provinces, on the basis of the existing compensation scheme and compensation agreement, establish a normalized compensation mechanism as the goal, continue to deepen cooperation method and content, form strategic cooperation in industrial output, ecological tourism and infrastructure construction, personnel training etc.. across the whole basin, break the time limit of compensation, establish a normalized compensation scheme and compensation agreement through consultation, make a dynamic adjustment according to the changes. The central government shall continue to provide appropriate subsidy for a certain period, coordinate to establish a trans-provincial long-acting basin ecological protection mechanism of cost-sharing, benefit-sharing, and co-governance for ecological protection.

5.2.2 Case analysis of Chishui River basin

5.2.2.1 Favorable conditions

An important economic corridor in the YREB. The Chishui River basin, which runs through four prefecture-level and 13 county-level administrative units in such three provinces as Yunnan, Guizhou and Sichuan, is an important economic corridor for the three provinces to integrate into the YREB, giving birth to the most important famous and superior liquor industry in China. As a pilot model of trans-provincial river basin compensation in the YREB, the ecological compensation in Chishui River basin has been given preferential policies and business guidance by the state. The financial support of the central government, based on the horizontal guidance funds, is conducive to promoting the establishment of a long-acting mechanism for the ecological compensation in Chishui River basin.

Having a relatively clear object of protection. Chishui River basin has four clear protection contents: one is to protect good water quality. As three-quarters water of Chishui River is hidden in the deep mountains, it is the only tributary of Yangtze River not polluted in China. The water quality is good and can reach Class II on the whole. The second is to protect the sound ecological environment. The Chishui River basin is ample in biological diversity, with 10 nature reserves. It is a priority area for biodiversity conservation and an important habitat for the protection of unique and rare fish species in the upper reaches of the Yangtze River. The third is to protect the liquor industry. Chishui River is the water source of national liquor Moutai and other enterprises, and also the water source of well-known liquor brands such as Langjiu and Xijiu. The fourth is to protect cultural resources. Chishui River has been an important channel of economic and cultural exchange in the three provinces of Yunnan, Guizhou and Sichuan since ancient times, which enjoys a unique ecological culture. The current ecological compensation scheme mainly focuses on the protection of good water

quality and ecological environment and has also protected the liquor industry and cultural resources indirectly.

The development of Chishui River basin is characterized by sub-regional gradient. On the middle and lower reaches of the Chishui River basin, utilization of water resources in the three provinces is not balanced, showing a great differences in development level of different areas. The middle and lower reaches are higher than the upper reaches in development level, of which, the middle reaches are the highest in development level. For instance, in Guizhou, only nearly 60 of the basin area and nearly 47% of the trunk length have achieved 79% of the total GDP. In 2015, the GDP of Renhuai City, the most developed city (Moutai distillery is located) amounted to RMB 50.57 billion, accounting for 20.3% of the basin, with the per-capita GDP up to RMB 91,778, while the GDP for the upstream Weixin County in Yunnan was RMB 2.988 billion, accounting for only 1.19% of the basin, with the per-capita GDP at only RMB 7,426, indicating that the gradient difference of development is very obvious. Moreover, the pollution brought by the development of middle reaches is also the most serious, thus, its development must be based on the sustainable development of water environment protection in the upstream to ensure the water to be fine in both quality and quantity. The unbalanced relationship between the upstream and downstream environment and economic interests featuring “upstream protectors suffer poverty and midstream and downstream utilizers become rich” needs to be straightened out by establishing an ecological compensation system to achieve the overall sustainable development of the upper, middle and lower reaches of the basin.

Table 5-2 Areas covered by the Chishui River basin

Province	City	County
Yunnan	Zhaotong City	Zhenxiang County
		Weixin County
Guizhou	Bijie City	Qixingguan District
		Dafang County
		Jinsha County
		Zunyi County
	Zunyi City	Renhuai County
		Tongzi County
		Xishui County
		Chishui City
Sichuan	Luzhou City	Xuyong County
		Gulin County
		Hejiang County
		Jiangyang County
		Naxi District

5.2.2.2 Restrictive factors

As a typical and representative river basin with good ecological environment and low development intensity, it is heavy to undertake the task of continuously safeguarding the “green mountain and green water” of Chishui River. Besides, as a typical poor area, the local development impulse is more intense, and all parties also hope that people in the basin can live a well-off life, and find a way to turn “green mountain and lucid water” into “invaluable assets”. Therefore, the content of ecological compensation shall not only lay focus on ecological protection, but also find a way to harmonize ecological protection and sustainable development through ecological compensation.

The watershed relations are complex. Chishui River basin involves such three provinces as Sichuan, Yunnan and Guizhou, but it is not a plain river basin with a clear upstream and downstream relationship. Firstly, judging from the position of the river basin, the part of Chishui River basin is not fully in the middle and lower reaches, in which, there is a river known as Daoliu River within the territory of Xuyong County, Sichuan Province, which is originated from Sichuan, flows into Yunnan, then converges with Chishui River and leaves the territory of Yunnan, thus, some areas in Sichuan are located in the upstream, midstream and downstream. Secondly, Guizhou and Sichuan, which are located in the middle and lower reaches, have a large part of common boundary sections (nearly 57.4% of the trunk in Sichuan and Guizhou are the common boundary sections) in the middle and lower reaches, making it difficult to accurately define the responsibilities of related subjects.

The population is concentrated but relatively poor. Chishui River basin is a typical under-developed area in China, most of which belong to the poor mountainous areas at the national level. The per-capita GDP is only 34% of the national average. In addition, the Chishui River basin is one of the densely populated areas in Yunnan, Guizhou and Sichuan, especially in such two counties as Zhenxiong and Weixin in the upstream Yunnan, the total population has reached 2 million, but their land area is only 3,817 km², with the population density up to 524 persons per km², far beyond the average population density in three provinces of Yunnan, Guizhou and Sichuan. It is the most densely populated area and also the counties with the lowest per-capita GDP. As the poor population in the river basin is relatively concentrated, the emphasis on ecological protection also needs to take into account the appeals of local development, especially the appeals of a large number of poor people for poverty alleviation. The pressure of economic and social development coexist with that of ecological protection.

Attention should be paid to the hidden danger of non-point source and industrial source in agriculture and countryside. The basin is a typical agriculture area, so the non-point source in agriculture is a main pollution source, especially in Zhenxiong and Weixin within the territory

of Yunnan. The single planting structure, intense use of chemical fertilizer, unreasonable use of pesticide, low recovery rate of agricultural film and low recycling degree of stalk are liable to cause secondary pollution to the surrounding environment and the water quality of Chishui River. There are abundant reserves of coal, sulfur and metal mineral in the basin, with mining industry occupying a considerable share in local economy, especially in Guizhou and Sichuan in the middle and lower reaches, where mineral processing and manufacturing industries have become local pillar industries, thus, hidden risks of industrial pollution sources remain.

The historical arrears for basic public services related to environment are considerable. The basic public services related to environment lag behind, the sewage collection pipe network and garbage collection system in the basin are not sound, the treatment capacity of sewage treatment plants is inadequate, the leachate treatment in landfill is not standard and the basic public services of the overall environment in the basin are lagging behind. Moreover, the water quality monitoring system in the river basin is not sound, most of the tributaries lack automatic monitoring capacity, making it difficult to assess the water quality to some extent and hindering the subsequent joint prevention and control of environmental risks in the upper, middle and lower reaches of the river basin.

5.2.2.3 Practical basis

(1) The central government promotes the establishment of ecological compensation for the Chishui River basin

The Agreement on Compensation for Horizontal Ecological Protection in Chishui River Basin has been signed. The realization and implementation of ecological compensation in the Chishui River basin largely benefited from the strong promotion and coordination of the central government. The Cooperation Agreement on Exploring New Roads for Development and Protection to Promote Guizhou's Ecological Civilization Construction was signed by the Ministry of Environmental Protection and Guizhou Provincial Government in 2017, which clearly proposed that ecological protection compensation across the Chishui River basin should be included in the national pilot. The General Office of the CPC Central Committee and the General Office of the State Council issued the Pilot Program of Setting Up Environmental Supervision and Administrative Law Enforcement Agencies in Accordance with River Basin, taking the Chishui River basin as the sole inter-provincial agency for pilot. In January 2018, the Ministry of Finance, the former Ministry of Environmental Protection, the National Development and Reform Commission and the Ministry of Water Resources convened three provincial finance and environmental protection administrations for two times successively, and held a "compensation agreement" three provinces coordination and communication meeting in Chengdu. Under the strong promotion of relevant ministries and

commissions, in February 2018, Sichuan, Yunnan and Guizhou signed the Agreement on Compensation for Horizontal Ecological Protection in Chishui River Basin, which became the first compensation agreement for the river basin ecological protection across multiple provinces in the Yangtze River basin.

The consultation on the Implementation Plan for Horizontal Ecological Protection in Chishui River Basin was carried out. In March 2018, the Ministry of Ecology and Environment held a promotion meeting for inter-provincial ecological compensation in Chishui River basin in Huairan, Guizhou for accelerating the implementation of the spirit of the Compensation Agreement. In March and June 2018, the Ministry of Ecology and Environment organized and held the seminar on the Implementation Plan for Horizontal Ecological Protection in Chishui River Basin (hereinafter referred to as “the Implementation Plan”) respectively in Chengdu and Beijing, and clarified the specific content of compensation assessment indicators and assessment rules. In July 2018, the Ministry of Ecology and Environment joined hands with Chinese Academy for Environmental Planning released the latest version of the Implementation Plan (draft for comment), which clarified and detailed the compensation term, compensation indicators, compensation objectives, compensation standards and compensation funds etc..

(2) Local governments collaborate to protect the Chishui River basin

1) The three provinces of Yunnan, Guizhou and Sichuan jointly carry out joint law enforcement actions

In order to strengthen the ecological and environmental protection of the Chishui River basin, the environmental protection departments of the three provinces of Sichuan, Yunnan and Guizhou signed the Agreement on Joint Environmental Law Enforcement for Trans-boundary Region of Three Provinces in Guiyang July 2013, forming an environmental protection mechanism of “data sharing, information sharing and joint prevention and treatment”. For the purpose to ensure the orderly, effective and powerful implementation of joint law enforcement, a cooperative security mechanism has been established, that is, establishing of a joint consultation system, an information notification system, a joint monitoring and early warning system, an environmental emergency response linkage system, a unified environmental access threshold system and a coordination mechanism of special funds for the prevention and control of trans-boundary river pollution in three provinces. The joint monitoring of such three provinces as Yunnan, Guizhou and Sichuan was conducted under the guidance of the Notice of the General Office of the Ministry of Environmental Protection on Implementation Plan of Water Quality Joint Monitoring of Trans-boundary (Provincial Boundary and Municipal Boundary) Water Bodies. They have

conducted coordinated law enforcement for many times successively, identified and rectified more than 150 environmental problems, broken the situation of “fighting alone” in river basin protection, and pushed on joint law enforcement in an all-around way. The three provinces of Sichuan, Yunnan and Guizhou have also formulated a series of laws, regulations and policies based on their actual conditions. Meanwhile, the three provinces have also signed the Agreement on Joint Working Mechanism for Fishery Administration in the Jointly-managed Waters of the Chishui River, which will ban fishing for 10 years from January 1, 2017.

2) Guided by the central government, the joint monitoring and law enforcement work of the three provinces are organized and collaborated

Under the coordination of Ministry of Environmental Protection, since 2011, they have gradually established a joint law enforcement mechanism for environmental protection for trans-boundary region in three provinces, realized the joint law enforcement system of “information exchange, data sharing, joint prevention and control”, requiring joint prevention and control of Chishui River’s trans-provincial boundary section, provincial boundary watershed joint prevention and control among provinces, key pollution source joint and cross law enforcement inspection, municipal and county joint law enforcement inspection, trans-regional environmental violation behavior investigation, major environment emergency joint disposal.

3) Yunnan, Guizhou and Sichuan jointly protect the Chishui River basin by issuing a series of plans, regulations and measures

- Yunnan Province

As a birthplace of Chishui River, Yunnan Province attaches great importance to the protection of Chishui River basin and has made a powerful contribution to the development of downstream industry. Yunnan has compiled the Work Plan of Yunnan Province’s Compensation and Incentive Policy for Promoting Ecological Conservation and Restoration of the Yangtze River Economic Belt on provincial level, and supported the establishment of a trans-provincial river basin ecological protection compensation mechanism for water bodies, with the ecological compensation mechanism covering 47 counties and districts including Zhaotong City. It has compiled and completed the Opinions on Establishing the Ecological Compensation Mechanism in Chishui River Basin within Yunnan Province, clarified the general requirements, governance priorities, capital management requirements and division of responsibilities at all levels, and strongly guided the protection work of Zhaotong City, Zhenxiong County and Weixin County in the basin. Zhaotong City, Zhenxiong County and Weixin County on the upstream of Chishui River have carried out actions of “efforts in seven aspects” to protect the Chishui River basin, adjusted the industrial structure and

canceled some key projects in the basin. They have implemented environmental access and banned all industries from entering the range of 38 square kilometers of Chishui River. Since 2014, the two countries have jointly restructured 24 enterprises involving coal within the basin by means of closing down, suspending operation, merging with others or shifting to different line of production. To strengthen the ecological governance, Zhenxiong County has completed more than 960 hectares of afforestation of closed hillsides and artificial afforestation, more than 9,500 hectares of returning farmland to forests and returning grazing land to grassland. Weixin County has implemented the water and soil conservation projects in Zhaxi Town and Shuitian Township, controlled 4 small river basins and 49 km² soil erosion area, planting 1,050 hectares of water and soil conservation forest and economic fruit wood and implemented blocking and governance of 1,700 hectares.

- Guizhou Province

In November 2007, Guizhou government implemented the *Planning of Ecological Protection Zone for the Upstream of Chishui River (within the Territory of Guizhou)*, taken “environmental pollution and ecological environment within the ecosystem function protection zone are generally governed, regional ecological environment is obviously improved and the ecosystem begin to move towards virtuous circle” as long-term goals of planning, and delineated the special wellhead protection areas and special economic zones for national liquor, strictly controlled the pollution of water pollutants to the national liquor special wellhead protection areas. Since then, Guizhou Province has released more than 40 relevant regulations, documents, plans and schemes related to river basin protection. In terms of financial support to the projects, Guizhou Province has further increased its capital investment in the Chishui River basin. Since 2014, the provincial finance has injected RMB 50 million into environmental improvement of the Chishui River basin, and Zunyi City has also invested about RMB 10 million in the upstream Bijie City annually in the way of ecological compensation. Kweichow Moutai Company Limited will donate RMB 50 million a year to prevent and control water pollution in the Chishui River basin per annum. For the aforesaid three funds alone, the total investment has reached RMB 110 million. In terms of fund-raising, Guizhou Province explored the ways to solve the problem of capital bottleneck through the pilot program of ecological civilization reform and proper river project application, tried to improve the investment and financing system of ecological and environmental protection in the river basin, boldly introduced social funds, and strengthened cooperation with international and domestic famous organizations and enterprises; finance departments at all levels will also explore the building of investment and financing platforms, strengthen the concept of asset management, and make money and pool wealth from

assets; the provincial environmental protection department has also joined hands with the provincial finance department, the provincial government finance office and Zunyi municipal government to explore the building of a higher-level platform for the connection between government, banks and enterprises, open a “green channel” for eco-environmental investment and financing in the Chishui River basin, and raise funds for the construction of pollution source control projects through multiple channels in PPP mode.

Ecological compensation system is one of 12 regulations of Guizhou Province’s Chishui River basin on river ecological civilization system and mechanism reform pilot. Since 2013 when Interim Measures of Guizhou Province on Ecological Compensation for Chishui River Basin Pollution Prevention and Control was issued, various governments at all levels and scientific research institutes of Guizhou Province have studied and explored the river basin’s ways of ecological compensation, responsibility identification, use of compensation fund, supporting system and mechanism etc.. In addition to government-led ecological compensation, Guizhou Province is also actively exploring more ways of ecological compensation. Since 2015, the “Global Environment Fund (GEF) Guizhou Chishui River Basin Ecological Compensation and Global Important Biodiversity Conservation Demonstration Project” was implemented in Renhuai, Guizhou Province, aiming to establish a market-oriented ecological compensation mechanism based on the concept of “payment for watershed service” (PWS) in the pilot of Chishui River basin in Guizhou. In 2018, more than 20 households of villagers and 3 liquor enterprises of Renhuai City in the basin pilot area signed the ecosystem service contract under the coordination of Renhuai Municipal Environmental Protection Bureau, Renhuai Municipal Environmental Protection Promotion Association and Wuma Town Government, and explored the establishment of an eco-compensation fund management model with trust fund as the core. The compensation under the agreement is not only limited to water quality, but also extended to the ecosystem services with broader implications, taking into account more ecosystem values such as water and soil conservation, changes in land use patterns, and fish biodiversity. The subject of compensation is not only the government, but also the government, liquor enterprises and social organizations; the object of compensation is not only the local government, but also the farmers and the investors and constructors of environmental protection in Chishui River. In addition to financial compensation, other ways of compensation like policy compensation and technical compensation are also in place.

- Sichuan Province

Sichuan Province also attaches great importance to the ecological and environmental protection of the Chishui River basin. Through the preparation of the Environmental

Protection Plan for the Chishui River Basin (Luzhou Section) (2014—2020), it has strictly controlled the project access, promoted the environmental impact assessment of planning projects and strengthened the control of pollution source; vigorously pushed forward the pollution abatement by strengthening the control of industrial pollution sources, urban pollution control, and agricultural and rural pollution control, closing and ceasing more than 150 small paper mills and brewers; advanced the construction of forestry ecological system in an all-around manner, intensified the soil improvement and rehabilitation and the management of natural ecological protection zones and earnestly enhanced the ecological conservation; issued the documents such as the Environmental Centralized Rectification and Supervision Scheme for the Chishui River Basin (Luzhou Section) and the Assessment Measures on Environmental Centralized Rectification and Supervision Scheme for the Chishui River Basin (Luzhou Section), pushed on the implementation of river-chief system in an all-around way, launched special monitoring and implemented incentive and restrictive assessment. On the basis of the Agreement on Compensation for Horizontal Ecological Protection in Chishui River Basin and the Implementation Plan for Horizontal Ecological Protection in Chishui River Basin, Sichuan Province is drafting the Rules of Sichuan Province for Implementation of Horizontal Ecological Protection in Chishui River Basin, specifying the model that the funds are jointly raised by the province, city and county, the allocation right of the funds is enjoyed by the city and the county and the ecological environment protection responsibilities are jointly assumed by the city and the county. The efforts have played a supporting and coordinating role on provincial level and activated the linking and coordinating role of Luzhou City in connecting the provincial level and county level.

5.2.2.4 Common appeals

The current compensation criterion is difficult to determine the responsibility of sections with common boundary and the value of ecological environmental protection scientifically. Due to a great number of sections with the common boundary of Sichuan and Guizhou, the current solution, for the purpose of realistic operability and timeliness, has not carried out elaborate and scientific calculation, distinguished the respective responsibilities of each subject of the common-boundary sections in a proper and scientific way, but taken a treatment way of simple equally sharing, in this case, the measure is not so reasonable and fair and cannot accurately clarify the responsibilities and obligations of the parties concerned. In addition, for the existing scheme, the amount of compensation funds is not based on scientific calculation of the region's direct cost in water environment protection and the loss of development opportunity and the positive externalities brought by the middle and lower reaches of the Yangtze River basin. As the Chishui River basin is located in the upper

reaches of the Yangtze River, the water quality is good throughout the river basin (Class II stably for the trunk and Class III stably for the tributaries). First, it has made a positive contribution to providing good water for the middle and lower reaches of the Yangtze River and the positive externalities arisen therefrom have exceeded the range of the river basin itself; second, according to the latest requirements of building the ecological barrier on the upper reaches of the Yangtze River and the comprehensive environmental protection of the YREB, the water quality of the river basin can only remain stable on the basis of current good condition without worsening, which will inevitably increase the difficulty of the protection and the restraint to the economic development of the region; third, the economic and social development of the river basin is relatively backward, with large quantity of poverty-stricken peoples, wide range and deep level in poverty; at the same time, the region also faces the dual tasks of ecological environment protection, poverty alleviation and industrial revitalization, etc., the current solution cannot accurately provide a scientific ecological compensation criterion obviously.

The existing compensation ways and funds are limited, which are not powerful enough to drive the sustainable development of the river basin. For ecological compensation of the river basin, on the one hand, the direct cost of pollution control and ecological protection in protected areas should be taken into account; on the other hand, the cost of development opportunity lost for ecological conservation in the protected areas shall also be considered. The current ecological compensation scheme of Chishui River basin has given insufficient consideration to the cost of development opportunity lost for ecological conservation in the protected areas, which has resulted in inadequate driving force for the sustainable development of the protected areas. First, the way of compensation is single, with fund compensation as a main approach, lacking insufficient hematopoietic ability; second, the use of funds is limited, which is obviously insufficient to support regional sustainable development and maintain the sustainable livelihood of relevant groups to make up for the loss arisen from the development opportunities. The construction of domestic sewage treatment plants in towns(townships) of three counties has basically been completed or the funding sources have been in place, and only a few have not started in construction yet.

The participants are single, which can't effectively promote the common governance among multiple subjects. The participants are mainly the governments, which has not involved in the important economy (large liquor enterprises in the middle reaches) and the masses, which depend on the development of the ecological environment of the river basin, so it failed to effectively promote the multiple subjects to participate in the joint protection and governance of the river basins. The relevant enterprises have created huge economic benefits

by relying on good ecological environment resources. Meanwhile, they have also caused considerable impacts on river basin water pollution, but they have not assumed corresponding social responsibilities in the ecological compensation mechanism; the people who lose the opportunity cost of development due to the construction of ecological protection have not got sufficient compensation from the mechanism of ecological compensation. The people lack the sense of obtaining the benefits from ecological compensation and are not highly motivated, which makes the ecological compensation not adaptable to the rapid promotion of ecological construction, social and economic development, poverty alleviation and difficulty tackling etc.

A community of interests and lacks lasting protection incentives has not been established. On the upper, middle and lower reaches of Chishui River basin, the utilization of the water resources by the three provinces is not balanced. Though the agreement signed among them is conducive to the establishment of joint prevention and control of the upper and lower reaches by the three provinces, however, as the compensation agreement failed to give an overall consideration to the economic and social development on the upper, middle and lower reaches and the left and right banks of the river, the unbalance for the basin water resource utilization will continue to exist. In addition, the development of liquor industry in Guizhou and Sichuan faces different policy environment, which will continue to expand the unbalance of three provinces for the basin water resource utilization. The interests of joint protection cannot be transformed into the interests of economic and social development shared by the three provinces, which makes it difficult to motivate the lasting protection of some provinces.

5.2.2.5 Recommendation Improvement

The responsibility relationship of the stakeholders in the basin ecological compensation shall be established. In the current “Implementation Plan on Horizontal Ecological Compensation in Chishui River Basin” (Draft) and “Recommendations on the Establishment of Ecological Compensation Mechanism in Yunnan Province in Chishui River Basin”, the conformance of the section water quality standards are both considered as the main assessment index, and the proportion to assess the water quality is very large in the assessment rules. However, the ecological protection compensation should be a means to reasonably compensate the ecological protectors on the comprehensive consideration of the ecological protection cost, the development opportunity cost, the ecological products and the ecological service value. Therefore, it is suggested to properly adjust the assessment rules in the Implementation Plan, and to add the relative indexes such as the opportunity cost loss value and the ecological service contribution value of the compensation object.

The ecological compensation fund source for Chishui River Basin shall be enriched.

At the present, a special fund for the ecological compensation fund of Chishui River Basin, is only established jointly by Yunnan, Guizhou and Sichuan Provinces, and the Central Government, and the single fund source channel and a large fund raising amount will bring the governments at all levels with a new debt pressure. In some regions, the compensation funds are depended on the upper-level funds and the economical environment protection investment increases sharply, which will seriously influence the collection of the economical compensation fund. At the same time, the environmental protection tax paid by the beneficiary enterprises is not enough to make up for the negative effect brought by them, that is, the enterprises fail to fully assume the ecological compensation, which is not conducive to advance the ecological compensation as scheduled. A reasonable compensation fund source is the important focus for the basin ecological compensation mechanism to exert its effect. A government-coordinating, multi-level and multi-channel ecological compensation mechanism shall be established, with the government leading as the basic principle, the beneficiary enterprises mobilized to participate in the basin environmental protection and the ecological compensation, and the preferential loans from the financial institutions shall be strived for, which will be conducive to promote the diversification and rationalization of the compensation fund source structure. Therefore, firstly, the integration of the financial funds at all levels shall be increased. By the consolidation of the vertical integration of the upper-level, middle-level and lower-level funds and the coordination of the horizontal integration of the funds related to the environmental protection tax retention, the ecological function zone transfer payment fund, and the carbon emission trading fund by the finances at all levels, a source of the ecological compensation fund with a stable amount and diverse channels is formed step by step. Secondly, the market-oriented funds shall be promoted and stimulated to participate in. The conditional regions shall be promoted to issue the local government special bond for the environmental protection, the financial institutes and the powerful enterprises (such as Maotai Group) mobilized to participate in establishing the special funds for the ecological compensation, the participation of the social capital deepened further, and the compensation capital amount shall be guaranteed. Thirdly, the financial institutions shall be encouraged and guided to innovate for the green financial service. The green credit support mechanism such as the financial discount, the insurance premium, etc.. shall be explored to establish, and the financial institutions shall be encouraged to increase the green credit distribution. The green guarantee shall be supported to develop, and the various guarantee mechanisms for the energy-saving and low-carbon, eco-environmental protection projects improved, and the stability of the compensation fund source shall be consolidated. Fourthly, the current bias trend that the ecological compensation fund and the water pollution

prevention fund are managed and used as the same nature shall be transferred. Due to the complexity and additionality of the water quality response, the loss of the development opportunity cost and the public product production are not necessarily and directly reflected in the form of the “improvement” of the water quality. It should be emphasized that the ecological compensation funds are the compensation for the loss of the development opportunity cost, and the purchase of the production of the ecological public products, and it shall not be directly linked to the water quality requirements in the aspects such as the assessment.

The use direction of the ecological compensation funds shall be expanded. At the present, the use scope of the ecological compensation funds is not specified in the compensation agreements and the implementation plans in Yunnan, Guizhou and Sichuan Provinces. If the fund use scope is strictly in accordance with the one of the water pollution control fund, it will be narrow, which is not conducive to supporting the green development and the mechanism construction projects, contrary to the basic principles of the ecological compensation development opportunity cost and the ecological asset value. If the use scope of the funds is not reasonably constrained, it may be used for other purposes, not widely supporting the ecological civilization and the environmental protection, contrary to the original intention of the policy that the ecological compensation supports the environmental protection. It is recommended to specify the use direction of the ecological compensation funds according to the fund sources and categories. Firstly, for the funds supported by the nation, if they come from the central finance’s special funds for the water pollution, they must be strictly managed in accordance with the relevant requirements of the document Measures for the Administration of Special Funds for the Prevention and Treatment of Water Pollution, and the special funds shall be used exclusively in the fields such as the water pollution prevention and treatment, the good water body and the drinking water source ecological environment protections. Secondly, for the horizontal compensation funds sponsored by the 3 provinces, the use scope of ecological compensation funds shall be flexible, and the funds can be used in the fields for promoting the development and improving the livelihood, such as the supports of the environmental protection capacity construction, the environmental protection mechanism and policy construction, and the ecological township construction demonstration, the ecological immigration relocation, the River Protector’s job subsidy, etc.. Thirdly, in the process of the next marketization and diversified ecological compensation mechanism construction, the key enterprises and the socialized capital shall be introduced into the ecological compensation, the use scope of the ecological compensation funds further broaden to the compensation opportunity cost and the ecological asset value fields, the fields

such as the poverty alleviation, the infrastructure construction, the ecotourism development, etc.. the 3-province tourism circle built, the adjustment of the High-Energy-Consumption, High-Pollution and Resource industries such as the upstream coal-related industries shall be promoted so that the upstream and downstream people can share the ecological welfare, and the poverty in regions such as Zhenxiong and Weixin, shall be changed.

A diversified and marketized ecological compensation method shall be built gradually. Under the background that National Development and Reform Commission and Ministry of Finance are inquiring the Action Plan for Building a Marketized and Diversified Ecological Protection Compensation Mechanism, Chishui River basin is the first multi-province compensation pilot in the YREB, the practice and the establishment of a marketized and diversified ecological protection compensation method shall be sped up. It is recommended to refer the ecological compensation experience implemented widely abroad, and guide the enterprises and the beneficiary industries to enter the ecological compensation. On the middle-stream and downstream of the Chishui River basin, there are many famous liquor enterprises such as Maotai, where is popularly named as Liquor River, forming a trillion-level industry scale. At the end of 2017, Maotai's stock market value has exceeded 150 billion US dollars, and the will to protect the water quality on the upstream of the Chishui River is stronger. Maotai Group also continuously recognizes that the good water quality of Chishui River plays a key role in the ecological products, and demonstrates its will to fund for and participate in the ecological compensation in Chishui River Basin. Secondly, it is recommended to actively innovate for the non-fund compensation mode, promote the implementation of the economic assistance compensation modes such as the Counterpart collaboration, the industrial parks and the joint-construction parks, and promote the implementation of the technical support compensation modes such as the personnel training, the population migration. The employment opportunities for the people in the poor regions shall be improved by creating jobs such as River Protector, Environmental Investigator. The beneficiary enterprises shall be encouraged to employ the people related to the ecological product supply regions, forming a stabilized employment mode. In the industrial parks in the ecological beneficiary areas, a certain space shall be specially allocated to build an enclave park to promote the economic development in the underdeveloped areas while reduce the environmental pressure in the compensated regions.

The ecological compensation matching system mechanism shall be improved. The objective of the ecological compensation is, by the upper-level fund guidance to the lower-level and the beneficiary's financial subsidies to the compensated parties, to compensate for the performance assessment to form the mutual restraint, to promote the joint prevention and

control of the upstream and the downstream, the river basin co-governance, and gradually form the benign interaction between the beneficiaries and the compensated parties, and jointly protect a clear water. But it is impossible to form a strong policy combination only depending on the implementation of the single ecological compensation policy, so the linkage of all the various environmental protection policies shall be strengthened, which can further improve the policy performance of the ecological compensation. Firstly, it is recommended to strengthen and play the core role of the River Protector System, rely on the organizational basis and coordination role of the provincial, municipal, county and township level river protector system, promote the ecological compensation and achieve the overall advancement. Secondly, it is recommended to strengthen the linkage of the space management and control, the total control policies with the ecological compensation, and link the implementation requirements of the environmental management and control systems such as the total control, the sewage permit, the regional limit and approval, and 3-line and 1-list, with the ecological compensation funds and the performance assessment. Thirdly, it is recommended to improve the joint prevention and control mechanism of the 3 provinces in Chishui River Basin, and establish the joint prevention and control mechanism with the unified planning, monitoring, supervision, assessment and coordination, jointly carry out the pollution remediation actions of the industrial enterprises in the river shore, strengthen the troubleshooting of the environmental risk points in the river basin, and establish an environmental emergency consultation mechanism. Fourthly, it is recommended to incorporate the results of the ecological compensation performance into the performance assessment of the leading groups of the counties (cities) within Chishui River Basin of the Yunnan, Guizhou and Sichuan provinces, and properly raise the assessment weight.

The policy coordination shall be further promoted. Limited by the natural conditions of the high mountains and deep valleys, Chishui River Basin is explored and developed insufficiently, so it has a large poverty area and a severe poverty, facing the double contradictions between the economic development and the environmental protection, and needs urgently the sustainable development. The construction of the ecological compensation mechanism is the strategy choice to achieve the sustainable development, and the measures such as the launch of the ecological poverty alleviation, the implementation of the rural revitalization strategy, the guidance and specification of the industry development under the ecological compensation mechanism, are conducive to improving the production conditions of the local residents, guiding the extensive industrial transformation and upgrading, improving or protecting the ecological environment in Chishui River Basin, which is the important way to achieve the sustainable development. Therefore, besides the core compensation system, the

management methods, the action programs and the layout plans corresponding to the aspects such as the scientific and reasonable use of the compensation fund to conduct the sustainable development, the rational excavation of the ecological product value to develop the ecological product industry chain, and the assessment for the compensation system's implementation, are used to guide the practice. How to systematically plan the functional space and strategy according to the ecosystem's functional characteristics, and combine the advantages of the different types of ecological products to accurately design the mode of ecological products, also needs to follow the scientific methodology to explore.

5.2.3 Countermeasures of total nitrogen emission in Danjiangkou

5.2.3.1 Variation of total nitrogen in river basin

The total nitrogen concentration (hereinafter referred as “total-N”) in Danjiangkou Reservoir area and the upstream basin is generally high. The average total-N in the Danjiangkou Reservoir area was reduced in the past two years, but it was still at a high level (1.19 mg/L in 2016) during 2006—2016. In 2016, among the 39 sections with monitoring data on total-N in the basin water, there are 13 sections with the total-N of class I—III, accounting for 33.3%, 14 with the total-N of class IV—V, accounting for 35.9%, and 12 with the total-N of class V, accounting for 30.8%. Among them, the total-N concentration at the middle sections of dam, Taocha section of water intake and Yangwei section of Han River increased by 13.9%, 51.9% and 49.5% respectively in comparison with those in 2006. The total-N in Zijingguan section of Danjiang River increased by 36.5% in comparison that with in 2012. In 2016, the average total-N in 112 national key lakes and reservoirs was varied from 0.11mg/L (Lugu Lake) to 6.62mg/L (Aibi Lake), Danjiangkou Reservoir is ranked the 68th from low to high. The overall situation is not optimistic.

The existing monitoring statistics and research foundation is weak, it is necessary to further study the accurate prevention and control measures. At present, the environment statistics are mainly COD and ammonia nitrogen, and the total-N index has certain missing, it is inefficient to support precise prevention and control measures. Based on the source apportionment model and the existing data in 2015, the total-N into the Danjiangkou Reservoir area was about 52,000 tons, 67.7% from the Hanjiang River and 12.3% from the Danjiang River, the remaining 20% came from other reservoir river and reservoir area source pollution; in terms of the emission source, 50.7% of total-N was contributed by the living source, 20.6% by the planting, 19.0% by the livestock and poultry, and only 1.0% by the industrial point, the remaining 8.7% from the natural background; when classifying from the administrative district, 49.9% was sourced from Shaanxi Province, 40.2% from Hubei

Province, 6.6% from Henan Province, and the remaining 3.3% from the upstream of Sichuan and Chongqing.

The algal blooms appeared in some areas of Danjiangkou Reservoir area, but the mechanism of algal blooms is not clear, the high concentration of total-N may be the main reason. According to the Measures for Evaluating the Environmental Quality of Surface Water (Trial), the water quality was maintained at Class II in the Danjiangkou Reservoir area from 2006 to 2016 with the comprehensive nutritive index of 30.6—35.7 (The limit between poor and medium nutrition is 30), which is generally at the level of medium and poor nutrition. As some dams have been constructed on the inflow river and the water flowing in the reservoir area slows down, the water exchange capacity becomes worse. In May, 2015, tens of kilometers of abnormal algae growth zone was observed near the dam of Danjiangkou Reservoir. Although it disappeared quickly, it rings the alarm about the risk of algal blooms. Judging from several water quality indexes, such as permanganate index, total-P and total-N, the permanganate index and total-P of Danjiangkou Reservoir were stably maintained at Class II from 2006 to 2016. Total-N was fluctuated between 1.09—1.46 mg/L since 2008, and the high concentration of total-N may be the main cause of algal blooms in Danjiangkou Reservoir. Reservoir ecosystem succession usually takes over 10 years. The Danjiangkou Reservoir was put into use since 2014. The steady operation has not been reached as designed, including normal storage water level of 170 m and the effective water transfer amount of 9.5 billion cubic meters. The ecological system in the reservoir area has not yet reached the equilibrium. Maybe the algal blooms is just an accidental phenomenon in the process of succession, however it may more likely occur after the reservoir is normally dispatched. The critical conditions of algal blooms are different in various lakes. At present, the mechanism of algal blooms in Danjiangkou Reservoir is not clear yet, and the research needs to be further studied.

5.2.3.2 Main countermeasures

Strengthen the monitoring and research on total-N to lay the solid foundation for management decision: it is necessary to strengthen the monitoring and statistics of total-N index of waters and pollution sources, and provide the detailed data basis for further refining analysis of total-N sources and migration and transformation laws; study the mechanism of eutrophication of Danjiangkou Reservoir, and determine the threshold of nitrogen and phosphorus concentration and hydrodynamic conditions, which provided the basis for effectively preventing the eutrophication of Danjiangkou Reservoir; establish a monitoring and evaluation system for the carrying capacity of the water environment and carry out monitoring and early warning on a pilot basis; study how to establish a total-N emission

control system in the water source area of the middle line of South-To-North Water Transfer Project; explore the mechanism of eco-compensation in the water source area and the affected area of the middle line of the south-to-north water transfer project, incorporate the cost of ecological protection into the water price of the affected area, and establish a long-term eco-compensation mechanism¹.

Promote ecological protection of river basins and intensify emergency prevention and control of algal blooms: it is necessary to further intensify management to small river basins, water and soil erosion, ecological isolation zones and rocky desertification zones, and build artificial wetland water purification projects in accordance with local conditions of inflow rivers to improve the water environment carrying capacity; strictly implement the space development system of protected area. The deadline shall be specified for the withdrawal of villages, agricultural land, enterprises and institutions and buildings within the ecological red line, which illegally occupied the coastal line and have a great impact on water quality. The file shall be established for each risk source in accordance with the principle of “one file for one source”, so as to implement dynamic management. The emergency mechanism shall be formed for sudden water pollution incidents in water source areas, and the emergency plans shall be formulated scientifically and emergency exercises carried out. For algal blooms, the emergency capacity shall be built and emergency material shall be reserved, meanwhile, the emergency plans shall be formulated to carry out emergency exercises, so as to effectively prevent the occurrence of algal blooms in tributary.

Strengthen construction and operation of infrastructure, and deepen comprehensive prevention and control of non-point sources of pollution: it is necessary to improve the supporting pipe networks of existing sewage plants as soon as possible, and implement rain-sewage diversion in new urban areas; renovate the joints and inspection wells of rainwater and sewage pipeline to control leakage; and solve the pollution from overflow and initial rainwater pollution caused by rain-sewage mixing in the pipeline network. Measures shall be taken to promote the upgrading of sewage treatment plants in the water source area, and reduce nitrogen and phosphorus pollutants. The monitoring and statistics shall be carried out in an all-round way for total-N emission from municipal sewage treatment facilities, and the total-N shall be listed as a daily monitoring index. According to the concept of “balanced cultivation and recycle development”, the comprehensive measures shall be taken to utilize livestock and poultry wastes, prevent and control the planting pollution, and control the rural domestic pollution; promote scientific agricultural planting technology, optimize agricultural

¹ WANG Dong, QIN Changbo, MA Lekuan, WANG Jinnan. Research in Reconstructing the System of National Water Quality Management in China[J]. Environmental Protection, 2017, 45(8):49-56.

planting methods in mountainous areas, rationally fertilize and reduce total-N pollutant emissions.

5.3 International Watershed Management Experiences

A lot of valuable experiences have been learned in management organization model, eco-environmental management and eco-compensation practices in some typical international trans-boundary watersheds, such as Mississippi, Tennessee, Amazon, Rhine and Danube.

5.3.1 Mississippi Valley

As a large basin, Mississippi Valley is jointly managed by various sectors and groups. The mature experiences have been obtained at the upper reach of Mississippi Valley. The Upper Mississippi Valley Association was originated from the Mississippi Valley Committee and dismissed under the Reagan Administration in 1975—1980. Either the Ministry of Natural Resources or the Ministry of Agriculture and Transportation will be designated by the Governor to perform the state functions; usually the former was selected since 1980. Federal agencies, USACE, USFWS, USGS, USEPA, and the Maritime Authority are all technical advisers and NGOs; they encourage the public participation which has greatly promoted the watershed management.



Figure 5-4 Map of Mississippi Valley

The management experiences in the Mississippi Valley are mainly composed of six aspects below:

(1) Strictly implement the drainage permit system: The NPDES (National Pollutant Discharge Elimination System) licensing system in the United States is to address water pollution through managing point sources with pollutants discharged into United States waters. The EPA authorizes each state government to issue, administrate and enforce the project licensing; the rainwater runoff that absorbed pollutants, such as garbage, chemicals, oil, and dirt/sediment, can cause water pollution of rivers, streams, lakes and coastal waters. The NPDES rainwater program aims to prevent harmful pollutants from being discharged into local surface waters with rainwater runoff.

(2) Federal watershed management policy: Various federal agencies, including the Ministry of Commerce and Ministry of National Defense, have played certain role in managing or supervising water resources. Some agencies have played a major role in water policy, such as the U.S. Army Corps of Engineers (USACE) and the Bureau of Reclamation. Especially, the USACE manages about a quarter of hydropower in the USA. It also created and manages water infrastructure projects and maintains waterway navigation along Mississippi River.

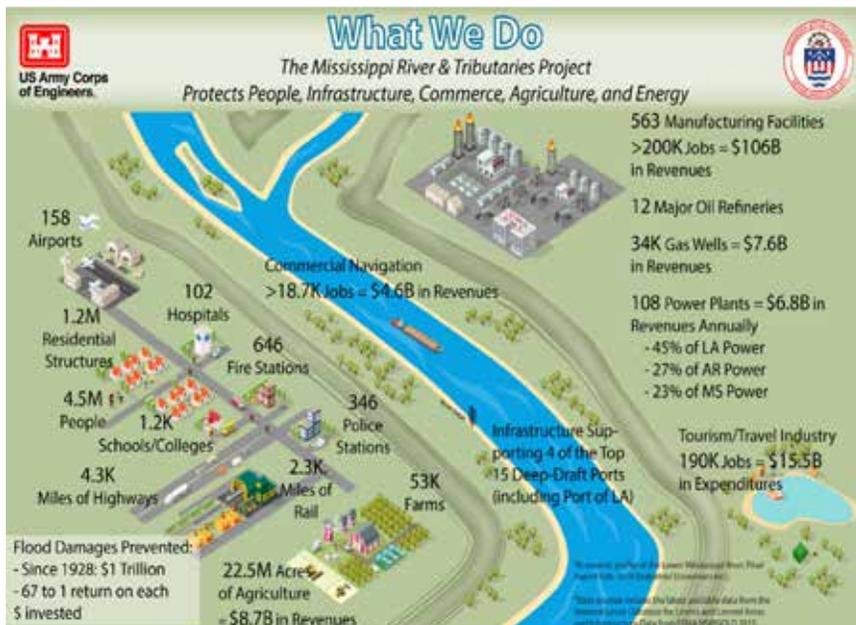


Figure 5-5 Plan of the USACE's projects along Mississippi River

(Source: USACE)

(3) Coordination and federal cooperation mechanism among states: The MICRA (Mississippi Interstate Cooperative Resources Association) is an organization composed of 28 state natural resources management body with rights to manage fisheries within Mississippi Valley. It aims to improve the management of fish and other aquatic resources across its jurisdiction. The UMRBA (Upper Mississippi Valley Association) is responsible for coordinating projects and policies related to Mississippi River of states; the LMRCC (Lower Mississippi River Conservation Commission) focuses on habitat restoration, long-term natural conservation planning and economic development.

(4) Special national action plan: One of the main tasks of the Hypoxia Task Force (HTF) is to develop and implement nutrient reduction strategies in the states. The figure below shows the priority watersheds of the HTF states.

Priority Watersheds of the Hypoxia Task Force States

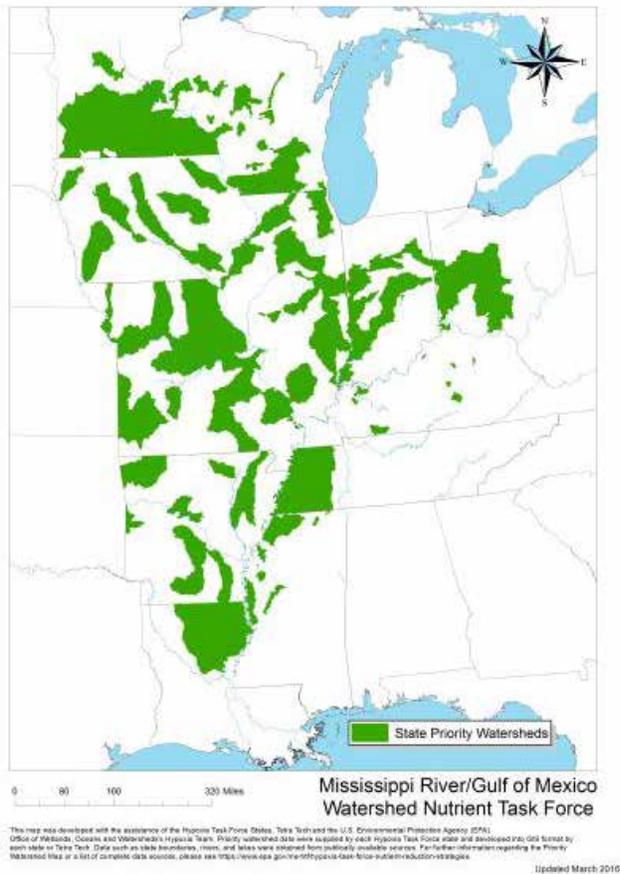


Figure 5-6 priority watersheds of the HTF states

(5) Multi-channel fund-raising: Most of the collaborations and initiatives benefit from multi-channel funding, which can include federal, state and local funds, as well as participation by corporations and NGOs. Several states in the Mississippi Basin have approved significant funding for conservation based on referenda approved by voters in those states.

(6) Drainage monitoring and evaluation system for the Mississippi River: The National Oceanic and Atmospheric Administration (NOAA) covers most of the monitoring of the dead zone in the Gulf of Mexico. The United States Geological Survey (USGS) has sophisticated monitoring techniques and provides data on river water quality. The EPA has its own monitoring of different data points and individual states sometimes have their own monitoring systems which have relevancy to the Mississippi.

5.3.2 Tennessee River Basin

The Tennessee and Cumberland River Basins are two of the most biologically diverse river systems in North America. Home to more than 300 species of fish and 125 species of freshwater mussels, these river systems are an irreplaceable part of Tennessee's natural heritage. Their watershed management experiences are mainly embodied in five aspects below:

(1) Comprehensive management: The Nature Conservation has many successful management experiences in the Tennessee River. It works with partners to strategically prioritize, remove or modify aquatic barriers, with purposes of helping to improve agricultural practices to keep these rivers cleaner, and bringing science, planning, and project management expertise to watershed planning, ecosystem restoration and river management efforts.

(2) Eco-compensation approach: A watershed planning approach for the Stones River provide recommendations related to the compensatory mitigation techniques. Federal regulations outline allowable forms of compensatory mitigation for wetland impacts. These include restoration, creation, enhancement, and preservation. In Tennessee, this preference is given to restoration over other forms of compensation. Compensatory mitigation for stream impacts is guided by a classification system which includes replacement, restoration, enhancement II, enhancement I, and preservation categories for determining credit ratios (TDEC 2004). Replacement, the removal of artificial structures and re-creation of a natural stream channel, and preservation are applied less often than restoration and enhancement.

(3) Diversified financing system: The Tennessee River Basin Authority is committed to providing cleaner and more reliable energy for its customers at the lowest possible cost,

especially in the area of electricity. Through some measures, such as installing control devices and expanding power upgrades, these actions have enabled our diversified generating fleet to produce more than half of their power from carbon-free sources and the Tennessee River Basin Authority can maintain a lower price for its customers.

(4) Water resources development and economic development: Through its partnerships with other economic development organizations, TVA's help foster capital investment and job growth in the area. TVA Economic Development works to attract new companies which results in more jobs and investments in the Valley and to engage existing businesses and industries to help them grow in a sustainable way.

(5) Legal and regulatory experience: TVA constantly adjusts management of its water system to those varying conditions to make sure it continues to efficiently provide all its life-supporting benefits, which are flood damage reduction, navigation, power production, water quality, water supply, and recreation.



Figure 5-7 "all system" protection case of the Nature Conservancy

5.3.3 Management Experiences in Amazon Basin

(1) Pay attention to river management and regulation: Tapajós River is one of the largest tributaries of the Amazon. At 1,200 miles long, the Tapajós touches three Brazilian

states (Mato Grosso, Para and Amazonas) and runs through 65 municipalities. Several dams have been built on the river way, which poses a great threat to water environment in river basin. The Nature Conservation is embarking on a global campaign to protect land on an unprecedented scale, save the world's great rivers and lakes, spur climate action, revolutionize ocean protection and make cities more resilient. The Amazon is a big part of this campaign, and the Nature Conservancy is working on the protection of Tapajós River Basin.

(2) Pay attention to environmental protection and water resources protection: By promoting the sustainable technologies, such as the electronic maps and satellite remote sensing, the Nature Conservation helps the local residents comply with forest laws and shares science and technology with local businesses, governments and developers, so as to balance the environmental protection and economic development. A series of measures contained in the Amazon Basin Comprehensive Sustainable Development Inter-regional Water Resources Project are used to address climate change and variation in the entire basin. The overall goal of the project is to develop a strategic action program for the Amazon Basin with a purpose to achieve sustainable development.

(3) Establish a protection mechanism for Amazon River together with neighboring countries: In view of the transnational natural and cultural heritage, Colombia, Ecuador and Peru have established joint management zones: Cuyabeno Wildlife Reserve, Güeppi-Sekime National Park, etc.. The Guiana Shield Facility (GSF) is a multi-donor funding facility for the long-term financing of national and regional activities related to Guiana Protective Area.

(4) Management system and law: Each country in the Amazon Basin has its own legal system to bind human activities, which provides an overall framework for government, community and group to jointly protect the ecosystem in Amazon. The Nature Conservation has established a basic law for the state-wide program: reward rural landowners in Rio de Janeiro who conserve forests and give priority to watershed wetlands.

(5) Ecology- monitoring system integrated the space and earth with total factors: MAAP (Monitoring of the Andean Amazon Project) is a project to protect the Amazon Environment, aims to use advanced and feasible technologies to timely grasp the scale, hot spots and causes of deforestation in the Amazon region of the Andes; and distribute the above-mentioned technical information to the users in a real-time, accessible and friendly manner, including policy makers, government authorities, civil societies, journalists, researchers and ordinary people.

5.3.4 Management Experiences in Rhine Basin

The Rhine, which flows into the North Sea from the Alps, is the most important cultural

and economic axis of Central Europe. It is used more busily and diversified than all other rivers in the Europe. A population of above sixty million of six countries is lived in the Rhine Basin. Its watershed management experiences are mainly composed of two aspects below:

(1) Restore the zoological and botanical diversity in the basin: Currently, great progress has been made in restoring the zoological and botanical diversity in the Rhine River basin. In 1998, the Council of Europe set the objective of extending the restoration of a single ecosystem to the entire natural ecological region, including the Rhine Estuary, Jurassic Mountains, Alps, Rhine Mountains, the ancient coniferous forests of the floodplain, the Rhineland-Pfaltz stream, Hessen and Vosges Mountains in southern Germany. The concerted efforts of all countries along the Rhine are conducive to restore the healthy river. The return of fish is a clear signal for water quality improvement. Although river water quality is excellent, it needs further improvement as a natural habitat.

(2) Pay attention to international cooperation: In January 2001, the minister in charge of the Rhine approved the Rhine 2020 Plan, which is a “plan for sustainable development of the Rhine River” following the most successful Rhine Work Plan (1987—2000). In this Plan, the overall goals are set for the policies and measures to achieve Rhine River conservation in the next 20 years. The core contents include interconnection of small habitats in the Rhine River, Salmon 2020 and the Work Plan for Flood Prevention to lower the economic losses caused by floods, further improvement of water quality and protection of the groundwater environment, and continued monitoring of the Rhine River.

5.3.5 The Management Experiences in Danube Valley

The Danube Valley covers an area of over 800,000 km², accounting for 10% of land area in Europe and stretching to the territory of 19 countries. It is considered to be the most international river basin in the world. The management experiences in Danube Valley laid emphasis on the multilateral and multi-level coordination mechanisms and supporting laws and regulations. According to the Danube River Protection Convention, the International Commission for the Protection of the Danube River (ICPDR) is committed to the sustainable and rational utilization of water resources in the Danube Basin. The Convention is the general legal instruments for cooperation and trans-boundary water resources management in the Danube Basin, which main objectives are to ensure the sustainable and rational management and utilization of surface water and groundwater in the Danube Basin. It involves the protection, improvement and rational use of surface water and groundwater; preventive measures against the flooding, freezing or hazardous material accidents; and reduction of pollutants from the Danube Basin into the Black Sea.

5.4 Policy Recommendation

On the Symposium on Developing the Yangtze River Economic Belt, General Secretary Xi Jinping pointed out in his important speech that, the ecological restoration of the Yangtze River must be placed in an overwhelming position from the perspective of the long-term interests of Chinese nation, we shall focus on the joint protection, instead of massive development in the Yangtze River, and explore a new path for ecology first and green development, so as to strive to build the Yangtze River Economic Belt with a more beautiful ecology, smooth transportation, harmonious economy, unified market and scientific mechanism. As the Yangtze River stretches over 6,000 km, and the YREB relates to 103 cities in 11 provinces or municipalities, the population and GDP of this area are more than 40% of the whole country. It is essential to coordinate the relations between the central and local, the governments, enterprises and society, the upstream and downstream, both banks, as well as main and tributaries, and give full play to the coordinating and guiding role of the central government, the leading role of local governments, the market-based role of enterprises and the public participation of all sectors of society. With “joint efforts” stressed, the effective recommendations on reform-deepened path is put forward from six aspects, namely green development, sustainable financing, residents living, ecological management, institutional mechanism and green energy, to form a benign mode of joint environmental treatment, namely water protection by policy, water protection by law, joint watershed protection, joint industrial planning and joint responsibility sharing.

5.4.1 Protect the Yangtze River by law

5.4.1.1 Speed up formulation of the Yangtze River Protection Law

Promote the Yangtze River Protection Law with an orientation of “comprehensive law”: it is suggested to take the Yangtze River Protection Law as a basic comprehensive law for watershed administration. The Law will take the Property Law and other basic law as the legislative guiding, take the improvement of water ecology, water environment and water resources, water safety as the core, make a comprehensive arrangement for the Water Law, the Law on Prevention and Control of Water Pollution, and will make the fundamental provisions on institutions and mechanism of the space control, development and utilization of water resources, water environment protection, ecological protection and restoration, and the risk prevention and control of ecological environment, etc.. It is also suggested to establish a specification on the fields of watershed comprehensive regulation, basin ecological compensation and basin legal responsibility, especially through information platform,

consultation mechanism, planning and coordination and other measures.

Formulate laws from the perspective of ecosystem integrity and systematization: it is essential to consider the ecological and social attributes of the Yangtze River valley, insist the strategic orientation of ecology first, green development, joint protection instead of massive development, take the integrated ecosystem construction and protection as the basic concept of legislation, interact from top to bottom, break the key elements and regional limitation, comprehensively consider all issues in view of the basin ecosystem rules, including water security, flood control, pollution control, port and shore, traffic and landscape, in order to establish a unified resources supervision system for resources, ecology, environment, disaster, and engineering in Yangtze River Basin, especially for prudential regulation water project, which can effectively change the fragmented management¹.

Engage with existing laws well: it is necessary to consider its cohesion with the laws below as a whole, including the Water Pollution Prevention Law, the Water Law, the Environmental Protection Law, the Environmental Impact Assessment Law, the Flood Control Law, the Water and Soil Conservation Law, the Waterway Law and the Fisheries Law, as well as the local laws formulated by all provinces along the Yangtze River Basin; evaluate all laws in accordance with the objectives and requirements for the system reform of ecological civilization and the construction of the YREB; sort out the water-related powers granted by the laws and regulations, so as to identify the existing problems in the current legislation and the special needs to formulate the Yangtze River Protection Law.

Strengthen the protection planning and mechanism support of Yangtze River: it is necessary to full play the top-level design role in the Outline of the Yangtze River Economic Belt Development Plan, which will be taken as the general program and blueprint to guide the development of Yangtze River Basin. Consolidate the basin ecological protection system established by the existing laws and regulations, including river-chief system, linkage and coordination mechanism for water environmental protection, early-warning mechanism of water ecological carrying capacity, ecological conservation redline system, eco-compensation system and planning environmental assessment system, etc.; and announce the basic concept, policy orientation, institutional framework and mechanism design to protect the Yangtze River, as well as the rights and obligations of different stakeholders, so as to ensure that they can not only be compatible with the existing administrative regulations and local legislation, but also leave enough space for the formulation and revision of local individual laws and regulations in the future.

¹ DU Qun. The Legal Adjustment of Interests Compensation for Ecological Conservation in the Yangtze River Basin[J]. Chinese Journal of Environmental Management, 2017, 9(3): 30-36.

5.4.1.2 Reform the ecological enforcement system

Set up an integrated basin regulatory institution to promote the system, institution and mechanism in place: it is suggested to set up a coordinating institution named the Yangtze River Protection Committee or the ecological environment protection bureau of Yangtze River basin, which is under the jurisdiction of the Ministry of Ecology and Environment. Set up an independent comprehensive law enforcement supervisory institutions and monitoring agencies, which is under the condominium of the Ministry of Ecology and Environment and the other involved departments, with the former as main administrative body.

Link up the authorities and responsibilities with the river-chief system, lake-chief system and statutory regulatory authorities: it is suggested that, the applicable statutory supervision systems shall be organically linked up with the river-chief system and lake-chief system in the next revision of the Water Law and the Water Pollution Prevention and Control Law, so as to promote joint law enforcement and joint assessment through information platforms and coordination mechanisms, which can improve the regulation performance.

Establish a law enforcement agency for the Yangtze River basin management: in view of the comprehensive administrative enforcement pilot in the Yangtze River basin, it is suggested to set up an administrative enforcement agency to be responsible for the integrated water administration in the Yangtze River basin, which will carry out joint consultation and law enforcement in different administrative regions between the basin agencies and local agencies, so as to normalize the joint enforcement. For the transport and disposal systems of solid wastes within the Yangtze River basin, the legislation shall be strengthened to stipulate the unified or coherent examination and approval system and a full-process supervision mechanism¹.

5.4.1.3 Improve the judicial system for ecological environment

It is suggested that the Yangtze River maritime court will accept wade dispute across the region, including damage the ecological environment, regional ecological compensation agreement dispute, etc.. It's also suggested to establish a unified court of Yangtze River, as the appeal court of maritime court in the Yangtze River basin. It is required to improve the conditions, scope and procedures of public interest litigation for water administration, and strengthen the legal supervisory role of prosecuting authorities. It is suggested that the system, institution and mechanism of judicial supervision shall be perfected over the executive power of water administration through amending the Criminal Procedure Law and the Administrative Procedure Law. It is also suggested that the Supreme People's Court

¹ CHANG Jiwen. Five Recommendations to Ecological Civilization Institutional Reform[N]. China Environment News, 2017-1-17.

shall establish a directory of the public interest, a directory or guidance for litigation claims on public environmental interest, and clarify the compensation conditions, claims and jurisdictions of in public interest litigation; as well as study on how to establish the criminal litigation system with collateral civil suit against water pollution and water ecological destruction¹.

5.4.2 Establish a sustainable green financing mechanism

5.4.2.1 Stabilize financing channels for ecological compensation

With the gradual decline of the central finance support, it is suggested to establish a horizontal eco-compensation fund pool for the YREB, which can effectively solve the complicated issues among the upper, middle and lower reaches, and both banks of the Yangtze River Basin. The annual amount contributed by 11 provinces and municipalities along the Yangtze River is calculated and distributed according to the local water resource, water environment and water ecosystem factors along the Yangtze River Basin, with the principle of “the polluters to govern, and the beneficiaries to be compensated”².

5.4.2.2 Establish the Yangtze River ecological fund

Set up the Yangtze River ecological fund, give play to the leading role of fiscal investment and leverage³, and attract financial institutions and social capital inputs such as Maotai, Lang Liquor and Luzhou Laojiao by the income priority guarantee mechanism. Use the equity investment method to give key support to major ecological environmental protection project of the YREB with the PPP and the third party governance mode. The first target of the fund is 300 billion yuan, among them, the government contribution by 25% with the commitment system. The capital will arrive in three years according to fund operation progress, with fund duration for ten years. Financial capital mainly comes from the existing national major water conservancy project construction funds, the central government finance, 11 provinces along the YREB, and so on.

5.4.2.3 Explore the market mechanism involved in wading enterprises

It is suggested to organize natural resources asset management committee of the Yangtze River, to exercise its rights to charge in terms of water resources, water environment, water ecology, water-heads right, water-surface right, and water engineering right of the Yangtze River. Through the contract to exercise the rights of charge for the utilization of resources

1 CHANG Jiwen, GUO Shunzhen. Embodies the Restriction and Supervision Effect of Environmental Nonprofit Litigation[N]. China Environment News, 2015-09-25.

2 WANG Jinnan, LIU Guihuan, WEN Yihui. Establish a Horizontal Eco-compensation Mechanism Between Upstream and Downstream to Improve Water Quality of Rive Basin[J]. Environmental Protection, 2017, 45(7): 13-18.

3 WANG Jinnan. Promote Joint Efforts in Yangtze River Protection by Ecological Compensation[N]. RENMIN RIBAO, 2018-09-17.

and environment of the Yangtze River from China Three Gorges, the Gezhou Dam. The ecological beneficial areas should pay for water utilization, sightseeing and other items. The eco-environmental damage areas should compensate for the country's water-related rights damaged. The ecological protection areas should be compensated¹.

5.4.2.4 Build a joint-protection platform of enterprises

Organization the wading enterprises that are willing to provide funds such as China Three Gorges group, Maotai group, Lang Liquor group, the enterprises focused on energy conservation and emissions reduction such as CECEP to build a joint-protection platform, explore the ecological industry chain with the overall planning of the Yangtze River and sub-streams, build a green chain from production, processing to sales, to realize the organic circulation of ecological industry chain, industry nurturing agriculture, benefit farmers and improve the basin ecological environment at the same time. The enterprises shall base the “green enterprise” as their development strategy, to establish a management pattern that is featured as strict prevention from the source, strict process control, and strict post-punishment.

5.4.3 Build a path to sustainable livelihoods

5.4.3.1 Establish benefit platform based on rural revitalization

It is suggested that the relevant ministries and commissions, such as NDRC and MEE, shall promulgate the guiding opinions to develop Characteristic Towns in the YREB specific to the backward areas with beautiful ecological environment in the middle and upper reaches. In accordance with the ecology-first concept, considering the ADB projects such as the green ecological corridor agricultural development project, select the projects and areas with necessary conditions to be cultivate preferentially. When planning the Characteristic Towns in the YREB area, it should be avoided to adopt the same industry patterns to the upper, middle and lower reaches. In fact, it is recommended to extend the industrial chain according to demands in the marketplace and promote the integrated development of primary, secondary and tertiary industries. For example, select pilot areas to carry out demonstration bases with bamboo industry, further strengthen ties with INBAR to actively promote scientific and technological innovation in the bamboo industry, fully explore its economic, ecological and cultural value, and extend its industrial value.

5.4.3.2 Promote the compensation based on rural productivity

It is suggested to increase investment in transportation facilities, open up channels of production factors, such as the export of ecological products, the import of external capital

1 SHI Yinghua. Exploring Diversified Ecological Compensation Financing Mechanism[N]. Anhui Daily, 2018-07-31(006).

and technology in the upstream areas¹, broaden the channels and promote the circulation between ecological products and consumer markets. Set up an integrated platform for the production and marketing of agricultural products in the upper and lower levels. The agricultural enterprises in the downstream provinces are encouraged to invest and set up factories in the upstream areas, develop the ecological agriculture and maintain biodiversity; assist to cultivate talents in the upper and middle reaches of the Yangtze River, to promote the industrial cooperation between the downstream and upstream of the Yangtze River².

It is also recommended to establish a joint development mechanism of industrial parks for upstream and downstream provinces. Setting up industrial parks at downstream provinces for upstream provinces and cities can promote the economic development and industry upgrade at district level³.

5.4.3.3 Explore protection mechanisms based on community agreement

Take Chishui River as pilot area, build a government-enterprise-third party organization-local communities-personal protection mechanism, sign an agreement by the stakeholders through negotiations to transfer the protection and development rights to the different stakeholders, formulate the protection plan and development plan, and carry out the evaluation of ecological benefit, economic benefit and social benefit.

5.4.3.4 Establish a carbon sink mechanism involving farmers

It is suggested that voluntary GHG emission reduction projects with obvious ecological restoration and protection benefits, such as forestry carbon sinks in the YREB, shall be preferentially included in the national carbon emission trading market. Farmers at upstream ecological protection areas put woodland absorb carbon dioxide by the trees with grassland-use, forest land certificate or artificial afforestation as a product on poverty alleviation platform for social marketing, guide carbon emissions performance enterprises preferred to buy support units.

In order to enhance the activeness of the ecological compensation market at YREB, there should be multiple ecological compensation participants. Currently, the main participants are governments, which leads to a lack of flexibility in trans-boundary marketization of ecological compensation patterns. Thus, compensation participants such as corporates, organizations, residents and NGOs should be motivated to participate in the marketization of ecological

1 WANG Jinnan, SU Jieqiong, WAN Jun. An Analysis of the Theory of “Lucid Waters and Lush Mountains are Invaluable Assets” and Its Innovative Development Mechanism[J]. Environmental Protection, 2017, 45 (11): 12-17.

2 HE Jun, LIU Guihuan, WEN Yihui. Thoughts on Promoting Ecological Protection Compensation[J]. Environmental Protection, 2017, 45(24): 7-11.

3 ZHOU Fengqi. Shanghai Promotes Joint Construction of Yangtze River Economic Belt[N]. Social Science Weekly, 2018-6-28

compensation projects¹.

Box 5-2 Xin'an River Basin explored and established a positively interactive mechanism for social capitals and the public to engage in environmental protection

Firstly, Xin'an River Green Development Fund was established to encourage social capitals to participate in Xin'an River ecological environment conservation. Based on the first round of piloting with China Development Bank, Huangshan city established the Xin'an River Green Development Fund. It was led by China Development Bank Anhui branch and was jointly established by the China securities co., LTD, China-Africa Xinyin Investment Management co., LTD and Huangshan government. It mainly invests in ecological remediation, environmental protection, green industry development, cultural tourism, etc. Meanwhile, with the upstream and downstream water environment compensation platform, the provinces of Anhui and Zhejiang cooperate closely. By launching a high-speed train between Huangshan and Hangzhou, the two provinces are exploring various ways of cooperating and developing.

Secondly, rural residents participated in environmental protection via the creative implementation of "waste exchange supermarkets" and a unified delivery system of fertilizers and pesticides. "Waste exchange supermarkets" effectively helped rural residents to sort out waste and eased the problem of waste in river during flood season. 24 "waste exchange supermarkets" have been set up in Huangshan city, and on average the efficiency of each one equals to that of 3 cleaners'. The criteria of the unified delivery system of fertilizers and pesticides are "governmental procurement, unified delivery, informational management, zero difference in price, and with fiscal subsidies". The e-management system of pesticides is piloting.

5.4.3.5 Explore the function-replacement compensation mechanism of ecological and construction land

It is suggested that the total amount land for functional replacement of ecological and construction land shall be determined in terms of main function orientation, economic development, ecological environment, and land use in the Yangtze River Economic Belt, and so on. The region to transfer construction land mainly covers the important areas with relative undeveloped economies and ecological missions undertaken, including the important ecological function areas and the ecological conversation redline, which can receive compensation through transferring construction land; while the region to receive construction land mainly covers the areas to be industrialized and urbanized, including the optimized

¹ LIU Guihuan, WEN Yihui, XIE Jing, RAO Sheng. A Thinking on Ecological Compensation Policy Under the Scheme of Completing Country Main Functional Regions[J]. Environmental Protection, 2015 (23) : 39-42.

development zones, key development zones, and so on¹.

5.4.4 Implement “mountaintop to ocean” system management

5.4.4.1 Coordinate the integrated management of ecosystems

Improve the integrated ecosystem management framework. It is suggested to pay attention to the health level and self-regulation capacity of the ecosystem, as well as the coordination degree with the social and economic system. Coordinate the comprehensive development, protection and governance of the ecosystem in the YREB, and establish an ecosystem development and protection system covering the whole basin. Fully consider the coupling, heterogeneity and diversity of natural ecology, economic development and social and cultural factors in various provinces and cities. Develop systematic solutions to environmental problems such as water pollution, solid waste pollution such as plastics, and soil erosion in the YREB. Taking Dongting Lake, Poyang Lake and Taihu Lake as pilots, based on the health assessment of the lake ecosystem, carry out the restoration and reconstruction of the three-dimensional ecosystem from point to line from the dimensions of atmosphere, water, soil, biology, etc.. Accelerate to summarize the experience of ecological environment management in small watersheds such as lakes, and gradually extend it to the entire Yangtze River basin².

Identify the important restoration space of “mountain, forest, field, lake and grass”, innovate new governance mode, and systematically promote the ecological restoration project. Carry out in-depth investigations into the natural resources and ecological environment of the Yangtze River Economic Belt, identify the spatial distribution and main features of key areas for protection and restoration of “mountain, forest, field, lake and grass”, and give priority to the designation of important restoration Spaces in areas where ecological service functions of the YREB are important and ecologically sensitive. Explore the restoration and governance model of “ecological + green financing” in the upper reaches of the Yangtze River actively. Give priority to the restoration of seriously damaged habitats such as important shorelines of the YREB, important coastal and estuary wetlands, and the lakeside belt around Taihu Lake. Actively promote the rehabilitation of abandoned mines in important ecological and residential areas, and focus on the rehabilitation of sensitive mines along transportation routes. Coordinate the ecological relationship between the Three Gorges Reservoir and the middle and lower reaches of the river system, stabilize basic ecological

1 WANG Wengang. Research on Theory and Practice of Land Use Function Replacement between Regions[D]. Northeast Normal University, 2012.

2 CEN Xiaoyu, ZHOU Yinkang, SHAN Wei, TENG Yun, LI Feng. Resource and Environmental Layout and Sustainable Development of Yangtze River Economic Belt[J]. China Development, 2015, 15(3): 1-9.

water use in the middle and lower reaches of the river and lake, and strengthen the capacity of large lakes, such as Dongting Lake, Poyang Lake and Honghu, to regulate and store stagnant water. Establish the ecological corridor of the Yangtze River national park and form the biodiversity conservation network¹.

5.4.4.2 Strengthen rural waste management

Improve solid waste management methods and follow the “3R” principle (reduce, reuse and recycle) to reduce waste throughout the product life cycle. Formulate national policies on circular economy and green supply chains to further strengthen the ability to control microplastics pollution. Innovative technologies for the collection and treatment of solid waste. Improve pollution control measures for livestock and poultry farming. Improve performance of sewage treatment plants and sludge treatment capacity, and raise awareness through community participation to reduce the water pollution of solid wastes throughout the Yangtze River Basin to the ocean.

5.4.4.3 Coordinate the construction of “water-road-port -industry-city”

Accelerate the construction of water resource monitoring systems for the important water resources and hydropower projects such as the cascade power stations of the Jinsha River and Danjiangkou Reservoir, as well as for nodes of river systems, faults under national and provincial control, and important rivers and lakes. Carry out the feasibility demonstration of water resources and manage water extraction permits strictly²; clarify the allocation of water rights among provinces and municipalities along the Yangtze River; and carry out water right trade when time is right. Work out water distribution plan in batches according to the main stream and tributaries, and coordinate production, living and ecological water use. Speed up the construction of key ports and feeder routes along the river, plan ahead to build railways along the river, and promote the interconnection and interchange between the expressways and access to port along the river. Attach importance to the coastline protection along the Yangtze River and establish a negative list of ecological admittance. Protect the green resources along the Yangtze River comprehensively. Create a bamboo and wood planting belt integrating economic benefits and ecological benefits. Strengthen the construction and maintenance of nature reserves, forest parks and wetland parks. Delineate access zones for transfer of heavily polluting industries such as petrochemicals, coal, paper making, printing and dyeing, and electroplating strictly. Plan the urban construction and industrial development as whole. Develop a circular economy such as modelled on the Chishui River

1 TANG Xiaolan, REN Yujie, MA Kun. Virtualization of the Yangtze National Park Ecological Corridor Based on the Ecological Dominance of Natural Resources[J]. Environmental Protection, 2017, 45(17): 38-44.

2 HUANG Lei. Make Good Use of the “Negative List” to Promote Green Development of the Yangtze River Economic Belt[N]. Economic Daily, 2018-04-19(015).

basin vigorously, so as to form a green urban spatial pattern which is featured as regional interactive, structural optimized, intensive and efficient, low carbon and clean, harmonious and livable¹.

5.4.5 Promote the reform of the environmental protection and governance system

5.4.5.1 Establish an industry planning and coordinating committee

In order for the administrative regions of the YREB to achieve prevention priority and green development, the fundamental solution is to plan, in a scientific and reasonable way, a green industry system that connects and coordinates different regions in the river basin and realize both self-development and coordinated development². As this would entail a green reform of the current industry planning system, we suggest that an industry planning and coordinating committee shall be established under the coordination mechanism of the Central Government for the green development of the YREB and that the Ministry of Ecology and Environment and National Development and Reform Commission undertake the daily routines of this committee. The main duty of the committee should include:

Establishing the negative list of industry access to the river basin by regional coordination. Steadily carrying out the rural land reform of the “separation of three rights”. Introducing unified measures to the reform of rural waste and sewage treatment. Carrying out structural adjustment of agricultural industry and institutional reform of the supervision of agricultural cultivation methods in the river basins³.

5.4.5.2 Explore a Comprehensive supervision system of ecological and environmental protection and natural resources

For institutional reform of supervision type, we suggest that special supervision systems should be established for YREB and state-owned enterprises. For institutional reform of supervision subjects, the National People’s Congress’ environmental protection law supervision should be included in the central environmental supervision in order to avoid multiple supervision. For institutional reform of supervision fields, relationships should be straightened out between the Central Environmental Protection Supervision and the National Land Resources Supervision, National Marine Supervision, and forest and grassland administrations. Two patterns are recommended in this regard: first, we suggest

1 HOU Lijun. Research on Building Yangtze River Economic Belt and Optimizing Industrial Layout[J]. Journal of Nanjing University of Finance and Economics, 2016(1): 35-40.

2 WANG Jiguang. Yangtze Rive Economic Belt Green Development Can Only be Achieved Through “Coordinated Efforts” [N]. Chinese People’ s Political Consultative Conference, 2018-07-19(003).

3 LI Min, XIE Bingeng, LIU Chunla, DENG Chuxiong. Targeted Poverty Alleviation Based on the Synergetic Development of Ecology and Culture in the Concentrated Poverty-Stricken Area in Yangtze River Economic Belt-A Case Study of Xiangxi in Hunan[J]. Economic Geography, 2017,37(10) :167-172.

that the Central Ecological and Environmental Protection Supervision Team uniformly carry out comprehensive supervision of ecological environment and natural resources on behalf of the CCP Central Committee and the State Council and the National Natural Resource Supervision Office be still established at the Ministry of Ecology and Environment. Second, a dedicated central natural resource supervision system may be established in parallel with the Central Ecological and Environmental Protection Supervision; the National Natural Resource Supervision Office is canceled and a Central Natural Resource Supervision Office is set up at the Ministry of Natural Resources.

5.4.5.3 Perfect an ecological environment protection supervision system

Establishing a uniform information and audit platform for the Yangtze River Basin by learning from the experience of the Chishui River Basin and some other places. The National People's Congress strengthen its judicial supervision on the ecological environment protection of the Yangtze River Basin and require procuratorates and courthouses to file special annual reports to the NPC Standing Committees on the same level about the status of comprehensive protection. The United Front Work Department of CPC Central Committee strengthen its supervision of provincial and lower-level United Front Work departments on their role in the democracy supervision of environmental protection in the Yangtze River Economic Belt, and that Chinese People's Political Consultative Conference strengthen its supervision of provincial and lower-level political consultative conferences on their role in the democracy supervision of environmental protection.

5.4.6 Develop green energy and industry

5.4.6.1 Exploit renewable energy in the upper reaches

Exploiting more clean electric power and energy storage resource by developing "photovoltaic pumped storage" according to the local conditions in the valleys and ravines around large reservoirs; and solve the problem of irrigation water supply through "photovoltaic pumped storage" in the upper storage reservoirs, in order to promote the development of high-quality feature agriculture in the high-heat regions such as Panzhihua and east Yunnan. It is suggested that we combine hydropower development and photovoltaic development in the dry-hot valley of the upper reaches of the Yangtze River¹.

5.4.6.2 Develop Bamboo Biomass Energy

Plant energy bamboos on land that is not suitable for grain cultivation, such as mountain and surrounding areas, barren hills and slopes, river banks, etc. Explore and develop bamboo

¹ Zhou J, Zhang M. On the Forefront Ecological and Environmental Problems of Current Yangtze River and Restoration Priorities[J]. Environmental Protection, 2017(15): 21-28.

energy forests in combination with the project of returning farmland to forest and protecting forest construction. Improve the preparation process of cellulose ethanol, so as to make a good technical reserve for the future development of bamboo biomass energy.

5.4.6.3 Promote the construction of green waterways

We shall establish a joint-action plan for the shipping and hydropower generation in the Jinsha River basin. More efforts shall be put into the exchange and cooperation with surrounding provinces and joint efforts shall be made to organize the planning of shipping and to determine the routes to be constructed from Panzhihua to Shuifu on the Jinsha River. We shall also study and establish a support plan for the Shuifu-Yibin waterway. To realize the grade matching of upstream and downstream channels, and better extend the radiating and driving effects of water transport to the upper reaches of the Yangtze River.

5.4.6.4 Build green ports

We should perfect the shore power operation system. Vigorous efforts should be paid to the construction of shore power operation platforms for inland river ports. To popularize the “green shore power technology”, and eventually realize its full coverage, among ports along the Yangtze River. Alternative energy plans shall be made to perfect the standards for construction of shore power facilities of the ports and the incentive policies for use of shore power by ships.

5.5 Prospect

To sum up, for the green development and eco-compensation mechanism in the YREB, it is essential to build a long-term mechanism based on the national strategic opportunities to reflect all stakeholders’ interests. In order to strengthen the consciousness of the whole basin, the state shall intensively guide all provinces and municipalities along the Yangtze River in an overall view, and coordinate common development and administration and win-win cooperation among all provinces and municipalities in the YREB as a whole. The local cities and counties shall be guided to initiatively participate in the ecological restoration, protection and construction in the YREB and plan it in the perspective of whole country. Through many approaches, such as mutual benefit and win-win development mechanism of ecological industry, incentive and restraint mechanism, diversified and multi-channel financing mechanism, a long-term green development and eco-compensation system shall be formed to integrate the whole basin and plan the integrated protection and administration of all ecosystems as a whole, so as to ensure the “joint protection, instead of massive development” can be effectively implemented in place.

Chapter 6 Goals and Pathways for Environmental Improvement by 2035

6.1 Introduction

The report delivered at the 19th CPC National Congress proposed that “there will be a fundamental improvement in the environment by 2035, and the goal of building a Beautiful China will be basically attained.” At the National Ecological Environmental Protection Conference held in May 2018, Xi Jinping emphasized that “we should step up efforts to establish an ecological civilization system to ensure that there will be a fundamental improvement in the environment by 2035, and the goal of building a Beautiful China will be basically attained.” The Opinions of the CPC Central Committee and the State Council on Comprehensively Strengthening Ecological Environment Protection and Taking Tough Steps to Prevent and Control Pollution issued on June 16 mentions that, “we should step up efforts to establish an ecological civilization system to ensure that by 2035, the spatial layouts, industrial structures, and ways of work and life that help conserve resources and protect the environment will be basically developed, there will be a fundamental improvement in the environment, and the goal of building a Beautiful China will be basically attained.”

In addition, the goal of environmental quality improvement by 2020 was defined, that is, “by 2020, the overall environmental quality will be improved, the aggregate emissions of major pollutants will be greatly reduced, environmental risks will be effectively controlled, and the level of environmental protection will be compatible with the goal of building a moderately prosperous society in all respects.” On July 10, 2018, the Standing Committee of the National People’s Congress passed the Resolution on Comprehensively Strengthening Ecological Environment Protection and Taking Tough Steps to Prevent and Control Pollution according to Law, mentioning that “our overall goal is that by 2020, the overall environmental quality will be improved, and the aggregate emissions of major pollutants will be greatly reduced.”

The thought on ecological civilization put forward by Xi Jinping provides a conceptual direction and a fundamental guideline for building a Beautiful China and realizing modernization featuring the harmony between human and nature. Its principles and five

systems provide ideological and practical guidelines for achieving the goal of environmental quality improvement by 2035.

Under the “new normal” economic situation, environmental goals of global sustainable development also provide added pressure on, and increased responsibilities for, China’s environmental governance system. The UN’s 2030 Agenda for Sustainable Development provides a new requirement to the transformation, upgrading and sustainable development of China’s economy, and promotes China to take tougher measures. Therefore, it is necessary to analyze the critical impact that the environmental goals will have on China’s environmental governance in the next 20 years, and to strengthen the research on global environmental governance.

Analysis of China’s mid- and long-term environmental quality improvement goals, and the pathways for achieving them, is of great significance. It will not only help to clarify the basic logic, institutional constraints and systematic challenges facing the current environmental governance operations in China, but also help to guide the future development of China’s environmental governance system.

The research team supporting the work of the SPS on Goals and Pathways for Environmental Improvement by 2035 identified three overall objectives for the project: to analyse in depth the implications of China’s goal of environmental quality improvement by 2035; to assess the obstacles to achieving the goal; and to explore the effective pathways for how it could be achieved.

Guided by these overall objectives, the research team organized its work around four main issues: a) Implications of China’s goal of environmental quality improvement by 2035 and assessment of the obstacles to the achieving the goal; b) China’s green transformation by 2035, its mechanisms and paths; c) Strategic Path for a Fundamental Improvement in the Environment by 2035; d) Rule of law measures for the realization of China’s goal of environmental quality improvement by 2035.

Since the launch of the project in July 2018, the research team has held 4 Sino-foreign joint meetings and 2 Chinese expert meetings, participated in academic exchanges in Germany and the United Kingdom, and conducted domestic field research. Extensive information on German experiences in environmental policy was compiled in response to ten questions by the Chinese team members.

6.2 Major Challenges and Changes China Faces towards 2035

General Secretary Xi Jinping pointed out in the report delivered at the 19th National

Congress of the Communist Party of China that: “We must continue the Beautiful China initiative to create good working and living environments for our people and play our part in ensuring global ecological security.” At the National Ecological Environmental Protection Conference held in 2018, he emphasized that “we should step up efforts to establish an ecological civilization system to ensure that there will be a fundamental improvement in the environment by 2035, and the goal of building a Beautiful China will be basically attained”. He attaches great importance to the establishing a Beautiful China and has delivered a series of important speeches, especially at the National Ecological Environmental Protection Conference in 2018, during which he highlighted the practical requirements for strengthening the construction of ecological civilization and building a Beautiful China.

Xi Jinping pointed out that “moving towards a new era of ecological civilization and building a Beautiful China is an important part of the Chinese dream of realizing the great rejuvenation of the Chinese nation.” “Strongly promote the construction of ecological civilization and implement the “blue water and clear sky” project to make the ecological environment better and better. Strive to build a beautiful China.” Beautiful China is premised on the construction of a beautiful natural environment, and is measured by the development and progress of ecological civilization. Beautiful China refers to developing China with a high degree of ecological civilization. It is the goal of China’s ecological civilization construction. Xi Jinping stated that the goal was to “realize environmental protection and build China into a country with a sound ecological environment.” “The modernization of harmony between man and nature requires not only creating more material and spiritual wealth to meet people’s growing demand for a better life, but also providing more high-quality ecological products to meet people’s growing demand for a beautiful ecological environment.”

Vigorously promoting the construction of ecological civilization and building a Beautiful China is a fundamental plan for the sustainable development of the Chinese nation. It is a major political issue that affects the Communist Party of China’s mission and a major social issue concerning the development of people’s livelihood. A Beautiful China is a strategic goal of ecological civilization construction based on China’s national conditions and future development.

How to define the goals of Beautiful China, how to realize the fundamental improvement of environmental quality, is the task of our SPS.

6.2.1 An Analysis of the Trend of China’s Green Transformation in Economic and Social Development towards 2035

The Chinese economy is making the transition from a high-speed growth phase to a

high-quality development phase. Leading sectors are shifting from heavy and chemical industries to the high-tech industry and the modern service industry. The driving force of economic growth is shifting from material factors to technological innovation and more skilled human capital. The factors driving the economy are shifting from investment and exports to consumption. Actively cultivating new drivers of economic growth toward green transformation is the only route to high-quality economic development.

A scenario analysis of China's economic and social development in the three periods to 2020, 2035 and 2050 was made based on the existing production model and using the dynamic Computable General Equilibrium (CGE) model of State Information Center. It followed the goal of "basic implementation of socialist modernization by 2035, and buildup of a great modern socialist country by 2050", in accordance with the spirit of the 19th National Congress of the Communist Party of China. Through balancing measurement of indicators in all fields, the main results are shown as follows.

6.2.1.1 Population to peak and aging trend

(1) Total population of China.

Total population of China will be about 1.41 billion by 2020, reach peak (about 1.43 billion) around 2028, and drop to about 1.35 billion by 2050.

(2) Population age structure

The population above 60 years old will reach 261 million, or 18.5% in proportion by 2020; the aging population of China will grow to 371 million by 2035, when the country starts to enter into the moderate aging phase; and grow to 448 million, or 33.2% in proportion by 2050.

(3) Urbanization level

The urbanization rate will reach around 60.6% by 2020, when China enters into the medium-level urban society; around 68.5% by 2035, when China enters into the later phase of the urbanization process; and around 72% by 2050, when the urbanization matures and stabilises.

6.2.1.2 Economic aggregate and structural trend

(1) Macro-economic growth rate shifts, and drive for growth gradually changes

In view of GDP growth rate, during 2021—2035, China's economy will be growing at a moderate speed ranging between 4% and 6% per annum, about 5% on average. The socialist modernization will be basically realized by 2035; during 2036—2050, China's economy will step into the phase of low-speed stable growth between 3% and 4%, averaging 3.5% per annum. A great modern socialist country will be built by 2050. In view of demand-side pull, consumption will become a key driver in the future. By 2035, the consumption rate is

estimated to hit 65%, and investment rate 32%; by 2050, the consumption rate 70%, and investment rate 29%. Per capita consumption is estimated to grow gradually from USD 2,700 at present to USD 16,000 in 2035, and to USD 40,000 in 2050. Especially in the areas of household facilities and articles, resident service, etc., the potential for growth is tremendous. Taken civilian car as an example, it is estimated that there will be approximately 500 million cars by 2035, equivalent to 330 vehicles per 1,000 people. Subsequently, growth will become stable, and by 2050, the total number will be about 550 million, equivalent to 370 vehicles per 1,000 people. New energy vehicles, including all-electric, hybrid and fuel-cell vehicles, will enter into a high-speed growth phase. Their number is estimated to be 140 million by 2035, about 28% of private car ownership; and 270 million by 2050, about 50% of private car ownership.

China's stock of civil buildings is expected to peak in around 2035. Accordingly, the added building area per annum from now on till 2035 will decline gradually. This means that the role of real estate investment, the key driver of China's economic growth for a long time ago, will fall progressively.

(2) To adapt to the shift of demand structure, the future industrial structure needs to be gradually optimized

From the perspective of industrial structure development trend, during 2016—2020, industrialization will be upgraded toward medium-to-high end, where the weight of the service industry will be continuously increased, positive results will be achieved in agricultural modernization. The share of primary, secondary and tertiary industries will shift from 8.8:40.9:50.2 in 2015 to roughly 7.5:37.5:55.0 in 2020. During 2021—2035, as the tertiary industry will sector gradually account for the largest share of economic development, and it will exceed 60% of GDP around 2030. By 2035, the shares of the three main sectors in the economy will be roughly 5:28:67. During 2036 to 2050, when China is among the most developed countries in the service sector, it will become the center of high-end service industries across the globe, and it will lead and guide the global value chain, with much greater economic power. The tertiary industry will exceed 70% of GDP around 2050, and the shares of the three main sectors will be roughly 3:24:73 at that time.

6.2.1.3 Total energy demand and structure

In line with the main spirit of ecological civilization in the report of the “19th National Congress of the Communist Party of China”, and based on the judgment of economic and social development trends, China's total primary energy demand will continue to increase. By in 2020, 2030, 2035 and 2050, it will reach nearly 4.8 billion tons, nearly 5.4 billion tons, 5.5 billion tons, and nearly 5.8 billion tons of coal equivalent respectively. Subsequently, it will

remain at a similar level.

The demand for coal and oil will peak successively. The demand for coal will remain stable until 2020, and is then expected to continuously decline. The non-coal share of energy demand is expected to climb from 35.7% in 2015 to 55% in 2030, 60% in 2035, and further to 73% in 2050. The demand for oil will remain stable until 2030, and will gradually decline as the scale of electric vehicles expands rapidly. At the same time, clean energy will gradually become a major source of energy demand. The proportion of non-fossil energy is expected to gradually rise from 11.8% in 2015 to 22.5% in 2030, 28% in 2035 and over 40% in 2050. In addition, increased electrification will lead to an increase in the share of energy used for electricity generation. The figure will rise from 40.9 percent in 2015 to 48.5 percent in 2030, over 50 percent in 2035 and 54.8 percent in 2050.

Based on the projection of the total energy demand and structure in primary energy, it is, tentatively estimated that China's energy-related carbon emissions will peak at about 10 billion tons around 2025. Thereafter, it is estimated that total carbon emissions will be basically stable. By 2035, the total amount of carbon emissions is estimated to gradually drop to 9 billion tons. Thereafter, the pace of carbon emission reduction will increase. By 2050, carbon emissions are estimated to fall to around 7 billion tons (Table 6-1).

Table 6-1 Future demand for primary energy and CO₂ emissions trend in China

Primary Energy and CO ₂ Emissions		2015	2020	2030	2035	2050
Total primary energy demand (in 100 million tons of coal equivalent)	Coal	27.5	26.7	24.3	22.3	15.7
	Oil	7.7	9.0	9.4	9.1	8.4
	Natural gas	2.5	4.6	8.0	8.6	9.0
	Non-fossil	5.1	7.5	12.1	15.4	24.2
Total		42.8	47.8	53.8	55.4	57.3
CO ₂ emissions (in 100 million tons)		91	97	96	90	71
Proportion of non-coal energy/%		35.7	44.2	54.8	59.9	72.6
Proportion of non-fossil energy/%		11.8	15.7	22.5	27.8	42.3
Primary energy used for electricity generation	In 100 million tons of coal equivalent	17.5	21.0	26.1	28.3	31.4
	Proportion/%	40.9	44.1	48.5	51.0	54.8

Note: According to China's existing calculation method for determining the primary energy demand, if included in the category of primary energy, non-fossil energy used for electricity generation shall be converted into coal consumed in electricity generation.

Actively encouraging and supporting high-end, green manufacturing development will become a critical direction for China's industrial transformation and upgrading. In view of

China's industrial development and industrial structure at present, in 2016, industrial added value accounted for 33.3% of gross domestic product in China, and energy consumption and resource consumption per unit of output were apparently higher than those of developed countries. Currently, the energy consumed per USD 1 of added value in China is 4.3 times of that in USA, 7.7 times of that in Germany and France, and 11.5 times of that in Japan. Technology and environmental factors have become two obstacles that impede the industrial development of China and its product competitiveness. Actively promoting green technological innovation, driving green transformation of traditional industries, and realizing modernization and green development of manufacturing are inevitable directions for China's industrial development. By 2035, the green enterprise standard system and the green manufacturing system will be formed gradually. By 2050, the intelligent and green manufacturing industries such as the new generation of information technology, new energy, new material, and high-end equipment will become key drivers of China's economy. Therefore, green transition shall be promoted in three ways: supply-side policy, demand-side policy and the transformation of institutional mechanisms.

6.2.1.4 Material use and the circular economy

In recent years, policy makers in China and the international community have become increasingly concerned that the rapid growth and inefficient use of natural resources is creating unsustainable pressures on the environment and may result in disruptions in the supply of inputs to some production processes. As a result, they have given an increasing priority to moving from a linear to a circular economy. A linear economy is one that “takes-makes-disposes” of materials. In contrast, a circular economy aims to keep materials in the economy for as long as possible in order to extract the maximum value from them. The objectives of the circular economy and China's green transition; are mutually supportive. Accordingly, promoting the circular economy should be an important building block in creating a Beautiful China(Figure 6-1).

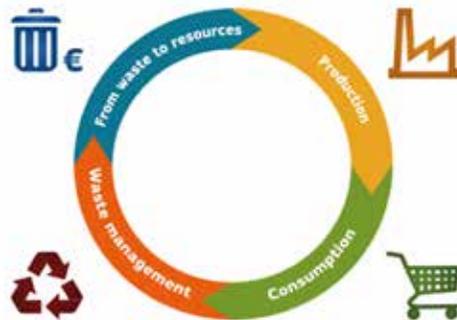


Figure 6-1 Circular Economy

A major driver for the circular economy has been concern about the adverse environmental consequences associated with the rapidly increasing use of materials. These include:

- More than half of all greenhouse gas (GHG) emissions are related to materials management activities. It has been estimated that global GHG emissions related to materials management will rise to approximately 50 Gt CO₂-equivalents by 2060.
- Fossil fuel use and the production of iron and steel and construction materials lead to large energy-related emissions of greenhouse gases and air pollutants.
- Metals extraction and use have a wide range of polluting consequences, including toxic effects on humans and ecosystems.
- The extraction and use of primary (raw) materials is much more polluting than secondary (recycled) materials.

In addition, there are economic considerations that support the transition to a circular economy:

- Reduced risks of disruptions and price volatility in the supply of raw materials and reduced dependency on imports.
- Reduced manufacturing costs resulting in enhanced productivity and competitiveness.
- New business opportunities, markets and job opportunities, e.g. the recycling and reuse of materials.

Of the 17 Sustainable Development Goals (SDGs), 12 directly depend on the sustainable, economy-wide management of a whole range of natural resources.¹

The OECD recently prepared a global outlook to 2060 for future materials use at the sectoral and regional level.² It projected that global primary materials use, and global primary materials extraction, would double between 2011 and 2060, from 79 to 167 Gt. In the case of China, it projected that materials use would increase from 27 to 38 Gt in the same period. In 2011, China accounted for about one-third of global material consumption. By 2060, China's share of global material consumption is projected to fall to less than one-quarter (Figure 6-2).

High levels of investment, infrastructure and construction have been important drivers of China's materials use. The continued convergence of GDP per capita with that in OECD countries will sustain a high demand for materials. However, this will be offset as the current investment boom comes to an end; as the share of services in the economy increases; and as technological change enables more efficient use of materials. As a result, the material intensity of the Chinese economy will decrease while the absolute volume of materials used will stabilize at a high level.

1 UNEP (2016) Resource Efficiency: Potential and Economic Implications. A report of the International Resource Panel. Ekins, P., Hughes, N., et al.

2 OECD (2019), Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences, OECD Publishing, Paris, <https://doi.org/10.1787/9789264307452-en>.

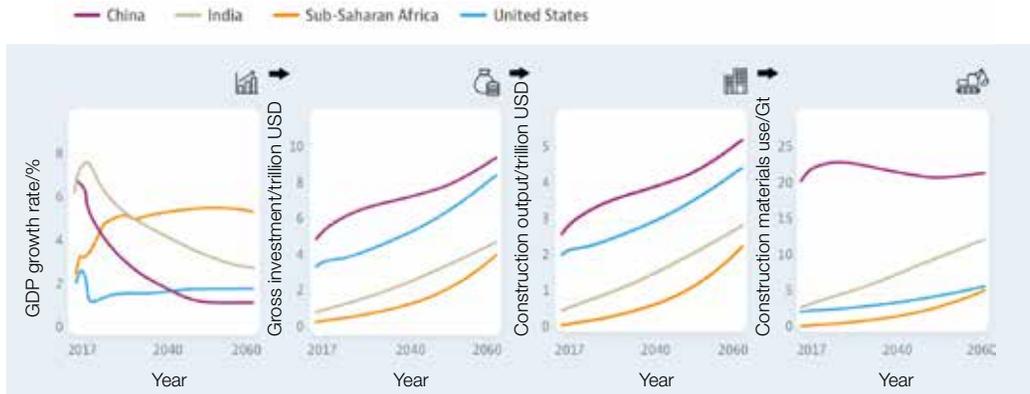


Figure 6-2 Economic growth drives use of construction materials

(Source: OECD, 2019. These projections are based on a business-as-usual scenario.)

The report identifies several other trends. The increased use of motor vehicles and electronics—which have low total materials intensities but are relatively large users of metals—will drive a fast increase in metals use. Recycling will gradually become more competitive than mining of minerals thanks to projected technological developments and changes in relative prices of production inputs. However, the increase in total demand for materials can only be easily met through increasing both primary and secondary materials use.

6.2.2 Challenges China faces by 2035

By 2035, China’s economic and social environment will be still in the process of transformation, and the ecological environmental protection is an inextricable part of this. Therefore, China’s pathway to ecological environmental targets for 2035 must reflect both improvement in addressing current gaps in environmental quality and “must have” changes enabling further achievements on the way to 2050.

During the “13th Five-Year Plan” period (2016—2020), China has made remarkable achievements in the battle of ecological environmental protection and pollution control. Ecological environmental protection and management have been on the right track. At the same time, however, China still faces severe challenges, and the existing problems and solutions are full of Chinese characteristics. Therefore, the focus in the future lies in persistence and implementation.

By 2035, China’s ecological environmental protection will face the following problems and challenges:

- The transformation of the industrial, energy and transportation sectors as well as land-use structure will continue. The improvement of China’s ecological environment quality must be based on the greening of production and consumption patterns, including

lifestyles. Equal attention shall be paid to economic structural and environmental improvement.

- The ways of integrating ecological environment protection into economic, political, cultural and social fields is still not obvious, and more needs to be done to provide incentives that make integration spontaneous and self-sustaining.
- We shall pay more attention to the public's ecological environment needs and interests, in view of China's social development, including environmentally related health impacts. The scope of ecological environment governance will be gradually expanded from the battle against pollution to solving more comprehensive and difficult problems such as climate change, resource efficiency, water management, air quality, soil, waste and chemicals management, biodiversity, environmental health, marine environment, environmental risks, etc..
- From the 14th Five-Year Plan period to beyond 2035, target setting, the implementation path, policy formulation and supporting measures for ecological environmental protection shall be consistent and forward-looking. The ecological and environmental protection strategy should not be affected by pressure from economic trends. Planning tools need to be utilized to ensure that existing and future Beautiful China targets will be achieved. Monitoring networks are necessary to assess baseline and progress.

6.2.3 Phased approach to ecosystems and environmental protection in 2020—2035

The combination of a long-term view and near-term urgency helps to outline a phased approach. It identifies key tasks for improving the eco-environmental quality during the period 2020—2035. In turn, these tasks can help to guide the direction of ongoing policy adjustment and optimization. They are as follows:

- Air quality nationwide must be brought up to national consistently agreed standards. The air quality of metropolitan areas around Beijing, Shanghai and Guangzhou will reach the current level of the air quality of, for example, London, the UK. The control of conventional pollutants such as PM_{2.5}, PM₁₀, SO₂, NO_x, etc.. will be completed by 2025, and the stabilization phase will begin by 2035. Incorporating new pollutants such as ground level ozone and volatile organic chemicals into the air quality management system requires the deployment of relevant action plans in advance.
- Focus on the treatment of seriously polluted water bodies and complete the restoration of water environment. The government should pay attention to key areas such as organic pollution control of water bodies, disposal of heavy metal pollution, underground

construction such as pipe networks, sediment pollution control, marine pollution control, etc., and completely eliminate black and odorous water bodies in urban built-up areas. These measures can make the quality of centralized urban drinking water sources in line with Class III or above. In addition, the water quality of major rivers should reach the current quality of, for example, the Rhine River. The water quality of offshore areas should be comprehensively improved, and the water quality of key sea areas should be as good as that of developed countries or regions. The water quality management system will still be dominated by end-of-pipe treatment and restoring the restoration functions of water environmental systems. The effectiveness of joint prevention and control of the upstream and downstream components of river basins will be further strengthened. Increasingly the management of the development of river basins should be based on integrated, holistic approaches.

- Strictly protect the soil environment and extend the restoration work from pilots to the whole country. China inventoried the soil pollution status of land and implemented laws and guidelines for dealing with contaminated land. By 2025, China will have established a soil pollution control system that focuses on controlling sources and risks, and comprehensively controls the environmental risks of contaminated land that is not being developed as well as contaminated land that is being redeveloped and utilized.
- Towards 2035, China's legacy of soil pollution from past decades will require special attention. In other countries, cleaning up even the most urgent contamination has proven to be costly. Towards 2035, China will feature widespread spatial shifts due to urban expansion, creation of new towns and fast changes in manufacturing. At the same time, its population will be better educated, informed and assertive. This combination of developments suggests that is beneficial at this particular point in time to a) make budgetary reservations and budget rules for priority clean-up, in particular for "orphan sites"; b) develop a priority system to guide the clean-up of contaminated sites in a manner that is both fair and cost-efficient; and c) build a contaminated-land register that is on-line available for all stakeholders and officials.
- Ecosystems enter a comprehensive recovery phase. The forest coverage rate and the proportion of ecological public welfare forests are continuously increasing, biodiversity reduction has been halted, and ecological service functions have been greatly improved. By 2035, there will be an improvement of various ecological restoration measures. The self-restoration and adjustment capabilities of the key ecosystems starts to be fully restored, and various regional ecosystems will be stable.
- Towards 2035, China like all other countries needs to initiate a comprehensive

programme of adapting to climate change. This includes urban size and layout as well as urban water management; agriculture; management of rivers, lakes and coastal areas; and the exact location of nature reserves. Long-term vision and adaptive planning can often help to limit year-to-year budgetary impacts and disruption in people's living environment.

- Public health should become one of the cores of the eco-environmental protection system, and a corresponding environmental health management system will be established. Air quality (outdoor and indoor), noise, chemicals, drinking water and climate change may all have an impact on public health and should be accounted for.

6.3 Background and Principles for Fundamentally Improving Environmental Quality Goals by 2035

Considering the basic economic and social features of the green transition to 2035, and the main challenges and changes China may face by then, this chapter examines the connotation and setting for fundamentally improving environmental quality by 2035 and realizing a Beautiful China.

6.3.1 Connotation of the fundamental improvement of environmental quality by 2035

General Secretary Xi Jinping proposed two, phased goals for realizing a Beautiful China at the National Ecological Environmental Protection Conference in 2018: First, by 2035, there will be a fundamental improvement in the environment, and the goal of building a Beautiful China will be basically attained. The second goal is, by the middle of this century, there will be harmonious coexistence between man and nature, and the modernization of China's governance system and capacity is basically achieved in the field of the ecological environment, and a Beautiful China will be built.

Specifically, a fundamental improvement in the environment involves solving the outstanding ecological and environmental problems, including: a) Air quality shall be clearly improved (binding requirement), and heavy pollution events are basically eliminated; b) the Action Plan for Water Pollution Prevention and Control will be implemented to ensure water safety and basically improve the black and odorous water bodies in urban areas; c) the Action Plan for Soil Pollution Prevention and Control will be fully implemented with a focus on key areas, industries and pollutants, and strengthening soil pollution control and restoration; d) economic and energy structures will be adjusted to achieve green development; and e) land

and spatial development will be optimized to adjust the regional, river basin and industrial layout.

6.3.1.1 There will be a fundamental improvement in the environment, and the goal of building a Beautiful China will be basically attained

In respect of the first goal “there will be a fundamental improvement in the environment, and the goal of building a Beautiful China will be basically attained”—this concerns the continuous improvement in the ecological environment, and ultimately achieving a certain standard by a specific time and for a specific space, so that the various elements of the ecosystem and the environment are in line with human survival and sustainable socio-economic development. A fundamental improvement in the environment is not just a change or improvement at a certain time point, but a long-lasting process or state. The natural ecosystem will basically restore its carrying capacity, and the environment will begin to realize self-regulation.

The following five features shall be realized in order to achieve a fundamental improvement in the environment over the coming decades:

Firstly, compliance. The quality of the ecological environment shall first of all reach the national standards of the time. This is the basic feature and the bottom-line requirement for the fundamental improvement in the environment. To evaluate whether the quality of the ecological environment is up to standard, efforts shall be made to quantify the applicable targets. By determining the standard and quantitative indicators, it is possible to formulate operational and detailed tasks for evaluation and assessment. “Laggards” shall catch up and achieve compliance with the quality standards; “front-runners” shall maintain the lead and move toward higher standards.

Secondly, stability. On the basis of compliance, the quality of the ecological environment must be maintained in a state of continuous compliance or above the standard with a small fluctuation range (which shall be agreed subject to minimizing any exceedances). This is the most essential feature that distinguishes it from the overall improvement goal of the ecological environment in 2020, and is the fundamental requirement for improving the environment and consolidating pollution control. Take air quality as an example: the goal is to achieve at least three consecutive years of compliance, 90% of days per year with quality air, basically no “off-the-charts” levels of pollutants such as $PM_{2.5}$, and no return of heavy pollution. It should be normal to have blue sky and white clouds. To achieve this goal, it is necessary to both mitigate the risk and actively respond to environmental risks, enhance early warning capability and prepare for a prompt response to reduce the ecological and environmental impacts of major incidents.

Thirdly, balance. The quality of the ecological environment should be comprehensively improved. This is the main feature, and a difficult task, in achieving the fundamental improvement in the environment. To achieve balanced development, it is necessary to improve the quality of the ecological environment on three levels. Firstly, comprehensively improve all elements in the environment, including air, water, soil, forest, wetland and biodiversity to meet the standards without any outstanding points of weakness. Secondly, efforts to improve the environment shall fully cover China's extensive areas. The natural resource endowment and level of social-economic development varies greatly among different regions, as does the degree of eco-environment damage, resulting in very different governance tasks. As far as the current environmental governance is concerned, emissions of conventional pollutants in the eastern region have reached their peak, showing slow yet steady improvement. The central region is experiencing its worst conditions and may require a longer treatment time. Emissions in the western region continues to increase, posing the biggest challenge. Based on the status quo, a fundamental improvement in the environment by 2035 requires narrowing the gap in environmental quality between regions and achieving balanced development, so as to realize a comprehensive and thorough improvement to the ecological environment. A whole-of-China approach is required to minimize the risk of high polluting industries being displaced to central and western China and a worsening of their ecological environment. Finally, we shall decouple environmental pollution from economic growth. Efforts shall be made to coordinate the development, and truly follow the principle that "green mountains and clear water are as good as mountains of gold and silver", which is the inherent requirement for achieving a fundamental improvement in environment.

Fourthly, comparability. We should regard the improvement of China's eco-environment from an international perspective. Its governance outcome and quality standards shall be comparable with those of developed countries such as the United States and Europe, and can provide a reference for late-developing countries. With growing globalization, China needs to gradually integrate itself into the global environmental governance process. As a responsible country, China shall ensure comparable quality of the eco-environment in the global context. The meaning is threefold. The first is that China shall have a comparable environmental agenda and concerns. In addition to the local outstanding eco-environmental issues, it is necessary to gradually incorporate key environmental issues of concern in international environmental governance into our national governance system, or further enhance our efforts in this regard. This includes issues such as climate change issues, marine micro-plastics, migration and diffusion of atmospheric pollutants, and biodiversity conservation issues. Secondly, it is necessary to gradually improve the quality standards and bring them in line

with those of the developed countries, enhance international recognition of our environmental governance performance, and strengthen our bargaining power. Finally, it is essential to gradually apply data monitoring technologies that are comparable to the developed countries.

Fifthly, consistency. According to the main contradictions in China's current society and the fundamental purpose of the Communist Party of China, the ultimate goal of people-oriented development, and to achieving a fundamental improvement in the environment, is to meet the people's desire for a better life. Therefore, the goal is not only an improvement in the statistics, but also an overall improvement in the feelings of the people about the environment. A sound eco-environment can thus truly become the growth point for a better life for the people. For example, we shall pay special attention to the current issues, e.g. decreasing concentrations of major pollutants in the atmosphere yet no significant improvements in visibility; environmental monitoring data showing compliance with environmental requirements yet persistent odors; water complying with environmental requirements but with low clarity; clear water but posing a risk to human health, etc.. Greater use of health-related data may be a useful means of demonstrating China's progress in addressing the less visible pollutants and minimizing public concerns. An important feature of achieving a fundamental improvement in the environment by 2035 is to ensure that the general public feels that its environmental quality of life has improved.

6.3.1.2 A Beautiful China will be built by the middle of 21st century

By the middle of 21st century there will be harmonious coexistence between man and nature, and the modernization of China's governance system and capacity is basically achieved in the field of the ecological environment, and a Beautiful China will be built.

To modernize the national governance system in the field of ecological environment, the policy framework shall include the following:

- Developing an ecological and cultural system based on ecological values. The main objectives include: popularization of ecological civilization education; construction of national forest parks; construction of natural and wetland protected areas to strengthen research of ecological cultural systems; development of ecotourism and cultural tourism.
- Establishing an ecological and economic system with eco-development of industries and industrialization of eco-development. It is required to closely integrate, coordinate and optimize the industrial, ecological and social systems within a specific regional space and to do so within the carrying capacity of natural systems, making full use of resources, ending environmental damage, and coordinating the sustainable development of nature, society and economy.
- Establishing an ecological civilization system that guarantees the modernization of the

governance system and capacity. The ecological civilization system mainly includes systems for natural resource property rights, the development and protection of land, spatial planning, total resource management and comprehensive conservation, payments for use of resources and ecological compensation, environmental governance, ecological civilization performance evaluation and responsibility, investigation and accountability, etc..

- Establishing an ecological protection system focusing on the virtuous cycle of ecosystems and the effective prevention and control of environmental risks. The requirements for the construction of an ecological protection system include restoring ecological space, improving the quality and area of ecosystems, improving and maintaining air quality, water environment, water resources, and soil resources, maintaining biodiversity and slowing down biodiversity degradation.

6.3.2 Eco-environmental quality and Beautiful China's milestone targets

6.3.2.1 Target for the next 5 years

The main task until 2020 is to achieve the environmental goals included in the “13th Five-Year Plan for Ecological Environmental Protection” and the climate change targets established by the NRDC.

6.3.2.2 2035 target

According to China's social and economic development, the goal building a Beautiful China by 2035 includes the following indicators (Table 6-2):

Table 6-2 The goals of building a Beautiful China by 2035

Indicator		2035	(Cumulative) compared to 2015	Attributes
1. Air quality	Prefecture and above cities ¹ : ratio of days with good and moderate air quality/%	90	—	Binding
2. Water environmental quality	The ratio of water body with surface water quality ² that is or better than Class III water/%	80	—	Binding
	Water quality compliance rate of important rivers and lakes in the functional area/%	90		Expected
2. Water environmental quality	Proportion of water quality (Class I and II) in coastal regions/%	85	—	Expected
3. Soil quality	Cultivated land safe use rate/%	100	—	Binding

	Indicator	2035	(Cumulative) compared to 2015	Attributes
4. Ecological status	Forest coverage rate/%	27	(1.38)	Binding
5. Reduction of total discharge of major pollutants/%	Chemical oxygen demand	—	(25)	Binding
	Ammonia nitrogen	—	(25)	
	SO ₂	—	(20)	
	NO _x	—	(25)	
6. Reduction of total regional pollutant emissions/%	Volatile organic compounds in key industries in key regions ³	—	(20)	Expected
	Key area total nitrogen ⁴	—	(20)	Expected
	Key area total phosphorus ⁵	—	(20)	
7. National key wildlife protection rate/%		—	—	Expected
8. National natural shoreline retention rate/%		—	—	Expected
9. Newly restored desertified land/(10,000 square kilometers)		—	(30)	Expected

Note: 1. The air quality assessment covers 338 cities across the country (including prefectures and some provincial-level cities, excluding Sansha and Danzhou).

2. The assessment of water environmental quality covered the national surface water control section, and the number of sections increased from 972 to 1,940 during the “Twelfth Five-Year Plan” period.

3. Promote total volatile organic compounds cap control in key regions and industries in order to drop the total national emissions by more than 10%.

4. Implement total nitrogen control in 56 cities along the coast and 29 eutrophicated lakes and reservoirs.

5. Implement total phosphorus emissions cap on non-complying entities and relevant upstream areas.

6.3.3 Overall considerations regarding the 2035 goals

6.3.3.1 The medium- and short-term goals must be consistent in direction and well connected

The medium- and short-term goals should be consistent over time, space, and levels of government; as well as connected to the foreseen changes in the economy, social context and urbanization. We shall carry out relevant work based on the 2035 goals. The goals of the 14th Five-Year Plan shall refer to the 2030 and 2035 goals and be defined based on the goals of Beautiful China 2035. Some of the target indicators of the 13th Five-Year Plan need to be improved steadily, and it is necessary to continue to meet and simultaneously strengthen the requirements for rural areas, ecosystems, climate change, and environmental health (especially the health problems of vulnerable groups such as women and children), so as to carry out relevant work in advance. A three-year moving average could be considered for setting some targets.

6.3.3.2 The 2035 targets should align with China's pathway to 2050

The 2035 targets should align with China's pathway to 2050. This is particularly important for slow-changing and long-lived systems, such as the energy system, urban layout and others. Methods of foresight need to be applied in order to enable timely initiatives, for example in large old-style manufacturing areas. Foresight methods are also required to avoid, as much as possible, painful write-offs of measures that may be of some use towards 2035 but have no role thereafter ("stranded assets"). For example, any strategy involving "clean coal" requires a planning horizon well beyond 2035¹. In addition, a timely understanding of the challenges and opportunities of adaptation to climate change is needed in order to minimize the eventual cost and disruption as well as potential public health risks.

6.3.3.3 Regional differences should be taken into account when working toward the 2035 goals

Due to the wide differences among regions with different levels of economic and endowments of natural resources and biodiversity, it is unrealistic to expect all regions to achieve the goals of Beautiful China by 2035. For example, the Pearl River Delta region may complete the goal by 2030, while it may take longer in central and western regions. For developed and underdeveloped regions, on the condition that they have met the same environmental standards and requirements, the principle of "common but differentiated responsibilities" shall also be determined; that is, we shall encourage some regions to achieve the goals of Beautiful China first while giving more support to poor and vulnerable regions so as to avoid the deterioration of the ecological environment. Environmental governance will put more emphasis on sharing positive experiences and win-win benefits. It is recommended to establish a Beautiful China demonstration zone. This could be done by establishing ecological provinces, cities, counties and districts that could play leading and demonstration roles. In line with this, and as far as possible, the target indicators and policy measures for the 14th Five-Year Plan shall be differentiated by region, and the related implementation guidance and capacity building shall be strengthened. Regional differentiation should be accompanied with a timetable showing the eventual application of ambitious protection to all regions of China and allowing investors and other actors to anticipate on this. Policies that provide perverse incentives for investments in regions with less stringent environmental requirements should be avoided.

¹ BAKKES J, et al. The worldwide context of China's Green Transition to 2050[R]. PBL Netherlands Environmental Assessment Agency, The Hague, 2017.

6.3.3.4 We shall establish a target and indicator system that is oriented to ecological priorities and green development, so that a high-quality development can be supported

This shall be the core guiding idea of the 14th Five-Year Plan. The SPS recommends targets that are ambitious, clear, measurable, outcome-based, use SMART-related criteria, focusing on absolute ambient-level targets rather than intensity targets. In terms of emission targets, it underscores the importance of setting and then sticking with long-term emission targets, to enable different actors to meet them. This approach could assist other countries in achieving environmental and development goals.

6.3.3.5 Regular and independent review of targets and indicators and establishment of the tracking system

As the general conditions for achieving sustainable development may change, new problems and possibilities may arise or new and better data may become available, a regular independent revision of indicators, targets and measures required is necessary. In terms of the Beautiful China demonstration zone, it is suggested to strengthen long-term tracking of the goal of achieving Beautiful China, build an evaluation system for achieving Beautiful China goals, implement assessment and early warning, establish improvement mechanism, and strengthen policy preparations.

Box 6-1 German Sustainable Development Strategy: Targets and Indicators

Targets and indicators reflect the status of sustainable development and form the basis for assessing the success of the measures taken.

The German Sustainable Development Strategy is not based on a single index per SDG but on several key indicators. The number of these key indicators is kept relatively small (in comparison to the UN SDGs, with a total of 232 indicators) in order to provide a quick overview of the current state of sustainable development in Germany. After the current revision of the strategy in 2018, 67 indicators have been established to track progress in 36 areas among the 17 SDGs. These key indicators also serve as points of entry for other national indicator systems, for example the indicators of the National Biodiversity Strategy.

Most indicators are linked to quantitative targets (e.g. “indicator x shall reach value y in year z”). Other indicators are linked to qualitative targets (e.g. “indicator x shall increase in the future”). Progress towards the target is evaluated in an independent report by the Federal Statistical Office of Germany. For a quick overview and better comparison, the result of the evaluation for each indicator is illustrated by weather symbols in four categories (e.g. sun for very good performance, thunderstorm for very poor performance).

1.Principles of target and indicator development

Specifying adequate long-term goals and indicators is a requirement for the successful implementation of any sustainability strategy. They reflect the status of sustainable development and form the basis for monitoring the success of measures taken.

2.Embedding national targets into the international framework (of SDGs)

The 2030 Agenda's SDGs provide an exceptional framework for the development of national targets and indicators. Linking national indicators and targets to a well-established international process leads to a broader relevance and acceptance of the strategy and facilitates the international exchange of experiences.

3.Highlighting the relevance of the targets

In order to promote acceptance and support for newly developed targets, it is important to link them to internationally agreed goals such as climate protection and to underpin them with recognized scientific findings.

4.Reflecting national priorities

Political priorities must include ambitious targets and indicators. This is the only way to link ambitious policy measures to targets and ensure successful monitoring. The number of indicators and targets should be limited.

5.Illustrating interdependencies, synergies and conflicts of social, environmental and economic targets

While targets are often assigned to one specific dimension of sustainability, they have interdependencies with the other two dimensions. These interdependencies and possible synergies and conflicts must be taken into account when developing indicators for the targets. An ecological economic system not only has a positive impact on the ecologic dimension of sustainability, e.g. reduced CO₂ emissions or reduced resource consumption. It may also contribute to achieving economic targets, e.g. by improving competitiveness through more efficient use of energy and decreasing dependence on potentially depleting resources.

6.Scaling down goals and indicators in order to be relevant for action and linking measures to them

Since overarching goals are generally broad in scope, the design of more specific sub-goals and related indicators is important in order to enable detailed monitoring. Targets and indicators should then be chosen in such a way that they can be linked to and affected by policy measures.

The goal of reducing CO₂ emissions for example can be divided into reductions in the sectors of industry, private households and transportation. A further subdivision would be possible for the different pathways for achieving this goal:

Increasing energy efficiency and increasing use of renewable energy sources.

As a result very specific targets and indicators (linked to specific measures) can be developed.

It has to be noted though that indicator-based monitoring is not the only instrument for the evaluation of the strategy and its implementation. Not all domains and measures that are relevant to sustainable development can be reflected in an indicator-based monitoring system.

Further feedback regarding the success of the strategy and its measures is given by all the relevant stakeholders (e.g. the Council for Sustainable Development, the Parliamentary Advisory Council for Sustainable Development, other social actors and international experts within the framework of the Peer Review).

7. Defining clear responsibilities and establishing transparent and credible monitoring

It is indispensable to monitor the progress towards achieving the targets and to take subsequent action. In Germany, the Federal Statistical Office is responsible for monitoring. It enjoys a high degree of recognition in the sense of high data quality assurance. The quality and acceptance of monitoring is also a decisive success factor.

8. Regular and independent review of targets and indicators

As the general conditions for the sustainable development process may change, new problems and possibilities may arise or new and better data may become available, a regular independent revision of indicators and targets is necessary. In Germany, this revision process is carried out by international experts as part of the peer-review process of the sustainability strategy. In the current revision of the 2018 strategy, 3 new indicators were introduced and 2 targets revised to better reflect the current state of science and policy.

6.4 Policy Recommendations

6.4.1 Transition to a Low-carbon, Resource-efficient Economy

6.4.1.1 Mitigating climate change

(1) To realize the structural green transformation of energy

1) Continuing to deepen the reform of the power system

Efforts in this regard include accelerating the establishment of transparent and efficient national and provincial power trading platforms, improving the medium- and long-term power trading mechanism, and further promoting the construction of auxiliary power service markets and pilots of the spot market. The work also includes speeding up system

reform of power generation and electricity use plans, increasing the proportion of market-oriented power transactions, further reducing the energy costs of enterprises, accelerating the innovation of power distribution/marketing and improving the fairness and openness of incremental distribution networks to the public. We shall also put in place a price and distribution mechanism that is conducive with the on-grid consumption of power generated from renewable energy, and gradually implement the power allowance assessment of renewable energy and green certificate trading mechanism, etc..

2) Continuing to deepen oil and gas reform

The reform of the oil and gas exploration and exploitation management systems shall be deepened, and detailed rules shall be issued as soon as possible; the exit mechanism of oil and gas exploration areas shall be strictly implemented, the competitive transfer of blocks shall be comprehensively put into practice, transfer of mineral rights in a market-oriented manner shall be encouraged, and the rules of transfer of mineral rights, reserves, and value assessment, among others, shall be improved. A mechanism for the disclosure and sharing of oil and gas geological materials shall be established and improved; the reform of the pipeline operation mechanism shall be promoted, the independence of the pipeline shall be realized, and the natural gas pipeline network and other infrastructure shall be available to third-party market entities in a fair manner. The price scheme of residential natural gas gate station and the sales price of residential natural gas shall be rationally implemented; differentiated price policies such as seasonal price difference and interruptible gas price shall be implemented to promote load shifting; price regulation of natural gas transmission and distribution links shall be enhanced, excessively high transmission and distribution price in provincial regions shall be reduced, etc..

(2) Setting a carbon price: taxes and emission trade systems (ETS)

The most cost-effective way to reduce carbon emissions and to promote the investments needed to drive the green transition is by putting a sufficiently high price on carbon.

Environmentally related taxes are one type of market-based instrument. In the context of mitigating climate change, they can take the form of a carbon tax whereby a tax is applied to the amount of carbon emitted by specified activities. Generally, a carbon tax aspires to improve the alignment between the cost of the polluting activity and the environmental cost.

Environmentally related taxes may also work indirectly when they are applied to activities that have an environmental impact but without targeting the environmental externality directly. In the climate field, taxes applied to energy and transport fuels are the most common form of this type of environmentally related tax. Indeed, in OECD countries, about 90% of the revenues generated by environmentally related taxes are from these

sources.¹ These taxes are often applied to generate revenues rather than for environmental purposes. Nevertheless, the level of tax applied to these fuels puts a price on carbon: an effective carbon prize.

ETS are another type of market-based instrument, and work is currently under way in China to develop a national trading emissions system based on several pilot studies. In an ETS, a cap on the total amount of carbon emissions is set and then permits, or emission allowances, are allocated specifying how much pollution each permit holder can emit. Permit holders with insufficient emission allowances can purchase permits from those with an excess at a price determined by the market. This enables emitters to find the most cost-effective way to reduce carbon emissions and in a way that helps achieve the overall target. An ETS creates certainty about the emission reduction goal, but the price of carbon (permits) will vary, sometimes significantly. In contrast, a carbon tax creates certainty about the price of carbon, but the level of emissions reduction will depend on the response of consumers and producers.

Box 6-2 Tax Incentives²

Market-based instruments aim to increase the relative price of production and consumption to better reflect their environmental costs. However, it is often argued that the same result could be achieved by providing tax relief or subsidies to environmentally friendly activities; for example, VAT exemptions for energy-efficient appliances or favourable depreciation rates for capital investments in renewable energy or pollution abatement. The use of such incentives is most effective where there are “positive externalities”; that is markets provide too little of a socially desirable activity. A good example is RandD where companies tend to invest too little due to concerns that some of the benefits will be captured by other companies. However, tax and other incentives generally are not effective in addressing “negative externalities” like carbon emissions: they often subsidise activities that would have been undertaken anyway; it is difficult and often costly to identify all of the environmentally beneficial alternatives that may merit support; incentivising some activities may actually result in increased pollution; and, while taxes and ETS generate revenues, incentives are a form of public expenditure.

¹ Comprehensive information on the taxation of energy in OECD and G20 countries can be found in OECD. Taxing Energy Use 2018: Companion to the Taxing Energy Use Database[M]. Paris: OECD Publishing, 2018. <https://doi.org/10.1787/9789264289635-en>.

² GREENE J, BRAATHEN N. Tax Preferences for Environmental Goals: Use, Limitations and Preferred Practices[Z]. //OECD Environment Working Papers(No. 71). Paris: OECD Publishing, 2014. DOI: <http://dx.doi.org/10.1787/5jxwrr4hkd6l-en>.

When well-designed and implemented, environmental taxes and tradeable permits are more or less equivalent. As such they share the advantages of market-based instruments over regulations.

First, whereas regulations specify how carbon emissions are to be reduced, market-based instruments allow for a wider range of abatement options. This in turn creates incentives to identify the least-cost, most cost-effective option. A 2013 OECD study tested this proposition empirically and confirmed that market-based instruments were the most cost-effective means for reducing carbon emissions.¹

Second, whereas target- or technology-based regulations provide no incentive to abate once the standard has been met, market-based instruments provide an ongoing incentive to do so. This creates incentives to innovate and find the least-cost approach for meeting the environmental requirement. A 2012 OECD study confirmed that price signals have played an important role in stimulating innovation in technologies that reduce carbon emissions.²

Third, in contrast to regulations, market-based instruments generate revenues that can be used in socially beneficial ways. Carbon and other environmentally related taxes can be collected as part of the established process of collecting national taxes. In the case of ETS, they generate revenues when permits are auctioned. In 2017, the OECD estimated that, in the OECD area, environmentally related taxes generated about 5.2% of total tax revenues, equivalent to 1.6% of GDP.³ In 2016 in China, the corresponding ratios were 3.59 and 0.7% respectively.⁴

Whereas charges for water, waste or other environmental services are used to finance the provision of those services, tax revenues should normally accrue to the national treasury. The traditional argument is that “earmarking” tax revenues for specific purposes will ultimately result in inefficient expenditures. On the other hand, earmarking can increase policy transparency and help to offset opposition from those who will be subject to the tax.

A recent OECD study examined how countries have used the revenues generated by carbon pricing, both taxes and ETS.⁵ It found that carbon taxes were often linked to broader tax reform; that is, carbon taxes were often linked to reductions in personal or corporate income taxes. Such approaches aim for a “double dividend” involving improved

1 OECD. *Effective Carbon Prices*[M]. Paris: OECD Publishing, 2013. DOI: <http://dx.doi.org/10.1787/9789264196964-en>.

2 OECD. *Energy and Climate Policy: Bending the Technological Trajectory*, OECD Studies on Environmental Innovation[M]. Paris: OECD Publishing, 2012. <https://doi.org/10.1787/9789264174573-en>.

3 OECD. *Green Growth Indicators 2017*, OECD Green Growth Studies[M]. Paris: OECD Publishing, 2017. <https://doi.org/10.1787/9789264268586-en>.

4 <https://www1.compareyourcountry.org/environmental-taxes>.

5 MARTEN M, VAN DENDER K. “The use of revenues from carbon pricing”[M]//OECD Taxation Working Papers, (No. 43). Paris: OECD Publishing, 2019. <https://doi.org/10.1787/3cb265e4-en>.

environmental quality and a reduction in more distortionary taxes. Excise taxes on energy and transport fuels – which account for the largest share of carbon-related revenues – were the least earmarked. In some countries they are used to finance transport infrastructure, suggesting that in those countries they are seen as form of user charge. Revenues from auctioned tradable emissions permits are almost exclusively earmarked to support energy efficiency, low-carbon mobility and other green spending measures, with the second highest share dedicated to compensating energy users for the higher costs they must bear.

While environmentally related taxes and ETS share some common benefits, they have different characteristics which make them better or worse suited for different tasks. Emissions trading systems may be preferred to taxes in cases where attaining a particular level of pollution is essential. They also work well when there is a well-defined set of large emitters potentially interested in trading permits. A carbon tax may be preferable if a wider, more diverse set of emitters is targeted. While there may be uncertainty about the environmental outcome, knowing the price of pollution helps investors make abatement decisions, so taxes can give stronger abatement incentives than emission-trading systems.

Another important consideration when choosing between taxes and ETS is administrative costs. Establishing an environmental tax system generally incurs less costs than ETS, though the costs may still be significant. The costs of monitoring taxable emissions may also be significant. Administrative costs can be reduced by integrating the collection and management of revenues into the existing tax administration. In contrast, the start-up and administrative cost associated with ETS can be significant. The management of the trading system to ensure its integrity and transparency may also be a challenge. However, given the level of effort and engagement in establishing an ETS, once it is up and running, it is likely to enjoy the support of participants.

In terms of environmental effectiveness, taxes will be most effective when they target carbon emissions most directly. Thus, a carbon tax will provide better incentives to reduce carbon emissions than taxing energy use or vehicles that use energy fuels. The environmental effectiveness of taxes has sometime been weakened by granting exemptions and when the real value of the tax is not adjusted in line with inflation.

In the case of ETS, permits should be auctioned rather than allocated for free (grandfathered). Auctioning makes sure that the rents linked to permits go to public authorities rather than existing polluters. Free allocation of permits weakens incentives to invest in less carbon-intensive technology. It may result in the oversupply of permits and a carbon price that is not sufficient to drive the low-carbon investments originally envisaged. Free allocation of permits may also enable some firms to make large windfall profits and

foster corruption in the trading system which erodes the credibility of the system. This was the case in the early phases of the EU's ETS.

Application of ETS internationally requires that all participating jurisdictions have declared, for specific points in the future, a limit (“cap”) on carbon emissions in absolute terms. Carbon prices in trading are based on that. China's current climate policy has no absolute cap, but a commitment in terms of intensity: emission per unit of added value. Such an intensity commitment is arguably better suited to a dynamic economy like China's. But China could someday declare an emission cap in absolute terms as a policy option at an appropriate time, thereby removing one obstacle to international ETS trading as a means of cost reduction on the way to 2035. In that situation, as a means to retain some flexibility, it could seek the privilege of periodically revising its carbon cap, for example in function of its five-year planning¹.

Whether taxes or ETS are used, the most important determinant of environmental effectiveness will be the price these instruments put on carbon. A 2018 study examined the effective carbon rate in OECD and G20 countries.² It also calculated the carbon pricing gap using EUR 30 as a reference price for a tonne of carbon. This was considered to be at the low end of the possible price range if international climate targets are to be achieved.³ The carbon price gap is a measure of the difference between the actual and reference carbon price. The report showed that 46% of Carbon-emissions from all energy use in the 42 countries are not subject to any carbon price, and only 12% to a rate of at least EUR 30 per tonne. 88% of emissions are priced below EUR 30 per tonne.

The picture was a bit more nuanced when broken down by sector. The road transport sector had the highest effective carbon rate and carbon pricing gap of 58%. This contrasts with industry and the residential and commercial sectors that had carbon price gaps of 95 and 93% respectively. Somewhat surprisingly, coal which is the most carbon-intensive energy source, was taxed at the lowest rates or not taxed at all in almost all countries.

The table 6-3 below shows the carbon price gap by country. China's carbon price gap belongs to one of the countries with the largest gaps.

Two factors have been important in preventing a higher a price being levied on carbon: concerns about its impact on the competitiveness of industry and concerns about how it

1 ZENG Yingying. *Obstacles to Linking Emissions Trading Systems in the EU and China. A comparative law and economics perspective*[D]. University of Groningen, 2018.

2 OECD. *Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading*[M/OL]. Paris: OECD Publishing, 2018. <https://doi.org/10.1787/9789264305304-en>.

3 At the beginning of 2018, the price of carbon in the EU ETS was less than 8 EUR/tonne. In August 2019, it was almost 29 EUR/tonne. The results presented here should take this development into account. The change in the price of carbon illustrates the volatility that can occur within and ETS.

might affect the affordability of energy for lower-income groups.¹ However, competitiveness impacts appear to have been exaggerated and affordability issues can be offset by flanking policies. This suggests that these concerns are not justified in preventing a higher price being put on carbon.

Table 6-3 The carbon price gap by country

Country	Carbon Price Gap
Norway	34
UK	42
Germany	53
Poland	67
USA	75
China	90
Indonesia	95

There is growing body of evidence that the immediate competitiveness impacts of existing carbon pricing mechanisms are negligible or nil. This includes carbon and energy taxes as well as ETS. While this can be partly explained by the low prices and free allocation prevailing in most mechanisms, these same prices nevertheless have reduced emissions, and windfall profits have occurred. This suggests that the prices have not been so low as to be ineffective environmentally or trivial economically. Other analysis suggests that a higher carbon price could boost the short-term productivity growth and longer-term competitiveness of the most productive firms and industries.

Regarding the impact on households, it depends on the type of tax involved. An OECD study found that that taxes on transport fuels tend to be progressive on an expenditure basis (higher for high-income groups compared to low-income groups). However, experience from France suggests that this likely to be the case for urban dwellers: taxes on transport fuels may be regressive for rural residents who are dependent on privately-owned vehicles for transport. Taxes on heating fuels were slightly regressive, and taxes on electricity were more regressive on both an income and expenditure. However, if an energy tax increase was complemented by income-tested compensation, this could improve energy affordability for the poorest population groups using just a third of the additional revenues raised. Thus, a higher effective carbon rate could be applied, and after implementing effective flanking policies, substantial amounts of revenues could still be available for other us.

¹ OECD (2017), Environmental Fiscal Reform: Progress, Prospects and Pitfalls, <https://www.oecd.org/tax/tax-policy/environmental-fiscal-reform-G7-environment-ministerial-meeting-june-2017.pdf>.

As with any policy instrument, side-effects, distributive impacts and sufficiency of a carbon price change under consideration should be quantitatively investigated. That is before and during implementation. Sufficiency questions include, most prominently, whether the envisaged intervention is likely to produce change that not only goes in the desired direction but is deep and fast enough, compared with alternative policy instrument mixes.

6.4.1.2 Enhancing material productivity and resource efficiency /Circular Economy

Global material resource consumption is projected to double by 2060. Unless environmental management and resource efficiency policies are significantly improved, natural assets will continue to degrade and become scarcer, with potentially serious adverse economic, social and environmental consequences. The underlying policy objective should be to decouple resource consumption from economic growth; at first relatively and ultimately absolutely.

Like other countries, China should carry out a careful analysis, in consultation with stakeholders, of the resource-consuming sectors that pose the greatest economic, environmental and social threats. On this basis, it can develop a national plan with targets and indicators. An effective national plan requires concerted and coherent policy action by the government, supported by effective governance arrangements at a sufficiently high level in order to respond to the systemic challenge in transitioning to a circular economy. Several OECD countries, including Finland and the Netherlands, have established overarching mechanism to support the coordination and coherence of resource productivity policies.

Drawing on country experience, a recent OECD report has suggested that national strategies should include four main policy approaches:¹

(1) Apply mixes of policy instruments so as to provide a coherent set of incentives for resource efficiency along the product value chain.

Policy mixes could include a set of complementary regulatory, market-based, finance and information instruments. Many countries have found it easier to apply instruments downstream in the value chain, e.g, taxes on waste going to landfill. It has proven more difficult to apply instruments that effectively target product design and that increase demand for resource-efficient products. Yet, influencing how products are designed, and creating demand for resource-efficient products, are potentially some of the strongest instruments to achieve resource efficiency objectives.

(2) Implement policies that promote resource efficiency across the lifecycle of products. Several approaches are available to achieve this objective: extended producer responsibility

¹ OECD. Policy Guidance on Resource Efficiency[M], Paris: OECD Publishing, 2016. <https://doi.org/10.1787/9789264257344-en>.

(EPR); green procurement; and partnerships involving business working along value chains.

Box 6-3 Possible Policy Mixes for Plastics¹

- Regulations can be used: to ban or restrict certain components of plastic; to ban some of the uses of single-use plastics; to require a minimum recycled content or uptake of secondary plastics; and to establish recycling targets and landfill bans.
- A variety of market-based instruments are available. Taxes can be applied to penalise specific products (or chemical additives) and less preferable waste treatment practices (i.e. landfilling or incineration). Well-designed deposit refund schemes and extended producer responsibility policies can recover the costs of waste management, and help to create a market for secondary plastics.
- Finance can be used: to support the development of waste management infrastructure; to fund RandD in areas like product design; and green public procurement.
- Information by means of certification and labelling can help to inform the purchasing choices of businesses and consumers.

EPR involves producers taking responsibility for collecting, sorting and treating end-of-life products, in line with the polluter-pays principle. This approach is now used by a majority of OECD countries for electric and electronic equipment, packaging and tyres. These policies have helped to reduce landfilling of waste and increase material recovery. However, a recent review of EPR systems in OECD countries suggested that there was scope to improve the operation of these policies and provided recommendations for how this could be done.²

Green Public Procurement (GPP) aims to establish resource efficiency criteria for public purchases. General government procurement accounts for 12% of gross domestic product and nearly one third of government expenditures in OECD countries. As a result, greening public procurement can provide important leverage to stimulate innovation and increase demand for green products. However, much remains to be done to integrate resource efficiency considerations – including the use of lifecycle analysis – into public procurement programmes. Furthermore, it is crucial that appropriate capacity is built in relevant agencies at national and subnational level.

One example of partnerships involving business is industrial symbiosis. This involves engaging companies in a network to foster eco-innovation and knowledge sharing in order to make one operator's waste another one's material input. Another approach involves large

1 Watkins E, et al. "Policy approaches to incentivise sustainable plastic design[Z]" //OECD Environment Working Papers(No. 149). Paris: OECD Publishing, 2019. <https://doi.org/10.1787/233ac351-en>.

2 OECD. Extended Producer Responsibility: Updated Guidance for Efficient Waste Management[M/OL], Paris: OECD Publishing, 2016. <https://doi.org/10.1787/9789264256385-en>.

companies working with the smaller supply companies to ensure that inputs produced along the value chain meet resource efficiency and other environmental criteria.

(3) Treat resource efficiency as an economic policy challenge and integrate it into cross-cutting and sectoral policies.

The transition to a circular economy requires a comprehensive set of policy measures at the macroeconomic and sectoral level. Opportunities should be sought to exploit synergies with other policies, including climate change: there are many win-win opportunities in pursuing low-carbon and resource efficiency objectives, such as in the area of sustainable mobility. At the same time, some of the main barriers to achieving resource efficiency goals are linked to the incentives embedded in policies in other sectors. Analysing the major resource consuming sectors – agriculture and food, transport, energy – can help to identify policy misalignments with resource efficiency objectives and how they might be overcome. Unless this analysis is performed, resource efficiency policies may be ineffective.

Governments can also support resource-efficient structural change by mainstreaming the pursuit of resource efficiency into cross-cutting policies:

Innovation is an essential means for decoupling resource consumption and growth. Accordingly, measures should be taken to mainstream resource efficiency into R&D programmes. Some OECD governments are also targeting innovation support on small- and medium-sized enterprises (SMEs) as these are often the source of radical innovation. Innovation may also be important in relation to business models. Indeed, the circular economy is closely associated with new business approaches for managing materials. Governments have a role to play in establishing a supportive policy framework while guarding against any unacceptable economic, environmental or social practices.

Box 6-4 Five Headline Business Models for a More Circular Economy¹

1. Circular supply models, by replacing traditional material inputs derived from virgin resources with bio-based, renewable, or recovered materials, reduce demand for virgin resource extraction in the long run.

2. Resource recovery models recycle waste into secondary raw materials, thereby diverting waste from final disposal while also displacing the extraction and processing of virgin natural resource.

3. Product life extension models extend the use period of existing products, slow the flow of constituent materials through the economy, and reduce the rate of resource extraction and waste generation.

¹ OECD. Business Models for the Circular Economy: Opportunities and Challenges for Policy[M/OL], Paris: OECD Publishing, 2018. <https://doi.org/10.1787/g2g9dd62-en>.

4. Sharing models facilitate the sharing of under-utilised products, and can therefore reduce demand for new products and their embedded raw materials.

5. Product service system models, where services rather than products are marketed, improve incentives for green product design and more efficient product use, thereby promoting a more sparing use of natural resources.

Investment in housing, transport and other infrastructure will continue to be a major driver of the Chinese economy until 2035 and beyond. It is crucial that these investments are resource-efficient and do not lock China into a high-carbon, resource-inefficient pattern of development. Public investors should set the example by integrating resource efficiency objectives into standards for buildings and other infrastructure. Private investors should be incentivised to integrate resource efficiency objectives into their investment strategies.

(4) Strengthen policy development and evaluation through better data and analysis.

The development of policies for a circular economy requires the development of appropriate metrics. To this end, many OECD countries have developed material flow analysis as well as new indicators to support their policy efforts. Better information is needed for both the environmental and economic aspects of the circular economy.

6.4.2 Strengthening, Protecting and Restoring Ecological Systems and the Human Living Environment

6.4.2.1 Reinforce the conservation and restoration of ecologically vulnerable areas and ecological function areas

- Firstly, to perform systemically ecological conservation and restoration in key regions in line with the characteristics of different vulnerable areas. To develop basic measures and technical countermeasures of ecological restoration in accordance with the principles of adaptation to local condition, combination of natural restoration and artificial measures, and benefiting livelihood, etc., based on comprehensive consideration of resources, environment, economy and other factors of the vulnerable areas.
- Secondly, to implement ecological restoration and conservation projects in an orderly manner, and promote the governance of ecological systems as a whole. To strengthen conservation of ecological systems such as forest, grassland, wetland, lake, etc.. as a whole, and embark demonstration projects for typical damaged ecological system restoration first in the ecological conservation red line areas with vulnerable ecological environment.
- Thirdly, to carry out the supervision and management mechanism of ecological

conservation and restoration, and strengthen subsequent regulation. Governments at all levels should clarify departmental duties and management requirements of ecological restoration and conservation by the managerial principle of no change of subject responsibility, realize the overall management of mountains, waters, forests, fields and lakes as well as grassland. Establish the “sky and land integration” monitoring and supervision system and achieve supervision normalization. Establish technical specifications for monitoring and warning of ecological restoration and conservation in typical ecologically vulnerable areas. Form a monitoring and warning network fully covering the restoration areas and conservation areas, and grasp dynamic changes in ecological restoration and conservation in a timely manner. Complete the ecological conservation compensation mechanism. Execute the compensation policies based on category and level. Properly integrate the ecological conservation compensation and targeted poverty alleviation. Develop innovative ways to use funds. Carry out comprehensive ecological compensation trial in poor areas and explore new paths to ecological poverty alleviation. Stringently perform evaluation and assessment. Reinforce subsequent supervision of ecological restoration projects. Regularly monitor and inspect the use of special funds for ecological restoration and project implementation. And formulate a regular reporting system.

- Fourthly, to underpin technological research for ecological conservation and restoration, and drive technological innovation. According to the dominant ecological functions in ecologically vulnerable areas, to undertake research on the ecological function based evaluation technology and diagnostic methods of degraded ecological systems. Identify key indicators of regional ecological degradation, establish the ecological function based evaluation index system, class determination criteria and corresponding technical methods of degraded ecological systems. Analyze driving factors of regional ecological degradation and ecological service function weakening. Search for suitable restoration modes for different types of ecological vulnerable areas through the restoration modes of integration of regional control and local restoration technology and coordination between regional ecological function improvement and economic development.

6.4.2.2 Sustain ecological security barriers, enhancing overall service capacity of the ecosystem

- To maintain holistic stability of the ecosystem, consolidate ecological security barriers, and enhance overall service capacity of the ecosystem. To adhere to the overall planning of land and sea, aiming at fundamental improvement of the quality of the ecological environment and achieving “Beautiful China”, to increase the protection and restoration

of ecosystems, optimize the ecological security barrier system, and achieve the improvement of ecological environment quality and sustainable use of resources.

- To implement important ecosystem protection and restoration major projects, to build ecological corridors and biodiversity conservation networks, and improve ecosystem quality and stability. To complete the work of delineating the three lines of ecological protection red line, permanent basic farmland and urban development boundary. To carry out national greening actions, promote comprehensive management of desertification, rocky desertification, and soil erosion, strengthen wetland protection and restoration, and strengthen prevention and control of geological disasters. To improve the natural forest protection system and promote the return of farmland to forests and grasslands.
- To make overall planning on marine ecological conservation and development, and build a “One Belt Multiple Spots” marine ecological security structure with coastal belts, island chains and all kinds of reserves as the support. To conserve marine living resources, strengthen monitoring and early warning of marine ecological environment, and prevent environmental risks.
- To anticipate on already “committed” climate change, starting now and continuing during the remainder of this century. This requires, among many other things, ample buffer zones around some nature reserves, on land and elsewhere, as they may need to be redefined spatially or otherwise adapted. It also requires to carry out foresight-based monitoring and periodic evaluation, in order to timely prepare for new zoning procedures.

6.4.2.3 Protect human health from environmental risks

Strengthen cooperation between health and environmental authorities in formulating environmental laws and policies to ensure they provide adequate protection for human health as well as the environment.

Key possible steps:

- Public safety. Strengthen the cooperation between health and environmental authorities in the setting and monitoring of key environmental standards, goals and milestones so as to ensure that they provide adequate protection for human health as well as the environment.
- Managing environmental health incidents. Establish mechanisms involving health and environmental authorities to manage health risks associated with environmental health incidents, for example, incidents related to air, water and soil pollution/food safety. For example, Health Response Protocols between public health and environment agencies and water utilities to guide their joint responses following the detection of physical and

chemical characteristics that exceed the safe drinking water guidelines and adversely affect public health.

- Public awareness. Increasing information available to the public about the adverse effects of air, water and soil pollution on human health to increase understanding of the need to act.
- Public access to real time data supported by health advice to encourage community members to keep their exposure levels to a minimum, with a focus on vulnerable populations.
- Key health metrics included in the proposed target and indicator system to support high quality development and good health/well being.
- Data coordination and sharing arrangements formalized between health and environment agencies and the public dissemination of this information.
- Food safety. Adopt a holistic approach to food safety and environmental health risks in partnership with industry and strengthen the food regulatory system to improve food security and food safety.
- Governance issues. Embed public health considerations in key environmental legislation supporting China's goal of environmental quality improvement.
- Capacity building. Build human and institutional capacity in health and environmental authorities to manage environmental health issues, including by investing in data linkages.

Potential benefits:

- Improves the well-being of the population by reducing premature deaths and illness related to environmentally related health risks.
- Reduces the economic costs related to environmentally related mortality and morbidity.
- Provide the population with precise and reliable information about environmental health risks thereby minimizing impacts of unfounded environmental or food safety scares.
- Assists in raising public understanding of the need for policy changes and supports well informed behaviours and consumption choices.
- Strengthen accountability of officials and enterprises.
- Provide key population health data to inform regionally differentiated targets and milestones.
- Assists in monitoring progress and where necessary, adapting pollution action plans based around risk to human health.
- Increasing public confidence in food safety and improving public health outcomes by strengthening food safety regulation; supporting increased focus on domestic consumption.

6.4.2.4 Innovate spatial and urban planning

(1) Reformulate the urbanization strategy. The 14th Five-Year Plan should formulate an urbanization strategy based on ecological civilization. The strategy should move away from the quantity-based model to a quality-based model where green urbanization becomes a key driver of China's high-quality economic development. The Strategy should mainly comprise a green transformation with the focus on city clusters and metropolitan areas, and a green urbanization with the focus on counties.

(2) Actively explore the intersection of environment management and spatial planning. Many of the changes in China towards 2035 and beyond imply environmental and spatial changes: expanding and changing cities; hundreds of new towns; the rural revitalization programme; old manufacturing giving way to new economic activities; expanding infrastructure and changing harbor areas; adaptation to climate change, and so forth. Increased attention for human health and equity in environmental conditions, as advocated in this report, will also have a strong spatial component. For example, in terms of neighbourhood exposure to environmental risks. Very large environmental and spatial changes will take place with the Green Development of the Yangtze Economic Basin; and similarly Beijing-Tianjin-Hebei Region, Pearl River Delta and various BRI projects.

As a matter of strategy, it is therefore required to actively explore the intersection of environment management and spatial planning. This is a matter of policy coherence (delivering better government service to citizens and enterprises) and better use of existing and new tools from both domains. For example:

- Exposure mapping, big data and risk analysis for vulnerable groups in relation to permits.
- Strategic environment impact assessment as a framework for subsequent monitoring and accountability.
- Strategic uncertainty analysis of economic, social and environmental development at city level.
- Optimized use and protection of pre-existing green and blue infrastructure in the development of new towns.
- Transport-oriented development (TOD) in relation to “green development” of larger areas.
- An official on-line register of the contamination status of land plots (as recommended in this report).

6.4.2.5 Take further action on China's legacy of soil pollution

China has inventoried the soil pollution status of agricultural land and implemented laws and guidelines for dealing with contaminated land. Urban expansion, creation of new towns

and fast economic developments are characteristic for present-day China. As a consequence, land use change, including bringing industrial and agricultural land into residential land use, is common practice. Between now and 2035, the spatial dynamic will be at least as widespread. Therefore it will be important to step up action to address, prioritize and manage China's existing soil pollution and land resources in addition to ongoing protection efforts.

(1) Further steps to be taken in the future could include:

- **Prevention.** Setting a date for a ban on bringing pollutants in or on the soil or groundwater. For contaminations that do occur after that date, the duty of care principle should be followed. It means that the polluter is fully liable and responsible for restoring the soil to its natural conditions.
- **The review of potentially contaminated site** should not be restricted to agricultural land and should include former industrial sites.
- **Soil quality management.** Developing a priority system in the form of a decision support system, enabling the identification of contaminated sites that cause the most negative societal impact. Criteria for societal impact could include the impact on human health and the environment and the risks from spreading of contaminants in the groundwater, financial aspects and perception of stakeholders.
- **Remediation.** Implementing legislation on and developing procures for sustainable – green - remediation approaches. These approaches are based on natural attenuation processes, which next to dig and dump remediations, can contribute to long term soil quality objectives, accounting for cost-effectiveness.
- **Public and stakeholder involvement.** Building a contaminated land register and making it available to all stakeholders, on the internet, using maps, coordinates and further information about the soil contamination. This would enable building contractors and other parties to anticipate on soil contamination in their building activities (e.g., residential development, road construction, transfer of industrial or harbour areas into other use). This register could include the results from the first national soil pollution survey (2006—2014) and the current “Detailed national soil pollution survey”.
- **A (governmental) funding mechanism** must be developed to be able to deal with so-called orphan sites, that is: sites for which no polluter can be found and no owner can be held financially responsible.
- **Communication.** Awareness raising regarding the impact of soil pollution among stakeholders, including farmers and the general public. Awareness raising must include information about the adverse effects of soil pollution on human health and the environment and costs involved. It might lead to realization of the negative impact of

polluting actions and can promote prevention. Moreover, awareness raising contributes to public support regarding public expenditure.

(2) Potential benefits

The steps mentioned above, would provide the following potential benefits:

- The possibility to anticipate better on the enormous land developments and corresponding huge shifts in land use that will take place in China in the period until 2035 and the period between 2035 and 2050.
- A more efficient and fair approach towards managing soil pollution, resulting in a better soil quality status in the year 2035, against the lowest possible costs.
- A better chance for success of reaching policy targets of the CCICED Task Force on China's Green Transition to 2050.

(3) Background

- Existing soil policy in China

Like every country in the world, China has a legacy of polluted soil and groundwater from the past. Moreover, current activities contribute to future soil and groundwater pollution. Initiatives in an early stage are needed to guarantee an optimal status of soil and groundwater pollution in the year 2035, regarding an efficient use of resources and budget.

In 2014, the first results of a nationwide soil pollution survey in China revealed the pollution of one fifth of agricultural land in China. In an analysis of these data, Wan et al.¹ concluded that metals were the major pollutant group, both from anthropogenic sources (arsenic, mercury, lead) as from natural sources (chromium, copper, nickel, zinc and also lead). After 2014, more ambitious sampling programs have been initiated, but the results have not yet been published. In 2016, the Soil Pollution Prevention and Control Action Plan was released, which stipulated that almost 7,000 square kilometers of contaminated agricultural land should be remediated before 2020.²

In 2014, the Ministry of Environmental Protection published a series of technical guidelines on environmental site investigation³, environmental site monitoring⁴, risk assessment of contaminated sites⁵ and on site soil remediation⁶. These guidelines were

1 WAN X, YANG J, SONG W. Pollution Status of Agricultural Land in China: Impact of Land Use and Geographical Position[J]. *Soil and Water Research*. 2018, 13(4) : 234-242.

2 CSC. Soil Pollution Prevention and Control Action Plan[R]. Beijing: CPC State Committee and State Council, 2016.

3 Ministry of Environmental Protection. Technical Guidelines for Environmental Site Monitoring: HJ 25.1-2014[S], 2014-02-19.

4 Ministry of Environmental Protection. Technical Guidelines for Environmental Site Monitoring: HJ 25.2-2014[S], 2014-02-19.

5 Ministry of Environmental Protection. Technical guideline for risk assessment of contaminated sites: HJ 25.3-2014[S], 2014-02-19.

6 Ministry of Environmental Protection. Technical Guidelines for Site Soil Remediation: HJ 25.4-2014[S], 2014-02-19.

developed for the purposes of enforcing the “Law of the People’s Republic of China on Environmental Protection”, protecting the ecological environment, safeguarding the public health, tightening the environmental supervision and management of contaminated sites, and setting standards for risk assessment of contaminated sites to the public health.

In 2018, soil screening values for non-agricultural land (“Soil Environmental Quality Risk Control Standard for Soil Contamination of development Land”) were released¹. They are based on human health risk assessment.

As part of its “war on pollution”, China issued its first law addressing soil pollution, the Law on the Prevention and Control of Soil Pollution, which took effect on 1 January 2019. This law brings attention and action towards addressing soil pollution by all stakeholders in China. It provides guidance and systematic mechanisms for preventing, investigating, and controlling soil pollution and clarifies responsibilities and liabilities of all stakeholders. The Law contemplates, and requires the development of, a system of comprehensive standards for implementing soil pollution control and prevention. The Ministry of Environment and Ecology is required to establish national standards for soil pollution risk control according to soil contamination status, public health risks and ecological risks. Local governments are authorized to develop additional, stricter standards. These will be mandatory standards. Finally, the Law advocates public participation in soil pollution management and establishes a framework for greater transparency and increased disclosure in relation to soil pollution.

- Experiences from abroad

In Europe more than three decades after soil pollution became a recognized threat to the environment more than 130 thousand sites have been identified that (might) need remediation². It illustrates that cost-efficiency is a major aspect of dealing with contaminated land. Contaminated sites policies in the world underwent an evolution since the late 1970s, often from a maximum risk control philosophy towards a more functional approach. Generally, the procedures became more pragmatic and cost efficiency became an important aspect. An interesting general characteristic of mature soil and groundwater policies is the function-specific approach. The basic principle of this approach is that land must be suited for its purpose. Consequently, the appraisal of a contaminated site in a residential area, for instance, follows a much more stringent concept than that of an industrial site. This

1 The Standardization Administration of the People’s Republic of China. Soil environment quality risk control standard for soil contamination of development land, National standard of the People’s Republic of China: GB 36600-2018[S], 2018-07-13.

2 Payá Pérez A, Rodríguez Eugenio N. Status of Local Soil Contamination in Europe[R]//JRC Technical reports EUR 29124 EN. Luxembourg: Publications Office of the European Union, 2018. ISBN 978-92-79-80072-6. doi:10.2760/093804, JRC107508.

has a major impact on soil quality assessment when the land use function changes into a more sensitive use, e.g., residential developments in a former industrial area. Experience from western countries shows that there can be serious health risks when these sites are redeveloped, particularly for residential housing.

Another development is to approach soil contamination and certainly groundwater contamination on a larger scale than one site or one plume, but rather consider risks on a more regional scale. In short, it focusses on the soil and groundwater quality of a region as a whole instead of the quality of individual volumes of contaminated soil or groundwater. Regarding remediation, sustainable–green–remediation approaches¹, in which organisms participate in contaminant removal, become more and more accepted as cost-efficient alternatives.

- Possible new beneficial developments

Prevention of soil pollution is by far the most (cost) efficient way for dealing with soil pollution. However, currently, there is no ban on bringing pollutants in or on the soil in China. Given the large number of (potentially) contaminated sites in China, progress of soil quality management between now and 2035 would benefit from a priority system which identifies the most serious cases of soil contamination². Given the urban expansion, creation of new towns and fast economic development in China, the review of potentially contaminated sites should not be restricted to agricultural land. It should include former industrial sites and waste disposal and treatment locations, which contributed most to soil pollution in European countries²⁹.

In China, many data on soil pollution status are available and many more will come available in the near future. China could benefit from a contaminated land register with the purpose to make these data available to all stakeholders, on the internet, using maps, coordinates and further information about the soil contamination. Moreover, a (governmental) funding mechanism much be developed to be able to deal with orphan sites.

Finally, Chinese soil quality management could benefit from awareness raising among the general public and stakeholders such as (municipal) policy makers, consultants and the research community.

1 PETER A, Th Held, N Hüser, et al. Natural attenuation//FRANK A Swartjes, Dealing with contaminated sites: From theory towards practical application. 2011: 979-1014. The Netherlands Springer Science+Business Media BV, Dordrecht: (Chinese version: pp 692-715. National Defense Industry Press, China).

2 SWARTJES F A, M Rutgers, J P A Lijzen, et al. State of the art of contaminated site management in the Netherlands: policy framework and risk assessment tools[J], Science of the Total Environment, 2012(427-428): 1-10.

6.4.3 Seizing the Economic Opportunities and Managing the Social Impacts of the Green Transition

6.4.3.1 New technologies and markets: changing production

(1) Focusing early on high-quality technological research and development and strengthening support for green technology

1) Building a public service platform for green technology

We shall strengthen the development of public service platforms and intermediary service institutions that promote the green upgrading of traditional industries, accelerate the establishment and improvement of innovative platforms such as green technology centers, etc., promote the dissemination and application of key and common industrial technologies, and enhance the green technology capacity of traditional industries as a whole; we shall develop technology service institution of various kinds, enhance the supportive role of platforms for science and technology, for instance, by building green technology literature service platforms, policy information service platforms, technology data and green technology information platforms, as well as sharing of large scientific research equipment; we shall develop some data bases on green science and technology commercialization achievements, focus on promoting the development of green innovation and entrepreneurship service centers to accelerate the commercialized application of scientific and technology achievements.

2) Improving an Industry-University-Research collaboration mechanism

Innovations in Industry-University-Research integration shall be made focusing on pillar industries such as green high-end equipment manufacturing and new energy, etc.. This could include encouraging enterprises to establish academician workstations, post-doctoral workstations and engineering technology research centers with universities and research institutes at home and abroad; and to form a scientific research and development and production collaboration mechanism with complementary advantages and benefit and risk sharing by making full use of technology achievements from universities and research institutes and production capabilities from enterprises.

3) Focusing on building a talent guarantee system

Optimizing the range of disciplines at higher education institutions to foster various talents needed for the green transformation and upgrading of manufacturing, and to develop a group of professionals and engineers in science and engineering. The curriculum design shall be aligned with fundamental, cutting-edge, and key generic technologies and applications, and combined with production practice; practical teaching of basic theory courses shall be

strengthened, by incorporating the assessment in the practice session into the assessment for the entire course. Shifting the talent selection from a “degree over skill” mindset. The green upgrading of traditional industries cannot happen without frontline skilled workers. We shall improve the vocational training system, popularize the vocational training for mid- and low-end labor force; improve support of resources for higher vocational and technical colleges, and enhance the status of higher vocational and technical colleges in the current collegiate system; accelerate the development of equivalent job title evaluation for skilled workers to enable skilled workers to enjoy the same benefits as senior engineers (researchers, professors); form an interactive dynamics with a view to cultivating skilled workers comprising government incentives, increased enterprise investment, and active participation by training institutions and workers.

4) To strengthen intellectual property rights protection

Putting in place an intellectual property rights protection system suitable for China’s national conditions and based on the key principle of equity. We must make bold explorations and implementations of the commercialization mechanism of scientific and technological achievements to protect and stimulate the enthusiasm of the market for scientific and technological innovation; strengthen the crackdown on intellectual property infringement, increase the penalties for infringers, by strictly cracking down on any infringement activities, exposing typical cases and incorporating infringement information into social credit records; we shall reform the patent examination and approval system and shorten the patent review cycle; to reform the patent royalties charging system, it is recommended that fees shall be charged reasonably according to the size of the economic benefits of the patent. Unreasonable fees shall be eliminated to avoid reducing incentives for invention. Speeding up the establishment of intellectual property rights protection assistance system for green innovation. Priority shall be given to the development of an intellectual property rights protection system and dispute settlement mechanism for green technologies by drawing experience from intellectual property rights protection issues faced by China’s manufacturing enterprises in international trade and investment. A deep cooperation mechanism among administrative departments, judicial departments, and large internet platforms shall be built to realize effective protection of intellectual property rights from the industry’s green innovation by the administrative and judicial authorities in the context of spatial network.

(2) To stimulate the active participation of enterprises

Encouraging a group of core enterprises to be front-runners can help to drive the green transformation of regional economies, give full play to the self-discipline and self-learning capacity of the industry, and integrate the concept of environmental protection into

design, layout, products, technologies and processes, rather than acting after pollution once caused. In particular, it is proposed to foster green and innovative enterprises. The status of enterprises as the actors of innovation shall be further defined. With a view of making breakthroughs in key and common technologies, resources shall be consolidated to strengthen support for the development of RandD centers of green technology businesses, provide guidance to enterprises to improve apparatus and equipment for scientific researches, upgrade their equipment capabilities, continuously enhance the level of technology in their products, to accelerate the cultivation of innovative enterprises; relevant tax policies, such as tax-deductible RandD costs, accelerated depreciation of fixed assets, custom duty exemption for introduced technical equipment, customer and import VAT exemption for key raw materials and components of major technical equipment, VAT deduction for enterprises purchasing machines and equipment, etc., shall be implemented. The development of the National Emissions Trading System shall be completed as soon as possible including the development and improvement of implementing rules and regulations, to encourage enterprises to increase investment in green technology innovations and enable to enjoy returns as soon as possible.

Box 6-5 Environmental Technology as Win-win for Ecology and Economy

As experience of environmental policy in the last century shows, relatively low hanging fruits for environmental policies are measures leading to a win-win-situation for ecology and economy.

1. Win-win measures in Germany

For example, Germany's long-standing pioneering role in the field of environmental technologies has both opened up export opportunities and brought longer-term dynamics to environmental policy. The substitution of fossil energies and other critical resources with renewable energies/material is a key area for harmonizing ecological and economic interests. The German Renewable Energy Act (EEG) from 2000 originally provided a feed-in tariff scheme to encourage market entry for electricity from renewable sources with a guaranteed tariff for 20 years. Since 2014, this scheme is being transferred to an auction system. The EEG led to a boom in renewable energy production (currently 36% of German electricity supply originates from renewables), numerous technological developments and generated more than 300,000 jobs. Another important field are all kinds of efficiency improvements optimizing the input-output-relation of resources on the one side and goods/services on the other side. Around one fourth of Germany's total final energy consumption is consumed by private households, most of it for space heating. Measures improving thermal insulation are

accordingly effective. Since 1976, several energy conservation acts, regulations and funding programmes were passed by the German government, leading to a relative reduction of the specific final energy consumption for space heating by more than a third (per m²) from 1996 to 2016. This is not only beneficial for environmental reasons but also implies important potential economic savings for residents and income for companies and workers. However, the decrease in specific final energy consumption (per m²) for space heating is partly compensated by an increase in living space per person.

2. Top-runner approach in Japan

The top-runner approach, first implemented in Japan, helps the most environmentally friendly technology within a certain product group to penetrate the market in short time. The best available product on the market is declared standard which has to be met by other products of the same group within a certain time frame. Products which fail to meet the standard within the specified time frame can no longer be placed on the market. Besides ecological benefits, this instrument furthers technological development and leadership of certain industries. Although not implemented up to date, the German government has been advocating a top-runner approach at EU level since 2007 in order to increase energy efficiency of products.

(3) Vigorously promote green finance

To speed up the green transition, we will also pay more attention to the role of various economic instruments such as taxation, finance and pricing in improving environmental conditions. It is also necessary to increase green investment, improve the environmental management model, and give full play to the long-acting market mechanism.

1) Improving tax and financial policies

We shall implement relevant tax incentives for eligible energy-saving, water-saving, environmental protection and comprehensive resource utilization projects or products, and include energy-intensive and high-pollution products and some high-end consumer goods in the scope of consumption tax collection. We shall also implement the electricity price policy for electric vehicles and improve the tiered pricing system for household electricity, water and gas.

We shall encourage banking and financial institutions to implement green credit guidelines, innovate financial products and services, and provide credit for green consumption. We shall also study and introduce progressive policies to support green consumption credit such as for energy-saving vehicles and new energy vehicles, green

buildings, new energy and renewable energy products and facilities, etc., and encourage financial institutions to increase credit support.

Stepping up efforts to develop financial products and service models needed for green transformation and upgrading. for example, by lowering business risks through the implementation of performance bonds, and encouraging businesses to lease advanced green technology equipment; by supporting green finance products and service model innovation, to facilitate financing for manufacturing enterprises, etc..

2) Establishing a mechanism in which the price of green elements is determined by the market as soon as possible

We shall urge enterprises to transform their competition from one that is driven by excessive depletion of energy and resources, as well as low costs, to one that relies on innovation and differentiation. The focus of the policy is to curb irrational investment and investment promotion methods such as low-cost land supply, tax reduction and exemption, and low-cost allocation of resources to avoid blind expansion of production capacity and homogeneous competition. We shall complete the development of the carbon emission trading market as soon as possible, and give full play to the carbon price discovery mechanism of the ETS, so that the economics of green innovation will be made explicit.

3) Accelerating resources tax reforms

We shall correct the abnormal current situation of “low-cost at front-end” and “low final price” by accelerating the price reform of resource products such as water, petroleum, natural gas, electricity, minerals, etc.. This could be done for example by an orderly opening up of feed-in tariffs, and an appropriate timing to deregulate the price of refined oil products. The aim would be to form a relatively reasonable relationship between primary resource products and manufactured goods, reasonably compensate for environmental damage costs, and rationalize upstream and downstream price adjustment linkage mechanism for resource products. We shall correct the abnormal current situation of “coexistence of multiple pricing methods”, by focusing primarily on the dual track approach for coal, electricity and gas pricing, and rationalize the terminal pricing mechanism for resource products.

6.4.3.2 New products and markets: changing consumption

(1) Promoting the green consumption transition

In view of the growing importance of China’s domestic consumption as a driver of its economy, we shall speed up the reform of the systems and mechanism concerning green products and services in order to accelerate their effective supply; perfect the green product standard system; strengthen public awareness of green consumption, and encourage people to have green low-carbon lifestyles and consumption patterns and vigorously promote green

consumer products. Green consumption will create demand for green production and help to strengthen environmental governance.

(2) Promoting the effective supply of green products and services in the production sector

- Speeding up the reform of the systems and mechanism concerning green products and services and increasing their effective supply

We shall remove institutional barriers to the supply of green products and services, and guide and support more social capital to invest in the weak fields of green products and services. We shall also loosen the restriction on market access for green products and services, encourage all types of capital to invest in green industries, and increase the supply of green products and services.

- Increasing the effective supply of green products and services

We shall guide and support enterprises to enhance their innovation capacity, increase investment in research and development, design and manufacturing of green products, reduce the cost of green products and services, and strengthen the core competitiveness and effective supply of green products and services. We shall also support enterprises in the research, development and storage of green technology, and accelerate the application of advances in science and technology. In addition, it is necessary to require manufacturing enterprises to reduce the use of toxic hazardous and volatile substances and substances which are difficult to degrade and dispose of, and to encourage them to build green supply chains, so as to reduce the environmental impact of the whole life cycle of products.

- Building a diversified supply system of green products and services

We shall support enterprises to focus on improving the quality of green product supply, enhance the diversified competition among medium- and high-end brands, and build a diversified supply system of green products. In addition, we shall diversify the production of green consumer goods such as energy- and water-saving products, resource recycled products, environmental protection products, green building materials, new energy vehicles, etc.. It is necessary to popularize the use of “Internet Plus” to promote green consumption, support the direct selling business of e-commerce enterprises or cooperate with bricks-and-mortar enterprises to supply green products and services, and encourage selling green products on the network.

(3) Improving green standards and label certification in the market

1) Perfecting the green product standard system

We shall improve the standard system of green products and services, expand the coverage of standards, speed up the revision of standards for energy consumption, water

consumption and material consumption in the production process, and dynamically adjust and continuously improve the resource and environment access criteria for products. We shall speed up the implementation of the top-runner approach for energy efficiency and environmental protection, and study and establish the top-runner approach for water efficiency. We shall also prioritize consumer products that are closely related to consumers, develop evaluation standards for green products, and organize certification to improve product quality.

2) Establishing a sound green product certification system

We shall promote China's certification program for environmental labeling, improve the labeling system for green buildings and green building materials, implement the certification management measures for energy-saving and low-carbon products, and accelerate the implementation of low-carbon and organic product certification. We shall also integrate environmental protection, energy conservation, water conservation, recovery, low-carbon, recycling and organic products that have been established separately into green products, and establish a unified green product system containing certification, labeling, etc., so as to strengthen the quality supervision of green products.

3) Establishing a supervision mechanism in and after the fact

We shall establish a quantitative evaluation mechanism for green product standards and assess the effectiveness of certification implementation, propose basic requirements for implementing extended producer responsibility and the joint and several liability of the implementing agency for testing and certification results according to China's practice, and enhance the in-process and post-mortem regulation of green standards and label certification.

(4) Promoting the practice of green lifestyles and patterns in the consumer sector

1) Establishing a sound incentive mechanism for consumers

We shall enhance the efforts to support the comprehensive promotion of energy-efficient vehicles and new energy vehicles and accelerate the construction of electric vehicle charging infrastructure. We shall implement the "old products for remanufactured products" pilots, promote remanufactured engines and transmissions, put in place an incentive mechanism for consumers, and study the consumption points system of green products.

2) Advocating a green and low-carbon lifestyle

We shall encourage low-carbon mobility methods such as walking, bicycle and public transport. We shall also establish reasonable controls on building temperatures by setting the indoor air-conditioning temperature higher than 26°C in summer and lower than 20°C in winter, except for specific purposes. We shall encourage consumers to travel with their own toiletries and reduce the use of disposable daily necessities. We shall encourage large-

and medium-sized cities to make use of mass leisure places and public welfare venues to set up flea markets for residents to exchange goods they no longer use. We shall improve the recycling system of renewable resources in residential communities and encourage the sharing of goods that are infrequently used. We shall also carry out in-depth actions against waste, over-packaging, food waste and excessive consumption.

3) Encouraging green product consumption

We shall encourage the purchase of water-saving products such as water-saving faucets, water-saving toilets, water-saving washing machines, as well as energy-saving products such as energy-efficient motors, energy-saving and environmentally-friendly cars, efficient lighting products. We shall promote products with environmental labels and encourage the use of coatings and dry cleaning agents with low VOCs. We shall promote green consumption in public institutions and improve the efficiency of using office equipment and assets by encouraging double-sided printing and working in paperless offices. We shall improve the evaluation criteria for conservation-oriented public institutions and rationally formulate indicators for water and electricity consumption. We shall promote the use of various green building materials and environmentally friendly decoration materials including energy-saving doors and windows, etc.. We shall also implement green building standards for public buildings, install rainwater recycling systems and recycled water utilization facilities.

4) Pay attention to the gender dimension of “green consumption”

Further investigate the influence of consumption by women to guide future green consumption policy development. Chinese women are usually the main managers of household consumption. Their consumption patterns will directly affect the social production structure; womens’ consumption choices can effectively improve the deteriorating urban and rural environment; womens’ own consumption is becoming a major driving force for social and economic development and is expected to become greener; women as the main educator for the next generation influence the expansion of green consumption behavior. It is necessary to consider the factors influencing women in green consumption, and prepare policy guidance.

(5) Promoting the cultivation of green consumer awareness, information, publicity and education

1) Green consumption education

We shall advocate traditional virtues, carry out green consumption education starting with children, and integrate the awareness of thrift, green and low carbon into family education, pre-school education, primary and secondary education, etc.. We shall also regard green consumption as an important part of family ideology and moral education, ideological

and political education for students, continuing education for employees and civil servant training, and incorporate it into the requirements for civilized cities, civilized villages and towns, civilized organizations, civilized families, civilized campuses and related educational demonstration bases.

2) Green consumption promotion

We shall incorporate green consumption into various thematic publicity and education activities such as the National Energy Conservation Propaganda Week, the Science and Technology Week, the National Low Carbon Day, the National Environment Day, etc.. We shall carry out actions advocating energy conservation and emission reduction and traditional virtues, and organize activities on building green families, green shopping malls, green scenic spots, green hotels, green canteens, conservation-oriented institutions, conservation-oriented campuses, conservation-oriented hospitals, etc.. We shall also give full play to the role of labor unions, the Communist Youth League, the Women's Federation and relevant industry associations and environmental protection organizations, and strengthen publicity and promotion, so as to create a good social atmosphere for green consumption.

(6) Improving the green procurement system

We shall strictly implement the government's preferential and compulsory procurement system for energy-efficient and environmentally friendly products, expand the scope of public green procurement, improve standards and the implementation mechanism, and expand the scale of public green procurement. In addition, it is imperative to make clear the institutional arrangements for green production, distribution, consumption and resource recovery. In particular, the Government Procurement Law establishes binding regulations for public green procurement and the need to develop supporting by-laws and systems.

Government procurement preferentially sources domestically produced products that have the same or similar performance as foreign products. A compulsory purchase ratio may be adopted for key innovative products in China, so that the government-supported green technology and industry development financial funds are more targeted. In terms of the negotiation on the entering into the Government Procurement Agreement under the framework of World Trade Organization(WTO), it is required to reserve the right to give priority to the procurement of products that are friendly to ecological and environmental protection.

Box 6-6 German Green Consumption

Sustainable consumption means living within the Earth's carrying capacity and ensuring that today's consumption patterns do not jeopardize the ability of current

and future generations to meet their needs. It is vital that our consumption behavior becomes significantly more sustainable. This challenge must be tackled by society as a whole.

1. International Initiatives

At the World Summit on Sustainable Development in Rio de Janeiro in 1992, first discussions were held on sustainable consumption. Then in Johannesburg in 2002, the Marrakesh Process was launched. Industrialized countries in particular were urged to promote sustainable consumption and production. At the World Summit on Sustainable Development in Rio de Janeiro (Rio+20) in 2012, the 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns was approved. It provides a global framework for measures in the area of consumption and production patterns.

In September 2015 at the UN headquarters, the heads of state and government adopted the 2030 Agenda for Sustainable Development, which sets out the global sustainable development goals. A number of chapters deal with the implementation of sustainable consumption and production patterns, and there is also a specific goal (SDG12: ensure sustainable consumption and production patterns).

Also the European Commission has launched numerous initiatives on environmental product policy. These include the Communication on integrated product policy (IPP) of June 2003, which laid foundations for taking into account the environmental impacts of products over their entire lifecycle. The European Ecodesign Directive ensures that environmental requirements are also observed in product design. Furthermore, there are numerous EU initiatives such as the EU eco-label, green public procurement initiatives and the eco-management and audit scheme (EMAS).

2. The National Programme on Sustainable Consumption

In 2016, the German Government adopted an updated National Sustainable Development Strategy, which is aligned with the UN's 17 sustainable development goals. In the same year, the German government launched the National Programme on Sustainable Consumption (NPNK), which describes the relevant fields of action and details over 170 specific measures. The programme with its whole-of-government approach, including all ministries and many stakeholder groups, is tackling consumption in a cross-cutting approach. The programme sets out how the German government plans to systematically strengthen and expand sustainable consumption in various areas, with various stakeholders at national level.

When it comes to sustainable consumption there are six areas (fields of need) with the greatest potential for reducing pressures on environment, such as mobility, food,

housing and households, office and work, clothing, tourism and leisure.

3. Developing and improving green standards and label certification

The Blue Angel was launched in 1978 as the world's first eco-label. It is regarded as a pioneer of product-related environmental protection and has been providing reliable guidance for many years for the purchase of environmentally friendly goods and services. The eco-label is now available for 120 different product groups, making it one of the most comprehensive eco-label programmes in the world. A total of 12,000 products from around 1,500 companies are currently labelled with the Blue Angel. So also the German Sustainable Development Strategy formulated the target, that eco-labelled products reach a market share of 34 % until 2030.

4. Innovating to ensure the effective supply of green products and services

Social innovations for sustainable consumption comprise new organizational forms, services, products and practices, which are able to make consumption habits more sustainable. Examples are sharing -formats for cars, tools or other products, urban gardening projects or other collective initiatives. The Federal Environment Agency (UBA) carried out research about sustainable consumption through social innovations, to systematize social innovations for sustainable consumption and derive recommendations for promoting the ones with potential to reduce environmental effects.

5. Sustainable public procurement

The state can also play a decisive role in the sustainability turnaround with its actions. Its huge economic potential gives sustainable public procurement major leverage to promote sustainable products and services. Furthermore, with an appropriate procurement policy the public sector can lead by example and contribute to the credibility of a sustainable consumption policy.

6. Institutional Monitoring

For Implementation of the German National Programme on Sustainable Consumption and its measures, an interministerial working group and a competence center has been set up. With this institutional structure, Germany wants to contribute to anchor sustainable consumption firmly in the public debate. To this end, there has been put in place a major information platform in order to establish an exchange between all stakeholders, including companies, local authorities, consumer protection agencies, associations, ministries and other public agencies and of course, citizens and to create a strong link between various organizations working on sustainable consumption as well.

For a more effective policy to promote sustainable consumption, there is a need

for comprehensive and continuous monitoring that shows what is happening with sustainable consumption in Germany and whether corresponding political measures are having an effect. For this monitoring the UBA, together with some other institutions, has now developed two new indicators for sustainable consumption in the national sustainable development strategy (the market share of products with government eco-labels and the energy consumption and Carbon emissions of private consumption). To develop a tool to systematically track the market for green products, to provide an estimate of the growth in green products and to evaluate measures and instruments of promoting green products, since 2013 a report is periodically published.

6.4.3.3 Helping those adversely affected by the green transition

The green transition in China and other countries will affect producers and consumers by changing relative prices. As a result, some will be better off and others less so. To some extent this is part of the usual churn generated by structural change. However, in some cases there may be good reasons to support those adversely affected.

The transition to a low-carbon, resource-efficient and more environmentally resilient economy will generate new jobs and destroy some traditional sources of employment. Most studies suggest that the net effect will be small; perhaps slightly positive or slightly negative. However, the negative impacts may be concentrated in specific sectors, particularly those associated with fossil fuels, and in specific localities. The affected firms and their workers may need support to ensure that they do not suffer unduly and that some people and communities do not “get left behind.” Not addressing the needs of displaced workers and communities would not only be unfair and a waste of resources, it could also result in a political backlash against the public authorities.

Structural change is a feature of all dynamic economies and creates “winners and losers.” For example, it is estimated that 10% of Sweden’s 5 million jobs are lost and slightly more are created every year. Industrial structures and labour markets may undergo even greater change in the future as the “new industrial revolution” results in the wider use of artificial intelligence, robotics and a range of new technologies. This underlines the need, independent of the green transition, for social welfare provisions and mechanisms that allow workers to adapt to changes in the labour market.

When companies are required to reduce capacity or close for environmentally related reasons, engaging workers in discussion is an important factor in effectively managing the transition. Explaining the rationale, including any health and environmental impacts, is a first step. But this needs to be supported by specific measures to assist workers to find new

employment. These include providing opportunities for learning, supporting new skills development and entrepreneurship, and re-locating public sector services to the affected areas.

However, in practice many OECD countries have found it difficult to support the redeployment of workers who lose their jobs due to structural change. Some of the challenges include the difficulty or unwillingness of workers to relocate to other regions and the difficulty of attracting new industries to areas with declining industries and high levels of unemployment, even when substantial incentives are offered. In addition, the experience from OECD countries suggests that a large share of the workforce affected by the low-carbon transition are men. The possible implications of this gender-specific impact, including possible second round consequences on female employment, should be analysed further.

Another approach that is frequently advocated is to provide financial support to ailing companies with a view to maintaining their operations and the associated employment. However, experience from OECD countries suggests that this is usually not an effective approach, particularly when the underlying challenges are related to over-capacity, insolvency and structural change. Targeted support may be effective when companies are undergoing a major restructuring to become more competitive and when the benefits of providing support outweigh the costs of not doing so. However, this involves governments having to “pick winners” which is often not successful. The provision of a large volume of state aid may also distort competition and result in a challenged within the WTO.¹ Financial support is often most effective when used to accelerate the exit of inefficient firms from the market. This could include establishing special funds to help to retrain or to relocate affected workers, or to manage potentially serious environmental risks, rather than providing unconditional support to the company.

In an international context where the effective carbon rate levied on companies varies widely among countries, it is often argued that support should be provide to sectors that are energy-intensive and trade exposed, particularly when there is a risk that they may relocate to a jurisdiction with a lower effective carbon rate. However, there are no simple solutions to this challenge. Support measures that lower the effective carbon price would also weaken incentives to reduce emissions and to develop cleaner technologies. Alternative approaches targeting trade, such as border tax adjustments, may provoke retaliatory trade measures.

Regarding consumers, climate mitigation policies, particularly taxes on energy and transport fuels, may result in increased energy prices. These may affect the affordability of

¹ Rules concerning state aid within the EU are much stricter than those within the WTO. <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN06775>.

transport and energy services for lower-income groups. An empirical study of this issue by the OECD suggested that higher income groups would tend to be more affected by higher transport fuel taxes as they generally had more cars and drove greater distances.¹ However, recent experience in France suggests that while this may be true for urban dwellers, it may not be the case for rural dwellers who are often totally dependent on private vehicles for transport. Taxes on heating fuels and electricity will tend to have a greater impact on the poorer households as these services constitute a higher share of income and expenditure than in richer households. However, the study suggested that if a tax on heating fuels and electricity was complemented by income-related compensation it would be possible to maintain the environmental incentives associated with the tax and, after compensating affected households, still have sufficient revenue to allocate for other purposes.

6.4.4 Reforming Environmental Governance

6.4.4.1 Improve the legal system for ecological protection

(1) Improve environmental legislation

1) Accelerate the process of environmental legislation

Regarding environmental protection, the Communist Party of China and the State, during the new round of institutional reform, will formulate the “Basic Environmental Law” to improve the current system and resolve fragmented and contradictory content. Meanwhile, we shall speed up the formulation of “Environmental Damage Compensation Law”, “Environmental Insurance Law”, “Nature Reserve Law”, “Climate Change Law”. This legislation will help legalize major reform measures while modernizing the national governance system and capacity of ecological protection.

At present, with regards to energy, priority shall be given to the formulation of the Atomic Energy Law which defines duties and powers of competent authority and supervision agencies, nuclear research and industrial development, nuclear deposit mining, nuclear material control, supervision and management of nuclear facilities, nuclear waste disposal, radiation protection, application of nuclear devices and radioisotopes, nuclear accident emergency management and damage compensation, and applicable legal liability. The Atomic Energy Law shall be in close connection with the “Nuclear Safety Law”, among other applicable laws.

2) Revise existing laws in a timely manner

Amend or revise the Environmental Protection Law, Forest Law, Grassland Law, Water

¹ Flues F, A Thomas. “The distributional effects of energy taxes” [R], OECD Taxation Working Papers(No. 23), Paris: OECD Publishing, 2015. DOI: <http://dx.doi.org/10.1787/5js1qwkkqrbv-en>.

Law, Water Pollution Prevention Law, Air Pollution Prevention Law and Environmental Impact Assessment Law to satisfy the latest demand for environmental protection.

(2) Recommendations on strengthening ecological environment law enforcement guarantee

1) Recommendations on improving the reform of the ecological environment supervision system and mechanism

Optimize environmental management system to achieve a combination of centralization and decentralization for the regulatory approach and an integration of legal implementation and supervision. Bring environmental management system reform onto the track of rule of law, clearly distinguishing the powers and responsibilities of environmental authorities and other relevant authorities; optimize the division of labor between the central and local environmental supervision systems by carrying out a new round of reform of administrative power in environmental protection and decentralizing administrative licensing and regulatory authority, giving intermediary organizations technical service rights; establish high-standard environmental management coordination agencies for specific problems, e.g. by setting up the national environmental protection committee at the central level, and office of the environmental protection committee under the Ministry of Ecology and Environment, and setting up the river basin environmental protection coordination agencies at river basins and coordination agencies at key air pollution prevention and control areas, etc.. Implement the system and mechanism of “equal liability for CPC and governments, dual liability for one post, and accountability for negligence”, and improve the system and mechanism of supervision by the people’s congress, so that governments and CPC committees at all levels can exercise environmental protection duties according to law.

2) Recommendations on improving the performance appraisal and evaluation mechanism

Firstly, improve the local government’s eco-performance appraisal and incentive compatibility mechanism, primarily by improving the civil servant performance and promotion mechanism, the explicit material incentive mechanism, the implicit reputation incentive mechanism, and by establishing an eco-performance quality credit rating system. Secondly, improve professional supervision mechanism for local government eco-performance appraisal. In the evaluation of eco-performance, it is necessary to avoid behaviors such as political fraud, exaggerating, and false reporting by establishing professional supervision mechanisms, to achieve institutionalization of supervision authority, specialization of supervision institutions, specialization of supervision talents and supervision comprehensiveness. Thirdly, improve the accountability mechanism for evaluation of local governments’ ecological performance appraisal, whereby a sanction ladder from low-

key or informal lesser punishment to severe measures, establishing a list of assessment responsibilities to strengthen disciplinary function

3) Recommendations on promoting the development of environmental health risk management mechanism

Assess the environmental health risks based on China's environmental realities and goals of environmental governance by 2035, design China's environmental health management mechanism by applying the risk management theory, and provide constructive advice for the country to gradually establish an environmental health risk management system: establish an environmental health risk monitoring system; establish an environmental health benchmark standard; integrate and link the basic system of environmental management; improve environmental health technical support capabilities; and establish an environmental health risk communication mechanism. The system should provide information at two scales:

- Strategic priority setting and allocation of resources, typically at the level of five-year plans and government work plans;
- Risk monitoring in concrete situations, such as industrial development, transport infrastructure and performance appraisal of cadres.

4) Recommendations on establishing a long-term mechanism for gender mainstreaming in environmental rule of law

Firstly, it may set up a special gender equality coordinator in general and branched departments concerning environmental protection management, which is responsible for coordinating and supervising the gender mainstreaming of the department, issuing expert opinions on gender impact assessment of environmental legislation and decision-making, implementing the environmental protection gender equality program and maintaining communication with the coordinators of other relevant departments, and carrying out relevant international cooperation. Secondly, carry out gender budgeting in general and branched departments concerning environmental protection management. Analyze existing environmental budgets, fully consider the different impacts on men and women, and select gender-sensitive factors in the budget as a focus to promote gender equality and environmental protection in this area. Thirdly, collect gendered data as a basis for gender equality decision-making as adding necessary gender specific data to existing environmental data, integrate the gender perspective into the environmental rule of law.

(3) Recommendations on strengthening judicial safeguards for ecology and environment

1) Recommendations on establishing a diversified resolution mechanism for ecological and environmental disputes

Firstly, the top-down design of a diversified resolution mechanism for ecological

and environmental disputes shall be strengthened. Based on the characteristics of China's system and social conditions, priority shall be given to the development of various types of public welfare settlement services, while gradually exploring the development model of market-oriented mechanisms and building a rational management system. Secondly, adopt a progressive, categorized and step-by-step approach starting from specific systems and procedures based on actual needs and conditions, establish effective and coordinated ecological and environmental dispute resolution system through special laws, separate regulations, legal amendments, etc.; and strengthen the coordination and integration of all material aspects including civil and administrative mediation and litigation, Thirdly, cultivate a new culture of dispute resolution, starting from education, popularization and the transformation of legal concepts.

2) Promoting centralized jurisdiction over environmental resource cases

The reform and exploration of centralized management and trial of environmental resource cases is of great importance. The judiciary shall summarize experience seriously and gradually form a sound legal system to promote it. At the same time, relevant judicial organs and relevant departments should actively build a multi-jurisdictional mechanism which aims at a joint mediation mechanism, and improve the judicial identification mechanism by strengthening the convergence of environmental justice and environmental administrative law enforcement. The judiciary must communicate and coordinate with the public security organs and the environmental administrative departments in a timely manner to create a good external environment for environmental resource trials.

(4) Strengthen public observance of law

Firstly, make efforts to create a social atmosphere in which all people consciously learn, abide by and utilize the law. The staff of CPC and government organs at all levels, especially those closely related to the sustainable development of the economy and society, shall take the lead in observing the Constitution and laws, and actively take advantage of emerging online media for its supervisory role. It is recommended that universities offer environmental law education courses. Secondly, adequately consider female factors in the design of public participation system and increase the proportion of women. Thirdly, propose a program for corporate law observance assistance and incentive mechanism to improve the legal self-consciousness.

It is suggested the competence of the law governance team be strengthened. For judicial and law-enforcing departments with high work intensity and heavy tasks, the government should appropriately expand the staffing structure to ensure the competency. In addition, the government should establish a sound standardized training system to normalize the training

and assessment mechanism towards the professional team, so as to improve the overall skills and professional quality of the staff of relevant departments.

6.4.4.2 Reforming environmental policies and instruments

Optimizing eco-environment governance structure, building long-term mechanism of green development.

(1) Building the consensus on the governance and improvement of ecological environment of the whole society

Consensus and public awareness are the foundations for promoting ecological environmental governance. This requires the transmission of ecological culture and ecological ethics, and fostering the public's collective consciousness and overall awareness. The government shall play a leading role and decentralize its power. The enterprises shall take the initiative to take the responsibility by promoting a better development of enterprises with green production; social organizations and the public shall be encouraged to take the initiative to participate in the environmental governance. The government should regard culture as an essential part of the eco-environmental governance system. Cultural transmission enables ecological civilization to be the mainstream value of social development, fostering ecological characteristics, and thus forming a good atmosphere for protecting the ecological environment in the whole society.

(2) Streamlining administration and delegating power, enhancing primary-level capacity building of eco-environment governance

1) Strengthening government guidance mechanism

Local governments should make overall arrangements for eco-environment governance. They should not only allow and mobilize residents to actively participate and innovate in the primary-level eco-environment governance, but also keenly identify and promote models in extensive primary government practices. They should also, lead in the formulation of rules and regulations to standardize eco-environment governance. The key is to establish a strong organization dedicated to eco-environment governance in cooperation with the government's internal governance activities. At the same time, consolidate government rules and regulations, implement laws, regulations, policies, environmental standards, assessment mechanisms and other means to regulate the conduct of all economic entities, and in particular, to guide local government officials to correctly handle the relation between economic development and environmental protection.

2) Innovative mechanisms for enterprises to participate in governance

By actively guiding enterprises and exploiting their state-of-the-art and innovative approaches, local governments and communities should contribute to the primary-level

government practice of joint building and enjoyment by diverse subjects. They should use market mechanisms to allow enterprises to assume social responsibilities during production and environmental governance. Firstly, to apply the principle of economic leverage, clarify ownership of ecological resources, improve market trading mechanism of ecological resources, put into practice the idea of beneficiary pays through levy of resource tax and eco-environment tax so as to realize market deployment of ecological resources and arouse enterprises' motive of eco-environment governance. Secondly, to drive industrial transformation and upgrading, which requires governments' positive promotion and guidance, and continuously push forward the development of strategic emerging industries like energy conservation and environmental protection, new energy, new material, and high-end equipment manufacturing by constantly adjusting economic structure and by strengthening technological innovation.

3) Driving extensive public participation in primary-level eco-environment governance

To enable residents and various social organizations in primary communities to participate extensively in the management of primary-level eco-environment affairs, jointly push forward community building and share governance results. It should also make sure that all interests of the public are secured from participation in eco-environment governance; expand the mechanisms for public participation in democratic decision making so that the public ecological policies can reflect people's interests and guarantee the public's rights to know; reinforce the monitoring and feedback mechanisms of public ecological policies; allow the public to know and conduct supervision through implementation of the environmental information disclosure system. The public can support the development and implementation of policies by tracing, evaluating and overseeing the policy implementation performance. At the same time, through supervision and feedback, exposure of ecological issues should be strengthened to generate strong pressure from public opinion and the whole of society for effective eco-environment governance.

(3) Transfer the focus of eco-environmental governance from end-of-pipe treatment to source control

From 2020 to 2035, China's eco-environment governance process will continue to advance in line with industrialization, urbanization and agricultural modernization. Therefore, it is necessary to change the ideas of eco-environmental governance based on end-of-pipe treatment. The focus when establishing environmental governance, designing policies and allocating human resources should be transferred to the control of pollution at source control to achieve sustainable governance. This would promote green development and the goal of a fundamental improvement in the environment.

1) Supply-side reform should continue to have a major role in eco-environmental governance

Starting from the production side, the government should further promote the adjustment of industrial, energy, and investment structures. In addition, the government should increase the proportion of emerging industries, especially environmental protection industries, in the industrial structure. The focus of subsidy policy has been transferred from supporting the industries to stimulating green production behaviors. The government should also build an energy utilization system consisting of the most clean, efficient and centralized utilization of coal, petroleum, natural gas, as well as renewable energy (especially biomass energy, solar energy and wind energy).

2) Enhance the attention to the demand side in eco-environmental governance

Starting from the consumption side, the government should further adjust the trade structure and improve infrastructure at the municipal and community level (e.g. establishing a sound green public transportation supplying system, etc.). This would make the external conditions of green consumption in line with the green consumption concept.

3) Loosening control over market access, encouraging investment diversification

Various types of capital can support investment, construction and the operation of public products and services for environmental governance and ecological conservation. The market can help to diversify investors. Firstly, improvements could be made to the operational mechanisms of PPP environmental infrastructure project and competition transparency improved. The principle of risk sharing between the parties should be established to optimize the whole project process including financing, engineering design and construction, and operation, maintenance. It is expected that this would improve environmental service performance. Secondly, improve third-party mechanisms by setting up a national environmental protection fund, establishing a bi-directional incentive mechanism to promote pollution reduction, and introducing a corporate environmental blacklist system as a part of the social credit system. Thirdly, improve the economic components of environmental governance, such as improving the price composition and adjustment policies of environmental service products, strengthening the verification and price supervision of environmental public service costs, and improving the tax incentives for environmental protection industries in a non-operating environment with poor return on investment, such as the areas of groundwater, soil, watershed management, etc.. When justified, to implement tax exemption and reduction policies for a certain year, and introduce tax incentives for environmental industries.

Box 6-7 Multi-level Governance in EU Countries

Take air treatment and control in London as an example. Air governance in the UK involves three levels: the EU, the UK government and the the local government. Among them, the EU mainly plays a regulatory role. At the UK level, the Department for Environment, Food and Rural Affairs (Defra) plays the main role in carrying out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU limit values for the specified pollutants.

1. EU supervision. It mainly includes three aspects:

(1) The European Union has set the goal of achieving air quality that does not give rise to significant negative impacts on human health and the environment. EU policy to control air pollution rests on three main pillars. Each of these is the result of extensive inputs by member states, and joint decision making by the European parliament and member states.

The first pillar comprises the ambient air quality standards set out in the Ambient Air Quality Directives for ground level ozone, particulate matter, nitrogen oxides, dangerous heavy metals and several other pollutants;

The second pillar consists of national emission reduction targets established in the National Emissions Ceiling Directive for the most important trans-boundary air pollutants: sulphur oxides, nitrogen oxides, ammonia, volatile organic compounds and particulate matter;

The third pillar comprises emissions standards for key sources of pollution, from vehicle and ship emissions to energy and industry.

However, the EU standards are generally more lenient than those set globally by the WHO. National governments though have the freedom of choice to set stricter national standards.

(2) A variety of measures exist at the level of the EU to help promote compliance with Directives concerning air pollution. These measures include: financial mechanisms; advisory services to facilitate access to technical and financial assistance (e.g. URBIS that is supported by the European Commission and European Investment Bank); peer reviews of performance through environment implementation reviews; dialogue between the European Commission and EU Member States on how to improve compliance; and mechanisms for exchanging experience and good practices.

(3) Judicial means. When countries remain not in compliance with EU air quality legislation, both the European Commission and citizens have recourse to courts in order to require governments to take the actions necessary to achieve compliance. At the EU level, the European Commission may launch infringement procedures which

involve documenting non-compliance and requesting information on measures that the Member State will take in order to achieve compliance. If the country still doesn't comply, the Commission may refer the matter to the European Court of Justice which may impose penalties. The European Commission has filed lawsuits against 16 Member States, including Germany, and 13 countries including Germany and the UK have been accused for nitrogen dioxide. The EU and its Member States can coordinate their policy framework and implementation. Countries with valuations for several consecutive years may face penalty.

2. Supervision of the British government.

The air quality commitments contained in EU Directives were agreed at UK level. However, implementation is devolved to the four national administrations within the UK. Scotland has already produced its own Air Quality Strategy, and Wales and Northern Ireland are currently in the process of drafting their own. At the UK level, Department for Environment, Food and Rural Affairs (Defra) is responsible for implementing air quality related EU directives and general policies, and plays the main role in carrying out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU limit values for the specified pollutants.

Some of the main policies to be implemented at the national level include: phasing out the sale of vehicles using fossil fuels by 2040 and requiring vehicles to be basically “zero-emission” by 2050; providing financial support for various measures including: vehicle charging infrastructure, cleaner buses and taxis; and measures for reducing emissions generated by major roads; and grants to assist local authorities to improve air quality. Note that the term “zero-emission” is slightly misleading. It refers to the absence of tailpipe emissions of carbon oxides, nitrogen oxides and hydrocarbons. A “zero-emission” vehicle in this sense will still cause significant emissions of fine particles ($PM_{2.5}$ and PM_{10}) as most these come from brakes, tyres and road surface.

3. Supervision and measures of local government.

Local authorities shall regularly review and assess air quality in their area, and to assess whether national objectives have been, or will be, achieved at relevant locations, by an applicable date. If national objectives are not met, or at risk of not being met, the local authority concerned must declare an air quality management area and prepare an air quality action plan.

4. Civil environmental organizations play a supervisory role.

NGOs are granted judicial remedies. Therefore, they have been active in using the courts to pressure the UK into complying with EU air quality standards. In particular, Client Earth has played a major role in using the courts, not just in the UK but in a range

of other EU countries including Germany. In 2016, the UK Supreme Court referred a case that Client Earth had brought concerning the interpretation of air quality plans in the EU Ambient Air Quality Directive. The ruling by the European Court of Justice on this interpretation is now binding on all national courts in the EU.

6.4.4.3 Attaching importance to the all-round participation of stakeholders, strengthen the disclosure of environmental information

(1) Nurturing public consciousness of ecological environment protection

To cultivate the concept of ecological civilization in the whole society, raise public awareness of ecological environment, cultivate ecological culture, and consolidate the platform of ecological environment education and turn the eco-environmental protection into all people's conscious action. To enhance all people's consciousness of saving, environmental protection and ecology. The relevant competent authorities shall make the top-level design on ecological environment education, and root the ecological environment education in the national education system. To strengthen dissemination of scientific knowledge related to environmental protection, and make environmental protection a genuine conscious activity of the whole public. To make great efforts in youth education on environmental protection knowledge, set real and believable samples that practice ecological civilization, at the same time enable penetration of the "green" ecological culture through various education and training systems, and bring into play the key role of community groups, public media, etc.. in spreading scientific knowledge on environmental protection, make great efforts to disseminate and report scientific knowledge on environmental protection, knowledge and accomplishments of green development, increase the public attention, elevate the public environmental consciousness, set up the concept of green development, and create a favorable atmosphere that advocates ecological civilization and environmental protection.

(2) Initiating national green actions

To initiate national green actions and to create an ecological environment sharing and co-governing pattern to mobilize the whole society to reduce consumption of energies and resources and pollution emissions through practical actions and make contributions to the ecological environment protection. To establish climate neutral foundations, add inputs in scientific research, set prices through market mechanism, employ flexibly rewards, punishments, incentives, etc., expand and satisfy the public demand for green products, guide the public to practice the concept of green development and improve consuming habits and behaviors step by step, and promote all-round development of green production and consumption. The government should leverage the gender advantages of women by

enhancing their participation in developing and implementing policies of green life, green consumption and other aspects. To create new eco-environment management systems, build communication platforms with the public on a regular basis, develop the approaches and channels for the public to take part in the green development, complete the systems and stages of public participation. To implement responsible entities, strengthen work collaboration, and ensure public participation in environmental decision-making. To establish an effective eco-environment public participation evaluation system, conduct regular evaluation and make feedback on public participation in the eco-environment through hearings, symposiums, questionnaires, telephone and letter return visits. It may also take advantage of technologies such as big data and cloud computing to control the quality and effectiveness of public participation in the ecological environment.

(3) Underpinning eco-environment information disclosure

Governments should, in accordance with the laws, delegate environmental supervision powers to social organizations to benefit them to supervise the waste discharge behavior of enterprises and publish information to the society; strengthen the development of the corporate environmental information disclosure system, establish a public directory of corporate environmental information, including classification of information, differentiation of degrees of disclosure, information disclosure using standardized templates, etc., improve the remedy mechanisms, penalties and incentives for all parties involved in the disclosure of corporate environmental information; open clear channels for the public to appeal, adopt the hearing system to key projects and policies, and initiate the round-table mechanism for hot topics. For the pattern of environment information disclosure, to build unified environment information disclosure platforms and formulate uniform disclosure assessment systems and criteria.

Box 6-8 EU Countries Emphasizing On Information Disclosure And Public Participation

1. Legislation guarantees citizens' right to know regarding environment

The German government attaches great importance to ensuring citizens' right to know in the legal provisions. Taking sustainable chemicals management as an example, Germany has introduced a series of laws and regulations, such as environmental protection laws and preventive protection laws, to ensure the public's right to know regarding the environment, including factory site selection and environmental protection measures.

2. Government at all levels pays attention to the disclosure of environmental information

First, the legislative departments of the EU and Member States have passed legislation to protect the public's right to know.

Second, government agencies such as the German Environment Agency have established public dialogue mechanisms, which ensures close contact with the general public. While drafting the Integrated Environment Program the Ministry for Environment held five dialogues are held each year in different cities in Germany with local public participation.

Third, the government joins universities and colleges to jointly publish environmental information. In the United Kingdom, for example, several open channels have been established for the disclosure of air quality information, including: UK-Air, NAEI and "CityAir" mobile app to share environmental information with the public, and announce early warning in the event of heavy pollution incident through subway and bus.

3. The concept of protecting citizens' right to know is deeply rooted in enterprises, and enterprises attach importance to public relations

Take the chemical industry park in Germany as an example. Enterprises in the park attach great importance to maintaining a good and trustful relationship with the residents, actively disclosing relevant information to the public, and never rejecting anyone's right to know. Thus, enterprises establish themselves as trustworthy.

4. Paying great attention to the impact of the environment on human health in disclosing environmental information

The environmental information disclosure in the UK attaches great importance to the impact of environmental pollution on human health, and is intended to raise people's attention to environmental protection. UK-Air contains information on the network of monitoring sites and how they function, data on local concentrations of air pollutants, including datasets on air quality trends and real-time air quality assessments, short-term forecasts for air quality, and information on how air quality affects human health and the environment. "CityAir" mobile app includes information about which roads are polluted, when and how much are the pollution is at highest. It informs the public by dos and don'ts under each pollution level, and helps plan a route with least exposure to heavily polluted areas before leaving the house.

(4) Access to information, public participation in decision making and access to justice in environmental matters

Developing environmental policies in an open, participatory way is a fundamental

element of good environmental governance. These measures enhance the quality of decisions, contribute to public awareness of environmental issues, give the public the opportunity to express its concerns, and enable public authorities to take due account of such concerns, so that public decision-making on environmental issues can be more transparent and accountable, and strengthen public support for environmental policies and their implementation.

The Aarhus Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters now provides the key international reference and benchmark in this policy area. It was originally adopted by members of the UN Economic Commission for Europe in 1998 and now has 47 Parties.¹ The Aarhus Convention explicitly recognizes that everyone, including future generations, has the right to live in an environment adequate for their health and well-being. It calls on public authorities to enable citizens to exercise this right by guaranteeing their access to information, public participation in decision making and access to justice in environmental matters.

1) Access to information

The Aarhus Convention obliges governments to provide environmental information requested by the public. They should do so as soon as possible, and generally within a month of receiving a request. However, governments may refuse some types of requests; for example, if the request is “manifestly unreasonable or too general”, or disclosure could prejudice ongoing proceedings or damage commercial confidentiality or national security. The authorities should explain a refusal to provide information. If they do not have the information requested, they should direct the requester to the appropriate source. The public authority may charge the requester for providing information. However, it should not exceed “a reasonable cost” and a schedule of charges should be available beforehand.

Public authorities are also obliged to collect information that they need to carry out their responsibility to protect human health and the environment, and to disseminate that information to the public. Information should be made available in a transparent way and be effectively accessible. Governments are also expected to ensure the integrity and reliability of environmental information. Many have done so by assigning responsibility for the collection and treatment of environmental information to independent institutions, such as an Environment Agency or National Statistical Office, that are managed at arms’ length from political control. Over the last decade, many governments have made increasing use of the internet and devised more user-friendly methods for disseminating environmental

¹ UN Economic Commission for Europe. The Aarhus Convention: an Implementation Guide, Geneva: UNECE, 2014. https://www.unece.org/fileadmin/DAM/env/pp/Publications/Aarhus_Implementation_Guide_interactive_eng.pdf.

information.

2) Public Participation

Public participation provides an opportunity for governments to have access to accurate, comprehensive, up-to-date information when making a decision that has significant environmental consequences. The Aarhus Convention recommends that, for specified activities, public authorities should conduct public participation early, and give the public notice, including time frames for the different phases of the process. The public should have access to all relevant information and opportunities to provide comments. The authorities should take the comments into account and inform the public of the decision eventually adopted, including the reasons. One of the key challenges in many countries is to ensure that public participation processes are not just formal exercises and that the public has a real opportunity to influence the decision.

According to the Aarhus Convention, the main activities that should involve public participation are:

- The proposed siting, construction and operation of certain types of facilities, often over a certain size. Such projects would generally be required under national law to undergo an Environmental Impact Assessment procedure including public participation;
- The development of plans, programmes and policies relating to the environment, including sectoral or land-use plans, environmental action plans, and environmental policies at all levels. In many countries, such plans would be subject to Strategic Environmental Assessment. In these cases, there may be a need to develop clear criteria for who can participate; and
- The preparation of laws and regulations. Again, criteria for participation may need to be established as well as a procedure for receiving comments on successive drafts.

In many countries, environmental NGOs can fulfil an important public function by bringing information and perspectives to decision making. Recognising this, many governments provide financial and other support to NGOs; for example, free office space, or contracts to perform defined tasks such as information collection or conducting surveys. In such cases, it is important to ensure that NGOs receiving government support remain independent of the government.

3) Access to Justice¹

Provisions for access to justice provide the public with the opportunity to seek legal

¹ For further information on experience in Europe with access to justice see Client Earth (2019), Access to Justice in European Union Law: a legal guide to access to justice in environmental matters, <https://www.documents.clientearth.org/library/download-info/16209/>.

review of alleged violations of environmental law. Effectively they enable the public to play a role in the enforcement of environmental law. The provisions on access to justice in the Convention apply to all matters of environmental law, but a distinction is made between three types of violation:

- Requests for access to environmental information;
- Public participation rights (e.g. permits, decision-making for specific activities);
- All other acts, decisions and omissions affecting the environment.

For the first two categories, governments must provide a review procedure involving a court or court-like body established by law. For the third category, access to justice may also be provided by means of administrative procedures.

In addition to procedures, governments must also ensure that appropriate remedies can be applied. They should include “injunctive relief”, that is a remedy that prevents the harm from (re)occurring. In accordance with the provisions of the Convention, the government should clarify who has “standing”, that is who is authorized to initiate a legal review. The government should also set the standards so that the procedures, decisions and remedies are fair, equitable, timely, not prohibitively expensive, and that decisions are publicly available in writing.

Annex 6-1: The Need for Scenario-based Outlooks

This SPS highlighted a need for foresight, in order to align the Beautiful China 2035 targets with China's vision for 2050 and to identify a critical path towards achieving both. A recommendation to this end is put forward by the SPS, specifically advising scenario methodology to guide China's environment policy.

In addition, focusing on CCICED itself, SPS members noted that a common base of mid- and long-term scenarios would provide great leverage to the whole programme of CCICED studies. Previous, summary work in this direction was undertaken by the CCICED task forces exploring the connections between China's environment policy and its social development and its economic transition, respectively.¹This annex summarizes the potential for CCICED.

1. Potential for the CCICED programme of studies

A common base of scenarios, underlying the whole programme of work, would conceivably provide the following potential to CCICED:

(1) A common baseline, or set of baselines, in order to facilitate comparison between all studies and combine their findings. It is a bit late in phase VI to establish this, but perhaps something of the sort can still be done.

(2) A softer variant, applied at a later phase in the development of the studies would be: stress testing draft recommendations from all current CCICED studies, against a simple set of contrasting scenarios, spanning the width of conceivable futures.

(3) Back casting in order to align the 2035 goals with the 2050 vision. Scenario work in this style was recommended as a first priority by the 2013 task force on the interplay between environment policy and China's social development.

(4) Input into the drafting of the annual issues paper.

Any relevant scenario for environment and development in China has to consider multiple geographical scales, including the wider region and the globe. The same goes for the associated modelling. A pragmatic way to accomplish this, instead of building your very own worldwide scenarios and models, is to use the existing Shared Socio-Economic Pathways as context². More detailed work for China's domestic developments, based on Chinese knowledge,

¹ Study on China's Environmental Protection and Social Development, CCICED executive report 2013; The New Era of Green development - China's Green Transition to 2050, CCICED discussion paper 2017.

² O'Neill BC, Kriegler E, Ebi K. The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century[J]. *Global Environmental Change*, 2017, 42: 169-180. <https://doi.org/10.1016/j.gloenvcha.2015.01.004>. Part of special issue on the Shared Socio-Economic Pathways.

can then be elaborated within that framework. Such an approach has recently been followed in analytical work for the CCICED Task Force on China's Green Transition to 2050.

2. Background: what is a scenario-based outlook?

Scenario methods belong to the larger domain of foresight. That is the ability to know about the future. Specifically, scenarios are used to build consistent stories about the future, with a consistent timeline. Typically, the various actors and forces interact, as in the theater. Hence the name. The key objective is to have thought through the future before it arrives so that you are better prepared.

What scenarios do NOT deliver are predictions. The world is too uncertain for that. In fact, scenario methods are key in exploring precisely the big uncertainties and their policy implications.

Thus, a scenario is a story, imagining how things could develop over time. It is NOT necessarily a story how things should develop, although important variants exist that have this character.

In matters of environment and sustainable development, scenarios are often composed of a narrative plus numbers, the latter based on models. The models should NOT be understood as a rigid law, but they are often useful in illuminating, for example, maximum rates of improvement and the longevity of “stuff” such as energy installations and spatial patterns.

Many types of scenarios exist and there is abundant literature. The simplest distinction is in terms of the reasons why one would want to know about the future. The technical characteristics follow from this (plus of course, time and money budgets, the audience, etcetera). Three archetypal reasons/purposes exist, as follows:

(1) Policy optimization: what policy variant is most effective, cost-efficient, fast, acceptable, and so forth.

(2) Advocacy: what are the positive changes we are going to fight for? Importantly, one flavour here is back casting, exploring how to reach the vision. Back casting is NOT planning. It is much more strategic, for example identifying “must-haves” and “dead alleys” to be kept in mind when making near-term decisions.

(3) Strategic orientation: for what alternative worlds do we need to prepare ourselves? What if our current assumptions were wrong? What would be robust strategies? Importantly, this is the archetype where the client is NOT in control, but wants to prepare strategically for what could come his/her way.

Chapter 7 Green Transition and Sustainable Social Governance

7.1 Introduction

Since China's Reform and Opening-up was initiated 40 years ago, leading to economic and social development, dramatic changes have taken place in both urban and rural residential consumption. This is visible in terms of the volume of consumption and its structure and patterns. Unprecedented features have revealed themselves, including: a) the volume of consumption continues to expand rapidly, with huge space for further growth of residential consumption; b) the consumption structure is shifting from being subsistence-based to consumption beyond basic needs (a well-off model), with an increasingly diversified consumption pattern; and c) consumption has contributed a soaring share to economic growth and become an important engine for economic development. At the same time, consumption activities have posted growing pressures on resources and the environment; consumption demand for resources and energy continues to grow steadfastly; irrationally excessive and wasteful consumption patterns have exacerbated resource and environmental problems; and consumption has become one of the major sources of environmental pollution and greenhouse gas emissions.

Consumption has become an obstacle and restrictive factor for China in its efforts to promote its overall green transition. Since 2004, the extent of green transition in China has progressed year by year. The green transition in both the production and consumption sectors has continued to progress upwardly through 2008. However, the trend curve has gradually flattened and shown fluctuations since 2008. In general, the green transition in the production sector has shown continuous improvement, and played a positive supporting role in boosting a comprehensive green transition. On the contrary, the green transition in the consumption sector has exhibited an obvious downward trend since 2008 and the abatement in the consumption sector exceeded the improvements made in the production sector in 2011. It can be said that the improvements in efficiency gained by the green transition in the production sector failed to offset the negative impacts on resources and environment caused by the expansion in the amounts being consumed. Consumption now restrains overall continued

progress towards a green transition. Making substantial progress towards a green transition in the consumption field will play a decisive role in the implementation of the overall green transition and in realization of high-quality development in China.

Green consumption can promote the green transition through multiple transmission mechanisms. The greening of consumption will lead and enforce the greening of production. The adoption of green concepts and measures will lead to changes in consumption volume, pattern, structure, quality, and preferences, and these in turn will inevitably be transmitted to the production field. This will affect the allocation of factor resources and lead to improvements in production pattern, adjustments in product structures and promotion of product quality. Green consumption is core to fostering a green lifestyle and can effectively push behavioral changes in the general public. Green consumption activities can convey and communicate green concepts and requirements into all aspects of public life, and guide and motivate the public to actively practice green concepts and requirements. In this way it can contribute to cultivating green lifestyles nationwide, and improve the governance system of the green social transition.

Green consumption can become a new driving force for the green transition. The demand for green consumption and a green market in China continues to expand, with constant upgrading in the quality of residential consumption, a growing variety of green consumer goods and services, continuous escalation in the number and size of green consumer groups, and an ever-rising willingness for green consumption. The green transition and upgrading of consumption can lead to innovation efforts in supplying green eco-labelled products and services and those making use of eco-labels; and the supply of green products and services and those with eco-labels can create new green consumption demand. Such benign interactive cycles between green production and consumption and green supply and demand can serve as a new driving force for boosting economic prosperity by facilitating green growth in the economy, adding new employment channels and platforms, and promoting the structural reform on the supply side. They can also serve as the endogenous conditions necessary for improving eco-environmental quality by drastically reducing resource consumption and environmental degradation, and in this way creating a win-win scenario for the environment and economy.

Green consumption is conducive to accelerating the modernization of the eco-environmental governance system. The set-up of institutional mechanisms to guide and prioritize the green consumption model can be very beneficial. First, they can expand the eco-environmental governance system from the production field to the consumption field, thus widening the coverage of eco-environment governance and adding new incentives and

voluntary leadership in this area. They are conducive to building an institutional system featuring equal emphasis on both incentives and constraints. Second, as consumption is a basic behavior choice made by the public, green consumption can enable the public to truly participate in the environmental governance process. Consequently, people's green consumption behaviors and their choice of green products and products with eco-labelled products can catalyze enterprises to improve environmental performance and increase green and eco-labelled products and green production supply. This is a practical way to spontaneously involve public participation in eco-environmental protection. Third, a green transition at the consumption end can be transmitted into production processes through the creation of a green supply chain, in which enterprises with leading green performance in the industrial chain can help manage enterprises that are not so green ("green-backward" enterprises). This can help blaze new ways of eco-environmental governance and improve the related system.

Such factors as residents' views on consumption, income level, consumption preferences, public policies, supply quality and the price level of green and eco-labelled products are crucial to promoting green consumption. Strengthening consumers' familiarity with green consumption and enhancing environmental awareness and environmental knowledge can effectively improve their ability to recognize the value of green products and services, and indirectly affect their green consumption behavior. Public policies mainly affect consumers' individual cognition of the environment and green consumption, and ultimately affect their attitudes towards green purchasing, green products use and waste disposal. The supply price level of green and eco-labelled products will affect the level and popularity of green consumption. It is also necessary to regulate the green consumer goods market and ensure the quality of products and services, so as to form a virtuous circle between green supply and green consumption. Technological progress has an important impact on residents' green consumption level.

By and large, China's green consumption policies pertinent to clothing, food, housing and transportation have achieved positive results, yet there is still room for improving the implementation of some green consumption policies. In terms of policy frameworks and practices, there are a number of green consumption policies but they are fragmented and have not been integrated into a systematic and effective policy framework. Specific observations can be made: a) There is a lack of systematic planning and top-level design. Most green consumption policies are conceptual, guiding and voluntary in nature, with incomplete

categories, limited policy impacts and enforcement efficacy, and insufficient operability. d) In relation to green consumption policies, the most emphasis is placed on resource and energy conservation; less attention is given to eco-environmental protection. There are insufficient economic incentives in these policies, leading to limited regulation effectiveness. c) Government functions and responsibilities related to green consumption are scattered in different agencies. The role of environmental authorities needs to be strengthened. The fragmentation of policies and management is quite prominent. If no systematic design and integration of related policies occurs, the environmental and economic effects of green consumption will be greatly weakened.

The timing and conditions are right for incorporating green consumption into the national 14th Five-Year Plan. China has a window of opportunity to promote a green transition in consumption, marked by the following features: a) consumption is undergoing a comprehensive transition and upgrading, leading China from a subsistence-based model of consumption to consumption patterns of a well-off society; b) residents' consumption patterns are changing significantly and willingness to engage in green consumption is growing; and c) consumption is playing an ever-growing role in stimulating the economy. It is a critical moment in which new consumption habits and models in society can be formed. China exhibits a strong political will in support of a green consumption transition. Chinese President Xi Jinping articulated the necessity of promoting a green development pattern and green lifestyles in May of 2017. The Chinese government has provided powerful guidance for how to take action for the enhancement of green lifestyle and green consumption. China's activities promoting a green transition of consumption are propelled by an increasingly mature social foundation and good practices. The general public has witnessed a dramatic rise in environmental awareness as well as awareness of the possibilities of participation and the safeguarding of environmental rights. They show an ever-increasing desire for and expectation that they will be able to enjoy a sound-quality life. Together this constitutes the social foundation for pushing forward green consumption. Meanwhile, China has built some effective policy and practices which serve as a foundation for green consumption. There are also many inspiring practices from the international community to take as reference. It is of great importance for China's overall high-quality development and ecological civilization construction that this precious window of opportunity be seized. It is a critical period for giving timely guidance which can accelerate the formation of resource-efficient and environment-friendly consumption patterns and lifestyles.

7.2 The Trends of China's Consumption and its Impacts on Resources and Environment

7.2.1 Definition of Consumption and Green Consumption

7.2.1.1 Definition of consumption

The expenditure approach for calculating gross domestic product (GDP) is the most internationally applied method to fully reflect final demand. The final consumption expenditure in the expenditure approach is a robust indicator for reflecting consumption demand, including household consumption (resident consumption) and government consumption. As government consumption represents a strong government will, it is generally regarded as an external variable for the economic operation. This chapter primarily focuses on resident consumption. In China's statistical system, resident consumption in the household survey is composed of resident consumption in both urban and rural household surveys, which is estimated from 8 main categories of a) food, b) clothing, c) residence, d) household facilities, items, and services, e) health care, f) transportation and communication, g) educational, cultural and recreational products and services, and h) other goods and services. Based on these 8 statistical categories, the researchers of this report unified the statistics standards for resident consumption used in expenditure approach for GDP and the classifications of resident consumption used in Input-Output Table.

7.2.1.2 Definition of green consumption

In 1992, the concept that “all countries should strive to promote sustainable consumption patterns”¹ was first proposed in the Agenda 21 adopted by the United Nations Conference on Environment and Development. In 1994, the United Nations Environment Programme (UNEP, now known as UN Environment) held a symposium in Oslo and released the report on policy factors for sustainable consumption, which defined sustainable consumption as “the use of services and related products, which respond to basic needs and bring a better quality of life while minimizing the use of natural and toxic materials as well as the emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of future generations”². In 2015, the 2030 Agenda for Sustainable Development with 17 Sustainable Development Goals (SDGs) at its core was adopted at the United Nations Sustainable Development Summit, in which SDG 12 is particularly designed to “ensure sustainable consumption and production patterns” and underpinned by 8 associated targets. Sustainable consumption and production (SCP) is about “promoting resource and energy

1 <https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf>.

2 Norwegian Ministry of Environment, Oslo Symposium, 1994.

efficiency, sustainable infrastructure, and providing access to basic services, green and decent jobs and a better quality of life for all”¹.

With the establishment of the environmental labelling system in 1993 as a symbol, China’s sustainable consumption related concepts and practices have been advancing basically in alignment with the international progress. In March 2016, China issued the “Notice on Guiding Opinions on Promoting Green Consumption”, clarifying that green consumption refers to consumer behaviours featured with resource conservation and environmental protection. The notion is specially characterized by promoting diligence and thrift, reducing loss and wastage, selecting efficient and environment-friendly products and services, as well as reducing resource consumption and pollution emissions in the consumption process. The definition highlights the “green” requirements of resource conservation and environmental protection in consumer behaviour. It is primarily consistent with the internationally-recognized concept of sustainable consumption, but does not explicitly emphasize the issue of inter-generational consumption equity. In 2017, special arrangement for promoting green production and consumption was deployed in the 19th National Congress of Communist Party of China (CPC). In general, China’s green consumption can be interpreted from five dimensions: a) in terms of concept, green consumption encourages sustainability and greening of consumption; b) in terms of quantity, green consumption stands for the moderation and reduction of consumption; c) in terms of structure, green consumption embodies the rationality and balance in consumption; d) in terms of content, the main concern at present stage is focused on main areas in daily life such as food, housing and transportation; and e) in terms of approach, consumption is expected to spur and lead a whole-process greening from production, circulation to disposal.

7.2.1.3 Definition of concepts discussed in this study

This research touches upon such concepts and terminology as green transition, green consumption, and green transition of consumption. In order to help readers better understand the research and avoid overlapping in conception, based on the research objectives and contents, the researchers put forward respective scope and connotations of related concepts and terminology used in this study, detailed as follows.

(1) Green transition

Green transition mainly includes the green transition in economic dimension and that in social dimension. Green economic transition refers to the decoupling of economic growth from resource use and environmental degradation, i.e. the increase of economic output is achieved with the reduction in resource consumption and environmental degradation.

1 <https://www.un.org/sustainabledevelopment/sustainable-consumption-production/>.

Decoupling can be divided into relative decoupling and absolute decoupling. Relative decoupling means that the economic growth rate is faster than the growth rate of resource utilization or environmental degradation; while absolute decoupling means that an increase in economic output is accompanied by a reduction in the absolute use of resources and an improvement in environmental quality.

Green social transition primarily refers to a) the shift in values of entire society towards a harmonious symbiotic relationship between human and nature, which advocates respect to nature, compliance to natural laws, and protecting nature; b) the shift in public behaviour patterns towards sustainable production and consumption, which will form moderate, simple and green behaviour and lifestyle; and c) the shift in social governance structure and system towards a modern social governance system which is green, fair and inclusive and suitable for developing ecological civilization and realizing SGDs.

(2) Green consumption

Green consumption can be defined in both a narrow sense and a general sense. Green consumption in narrow sense refers to the products and services with less resource consumption, lower environmental pollution, and rational price that can meet varied human needs and properly consider the inter-generation equity. It can be calculated in quantitative analysis by the final resident (household) consumption expenditure in national economic accounting, in particular the typical categories of food, housing, goods and transportation. The generalized green consumption is about absolute reductions in the material and energy throughput of total consumption volume and of per capita lifestyles, a shift towards greener production structure and consumption structure, the reduction in energy and resource consumption for per unit of output, as well as minimized impacts of production and daily life on eco-environment. It includes not only the greening of final consumption, but also the greening of production process, greening of government procurement, as well as new business types, new modes, and new cultures that focus on wellbeing rather than on consumption.

In the following chapters, the forecasts on green consumption and its impacts on eco-environment are estimated based on the narrow of sense green consumption and data of resident consumption expenditure; while the overall policy evaluation and case studies on China's green consumption mainly focus on the generalized green consumption.

(3) Green transition of consumption

Green transition of consumption is a significant constituent of green economic transition. Green consumption is a relatively static concept to indicate the green level and status of consumption. Green transition of consumption is a relatively dynamic concept to describe the

process and changes that consumption transforms in the green direction(Figure 7-1).

7.2.2 China's consumption trends and corresponding impacts on resources and environment

Since China's Reform and Opening-up initiated 40 years ago, with the economic and social development, dramatic changes have taken place in both urban and rural resident consumption in terms of consumption volume, structure and patterns. Unprecedented features have revealed themselves. Such changes have further brought profound and long-term impacts on economic growth, social development, and the sustainability of resource and environment.

7.2.2.1 Consumption scale continues to expand rapidly, with huge space for growth of resident consumption

In recent years, consumption in China has maintained steady and rapid growth. The total retail sales of consumer goods in China has increased from 21 trillion CNY in 2012 to 38 trillion CNY in 2018, marking an average annual growth rate of 11%, which is 2.7 percentage points higher than the nominal annual average GDP growth rate in the same period. However, there is still enormous space for consumer spending to grow. By 2017, China's urban and rural consumption ratio has reached 40%, which was still substantially lower than the consumption ratio of 70% in the developed world. In 2017, China's per capita final household consumption expenditure only reached 2,700 USD, merely accounting for 13% of the average level (20,000 USD) in Japan, Europe, and Singapore. There exists huge potential for mid- and long-term consumption growth. This study predicts that consumption will grow by 7.2% annually from 2015 to 2020, and the total urban and rural resident consumption volume will reach 41.7 trillion CNY (current price, the same below) in 2020. From 2021 to 2035, consumption is projected to grow at an annual average rate of 5.3%, reaching 135 trillion CNY by the end of 2035. From 2036 to 2050, the annual average growth rate for consumption will come to 3.5%, and the scale in 2050 will be close to 340 trillion CNY(Figure 7-2).

7.2.2.2 Consumption structure is shifting from a subsistence-based model to a well-off one, with an increasingly diversified consumption pattern

According to the data released by China's National Bureau of Statistics (NBS), the Engel coefficient of China's household consumption has dropped from 31.2% in 2013 to 28.4% in 2018. It is projected by this study that the Engel coefficient will continue the momentum and decline to 20% by 2035 to reach the well-off line of 20% to 30% set by United Nations (UN). As the demographic structure changes and the urbanization level improves, such favourable factors as employment, income, and social security will jointly contribute to a further shift

in consumption model from a material-oriented one to a service-oriented one, and from a subsistence-based one to a well-off one. An increase can be expected in the share of per capita consumer spending on services such as transportation and communication, education, culture and entertainment, as well as health care(Figure 7-3).

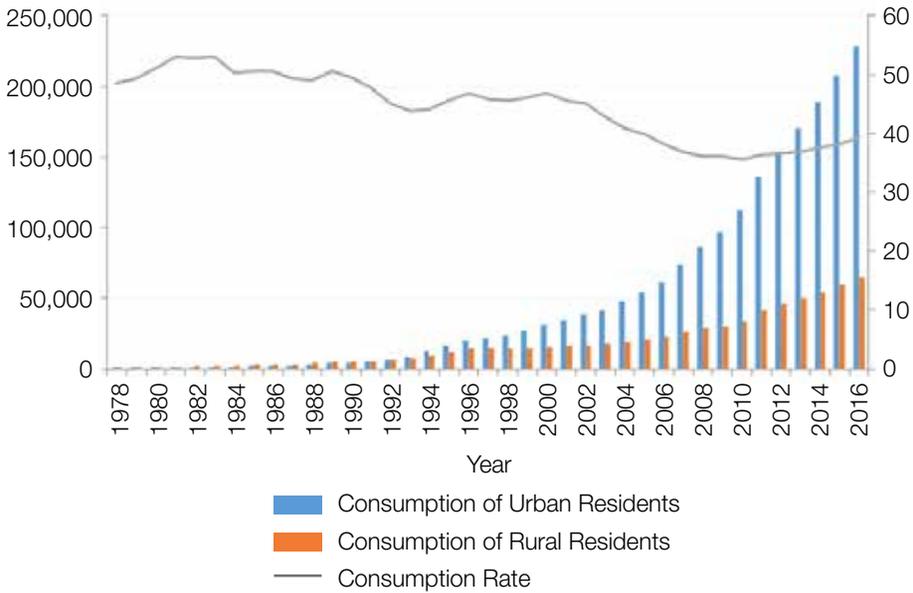


Figure 7-1 Historic development of residents consumption in China

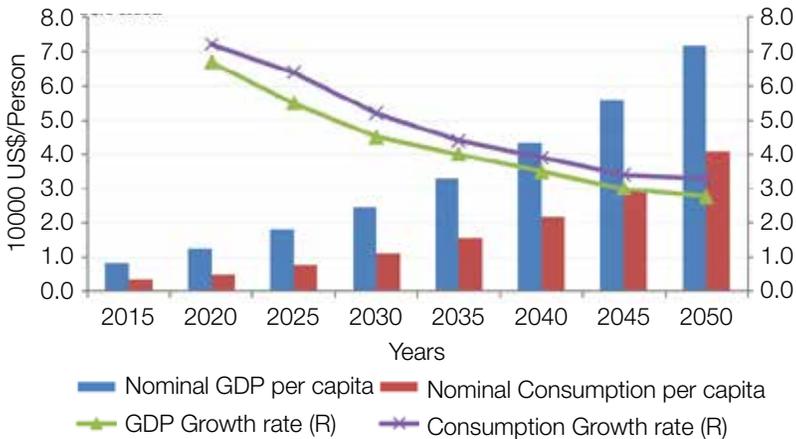


Figure 7-2 Forecasted resident consumption trend of China in the future

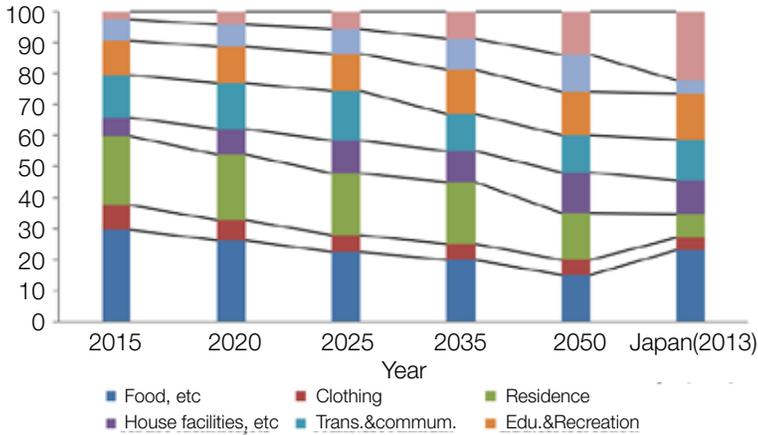


Figure 7-3 An Outlook of Consumption Structure Change in China by 2050

At the same time, with the progress of science and technology and the change of life style, consumption pattern will also become increasingly diversified. In particular, with the support of Internet technology, consumption pattern is moving from the traditional off-line retail to the integration of on-line shopping and off-line retail. In 2018, China's online retail sales reached 9 trillion CNY, presenting a year-on-year growth of 23.9% which was significantly higher than the 9% growth rate of total retail sales of consumer goods. China's practices in e-commerce, mobile payment and sharing economy are leading the world. Consumer behaviour is shifting from a conformity and imitation oriented style to an experience-driven personalized style. New consumption focuses such as smart phones, wearable device and digital homes are booming. Personalized, customized and diversified consumption underpinned by "Internet plus" has gradually become the mainstream.

7.2.2.3 Consumption has contributed a soaring share to economic growth and become an important engine for economic development

Since 2011, consumption has become the dominant driving force for China's economic growth. In 2017, final consumption expenditure accounted for 53.6% of GDP, with 3.5 percentage points higher than the 2012 level; and its contribution to economic growth took up to 58.8%, 3.9 percentage points higher than the 2012 level. Meanwhile, the tertiary industry, the indicator of consumption development level, has witnessed rapid growth. Since 2013, the share of its added value in GDP has exceeded the proportion of the secondary industry, and further surpassed 50% after 2015. In 2018, the contribution of final consumption expenditure to economic growth was 76.2%, 43.8 percentage points higher than the contribution of total capital formation. Economic growth has been jointly driven by consumption, investment and

export instead of investment and export. By 2050, consumption is expected to attain about 70% of GDP, and per capita consumption will become 40,000 USD, basically reaching the average level of developed countries at that time.

Table 7-1 Comparison of GDP volume and structure in China and U.S. in 2018

GDP Volume and Structure	China	United States
GDP Volume/(trillion USD)	13.6	20.5
Share of Primary Industry	7.2	0.8
Share of Secondary Industry	40.7	18.6
Share of Tertiary Industry	50.1	80.6

Note: The above results are calculated by researchers of this study based on statistical data.

7.2.2.4 The consumption activities have posted growing pressure on resources and environment and become one of the major sources of environmental pollution and greenhouse gases emissions

Due to changes in consumption volume, structure and pattern, consumption activities have put mounting pressure on resources and environment, led to prominent problems, and become a most critical sources of environmental pollution and greenhouse gases (GHGs) emissions. The impacts are reflected in three major aspects.

(1) Consumption demand for resources and energy continues to grow rigidly

China's resident consumption of resources and energy has jumped rapidly. The direct energy consumption by Chinese residents totaled 540 million tons of standard coal equivalent (SCE) in 2016, 3.2 times of the 2000 level (170 tons of SCE). The corresponding annual average growth rate was 7.7% and slightly higher than the annual average growth rate of 7% for total energy consumption. Its share in the total energy consumption also rose from 11.6% to 12.4% over the same time period. Meanwhile, based on the 2015 Input-Output Table newly released by NBS, it is estimated that the comprehensive energy consumption¹ by residents in 2015 was 1.14 billion tons of SCE, taking up to 26.5% of the total energy consumption of the year. It is projected that the comprehensive energy consumption by residents will reach 2.28 billion tons of SCE in 2035, with an increase of 1.1 billion tons of SCE from the 2015 level. The estimated amount marks a rise by 88% and a proportion of more than 40% in total energy consumption. By 2050, the figure will be 3.04 billion tons of SCE, 33% higher than the 2035 level. According to the research of World Wildlife Fund (WWF), China's per capita

¹ The comprehensive energy consumption by residents includes energy directly consumed in daily life and energy consumed in producing various consumer goods.

ecological footprint in 2010 was 2.2 global hectares of productive land. Although this figure was lower than the global average level of 2.6 global hectares, it was more than twice the per capita ecological carrying capacity of China in 2010. About 90% of China's ecological footprint is generated by consumption activities in areas of food, housing, and transportation, bringing enormous pressure on resources and environment.

(2) Irrationally excessive and wasteful style of consumption has exacerbated resource and environmental problems

According to statistics released by the Traffic Management Bureau of the Ministry of Public Security (MPS), China's motor vehicle quantity has reached 327 million in 2018, including 240 million cars, among which 189 million are private cars (private small and micro passenger cars) and 25.7 million cargo vehicles. The number of new energy vehicles was 2.61 million, accounting for only 1.09% of the total vehicle quantity in 2018. Data from State Radio Administration of Ministry of Industry and Information Technology (MIIT) shows that China had 1.57 billion mobile phone users in 2018. According to a report issued by Electrical Appliance Recycling Technology Center under the China Household Electronic Appliances Research Institute (CHEARI), in 2017, the quantity of discarded TV sets, refrigerators, washing machines, air conditioners, and computers was 120 million units, with 230 million waste mobile phones and 150 million other household waste electronic appliances. The total waste electronic device weighed over 5 million tons. At present, the annual output of packaging products in China stands at 30-odd million tons with only less than 30% having been recovered. Preliminary estimates from the State Post Bureau (SPB) show that, in 2018 the express delivery industry consumed more than 50 billion waybills, 5.3 billion woven bags, 24.5 billion plastic bags, 5.7 billion envelopes, 14.3 boxes, and 43 billion meters of tape. The packing tape used for domestic delivery in the whole year could wrap around the entire Earth 1,077 times. As shown by the primary estimates from WWF and Institute of Geographic Sciences and Natural Resources Research (IGSNRR) of Chinese Academy of Sciences (CAS), food waste from the table in catering industry in Chinese cities alone amounted to 1.7 to 1.8 million tons in 2015, equivalent to the annual food demand of 30 to 50 million people.

(3) Consumption has become a major source of environmental pollution

According to the calculation by this study, in 2015, terminal demand in China's residential consumption has triggered emissions including 11.84 million tons of chemical oxygen demand (COD), 1.28 million tons of ammonia nitrogen, 7.2 million tons of sulfur dioxide (SO₂), and 5.12 million tons of nitrogen oxides (NO_x), accounting for 56.1%, 57.8%, 70.2% and 84.5% of corresponding total emissions respectively. It is estimated that by

2035, the emissions of COD, ammonia nitrogen, SO₂ and NO_x result from China's consumer terminal demand will reach 20.56 million tons, 2.17 million tons, 14.05 million tons and 9.79 million tons respectively, with an respective increase of 74%, 69%, 95% and 91% compared to the 2015 level, accounting for 52%, 54%, 61% and 60% of the corresponding total emissions respectively. The emissions will further rise to 24.97 million tons, 2.61 million tons, 17.22 million tons and 11.57 million tons by 2050, respectively accounting for 60%, 60%, 68% and 68% of the corresponding total output.

In addition, source apportionment of ambient fine particulate matter (PM) shows that emission from mobile sources has become the primary share of PM pollution in megalopolises such as Beijing, Shanghai, Hangzhou, Guangzhou, and Shenzhen. The contribution of mobile source emissions has reached 52% in Shenzhen. Motor vehicles are the leading mobile sources in urban areas. In 2015, the urban domestic sewage discharge was 2.68 times that of industrial wastewater discharge nationwide. While in 1997, the ratio between the two was only 0.83. The domestic sewage discharge volume witnessed 1.83 times growth over 18 years. The amount of household waste generated in Beijing in 2015 has overtaken that of the industrial waste, registering the largest source of municipal solid waste (MSW) in that year.

7.3 Analysis on the Role of Green Consumption in the Promotion of Green Transformation of Socio-Economy in China

The key to green transition of economy lies in the decoupling of economic growth from resource use and eco-environmental degradation, which is embodied in the greening of production and consumption. The green transition and upgrading of consumption can lead the innovation efforts in supplying green and eco-labelled products and services; and the supply of green and eco-labelled products and services can create new green consumption demand. Such benign interactive cycle of green production and consumption, green supply and demand can serve as a new driving force for boosting economic growth, the endogenous condition for improving eco-environmental quality, and a new growth pole for promoting high-quality development. Meanwhile, the green consumption can lead a new fashion in society, help cultivate ecological and cultural values, and foster new green behavior and lifestyle. It has significant implications to building a sustainable social governance system and promoting green transition of society.

7.3.1 Consumption has become an obstacle and restrictive factor for China to promote its overall green transition

The degree of green economic transition mainly depends on the status of green transition in the production and consumption sectors. In order to gauge the degree of green economic transition, this study constructed a green transition index and indicator system built on the resources and energy consumption as well as the eco-environment quality changes in the production and life consumption process, so as to reflect the degree of green transition in the production and life consumption sectors.

7.3.1.1 Establishing an indicator system for green transition

The green transition index in the production sector is measured by four categories of indicators, including productive energy consumption, industrial water use, construction land, and freight volume. The weight of each category is 6.25%. The eco-environmental quality change index in the production sector consists of five categories of indicators, including the main air pollutant emissions (industrial), the main industrial wastewater pollutant emissions, the industrial solid waste, the rate of air quality improvement to economic growth, as well as the rate of water quality improvement to economic growth. The weight of each category is 5%. There are 3 indicators under the category of the main air pollutant emissions (industrial), with 1.67% weight for each indicator; and 2 indicators under the category of the main industrial wastewater pollutant emissions, with 2.5% weight for each indicator.

The green transition index in the life related area is developed to evaluate the degree of green transition in people's lifestyle, which involves the resources and energy consumption as well as eco-environment quality changes in life consumption process. Among them, the energy and resource consumption index in life are composed of four types of indicators, which are designed to measure the changes in domestic water consumption, domestic energy consumption, residential land use, as well as means of transportation respectively. Each type of the indicator is given the same weight of 6.25%. The eco-environmental quality change index in the life related area is calculated through five categories, including main air pollutant emissions (life), household wastewater, household waste, park green space, and change of transportation means, with 5% weight for each category. The main air pollutant emissions (life) cover 2 indicators, each with a weight of 2.5%.

The relevant indicators under green transition indexes in production and life sectors are divided into positive indicators and negative indicators. In terms of positive indicators, the higher the value, the higher degree of the green transition; while in terms of negative indicators, the higher the value, the lower degree of the green transition (Table 7-2).

Table 7-2 Green transition index and indicator system

Primary Index	Secondary Indicator	Third Class Indicator	No.	Unit	Index Weight/%	Indicator Type
Resource and Energy Consumption Index	Production Sector	Energy consumption per unit of GDP (production)	1	kgce / 10,000 CNY	6.25	Negative
		Industrial water consumption per unit of GDP	2	m ³ / 10,000 CNY	6.25	Negative
		Construction land area per unit of GDP	3	m ² / 10,000 CNY	6.25	Negative
		Freight volume per unit of GDP	4	ton / 10,000 CNY	6.25	Negative
	Life related area	Daily per capita domestic water consumption	5	l / person	6.25	Negative
		Per capita domestic energy consumption	6	kgce / person	6.25	Negative
Resource and Energy Consumption Index	Life related area	Per capita private passenger car ownership	7	unit / 10,000 persons	6.25	Negative
		Per capita residential land area	8	m ² / person	6.25	Negative
Eco-Environmental Quality Change Index	Production Sector	Air quality improvement rate / GDP growth rate	9	%	5.00	Positive
		Water quality improvement rate / GDP growth rate	10	%	5.00	Positive
		CO ₂ emission per unit of GDP (production)	11	kg / 10,000 CNY	1.67	Negative
		SO ₂ emission per unit of GDP (industrial)	12	kg / 10,000 CNY	1.67	Negative
		NO _x emission per unit of GDP (industrial)	13	kg / 10,000 CNY	1.67	Negative
		COD emission per unit of GDP (industrial)	14	kg / 10,000 CNY	2.50	Negative
		Ammonia nitrogen emission per unit of GDP (industrial)	15	kg / 10,000 CNY	2.50	Negative
		Industrial solid waste generation per unit of GDP	16	ton / 10,000 CNY	5.00	Negative
	Life related area	Per capita park green space	17	m ² / person	5.00	Positive
		Public transport passenger volume per 10,000 persons	18	10,000 person-time / 10,000 persons	5.00	Positive
		Per capita CO ₂ emission (life)	19	kg / person	2.50	Negative
		Per capita SO ₂ emission (life)	20	kg / person	2.50	Negative
		Per capita domestic wastewater emission	21	kg / person	5.00	Negative
		Per capita domestic waste collection volume	22	kg / person	5.00	Negative

7.3.1.2 Results for green economic transition evaluation

In view of the statistical standards and availability of data for each indicator, this section calculates the green transition index of each year from 2004 to 2017. The results are shown as follows.

(1) The level of the green transition has been upgrading year by year, however, the curve of such growth trend has gradually flattened. From 2004 to 2008, the green transition index increased substantially on a yearly basis. From 2009 to 2012, the growing momentum of green transition index slowed down. In 2013, the green transition index showed a sharp decline, mainly due to the significant decline in air quality that year while other indexes kept the change trend of previous years(Figure 7-4).

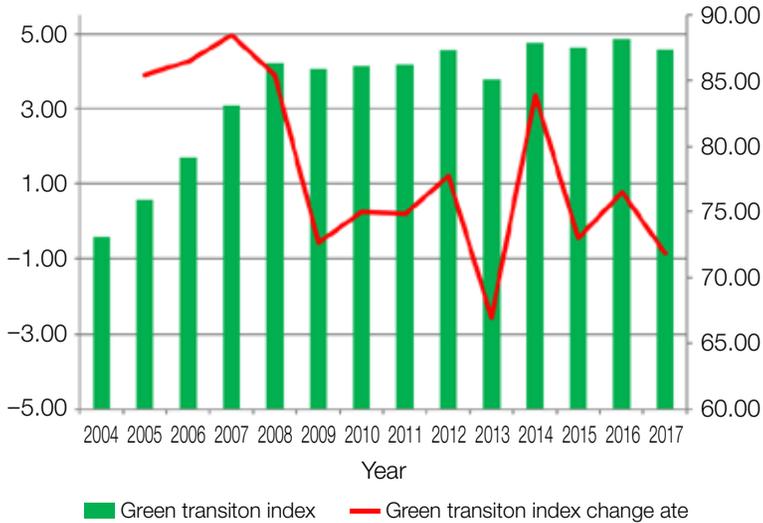


Figure 7-4 Trend of green transition index change (2004–2017)

(2) Green transition gains in production sector has played an important supporting role in the overall green transition process. As revealed by the comparison and analysis of the changing trend of green transition index in the production sector and life related area, there has been a remarkable improvement in production sector since 2004. The index in life related area has shown slight increase only from 2004 to 2008, but kept dropping from 2009 to the present. The index in production sector has been outnumbering that in life related area since 2011. This reflects that the improvement by green transition in production sector plays a vitally important supporting role to the comprehensive progress of green transition; whereas the setback of green transition in life related area render the current comprehensive green transition impotent. It shows to some extent that in recent years, China has made prominent achievements in environmental governance in production sector, but paid inadequate attention to environmental problems in life related area(Figure 7-5).

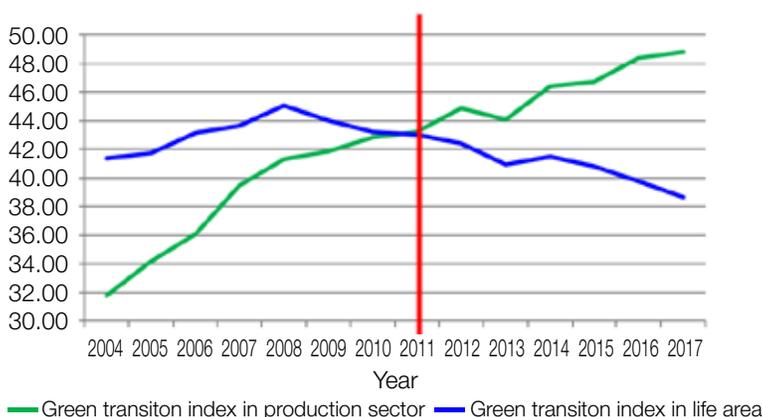


Figure 7-5 Trend of green transition index change in production sector and life related area (2004—2017)

(3) The growth rate of green transition in the production sector has slowed down, and the green transition in life related area has dropped significantly. There is huge potential for green transition in life related area. The green transition index in the production sector has been on an upward trend since 2004. Among all the indexes, the index of resource and energy consumption in the production sector has shown a steady upward trend. Since 2010, it has been higher than the index of resource and energy consumption in the life related area, but its growth rate tends to slow down. At the same time, the eco-environmental quality change index in the production sector has an obvious rising trend in fluctuations. Since 2014, it has been exceeding the eco-environmental quality change index in the life related area by a large margin, which indicates that the efficiency of resource and energy use in the production sector has been gradually improving in recent years, and the negative impact of production activities on the eco-environmental quality has also been reducing step by step(Figure 7-6).

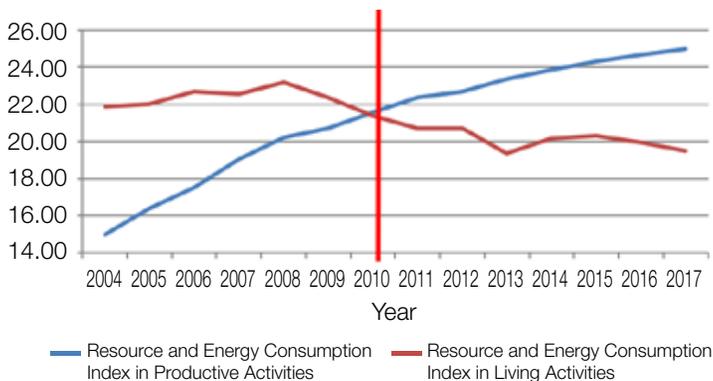


Figure 7-6 Trend of resource and energy consumption index change(2004—2017)

The resource and energy consumption index in life related area has shown a downward trend since 2009. The eco-environmental quality change index in life related area has demonstrated an obvious downward trend since 2011, and the decline rate has increased since 2014. This shows that the resource and energy consumption in the life related area is gradually increasing, with low use efficiency. At the same time, the negative impact of consumption in life related area on eco-environmental quality is also gradually expanding, which has exceeded that in the production sector(Figure 7-7).

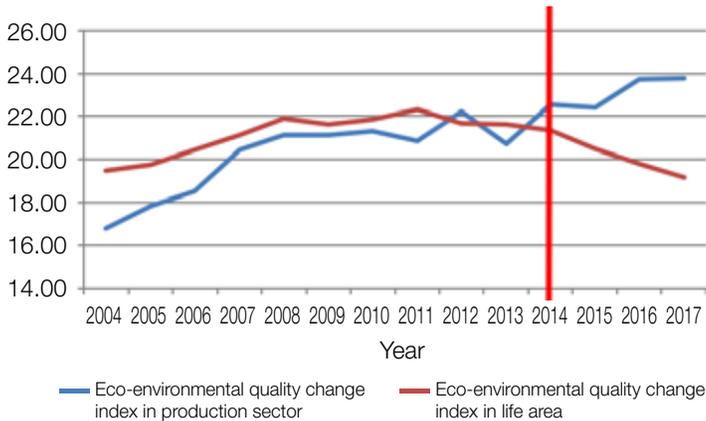


Figure 7-7 Trend of eco-environmental quality index change(2004—2017)

(4) Significant progress has been made with regard to the green transition in resource and energy consumption in the production sector. Four indicators are selected to gauge the level of green transition in resource and energy consumption in production sector, including energy consumption per unit of GDP (production) index, industrial water consumption per unit of GDP index, construction land area per unit of GDP index, and freight volume per unit of GDP index. From 2004 to 2017, the four indexes increased significantly, indicating that in production sector, resource and energy consumption per unit of GDP is shrinking, while use efficiency is witnessing a steady increase. These has been remarkable achievements in the green transition in terms of resource and energy consumption during production activities(Figure 7-8).

(5) The green transition of the eco-environmental quality dimension in production sector has been continuously upgrading. Since 2004, the emission of pollutants per unit of GDP in the production process, such as major air pollutants, major pollutants in industrial wastewater, and industrial solid waste, has shown a gradually decreasing trend, reflecting that the negative impact of production on eco-environmental quality is weakening. However, the downward

trend in major air pollutants emission and industrial wastewater pollutants emission per unit of GDP appears to be moderate. It is only the industrial solid waste generation per unit of GDP that shows great decline. Such results indicate that it is getting difficult to further reduce emissions of air and water pollutants in production sector, while there is still great potential in industrial waste generation control(Figure 7-9).

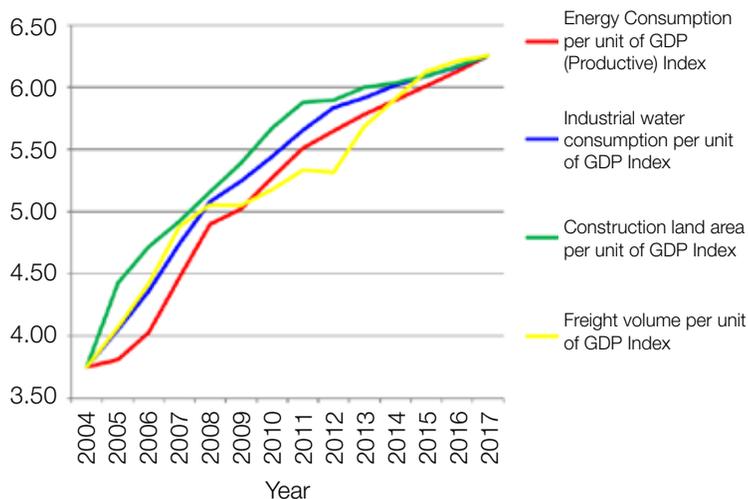


Figure 7-8 Resource and energy consumption related indexes in production sector(2004—2017)

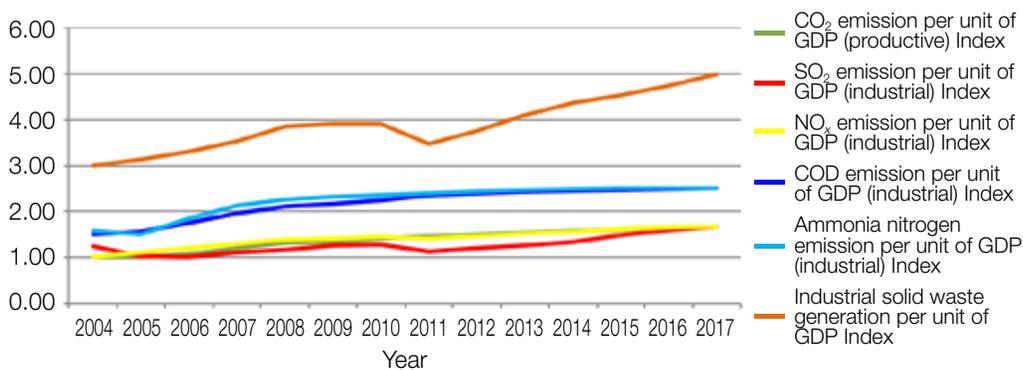


Figure 7-9 Trend of eco-environmental impact related indexes change in production sector(2004—2017)

(6) The per capita consumption of resources and energy in the field of life is constantly rising, and the greening scenario of life style needs to be urgently formed. Figure 7-10 shows the trend of changes in resource and energy consumption related green transition indexes in life related area between 2004 and 2017. The per capita domestic energy consumption

index and per capita private passenger car ownership index has been declining year by year from 2004 to 2017. It shows that with the improvement of living standards, there is constant growth in consumer demand for energy and vehicle ownership in consumption, with a prominent growth momentum. The per capita domestic water consumption index has shown a decreasing trend since 2011, which shows that with the improvement of infrastructure, the coverage of domestic water supply is gradually expanding, and the per capita domestic water consumption is gradually rising. The per capita residential land area index dropped in fluctuation from 2004 to 2013, and then bounced back gradually since 2014, indicating that the per capita residential land area has decreased significantly and the utilization efficiency of residential land increased year by year.

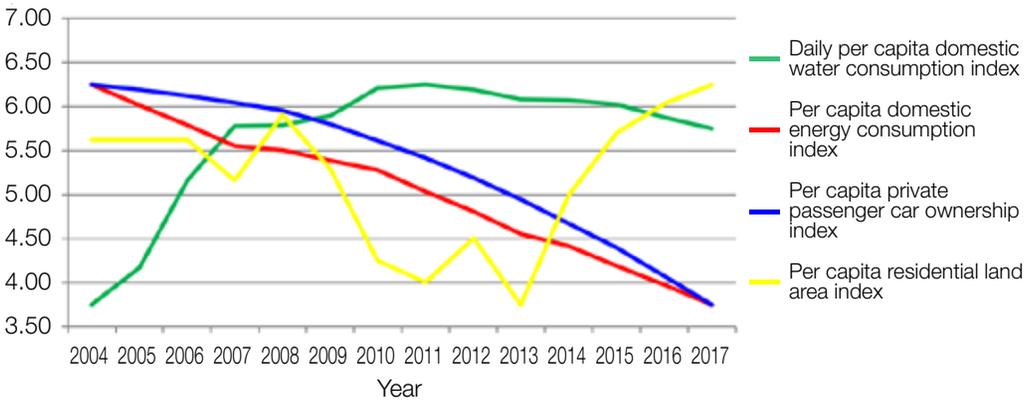


Figure 7-10 Trend of resource and energy consumption related green transition indexes in life related area(2004–2017)

(7) The emission of pollutants from domestic sources is increasing, and the negative impact of lifestyle on eco-environmental quality is significant. The eco-environmental quality change index in life related area involves 6 indicators, and the change trend for each indicator from 2004 to 2017 is shown in Figure 7-11. On the one hand, the per capita park green coverage index and public transport passenger volume index have indicated an obvious upward trend since 2004, yet the rising momentum was slowing. It reveals the growth of people’s demand for high-quality living environment as well as the improvement of public infrastructure. On the other hand, distinct decline was observed in major air pollutant (CO₂ and SO₂) emission indexes in life related area, domestic wastewater emission index, and domestic waste collection volume index. It reflects that the adverse effects of people’s consumption behavior on eco-environmental quality are expanding, and green lifestyle needs to be formed urgently.

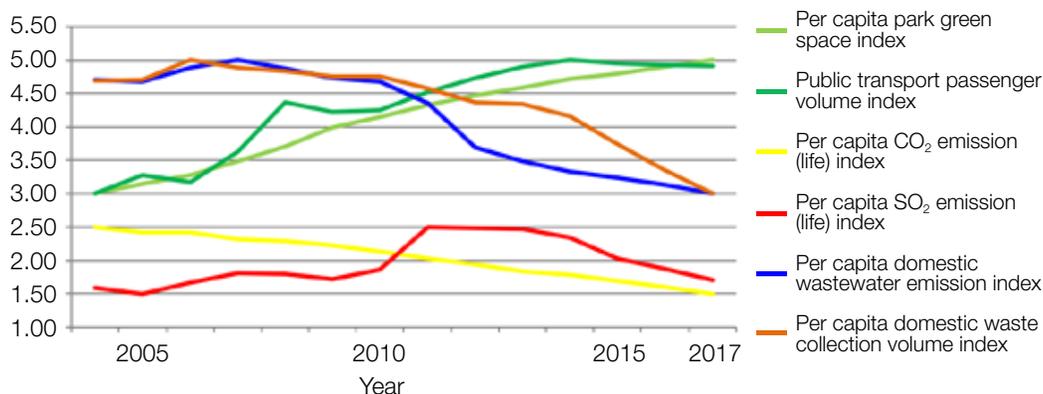


Figure 7-11 Trend of eco-environmental impact related indexes change in life related area(2004 – 2017)

In overall terms, since 2004, the level of green transition in China has been upgrading year by year. Green transition in both production and consumption sectors continued to progress with a climbing trend up to 2008. However, the curve of such trend has gradually flattened and shown fluctuations since 2008. In general, green transition in production sector shows continuous improvement, and plays a positive supporting role in boosting comprehensive green transition. On the contrary, green transition in consumption sector has exhibited obvious downward trend since 2008 and the loss in consumption sector exceeded the improvements gained in production sector in 2011. It can be said that improvement of efficiency gained by green transition in production sector failed to offset the negative impacts on resources and environment caused by consumption scale expansion. The shortcomings of consumption is that it restrains the overall progress of green transition. Substantial progress of green transition in consumption field will play a decisive role for the overall green transition and high-quality development in China.

7.3.2 Multiple transmission mechanisms for green consumption to drive green transition

Viewing from the dialectical relationship between consumption and production and that between consumption, resources and environment, consumption plays an essential role in economic development and imposes significant impacts on critical proportional relationships in national economy such as production and consumption. If consumption guidance and supply-side structural reform can enable mutual improvement, economic transition and upgrading will then be spurred, high-quality development accelerated, and modern economic

system further developed.

7.3.2.1 Transmission mechanisms for green consumption in promoting green transition

The greening of consumption will lead and enforce the greening of production. The changes in consumption volume, pattern, structure, quality, and preference guided by green concepts and measures will inevitably be transmitted to the production field, which will affect the allocation of factorial resources, the improvement of production pattern, the adjustment of product structure and the improvement of product quality.

Green consumption is the core component to foster the formation of green lifestyle and serves as an effective approach to push behavior changes of the general public. Lifestyle is a concept with extensive connotation, including people's material life such as clothing, food, housing, transportation, labor, recreation and entertainment, and social interaction, as well as spiritual life such as core values, morality and related aspects. Consumption constitutes an important part of lifestyle. Green consumption activities can convey and communicate green concepts and requirements into all aspects of public life, guide and motivate the public to actively practice green concepts and requirements, so as to cultivate a green life nationwide, and improve the governance system of green social transition.

In the field of modernizing eco-environmental governance system, China's current environmental policies are mostly concentrated on the production area, with restriction and supervision as major approaches, government and businesses as key bodies. The set-up of institutional mechanisms to guide and prioritize green consumption model can be very beneficial. First, it can expand eco-environmental governance system from production to consumption field, thus widening the coverage of eco-environment governance and adding new incentives and voluntary leadership into this area, which are conducive to building an institutional system featuring equal emphasis on both incentives and constraints. Second, as consumption is a basic behavior choice made by the public, green consumption can enable the public to truly participate in the environmental governance process. Consequently, people's green consumption behaviors and choices of green and eco-labelled products can reversely force enterprises to improve their environmental performances and increase green and eco-labelled products and their green production supplies, which is a practical way to involve spontaneous public participation in eco-environment protection. Third, the green transition at consumption end can be transmitted to production end through the practice of green supply chain, in which the "green-advanced" enterprises in the industrial chain can help manage the "green-backward" enterprises so as to explore new ways of eco-environmental governance and improve the related system(Figure 7-12).

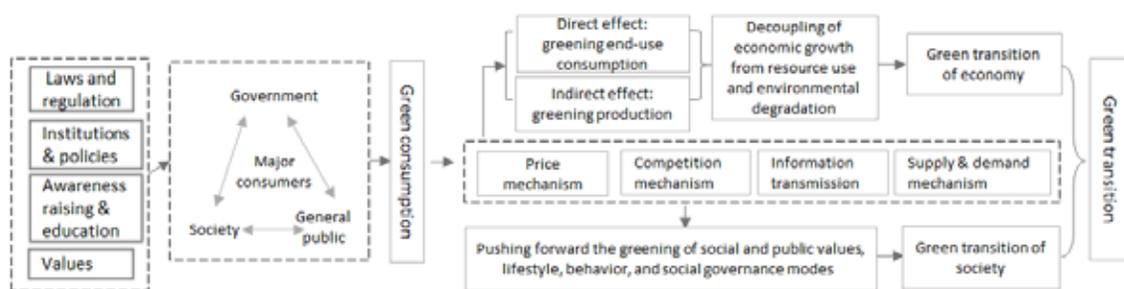


Figure 7-12 Mechanisms for green consumption to promote green transition

7.3.2.2 Green consumption gradually becomes a new driving force for green transition

Green consumption can become a new driving force for green transition. Current green consumption demand and market in China continues to expand, with constant upgrading of resident consumption, a growing variety of green consumer goods and services, continuous escalation in the scale of green consumer groups, and ever-rising willingness for green consumption. The green transition and upgrading of consumption can lead the innovation efforts in supplying green and eco-labelled products and services; and the supply of green and eco-labelled products and services can create new green consumption demand. Such benign interactive cycle of green production and consumption, green supply and demand can serve not only as a new driving force for boosting economic growth by facilitating green growth in economy, adding new employment channels and platforms, and promoting the structural reform on the supply side, but also as the endogenous condition for improving eco-environmental quality by largely reducing resource consumption and environmental degradation, thus realizing a win-win scenario for environment and economy.

(1) Green consumption demand and market in China keeps expanding, becoming a trend in the process of consumption transition and upgrading

As shown by the data from China Chain Store and Franchise Association (CCFA), the consumer market for organic food in China is growing at an annual rate of 25%. According to a report issued by JD.com, a Chinese ecommerce giant, in the first half of 2017, the sales volume from green consumption contributed 14% of the total sales volume in JD.com, with a year-on-year growth of 86%. The overall contribution of green household electronic appliances and green home decoration goods reached 79%; while the product penetration of green clothing attained 12%.

(2) Resident consumption continues to upgrade, with a growing variety of green consumer goods and services

In recent years, with the improvement of people’s living standards, the content of

residents' consumption has changed significantly, with a shift in focus from satisfaction in quantity to the pursuit of quality improvement, and green consumption is rising. The variety of green consumer goods and services is being enriched continuously, such products as energy-saving household appliances, water-saving appliances, products with environmental labels, organic products, green food, and green building materials are widely consumed in households. It is conservatively estimated that in 2017, the sales quantity of 5 categories of high-efficiency and energy-saving products reached nearly 150 million sets within China, with a total value of 500 billion CNY, including high-efficiency and energy-saving air conditioners, refrigerators, washing machines, flat-screen TVs, and water heaters. The output value of organic products amounted to nearly 140 billion CNY. 1,500 green hotels and enterprises were in business. The number of individual green building projects reached 4500. There were 31,946 kinds of products with green food label. More than 777,000 new energy vehicles were sold. More than 25 million shared bikes were put into use. According to the China's Green Consumer Report 2016 released by Ali Research Institute, in 2015, there were 50 major categories of green basket goods (green basket goods refer to a collection of goods that are "resource-efficient, energy-saving, environment-friendly, healthy, and high quality") in Alibaba online retail platforms, worthy of 200 million CNY. The sales volume of green basket goods accounted for 11.5% of Alibaba's overall online retail volume.

(3) The scale of green consumer groups is escalating, and the willingness for green consumption is improving

According to data from Alibaba platform, the number of green consumers in China reached 65 million in 2015, showing an increase of 14 times in four years. Driving by the impetus of global consumption upgrading, the scope of green and eco-labeled products that attract green consumers' attention has covered all aspects of food, clothing, housing, transport, and daily utensils. Attention is placed not only on organic and green level of food, and on the greening of cosmetics, personal care, and clothing, but also on household related products like household electronic appliances, home decoration and appliances and their impacts on health and environment. The new generation consumers are more in favor of such consumption concepts as LOHAS and environmental sustainability. They are willing to buy high-quality products and at the same time show concerns over the impact of production methods on nature and environment. On the Alibaba retail platform, the proportion of green consumers increased rapidly from 3.8% in 2011 to 16.2% in 2015, with the age group of 23 ~ 28 witnessing the fastest growth; and the average premium rate (the ratio of green goods prices to non-green and eco-labelled products prices) of green goods was 33%(Figure 7-13).

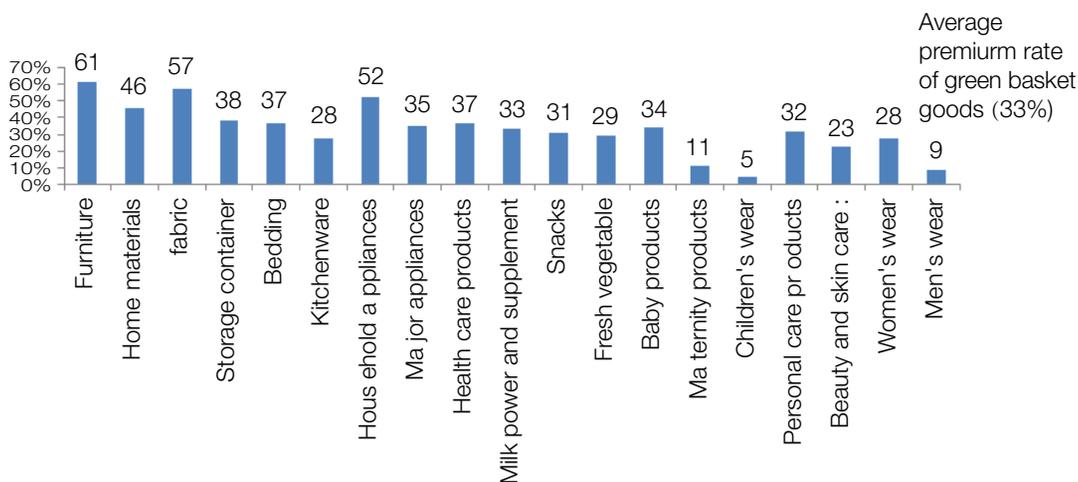


Figure 7-13 Premium rate for green basket goods

Source: Ali Research Institute.

7.3.2.3 Case studies on the effects of green consumption on green transition: Environmental labelling and certification system and ride-sharing

(1) Environmental labelling and certification system

At present, China has established such labeling systems as the environmental label, the energy conservation label, the green building label and the organic food label. China's environmental labelling system was created in 1993 and green procurement by the government began to be implemented in 2006. These important institutions that promote the provision of green and eco-labelled products and services have played an important leading role in shaping green consumption and production patterns. By the end of 2018, China's environmental labeling and certification covers 101 categories of products, and the output value of environmental label products has reached 4 trillion CNY. In 2017, the volume of energy-efficient and environment-friendly products purchased by the Chinese government accounted for 91% of similar products. With the continuous growth of the variety and scale of environmental labeled products and certified energy-saving and water-saving products, the dual performance of resource conservation and pollution reduction has gradually emerged. In 2016, products with environmental label and energy-saving and water-saving certification have saved about 19 billion kilowatt-hours of electricity, more than 4.6 million tons of water and reduced more than 12.3 million tons of carbon dioxide emissions. Since 2011, environmental label certification has promoted the development of green printing industry. The annual VOCs emission and energy consumption of the industry have been reduced by 15% respectively. Currently China's 1.3 billion primary and secondary school

textbooks have all been produced through green printing. In 2016, electronic office supplies with environmental labels purchased by the Chinese government reduced carbon dioxide emissions by 190,000 tons and saved 230 million CNY in e-waste disposal costs (Table 7-3).

Table 7-3 Environmental performance of products with environmental labelling and energy-saving and water-saving certification in 2016

No.	Category	Pollution Indicator	Environmental Labelling	Energy-saving and Water-saving Product Certification
			Emission/Consumption Reduction in 2016	
1	Air Pollution	VOCs	890,100 tons	/
		CO ₂	5.8 million tons	6.5 million tons
		SO ₂	7,000 tons	14,000 tons
		NO _x	26,000 tons	14,000 tons
		PM	/	11,000 tons
2	Water Pollution	COD	37,000 tons	/
		Total Phosphorus	77,660 tons	/
3	Solid Waste and Hazardous Waste	Plastic Waste	12,267 tons	/
4	Energy Conservation	Electricity	89.81 billion kW·h	100 billion kW·h
5	Resource Conservation	Water	44.31 million tons	46.222 billion tons
		Recycled Plastics	30,000 tons	/
		Industrial Residue	21.567 million tons	/
		Pulp	2.53 million tons	/
		Toner/Inkjet Cartridge	28.39 million units	/

Note: The above results are estimated based on the sales of labelled/certified products in 2016.

(2) Ride-sharing

As an important form and content of residents' green consumption in the field of transportation, ride-sharing has facilitated the efficient use of automobile resource, greening of public transport modes, popularization of new energy vehicles, and smart operation of urban transportation. According to estimates, the mileage covered by Express and Hitch services of Didi Chuxing (DiDi), the largest shared-trip solution provider in China totaled 17.75 billion km in 2017, with 1.52 billion passengers being served. DiDi Express and DiDi Hitch can serve an average of 2.34 ~ 2.58 passengers per car, more than 1.5 times of the passenger number of private cars. Currently, there are 400,000 new energy vehicles registered in DiDi platform, which is equivalent to 20% of the national total and 12.9% of the global total. DiDi's smart traffic light service covers more than 1,300 traffic lights, reducing congestion time by 10% ~ 20% on average and increasing vehicle speed by 20% ~ 30%.

Meanwhile, the environmental performance of shared trips is obvious. In 2017, the emission reduction effect of Didi Chuxing platform was significant. The Carbon emission was cut by 1.507 million tons, which was equivalent to the yearly emission of 800,000 cars running 10,000 km, and the annual carbon absorption of 21 National Olympic Forest Parks or 2 Saihanba Forest Farms. If calculated with the trade price of carbon trading market in Beijing, the reduction value equally produced an economic benefit of 75 million CNY. The emissions of CO, NO_x, PM₁₀, and PM_{2.5} were reduced by 7,130.1 tons, 440.0 tons, 40.2 tons and 37.4 tons, respectively. The emission cut of nitrogen oxides (NO_x) and particulate matter (PM) was equivalent to the corresponding emission of 1.1 million private cars in one year.

7.3.3 Social and economic factors for promoting green consumption

The major influencing factors on the green consumption include: consumption concept, income level, consumption preference, public policies, as well as supply quality and price level of green and eco-labeled products.

7.3.3.1 Consumption concept

Consumption behavior is directly controlled and regulated by consumption concept (or consciousness). Consumers' concept for green consumption, environmental awareness and environmental knowledge can effectively improve their recognition of perceived green value of products and services, and indirectly affect their green consumption behavior.

7.3.3.2 Public policies

The negative externality of non-green consumption can be offset by the gains from positive externality of green consumption. Public policies mainly affect consumers' individual cognition of environment and green consumption, and ultimately affect their attitudes towards green purchase, green product use and waste disposal. However, the green standard certification system, government green procurement system and tax incentive mechanism have different functions on green consumption:

(1) The green standard certification system has two main functions. First, it can lead enterprises to reduce pollutants from the source and help their green high-end products gain more popularity in the market, so as to stimulate the endogenous momentum in enterprises to improve the green process. Second, as an important system, the green standard system addresses the issue of incomplete information in the market economy, reduces the blindness of consumers in purchasing products, and helps consumers to quickly identify and purchase green and eco-labelled products and services.

(2) The government green procurement system makes use of the demonstration effect of government procurement to guide enterprises to adjust their production structures, improve

technology content of their products, enhance their environmental awareness and conduct green production, which can directly promote GDP growth, environmental protection and resource conservation and utilization. It can send price and demand signals to the production sector, and guide leading enterprises, brand enterprises and even medium- and small-sized enterprises (SMEs) to carry out green procurements. The system can at the same time stimulate the research, development and application of clean and energy-saving technologies in production sector and the manufacture of green products and eco-labelled products.

(3) The functional mechanisms for tax incentive on green consumption are as follows: The taxation on one item will trigger a downward movement of the demand curve, leading to the reduced the equilibrium price and equilibrium quantity. The change of consumption tax burden will alter the price rate among different consumer goods and affect the consumption “cost”. As a result, consumer behavior will be guided to different direction, and the consumption demand structure will be changed. Changes in consumption sector will be transmitted to the production sector to influence the structure of yield rates of different products, so as to lead the change of production structure.

(4) The green consumption incentive mechanism (mainly in the forms of rewards and subsidies) directly subsidizes consumers who buy or use green consumer goods or services, which can cut consumers’ cost in using green and eco-labelled products. This mechanism can effectively promote energy conservation, emission-reduction, and green and eco-labelled products; push consumption towards green consumption; and guide manufacturers to produce green and eco-labelled products and provide green services through the formation of green consumption behavior, so as to facilitate a virtuous cycle.

7.3.3.3 Supply of green and eco-labelled products

The supply price level of green and eco-labelled products will affect the level and popularity of green consumption. It is also necessary to regulate the green consumer goods market and ensure the quality of products and services, so as to form a virtuous circle between green supply and green consumption. The transmission effect of green and eco-labelled products at production end is different from that at consumption end:

(1) At production end, measures such as marketing, government incentive mechanism and prohibition of use will affect the scale of production and use of green and eco-labelled products. Good marketing can rapidly spur the sales of green and eco-labelled products. Government subsidies and tax deduction and exemption can expand production and consumption of green and eco-labelled products. Government regulations can ban the use of non-green and eco-labelled products made from endangered species.

(2) At consumption end, the scale of green product consumption will be affected by the

novelty-seeking behavior of teenagers, the demonstration effect of celebrities, and the benefit-seeking behavior and bandwagon effect from buyers. The influence of teenagers' novelty-seeking behavior stays at local level, while the demonstration of celebrities will influence the consumption fashion of the society. The imitative and copycat behavior of buyers will affect the production and consumption of green and eco-labeled products, whereas benefit seeking is the dominant reason for consumers to choose green and eco-labelled products.

7.3.3.4 Technological progress

Technological progress has an important impact on residents' green consumption level. First of all, technical breakthrough is necessary to translate the potential need into real needs. When a technological breakthrough provides an opportunity for potential social needs to be satisfied, potential needs will turn into real needs. Secondly, technological innovation reduces product prices by influencing the scale of green consumption. It is only when the level of technological innovation can bring the price of green and eco-labelled products and services close to that of ordinary products that large-scale green consumption will be ultimately formed. This will in turn drive the adoption and upgrading of green technologies. Thirdly, technological progress is constantly widening the field of green consumption. Producing new products through technological innovation can lead to new types of green consumption. For example, the reform of low-carbon technology not only promotes the change of people's consumption consciousness, but also enables the rise of low-carbon consumption related to solar energy and wind energy.

7.4 Review of Relevant Policies and Practices in Green Consumption of China

In recent years, China has attached great importance to green consumption. The Chinese government has issued a total of 101 policies to promote green lifestyle in society, among which 26 policies are issued by the Central Government and the State Council in the forms of notice, opinions and plans, accounting for 26% of the total. The line ministries have released 75 policies in total, which are specific measures and actions to implement national decisions, taking up to 74% of the policy portfolio. Generally speaking, the institutional framework for green consumption in China has been preliminarily shaped.

In order to carry out detailed analysis of the status and practice of green consumption policies, this study makes a comparative analysis of 75 green consumption policies released by line ministries and the 8 categories and 24 classifications from the Classification of Resident Consumption Expenditures issued by the National Bureau of Statistics (NBS) in

2013 to sort out and analyze the distribution and characteristics of these policies. At the same time, this study analyzes the actual effects of mandatory, regulatory and information-based policies that have been implemented in China, so as to study and identify the challenges faced by green consumption policies and practices in China.

7.4.1 Legislative framework for green consumption in China

Green consumption related policies at central government level mainly include various plans, opinions and programs on green consumption promotion issued by the CPC Central Committee and the State Council. The green consumption related policies by line ministries can be divided into two categories: one category refers to the economic policies in the macroeconomic field, and the other covers policies of other types, such as the information-based policies(Figure 7-14).

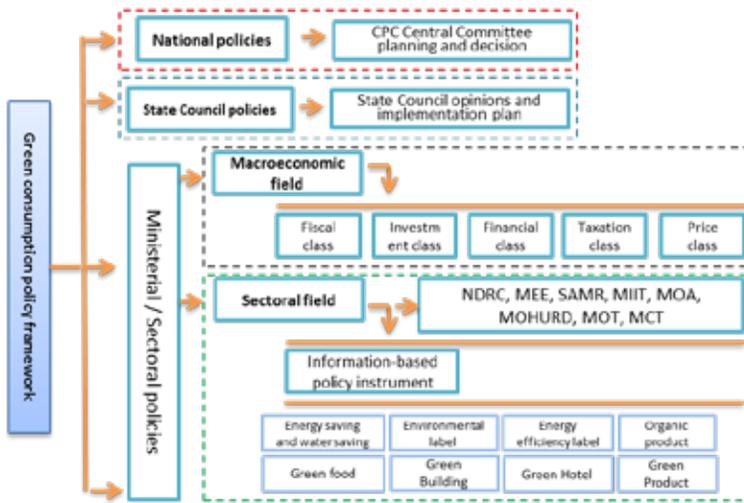


Figure 7-14 Framework for green consumption policies related to people’s life

The quantity distribution of green consumption policies at all levels in China is shown in Table 7-4.

Table 7-4 Quantity of green consumption policies at all levels

No.	Category		Number of Policies
1	National level	CPC Central Committee/State Council decisions	26
2	Ministerial level	Ministerial policies	75
Total			101

Ministerial Policies	No.	Economic policies	Quantity	No.	Policies of other types	Quantity
	1	Fiscal policy	25	1	National Development and Reform Commission (NDRC)	10
	2	Taxation policy	7	2	State Administration for Market Regulation (SAMR)	7
	3	Price policy	5	3	Ministry of Housing and Urban-Rural Development (MOHURD)	6
	4	Investment policy	2	4	State Administration of Press, Publication, Radio, Film and Television (SAPPRFT)	3
	5	Financial policy	1	5	Ministry of Ecology and Environment (MEE)	2
	No.	Economic policies	Quantity	No.	Policies of other types	Quantity
Ministerial Policies	/	/	/	6	Ministry of Agriculture and Rural Affairs (MOA)	2
	/	/	/	7	Ministry of Commerce (MOFCOM)	2
	/	/	/	8	Ministry of Industry and Information Technology (MIIT)	1
	/	/	/	9	Ministry of Transport (MOT)	1
	/	/	/	10	Ministry of Culture and Tourism (MCT)	1
	Sub-total			40	Sub-total	

Such green consumption related concepts as green lifestyle and green and eco-labelled products appear in different national policy documents. Relevant documents issued by the CPC Central Committee include “Several Opinions on Improving Consumption Mechanism and Further Motivating Consumption Potential of Residents”, “Notice on Implementation Plan for Improving Consumption Mechanism (2018—2020)”, and so on. The State Council also issued relevant documents, such as the “Guiding Opinions on Fully Exerting the Leading Role of New Consumption Model and Accelerating the Cultivation of New Supply and Impetus” (Guo Fa [2015] No. 66).

Line ministries have issued various policies to promote green consumption, which can be divided into two major categories. One category is economic policies, including aspects of fiscal, taxation, price, investment, and finance policy. The other category is information-based policies, such as certification, assessment, and technical specifications. Among them, there are 40 economic policies, accounting for 53%; while the rest 35 are policies of other types, taking up to 47% of the total.

7.4.2 Evaluation of green consumption policy in China

7.4.2.1 A comparative analysis of green consumption policies and consumer spending areas

(1) Economic policies

This study makes a comparative analysis of 40 economic policies on green consumption released by line ministries and eight categories¹ of household consumption in China.

Table 7-5 Summary table of macroeconomic policy pairs (general categories)

Eight Categories of Household Consumption Expenditure	Number of Policies (Unit)	Fiscal	Investment	Price	Taxation	Financial
01- Food, tobacco and alcohol	2	2 (100%)	—	—	—	—
02- Clothing	2	2 (100%)	—	—	—	—
03- Residence	9	4 (44%)	1	4	—	—
04- Household items and services	12	11 (92%)	—	—	1	—
05- Transportation and communication	22	14 (67%)	1	1	6	—
06- Education, culture and entertainment	8	7 (88%)	—	—	1	—
07- Health care	0	-(0%)	—	—	—	—
08- Other goods and services	3	2 (67%)	—	—	—	1

Note: E.g. 01 Food, tobacco and alcohol, Ratio of fiscal policy quantity = Number of fiscal policy (2) / Total policy quantity (2) *100%=100%.

The distribution of green consumption policies in household consumption general categories has the following features: a) Economic policies are concentrated in the “Transportation and Communication” category and “Household Items and Services” category, with a respective share of 38% and 21% in the total policies. The categories of “Food, Tobacco and Alcohol”, “Clothing”, “Residence”, “Education, Culture and Entertainment”, and “Other Goods and Services” account for 3%, 3%, 15%, 14% and 5% respectively in the total policy portfolio. There is no sustainability related policy issued in the 7th category of health care. b) Within economic policies, fiscal policies (including subsidies, preferential measures, and procurement, etc.) have the highest coverage rate in seven general categories

¹ The Classification of Resident Consumption Expenditures issued by the National Bureau of Statistics (NBS) in 2013 divides household consumption expenditures into 8 general categories, 24 classifications and 80 types. The 8 general categories are: (1) food, tobacco and alcohol, (2) clothing, (3) residence, (4) household items and services, (5) transportation and communication, (6) education, culture and entertainment, (7) health care, and (8) other goods and services.

(health care excluded), reaching 88%. In comparison, the coverage rates of taxation, investment, price, and financial policies are 38%, 25%, 25% and 13% respectively.

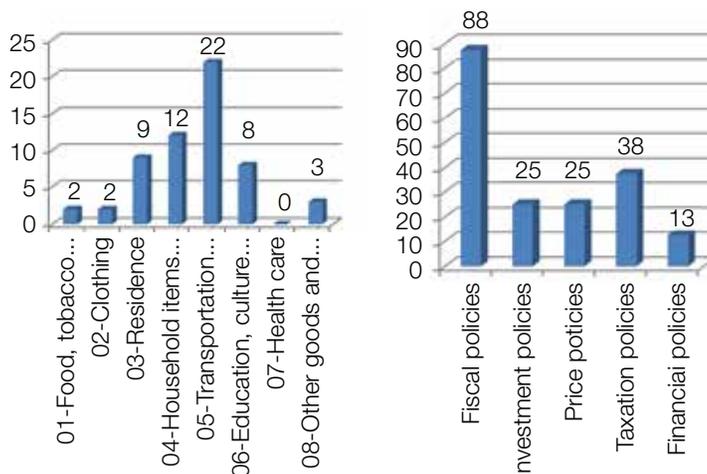


Figure 7-15 The distribution of macroeconomic policies in the eight general categories of household consumption expenditures

An analysis is made to further compare the 40 macro-level green consumption policies and 24 classifications¹ of household consumption. The results are illustrated in Figure 7-16 and Figure 7-17.

As shown by the above Figure 7-16 and Figure 7-17, the distribution of green consumption economic policies in household consumption classifications has the following features. 1) Economic policies are mainly distributed in classifications of “Transportation”, “Household Appliances”, and “Culture and Entertainment”, which account for 38%, 19%, and 14% of the total number of the policies respectively. The rest 29% of the policy portfolio are policies pertinent to “Beverage”, “Catering Service”, “Clothes”, “Footwear”, “Housing Maintenance and Management”, “Water, Electricity, Fuels and Others”, “Furniture and Indoor Decoration”, “Household Textile”, “Household Daily Use Articles”, “Communication”,

¹ The 24 classifications include: (1) food, (2) beverage, (3) tobacco and alcohol, (4) catering service, (5) clothes, (6) footwear, (7) housing maintenance and management, (8) water, electricity, fuels and others, (9) imputed rent for self-owned residence, (10) house rent, (11) furniture and indoor decoration, (12) household appliances, (13) household textile, (14) household daily use articles, (15) personal care items, (16) family service, (17) transportation, (18) communication, (19) education, (20) culture and entertainment, (21) medical apparatus and medicine, (22) medical service, (23) other items, and (24) other services.

“Education”, “Other items”, and “Other Services”. In addition, there is zero economic policy in 8 classifications (including “Food”, “Tobacco and Alcohol”, “House Rent”, “Imputed Rent for Self-owned Residence”, “Personal Care Items”, “Family Service”, “Medical Apparatus and Medicine”, and “Medical Service”). 2) Among all the economic policies, fiscal policies (including subsidies, preferential measures, and procurement, etc.) have the largest corresponding proportion in 24 classifications, with 100% share in 10 classifications. There are 4 price policies in the classification of “Water, Electricity, Fuels and Others”, accounting for 80% of total policies in this class. There are 6 taxation policies in the class of “0501 Transportation”, taking up to 43% of the total policies in the class. 3) The coverage rate of different policies varies greatly. Fiscal policies cover 16 of the 24 classifications, attaining the highest coverage rate (67%). Taxation policies are found in 8 classifications, with a coverage rate of 33%. Price policies are used in 3 classifications, with a coverage rate of 13%. Investment policies are put in place in 2 classifications, with a coverage rate of 8%. Financial policies are applied in only one class, with a coverage rate of 4%.

In general, China’s current economic policies place major emphasis on transportation, household appliances, and culture and entertainment, among which fiscal policies contribute to a relatively large proportion.

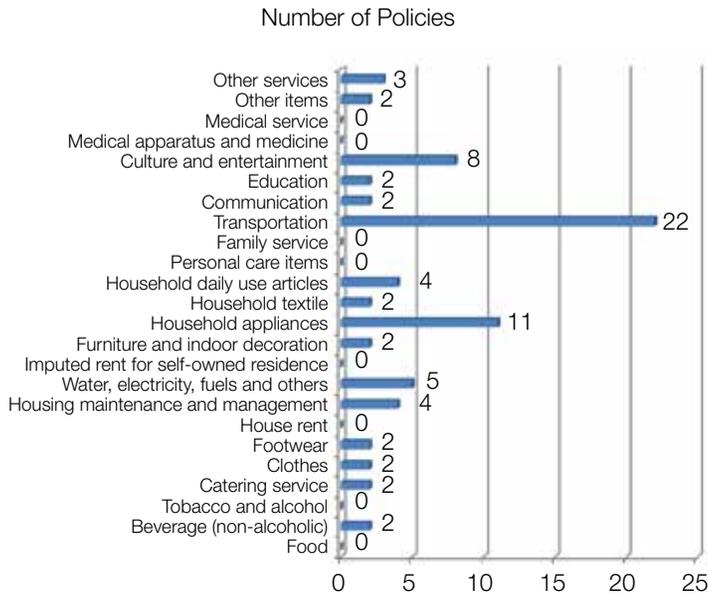


Figure 7-16 Quantity of green consumption policies in the 24 classifications



Figure 7-17 Distribution of economic policies in 24 classifications

(2) Other policies

Among the 75 ministerial policies, 40 are economic policies, while the remaining 35 policies are focusing on green product/service certification and assessment.

Based on thorough consideration of pertinence, representation, credibility in the government, standardization, data availability, consumer cognition, as well as the implementation status, this study finally selects the following certification and assessment policies to make comparative analysis with the household consumption expenditure categories, including energy-saving and water-saving product certification, environmental labelling and certification, green building certification, green building materials assessment, green food, organic products, and green hotel.

As shown in Table 7-6, compared with other certification and assessment types with strong “special attribute”, environmental labelling and certification covers the widest range, involving 7 categories, 15 classifications and 30 types of household consumption expenditures respectively, showing the highest coverage. Viewing from the launching year, China’s green food labelling and certification was the earliest, which was initiated in 1991. With regard to the number of published evaluation standards, the number of energy-saving and water-saving products have the largest quantity of standards. In terms of environmental performance, environment-labelled products can generate the synergetic effects of resource conservation, pollutant emission and GHGs emission reductions, and achieve better environmental performance than other certification tools.

Table 7-6 A Summary of implementation status of market-oriented mechanisms in green consumption related fields

No.	Certification/ Assessment Type	Starting Year	Competent Authorities	Number of Standards (Item)	Household Consumption Expenditure Classification Pairing	Benefits of Market- oriented Policy Instruments
1	Energy-saving and water- saving product certification	1999	Certification and Accreditation Administration (CNCA)	160	<ul style="list-style-type: none"> • 3 categories • 5 classifications • 9 types 	<ul style="list-style-type: none"> • Saving energy • Saving water • Saving materials • Reducing CO₂ emission
2	Environmental labelling and certification	1993	Ministry of Ecology and Environment (MEE)	101	<ul style="list-style-type: none"> • 7 categories • 15 classifications • 30 types 	<ul style="list-style-type: none"> • Saving energy • Saving water • Saving materials • Reducing CO₂ emission • Reducing pollutant discharge
3	Green building assessment	2007	Ministry of Housing and Urban-Rural Development (MOHURD)	10	<ul style="list-style-type: none"> • 3 categories • 6 classifications • 11 types 	<ul style="list-style-type: none"> • Saving energy • Saving water • Saving materials • Reducing CO₂ emission • Reducing pollutant discharge
4	Green building materials assessment	2014	Ministry of Housing and Urban-Rural Development (MOHURD), Ministry of Industry and Information Technology (MIIT)	8	<ul style="list-style-type: none"> • 2 categories • 2 classifications • 3 types 	<ul style="list-style-type: none"> • Saving materials • Reducing pollutant discharge
5	Green food labelling and certification	1991	Ministry of Agriculture and Rural Affairs (MOA)	126	<ul style="list-style-type: none"> • 1 category • 3 classifications • 15 types 	<ul style="list-style-type: none"> • Reducing pollutant discharge
6	Organic product certification	1995	Certification and Accreditation Administration (CNCA)	127	<ul style="list-style-type: none"> • 4 categories • 6 classifications • 17 types 	<ul style="list-style-type: none"> • Reducing CO₂ emission • Reducing pollutant discharge
7	Green hotel assessment	2008	Ministry of Commerce (MOFCOM)	2	<ul style="list-style-type: none"> • 4 categories • 4 classifications • 20 types 	<ul style="list-style-type: none"> • Saving energy • Saving water • Reducing CO₂ emission • Reducing pollutant discharge

7.4.2.2 Effects of Implementing Green Consumption Policies in China

At present, China has not yet carried out any top-level design nor developed any national strategy or action plans for boosting green consumption. The promotion of green consumption is still dominated by policies issued by various line ministries and administrations. To better analyze the actual effects of China's green consumption policies, this study divides the green consumption policies into mandatory policy, regulatory policy, and information-based policy according to the management means used by each policy (Table 7-7).

Table 7-7 Major policy instruments for green consumption in China

Types of Green Consumption Policy	Major Policy Instruments	Policy Areas
National strategy	None	—
National action plan	None	—
Mandatory policy	Financial aids or subsidies	<ul style="list-style-type: none"> • Efficient lighting products, efficient energy-saving products • Energy-saving and new energy vehicles, energy-efficient and environment-friendly vehicles • “Old for new service” for remanufactured products, recycling of discarded and old goods • Discarding and upgrading old cars • “Old for new service” for cars, “Old for new service” for household electronic appliances • “Old for new service” for furniture, tax reduction for low-pollution and low-emission cars
	/	<ul style="list-style-type: none"> • Subsidized loan for upgrading refined oil product quality • Solid wood floor, disposal wooden chopsticks • Organic fertilizer product • Reclaimed oil product from waste mineral oil
	Price differentiation and tiered pricing	<ul style="list-style-type: none"> • Tiered pricing for electricity, tiered pricing for water, tiered pricing for gas
	Waste disposal fund	<ul style="list-style-type: none"> • Recovery and disposal of waste electronic products
Regulatory policy	Standards	<ul style="list-style-type: none"> • Green product standards • Standards for China environmental labelled products
	Orders and bans	<ul style="list-style-type: none"> • Government green procurement of environmental labelled products • Government green procurement of energy-saving products • Green printing of textbooks for primary and secondary schools • Green printing of receipts and tickets • Recycling of discarded cars, ban on free plastic bags, prohibition on excessive food packaging • Prohibition on excessive cosmetics packaging • Waste separation
Information-based policy		<ul style="list-style-type: none"> • China environmental labelled products, energy-saving products, water-saving products, energy efficiency label • Water efficiency label, green and eco-labelled products, organic food, green food, organic products • Pollution-free agricultural products, green hotels, green buildings

(1) Mandatory policies

This study analyzes and summarizes the implementation effects of mandatory green consumption policies in China, including the promotion of efficient lighting products, promotion of efficient household electronic appliances, promotion of high efficiency desk-top computers, promotion of energy efficient electric generators, promotion of energy-saving and new energy vehicles, gasoline quality upgrading, recycling and remanufacturing of waste electrical and electronic products, recycling of discarded and old vehicles (Table 7-8).

Multiple benefits have been achieved through implementing such mandatory green consumption policies. Objectively, policy implementation has improved the market share of energy-efficient products in a short period of time, promoted the adjustment of industrial structure, stimulated the consumption demand, and generated a sound demonstration effect for boosting green product consumption in the society. The result of such policy output also channels multiple benefits to the target groups and enables them to enjoy “lowered price, savings in energy and expenditure, and improved life quality”. For instance, the policy on upgrading gasoline quality pushes forward the upgrading of product quality of China’s entire fuel oil industry; whereas, policies on recycling and remanufacturing of waste electrical and electronic products as well as used and old vehicles have made substantial contributions to the development of recycling industries for waste electrical and electronic products and old automobiles, and generated huge environmental benefits by greatly reducing pollution discharges.

However, certain problems emerged during the policy implementation process, which make the policy results deviate from the design objectives. Such problems include, for instance, the pollution caused by discarded energy-saving lamps; the subsidy fraud under promotion of efficient household electronic appliances and promotion of new energy vehicles; the timing issue for promotion of high efficiency and energy-saving desk-top computers; the subsidy time for energy efficient electric generators; as well as the problem caused by the excessively rapid decline of subsidies for energy-saving and new energy vehicles.

(2) Regulatory policies

This study assesses the effects of such policy practices as government procurement of energy-saving products, government procurement of environmental labelled products, as well as green printing. As shown by the assessment results, government procurement of energy-saving products and environmental labelled products and green printing are the most successful policies in practice. No additional financial input is required from the government for policy execution. The implementation merely depends on the regulations issued by the government and targets at the government and the industries. These policies have driven the upgrading and transition of the entire industry, with the help of positive guidance and demonstration from government green consumption. Excellent environmental benefits and social benefits have been achieved (Table 7-9).

Table 7-8 Analysis of implementation effects of mandatory policies

Policies	Policy Documents	Policy Effects	Existing Problems
1 Promotion of efficient lighting products	“Interim Measures for Management of Financial Subsidy Fund for Promoting Efficient Lighting Products” (Cai Jian [2007] No. 1027) Implementing period: 2007—2013	By 2013, China had adopted 780 million energy-saving lamps and other high-efficiency lighting products, saving 32 billion kilowatt-hours of electricity and reducing 32 million tons of carbon dioxide annually	The recycling of energy-saving lamps is faced with “three neglect” (by the market, by the producer, and by the competent authority). The discarded energy-saving lamps are generally treated as ordinary waste, and the mercury contained in these products directly enters the food chain in nature, threatening public health
2 Promotion of efficient household electronic appliances	“Energy-saving Products for the Benefit of the People” Program Implementing period: 2009—2013	In 2017, the sales quantity of 5 categories of high-efficiency and energy-saving products reached nearly 150 million sets within China, with a total value of 500 billion CNY, including high-efficiency air conditioners, refrigerators, washing machines, flat-screen TVs, and water heaters. The annual power conservation is 10 billion kW·h, equivalent to emission reduction of 6.5 million tons of CO ₂ , 14,000 tons of SO ₂ , 14,000 tons of NO _x , and 11,000 tons of PM. The co-benefit of carbon emission reduction and pollution cut is prominent	The relevant in-process and post-supervision was not in place, leading to the subsidy fraud in the implementation of the subsidy policy for the promotion of efficient and energy-saving household appliances
3 Promotion of high efficiency desk-top computers	“Energy-saving Products for the Benefit of the People” Program Implementing period: 2012—2013	The policy penetration degree was not enough. The computer promotion subsidy policy received little attention and the effect was not obvious	Desk-top computer had very small market share, with limited range of brand and model; while the lap-top computer was not covered by the policy. The dealers had to pay the energy-saving subsidies to the customers in advance, which was complicated in operation. In addition, the amount of subsidy was low and the benefit limited. Therefore the sellers were not interested in the subsidies
4 Promotion of energy efficient electric generators	“Energy-saving Products for the Benefit of the People” Program Implementing period: 2010—2017	By 2017, the market share of energy efficient electric generators was 10%, and the promotion effect of efficient electronic generators was not significant	The price of energy efficient electric generator is generally high. Its price is usually 20% higher than that of ordinary generator and some price gap even exceeds 50%. The effect of subsidy was not obvious. The subsidy was not given timely. The policy was launched in 2010. However, it was until 2017 that the promotion subsidy was liquidated

Policies	Policy Documents	Policy Effects	Existing Problems
Subsidies for energy-saving and new energy vehicles 5	<p>“Notice on Launching Pilot Operation of Promoting Energy-saving and New Energy Vehicles”</p> <p>Implementing period: 2010</p>	<p>In 2017, the production and sales of new energy vehicles in China reached 794,000 and 777,000 respectively, with the corresponding year-on-year rise of 53.8% and 53.3%. The figures were 45 times and 44 times of the respective levels in 2013. It took only three years for China to become the world’s largest new energy vehicle producer and seller, with its share in global market soaring from less than 10% to 44.39%</p>	<p>In the initial stage of promotion, the subsidy level was too high and thus unsustainable. However, in the subsequent subsidy reduction policy, the subsidy cut was too abrupt and excessively fast. In 2017, the subsidy amount of main models was reduced by 40% ~ 50% (the central and local subsidies combined) compared with that before subsidy reduction. The industrial development orientation in the subsidy policy was insufficient. The setting of subsidy threshold and admittance standard failed to give clear and strict industrial development orientation. There existed subsidy fraud and arbitrage</p>
Gasoline quality upgrading 6	<p>“Notice on the Opinions on the Price Policy for Gasoline Quality Upgrading by National Development and Reform Commission” (DR Price [2013] No. 1845)</p> <p>Implementing period: 2013—2017</p>	<p>In view of the process from National I Standard to National IV Standard, each standard improvement will lead to a pollutant emission cut of 30% ~ 50% per car. Compared with the National IV Standard, the National V Standard further cuts the sulfur content from 50 ppm to no more than 10 ppm. According to the estimates by the Standardization Administration, the implementation of National V Standard for gasoline alone will significantly reduce the pollutant emissions of vehicle. It is estimated that the annual reduction of NO_x for in-use vehicles will be about 300,000 tons; and the 5-year cumulative reduction of NO_x for new cars will be about 90,000 tons</p>	
Recycling and remanufacturing of waste electrical and electronic products 7	<p>“On Implementing the Promotion Plan for “Old for New Service” for Household Electronic Appliances” (Shang Shangmao Fa [2010] No. 190)</p> <p>Implementing period: 2010—2011</p>	<p>The “old for new service” and subsidies for household electronic appliances have brought excellent environmental benefits and given birth to a number of terminal sales enterprises trading in “old for new” and disassembly enterprises for old home appliances. The policy has greatly promoted the development of home appliance recycling industry. By the end of 2017, 109 disassembly and disposal enterprises of waste electrical and electronic products in 29 provinces (autonomous regions and municipalities) had been included in the list of enterprises subsidized by the fund for the disposal of waste electrical and electronic products</p>	<p>Disassembly enterprises rely heavily on fund subsidies to generate income, with poor self-sustaining mechanisms. As the issuance of subsidies takes a long time, disassembly enterprises generally face greater financial pressure. The subsidy fund cannot make ends meet, and the system needs to be improved. The main reason for the fund insufficiency is that the standard for producer payment is significantly lower than the subsidy standard</p>

Policies	Policy Documents	Policy Effects	Existing Problems
Recycling and remanufacturing of discarded and old vehicles	“Interim Measures for the Management of Subsidy Funds for Discarding and Renewing Old Automobiles” Implementing period: 2004	The trade-in policy has not only boosted automobile consumption, but also accelerated the process of phasing out high-emission and high-pollution “yellow label” cars and old cars. It has played a positive role in guiding car owners to discard and update their vehicles in a timely manner, preventing scrapped vehicles from flowing into society, reducing road traffic safety risks, and protecting people’s lives and property. In 2017, a total of 1.741 million scrapped motor vehicles were recovered by 689 recycling enterprises in China, with a year-on-year cut of 3.2%. Among them, 1.472 million were automobiles, which had a year-on-year decrease of 7.6%	Although China’s scrapped car recycling and dismantling industry has been developing rapidly in recent years, China’s recycling and dismantling enterprises still suffer from low level of capacity, compared with developed countries. Most of the enterprises adopt extensive scrap and recovery method, commonly with backward management mode, technical means and simple facilities. Due to low recycling level, it is difficult to improve the recovery rate of parts in scrapped cars. As a result, parts that could be recycled become waste parts, thus increasing the environmental burden

Table 7-9 Analysis of implementation effects of regulatory policies

Policies	Policy Documents	Policy Effects	Existing Problems
Government procurement of energy-saving products	“Opinions on Implementing Government Procurement of Energy-saving Products” Implementing time: 2004	By 2018, the 24 th List of Energy-saving Products for Government Procurement has been published (issued on August 10, 2018). According to the 24 th List, the certified energy-saving and water-saving products for government mandatory procurement and priority procurement total to 26 categories, including 51 types of energy-saving products and 8 types of water-saving products. Among them, 23 types of energy-saving products (office equipment, lighting products, etc.) and 4 types of water-saving products (toilet, etc.) are for government mandatory procurement. The government procurement system has effectively promoted the transition of consumption towards efficient and energy-saving products and pushed forward the energy conservation efforts of public institutions	There is limited variety of energy-saving products for mandatory procurement
Government procurement of environmental labeled products	“Opinions on Implementing Government Procurement of Environmental Labeled Products” Implementing time: 2006	As of 2018, a total of 22 issues of List of Environmental Labeled Products for Government Procurement have been released. The content expanded from 14 categories of products in the 1 st issue to 69 categories of products in the 22 nd issue, including office equipment and consumables, passenger cars, household appliances, furniture and building materials, etc.. The number of selected enterprises and products have increased from 81 enterprises and 856 product models in the 1 st issue to 3,077 enterprises and 392,586 product models in the 22 nd issue. According to statistics from the Ministry of Finance (MOF), the volume of government procurement of environmental labelled products in China reached 171.13 billion CNY in 2017, accounting for 90.8% of the total similar products by government procurement	Such products are listed as products for priority procurement. There is limited coercive power for mandatory procurement

Policies	Policy Documents	Policy Effects	Existing Problems
Green printing	“Announcement on Implementing Green Printing” Implementing time: 2011	Since 2016, all of the 1.3 billion textbooks of fall semester for primary and secondary schools in China have been produced through green printing. Some children’s reading materials in localities such as Beijing, Shanghai and Shaanxi province are also published using green printing. According to estimates based on sampling statistics, at present, the use of environment-friendly ink has accounted for 25% of the total ink use nationwide, increasing by 5% compared with the level of previous year. In the field of offset printing, more than 30% of the enterprises have installed dust collection device, which has improved the working conditions of nearly 55% of the employees in the printing industry. Around 60% of the bills and tickets have been made by green printing, which has effectively improved the health of the bill printing personnel and users. The implementation of green printing has benefited the workers in the entire printing industrial chain as well as the general public	At present, there are only 4 product standards/specifications issued for green printing. The types of standards are relatively few

Table 7-10 Analysis of implementation effects of information-based policies in China

Policies	Policy Documents	Policy Effects	Existing Problems
Energy-saving and water-saving product certification	Management Measures for Energy-saving Products Certification in China Implementing time: 1999	By the end of 2017, 4,812 enterprises had obtained 104,816 certificates for energy-saving and water-saving products with a “saving” label, showing respective year-on-year increase of 15.8% and 16.1%. In 2016, the certified energy conservation products saved 565,432,600 kW·h of electricity, equivalent to 17,811,100 tons of standard coal. The certified water-saving products conserved 46.222 billion tons of water in 2016	A number of domestic institutions can carry out similar certification. Their technical specifications are different and the assessment results have poor comparability. The existence of varied certification labels affects the authority and effectiveness of the certification. There exists vicious competition
Environmental labelling and certification	Management Measures for Environmental Labelling and Certification in China Implementing time: 1993	By the end of 2018, there have been 3,418 enterprises with valid environmental labels. More than 400,000 models of products have been certified, and a green market with an output value of 4 trillion CNY formed. It is estimated that in 2016 China environmental labelled products saved 24.74 billion kW·h of electricity and 44.31 million tons of water; reduced emissions of 5.79 million tons of CO ₂ , 890,000 tons of VOC, 36.65 million tons of COD, and 80,000 tons of total phosphorus; reduced the generation of 12,300 tons of plastic waste and 21.56 million tons of industrial residue; reduced use of pulp by 2.53 million tons; and improved 30,000 tons of recycled plastics	At present, there are only a small number of standards types for environmental labels in China, which are limited to products that are in close contact with consumers. In the production process, there is relatively large consumption of resources and energy, and there is a lack of relevant standards for those products and services with serious pollution

Policies	Policy Documents	Policy Effects	Existing Problems
3 Green hotel	Notice on Further Promoting the Development of Green Hotel Implementing time: 2008	As of 2018, the number of certified green hotel exceeded 1,500, with more than 2,300 green hotel reviewers	Although the industrial standards for green hotel has been issued, and the accreditation criteria for green hotels been elaborated and quantified for scoring, there is no legal-binding power in the real implementing progress, because the standards are only industrial regulations. Even if the hotel violates the regulations, it will receive no legal punishment. The effect of the policy is limited
4 Organic product	Management Measures for Organic Food Labelling Implementing time: 1995	As of 2017, a total of 18,330 organic product certificates have been issued in China, and 11,835 enterprises have been accredited. In 2017, China's organic products were still dominated by primary commodity, with plant products accounting for the largest proportion, followed by processed products. The largest number of certificates reached 11,814, accounting for 63.3% of the total organic certificates. The number of certificates for processed products was 4,928, accounting for 26.4%. 951 certificates were given to livestock and poultry products, accounting for 5.1% of the total number of certificates. There were relatively few certificates for aquatic products and wild collection products, with 541 for aquatic products and 441 for the other, accounting for 2.9% and 2.4% respectively	There is emphasis on certification process, but lacks inadequate supervision and management after certification. In current organic product certification industry, there are such phenomena as trading of labels, illegal printing or use of organic product labels, etc.. which brings ill market effect
5 Green food	Management Measures for Green Food Labelling Implementing time: 1993	By 2018, a total of 31,946 products from 13,860 enterprises have obtained the green food label (including the expired green food label)	The publicity efforts for green food labelling are not enough, and there are insufficient efforts to publicize green food's role in protecting eco-environment. However, the shares of those products that are most concerned by consumers or have large market demand in the total certified goods are relatively small. Such products include livestock, poultry, meat products and aquatic products

Policies	Policy Documents	Policy Effects	Existing Problems
6 Green building	<p>Management Measures for Green Building Assessment</p> <p>Implementing time: 2007</p>	<p>By 2016, 387 projects passed the green building assessment, among which 51 projects were given operation labels, accounting for 13.18%; and 336 projects obtained design labels, accounting for 86.82%</p>	<p>The current management system for green building assessment mainly stipulates relevant procedures such as application, filing, publicity, and announcement. First, there is a lack of effective supervision mechanism for the project quality assessed by evaluation institutions at all levels, so it is difficult to guarantee the assessment quality. Second, the supervision of the implementation of labeled projects needs to be strengthened. It is quite common that the actual building fails to follow the original design. Third, there lacks restriction on whether the project with design label can apply for operation label. Thus it is difficult for the labelling to fully play its due role</p>
7 Green building materials	<p>Management Measures for Green Building Material Assessment</p> <p>Implementing time: 2014</p>	<p>As of 2018, a total of 924 products were recognized as green building materials in China. Among them, 163 products were masonry materials, accounting for 17.64%; 86 thermal insulation products, accounting for 9.31%; 428 ready-mixed concrete products, accounting for 46.32%; 8 glass products for building energy conservation, accounting for 0.87%; and 98 ceramic products, accounting for 10.61%. There were 25 sanitary ceramic products, accounting for 2.71%; and 115 pre-mixed mortar products, accounting for 12.45%. In all categories of assessment labels, the proportion of three-star label products was 67.10%, and that of two-star and one-star products accounted for 31.39% and 1.52%, respectively</p>	<p>At present, the level of recognition and acceptance of green building materials is not high in China. There are inadequate inputs in basic research and development as well as standard development for green building materials</p>

(3) Information-based policies

This study evaluates the policy implementation effects of China's energy-saving and water-saving product certification, environmental labelling and certification, green building certification, green building materials assessment, green food, organic product and green hotel. The evaluation results show that the green product/service certification and assessment has furnished a large number of green and eco-labelled products for the market, and built a consumption scenario for Chinese consumers to practice green consumption.

Secondly, green product/service certification and assessment has produced promising environmental performance. With the continuous expansion of green product variety and scale, environmental performance of the green product/service certification and assessment has been showing gradually.

7.4.3 Challenges for green consumption policies and practices in China

Green consumption in China is facing two major problems. On the one hand, the supply of green consumer products is insufficient. In terms of green food, energy-saving product, green building, public transportation or environmental labelled product, the provision scale is relatively small and far from serving as the mainstream of consumer goods in areas of food, clothing, housing and transportation. Thus the corresponding scale effect of resource and environment benefits brought by sustainable consumption choices is finite. On the other hand, people's willingness to choose green goods is growing rapidly, but with more attention paid to the impact of consumption on their own health, so the status quo of certain consumer behaviors is hardly being gratifying. According to an analysis by the Ali Research Institute, the proportion of sustainable consumers on Alibaba retail platform had jumped from 3.8% in 2011 to 16.2% in 2015, with the age group of 23 ~ 28 taking the lead; and the average premium of green commodities reached 33% (the ratio of green commodity prices to non-green commodity prices). A public survey on China's environmental labeling shows that 90% of the respondents are aware of the "China Environmental Labelling", and 78.4% of the respondents are willing to pay equal or even higher price for products certified by "China Environmental Labelling". However, the dilemma of waste sorting problems, and the current issues of waste separation, and the current situation of excessive consumption and waste indicate big challenges in greening consumption behaviors and lifestyle in China.

On the whole, out of mandatory policy, regulatory policy or information-based policy, no matter which policy approach has been chosen, positive results have been achieved in China's green consumption policies on clothing, food, housing and transportation, . However, there is still room for improvement in the implementation process of certain green consumption

policies. From the perspective of policy framework and practice, China's green consumption policy system still faces the following challenges.

First, there is a lack of systematic planning and top-level policy design. Relevant documents and regulations at national level have outlined the concept, principles, and requirements of green consumption. However, most of the current specific policies are regulatory documents such as management measures, notices, guiding opinions which are issued by governmental departments. They cover incomplete categories, with relatively low level of administrative power and limited effectiveness. A sound legislative framework is waiting to be formed, which is underpinned by laws and regulations, policies, standards, technical specifications, supervision mechanisms, and accountability system. The green consumption related government responsibilities and functions are scattered in different departments; the role of eco-environmental protection authorities in promoting green transition of consumption needs to be effectively improved; and the fragmentation of policies and management is quite prominent.

Second, the promotion efforts for green consumption are insufficient. At present, China's green consumption policies focus on daily supplies, services and transportation, with narrow policy scope, and lack of policy norms, support and guidance in service areas for green consumption, including *inter alia* eco-tourism, environmental services, green design, and clothing. In the field of green and eco-labelled products, there are plenty of policies on resource and energy conservation which have yielded sound effects; whereas the policies relating to environmental protection are few and corresponding effects are weak. The present policies are limited to subsidies on energy-saving products. Good market and energy conservation effects have been achieved by the financial subsidies on high efficiency and energy saving products such as air conditioners, refrigerators, flat-screen TVs, washing machines and electric generators. However, the subsidies for green products which can cut environmental pollution are not adequate. Given the lack of financial support, consumption choices are completely depending on consumers' own environmental awareness. Thus, there is insufficient impetus for green consumption which only has limited regulatory effects.

Third, green consumption is not firmly linked with the goal of improving environmental quality. On the one hand, with regard to the information tool products, various certification systems fail to properly consider China's present priorities and major tasks in environmental protection, in particular the tough battle against pollution control and prevention. Thus, they have weak objectives on environmental quality improvement, and the expected policy effects of product certification are not yet fully reached. On the other hand, the insufficient national level driving force for green consumption has resulted in inadequate role of the macro

environment in leading green consumption.

Fourth, the endogenous motivation of green consumption from both enterprises and the public are highly needed. Enterprises and the public differ greatly in their cognition of the maturity of the green consumption market. It is still in the initial phase to foster the green consumption concept for the whole society, and the industries lack momentum for green consumption. Viewing from the provision perspective, there is inadequate supply of green consumer products. In terms of green food, energy-saving product, green building, or environmental labelled product, the provision scale is relatively small and far from meeting the mainstream needs in areas of food, clothing, housing and transportation. In addition, the enterprises have limited willingness to develop and produce green and eco-labelled products, and both of their innovation capacity and core competitiveness are not strong. Some enterprises intentionally speculate the “green” concept. It still lacks sufficient and effective supply of green and eco-labelled products. From the perspective of demand, people’s willingness to choose green consumer goods is growing rapidly, but with more attention paid to the impact of consumption on their own health. In addition, the cost of green and eco-labelled products is relatively high, and sometimes the green and eco-labelled products are well advertised but not well sold. The market demand still needs to be further explored.

7.5 Review of International Experiences and Related Lessons

7.5.1 Introduction

This chapter summarises how sustainable consumption and production (SCP) has evolved in the past, and gives an overview of SCP in the international arena, explains national approaches to sustainable consumption, highlighting the cases of Sweden and Germany, and suggests elements of a national SCP policy for China.

7.5.2 Sustainable Consumption and Production

The strategy to control the impacts of economic development has evolved from addressing end-of-pipe issues to taking on a broader systemic lens (such as norms and values that inform the economic system). Key early concepts included local pollution control at point of impact and technical (eco-) efficiency by industry. Now greater attention is given to sufficiency¹, adopting a system-wide approach and addressing drivers of endless economic growth and consumerism.

¹ O’Neill D W, Fanning A L, Lamb W F, et al. A good life for all within planetary boundaries. *Nature. Sustainability*, 2018, 1: 88-95.

- At the time of the 1972 UN Conference on the Human Environment (Stockholm), the effects of industrialisation, such as air and water pollution, poor waste management, and the consequences on cities and communities were perceived as isolated, site-specific issues and addressed through reactive policies¹.
- By the 1980s, a more preventative approach embracing cleaner production in order to reduce the pollution from factories and manufacturing processes emerged. Policies aimed to increase efficiency of natural resource use, minimize waste generation and reduce pollution impacts and health risks from production using the precautionary principle and other tools².
- Later, efficiency and the greening of material cycles and supply chains gained more attention as did developing technological solutions. The term “unsustainable patterns of production and consumption” was used for the first time by UN member states³. Excessive consumption and related waste problems came into the discussion. Connections to poverty reduction and addressing inequality of access and decision-making power over natural resources were also clearly raised.

Government leadership can aim to shift society towards more sustainable consumption patterns; realize fundamental changes in values, norms, and principles; and, foster structural changes to reduce the energy and material throughputs of our economies so that we can live within the capacities of the Earth’s life support systems.

7.5.2.1 International developments towards SCP

Several international frameworks address sustainable consumption and/or behaviour change. For example, Agenda 21⁴ calls for development of “new concepts of wealth and prosperity which allow higher standards of living through changed lifestyles and are less dependent on the Earth’s finite resources and more in harmony with the Earth’s carrying capacity.” The 2015 Paris Agreement⁵ on climate change recognises the need for sustainable lifestyles, sustainable livelihoods, and resilient communities. The Sustainable Development Goals⁶ include targets and goals, notably with SDG 12 being focused on SCP. The people-

1 Akenji L, Bengtsson M, Schroeder P. Sustainable Consumption and Production in Asia — Aligning Human Development and Environmental Protection in International Development Cooperation[M]//Sustainable Asia: Supporting the Transition to Sustainable Consumption and Production in Asian Developing Countries (Schroeder P, Anggraeni K, Sartori S, et al.) World Scientific Publishing, 2017: 17-43.

2 UNEP. Global outlook on sustainable consumption and production policies: Taking action together[R]. UNEP, 2012.

3 UN. Agenda 21[R]. United Nations Conference on Environment and Development.1992. doi:10.1007/s11671-008-9208-3.

4 Same with 3.

5 UNFCCC. Paris Agreement[R]. 21st Conference of the Parties 3, 2015. doi:FCCC/CP/2015/L.9.

6 UNGA. Transforming Our World: The 2030 Agenda for Sustainable Development[R]. 2015: 1-5. doi:10.1007/s13398-014-0173-7.2.

centred nature of the SDGs makes its success or failure a matter of how human behaviour is altered as a response to unsustainability risks.

The 10-Year Framework of Programmes for Sustainable Consumption and Production (10YFP) (2012)¹ developed numerous mechanisms for delivering on the framework: consumer information, sustainable lifestyles and education, sustainable public procurement, sustainable buildings and construction, sustainable tourism, and sustainable food systems. Rather than addressing individual stages in the production-consumption system and the supply chain, the programmes take a system-wide approach (e.g. food systems), addresses drivers (e.g. lifestyles), and bring together major stakeholders (e.g. governments, and businesses).

European states in June 2016 endorsed a voluntary Pan-European Strategic Framework for Greening the Economy to align their green economy strategies with the sustainable development goals. Three of nine focus areas directly relate to consumption: a shift in consumer behaviours towards sustainable consumption patterns; promotion of green and fair trade; and creation of more green and decent jobs, while developing human capital. Similarly, the Asia Pacific Roadmap on Sustainable Consumption and Production 2017—2018 addresses sustainable lifestyles and education.

7.5.2.2 National government approaches to sustainable consumption and production

Sustainable consumption, which requires dematerialization and changing current predominant production-consumption systems, poses several challenges to the traditional endless-growth economic paradigm². Sweden and Germany have developed national strategies dedicated to sustainable consumption and behaviour. They co-lead two 10YFP Programmes—Sweden co-leading with Japan on Sustainable Lifestyles and Education³, and Germany with Indonesia and Consumers International on Consumer Information⁴.

(1) Sweden

The Swedish national Strategy for Sustainable Consumption⁵ was introduced in 2016. It focuses on the consumer-citizen. Strong roles are assigned to and cooperation is expected from municipalities, the business sector and civil society. Policy measures are presented under seven focus areas: increasing knowledge and deepening cooperation; encouraging sustainable ways of consuming; streamlining resource use; improving information on companies'

1 United Nations. A 10-year framework of programmes on sustainable consumption and production patterns[R], 2012.

2 Jackson T. Prosperity Without Growth: Economics for a Finite Planet[M]. Earthscan, 2009: 14.

3 <http://www.oneplanetnetwork.org/sustainable-lifestyles-and-education>.

4 <http://www.oneplanetnetwork.org/consumer-information-scp>.

5 <https://www.government.se/4a9932/globalassets/government/dokument/finansdepartementet/pdf/publikationer-infomtrl-rapporter/en-strategy-for-sustainable-consumption--tillganglighetsanpassadx.pdf>.

sustainability efforts; phasing out harmful chemicals; improving security for all consumers; and addressing the sectors of food, transport and housing. Responsibility for the strategy is placed within the government's Ministry of Finance and not the Ministry of the Environment and Energy (as is often the case with sustainability policies). Sustainable consumption is thus not being treated as an environmental, but as a system-wide issue. The Ministry of Finance also has more resources for implementation, and stronger authority over other agencies that are supposed to engage in enforcement of compliance.

- SCP policy example: sustainable waste management in Sweden

Sweden's Strategy for Sustainable Consumption calls for "streamlining resource use". Sweden is one of the most advanced countries in waste treatment and its waste recycling rate has reached 99%.¹ As a member of the European Union, Sweden's waste disposal follows the EU's Waste Framework Directive. The waste hierarchy priority in Sweden is as follows: a) waste prevention; b) reuse; c) material recycling and biological treatment; d) other recycling, e.g. energy recovery; e) disposal, e.g. to landfill.²

The Swedish government has issued multiple pieces of legislation on waste disposal and supervision mechanisms, including: the Waste Ordinance which detailed rules for classification of Swedish life garbage collector and processing; the national Environmental Code, which stipulates the general principles, basic concepts, and responsibilities of government regarding MSW management; the Swedish EPA ban on the landfill of combustible household waste; and subsequent ban on landfill of organic household waste, such as kitchen waste; the 2012—2017 household garbage disposal plan and the 2014—2017 household garbage reduction plan. It also has an extended producer responsibility system by which the law requires manufacturers of packaging, tires, paper, batteries, electronics and cars to recycle and dispose of their products.

These laws and regulations form a rigid behavioral constraint, forcing enterprises and the public to fulfill their due environmental responsibilities and obligations. Tax policy is an important instrument. The EPB issued a domestic waste landfill tax of 250 kroner/tons in 2000 and subsequently increased the level to 435 kroner/tons in 2006. Since the tax was introduced, landfills in Sweden have fallen sharply, from 22% of municipal solid waste in 2001 to just 1% in 2010 at which point the tax was ended.

In 2011, the Swedish government began supporting enterprises in environmental

¹ <https://sweden.se/quick-facts/recycling-sweden/>.

² Avfall Sverige (the Swedish Waste Management and Recycling association), Waste Management 2018, URL: https://www.avfall sverige.se/fileadmin/user_upload/Publikationer/Avfallshantering_2018_EN.pdf.

protection science and technology, focusing on three main tasks: a) promoting the export of Swedish environmental protection science and technology and promoting the domestic economic growth of Sweden; b) promoting the RandD and innovation of environmental technology enterprises; and, c) creating conditions for the market-oriented application of environmental technology. The total fiscal expenditure of this strategy was 400 million SEK, with 100 million SEK invested annually from 2011 to 2014. According to the national Statistics Sweden and the Swedish Environmental Technology Council, 40,000 people work in the industry, creating an output value of 120 billion SEK.

(2) Germany

The German National Programme for Sustainable Consumption was introduced in 2016 and outlines relevant action in six implementation areas: food consumption, housing and households, mobility, clothing, work and office, and free time and tourism¹. It is based on five key ideas: a) making sustainable consumption a feasible option for consumers; b) taking sustainable consumption out of the niche into the mainstream; c) ensuring all sections of the population participate in sustainable consumption; d) looking at products and services from a lifecycle perspective; and e) shifting the focus from products to systems and from consumers to users.

The German National Programme was developed under the shared leadership of three federal ministries (Environment, Nature Conservation and Nuclear Safety; Food and Agriculture; and Justice and Consumer Protection), and is coordinated across all ministries on the basis that SCP is a cross-cutting issue requiring cross-departmental networking and implementation². The programme is “a way for Germany to drive the necessary structural change towards sustainability in the economy and society”³.

- SCP policy example: Eco-labelling in Germany

Over the years, Germany and China have cooperated on eco-labelling work and continue to do so, e.g. within the context of work on this SPS. Germany’s position as co-lead on the 10YFP Consumer Information Programme reflects its position as a longstanding leader in the field: its Blue Angel eco-label was the first in the world, introduced more than 40 years ago by the German Federal Government, and identifies products and services which are particularly environmentally friendly.⁴

1 https://www.bmu.de/fileadmin/Daten_BMU/Download_PDF/Produkte_und_Umwelt/nat_programm_konsum_bf.pdf.

2 Helen Czioska, Dr. Laura Spengler. National Programme on Sustainable Consumption and Competence Centre for Sustainable Consumption: Societal change through a sustainable lifestyle. The Competence Centre for Sustainable Consumption, 2019-03-23.

3 Programme document, at page 5.

4 http://www.oneplanetnetwork.org/sites/default/files/181017_uba18002_40jahreblauerengel_publication_en_web.pdf.

In line with its leadership in this area, Germany has come up with a Sustainability Standards Comparison Tool (SSCT) to benchmark voluntary sustainability standards. One manifestation of this is Siegelklarheit (www.siegelklarheit.de), a website (and accompanying mobile application) for consumers to compare criteria across the 129 standards currently listed on the website. At present, there are 96 types of environmental labelled products across sectors in China.¹ As awareness on sustainable consumption increases among consumers, public procurers and practitioners, an online system such as the SSCT in Germany could thus be of interest in China as well.

7.5.3 Creating a national SCP policy for China

In today's consumption-oriented societies, achieving sustainable consumption remains a far-off goal. Much needs to be done to stem the growing global waste crisis which is polluting land and ocean and doing damage to human health and the environment. The Chinese government is in a strong position to take measures for the benefit of the greater good and to avoid the tragedy of the commons by promoting sustainable behaviour. While western economies have emphasised individualism and fostered more individualistic social structures, China tends to take an approach of collectivism (shared responsibility). In theory, collectivism is more in keeping with sustainable consumption approaches, emphasising community building and trust, and shared prosperity, shared economy and a tendency for acceptance of solutions that are seen as fair to everyone (Figure 7-18).

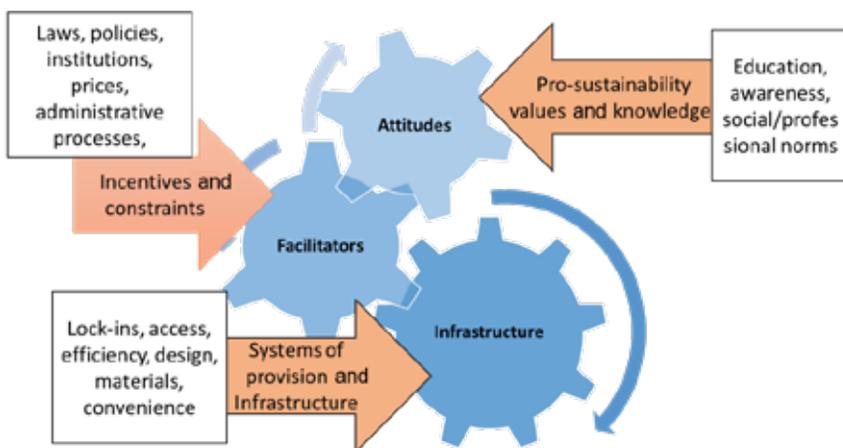


Figure 7-18 Key elements of policy design to enable sustainable consumption

¹ http://en.mepceec.com/yinxing_xgl.html.

7.5.3.1 A three-prong strategy for sustainable consumption policy

Determinants of consumption and lifestyles can be used as a framework to support design of policy and other interventions: engendering pro-sustainability attitudes in consumers, businesses and institutions, and government; establishing facilitators of access to sustainable options and constraints on unsustainable ones; and developing the appropriate *infrastructure* and product options for sustainable living¹. Interventions using the attitude-facilitator-infrastructure framework would address: the attitude and knowledge-behaviour gap, behaviour restrained by lock-in to prevailing systems and infrastructure, and macro-level social and physical factors that determine behaviour patterns².

(1) Attitudes can refer to both individual orientation and collective social values towards sustainability. This is about the attitudes of all stakeholders involved in the production-consumption system, as well as those influencing or being influenced by it: consumers, entrepreneurs, policy makers, legal practitioners, farmers, community leaders, politicians, and teachers. All actors need to recognize the importance of sustainable consumption and be aligned in making it happen. By implication, all institutions responsible for these factors would need to be engaged in engendering sustainable living³.

(2) Facilitators are elements that translate knowledge or intentions into action – they make it easy to find and choose the sustainable products and services. Government laws and policies are facilitators. The most widely recognised facilitators are institutional elements⁴, the various soft and often intangible aspects directing choices and behaviour and that together define the operating system of a society. Examples of such facilitators include laws and regulations, administrative procedures, culture and norms, and markets. This is one area where government can play a decisive role – also making sure to have implementation mechanisms, proper indicators and monitoring systems in place.

(3) Infrastructure influences greatly possibilities for sustainability. Part of the importance of infrastructure such as for transportation and housing is how it creates lock-ins – making people using them behave in certain predetermined ways for as long as they exist. Infrastructure for sustainable consumption should remove the lock-ins to unsustainable behavior patterns⁵. Design of systems of provision and default settings should reflect sustainability concerns⁶. The configuration of infrastructure for everyday living should

1 Akenji L. Consumer scapegoatism and limits to green consumerism[J]. *Journal of clean Production*, 2014, 63: 13-23.

2 Akenji L, Chen H. A Framework For Shaping Sustainable Lifestyles: Determinants and Strategies. 2016.

3 Fine B. *The World of Consumption: The Material and Cultural Revisited*[M]. Routledge, 2006.

4 North D C. Institutions[J]. *J. Econ. Perspect.* 1991, 5: 97-112; Hall P A. *Governing the Economy*[M]. Polity Press, 1986.

5 Sahakian M D, Steinberger J K. Energy Reduction Through a Deeper Understanding of Household Consumption: Staying Cool in Metro Manila[J]. *J. Ind. Ecol.* 2011: 15, 31-48.

6 UNEP. *Sustainable, Resource Efficient Cities - Making it Happen! United Nations Environment Programme*[R]. 2012.

encourage overall low ecological impact. An example is a combination of passive housing (built with sustainable material and with low-energy consumption), set in an urban planning zone that is in close proximity to work (reducing commuting costs)¹, and where local crafts and community supported agriculture is practiced.

Footprint analyses point to four key domains of everyday living where consumption has over 75% impact on the environment: food, transport, housing, and manufactured goods. Along with these are cross cutting themes such as work and leisure. Focusing on these, and using the Attitudes-Facilitators-Infrastructure framework could see substantial reductions in environmental impacts due to policy implementation.

Table 7-11 Tool for mapping comprehensive sustainable consumption policy for key lifestyle domains

Key Lifestyle Domains	Attitudes	Facilitators	Infrastructure
Nutrition—food systems			
Mobility—Transportation			
Housing—construction and living spaces			
Stuff—Manufactured goods			

7.5.3.2 Implications for China

It is important to clarify the main objectives of sustainable consumption policy and to develop policy packages that directly address the Chinese context. A ten point plan for a sustainable future could include:

(1) Embed sustainable consumption and production in a national (sustainable) development strategy and in sectoral policies

The government can prioritize sustainable consumption by integrating it into its broader planning and operations, in national vision documents, national (sustainable) development strategies, national green growth or green economy strategies, and national SDGs implementation plans. Incorporating sustainable consumption as part of the national development framework has the advantage that consumer behaviour is not addressed in isolation from the broader development trajectory. Since lifestyles and consumption touch on a variety of soft (e.g. education, health) and hard issues (e.g. industry, infrastructure), a wide, coherent and concerted approach is needed². New forms of institutions can also be put in place for the promotion of sustainability. In 2007, the Hungarian Parliament created a special Ombudsman for Future Generations. This position has the responsibility of speaking

¹ Wiedenhofer D, Lenzen M, et al. Energy requirements of consumption: Urban form, climatic and socio-economic factors, rebounds and their policy implications[J]. *Energy Policy*, 2013, 63: 696-707.

² Akenji L, Chen H. A Framework For Shaping Sustainable Lifestyles: Determinants and Strategies[R]. 2016.

up in parliamentary debates when state policies would lead to overconsumption and thus endanger prospects for the society of tomorrow¹. The United Kingdom has argued for similar foresight². Sustainable consumption also can be embedded in sectoral policies; examples include promotion of sustainability into energy and resource sectors, transportation, health, and housing.

(2) Shift from a linear to a circular economy logic

Government agencies, large organizations, companies and schools can facilitate shifts towards sustainable consumption through their production. In a linear economy raw materials are used to make a product, and after its use waste (e.g. packaging) is thrown away. In a re-use economy it is based on recycling and the reuse of materials. To ensure that, in the future there are enough raw materials for food, shelter, heating and other necessities, our economies must become circular, that is, they must prevent waste by making products and materials more efficiently, reusing them, or if new raw materials are needed, obtaining them sustainably. In a circular economy, manufacturers design products to be reusable. For example, electrical devices are designed for easier repair. Products and raw materials are reused. The use of one-way plastic cups, utensils, plates, etc. in restaurants and fast food shops is ended. In their place, regular cutlery, plates and cups are used. At a minimum, sustainably produced containers (e.g. made of recycled paper) and utensils (e.g. made of scrap wood) are expected. The transformation from supply chain to a value cycle means that the business case is focused on the long-term horizon. The quality of the business case is not measured on short-term profit but on long-term sustainability and innovation (The Trillion Dollar Shift, Marga Hoek, 2018).

(3) Mandate producer responsibility and the greening of supply chains

To some extent large multi-nationals require sustainable production and consumption in their supply chains, dramatic shifts in material use and waste flows, value creation can be realized. Chinese multi-nationals have a reach beyond national borders through their supply chains and this results in a large global ecological footprint. Sustainably produced products, and products with high recycled material content, should be incentivized. Companies can be required to issue sustainable production and consumption reports that can be monitored by independent agencies. They can be required to show how they plan to make improvements to the sustainability of their products and services and be held to account for meeting those targets. Companies could be required to reduce the waste associated with their products by a given percentage that increases with time. In Germany, companies must pay for the recycling

1 <http://environmentalrightsdatabase.org/hungarys-ombudsman-for-future-generations/>.

2 <http://www.if.org.uk/2011/08/16/a-parliamentary-ombudsman-for-future-generations/>.

of the waste that enters the waste stream from their products. This was a powerful incentive for companies to reduce unnecessary packaging and to make greater use of recycled materials in packaging. Incentives could be offered to enhance the use of recycled materials in product manufacturing. Labeling of products for their sustainability could become a requirement. Japan and the EU use a Top Runner Model for company products related to their energy efficiency. A similar model for top sustainability could be considered.

(4) Create a database of traded resources

There is currently no database of the world's traded resources. As one of the world's largest importers and exporters Chinese consumption has a large global impact. Developing a consumption-based environmental impact database could assist in tracking the flow of the ecological footprint of Chinese consumption. An environmentally-extended multi-regional input-output analysis could be used to identify the global environmental impacts of Chinese consumption.

(5) Incentivize sustainable investment

The greening of bank investments and financing could play a crucial role in promoting sustainability. Green investments can be rewarded with tax breaks. Banks can be encouraged to add sustainability requirements linked to the SDGs in their lending policies and this could be made mandatory for government-generated/backed loans. Pension funds can add sustainability requirements into their investment schemes.

(6) Foster sustainable lifestyle campaigns

The government can foster sustainable lifestyle campaigns that engage citizens on sustainable well-being and living¹ by introducing the arts in depicting how sustainable lifestyles could be visualized and sensed; providing toolkits and guides to enable citizens, government, business and other sectors to take strategic action on sustainable lifestyles²; engaging citizens in collective groups such as sports clubs, faith groups, schools, and workplaces to enable sustainable lifestyles³; incentivizing green consumerism at the individual and organizational level (tax polluting behaviour; encourage recycling and reuse); having communities cooperate for waste free living and best performance on recycling; and, changing the logic of the eco-label (where the burden of proof is on the green producers) and developing an “un-eco” label for unsustainable products where the burden of proof is put on the unsustainable producer.

1 <http://www.oneplanetnetwork.org/resource/fostering-and-communicating-sustainable-lifestyles-principles-and-emerging-practices-ful>.

2 <http://www.oneplanetnetwork.org/resource/sustainable-lifestyles-options-and-opportunities>.

3 <http://www.oneplanetnetwork.org/resource/sustainable-lifestyles-options-and-opportunities-workplace>.

(7) Develop a sustainability indicator focused on well-being

Agenda 21 called for “new systems of national accounts and other indicators of sustainable development”, including “new concepts of wealth and prosperity which allow higher standards of living through changed lifestyles and are less dependent on the Earth’s finite resources and more in harmony with the Earth’s carrying capacity”¹. Examples of relevant initiatives include: Sustainable Development Indicators (UK); Gross National Happiness (Bhutan); The Commission on the Measurement of Economic Performance and Social Progress (the “Stiglitz Committee”) (France); Happiness Indicators (Japan). The opportunity exists to tie these efforts to culturally aligned values of harmonious and happy living in China. These include: Human Development Index² (UNDP); Better Life Index³ (OECD); Happy Planet Index⁴ (New Economic Foundation); Ecological Footprint⁵ (Footprint Network); Genuine Progress Indicator⁶ (Redefining Progress). There is a double dividend which can be obtained from sustainable consumption: reducing excessive materialism is environmentally sustainable, and makes people happier⁷. The shift to sustainable consumption can also be directed to address inequality and advance more just societies and economies.

(8) Protect and reward traditional sustainability knowledge and practices

Draw on traditional knowledge to promote home-grown sustainability and to protect sustainable traditional crafts and practices and communities with alternative sustainable and non-consumerist ways of living. Encourage community forestry management, rural farmers’ lifestyles, and mandating minimum periods to ensure (long) product warranties’ reparability and reserving percentage trading space in shopping centres for “used goods”, repair and trade-by-barter shops. Institute citizen capacity development centres for Do-It-Yourself and life skills (e.g. sewing, gardening, financial literacy).

(9) Address inequality

Inequality is not only a source of unsustainable consumption and cause for dependence and harm to ecosystems, it also leads to social and political tensions. Reducing inequality reduces some of the social tension that drives consumerism. This could include: a) developing

1 UN. Agenda 21. United Nations Conference on Environment and Development[R], 1992. doi:10.1007/s11671-008-9208-3.

2 Human Development Index: <http://hdr.undp.org/en/content/human-development-index-hdi>.

3 Better Life Index: <http://www.oecdbetterlifeindex.org/>.

4 Happy Planet Index: <http://happyplanetindex.org/>.

5 Ecological Footprint: <https://www.footprintnetwork.org/our-work/ecological-footprint/>.

6 Genuine Progress Indicator: http://www.rprogress.org/sustainability_indicators/genuine_progress_indicator.htm.

7 Jackson T. Live better by consuming less? Is there a “double dividend” in sustainable consumption?[J] *J. Ind. Ecol.* 2005, 9: 19-36.

progressive charging systems: e.g. progressive taxation, including income, property, and luxury goods taxes; allowing free/subsidized minimum for basic services and implementing progressive charges on basic utilities (e.g. water, energy). b) Providing free and/or subsidised goods and services for low-income groups- such as health centres, education, public parks. Finland is now experimenting with mandatory basic income for all citizens¹ combined with redirecting attention from consumerism towards more creative activities that increase wellbeing and contribute to society. c) Protecting micro, small and medium size enterprises (MSMEs), which employ the majority of people, protect traditional crafts, and provide meaning beyond the economic; limiting licences for major corporations that infringe on MSMEs; developing recognition systems and licenses for local farmers and crafts; and giving mandatory priorities to local-produce markets in urban locations.

(10) Partner with societal organizations

Societal actors can help promote change. The rise of consumer organisations in Europe and North America signals public concern about the market prioritizing profits over consumer well being. Test Achats in France, Whick Uk! In the UK, Consumentenbond in the Netherlands, Stiftung Warentest in Germany are examples of transitional consumer organisations that have shifted concern from product price, quality, and respect for consumer rights, to broadened mandates that include responsible/sustainable consumption.

7.5.4 Summary

A sustainable consumption society can be defined as one which values natural resources, respects the labor and inputs that go into the development of products, shuns the notion of waste, and aims at lifestyles that at their core are socially meaningful, rather than defined by levels of consumption. Through a combination of goal setting, incentive structures and legislative measures, on the one hand, and educational and value-oriented change on the other, China can do much to shift away from the “purchase, use, discard” mentality that has prevailed in most industrialized societies in the past decades and that has become more visible in China of late. As in many other environmental areas, China can become a sustainability pioneer that by taking the lead can awaken the interest and respect of other nations dealing with their own mounting waste and pollution problems associated with excessive consumption.

¹ <https://www.theguardian.com/world/2017/jan/03/finland-trials-basic-income-for-unemployed>.

7.6 Policy Recommendations

7.6.1 Strategic positioning of promoting green consumption in China

At present, China is shifting from high-speed growth to high-quality development, in which consumption serves as the main driving force for economic growth and key momentum for high-quality development. As previously mentioned, due to changes in consumption volume, structure and patterns, consumption activities have imposed rising pressure on resources and environment, and thus led to a series of problems. Judged from China's overall progress and status of the green transition, the problem of imbalance and dis-coordination looms large. In the entire economic and social system, the green transition of economy is developing faster and better, while the green transition in social dimension is relatively lagging behind. Within the economic sector, stronger measures have been put into place in the production sector to boost green transition; while measures in the consumption sector are comparatively weak. Therefore, how to boost green transition in social dimension especially in daily life has become a critical issue that deserves prompt attention and immediate actions from the Chinese government. To solve the problem, the most urgent task at this stage is to clarify the strategic positioning and role of the green transition of consumption in promoting green development and the modernization of the governance system.

7.6.1.1 Attaching great importance to and making full use of the current historical opportunity for boosting the green transition of consumption

China is now embraced by a window of opportunity for promoting the green transition of consumption, which is marked with following features: a) consumption is undergoing comprehensive transition and upgrading from a subsistence-based model to a well-off one; b) residents' consumption patterns and willingness are changing significantly; and c) consumption is playing an ever-enhancing role in stimulating economy. It is a critical period to form new consumption habits and models in the society. Consumption reflects final needs and serves not only as the ultimate purpose and driving force of production, but also as the direct embodiment of people's need for a better life. It is of great importance for China's overall high-quality development and ecological civilization construction to seize this precious window of opportunity and critical period to give timely guidance and accelerate the formation of resource-efficient and environment-friendly consumption patterns and lifestyle.

At present, China has a strong political will to propel green transition of consumption. Chinese President Xi Jinping particularly articulated the necessity of promoting green development pattern and green lifestyle in May of 2017. The 19th CPC National Congress spelt out the requirements to advance green development; accelerate the establishment

of legal system and policy guidance over green production and consumption; set up and consolidate the green, low-carbon and circular economic system; initiate simple, moderate, green and low-carbon lifestyle; fight against extravagance, wasting and irrational consumption; practice building of conservation-oriented governmental agencies, green households, green schools, green communities, and green way of commuting; as well as form the spatial layout, industrial structure, production mode and lifestyle in favor of resource conservation and environmental protection. All of these have provided powerful action guidance for the enhancement of green lifestyle and green consumption.

China's current action in promoting green transition of consumption has an increasingly mature social foundation and good practice basis. At present, the general public has witnessed an outstanding rise in the environmental awareness as well as the awareness for participation and safeguarding environmental rights, and an ever-increasing request and expectation for enjoying a sound-quality life, all of which constitute the social foundation for pushing forward green consumption. Meanwhile, China has built some effective policy and practice foundation for green consumption. There are also plenty of inspiring practices from the international community to take reference.

7.6.1.2 Taking green consumption as a pillar to support people's growing need for a better life and as a new growth pole to drive high-quality development

At this stage, consumption is undergoing continuous transition and upgrading in China, and reflects people's ever growing need for a better life. There are observations of constant growth in public's willingness for green consumption, ever-climbing premium rate of green and eco-labelled products in the consumer market, and increasing green behaviors in online consumption. Green consumption constitutes a crucial part of people's growing need for a better life. In this connection, vigorously promoting green consumption with focus on and adaptation to the change of major social conflict at the current stage and in the future can strongly underpin the efforts to meet people's ever-growing need and pursuit for a better life. At the same time, the green transition and upgrading of consumption can lead the innovation efforts in supplying green and eco-labelled products and services; and the supply of green and eco-labelled products and services can create new green consumption demand. Such benign interactive cycle of green production and consumption, green supply and demand can serve as a new driving force for boosting economic growth, the endogenous condition for improving eco-environmental quality, and a new growth pole for promoting high-quality development. Given that insufficient supply of green and eco-labelled products and services stands out as one of the short-boards for the current scenario of green consumption, it is necessary to follow the general trend of upgrading green consumption and meet people's diversified green

consumption demands at differentiated levels, with special focus on such consumption links as food, clothing, housing, daily utensil, commuting and recreation. Efforts are needed to build a more mature and specifically-classified green consumer market; step up certification, marketing and promotion of green, environment-friendly and energy-saving products and technologies; enhance the social coverage of green and eco-labelled products and services; and substantially improve the effective supply of green and eco-labelled products and services, so as to truly provide support and impetus to meet people's growing need for a better life and to promote high-quality development.

7.6.1.3 Taking green consumption as a key component and a means to facilitate transition in an economic and social system and push forward the structural reform on the supply side

First of all, green consumption should be regarded as the basic content of green economic transition and a key driving force for propelling supply-side structural reform. The green transition of economy comprises of the greening of both production and consumption, in which greening of consumption will lead and enforce the greening of production. The changes in consumption scale, pattern, structure, quality, and preference guided by green concepts and measures will inevitably be transmitted to the production field, which will affect the allocation of factor resources, improvement of production pattern, adjustment of product structure and the improvement of product quality, thus promoting supply-side structural reform.

Secondly, green consumption should be treated as a crucial component and a means for green social transition. Green consumption is the core component to foster the formation of green lifestyle and serves as an effective approach to push real actions of the general public. Lifestyle is a concept with extensive connotation, including people's material life such as clothing, food, housing, transportation, labor, recreation and entertainment, and social interaction, as well as spiritual life such as core values, morality and related aspects. Consumption constitutes an important part of lifestyle. Green consumption activities can convey and communicate green concepts and requirements into all aspects of public life, guide and motivate the public to actively practice green concepts and requirements, so as to cultivate a green life nationwide, and improve the governance system of green social transition.

7.6.1.4 Taking green consumption as a key instrument to promote eco-civilization development and the modernization of environmental governance system

Green consumption is an integral part of green development and ecological civilization construction. There is a view upholding that consumption can have the transmission effect

from upstream to downstream. Reducing consumption can cut resources and energy input at exponential rate and curb pollution discharge that would otherwise be tens of times the volume. Consumption has an elastic effect, and the increase of consumption tends to offset the effect of increasing production energy efficiency, resource conservation and pollution reduction. Thus, reasonable, moderate, resource-efficient, and environment-friendly ways of consumption will play a significant role in reducing pollution discharge, improving environmental quality, and even the overall cause of ecological civilization construction.

In the field of modernizing eco-environmental governance system, China's current environmental policies are mostly concentrated in the production area, with restriction and supervision as major approaches, government and businesses as main parties. The set-up of institutional mechanisms to guide and prioritize green consumption model can be very beneficial. First, it can expand eco-environmental governance system from production field to consumption field, thus widening the coverage of eco-environment governance and adding new incentives and voluntary leadership in this area, which are conducive to building an institutional system featuring equal emphasis on both incentives and constraints. Second, as consumption is a basic behavior choice made by the public, green consumption can enable the public to truly participate in the environmental governance process. Consequently, their green consumption behavior and choice of green and eco-labelled products can reversely force enterprises to improve their environmental performance and increase green and eco-labelled products and green production supply, which is a practical way to involve spontaneous public participation in eco-environment protection. Third, the green transition at consumption end can be transmitted to production end through the practice of green supply chain, in which the "green-advanced" enterprises in the industrial chain can help manage the "green-backward" enterprises so as to blaze new ways of eco-environmental governance and improve the related system.

7.6.1.5 Putting green consumption high on the government's policy agenda for green development

On the basis of accurately identifying the strategic positioning and role of the green consumption in promoting green development, meeting people's growing need for a better life, and improving eco-environmental governance system, the Chinese government should incorporate promoting green consumption into its daily agenda, so as to convert its strong political will into systematically strategic plan, specific and effective policy measures, and social practice of the general public for comprehensively pushing forward the green transition and upgrading of consumption based on its scattered theory and practice.

7.6.2 Policy recommendations on promoting green consumption in China

Judged from China's overall progress and status of the green transition, the issue of imbalance and dis-coordination looms large. The green transition of economy is developing faster and better, while the green transition in social dimension is relatively lagging behind. The outstanding problems in resource and eco-environment brought by consumption have become a critical constraint to ecological civilization construction. The consumption-induced depletion of and pressure on resource and environment continues to grow. The excessive and wasteful style of consumption has exacerbated resource and environmental problems; and certain pollution load in consumption field even exceeds that in production sector. It is thus necessary to make full use of the current historical opportunity for boosting green transition of consumption; take green consumption as a pillar to support people's growing need for a better life, as a new growth pole to drive high-quality development, and as a key component and a means to facilitate transition in the economic and social system and push forward the structural reform on the supply side; and put green consumption high on the government's policy agenda for green development. Specific recommendations are detailed below.

7.6.2.1 Integrate green consumption into the national 14th Five-Year Plan as a key task for green development and ecological civilization construction, and develop a national strategy or action plan dedicated to promoting green consumption

China currently has a window of opportunity to promote green consumption transition, people's willingness to change their consumption patterns is significant, and green consumption can play a major role in driving the economy. There has been an impressive rise in people's awareness of environmental protection, public participation and safeguarding environmental rights, there have been continuously growing demands for, and expectations that it will be possible to enjoy as a good-quality life. All of these factors constitute the social foundations necessary for pushing forward green consumption.

Therefore, China's 14th Five-Year Plan should call for steps to be taken to achieve green consumption patterns and green lifestyles as these are important components for promoting green development and ecological civilization construction. It should further clarify corresponding objectives, tasks, as well as appraisal and evaluation indicators. In addition, drawing on related international experiences such as those from Germany and Sweden, China should research and then develop its own specific national strategy or action plan for propelling green consumption and green lifestyles in order to address the problems associated with currently fragmented and ineffective policies and practices. Systematic arrangements should be made to identify objectives, tasks, institutions, policy mechanism innovations,

evaluation methodologies and indicators, etc., so as to enhance the integrity and effectiveness of efforts to boost green consumption.

7.6.2.2 Highlight priorities for improving and enhancing innovative institutions, policies and actions for promoting green consumption

First, efforts should be made to clearly identify key areas for promoting green consumption. Guided by the goal of improving environmental quality, the key areas pursued to promote green consumption should be directed to those fields that are closely linked with resource and energy conservation and environmental quality improvement goals, including the supply of green products and products identified with eco-labels waste separation and recycling, development of public transportation facilities, energy-saving and environment-friendly buildings, and related technological innovation.

Second, the supply of green products and services and eco-labelled products should be expanded. It is recommended to strengthen the certification and standard systems for green and eco-labelled products and services. Priority should be given to revising the Government Procurement Law to increase the intensity and scope of green public procurement and promote mandatory green public procurement. It is also important to liberalize market access for green and eco-labelled products and services, encourage all types of capital to invest in green industries, and use the “Internet plus” initiative to promote green consumption.

Third, intensified efforts are needed to further promote the development of a circular economy. Specific actions include: promoting the implementation of an extended producer responsibility system; building green supply chains for enterprises and society; and, extending the resource and environmental responsibilities of producers for their products from the production section to the entire life cycle to cover product design, circulation, consumption, recycling, and waste disposal, so as to promote green production and consumption through life cycle management.

Fourth, it is proposed to launch a nationwide green consumption and new lifestyle campaign. Take advantage of the positive image power of stars and celebrities to demonstrated green consumption and make green consumption into a social fashion. At the same time, integrate the concept of green consumption into relevant education and training activities, include it in the basic requirements and assessment indicators for government activities, and incorporate it into all kinds of thematic publicity and education activities.

Fifth, a social governance system and the corresponding mechanisms for green consumption should be established which are to be built, governed, and shared by all. It is recommended to clarify the role of relevant government departments in promoting green consumption, strengthen the role of consumer associations in promoting green consumption,

encourage enterprises to assume more environmental and social responsibilities, and set up the carrot and stick approach to encourage green consumption by the public.

Sixth, it is necessary to improve and strengthen market and economic incentive policies to promote green consumption. With the guidance of regulatory constraints, focus should be placed on establishing an economic incentive and market-driven system from the aspects of price, finances and taxation, credits and loans, supervision and market credit, so as to guide the supply of green and eco-labelled products and encourage green choices in residential consumption. Incentives can also be oriented toward enabling sustainable lifestyles beyond purchasing choices and enabling green lifestyles.

Seventh, it is important to strengthen infrastructure and capacity building for green consumption. Suggested actions include: establish a sound statistical indicator system for green consumption; set up a nationally unified information platform for green consumption; strengthen capacity building and training on green consumption for governments, social organizations, enterprises and the public; and carry out environmental and social impact assessments in international infrastructure development projects to further the greening of infrastructure development processes.

Each and every one of the above recommendations should be further concretized in follow-up studies to make them operable.

Chapter 8 Green Belt and Road Initiative and 2030 SDGs

8.1 Introduction

The implementation of the United Nations 2030 Agenda for Sustainable Development led the international community into a new era of pursuing sustainable development. Building Green Belt and Road meets the requirement of ecological civilization construction and responds to the trend of the times. The Belt and Road Initiative(BRI) and the 2030 Agenda for Sustainable Development have shared concepts, principles and goals. Policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people bond proposed by BRI correspond to the 17 goals proposed by the 2030 Agenda for Sustainable Development. BRI has been recognized as an effective solution to promoting the implementation of the 2030 Agenda globally. The synergistic development of Green Belt and Road and the 2030 Agenda for Sustainable Development will facilitate sustainable development in the region, help developing countries to get rid of the mindset of “developing first and taking green issues in a second stage”, and making BRI a platform for ecological civilization construction and the building of a green community of shared destiny.

Consultation, contribution and shared benefits are the golden principles of building BRI. Since its initiation in the Autumn of 2013, BRI has been widely recognized and positively received in the international community. BRI has become a global public good, both in terms of infrastructure connectivity and systems and concepts, which will contribute to the formation of a fair and reasonable global governance system and promote global efforts in addressing shared challenge in environment, climate and poverty reduction.

In the past 5 years, BRI has been upholding the green development principles, emphasizing alignment with the 2030 Agenda for Sustainable Development, promoting the green and low-carbon construction, operation and management of infrastructure and enhancing cooperation in ecological and environmental protection, biodiversity conservation and climate change mitigation. These efforts have created new impetus for the implementation of 2030 Sustainable Development Goals (SDGs) and delivered new opportunities for green development in related countries. First, Green Belt and Road will

promote policy communication in ecological and environmental protection and alignment of Green Belt and Road and SDG on policy level; second, Green Belt and Road will construct an integrated ecological and environmental risk prevention and governance system to prevent environmental risks caused by infrastructure construction; third, Green Belt and Road will promote green and unimpeded trade, improve the efficiency of production and consumption, promote green financial integration and guide investment to clean energy and other green industries; fourth, Green Belt and Road will enhance people-to-people bond to promote ecological and environmental protection capacity building in developing countries.

BRI is a large and ambitious program with both opportunities and challenges. In terms of green-oriented philosophy, many countries are under-developed and they never had the chance before to get steadily in touch with such concepts; in terms of policy and monitoring assessment, BRI projects are mostly very complex and transnational, they involve different standards and procedures to plan, design, construct, operate and assess projects. In terms of green finance and green investments, there is a lack of policy guidance; in terms of projects, BRI projects are mostly large infrastructure projects that create both opportunities and risks.

The Belt and Road is a road to green development that calls for the efforts of all sides. To promote practical efforts in promoting ecological and environmental cooperation on the Belt and Road, the following recommendations are proposed: a) actively participating in global environmental and climate governance to build the Belt and Road into a road to ecological civilization and green community of shared destiny; b) developing the strategic alignment mechanism for Green Belt and Road and promoting the coordination and implementation of strategies with policies, plans, standards and technologies; c) establishing a Belt and Road risk prevention mechanism to guide green investment with green finance and ecological and environmental impact assessment; d) Building Green Belt and Road project management mechanism to encourage green development practice by businesses; and e) promoting people-to-people bond to strengthen personnel exchange and capacity building.

A green Silk Road requires the establishment and implementation of the strong consciousness that lucid waters and lush mountains are invaluable assets and joint efforts in promoting ecological civilization construction worldwide. A Green Belt and Road will provide more green public goods to BRI participating countries and regions and effectively promote the implementation of the 2030 Agenda for Sustainable Development. It is believed that with concerted efforts of Chinese and foreign partners, fruitful outcomes will be achieved in greening the Belt and Road.

8.2 Green Belt and Road and 2030 Agenda for Sustainable Development

8.2.1 The proposal and development of BRI

Since the outbreak of the global financial crisis in 2008, the world economy has been sluggish. Trade growth has been slow and instability persists. There is an urgent need of global economy for new growth engines and new cycles. The huge demand for infrastructure and industrial development in developing countries, emerging economies included, is expected to serve as the new momentum for economic growth.

It was against this backdrop that in 2013, Chinese President Xi Jinping proposed in Kazakhstan and Indonesia to build the Silk Road Economic Belt and the 21st Century Maritime Silk Road, namely BRI. In March 2015, the Chinese government issued Vision and Actions on Jointly Building Silk Road Economic Belt and 21st Century Maritime Silk Road (hereinafter referred to as Vision and Action) (National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce of the People's Republic of China, 2015), which proposes the top-down design framework for jointly building the Belt and Road, including objectives and vision, principles and future potential and directions.

According to the Vision and Action, the Belt and Road is aimed at promoting orderly and free flow of economic factors, highly efficient allocation of resources and deep integration of markets. It encourages the Belt and Road participating countries to achieve economic policy coordination and carry out broader and more in-depth regional cooperation of higher standards; and advocates jointly creating an open, inclusive and balanced regional economic cooperation architecture.

The Belt and Road takes achieving shared growth through discussion and collaboration as its fundamental principle. The core lies in encouraging the Belt and Road countries to align and coordinate development strategies, build consensus to the maximum extent, and leverage their respective comparative advantages, so as to share the achievements of the initiative and the long-term dividends. Priorities for the initiative include policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people bond.

Since being proposed, BRI has been well-received in more and more countries. Now, it has become a “Chinese solution” for participation in global openness and cooperation, improving global environmental governance system, promoting shared development and

prosperity around the world and building a community of shared destiny. In May 2017, the Belt and Road Forum for International Cooperation (BRF) was held. 29 heads of states and representatives from more than 130 countries and 70 international organizations reaffirmed the BRI core principles of consultation, contribution and shared benefits. In April 2019, the Second Belt and Road Forum for International Cooperation was successfully held. 38 heads of states, and 40 leaders of international organizations including Secretary General of the United Nations and IMF Chief attended the Leaders' Roundtable of the 2nd BRF. Over 6,000 international guests from 150 countries and 92 international organizations attended the 2nd BRF, which provides a platform for participants to exchange opinions in-depth with each other on jointly implementing the BRI. It is widely accepted that the Belt and Road marks a road of opportunities with consensus achieved on realizing high-quality development on the Belt and Road, and fruitful outcomes have been achieved.

In the past 6 years, BRI has developed from a concept and vision to concrete actions, and entered the phase calling for full implementation and outcomes delivered. 127 countries and 29 international organizations have signed Belt and Road related cooperation agreements with China. From 2013 to 2018, the total volume of trade in goods between China and countries along the Belt and Road exceeded 6 trillion USD. China has invested more than 20 billion USD in developing overseas economic and trade cooperation zones, creating hundreds of thousands of jobs and several billion USD of tax revenue for the local area. A series of cooperation projects have achieved concrete progress. China-Pakistan Economic Corridor (CPEC) is being developed according to schedule, China-Laos Railway, China-Thailand Railway and Hungary-Serbia Railway is under construction, parts of Jakarta-Bandung High Speed Railway have been put into construction, Gwadar Port is ready to be put into full operation. China Railway Express to Europe has connected 108 cities in 16 countries on the Asia-Europe continent, with a total of more than 13,000 trains operated.

8.2.2 Progress of building a Green Belt and Road

8.2.2.1 The ecological and environmental condition of key areas along the Belt and Road

The Belt and Road Participating Countries along the Belt and Road have diverse environmental and climate conditions with shared ecological and environmental challenges. Most of them are developing countries in Southeast Asia, South Asia, West Asia, ASEAN and North Africa. With excessive population growth and rapid industrial expansion, soaring resource consumption and pollution discharge is putting increasing pressure on the environment.

(1) The overall ecological environment is sensitive. China-Pakistan Economic Corridor

faces the challenge of drought in Xinjiang; China-Mongolia-Russia Economic Corridor covers large patches of permafrost in Southwest Russia; Areas along the Mekong River are plagued with disputes over water resources and severe water pollution; Bangladesh-China-India-Myanmar Economic Corridor faces the challenge of segmented ecological landscape and decrease in biodiversity as a result of deforestation in mountainous areas and highlands; New Eurasian Land Bridge Economic Corridor faces the challenge of drought and desertification in Western areas.

(2) Water pollution disrupts regional economic development and social stability. Situated at the Eurasian hinterland, Central Asia faces the environmental challenge of water pollution and shortage; South Asian countries are plagued by severe water pollution; Middle East countries are suffering from water shortage with most of the population living in coastal areas or drainage areas of major rivers.

(3) Air pollution is a prominent issue in countries along the Belt and Road. The level of air pollution in Belt and Road countries is lower than the global average. Among the 65 Belt and Road countries, 22 see relatively high PM_{2.5} density, in which 11 are West Asian and North African countries and 6 are South Asian countries.

8.2.2.2 SDG index of countries along the Belt and Road

(1) Environmental targets are important components of the 2030 SDGs

SDGs are core components of the 2030 Agenda. Covering economy, society and resource and environment, SDGs are composed of 17 sustainable development goals and 169 targets. Goal 16 (promote just, peaceful and inclusive societies) is a goal for the international community and Goal 17 (partnership) emphasizes global efforts to promote the implementation of the 2030 Agenda.

Environmental targets are important components of the 2030 SDGs. The 2030 Agenda emphasizes challenges brought by resource and environment issues on human existence and livelihood. Environmental targets are almost prevalent in all goals and index, covering every aspect of ecological and environmental protection. After summarizing sustainable development goals and index and analyzing those relevant to environmental sustainability, it is found that 52.9% of the 17 goals and 14.2% of all targets are related to ecological and environmental protection (Table 8-1).

Table 8-1 Environment-related goals and targets proposed by the 2030 Agenda

Goals		Environment-related issues	Number of targets
Goal 6	Ensure access to water and sanitation for all	Clean water and sanitation	8
Goal 7	Ensure access to affordable, reliable, sustainable and modern energy	Sustainable modern energy	5

	Goals	Environment-related issues	Number of targets
Goal 9	Building resilient infrastructure, promote sustainable industrialization and foster innovation	Sustainable industrialization	8
Goal 11	Make cities inclusive, safe, resilient and sustainable	Sustainable cities	10
Goal 12	Ensure sustainable consumption and production patterns	Sustainable consumption and production	11
Goal 13	Take urgent action to combat climate change and its impacts	Climate change	5
Goal 14	Conserve and sustainably use the oceans, seas and marine resources	Oceans and marine resources	10
Goal 15	Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss	Land bio-system, forest, desertification, land degradation, biodiversity	12
Goal 17	Revitalize the global partnership for sustainable development	Sustainable global partnership	19

(2) Environmental sustainability goals and index in 2017 SDG Index and Dashboards Report

The SDG Index and Dashboards assess where each country stands with regard to achieving the SDGs. Sustainable Development Solutions Network(SDSN) and other parties of interest proposed SDG Index and SDG Dashboards, which uses Organization for Economic Cooperation and Development(OECD 2018) country specific construction comprehensive index to propose critical hypothesis on the basis of bridging the gap of related data with United Nations SDGs index and other reliable data to work out a set of measurement standards on state level.

The SDG Index and Dashboards Report is co-produced every year since 2016 by the SDSN and Bertelsmann Foundation. The SDG Index and Dashboards Report 2017—Global Responsibilities: International Spillovers in Achieving the Goals was launched by SDSN and Bertelsmann Foundation in July 2017. The Report ranked different country based on how leaders can deliver on their promise for each of the 17 goals and showed the general implementation of the 17 goals through color coding and present the final result as SDG Dashboards. A separate report for each country on their fulfillment of SDGs is produced, which makes it possible to compare the development of different countries.

In 2017 SDG Index and Dashboards Report, nine goals and 31 index are directly or indirectly related to ecological and environmental protection. The SDG Index and Dashboards Report 2017---Global Responsibilities: International Spillovers in Achieving the Goals updated and adjusted the index and methodology on the basis of 2016 data and analyzed the performance of 157 countries in realizing the 17 SDGs. In general, among the 17 SDGs and

99 index assessed in 2017, 9 SDGs and 31 index are directly or indirectly linked to ecological and environmental protection¹. Compared with 2016, with the enrichment of data and improvement in statistical methodology, the index chosen are slightly different. The number of index has been increased from 77 in 2016 to 99 with new index on international spillover. It could be seen that 1/3 of the newly-added or adjusted index are related to ecological and environmental protection.

Table 8-2 9 SDGs and 31 indicators related to ecology and environment in The 2018 SDG Index and Dashboards Report

SDG	Description / Tag
2	Sustainable nitrogen management index
3	Age-standardised death rate attributable to household air pollution and ambient air pollution (per 100,000 population)
6	Freshwater withdrawal as % total renewable water resources
	Imported groundwater depletion (m ³ /year/capita)
7	Share of renewable energy in total final energy consumption (%)
	Access to clean fuels and technology for cooking (% population)
	CO ₂ emission from fuel combustion / electricity output (MtCO ₂ /TW·h)
11	PM _{2.5} in urban areas (μgT ³)
	Improved water source, piped (% urban population with access)
12	E-waste generated (kg/capita)
	Municipal Solid Waste (kg/year/capita)
	Percentage of anthropogenic wastewater that receives treatment (%)
	Production-based SO ₂ emissions (kg/capita)
12	Net imported SO ₂ emissions (kg/capita)
	Nitrogen production footprint (kg/capita)
	Net imported emissions of reactive nitrogen (kg/capita)
	Energy-related CO ₂ emissions per capita (tCO ₂ /capita)
13	Imported emissions, tech-adjusted (tCO ₂ /capita)
	Climate change vulnerability Monitor (best 0-1 worst)
	CO ₂ emissions embodied in fossil fuel exports (kg/capita)
14	Effective carbon rate (€ /tCO ₂)
	Marine sites, mean area protected (%)
	Ocean health index-biodiversity (0 ~ 100)
	Ocean health index-clean waters (0 ~ 100)
	Ocean health index goal - fisheries (0 ~ 100)
	Fish stock overexploited or collapsed (%)

1 Zhou Quan, Dong Zhanfeng, Li Hongxiang, I it is urgent to build a domestic index system to effectively promote the implementation of the UN Sustainable Development Agenda with scientific monitoring [R]. Reference to Major Decisions of the Environmental Planning Institute, 2018, 14 (11) .

SDG	Description / Tag
15	Terrestrial sites, mean area protected (%)
	Freshwater sites, mean area protected (%)
	Red list index of species survival (0 ~ 1)
	Annual change in forest area (%)
	Imported biodiversity impacts (species lost/1,000,000)

(3) General performance of SDG Index in countries along the Belt and Road in 2018

2018 SDG Index and Dashboards Report shrank the coverage of countries from 157 to 156. A comparison of the 65 countries along the Belt and Road¹ and the 156 countries shows that except for 6 countries including Brunei, The Republic of Maldives, The Kyrgyz Republic, The UAE and the State of Palestine, 59 Belt and Road countries are included in the Report. Table 8-3 lists the index on the fulfillment of 17 SDGs in the 59 countries and their global rankings.

It could be found that the performance of SDG index differs in Southeast Asian, South Asian, Central Asian, West Asian, Central and Eastern European, Easter European and North African countries. Central and Eastern European and Eastern European countries rank higher in terms of SDGs Index, Southeast Asian and Central Asian nations are diverse in their rankings, West Asian nations are sparsely-ranked.

Table 8-3 2018 SDG index scores of 59 countries along the Belt and Road and Their Ranking Among 156 Countries

No.	Country	Score	Ranking	No.	Country	Score	Ranking
1	Slovenia	80	8	16	Singapore	71.3	43
2	Czech Republic	78.7	13	17	Romania	71.2	44
3	Estonia	78.3	16	18	Azerbaijan	70.8	45
4	Croatia	76.5	21	19	Georgia	70.7	47
5	Belarus	76	23	20	Cyprus	70.4	50
6	The Slovak Republic	75.6	24	21	Uzbekistan	70.3	52
7	Hungary	75	26	22	Malaysia	70	55
8	Latvia	74.7	27	23	Vietnam	69.7	57
9	Moldova	74.5	28	24	Armenia	69.3	58
10	Poland	73.7	32	25	Thailand	69.2	59
11	Bulgaria	73.1	34	26	Macedonia	69	61
12	Lithuania	72.9	36	27	Russian Federation	68.9	63
13	Ukraine	72.3	39	28	Albania	68.9	62
14	Serbia	72.1	40	29	Kazakhstan	68.1	65
15	Israel	71.8	41	30	Turkey	66	79

¹ Wang Yiwei. The World is Connected—The Logic of the Belt and Road [M]. Beijing: The Commercial Press, 2016: 106.

No.	Country	Score	Ranking	No.	Country	Score	Ranking
31	Montenegro	67.6	69	45	Nepal	62.8	102
32	Bosnia and Herzegovina	67.3	71	46	Kuwait	61.1	105
33	Tajikistan	67.2	73	47	Qatar	60.8	106
34	Bahrain	65.9	80	48	Lao PDR	60.6	108
35	The Islamic Republic of Iran	65.5	82	49	Cambodia	60.4	109
36	Bhutan	65.4	83	50	Turkmenistan	59.5	110
37	Republic of the Philippines	65	85	51	Bangladesh	59.3	111
38	Lebanon	64.8	87	52	India	59.1	112
39	Sri Lanka	64.6	89	53	Myanmar	59	113
40	Jordan	64.4	91	54	The Syrian Arab Republic	55	124
41	Sultanate of Oman	63.9	94	55	Pakistan	54.9	126
42	Mongolia	63.9	95	56	Iraq	53.7	127
43	The Arab Republic of Egypt	63.5	97	57	Afghanistan	46.2	151
44	Saudi Arabia	62.9	98	58	The Republic of Yemen	45.7	152

8.2.2.3 Progress on Building a Green Belt and Road

(1) Being green is an important part of the Belt and Road Vision and Actions on Jointly Building Silk Road Economic Belt and 21st Century Maritime Silk Road states that “we should promote ecological progress in conducting investment and trade, increase cooperation in conserving eco-environment, protecting biodiversity, and tackling climate change, and join hands to make the Silk Road an environment-friendly one”. Chinese President Xi Jinping, in his speech at the Legislative Chamber of the Supreme Assembly of Uzbekistan in June 2016, called for the pursuit of green development and efforts to jointly build a Green Silk Road. At the Belt and Road Forum for International Cooperation in May 2017, President Xi Jinping said “we should pursue the new vision of green development and a way of life and work that is green, low-carbon, circular and sustainable. Efforts should be made to strengthen cooperation in ecological and environmental protection and promote ecological civilization so as to realize the goals set by the 2030 Agenda for Sustainable Development”.

In April 2019, President Xi Jinping highlighted at the Opening Ceremony of the 2nd BRF that “The Belt and Road aims to promote green development. We may launch green infrastructure projects, make green investment and provide green financing to protect the Earth which we all call home.” In addition, he pointed out that “China and its partners have set up the Belt and Road Sustainable Cities Alliance and the BRI International Green Development Coalition, formulated the Green Investment Principles for the Belt and Road

Development, and launched the Declaration on Accelerating the Sustainable Development Goals for Children through Shared Development. We have set up the BRI Environmental Big Data Platform. We will continue to implement the Green Silk Road Envoys Program and work with relevant countries to jointly implement the Belt and Road South-South Cooperation Initiative on Climate Change.”

(2) The essence of green Belt and Road is to integrate green development and ecological and environmental protection into every aspect of the development of the Belt and Road with the principle of energy conservation and environmental protection under the guidance of ecological civilization and green development concepts. First of all, it could be a trigger to promote policy communication with Belt and Road countries; second, it could prevent and control ecological and environmental risks to ensure facilities connectivity with Belt and Road countries; third, it could make industrial capacity cooperation greener to promote unimpeded trade with Belt and Road countries; fourth, it could improve investment and financing mechanisms to serve financial integration with Belt and Road countries; fifth, it could strengthen international cooperation and exchange on environmental protection to promote people-to-people exchange with Belt and Road countries; all the above to provide direct contributions to the realization of environment-related SDGs in Belt and Road countries.

As a major initiative driving economic development in related countries, BRI has been widely recognized by the international community as an important solution to the implementation of the 2030 Agenda. President of the UN General Assembly Miroslav Lajčák said that China is sharing wealth and best practice through BRI to promote the implementation of SDGs. UN Secretary-General António Guterres pointed out that the 2030 Sustainable Development Agenda and BRI have the same ambitious goals. They all aim at creating opportunities, bringing beneficial global public products and promote global links in multiple areas including infrastructure construction, trade, finance, policy and cultural exchange with new markets and opportunities. BRI plays an important role in promoting the implementation of 2030 Sustainable Development Agenda; for instance, Fred Krupp, President of Environmental Defense Fund (EDF) agrees that EDF could bring economic prosperity and environmental improvement.

(3) The overall objectives and specific tasks and measures are further clarified. In April and May 2017, it issued Guidance on Promoting Green Belt and Road and Belt and Road Ecological and Environmental Cooperation Plan. The Guidance pointed out that China will try to establish a practical and highly-efficient system for ecological and environmental

protection cooperation, support and serve platforms and industrial technological cooperation bases and implement a series of policies and measures on ecological and environmental risk prevention in 3 to 5 years; establish a well-developed ecological and environmental protection service, support and guarantee system in 5 to 10 years. The Plan clarified that China would incorporate green development into major activities of the development of Belt and Road, including policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people exchange with 25 key projects being listed.

(4) A platform for international partnership for green development on the Belt and Road is in the process of establishment. In order to enable BRI countries to better understand the green Belt and Road, international organizations, China, some BRI countries and non-governmental organizations(NGOs) have been proactively engaged in seminars, seeking exchanges and coordination on issues related to the green Belt and Road. The Ministry of Ecology and Environment of China and Partners home and abroad jointly launched the BRI International Green Development Coalition, with the goal of improving the capacity of BRI countries on environment governance by building an international platform to exchange ideas, policies and practice and organizing workshops and dialogues. By organizing China-Arab States Environmental Cooperation Forum, China-ASEAN Environmental Cooperation Forum, and China Week for SCO Cooperation, China is proactively engaged in policy dialogues with BRI countries.

Box 8-1 BRI International Green Development Coalition

In May 2017 President Xi Jinping of China proposed to establish the BRI International Green Development Coalition (BRIGC) in the opening address to the Belt and Road Forum for International Cooperation. Under the joint efforts from the Ministry of Ecology and Environment of China and Partners at home and abroad, BRIGC is officially launched at the Thematic Forum of Green Silk Road of the 2nd Belt and Road Forum for International Cooperation in April 2019. It is an open, inclusive and voluntary international network which will integrate green development into the process of constructing the Belt and Road. It aims to promote international consensus and collective actions of Belt and Road countries to implement the 2030 Agenda for Sustainable Development. By May 2019, over 130 Partners from China and the international community joined the Coalition, including 26 environmental authorities from Belt and Road countries, international organizations, research institutions and business, accounting for over 70 international Partners (Figure 8-1).



The mandates of the Coalition include:

A platform for policy dialogue and communication to:

- Share green development concepts and environmental policies;
- Provide communication opportunities amongst different stakeholders, and establish a joint research network.

A knowledge and information platform to:

- Build an environmental information sharing mechanism;
- Provide environmental data and analysis related to the green development of the Belt and Road;
- Promote capacity building on environment management.

A Platform for green technology exchange and transfer to:

- Promote the exchange and transfer of advanced green and low-carbon technology;
- Promote investment in green infrastructure and trade.

The Coalition's work will be delivered through a number of Thematic Partnerships made up of coalition partners. The areas of Thematic Partnerships may include, but are not limited to:

- Biodiversity and ecosystem management;
- Green energy and energy efficiency;
- Green finance and investment;
- Improvement of environmental quality and green cities;
- South-South environmental cooperation and SDGs capacity building;
- Green technology innovation and Corporation Social Responsibility;

- Environmental information sharing and big data;
- Sustainable transportation;
- Global climate governance and green transformation.

By far, 9 Thematic Partnerships have been initiated. In addition, under the Coalition research on green Belt and Road, a series of seminars and workshops, capacity building activities and pilot projects will be carried out.

(5) The importance of enhancing the corporate environmental and social responsibility of Chinese enterprises operating overseas is emphasized. It has been the focus of UN Environment, OECD and World Bank to appeal international investors to follow the high standards of environmental and social responsibility. The UN Global Compact, launched in July 2000, was envisaged to accelerate responsible business action and to ensure that business action and strategy implemented worldwide comply with the ten principles of Global Compact including environment and labor standards, under which the businesses should support a precautionary approach to environmental challenges, undertake initiatives to promote greater environmental responsibility and encourage the development and diffusion of environmentally friendly technologies. Since the 1970s, OECD has started to promote its Guidelines for Multinational Enterprises which has been revised several times to underline the dimension of sustainable development by asking enterprises to seriously take the potential environmental impacts of their operation and to strengthen environmental management systems. The World Bank has also adopted environmental safeguards for their financing programs and requires projects to prepare EIAs that meet World Bank standards.

In 2013, China issued the Guidelines for Environmental Protection in Foreign Investment and Cooperation (Ministry of Commerce, Ministry of Environmental Protection of the People's Republic of China, 2013) to guide enterprises to reinforce environmental awareness, perform environmental responsibilities, observe environmental laws and regulations of the host country, conduct environmental impact assessment, implement emergency management and ensure that pollutants' emission meet international standards. In December 2016, 19 global companies of China in the fields of energy, transportation, manufacturing and environment jointly launched an Initiative on Corporate Environmental Responsibility Fulfillment for Building the Green Belt and Road. The Chinese enterprises that join the initiative declare that they will observe environmental laws, reinforce environmental management and contribute to green Belt and Road in overseas investment and international production capacity cooperation. In April 2019, major financial institutions of China, the UK, France, Singapore, Pakistan, the UAE, Hong Kong SAR China and other countries and

regions signed up to the Green Investment Principles for Belt and Road Development, which marked a new chapter for greening the Belt and Road investment.

(6) Regional environmental governance capacity improves constantly. Forum on China-Africa Cooperation (FOCAC) proposed to implement China-Africa Green Development Plan. 50 foreign aid programmes on green development and ecological and environmental protection were committed to be implemented in Africa. China-Africa Environmental Cooperation Center will be established to boost the capacity to realize green, low carbon and sustainable development in Africa. The Lancang-Mekong Environmental Cooperation Center was established and Green Lancang-Mekong was implemented. Interim Office of China-Cambodia Environmental Cooperation Center was put into use. In order to push forward environmental capacity building and personnel exchanges among BRI participating countries, the Chinese government embarked on Green Silk Road Envoys Program and South-South cooperation training programs to address climate change for environmental officials, youths, students, volunteers of NGOs, scholars and experts from BRI countries. These programs provided support to over 300 delegates from BRI countries to China for discussing issues ranging from environmental impact assessment, air pollution control to water pollution control¹.

(7) The concept of green economy is being incorporated into BRI. At present, it is the global consensus to develop green economy. UN Environment has also initiated activities on green economy in Africa, Asia-Pacific, as well as Caribbean and Latin America, including research on policy, strategy and indicator system for green economy. In addition, UN Environment is propelling actively the integration of green economy concept into Belt and Road. The Industrial and Commercial Bank of China issued the first Belt and Road Bankers Roundtable Mechanism (BRBR) green bond, and jointly released the Belt and Road Green Finance Index with relevant members of the BRBR mechanism including the European Bank for Reconstruction and Development, the Credit Agricole Corporate and Investment Bank and the Mizuho Bank, to further enhance Belt and Road cooperation on green finance. The China Everbright Group will co-launch the Belt and Road Initiative Green Investment Fund with financial institutions of relevant countries.

(8) Enterprises and environmental NGOs are popularizing high efficiency clean technologies in BRI countries. China has been vigorously promoting the use of high efficiency clean technologies in BRI projects. In October 2016, the Belt and Road Science, Technology and Innovation Cooperation Action Plan came into force. The Plan sets out that energy efficiency and emission reduction should be fully integrated into the key areas for technological cooperation, including joint development and demonstration of agricultural

technologies, equipment and machinery such as energy and water-efficient agriculture, dissemination of climate-smart agricultural development model, promotion and demonstration of research and development on modern and efficient use of conventional energy such as coal, oil and gas, promotion of cooperative development of new energy vehicle and sharing of data, technology and experience in coping with extreme weather, geological disasters, flood and drought. China and the United Nations Development Programme jointly carried out the BRI Sustainable Investment Facility Project and conducted pilot projects in such countries as Ethiopia.

(9) Steady progress is achieved in marine environmental cooperation. China has set up marine cooperation mechanisms with Thailand, Malaysia, Cambodia, India and Pakistan. At present, the construction of Thailand-China Joint Laboratory for Climate and Marine Ecosystem, China-Pakistan Joint Marine Research Center and China-Malaysia Joint Marine Research Center are well underway, which focus on cooperation in marine and climate change observation research, marine and coastal line protection, marine resource development and utilization, typical marine ecosystem protection and restoration, and endangered marine species protection.

(10) Green financing safeguards the development of green Belt and Road. In order to support BRI, the Chinese government pledged USD 40 billion for the creation of the Silk Road Fund in the end of 2014. In May 2017, at the opening ceremony of the Belt and Road Forum for International Cooperation, China pledged to contribute an additional RMB 100 billion to the Silk Road Fund to scale up the support for Belt and Road development. By the end of 2018, the total investment according to the agreements of Silk Road Fund reached 11 billion USD with an investment of 7.7 billion USD in implement. Silk Road Fund advocates green, environment-friendly and sustainable development and supports green financing and green investment.

8.2.3 Promoting the green development of the BRI, transforming opportunities into reality

(1) Promoting the green development of the Belt and Road requires the establishment of an integrated decision-making mechanism for environmental protection and development in the construction of the Belt and Road. Green development and ecological and environmental protection needs to be integrated into every aspect of the development of the Belt and Road. Policies and operable guidelines on greening the Belt and Road in line with the principles of international cooperation and the implementation of the 2030 SDGs need to be developed to directly help countries along the Belt and Road to realize SDGs related to environmental

protection and social development.

(2) Greening Belt and Road requires understanding the impacts that current and planned Belt and Road projects will have on the local and global environment, as well as on sustainable development. It is fundamental to have a specific analysis of the local and global impacts of Belt and Road projects on the environment and sustainable development; this will help to identify which categories of projects should get political and financial attention in upcoming years. Showing the impacts that companies and investors are having through their involvement in Belt and Road projects, both positive and negative, can create significant opportunities to change behaviours and ensure that greener categories of projects are approved and developed¹.

(3) Greening Belt and Road requires applying the principle of Green Infrastructure. “Infrastructure that contributes towards achieving low carbon and environmentally sustainable outcomes, such as renewable energy generation plants and mass-transport systems” and going beyond Sustainable Infrastructure: “Infrastructure that integrates environmental, social and governance aspects into a project’s planning, building and operating phases.”

(4) The promotion of green development in Belt and Road projects and all involved countries requires financing, at early stage, greener projects. Green finance has been defined as fundamental support for environmental improvement, climate change mitigation and adaptation, resource conservation and efficient use of economic activities; namely financial services for project investment and financing, project operation and risk management in such fields as environmental protection, clean energy, green transportation, green building and sustainable agriculture. Constantly implementing green financing could direct the flow of capital to greener industries and projects.

(5) Greening Belt and Road requires greening the industrial chain and value chain **to build a green supply chain system**. Promotion of green production, green procurement and green consumption to drive upper-stream and lower-stream industries to take energy conservation and environmental protection measures and reduce ecological and environmental impact is needed.

(6) Greening Belt and Road requires cooperation in green, efficient and environmental protection technologies and industrial processes to provide effective plans for environmental governance. It is necessary to enhance the sharing of best practice in the application of environmental protection technologies to promote capacity building in pollution prevention and treatment, facilitate the transfer and development of environmental protection

¹ A green BRI is a Global Prospective. 2017: 12-15. <https://www.chinadialogue.net/blog/10299-A-green-BRI-is-a-global-imperative/en>.

technologies and help countries along the Belt and Road to develop clean industries according to their specific needs and conditions and promote effective pollution control technologies.

8.2.4 The potential contribution of Green Belt and Road to the implementation of the 2030 SDGs

In 2015, the adoption of the 2030 Agenda for Sustainable Development and Paris Agreement offers a roadmap for a new era of sustainable development. China has committed to building a Green Silk Road. Building a Silk Road corresponds to the international green trend and is consistent with the 2030 Agenda as well as Paris Agreement.

(1) Promoting ecological and environmental protection policy coordination, strengthening sustainable development partnership. Policy coordination is the foundation of the development of BRI. China will strengthen the construction of ecological and environmental protection cooperation mechanisms and platforms to carry out high-level intergovernmental dialogues with Belt and Road countries and use cooperation mechanisms including China-ASEAN, Shanghai Cooperation Organization, Lancang-Mekong, Euro-Asia Economic Forum, Forum on China-Africa Cooperation and China-Arab States Cooperation Forum to strengthen regional communication and exchange on ecological and environmental protection. Policy coordination and exchange could effectively promote the development of sustainable partnerships among Belt and Road countries (SDG Target 17.16) and improve the consistency of regional policy on sustainable development (SDG Target 17.14). Currently, The Ministry of Ecology and Environment of the People's Republic of China and Partners at home and abroad are working together for the establishment of the BRI International Green Development Coalition, which has gained the active response from the international community, international organizations and the Belt and Road participating countries.

(2) Reducing the environmental risks brought by facilities connectivity, protecting regional ecological systems. Green Belt and Road requires green infrastructure construction, which means constantly promoting ecological and environmental friendly public goods and infrastructure construction for environmental protection, promoting the development and transfer of environmental protection technologies, exchange and cooperation between clean industrial parks and ensure the adoption of clean technologies in infrastructure construction. Green facilities connectivity is linked to multiple SDGs and targets. It could protect and sustainably use terrestrial and internal freshwater ecosystems and their services (SDG Target 15.1), reduce the degradation of natural habitats and halt biodiversity loss (SDG Target 15.5) and help related countries to upgrade infrastructure with increased resource-use efficiency and greater adoption of clean and environmentally sound technologies and industrial processes

(SDG Target 9.4).

(3) Promoting green unimpeded trade, improving the efficiency of production and consumption. In trade, green Belt and Road will facilitate environmental-friendly product and service trade, make the market of environmental services more open and expand the import and export of environmental products and services. International cooperation on green supply chains is an important measure, which promotes green development throughout the industrial chain from production to product flow and to consumption through the development of Belt and Road green supply chain cooperation platforms. These activities could increase sustainable production and consumption in countries along the Belt and Road through trade and help Belt and Road countries to gradually improve resource-use efficiency in global consumption and production (SDG Target 8.4).

(4) Promoting green financial integration, encouraging investment in clean technologies. Green Belt and Road needs financial tools to identify and prevent social and environmental risks brought by related projects, improve environmental information disclosure, strengthen project environmental risk management and make foreign investment greener. Green investment in countries along the Belt and Road has attracted wide attention with promising prospect for the development of green industries¹. Green finance could effectively promote investment in energy infrastructure and clean energy technologies (SDG Target 7.a) and mobilize additional financial resources for developing countries from multiple sources (SDG Target 17.3). For example, the Silk Road Fund has been implementing the concept of green development and green finance with emphasizing green, environmental-friendly and sustainable development as one of the four investment principles and promoting the interaction of clean and renewable energy on multiple levels for extensive cooperation in energy and resource as one of the four investment priorities.

(5) Strengthening people-to-people exchange in environmental protection and, promoting capacity building in developing countries. Green Belt and Road will strengthen the support to green demonstration projects, promote exchange and cooperation in environmental protection policy, legal system, talent training and demonstration projects, continue to carry out the Green Silk Road Envoy Plan, increase the interaction and communication between environmental management experts and technical experts in Belt and Road countries, promote environmental protection technology and industrial cooperation and improve the environmental protection capability of Belt and Road countries. These activities and projects will effectively support developing countries to improve technological and technical

¹ Belt and Road: Promoting new Opportunities in the Development of Green Finance, 2018-07-09. <http://greenfinance.xinhua08.com/a/20180709/1768414.shtml>.

capabilities, adopt more sustainable production and consumption patterns (SDG Target 12.a), promote the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries (SDG Target 17.7) and enhance international support for implementing effective and targeted capacity-building in developing countries through South-South cooperation (SDG Target 17.9).

8.3 Opportunities and Challenges in the Development of Green Belt and Road

8.3.1 Opportunities

China, a prominent green development player domestically, has the capacity to promote environmental convergence among the Belt and Road partners (for example, on circular economy) and provide a solution to realizing environmental-related SDGs in the region. Ecological civilization could improve the capacity of green governance and green Belt and Road could promote joint efforts with Belt and Road to implement global ecological civilization construction. Most of western countries and China have approached the concept of developing first and clean in a second stage. Greening Belt and Road can bring in developing countries the idea of integrated environment, social and governance aspects into a comprehensive project's planning, so as to promote economic growth in a green manner.

Green Belt and Road will create tremendous opportunities for green development and capacity building in countries along the Belt and Road, including:

- Use the “Greenization” to promote conservation culture and lowering resource consumption, boosting green industries and low-carbon lifestyles;
- Help Belt and Road countries integrate the SDGs at country, regional and project levels;
- Promote high standards in all Belt and Road projects;
- Construct an integrated risk governance system for the Belt and Road while enabling sustainable development;
- Engage with policy-makers in Belt and Road countries to establish frameworks that incentivise sustainable Belt and Road infrastructure investments that are currently not financially viable and set up an open access database for sustainable Belt and Road infrastructure projects to implement best practice in environmental and infrastructure planning;
- Set up a cross-sector “Greening the Belt and Road” learning and leadership platform to draw attention to the environmental risks and opportunities and ways to respond to them;

- Support efforts to create an open and optimized policy environment and constantly improve transparency.

8.3.2 Challenges

BRI is the largest infrastructure program ever planned (Figure 8-1). It comes with both opportunities and risks – for investors, for sustainable development, and for natural resources. At the same time, although sustainable development has become a global consensus, the inability of Belt and Road countries in promoting ecological and environmental protection and the complexity of international cooperation projects bring a series of challenges to greening the Belt and Road.

In terms of green-oriented philosophy, in many Belt and Road countries, the introduction of low carbon technologies and environmental design requirements are disregarded or best in early-stage. Many countries are under-developed and they never had the chance before to get steadily in touch with such concepts. Moreover, they have the understandable desire to develop fast, talking “green issues” in a second stage.

In terms of policy and monitoring assessment, Belt and Road projects are mostly very complex and transnational; they involve different standards and procedures to plan, design, construct, operate and assess projects. Moreover, the business scenario for investing in green or natural infrastructure is often not clear. In many cases local laws and technical standards are very vague or completely missing. The number and variety of sustainability standards and assessment methods makes it difficult for financial investors to ensure they invest only in sustainable infrastructure. Risk-adjusted returns are too low for some sustainable infrastructure designs because investments in sustainability are not adequately compensated by revenue streams or public incentives.

In terms of information and transparency, in particular transnational Belt and Road projects tend to be extremely difficult; data is scattered and difficult to locate as planning (in some cases completely missing), designing and implementing Belt and Road projects is mostly decentralised. The complexity of Belt and Road projects, in order to attract the attention of international private companies, requires precise planning and complete transparency in its execution.

In terms of green project’s implementation, so far, most of the developed projects cannot be defined as “green” at least according to international standards; moreover, as most of involved Belt and Road countries are under-developed, it is mostly requested to quickly develop projects so to ensure fast economic and social development without taking too much into consideration negative environmental impacts of projects developed within Belt and

Road. International and private companies feel too exposed in getting directly involved in Belt and Road projects.

In terms of green finance and green investments, so far they have not yet gained adequate attention among finance and wider private sector players or broader stakeholders. There is not yet a general acceptance in the definition of green projects and consequently in defining what can be financed within present green investments, moreover ROR and ROI in Green Belt and Road projects is limited connected to the expected risks in the long run.

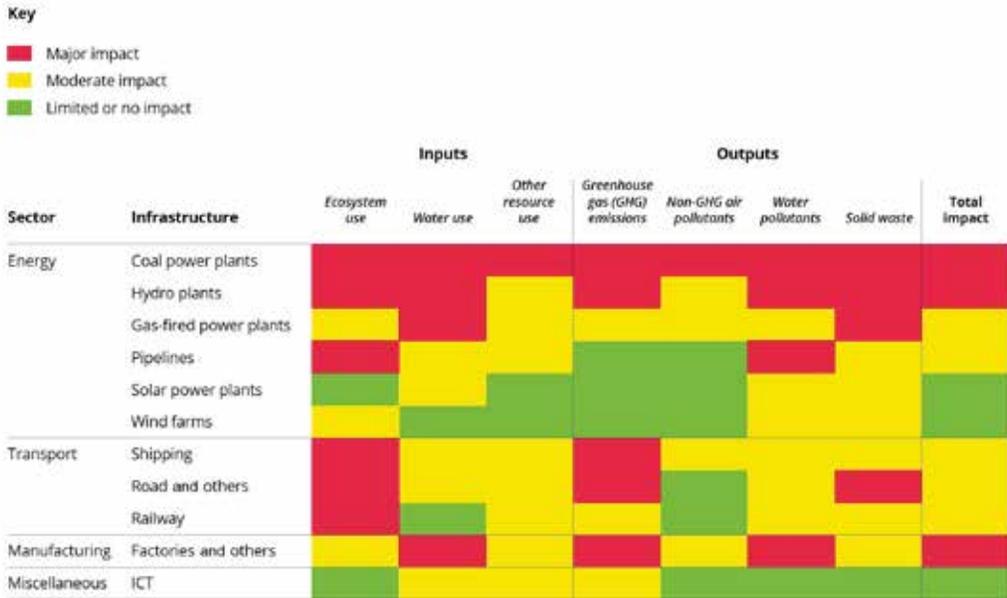


Figure 8-1 Infrastructure Heat Map

(Source: Greening BRI report[R]. HSBC-WWF, 2017.)

8.4 Major Issues on the Belt and Road

8.4.1 Strategic arrangement and implementation mechanism of green finance in the development of BRI

Green finance facilitates the development of BRI through addressing two issues: environmental risk management and green investment and financing. In terms of environmental risk management, green finance helps financial institutions to integrate environmental protection, ecological conservation and climate change mitigation into the decision-making process; in terms of green investment and financing, green finance helps financial institutions to increase the investment in green, low-carbon and circular economy

projects with streamlined procedures. Financial institutions need to develop green finance or green credit, as has been indicated in the Green Credit Guidelines issued by the former China Banking Regulatory Commission (CBRC) in February 2012 and Guidelines for Establishing the Green Financial System issued by seven ministries, including the People's Bank of China and NDRC, in August 2016. To effectively support the development of BRI, Chinese financial institutions not only need to implement the two documents, but also adopt new approaches to developing green finance that are different from those adopted in the domestic market. Chinese financial institutions have two objectives: integrate the principles of ecological civilization and Sustainable Development Goals (SDGs) into the development of the BRI through finance; promote the good practice of China in green finance based on the reality and investment environment of countries and regions along the Belt and Road.

8.4.1.1 Good Practice and Experience of Green Finance Worldwide

Requirements for financial institutions worldwide on promoting environmental risk management come from four aspects:

First, international rules and international cooperation. Many international organizations and regional multilateral institutions have developed or promoted the formation of international standards on environmental and social governance, with much effort being taken to promote dialogue among countries and institutions. Examples include United Nations Global Compact, Equator Principles and United Nations Principles for Responsible Investment.

Second, rules and standards developed by multilateral developmental financial institutions. Based on their tenants or rules, developmental financial institutions have developed and issued their own standards and guiding principles, such as Inter-American Development Bank, World Bank Group, Asian Development Bank and African Development Bank. These standards and instruments have been adopted, to a large extent, by governments and financial institutions around the world.

Third, national policies and regulations. This mechanism could manifest itself in different ways. Typically, environmental laws and regulations would require environmental impact assessment for development projects, identify protected areas and define the upper limit of pollutants. Besides, regulations on the green development of financial institutions have been tightened and improved in recent years through restrictions on investment in certain areas/industries and incentive measures for green investment. Examples include Green Credit Guidelines and related policies issued by China, Resolution No. 4.327 issued by the Central Bank of Brazil, Sustainable Banking Principles issued by the Central Bank of Nigeria and Environmental Risk Management Guidelines issued by the Central Bank of Bangladesh.

Fourth, voluntary commitment of commercial financial institutions. To pursue sustainable development and keep in line with domestic and international trends, commercial financial institutions would make voluntary commitments to comply to environmental and social standards to improve its environmental and social performance and enhance environmental risk management in investment and operation.

In spite of the varying sources and forms, environmental risk management is manifested as the adoption of sustainable development as the strategic priority by financial institutions, the integration of environmental considerations into the process of investment and decision-making and the disclosure of investment and credit policies for environmental-sensitive industries.

Green investment is often guided by the following four factors.

First, green investment catalogues or standards, which is the major approach adopted by China to encourage green investment.

Second, green investment institutions established and funded by the country committed to guiding the market and commercial institutions to make green investment, UK Green Investment Bank is a typical example.

Third, priority considerations and key areas for investment identified by financial institutions based on their own strategies and tenants. World Bank, for example, highlights in its 2018 Annual Report that the World Bank supports its client countries in three priority areas: promoting sustainable, inclusive economic growth; investing more-and more effectively-in people; and building resilience to fragility, shocks, and threats to the global economy. Commercial financial institutions such as HSBC and Citibank have also developed strategies to increase investment in renewable energy and low-carbon infrastructure.

Fourth, standards initiated and widely recognized by industrial associations and research institutions with green bond as a typical case. The “Green Bond Principles” developed by International Capital Market Association (ICMA) and some standards and tools developed by Climate Bonds Initiative have been gradually accepted and adopted by financial institutions.

By the same token, the substantive manifestation of promoting green investment is a growth in investment in green, low-carbon and circular economy projects through product, institutional and procedural innovation with controlled risks.

8.4.1.2 The institutional arrangement of environmental risk management in the development of Green Belt and Road

The Chinese government has been attaching great importance to controlling the environmental and social risks of overseas operations of financial institutions. Article 31 on “enhancing the ‘greenness’ of China’s outward investment” of Guidelines for Establishing the

Green Financial System and Article 21 on “the environmental and social risk management for overseas projects” of the Green Credit Guidelines, Key Indicators for the Evaluation of the Implementation of Green Credit, and Article 5 on “strengthening environmental and social risk management” of Guidelines for Regulating the Banking Industry in Serving Businesses to Go Global and Strengthening Risk Prevention and Control all have strict and detailed rules and requirements for financial institutions in greening overseas operation and investment and strengthening environmental risk prevention and control.

However, the implementation of these rules are far from satisfying. Major problems include:

First, there is a lack of unified standards for green and environmental-friendly investment, which increases the risks of overseas investment. Currently, most Chinese financial institutions have not joined any international codes. Therefore, the environmental policies being implemented in international financing by Chinese financial institutions could be seen as an extension of domestic policies on green credit. The common practice is to adopt Chinese laws and regulations or refer to related standards of the hosting country. However, the standards designed for the Chinese market may not be applicable in the hosting country. International investment and cooperation have greater uncertainties due to differences in political, social and cultural realities, legal systems, values and investment environment. Therefore, existing policies on green credit of the Chinese banking industry, developed to meet the demand of the domestic market, may be unable to cope with the complexity and uncertainty of overseas investment. By the same token, standards of the hosting country are also subject to changes due to adjustments in environmental protection policies.

Second, the policy framework of green finance is underdeveloped, weakening the effect of implementation. Government departments play a leading role in the development of green finance for BRI. However, they are merely providing strategic guidance for the development green finance overseas with concrete measures yet to be launched. In project approval, government departments failed to take environmental considerations as important factors in selecting projects. Besides, related policies having been launched couldn't effectively guide foreign direct investment to environmental-friendly projects as they don't have enough binding force.

Third, the implementation of green financial policies needs to be more carefully aligned with greater operability. As important participants in the development of BRI, Chinese financial institutions still couldn't meet international standards in the environmental and social management of overseas projects. In the process of policy implementation, Chinese financial institutions usually replace compliance assessment with quantitative environmental

risk assessment and integrate environmental policies into financing decision-making based on “veto” and “blacklists” without clear, effective and quantitative detailed rules for the credit issuance or defined assessment standards for overseas investment projects.

Fourth, there is still lack of corporate awareness in environmental protection and effective supervision. In the implementation of green finance, improvement in corporate awareness, the guidance of governments and the participation of banks are equally important. Currently, most Chinese businesses engaged in the development of BRI have accumulated relatively rich experience in environmental protection and social responsibility. However, some of them failed to take their environmental responsibility. Besides, government departments and financial institutions also have much to improve in the supervision of overseas projects.

The key to improving environmental risk management in BRI investments lies in strengthening legal and administrative supervision and impose stricter punishment for behavior with environmental impact that cause business loss.

8.4.1.3 Institutional Arrangement of Green Finance in BRI

Currently, China has developed detailed rules and standards for green investment at home, including Statistical System for Green Credit issued by CBRC, Catalogue of Projects Supported by Green Bond issued by the People’s Bank of China, and Guidelines for the Issuance of Green Bond issued by NDRC. Statistical System for Green Credit, in particular, identified the catalogue of eleven green industry categories and projects and made it clear that “overseas projects adopting international practices or international standards” are also within the scope of Statistical System for Green Credit. Green bond issued by Industrial and Commercial Bank of China, Agricultural Bank of China, Bank of China and Industrial Bank overseas also comply to the rules on the issuance of green bond in China.

Currently, investment in BRI green projects is still in the primary stage with limited successful cases. Four issues need to be addressed for further improvement.

First, the standards of BRI green projects. Three issues needs to be clarified in terms of the standards of BRI green projects. The first is the scope of green projects. Whether they are projects engaged in the development of green, low-carbon and circular economy or projects in key industries or areas needs to be further clarified. The second is the definition of green standards. We need to decide whether to adopt domestic standards on green finance and green credit or the best practice of international institutions, multilateral banks and commercial financial institutions, and whether to use the standards of hosting countries or develop new standards for BRI green projects. The third is the quantitative assessment of green standards. We need to decide whether to identify green projects with the type and nature of the projects

or with the effects, impact and contribution of the projects.

Second, risk control for the investment environment in countries along the Belt and Road. Unclear business and political rules, market and exchange rate risks caused by uncertainties are the major challenges hindering the implementation of BRI projects. This is caused by several reasons: first, countries along the Belt and Road have different political, social, religious and cultural realities with China and among themselves; second, financial institutions lack the experience and expertise for non-financial risk management; third, the coordination mechanism on business and trade between China and related countries have to be improved.

Third, the business return of BRI green projects. High cost, huge investment, low short-term ROI and long investment cycle contribute to the financing difficulties faced by green projects. In the development of BRI, Chinese financial institutions lack effective information and understanding of overseas projects, which adds to the uncertainty on the return of green projects.

Fourth, the incentive mechanism for the investment in BRI green projects. The fundamental reason for the lack of investment is the lack of incentives. Except for implementing international strategies, fulfilling corporate social responsibility and improving brand reputation, financial institutions could neither get substantial support from China nor enjoy preferential policies of hosting countries in investing BRI green projects. In other words, by engaging in investment in BRI green projects, financial institutions have greater responsibilities and risks without extra business return. To address the issue, we need to encourage and support the development of BRI green projects with risk compensation, credit guarantee, favorable tax policies and subsidized loans and motivate financial institutions for more effective implementation of green credit.

8.4.2 BRI and Green Value Chain

8.4.2.1 The significance of building green value chain in greening the Belt and Road

The core of green value chain. In the past 40 years, with the liberalization and facilitation of investment and trade, international division of labor has transformed from interindustry division of labor to intra-industry division of labor. With the transformative development of information and communication technologies bringing down the cost of transboundary communication and coordination, global production lines emerged, which leads to the formation of Global Value Chains(GVCs), as the value created by the production process is distributed around the world. Developed and developing countries alike engage in the process of value creation, distribution and redistribution, covering design, research and development,

production, transportation, consumption and recycling, although they play different roles. Green Global Value Chains (GGVC) incorporates green development concepts into GVCs, highlighting the environmental and climate impact of and in each process. It forms a closed loop comprising green management, green design, green production, green products, green marketing, green consumption, green recycling and green materials and reflects the environmental footprint of the transboundary transfer of value creation against the background of the global relocation of production.

(1) The development of BRI creates opportunities for the construction of a more inclusive GGVC. BRI links countries in different stages of development and of different historic and cultural backgrounds closely together through promoting connectivity, building an international platform for integration of products and services. However, BRI participating countries are in different stages of economic growth with different environmental and development priorities. Consequently, it is impossible for a unified environmental rule to meet the demands of all BRI participating countries. To address the issue, it is necessary to develop multi-dimensional, multi-layer environmental standards in relation to the actual needs and ecological and environmental conditions of countries in varying stages of development through “rule-based governance” on the basis of connectivity and mutual trust promoted by BRI.

(2) A more inclusive GGVC is crucial to the continuous development of BRI. BRI promotes productive capacity cooperation based on mutually-beneficial win-win cooperation for the sound development and share prosperity of BRI participating countries and regions. As an important part of BRI green development, GGVC promotes global division of labor guided by the principles of green development, which enables all participants to take their fair share of the benefits of the industrial chain while encouraging synergistic efforts to reduce the burden on environment. The result is a win-win situation with economic, social and environmental benefits that safeguards the continual and sustainable development of BRI.

8.4.2.2 The necessity of constructing GVCs

As a global public good, environment is an important spectrum of global governance. In the context of fragmented global production, constructing more inclusive GVCs is crucial for greening the Belt and Road. Currently, developed countries still take the dominance in global environmental governance, with the United States and EU asking trade partners to adopt their environmental standards through incorporating environment-related rules in trade agreements. The practice has, to some extent, promoted the development of global environmental governance and the environmental governance system of developing countries. However, the environmental value chain established as a result represents the interests and appeals of

developed countries, with the risk of putting developing countries in a disadvantaged position in the value chain. Therefore, constructing a Green Global Value Chain that reflects the interests and appeals of developing countries, where the majority of the world's population live, is one of the most important tasks in promoting the green development of the Belt and Road.

First, constructing a Global Green Value Chain helps developing countries to reduce resource intensity in industrial production and the reliance on resource-based bulk commodities, which is conducive to the sustainable regional development. In the future, through strengthening South-South Cooperation and implementing BRI, constructing Global Green Value Chain has the potential to be an important means for developing countries to realize their own development goals and fulfill international responsibilities. Second, constructing coordinated, inclusive, green and sustainable GVCs is an urgent task that requires all countries to reconsider international investment, production, trade and cooperation from a strategic perspective and reshape Global Value Chains with green and sustainable development concepts.

8.5 Case Studies on Green Development on the Belt and Road

8.5.1 Case 1: SPS field studies on Pakistan and Sri Lanka

During February 20th and 27th, 2019, SPS visited Pakistan and Sri Lanka for field studies. The goal of the field studies to Pakistan and Sri Lanka was to achieve a greater understanding of the ongoing BRI investment in BRI host countries and to identify the environment impacts and challenges of the BRI projects and how best they could be assessed. In addition, to identify lessons to be learnt from the existing BRI projects and look at new opportunities for policy interventions to make BRI greener.

The field studies goal fits within the overarching goal of the SPS to enhance international cooperation on ecological and environmental protection and facilitate green BRI development.

The two country field studies have established a base of interest within the governments of Pakistan and Sri Lanka and private sector partners to develop their cases as examples of how to demonstrate the Greening of BRI. More specifically;

- The study to demonstrate the Greening of the Hambantota Port by accessing Chinese expertise and funding through the BRI related funds; and,
- The study to demonstrate the impacts of the CPEC on the biodiversity of the northern areas of Pakistan partially through Italian ODA funding.

In tandem, the same approach is being explored for the Greening of the Gwadar Port and the Thar Coal Power Plant project in Pakistan.

It is recommended that these projects and their development continue to be analysed and supported by the BRI-SPS in their design and subsequent implementation for the policy lessons derived for a Green BRI in other countries.

Principles applying to all BRI projects more generally follow:

(1) Aligning BRI and 2030 Agenda

- The objectives of the BRI closely align with the spirit of the 2030 Agenda and Paris Agreement on Climate Change. The concept that cumulatively BRI projects have to stay within the limit of the planet would be useful to state.
- There is an intended shift from the first BRI phase oriented to mega infrastructure projects to a second phase BRI oriented to the establishment of special economic zones, social investments, and a greater focus on environmental issues.
- China is today the champion of environmental multilateralism and green leadership (Paris climate agreement, host of CBD COP15, fight against pollution etc.).
- All new BRI-related organisations and networks being created (BRI Green Coalition, BRI Green Cooling Initiative, BRI Green Lighting Initiative, BRI Green Going-Out Initiative) need to reinforce existing multilateral institutions and the 2030 Agenda.
- Green finance and investment and CSR standards need to be implemented by Chinese investors and project implementation companies. The BRI Green Investment Principles, supported by 27 international banks and investors, and BRI Green is a good start. Via its new Going-Out Initiative China could export its green finance norms and standards.
- Strong convergence is needed between the principles of implementation of the 2030 Agenda and the BRI implementation agenda on national trajectories for transformation towards sustainable development, which are country-specific.
- The alignment between the BRI objectives and 2030 Agenda is not reflected in the BRI energy projects which are targeting mostly fossil fuel projects while the NDCs of BRI countries indicate strong need for investment in renewables.

(2) Enacting principles that ensure new projects are green from the start

- There is a need for principles that ensure new projects are green from the start – these include creating a more environmental-focused mind set amongst donors; developing guidelines for development banks in China to think long-term, building in the environmental factors; and starting pilot projects within a 5-year time horizon where infrastructure designs is aligned with ecological concepts (e.g. nature-based solutions for infrastructure).

- Holistic and integrated approaches need to be used to combine the dynamics of multiple projects and evaluate their cumulative impact. Ecological approaches such as the one behind the development of the Yangtze River Economic Corridor, holistic in nature, cost-effective and bringing extensive ecological benefits can be followed.
- Special Economic Zones (SEZs) need to also be Environmental SEZs. Benchmarks for emission-free economic zones need to be in place.
- Ex ante and ex post evaluation by Chinese-international teams including academics and think-tank experts is needed of the environmental and social impacts and alignment with 2030 Agenda and its implementation in host countries.
- Facilitation of South-South Cooperation addressing the main environmental issues in BRI is needed.

At each BRI project level:

- As a minimum: avoiding, reducing and compensating local environmental and social damage (by providing environmental and social safeguards). It involves stakeholder consultation and participation.
- Evaluating the environmental impact of the project using internationally established methodologies integrating long-term impacts and potential irreversibility.
- Evaluating the alignment of the project with the implementation of the 2030 agenda and the Paris Agreement in the host country. Avoiding path dependencies and lock-in effects of fossil-fuel investments and non-resilient infrastructure.
- Address the challenge of complexity and sometimes transnational nature of projects.

At the Corridor/program level:

- Ensuring environmental sustainability, cumulative impact evaluation and policy coherence;
- Understand how the Corridor/program fits within the structural transformation of the country towards low carbon economy and national debt level.

At whole BRI level:

- Compatibility of the BRI impact on global production, trade and exchanges intensification with the global CO₂ reduction needed by 2050.

(3) Enforcing environmental regulations in host countries needs to be incorporated into the loan conditionality by China

- The environmental impacts observed in the BRI projects are not directly due to inherent flaws of the projects, but often due to flaws in the environmental governance system in the host country. Chinese companies are often operating in an environment where the local government or contracting party needs or wants quick results.

- Strategic environmental impact assessments (SEAs and EIAs) take time to do properly and can result in changes to original specifications — all of which can lead to projects being delayed. Projects with stringent safeguards tend to get rejected. The natural capital to be affected by the project is often not evaluated ex ante because the host country does not have the skills and capacity to take the required interventions. This is an opportunity for capacity development that needs to be addressed with the framework of the loan.
- EIAs carried for large scale projects as well as for those located in environmentally sensitive areas often do not satisfactorily explore the impacts and irreversibility (they sometimes result in “no issue”). SEA is planned to be introduced in national environmental legislation, but it is delayed, and the capacity is lacking.
- There is a challenge for China to deal with countries with weak capacity (e.g. weak Environmental Protection Agencies), low data availability, high corruption, low transparency, little sustainability appetite and lack of monitoring capacity of incidents. In addition, red tape bottlenecks, provincial disputes and private interests create extra barriers towards ineffective project and program implementation.
- Chinese investors could consider environmental standards beyond the required host country standards and go for international environmental and social safeguards. Their implementation needs to be supported from outside to make sure projects go ahead with proper scrutiny. BRI investors could copy international financiers supported projects (World Bank, ADB etc.) where environmental safeguards are built into the project design.
- While some national authorities take on board SDGs, it is difficult to see how they are implemented into the BRI projects.
- Chinese public-private partnerships can play a vital role in the BRI environmental impact and its mitigation. Convergence is needed between public authorities and private sector entities in both China and the host countries.

(4) Understanding the role of the Digital BRI can play

- There is lack of studies on the BRI and its impacts developed by host country research institutions due to lack of access to project data and sometimes low capacity and expertise. Such lack of scientific scrutiny from local institutions resulted in mistrust related to possible “debt trap diplomacy” (e.g. Hambantota Harbor).
- The Digital BRI, platform for participating countries to share the data obtained as part of their collaborative projects with each other and with China, and particularly the BRI Environmental Big Data Platform launched at the Second BRI Forum and aimed at sharing environmental performance data of BRI projects can help. However, such

developments also have implications regarding China's rising position as a science-development superpower with tens of thousands of researchers and students, and hundreds of universities in low- and middle-income countries involved.

- The creation of a fund for BRI Studies Network, which would finance independent research consortia, recognized by the various BRI stakeholders, could be a possible solution.
- The Digital BRI could facilitate an exchange of methodologies practiced by each country.

(5) Implementing projects which are demand-driven and sustainable

- Eagerness of developing countries to engage with power economies like China can overlook local needs for sustainable development and translation of the 2030 Agenda. Are these supply side or demand side projects?
- Host countries can have an important gap between high environmental aspirations in relations to development projects and their implementation.
- Even when China has the resources, technology and drive to invest in green cooperation and development, there is a significant gap in host countries in understanding regarding how to deliver the same.
- There is a need to raise awareness that economic benefit of investing in green solutions based on local context and native design and landscapes can be the same or even greater than conventional investments.
- Appropriate channels and signals need to be in place to engage with stakeholders (Industry, local or independent research organizations, local industry, civil society organisations) on social, environmental and economic concerns related to the BRI so that their inputs are valued and taken into account. Otherwise, polarization of stakeholders can occur between “pro-China” and “against China”. In Pakistan, some Chinese companies are working closely with local and international NGOs, and this provides a model to be expanded.
- Successful and environmentally-sound implementation of BRI projects in host countries such as Sri Lanka and Pakistan could help BRI projects to be welcomed in other countries as well.

(6) Engaging in concrete environment-related projects

- Identify high priority, well-defined projects which are workable and clearly show environmental benefits.

- Engage in concrete cooperation, bring Chinese best practices and provide technical and/or financial assistance on environment-related issues possibly via twinning projects. Examples include floodwater management, water governance, ecological redlining, forest management, National Parks management, large-scale forest restoration, restoration in arid zones.
- Support to the 10 Billion Tree Afforestation programme in Pakistan to build on China's experience of establishing the Great Green Wall.

(7) Observations

It is clear from the experience of the two field studies that the BRI has vast and far reaching implications on social and biological impact that needs to be considered within the framework of its Greening. Some of this would be addressed by considering the following:

- Greater synergy and work between the BRI-SPS and the SPS on Oceans, Biodiversity and Energy. Perhaps a sub-group could be established for cross collaboration. If the demonstration projects take off as planned, these groups will need to be involved in their implementation.
- The BRI carries with it not just Chinese technology, funding and expertise, but also culture, thought and is an example of China's growing soft power and influence. The boost to local economies in terms of Chinese language, goods and cultural values must not be underestimated. If one adds to this the literally thousands of young people that are on Chinese scholarships in China from all over the world, it would not be an exaggeration to say that BRI will shift the perception of knowledge and cultural paradigms between China and BRI recipient countries within the next decade. The work and influence of the Chinese Academy of Sciences (CAS) along the science corridors accompanying the BRI has been described in more detail recently in a series of articles in the journal *Nature*. The BRI SPS will need to find a way to recognise this impact and influence in its work, and answer two questions: What kind of BRI do we currently have? What kind of BRI do we want for the future?
- While the economic implications of the BRI are relatively well recognised and understood, and recognition of the environmental impacts are growing in prominence, the cultural and social impacts are relatively nascent. Any greening of the BRI will need to take all these into consideration. The case studies currently being planned should do so, but at a broader level, these should also be considered by the SPS's more holistically and by the work of the BRI coalition.

Box 8-2 China-Pakistan Economic Corridor

The northern areas of Pakistan are home to a large variety of fragile ecosystems recognized globally, including temperate deciduous forests, coniferous alpine forests, tundra and grasslands. The mountain ecosystems in these areas include glaciers which support biodiversity and are an important source of freshwater for local communities as well as downstream populations. These mountain ecosystems are also an essential source of livelihood for the communities that dwell in this high-altitude region. With extreme weather and climate change related challenges, including glacial melting and glacial lake outburst floods, the vulnerabilities of local communities are exacerbated. Poverty and the extreme dependence of these communities on natural resources is a major challenge. Ensuring ecological balance to avoid the impact of natural disasters emphasizes the need for an ecosystem-based approach. Conservation of natural resources is crucial for ensuring ecosystem services on a long term basis.

The China-Pakistan Economic Corridor (CPEC) is a key component of BRI. Among BRI's six most important "corridors", CPEC is China's flagship economic corridor. CPEC aims to connect Gwadar Port in southwestern Pakistan to China's northwestern autonomous region of Xinjiang. This economic corridor is considered central to China Pakistan relations and is viewed as a game changer for the region. CPEC is a framework of regional connectivity involving the development of transportation, energy, industrial and other forms of infrastructure to enhance regional integration and trade flows. The China Pakistan Economic Corridor originates from the northern areas of Pakistan. Described as the "gateway to CPEC", the northern areas have huge potential, particularly in terms of hydropower and eco-tourism; these areas are also rich in natural resources including forest, water, glaciers, biodiversity and minerals to be highlighted.

CPEC represents over 62 billion USD worth of investment in infrastructure. If these infrastructure projects are not planned well, they could have a major negative impact on biodiversity and the livelihoods of local communities. While the benefits of this development project may be significant, there is a need to focus on who these benefits will accrue to, and on the impacts it will have at the local level, especially on the communities that dwell in these areas. While recent glacial melting in the northern areas has already put communities and their livelihoods at risk, the commencement of CPEC now introduces greater threats to both the community livelihoods and the fragile biodiversity and ecosystems on which the livelihoods of the communities depend.

As CPEC gains momentum, environmental considerations need to be fully factored in, as early as possible. The construction of roads, railways and pipelines – which CPEC entails, for instance, while reducing the costs of transportation, may cut through the

natural wilderness, leading to biodiversity loss in the area. Other construction projects, such as the setting up of hydropower plants, can also lead to habitat fragmentation, deforestation, and groundwater and soil pollution. Given the dependence of local communities on these resources for their livelihoods, it is likely that such development projects may leave them worse off. Displacement of these communities is also an issue, as is the over-harvesting of resources for commercial purposes, in which case the benefits may not accrue to the locals. The clear connection between environmental degradation and livelihood opportunities means that it is vital that certain measures be in place to safeguard both. A number of eminent Chinese environmentalists have been widely involved in the studies on CPEC. These studies concluded that virtually every ecological region in the country will be impacted by CPEC projects.

The Parliament of Pakistan adopted the SDGs as its own national development goals in February 2016. The SDGs were subsequently internalized in the national development framework and embedded in the Pakistan Vision 2025 document. A National SDG Framework has also recently been adopted with clearly defined priority targets, indicators and baseline values. Greening BRI and CPEC directly aligns with National Priority Target 9.2 for delivery of SDG 9, i.e. “Promote inclusive and sustainable industrialization and, by 2030, significantly raise industry’s share of employment and gross domestic product, in line with national circumstances, and double its share in the least developed countries”. In addition, the greening of the BRI and CPEC will also support the delivery of a range of national priority targets across other SDGs.

International Union for Conservation of Nature and Natural Resources—IUCN is collaborating with the Government of Pakistan on a project in the northern areas of Pakistan. The project focuses on addressing the impact of CPEC on the region’s biodiversity. As part of the project, IUCN will undertake comprehensive Strategic Environmental and Social Assessments of proposed investments and establish a Technical Advisory Panel composed of Pakistani and Chinese sustainable development experts. These experts will review proposed infrastructure development investments in the northern areas and provide recommendations on mitigating impacts to both the Government of Pakistan and the Government of the People’s Republic of China.

To begin with, the governments of China and Pakistan can jointly conduct a Strategic Environmental Assessment of CPEC. For all CPEC projects, the governments of China and Pakistan should ensure that EIAs meet certain criteria, and that mitigation measures are implemented.

Additionally, there must be focus on Key Biodiversity Areas that require special avoidance and mitigation measures. Chinese state-owned and private enterprises that are implementing projects in Pakistan should allocate a reasonable budget for

environmental and social investments in impacted areas and communities.

Last but not the least, efforts could also be undertaken with the general public. There are opportunities to initiate crowdfunding campaigns to support ecosystem restoration, reforestation, and carbon emission reduction activities.

8.5.2 Case 2: China-Malaysia Qinzhou Industrial Park

China-Malaysia Industrial Park located in Qinzhou, Guangxi Zhuang Autonomous Region, is one of the most exemplary cases on BRI green development. Guangxi plays an important role in the development of BRI with special advantage in green development. Located in the South of Guangxi, Qinzhou is at the intersection of the Silk Road Economic Belt and the Maritime Silk Road and the frontier of China-ASEAN cooperation. In recent years, Qinzhou has been attaching great importance to ecological civilization construction and green development, especially the green development of China-Malaysia Qinzhou Industrial Park (CMQIP). It is believed that the experience of CMQIP in green concept promotion, system construction, planning and policy implementation is of great value to other countries and regions in greening the Belt and Road.

CMQIP is a flagship project of China-Malaysia investment cooperation. With a planned area of 55 km², CMQIP prioritizes the development of bio-technology, medicine, electronic information, equipment manufacturing, new energy and new material, modern services and major industries of ASEAN. CMQIP aims to build CMQIP into a high-end industrial cluster, a model park for industry-city integration, an area with rich scientific, education and human resources, a pilot zone of international cooperation and free trade as well as a flagship project of China-Malaysia cooperation and a role model zone of China-ASEAN cooperation. CMQIP Phase I covers an area of 15 km², including the 7.87 km² start-up area. The positioning of CMQIP is an advanced manufacturing base, an information corridor, a modern town of culture and a platform for cooperation and exchange.

8.5.2.1 Practices of CMQIP in promoting green development

(1) Practice 1: Incorporating green development in China-Malaysia Qinzhou Industrial Park Regulation

Legislation for industrial parks is rare in China. However, to support and promote the development of China-Malaysia Qinzhou Industrial Park, the Standing Committee of the 12th People's Congress of Guangxi Zhuang Autonomous Region adopted China-Malaysia Qinzhou Industrial Park Regulation in 2017. The Regulation is the bases for the development of CMQIP, content related to green development include:

Article 28 of Chapter 4 has stipulates: CMQIP shall follow the concept of green development, build a green industrial system and spatial layout, improve ecological protection facilities and measures, promote eco-industries, establish an energy-conservation, environment-friendly and smart industrial park, and build a new eco-city which integrates industries and urban areas.

Article 34 of Chapter 4 stipulates: CMQIP shall establish and improve its system of ecological and environmental protection indicators; promote recycle of energy, comprehensive use of water resources, reduction, innocuous treatment and recycle of waste; and control the total discharge of key pollutants and promote low-carbon and circular economy.

CMQIP shall toughen environment threshold on market access; improve construction of environment infrastructure; promote the environment industry; put a ban on industrial projects with high energy consumption, high pollution and high environmental risks; support the development of enterprises with low energy consumption and low emission; encourage clean production in businesses; and protect and improve the environment.

(2) Practice 2: Incorporating green development in the Master Plan of CMQIP

Master Plan of CMQIP was approved by the government of Guangxi Zhuang Autonomous Region in June 2013. The Master Plan identified the six overall requirements of high-quality development, industry-city integration, innovation in mechanism, openness and win-win cooperation, wealth and harmony, green development, in which “green development” is one of the major goals and principles.

The Master Plan was amended in January 2018 to highlight green industrial development through adjusting the six priority industries of equipment manufacturing, electronic information, food processing, traditional and new materials, bio-technology and modern services to seven priority industries of electronic information, smart manufacturing, bio-medicine, new energy, new materials, modern services and traditional ASEAN industries. Equipment manufacturing with high energy consumption and food processing with heavy pollution are removed from the list of priority industries.

(3) Practice 3: CMQIP is committed to building itself into a national green industrial park

Related departments of the central government (e.g. Ministry of Industry and Information Technology) attach great importance to the development of green manufacturing and green industrial parks and have released the Green Industrial Development Plan (2016—2020), Guidelines for the Development of Green Manufacturing Standards and Industrial Energy Conservation and Green Standardization Action Plan (2016—2020) to encourage and support

the green development of industrial parks. As an industrial park under construction, CMQIP has been regarding becoming a national green industrial park as its primary goal; CMQIP has been promoting and improving the construction and management of the Park according to related documents released by the central government.

(4) Practice 4: Implementing ecological redlining

CMQIP Authority commissioned professional agencies to work out Research Report on Ecological Redlining of China-Malaysia Qinzhou Industrial Park. The Research report identified the ecological redline of CMQIP, defined Class 1 ecologically controlled area that includes the mangroves and Class 2 ecologically controlled area that includes wetlands. The Research Report also identified specific rules and regulations for the two kinds of ecologically controlled areas. Damaging and forced restoration of mangroves are prohibited in Class 1 ecologically controlled area; development activities are restricted and ecological conservation and restoration efforts are encouraged in Class 2 ecologically controlled area. The Research Report also identified the proportion and layout of space for ecological functions.

(5) Practice 5: The municipal government of Qinzhou incorporated green development into the assessment of CMQIP

The municipal government of Qinzhou carried out assessment of CMQIP according to Implementation Plan for the Trial Assessment of Industrial Parks in Qinzhou, covering water and soil conservation, geographical disaster risks, mineral resources, earthquake resistance capacity, climate impact and the protection of cultural relics.

8.5.2.2 Initial progress of CMQIP in green development

First, environmental quality in CMQIP remained stable. CMQIP attaches great importance to the development of distributive energy and solar power generation. Data captured by local environmental authorities show no significant difference in environmental quality in CMQIP and other areas of Qinzhou City. Besides, the water environment functioning zone met water quality standards with no significant water pollution incident.

Second, CMQIP witnessed continual improvement in major environmental indicators. CMQIP achieved a better performance than the national average of green industrial parks in major indicators for green development, including per unit GDP energy consumption, water consumption, COD, SO₂ emission, NO_x emission, ammonia nitrogen emission and the comprehensive utilization rate of industrial solid wastes.

Third, progress has been made in the development of green buffer zones. The buffer zones on both sides of the road and the coast have been basically built to effectively protect mangroves and wetlands.

Fourth, industries developed in CMQIP meet the requirements for green and

environmental-friendly industries. CMQIP developed and implemented strict rules for the approval of companies to be settled in the Park according to the Master Plan. By the end of 2018, 350 companies have settled in CMQIP. They are mainly engaged in modern services, including financial services, modern logistics and cultural development, modern manufacturing, including electronic information and modern equipment manufacturing, and strategic emerging industries, including bio-medicine, Nano-technology and cloud computing.

8.5.2.3 Experience of the green development of CMQIP

First, sticking to the concept of ecological priority and green development. The Chinese government is promoting ecological civilization construction nationwide with ecological priority and green development as the core. Ecological priority means that development should never cross the ecological red line and should always regard ecological conservation as an important goal; green development means promoting energy conservation, environmental protection and ecological conservation.

Second, incorporating green development into every aspect of Park planning. Green development must be incorporated into the plans for the development, operation and management of the Park to ensure that all activities in the industrial park and all functional zones follow the principles of green development. Therefore, it is necessary to incorporate green development concepts, including energy conservation, environmental protection and ecological conservation, into the construction and development plans of the industrial park.

Third, incorporating green development into legislation. The construction and development of industrial parks is a long-term, complex process that requires the support of legislation. To ensure the implementation of green development concepts in the construction and operation of industrial parks, it is necessary to incorporate green development into industrial park legislation, making compliance with green development principles a legislative duty.

Fourth, incorporating environmental considerations into the approval of projects. Industrial parks are established to promote industrial development. To ensure green development of the parks, projects with high energy consumption, heavy pollution and occupation of ecological resources should be prohibited. An inspection and approval system needs to be established to ensure that only green projects are allowed in the park.

Fifth, establishing a green development dynamic assessment mechanism for industrial parks. It is necessary to establish a dynamic assessment mechanism for the green development of industrial parks to identify projects and businesses failing to comply with green development principles. Related projects and businesses should be asked to solve

the problem within a certain period of time and should be expelled from the industrial park in case they failed to do so. Therefore, a project withdrawal mechanism should also be established.

8.6 Policy Recommendations

The United Nation 2030 Agenda for Sustainable Development is a far-reaching framework for all the countries in the world as the goal and consensus to develop and achieve in the future. However, the significance and benefits of building green Belt and Road may differ for countries along the route. Only when all the parties recognize the positive role of greening Belt and Road in their long-term sustainable development can cooperation under the Initiative advance. Therefore, firstly strategic coordination between countries' implementation plans of sustainable development and the green Belt and Road Initiative, should be enhanced without violating the main principles of BRI, including inclusiveness, coordination, consistency and capacity-building. Secondly, by understanding the essence of the green Belt and Road Initiative, the concept of green development needs to be embedded into the efforts in achieving the “Five Goals” (namely policy coordination, facilities connectivity, unimpeded trade, financial integration and people-to-people bonds) and reduce the adverse effect to ecological environment during the implementation of BRI. Greenization of activities related to promoting “facilities connectivity” and “unimpeded trade” is the focal point while the goals of “green policy coordination”, “green financial integration” and “green people-to-people bonds” could function as policy and financial support and be conducive to create an amicable external atmosphere (Figure 8-2).



Figure 8-2 The main principles of green Belt and Road Construction

8.6.1 Play an active role in global environmental governance and climate governance, transforming BRI into an important instrument for global ecological civilization construction and building a green community of common destiny

(1) Forging the international partnership and network for green development on the platform of green Belt and Road. The international community needs to make concerted efforts to respect nature and to stress green development. Ecological civilization construction is not only an effective attempt of China in promoting sustainable development as the largest developing country in the world, but also an important concept and path provided by China for global environmental governance. In developing the Belt and Road, the concept of ecological civilization to provide Chinese wisdom to constructing green human community of shared destiny as well as models and experience that could help late-comers in green development to avoid reliance on traditional path and lock-in effect need to be followed so as to help more countries and regions to accept and implement sustainable development.

(2) Enhancing ecological and environmental cooperation on the Belt and Road through establishing the BRI International Green Development Coalition. The Coalition is an open, inclusive and voluntary international network. The Coalition will provides a platform of policy dialogue and communication, sharing ecological civilization and green development, and facilitating green development into the implementation of BRI. It will promote international consensus and collective actions. Meanwhile, the Coalition will provides a platform of knowledge and information, bringing together international think tanks, carrying out joint research and jointly promoting Belt and Road participating countries to implement the 2030 Agenda.

(3) Participating in global environmental governance and jointly promoting ecological civilization construction worldwide on the platform of green Belt and Road. Active involvement in the reform and construction of the global environmental governance system is needed. Moreover, an increase in the awareness of countries along the Belt and Road in building a community of shared destiny with shared responsibilities and benefits and develop international rules through joint discussion and negotiation to conduct global environmental governance is also needed. Launching fair rules for global environmental governance with the interest of all sides being taken into consideration, promoting capacity building in global environmental governance, offering a new path and new plans for the implementation of the 2030 Agenda on a global level and advancing the global environmental governance system could be elements of solution.

(4) Promoting the concept of ecological civilization and facilitate consensus on

ecological civilization achieved on the platform of green Belt and Road. The concepts of ecological civilization and sustainable development are both formed against the background of deep adjustment in the global economic governance system. The two concepts aim at building a green home for the human society, and therefore have a lot in common regardless of their difference in perspectives, stands and expression of the final goal. As a result, promoting the alignment of the development of the green Belt and Road and the United Nations 2030 Agenda and the mutual learning, understanding and support of ecological civilization in China and sustainable development in countries along the Belt and Road could advance the global green agenda.

8.6.2 Promoting strategic alignment in the development of the green Belt and Road with connection of policies, planning, standards and technologies

8.6.2.1 Promoting strategic alignment in constructing a green Belt and Road

(1) Integrating green development into the Belt and Road projects as an important part of the MOUs on the Belt and Road construction between China and related countries and international organizations. Any MOU should include contents related to ecological civilization and green development concepts, jointly building a green Belt and Road, promoting the alignment of the Belt and Road development with the United Nations 2030 SDGs. Making full use of the bilateral strategic agreements between China and countries along the Belt and Road and international organizations to establish ecological and environmental work groups who are responsible for the alignment of strategies and plans on green development is needed.

(2) Making full use of platforms for communication to promote strategic alignment. Negotiation with related parties is needed to establish a fixed panel on the development of green Belt and Road under dialogue mechanisms such as the Forum on China-ASEAN Environmental Cooperation, Euro-Asia Economic Forum and China-Arab States Environmental Protection and Cooperation Forum. It is also suggested to resort to the Advisory Committee and the Communication Office of BRF to set up a parallel panel on green development of the Belt and Road. The Panel aims to discuss project construction, financing guidelines and technical standards for the development of the green Belt and Road to promote strategic alignment in standards and rules.

(3) Promoting ecological and environmental protection policy alignment with hosting countries. The Belt and Road projects need to be strictly monitored so to have a clear understanding of their impact on local and global environment; the implementation of an international partnership can support a successful monitoring system. The partnership should

be involved in outlining a Belt and Road policy coordination and in defining an overall and internationally accepted notion of “Green vs. Non Green”.

(4) Promoting alignment of the Belt and Road and South-South Cooperation. The BRI overlaps with South-South Cooperation in many aspects. Therefore, strengthened efforts in promoting the Belt and Road strategy under the framework of South-South Cooperation to make it a model for South-South Cooperation between China and developing countries is needed. An international research group needs to be established to help developing countries to better understand green development and sustainable development.

8.6.2.2 Integrating ecological and environmental cooperation into the whole process of implementing BRI

(1) Enriching and stressing content related to ecological and environmental cooperation in the planning for the development of BRI. It is necessary to formulate the Guidelines for Compiling Belt and Road Development Cooperation Plan that mandate the inclusion of ecological and environmental protection and cooperation on green development in Belt and Road development planning and guide authorities to enrich the content of related chapters in comprehensive plans and sector-specific plans and include the building of green Belt and Road as a key part in related documents in the future.

(2) Jointly working on ecological and environmental protection plans with the Belt and Road countries, particularly those with multiple collaborative projects. Joint analysis of ecological and environmental protection and green development plans with the Belt and Road countries together with infrastructure connectivity and international industrial capacity cooperation plans and prominent ecological and environmental challenges is needed. Such analysis needs to be updated regularly.

(3) Facilitating cooperation and application of environmental standards. Efforts on the coordination of standards for green infrastructure of China and Belt and Road countries are needed. Through joint research, a set of international standards widely acknowledged by Belt and Road countries, in green transportation, green architecture, and green energy should be developed. Relying on the Belt and Road Center for Environmental Technology Innovation and Transfer, as well as on the demonstrative base for industrial cooperation, support to businesses cooperating within Belt and Road countries, and jointly releasing environmental industry standards recognized along with relevant associations should be provided.

(4) Promoting technical alignment among different Belt and Road projects. Belt and Road projects are mostly transnational and extremely complex to develop due to stringent technical constraints. A special commission should be established in order to develop, over the years, agreed major Belt and Road technical standards, defined for key sectors, with the

intent to simplify public tenders and international bidding procedures.

8.6.3 Safeguard mechanisms for constructing a green Belt and Road from its source, and guiding green investment with mechanisms of green finance and ecological impact assessment

8.6.3.1 Supporting the development of Green Belt and Road with green finance

(1) Adopting green financial tools for greening the Belt and Road on the global level. First, Belt and Road green investment and financing principles need to be further studied. Principles and guidelines for Belt and Road green investment and financing according to the United Nations 2030 SDGs and the Paris Agreement in reference to international rules and standards need to be developed. These principles and guidelines, once launched, need to be promoted in countries along the Belt and Road. Second, multilateral Belt and Road green investment and financing guarantee institutions need to be established to provide guarantee for investment and financing in green projects and energy conservation and emission reduction projects to share risks and attract the private sector to invest in green industries. The guarantee institutions are non-profit, market-oriented institutions guiding and promoting the development of Belt and Road projects. Third, an environmental and social information database on the Belt and Road Ecological and Environmental Protection Big Data Service Platform needs to be established to provide information services to investors, lenders, financiers and property owners along the Belt and Road. Fourth, financial institutions along the Belt and Road need to disclose environmental information, so as to promote the green development of financial institutions while helping businesses to pursue green development and achieve green economic development and improvement in environmental quality.

(2) Encouraging countries along the Belt and Road to regard green finance as an important instrument to realize the transition to a green development model. Improving the capability of Belt and Road countries in developing green finance and encouraging them to share experience in this field. First, by encouraging the development of green industries, sectors and customers and fostering growing demand for green investment and financing. Second, by launching financial regulatory policies to encourage financial institutions to actively support the development of green industries, sectors, companies and customers, guide and encourage financial institutions to establish green investment and financing mechanisms and form a long-term mechanism for promoting green economic and social development with green finance. Third, by nurturing responsible investors.

(3) Giving full play to the role of financial institutions as agents to improve the environmental performance of corporate customers. First, by encouraging financial

institutions to establish a clear strategy for the development of green finance. They need to identify the strategic goals for green finance, foster green philosophy and values, improve the organizational structure of green finance and actively expand the market of green finance, so as to effectively control environmental and climate risks. Second, by establishing and improving green finance policies and systems for overseas operations. Environmental and climate factors present both risks and opportunities, which require financial institutions to carry out in-depth research to assess and effectively control environmental risks and launch innovative green finance products for optimized green finance services. Third, by establishing an environmental and social risk assessment toolkit on the basis of international standards such as IFC Environmental and Social Performance Standards and the Equator Principles, to analyze the environmental and social conditions along the Belt and Road. Fourth, by ensuring the lifecycle management of environmental and social risks through incorporating environmental and social risk management into credit and investment management before, during and after an investment is made. Fifth, by implementing environmental information disclosure through establishing the system and framework of environmental information disclosure and improving the capability of information disclosure. Sixth, by designing a mechanism to address environmental and social risks.

8.6.3.2 Establishing ecological and environmental impact assessment mechanism for Belt and Road projects

(1) Establishing the environmental assessment rating mechanism for Belt and Road projects. An environmental impact assessment and management database for Belt and Road development and investment projects needs to be set up to include ecological and environmental impact into the Belt and Road development project rating system and risk rating system and conduct risk assessment to Belt and Road development projects in terms of economic risks, political risks, social risks, cultural risks and ecological and environmental risks. Identification of the ecological and environmental impact of investment projects on different dimensions such as ecological security and environmental pollution and assess the environmental benefit of these projects is also needed. The assessment results could become an important reference for developmental and policy-based financial support.

(2) Developing EIA tools for Belt and Road projects. Tools for the identification, assessment, monitoring and management of environmental, climate and social risks of development and investment projects, carry out research on investment and consulting service tools with full visibility to policy, laws and regulations, data and information and develop country-specific ecological and need to be developed along with environmental information system and assessment tools for key investment destinations along the Belt and

Road as well as technical supporting tools for greater availability of public environmental data. Comprehensive and in-depth assessments of ecological and environmental risks in ecologically sensitive and vulnerable areas need to be conducted along with establishing lists of risks and control measures and requiring investment projects to carry out the tasks and requirements of related lists. In terms of the range of assessment, the inclusion of ecological health and climate change into environmental assessment on a voluntary basis with regard to international hotspot issues needs to be promoted.

(3) Improving the EIA platform and procedures for Belt and Road projects. An environmental protection assessment consulting service platform along with an investment and financing information sharing platform among governments, businesses, banks and other stakeholders are needed to conduct independent assessment and discussion of “Belt and Road” development project information disclosure and to ensure the implementation of environmental and social security measures of related projects and protect the interests of stakeholders.

(4) Encouraging the participation of stakeholders in the EIA procedures. Stakeholders need to be encouraged to comprehensively and effectively engage in environmental impact assessment and implement projects strictly in line with legislations and regulations in the hosting countries. It is important to ensure objective and scientific judgement and eliminate potential risks and hidden dangers.

8.6.4 Constructing a mechanism for Belt and Road project management and promoting the business to adopt practices on green development

(1) Strengthening green supply chain management. Integration of China’s and international competitive industries into a green global supply chain system is needed. By joining government departments, institutions and enterprises of the Belt and Road countries together, a regional green supply chain system can be developed. Each country can bring its industrial and market advantages into full play, which makes international cooperation more extensive, deeper and to higher level. Besides, full use of the Belt and Road green supply chain cooperation platform to support and encourage enterprises should be made to actively get involved in foreign trade and investment cooperation and to promote green innovation. Pilot demonstration projects of green supply chain management, development of green supply chain environmental management policy tools and promotion of green development of the entire industrial chain of production, distribution and consumption should be carried out. A green supply chain performance measurement indication system to evaluate the performance of the enterprises and improve corporate social responsibility for sustainable development

needs to be developed.

(2) Exploring to set up the Belt and Road Green Development Fund. It is necessary to enhance financial input, and safeguard the implementation of green Belt and Road related work. We need to promote to set up a special fund for resource development and environmental protection, with priority given to supporting environmental infrastructure, capacity building and green industries of countries along the Belt and Road. Meanwhile, it is necessary to give full play to the leading role of policy banks such as China Development Bank and the Export-Import Bank of China, to guide and encourage the pooling of all kinds of resources to the Green Development Fund. It will support and bring new momentum to green Belt and Road.

(3) Developing green value chain. First, China should strengthen the capture and promotion of the spillover of green technologies of developed countries, improve the capability of developing countries in adopting the green technologies of developed countries and promote the application of the advanced green technologies in countries along the Belt and Road. Second, China should promote the development of Green Value Chain in international productive capacity cooperation and industrial parks through promoting the recognition and application of industrial rules and regulations on environment to promote energy conservation and emission reduction in industries with heavy pollution, and developing incentives and supportive policies to nurture and develop clean energy and other environmental-friendly industries. Third, China should guide the development of Green Value Chain with green standards and labeling. It is necessary to develop green standards for key stages of the product lifecycle and players on the value chain, ensure environmental-friendly input and output along the value chain and establish green standards and assessment and certification mechanisms for raw materials used in production and the finished products.

(4) Facilitating trade in environmental goods and services. Facilitating trade in environmental goods and services will bring huge environmental benefits to countries along the Belt and Road. Increasing market openness for environmental products and services, developing green industries, and encouraging the import and export of environmental products and services related to air pollution control, water pollution prevention and control, as well as solid waste management and disposal technologies and services to be promoted. Differentiating policies for green products and non-green products, and providing classified guidance and management for product trade and investment, such as reducing tariffs of green products, offering special or preferential customs treatment, listing green products as an encouraged category for industrial investment, as well as providing green financial services is recommended. Seeking concessional loans for green projects from international financial

institutions such as the World Bank and the Asian Development Bank is also encouraged. Besides, improving green product identification and labeling systems and mutual recognition of green products between countries, as well as encouraging more procurement of products with eco-labels by governments along the Belt and Road is also recommended.

8.6.5 Building a green Belt and Road through enhancing people-to-people bond, and enhancing personnel exchange and capacity building

(1) Making the Green Envoys Program for Maritime Silk Road the flagship activity for environmental protection capacity building. The Green Envoys Program (upgraded to Green Envoys Program for Maritime Silk Road in 2016) functions as an important platform for China to carry out South-South environmental cooperation and to promote regional sustainable and green development. The Green Envoys Program for Maritime Silk Road should be the flagship activity, capable of enhancing public awareness on environmental protection and strengthening capacity building in the countries along the Belt and Road. By advancing “policy communication” and facilitating “people-to-people bonds”, China will strengthen cooperation and exchanges in environmental management, pollution prevention and control, green economy and other fields through providing environmental management personnel and professional training, as well as policy guidance, and share China’s ideas and practices realizing ecological civilization and green development. Local governments should be encouraged to participate in the Green Envoys Program for Maritime Silk Road, and guide environmental protection enterprises to “go global” in an orderly manner via platforms such as China-ASEAN Demonstration Base for Environmental Technology and Industry Cooperation and the Belt and Road Environmental Technology Exchange and Transfer Center (Shenzhen).

(2) Supporting and promoting exchanges and cooperation of environmental protection social organizations between China and countries along the route. A supporting network ensuring government guidance, enterprise support, social participation, and industry mutual assistance needs to be established. Roles of government entities that are responsible for cooperation should be clarified and overseas environmental responsibilities of Chinese enterprises should be defined by issuing policies or guidelines to attract various parties and involve and encourage environmental social organizations to establish a cooperation network of their own. Diversified financial mechanisms and increase government procurement of services by environment protection organizations should be formulated. Special cooperation funds to support environmental protection social organizations to go global should be set up. Participation mechanisms for environmental and social organizations should be designed

so to encourage their involvement in negotiations and decision-making, and create an international communication event list for environmental and social organizations.

(3) Promoting gender mainstreaming and improving the leadership of women. It is necessary to improve the awareness of policy makers on the role of women in social and environmental development and promote the integration of gender mainstreaming in Belt and Road policy development and project implementation. It is important to implement the best practice of gender mainstreaming in the development of Belt and Road projects and promote female government leaders, experts and young scholars in the ecological and environmental protection sector in countries along the Belt and Road to engage in the training program of “Improving the Green Leadership of Women” and share with Belt and Road partners the methods and experience of realizing gender mainstreaming with the help of Green Envoys Program.

Appendix I: Enhancing New Consensus on Green Development: The pathway to China's high-quality development during the 14th Five-Year Plan period

——Policy recommendations from the 2019 AGM
of China Council for International Cooperation on Environment and Development
(CCICED)

The transition from high-speed to high-quality development reconciles the conflict among competing objectives such as unbalanced or insufficient economic development and the needs of people for a better life. This transition can also promote environmental protection, ecological stewardship and sustainable development. Green development constitutes an important part of high-quality development. A broad-based consensus on green development as centered around Xi Jinping's Ecological Civilization Thought is the premise to achieve eco-civilization.

The 14th Five-Year Plan is a period of critical importance for China's high-quality development. Scientific evidence confirms that environmental, climate, ecosystem and biodiversity degradation are worsening at the global level. Ambitious domestic environmental actions need to be aligned with multilateral commitments that include the United Nations Framework Convention on Climate Change's Paris Agreement, the Sustainable Development Goals (SDGs) and the post-2020 global biodiversity framework. The CCICED recommends that the 14th Five-Year Plan (FYP) firmly demonstrates that:

(1) Green development is holistic. Green development includes but extends beyond preventing and controlling pollution, low-carbon and decarbonization and protecting ecosystems to encompass green consumption and production, circular economy, green standards and safeguards, market incentives, green finance and regulations and laws. By realigning the relationship between the economy and the environment, reconciling the conflict, green development in a holistic manner is reducing pollution, improving public health and well-being, reducing waste and improving the efficient allocation of productive resources.

(2) Green development amplifies innovation. Green development creates dynamic new markets in green production, green consumption, and related technologies. Green innovation is a key driver of total factor productivity.

(3) Green development is modernizing consumption. Consumers are willing and able to pay for green consumption. Demand-led green development is a powerful complement to supply-side economic reform.

(4) Green development is supported by integrated indicators, innovative institutions and governance. Green development should revise key development concepts, reform and modernize governance mechanisms, and advance ecological capital accounting. Green development indicators should be integrated and evaluate both policy and cadre performance. Green finance, eco-taxation, green pricing, green procurement and green consumption should work in a coordinated manner to internalize ecological costs.

(5) Green development includes projects with medium and longer-term timelines. The 14th FYP should anticipate and support Beautiful China 2035, climate change targets and 2050 Vision for Biodiversity.

The following sections elaborate on detailed recommendations.

1. Promote Green Consumption

Green consumption is critical to ecological civilization and should be incorporated as a strategic objective in the 14th FYP.

(1) Expand green consumption in key sectors. Include agriculture, transport, e-commerce, housing and buildings, and electronic and other consumer goods.

(2) Expand green products and services supply. Ease market access for green products and services; encourage increased investments in green industries; strengthen the construction of green infrastructure and promote green consumption.

(3) Revise the Government Procurement Law. Government procurement should prioritize green mobility and green buildings, encourage waste minimization, zero-deforestation food supply chains and nature-based products and services.

(4) Promote green supply chains and the circular economy through Extended Producer Responsibility rules.

(5) Reduce plastics. Interim steps include eliminating single-use plastics, reducing upstream plastic use in packaging and implementing waste sorting to recycle plastic waste.

(6) Apply market incentives. Establish a science-based, coherent green labelling and certification system. A green consumption statistical indicator system and national green consumption information platform should be developed. Complement market-based approaches with mandatory green product requirements supported by differential taxes and market credit incentives. Phase out subsidies that disadvantage or impede the circulation of green goods.

(7) Promote the Green Lifestyles Campaign. Encourage demand for green products.

Engage celebrities as frontrunners and motivators for change, as they have a positive influence on consumers' behavior and turn green consumption into new trends. Emphasize the public health and environmental benefits of green consumption lifestyle choices.

2. Advance Green Urbanization

With the advent of the green development model, the digital economy and high-speed train connectivity, the traditional dichotomies between urban-versus-rural development, or industry-versus-agricultural development, are undergoing profound changes.

(1) Reformulate the Urbanization Strategy. The 14th FYP should formulate an urbanization strategy based on ecological civilization. The strategy should move away from the quantity-based model to a quality-based model where green urbanization becomes a key driver of China's high-quality economic development. The Strategy should mainly comprise a green transformation with the focus on city clusters and metropolitan areas, and a green urbanization with the focus on counties.

(2) New understanding of the relationship between urban and rural areas. The new development concept defines the countryside as a new type of economic region rather than a subordinate from the anachronistic industrial perspective. It is necessary to go beyond the traditional concepts of "agriculture, rural areas and farmers" and expand the green supply of rural areas by harnessing technologies such as the Internet and the unique natural environment and culture of the countryside.

3. Promote Green Development in the Yangtze River Economic Belt

The 14th FYP should establish a protection strategy for the Yangtze River Economic Belt (YREB) and set an example for green river basin development.

(1) Accelerate the formulation of a holistic YREB protection strategy: Establish a science-based goal setting and evaluation system, translate the strategic visions for 2035 and 2050 as specified in the 19th National Congress, into a goal setting and evaluation system tailored to the ecological features of the YREB. Lay out the key missions to protect and recover the Yangtze ecosystem in the medium-to-long term.

(2) Ecological compensation: Implement an ecological compensation mechanism featuring "one vertical + multi-horizontal" dimensions. Rely primarily on local budgets for an eco-compensation fund, complemented by incentives provided by the central budget.

(3) Strengthen the hard constraints on YREB ecological protection through the rule of law: The specific requirements for the protection of the Yangtze River and its unique positioning should be codified by a law that establishes basin-wide eco-environmental protection targets and protected areas, and coordinates action between the central and local governments and across different jurisdictions and agencies.

(4) YREB natural capital accounting system: Establish a YREB-wide natural capital balance sheet and related indicators for natural capital accounting to identify the ecological benefits of nature. Share the accounting results across the Yangtze River basin and enhance professional capacity in natural capital accounting.

(5) A cross-jurisdiction digital Yangtze River platform that involves multiple sectors and players: Enhance environmental governance and early warning systems through expanded digital platforms. Establish an “Eco-industry Intelligent Platform” and a cross-regional cooperation platform on green finance. Establish a green supply chain system in YREB.

4. Accelerate Climate Action

(1) Develop a clear vision of China’s low-carbon development: Through an updated Nationally Determined Contribution, set new targets to attain GHG emissions peaking for key sectors and certain regions during the 14th FYP and set an emissions cap during this period. Develop decarbonization pathways to 2050. Accelerate reductions in the total use of coal and expand renewable energy use. Climate mitigation targets should comprise carbon dioxide and other GHGs, including hydrofluorocarbons (HFCs), methane and other short-lived climate pollutants.

(2) Synergetic advancement of economic development, energy revolution, environmental protection and climate action: By giving full play to the National Leading Group on Climate Change, Energy Conservation and Emission Reduction, use the war on pollution to accelerate the optimization of industrial structures, the energy mix, the transportation system and land-use planning to complement climate action. Coordinate targets on economic development, energy reform, eco-environmental protection and climate adaptation. Execute plans, technological advancements, and sustainable investment and financing and other policy measures to promote sustainable development.

(3) Total carbon emission control indicators: The total energy consumption control should be replaced by total carbon emission control (including also non-carbon dioxide GHG emissions). It will not only reduce the percentage of coal use but also boost the growth of clean energy resources, especially zero-carbon energy supplies. Apply “double control” (control of total carbon emission and its intensity).

(4) Incorporate climate change into the Central Environmental Inspection Program: Enhance local climate change institutions and their capacity. Integrate climate change tasks into the existing supervision system for eco-environmental protection.

(5) Step up coal control to win the blue-sky battle with determination: Elaborate a national long-term zero-emission strategy toward the eventual phase-out of coal. Expand subsidies and financing for renewable energy sources and phase out subsidies to fossil

fuels. Accelerate the phase-out of all non-industrial coal use by around 2020 in the Beijing-Tianjin-Hebei and Fenhe-Weihe River Plain regions. Priority for non-fossil fuel energy grid connection.

(6) Activate the carbon market: Improve total emission control objectives and accelerate legislation to enhance a binding national emissions trading system. Implement a system of quota auctions and broaden the scope of carbon pricing to other sectors. A sound carbon market with a strong enforcement mechanism is needed.

(7) Climate adaptation and nature-based solutions: Climate adaptation plans should be integrated into national and local government planning. Seek synergies between climate adaptation and freshwater management, biodiversity conservation, marine governance, human health protection and green infrastructure. Identify key regions, sectors and communities vulnerable to climate-related events, and implement pilot programs in building climate resilience, drawing on recommendations from the Global Commission on Adaptation. Strengthen research and capacity building on nature-based solutions. Enhance effective linkage between climate and biodiversity action to better promote forestry protection and reforestation, and to promote the protection of wetlands, peatlands, grasslands, tidal basins and other ecosystems.

5. Biodiversity Conservation

The 15th Conference of the Parties of the UN Convention on Biodiversity (COP 15) is an important opportunity to implement a new global biodiversity framework and ambitious post-2020 agenda.

(1) Host a successful COP 15. Learning from the successful experience of the Paris climate negotiation, use green diplomacy to build high-level political momentum, enlist businesses, the academic community, non-governmental organizations (NGOs) and the public to contribute to the post-2020 biodiversity framework and its implementation. The Action Agenda for Nature and People should raise public awareness and catalyze cooperative initiatives. Align biodiversity and climate change action through the scaling-up of nature-based solutions. Share with other countries China's successful experiences in building ecological civilization and eco-environmental protection, especially those on ecological redlines system.

(2) Accelerate biodiversity conservation in China. Reference the 2019 IPBES and other scientific reports to enhance species and habitat protection. It should tackle the underlying drivers of biodiversity loss, notably changes in land use, climate change, environmental pollution (including marine pollution) and the invasion of alien species. A robust monitoring and review mechanism should track progress. Comprehensively assess the state of land,

freshwater and marine biodiversity and other ecosystems regularly, using advanced remote sensing and analysis, combined with physical surveys. Publicly disclose assessment results. Strengthen a national management system for protected natural areas mainly comprised of national parks. Demarcate ecological protection redlines. Adopt and enforce comprehensive laws, regulations, market incentives and policies to ensure implementation. Cross-ministry efforts are needed to eliminate ecologically harmful subsidies. Enhance research on breeding and the cultivation and sustainable use of wildlife resources, upgrade technologies to reduce consumption of natural and biological resources and improve the ecological compensation system to benefit local communities. Actively prosecute all illegal wildlife sales and traffic.

(3) Effectively align biodiversity protection with Belt and Road Initiative (BRI). Strengthening the development of Green BRI to promote biodiversity protection. Platforms should be developed to share best practices for environmental, conservation and sustainability impact assessments. Nature-based solution initiatives should be a priority, supported by natural capital assessments and related indicators. Prioritize biodiversity in China's overseas aid; establish safeguards, standards and innovative project finance; promote technical cooperation; and develop eco-tourism and other green markets. Support sustainable trade by initiating cooperative action to enhance green supply chains with a focus on establishing the green supply chain of soy, palm oil, fish, beef, timber and other commodities.

6. Marine Sustainable Development

China should enhance marine ecological protection, actively participate in global ocean governance and enhance governance capabilities for marine ecological protection.

(1) Advance integrated marine governance: The network of protected areas should be activated, including the marine ecological redlines and national park system. Step up long-term baseline research and monitoring, in particular of important habitats, such as coral reefs, mangroves, tidal flats and seagrass beds, and key species, including cetaceans, sea turtles, spotted seals, water birds and fish stocks. Keystone or umbrella species such as the Chinese white dolphins are especially important to monitor. Establish a database to form the basis of marine zoning. Simultaneously consider the multiple objectives of protecting natural resources, biodiversity and ecosystem services. The “non-market” value of ecosystem services in developing China's marine economy should be appreciated. During the 14th FYP period, all plans involving onshore and offshore development must factor in the vulnerability of the offshore ecosystem. A strategic environmental impact assessment of the whole area should be conducted to assess the cumulative impact before proceeding with major development projects.

(2) Support innovative global marine governance: More attention must be directed

to marine sustainable development during the 14th FYP period. Achievable goals on development and protection must be set and measures must be in place. In the development and protection of the deep sea and the exploitation of its resources, China should actively contribute to developing and reviewing international norms for sustainable development resources. China should work with BRI countries on the development of a sustainable marine economy.

7. Green Belt and Road Initiative

The BRI presents a new and important platform to advance multilateral cooperation.

(1) Align the BRI with the multilateral agenda. Develop guidance, policies and tools to align BRI investments with the SDGs, the Paris Agreement and the post-2020 biodiversity targets. BRI investments should prioritize green, climate-resilient infrastructure, support and accelerate decarbonization, and protect areas of ecological importance.

(2) Advance the alignment of sustainable development strategies of BRI countries. Disseminate the concept and best practices of eco-civilization through the International Coalition for Green Development on the Belt and Road. Advance the development of Green BRI by aligning the sustainable development strategies of the BRI countries. Create platforms to support the construction of green infrastructure and green ports in BRI countries.

(3) Develop a precautionary mechanism for green finance. Establish environmental safeguards and an environmental impact assessment mechanism to mitigate environmental risks of proposed projects. Operationalize the Green Investment Principles. Require the disclosure of environmental and climate-related risks. Encourage public feedback before final project decisions are made. Globally, implement high-ambition, binding and measurable BRI green investment and financing principles. Introduce environmental and climate regulations for overseas investments. Domestically, encourage market demand for green financing; encourage financial institutions to establish green investment and financing mechanisms. Formulate and implement green finance development strategy, establish a set of comprehensive risk assessment methods and comprehensive management systems to mitigate environmental, climate, social and other risks in all financing and co-financing initiatives.

(4) Promote green production, trade and consumption. Promote green labels and government green procurement. Develop green supply chain pilot projects.

(5) Strengthen people-to-people ties. Assign MEE staff to become Environmental Counsellors in China's embassies overseas. Implement the program of the Green Silk Road Envoys to build capacity on eco-environmental protection and climate mitigation among young environmental officials and scholars. Enhance exchanges and cooperation among environmental NGOs. Offer training to strengthen women's leadership in environment matters.

8. Cross-Cutting Issues: Technological and institutional innovation

(1) Strengthen research, development and promotion of major low-carbon technologies, such as energy storage technologies, carbon capture and storage (including both nature and technology based), photovoltaic efficiency-improvement technologies, long-term battery storage and other areas of low-carbon/zero-carbon innovation.

(2) Promote technological innovation in urban infrastructure and energy systems, including expanding urban green and nature-based infrastructure and green zones; high-standard green buildings; clean, low-carbon energy systems; stringent energy-efficiency standards for consumer goods like appliances; cooling and lighting systems; and establishing a circular economy system covering waste reduction, sewage treatment and waste disposal.

(3) Establish Beautiful China demonstration zones, such as ecological provinces, cities and counties that are selected as Pilot Demonstration Zones for Building Beautiful China. Best practices will be replicated in other areas.

(4) Strengthen regulations and risk prevention for chemicals, nanomaterials and other substances by providing ongoing risk assessment and risk management for legacy as well as new chemicals, including assessing the acute and chronic effects of new nanochemicals.

(5) Enhance information disclosure and public participation to make full use of the positive contribution by individuals and NGOs. The rules on environmental information disclosure and public participation should be fully implemented and widened.

Appendix II: Progress on Environment and Development Policies in China and Impact of CCICED's Policy Recommendations (2018—2019)

In 2019, good development momentum has been witnessed in global economic development due to multiple factors, such as global trade tension, tightening of the financial environment and rising policy uncertainty. The international community has formed the view that we should still be cautiously optimistic about the world's economic development. According to the latest forecast of the International Monetary Fund (IMF), expectations about the growth rates of major economies such as the United States, Eurozone, Japan and India are all to be lowered. China is the only country in the major economies with raised economic growth rate expectations.

For China, 2019 is a crucial year for building a well-off society in an all-round way. At the same time, marking the 70th anniversary of the founding of new China, it is destined to be a year of focus on China's way to a modern strong country. This year has seen the continuous enrichment and development of Chinese President Xi Jinping's thought on ecological civilization. During the deliberation of the Inner Mongolian delegation at the second session of the 13th National People's Congress on March 5, 2019, President Xi proposed to maintain the strategic focus on strengthening ecological civilization and explore new ways of high-quality development oriented to prioritizing ecology and pursuing green development. At the opening ceremony of the "Belt and Road Forum for International Cooperation," President Xi proposed to pursue open, green and clean cooperation, promote green development, launch green infrastructure projects, make green investments and provide green financing to protect the Earth that we all call home. He also said at the Beijing International Horticultural Exhibition that building a beautiful home is a common dream of mankind. Facing the challenges of the ecological environment, we are one community with shared glory and loss, and no country can be left alone. Only by working together can we effectively address global environmental issues such as climate change, marine pollution, and biological protection, and achieve the UN 2030 Sustainable Development Goals (SDGs). Only by walking side by side can we promote the green development concept well and take on a steady and far-reaching path to global ecological civilization. President Xi's speech not only further consolidated the strategic focus of the whole country at the critical moment of the tough fight against

pollution, it also boosted the confidence to build a beautiful China. At the same time, he also paid attention to the international community and called on all countries to work together to jointly tackle climate change, marine pollution, biological protection and other global environmental issues, build the Earth into a beautiful home and follow a road to global ecological civilization.

Over the past six months or so, under the guidance of Xi Jinping's thought on ecological civilization, the central government and local governments, the government sector, the masses, enterprises and public institutions have maintained the strategic focus, firmly stuck to the tough fight against pollution, maintained high-pressure eco-environmental supervision and rectification, accelerated the reform of the ecological civilization system, focused on key area issues and outstanding environmental issues, and increased ecosystem and biodiversity protection. They have carried out strict environmental law enforcement; promoted industrial, energy, transportation, and land use structure adjustments; and strengthened source control, while vigorously developing green finance and promoting eco-environmental protection in the Yangtze River Basin and Xiongan. Remarkable achievements have been made, mainly including: coal power ultra-low emission and energy-efficiency renovation targets for the 13th Five-Year Plan period were completed two years in advance, establishing the world's largest clean coal power supply system; the target proposed in the Convention on Biological Diversity that the terrestrial area under protection will reach about 17% of land area by 2020 was completed ahead of schedule; the carbon intensity was reduced by about 46% compared with the 2005 level, fulfilling the 40% ~ 45% carbon intensity reduction target for 2020 on the basis of 2005, three years ahead of schedule. At present, green development is overwhelmingly prevailing over the previous development models that pay no attention to eco-environmental protection and sacrifice the ecological environment. In many places, new and old growth drivers are shifting in an accelerated manner, and the model that promotes high-quality development with environmental protection and achieves higher productivity development through eco-environmental conservation is becoming the mainstream. Some enterprises are losing their unequal financial advantage previously obtained at the cost of the environment. More socially responsible enterprises with good product quality and high-level eco-environmental protection have become the main force for high-quality development. The new ways of ecological civilization governance, including the implementation of the river chief system, have made the "public land" a "responsibility field" under the leadership of the government, and the ecological environment that bears social and human civilization, as well as the most inclusive public services, is allowing more and more people to enjoy the beauty of "harmony between man and nature."

As a direct policy shuttle to the Chinese government which also serves as a bond, a bridge and a window for China and the international community to cooperate in environment and development, CCICED has been changing with the times and carrying out reforms and innovations. In response to the typical and prominent environmental and development issues in China in the new era, it has fully mobilized intellectual resources at home and abroad, conducted much innovative and leading policy research in areas like green urbanization, and achieved periodic results and proposed preliminary forward-looking, strategic and early-warning policy recommendations. It continues to contribute its wisdom and strength to China's ecological civilization and sustainable world development.

1. Environmental and development plans

1.1 The 14th Five-Year Plan(FYP) for Environment and Development has begun to brew

At the beginning of December 2018, the National Development and Reform Commission (NDRC) held a symposium on the preparation of the 14th FYP in Beijing. The meeting mainly focused on the mid-term evaluation of the 13th FYP, the connotation and characteristics of the 14th FYP period as a strategic opportunity period, the main theme and thread of development in the 14th FYP period, and the major issues that need to be highlighted in the development of the 14th FYP period as well as the basic ideas of five-year planning.

The relevant research department of the Ministry of Ecology and Environment (MEE) held a symposium on the country's 14th FYP for eco-environmental protection in April 2019, focusing on the strategic positioning of eco-environmental protection in the national economic and social development in the 14th FYP period, investigating how to maintain and implement the concept to "put ecology first and pursue green development," aiming at the 2035 strategic goal to achieve a fundamental improvement in eco-environmental quality and basically build a "Beautiful China," actively planning strategic tasks that reflect the improvement of environmental quality so as to make a fundamental breakthrough in phased targets.

The study on the 14th FYP for national economic and social development needs to be linked to the mid-term evaluation of the 13th FYP and also needs to focus on the overall development strategy and new requirements of the country, forming a systematic and strategic layout for 2035. According to the procedures for the formulation and implementation of the 13th FYP, preliminary research should be done for the 14th FYP. The central government will then formulate planning proposals based on which a planning outline will be made and submitted to the National People's Congress for adoption and implementation.

1.2 Green development plan for the Greater Bay Area

In order to better promote the overall coordinated development of the Greater Bay Area,

in February 2019, the Central Committee of the Communist Party of China and the State Council issued the Outline of the Development Plan for the Guangdong-Hong Kong-Macao Greater Bay Area (hereinafter referred to as “Outline”).

The *Outline* aimed to establish and implement a firm belief that green mountains and clear water are valuable assets, treat the ecological environment like we would treat our own lives, and implement the most stringent eco-environmental protection system. It requires adherence to the principle of prioritizing protection and restoring nature, guided by the goal to build a beautiful bay area, focus on improving the quality of the ecological environment, and form a spatial pattern, industrial structure, production mode, and lifestyle that conserves resources and protects the environment, achieves green, low-carbon and circular development, and builds the Greater Bay Area into a place with bluer sky, greener mountains, clearer water and a more beautiful environment. Specifically, the Outline deployed the ecological civilization work for the Greater Bay Area from three aspects: building an ecological protection barrier, strengthening environmental protection and governance, and innovating a green and low-carbon development model.

In terms of building ecological protection barriers, the Outline proposed to implement major ecosystem protection and restoration projects; delineate and strictly observe ecological red lines; strengthen the protection of mountains, hills and forest ecosystems around the Pearl River Delta; strengthen coastline protection and pollution control; reinforce the protection and restoration of coastal sea ecosystems; promote the Blue Bay Initiative and protect coastal mangroves; strengthen Guangdong-Hong Kong-Macao eco-environmental cooperation; and strengthen wetland protection and restoration.

In terms of strengthening environmental protection and governance, the Outline emphasized water resources protection and water environment management, and proposed to carry out cooperation on water resources, water environment and water-related project management in the Pearl River estuary. It focuses on rectifying pollution on the eastern and western banks of the Pearl River; strengthening the management of land-based source pollution projects, water-related projects, and shoreline and tidal flat; stepping up the protection of marine resources and environment; implementing total pollutants control in Dongjiang River, Xijiang River and the river network area of the Pearl River Delta; and strengthening the protection of the water environment and aquatic resources in important rivers. In addition to strengthening the management of heavily polluted river systems such as the Shenzhen River, it promotes urban black and odorous water body improvement and seeks to connect the Pearl River Delta water network and build a regional green ecology water network.

At the same time, the Outline also deployed air, soil and agricultural pollution prevention and control, and proposed to strengthen regional atmospheric pollution joint prevention and control. It implements a more stringent clean shipping policy and multi-pollutants synergistic emission reduction and coordinates the prevention and control of ozone and fine particulate matter (PM_{2.5}) pollution. In terms of waste, the Outline strengthens the capacity building for regional coordinated disposal of hazardous waste and cross-border transfer supervision, and improves the recycling, reduction and reuse of solid waste. The Outline carries out Guangdong-Hong Kong-Macao exchanges and cooperation on soil improvement and remediation technologies, actively promotes the demonstration of improvement and restoration of contaminated soil, strengthens the safe use of contaminated cultivated land and polluted plots, prevents and controls agricultural non-point source pollution, and ensures the quality of agricultural products and the safety of the living environment. In terms of system security, the Outline proposed to establish a “blacklist” system for environmental pollution and improve the systems for environmental credit evaluation, mandatory disclosure of information, and severe punishment.

1.3 Beijing-Tianjin-Hebei coordinated development and plan

At the beginning of January 2019, with the approval of the Central Committee of the Communist Party of China and the State Council, the State Council made an official reply on the Hebei Xiongan New Area Master Plan (2018—2035), marking a new stage of large-scale development and construction of Xiongan New Area. As a gathering place that undertakes the non-capital functions of Beijing, Xiongan New Area and the Beijing City Sub-center form two new wings of Beijing, which is beneficial to alleviate Beijing’s “big city disease” and explore new models of optimized development in densely populated and economically concentrated areas. In accordance with the requirements for high-quality development, Xiongan New Area should closely focus on the advancement of the overall layout for “economic, political, cultural, social, and ecological progress” and the coordinated advancement of the “Four-Pronged Comprehensive Strategy”; create “Xiongan quality”; set a national example in promoting high-quality development; and build a new engine for the modern economic system.

At the beginning of January 2019, the State Council made an official reply to the Regulatory Plan for the Beijing City Sub-center (Block Level) (2016—2035), which is also a master plan for Tongzhou, Beijing’s sub-center, recognized at the national level for the first time. The city’s sub-center will firmly establish the development concept of innovation, coordination, green, openness and sharing. In accordance with the requirements for high-quality development, the supply-side structural reform will be the main line, and a global

vision, international standards, Chinese characteristics, and high positioning will be adhered to. With the spirit to create history and pursue art, we should closely focus on these priorities: undertaking the non-capital functions of Beijing; the coordinated development of Beijing, Tianjin and Hebei; and ecological protection and continuing the historical context, while attaching importance to safeguarding and improving people's livelihood, and the "integration of plans."

In March 2019, MEE compiled and issued the 2019 Key Work Points in National Atmospheric Pollution Prevention and Control, and clearly proposed to draft the Regulations on Atmospheric Pollution Prevention and Control in Beijing-Tianjin-Hebei and Surrounding Areas. In addition, it sets out goals to study and formulate supporting rules and regulations such as motor vehicle atmospheric pollution supervision in Beijing-Tianjin-Hebei and surrounding areas, and to improve the joint prevention and control work mechanism. It will refine the operational rules of "unified planning, unified standards, unified environmental impact assessment, unified monitoring, and unified law enforcement" and organize implementation; solidly promote the key tasks of clean heating in the northern region; promote ultra-low emission renovation in the steel industry; and adjust the transportation structure.

1.4 Green development of the Yangtze River Economic Belt

In December 2018, MEE and NDRC jointly issued the Action Plan for the Protection and Restoration of the Yangtze River, proposing that, by the end of 2020, the proportion of state-controlled sections with excellent water quality (reaching or better than Class III) in the Yangtze River Basin will reach 85%, and the proportion of state-controlled sections with loss of use function (inferior to Class V) will hit less than 2%. It also set goals for the proportion of eliminated black and odorous water bodies in the built-up areas of cities at or above prefecture level in the Yangtze River Economic Belt to rise to over 90%, and the proportion of centralized drinking water supply with excellent water source quality in cities at or above prefecture level be higher than 97%.

The main tasks include strengthening eco-environmental spatial control and strictly observing ecological red lines; investigating and rectifying sewage outlets and promoting unified supervision of land and water; strengthening industrial pollution control and effectively preventing eco-environmental risks; continuing to improve the rural living environment and curb agricultural non-point source pollution; eliminating environmental infrastructure weaknesses and ensuring the safety of drinking water sources; strengthening the prevention and control of shipping pollution and environmental risks in ship ports; optimizing water resource allocation and effectively meeting ecological water demand; strengthening the

management and protection of ecosystems; and cracking down on ecological destruction.

1.5 Green urban development plan

The 2018 CCICED Policy Recommendations proposed to change the traditional thinking, fully integrate green standards into green urban planning, fully take into account local realities, and find innovative solutions to problems.

On March 31, 2019, NDRC released the Key Tasks for New Urbanization Construction in 2019, which clarified the work requirements in 2019 and proposed that the new urbanization should fully consider the actual carrying capacity of resources and environment. It should also pay attention to coordinated development and make full use of intelligent information technologies for refined management, while collaboratively promoting environmental governance work such as atmospheric pollution control.

The primary task of the new urbanization construction in 2019 is to accelerate the coordinated development of Beijing-Tianjin-Hebei, the integrated development of the Yangtze River Delta region, and the construction of the Guangdong-Hong Kong-Macao Greater Bay Area. The second task is to promote the implementation of the orderly development plans for city clusters, such as Chengdu-Chongqing, Harbin-Changchun, the middle reaches of the Yangtze River, Beibu Gulf, Central Plains, Guanzhong Plain, Lanzhou-Xining, and Hohhot-Baotou-Ordos-Yulin.

Urban spatial layout will be optimized by comprehensively promoting the preparation of urban land and space plans, strengthening the management of “three zones and three lines,”¹ driving the “integration of plans” and promoting urban smart growth. Based on the resource and environmental carrying capacity and the suitability evaluation of land and space development, the national land and space plan will delineate the three control lines for ecological protection, as well as permanent basic farmland and urban development boundaries, and formulate corresponding control rules. Regarding the preparation of urban land and space plans, the plan will guide all regions to take into account factors such as urban open space, atmospheric transport corridors, and change of local diffusion conditions, and jointly promote atmospheric pollution prevention and control.

In strengthening urban infrastructure construction, the urban transportation network system will be optimized, with improvements to non-motor vehicle and pedestrian transportation system and pedestrian crossing facilities, and bicycle lanes encouraged in eligible cities. The plan will implement a policy that develops buses as a priority; promotes the integration of rail transit, public buses and electric vehicles, and facilitates transfer. It

¹ Three zones include urban space, ecological space and agricultural space, and three lines include urban development boundary, permanent basic farmland red line, and ecological red line.

will also continue to promote the construction of water-saving cities and sponge cities; carry out special initiatives for urban black and odorous water remediation and environmental protection; and launch a three-year urban sewage treatment action to improve quality and efficiency. The plan will also urge the northern region to accelerate the promotion of clean heating and focus on the renovation of old residential areas, the improvement of comprehensive service facilities in communities and surrounding areas, and the classification of domestic wastes.

2. Ecosystem and biodiversity conservation

2.1 New progress in ecological red line delineation and ecological protection

By the end of 2018, the ecological protection red lines of 15 provinces including Beijing-Tianjin-Hebei, Yangtze River Economic Belt and Ningxia Hui Autonomous Region were initially delineated, and 16 provinces including Shanxi basically formed delineation plans. By 2020, the ecological red line delineation will be fully completed. At present, MEE is formulating the Measures for the Management of Ecological Protection Red Lines, building a national red line supervision platform, and incorporating red line delineation and implementation into the scope of the central government's environmental supervision. Local Party committees and governments shall be the main force to delineate and safeguard ecological red lines, and hold those who destroy the lines accountable so as to ensure the red lines are well delineated and protected.

Local governments have accelerated the development of ecological red line management methods in line with local conditions. In 2018, Hebei Province promulgated the Measures for the Management of Ecological Red Lines in Hebei Province. On November 29, 2018, Ningxia Hui Autonomous Region promulgated the Regulations on the Management of Ecological Red Lines in Ningxia Hui Autonomous Region, which was officially implemented on January 1, 2019. Jiangxi Province released the Measures for the Management of Ecological Red Lines in Jiangxi Province (for Trial Implementation); Liaoning Province issued the Interim Measures for the Management of Ecological Red Lines in Liaoning Province; Shenyang City issued the Measures for the Management of Ecological Red Lines in Shenyang City; and Hubei Province released the Measures for the Management of Ecological Red Lines in Hubei Province (for Trial Implementation).

The construction of a national ecological protection red line supervision platform has been approved and is expected to be completed by the end of 2020. This platform will rely on satellite remote sensing technologies and ground ecosystem monitoring stations to form an air-space-ground integrated monitoring network that can obtain ecological protection red line monitoring data, show the ecosystem composition, distribution and dynamic changes, assess

and warn of ecological risks in a timely manner, monitor human interference activities in real time, discover behaviors destroying the ecological protection red line, and handle them according to laws and regulations. With this platform, MEE will gradually establish a red line supervision mechanism to strictly monitor and protect ecological red lines and ensure that ecological functions are not reduced, the area is not decreased and the nature is not changed.

2.2 Continuous advancement of the “Green Shield” special action

The “Green Shield 2018” special action on nature reserve supervision and inspection was carried out, and illegal activities involving nature reserves received stringent investigation and handling. Green Shield 2019 continues to deepen eco-environmental protection and governance, and has won the first battle.

Heilongjiang Province will continue to carry out the “Green Shield Action” and the “Green Shield 2019” special action on nature reserve supervision and inspection. It will instruct all cities and counties to form three ledgers based on the “Green Shield 2017” and “Green Shield 2018” special actions, including a general ledger of nature reserves in the Green Shield special action, a ledger of four types of focus issues (quarrying and sand mining, industrial and mining land, tourism facilities and hydropower facilities in the core zone and the buffer zone), and a ledger of problems identified in the inspection. Cities and counties are required to continue to rectify the problems in the ledger to be rectified or under rectification according to the rectification schedule and roadmap, as well as distinguish key points and hold violators accountable. At the same time, the “13 nature reserve issues in need of concentrated improvement” in the General Plan for Rectifying Outstanding Problems in Natural Ecological Protection in Heilongjiang Province issued by the General Office of the provincial Party committee and the General Office of the provincial government will be included in the “Green Shield 2019” special action.

Shaanxi Province will continue to carry out the “Green Shield 2019” special action on nature reserve supervision and inspection. According to the special action arrangement, the province’s ecological environment, natural resources and forestry departments will comprehensively investigate the outstanding environmental problems in the 61 nature reserves of the province, fulfill management responsibilities, and resolutely shut down and ban illegal projects such as mining, quarrying, sand mining, and reclamation in nature reserves. It will gradually dismantle all ground facilities such as oil well sites in nature reserves, speed up the withdrawal of mining rights and small hydropower stations from nature reserves, and strictly prohibit tourism facilities in the core zone and the buffer zone of the nature reserve. It will also crack down on illegal activities involving wildlife and protect biodiversity, carry out orderly ecological governance and restoration in nature reserves, and

gradually establish a long-term regulatory mechanism.

2.3 Preparations for the Conference of the Parties to the Convention on Biological Diversity

The 2018 CCICED Policy Recommendations proposed to actively promote the implementation of the Convention on Biological Diversity and play a strong leadership role in the development of global biodiversity conservation goals after 2020.

In terms of biodiversity compliance, the Chinese government actively established a national protection network as early as 2015. The terrestrial area under protection accounted for approximately 18% of the land area, fulfilling the 17% target for 2020 proposed in the Convention on Biological Diversity five years ahead of schedule. Various provinces and municipalities directly under the central government, such as Chongqing Municipality, Sichuan, Yunnan, and Guangxi, have introduced action plans to protect biodiversity. Yunnan Province has also introduced the country's first local biodiversity protection regulation.

In recent years, the Chinese government has accelerated the pace of biodiversity conservation, and has launched many initiatives and a number of effective actions. The Chinese government has established the China National Committee for Biodiversity Conservation, implemented biodiversity conservation strategies and action plans, launched the UN Ten-Year Action on Biodiversity, and specifically strengthened biodiversity conservation in new relevant policy documents. For example, the revised Environmental Protection Law emphasized the delineation of the ecological red line and required all levels of governments to take measures to protect the rare and endangered wildlife conservation areas, and strictly prohibit destruction. The Opinions on Strengthening the Construction of Ecological Civilization promulgated by the State Council of China pointed out that one of the main objectives is to basically control the loss speed of biodiversity and significantly increase the nationwide ecological stability. It specified that “implementing major projects of biodiversity conservation,” “actively participating in the negotiation and implementation of international conventions on biodiversity,” and “strengthening the construction and management of nature reserves” should be set as key tasks.

As the host country of the 2020 COP 15 on the implementation of the United Nations Convention on Biological Diversity, the Chinese government attaches great importance to strengthening biodiversity work. On April 13, 2019, Vice Premier Han Zheng hosted a meeting of the China National Committee for Biodiversity Conservation. The meeting requested that biodiversity conservation work be further improved. According to the concept that mountains, waters, forests, crops, lakes, and grasses are a community of life, a nature reserve management system with national parks as the main body, nature reserves as the foundation and various natural parks as supplements should be formed. It is necessary to

strengthen the supervision and management of wildlife protection and the management and protection of natural genetic resources, as well as crack down on wild animal hunting and investigate and deal with cases of wildlife resource destruction. It is necessary to do a good job in monitoring and investigating biodiversity through actively implementing COP 15 of the Convention on Biological Diversity, fully implementing host country obligations and ensuring a successful and landmark meeting of the Conference of the Parties.

3. Energy and Climate

3.1 Clean energy transition helps improve the environment

The 2018 CCICED Policy Recommendations proposed to strengthen coal use control, promote renewable energy, and increase energy efficiency. It also proposed to settle renewable energy subsidies that have not been put in place and build a new renewable energy support policy system.

On January 7, 2019, NDRC and the National Energy Administration (NEA) issued the Notice on Actively Promoting the Grid Parity of Non-subsidized Wind Power and Photovoltaic Power Generation (hereinafter referred to as “Notice”). The Notice pointed out that, with the large-scale development of wind power and photovoltaic(PV) power and the rapid advancement of technology, areas with good resources, low construction costs, and good investment and market conditions basically have the conditions to achieve parity with coal power benchmark tariffs (no state subsidies required).

In interpreting the Notice, NEA explained that the promotion of grid parity (low-cost) projects does not mean the immediate cancellation of subsidies to all new wind power and PV power projects. At this stage, non-subsidized grid parity (low-cost) projects are mainly carried out in areas with superior resource conditions and secured markets. At the same time, in areas where it is still impossible to achieve non-subsidized grid parity, construction will still be organized in accordance with the policies and management requirements for competitive allocation projects issued by NEA. However, these projects shall also significantly reduce electricity prices through competition to reduce electricity subsidy intensity. In addition, the *Notice* clarified that local energy authorities at all levels may, in conjunction with other relevant departments, issue local subsidy policies for a certain period of time. Projects that only enjoy local subsidy policies are still regarded as grid parity projects.

Regarding the formulation of new renewable energy policies, NEA pointed out that policies for wind power and PV power projects approved (recorded) after the end of 2020 will be re-studied according to the degree of technological progress and cost reduction.

In response to CCICED’s 2018 policy recommendations on expanding renewable energy development, China’s national energy authority continues to promote a clean, low-

carbon, safe and efficient transition of the national energy system. It focuses on the battle against pollution, and continues to promote ultra-low emission renovation in the thermal power industry, PV poverty alleviation, rural grid transformation, oil quality upgrade, winter clean heating in the northern region and other major projects. It boosts the fundamental improvement in the quality of the ecological environment through energy structure adjustment.

In 2019, the utilization rate of renewable energy power in the country should be further improved, and the curtailment amount and rate should be kept at a reasonable level. By 2020, the problem of hydropower, wind power, and PV power curtailment will be basically solved. While promoting the large-scale development of clean energy, we should vigorously develop distributed clean energy; improve relevant policy guarantees, market mechanisms and standard systems; promote the expansion of pilots and demonstrations; and strive to achieve regional energy supply and demand balance. In 2019, the proportion of non-fossil energy consumption shall increase to 14.6%, the national average wind power curtailment rate should be less than 10%, and the figures for PV power and hydropower should be less than 5%.

3.2 Strengthen energy conservation and improve energy efficiency

The 2018 CCICED Policy Recommendations proposed to strengthen coal use control and increase energy efficiency.

The March 2019 Chinese government work report clearly stated that the energy efficiency indicator for 2019 is that the energy consumption per unit of GDP drops by about 3%. In 2018, China achieved a 3.1% reduction in energy consumption per unit of GDP.

It should be pointed out that the clean and efficient development of coal power in China has achieved periodic progress: coal power ultra-low emission and energy-efficiency renovation targets for the 13th Five-Year Plan period were completed two years in advance, establishing the world's largest clean coal power supply system. In 2019, we will continue to promote the ultra-low emission and energy-efficiency upgrading and renovation of the coal power industry and accelerate the creation of an “upgraded version” of efficient, clean and sustainable coal power industry. We will continuously improve the energy efficiency of coal power units, reduce air pollutant emissions, urge localities and enterprises to implement the goal of ultra-low emission and energy-efficiency renovation of coal power, and increase the efforts on ultra-low emission and energy-efficiency renovation of coal power in western China. Further, we will reduce the impact of power plants on the ecological environment and promote the application of advanced technologies for ultra-low emission and energy conservation in coal power to other coal-fired industries to promote the clean and efficient use of coal.

In addition, with the acceleration of energy transition and the continuous deepening of power system reform, the relationship among energy, electricity and user has become increasingly close. The State Grid Corporation of China proposed to build “three-type and two-network” enterprises¹ and accelerate the construction of world-class energy Internet enterprises. Carrying out comprehensive energy services to meet the diversified needs of energy production and consumption is its key content. This new energy service mode will break the traditional mode of separate planning, separate design and separate operation of different energy varieties. It will realize horizontal synergy among “electricity, thermal energy, cooling energy, gas, and water” and vertical synergy among the energy supply links of “source, network, load, storage, and use.” It will oversee interaction between the production side and the consumption side, thereby improving the comprehensive energy efficiency of the society.

In terms of energy conservation, the National Government Offices Administration held the 2019 key work promotion meeting of central state organs in energy resource conservation and eco-environmental protection in March 2019. At the meeting, they proposed to further improve the energy conservation network, complete the preparation of energy consumption quota standard by central state organ, and push energy consumption quota target management to a higher level. The energy conservation supervision system will be used to improve refined and information-based energy conservation management, and they will continue to cultivate energy conservation and environmental awareness and habits, and carry out waste classification volunteer actions and other encouraging activities. In April 2019, the 2019 key work promotion meeting of national public institutions in energy resources conservation and eco-environmental protection was held. Before the end of December 2019, 200 public institutions will be selected as energy-efficiency pacesetters; before the end of October 2020, 1,500 public institutions will be built into conservation demonstration models.

3.3 Actively promote the coordinated control of greenhouse gases and atmospheric pollutants

The 2018 CCICED Policy Recommendations proposed to strengthen collaborative management in addressing climate change and improve environmental air quality; strengthen the coordination of tackling climate change and other environmental issues in the formulation of laws and regulations and the design of systems for data disclosure, monitoring, law enforcement, supervision, and accountability.

Better coordination of relevant policies and actions will better facilitate synergy in

¹ Three types mean hub type, platform type and sharing type, and two networks indicate strong smart grid and ubiquitous electric Internet of Things.

tackling atmospheric pollution control and climate change targets and measures. According to estimates, for every tonne of Carbon emissions reduced, 3.2 kg of SO₂ and 2.8 kg of NO_x emissions will be reduced accordingly. Over-fulfilling the carbon intensity reduction target is also contributing to atmospheric pollution control. China's energy consumption is dominated by coal, and coal consumption is the most important source of air pollution. The air pollution control action plan formulated and implemented in the past few years has adopted measures such as controlling new production capacity in energy-intensive and high-pollution industries, promoting clean production, accelerating adjustment of energy structure, and strengthening energy conservation and environmental protection constraints. These are also measures to address climate change. Air quality has improved significantly through the implementation of the air pollution control action plan. According to statistics, the implementation of the action plan has achieved an emission reduction of 175 million tonnes of CO₂ equivalent (CO₂e) in the past few years. Actions to improve air quality have played a positive role in achieving climate change goals.

In the next step in fighting climate change, controlling greenhouse gas emissions and air pollution control, and broader eco-environmental protection, further efforts shall be made to coordinate and integrate monitoring and observation, goal setting, policy action plan formulation, and supervision and inspection of the implementation of policy objectives. Coping with climate change will render a synergistic effect on air pollution control in China. At the same time, we must, get ready to launch a national carbon market first in the power-generation industry, implement the National Climate Change Adaptation Strategy, and carry out various low-carbon pilots and demonstrations.

3.4 Solidly push forward carbon market construction

At the beginning of April 2019, MEE officially issued the Interim Measures for the Administration of Carbon Emission Permit Trading for comments. The measures are currently a basic legal framework for the construction and operation of a national carbon market. At the same time, supporting management systems, including carbon market management, corporate carbon emission reporting management, and verification agency management, will be introduced in due course. Seen from the experience of pilot provinces and cities in China, the legal effect of the rules of local governments is far from reaching the purpose of effective supervision. There must be a legal basis at the national level to ensure the sound operation of the national carbon market.

For more than half a year, the pilot carbon markets have made useful explorations in different dimensions, and for example, have accumulated valuable practical experience in including industry coverage and standards, the initial allowance allocation method with “free

allocation as the main method, paid allocation as a supplement and reserved allowance for regulation,” greenhouse gas emission verification standard and other aspects. However, due to the large differences among the pilots, there is no ready-made experience in the national market. The process from pilot to unified market is full of challenges. For example, the carbon price varies greatly from place to place. For example, in 2017, the average transaction price of the Beijing pilot was higher than 50 yuan/tonne; Shanghai, Shenzhen, and Hubei were between 30 ~ 40 yuan/tonne; Guangdong and Tianjin were around 15 yuan/tonne; and in Chongqing, the price can be as low as 1 yuan/tonne. In low-priced regions, even if enterprises are not doing well in reducing carbon emissions, they can still buy allowances at a low price, which inevitably leads to unfairness. The national carbon market needs a top-level design and various supporting systems in place on the basis of examining the different development levels of various regions and industries across the country.

The National Carbon Emissions Trading Market Construction Plan (Power Generation Sector) clarified that carbon market work will start from the power generation sector. A lot of work around the power generation sector has been done, including mobilization, training, allowance allocation technical guidelines, scientific allocation, allowance testing, and capacity building. After completing the relevant technical preparations and building the infrastructure, it will take a period of testing to test the entire system and all procedures of market trading to verify the system stability and reliability. Actual trading will only be possible on this basis. Seen from the actual situation of local pilots and international practical experience, it takes a process from launching the system to realizing transaction.

4. Pollution control and marine governance

4.1 Atmospheric pollution prevention and control

In December 2018, 11 bodies, including MEE, NDRC and the Ministry of Transport, jointly issued a notice on the Action Plan for Pollution Control of Diesel Trucks, proposing that by 2020, the diesel truck emission compliance rate will significantly increase; diesel and vehicle urea quality will significantly improve; total NO_x and $\text{PM}_{2.5}$ emissions from diesel trucks will significantly decrease, concentration of NO_2 in urban areas of key regions will gradually decline; regulation capacity and level for motor vehicle emissions will greatly improve; nationwide railway freight volume will significantly rise; and a green, low-carbon, clean and efficient transportation system will take form. The plan also proposed to carry out initiatives on clean diesel vehicles and strengthen supervision and law enforcement for vehicles in use.

In February 2019, MEE issued the 2019 Key Work Points in National Atmospheric Pollution Prevention and Control and proposed the overall atmospheric environment targets.

In 2019, the annual average concentration of fine particulate matter (PM_{2.5}) in the country's substandard cities should decrease by 2% year on year, the proportion of days with good air quality in cities at or above prefecture level should reach an average of 79.4%, and the total emissions of SO₂ and NO_x in the country should be reduced by 3% year on year. The document provides comprehensive management measures in four aspects, including organizing assessment and evaluation, and strengthening supervision and inspection. The document has put forward focused and targeted guiding opinions in industrial structure, energy structure, transportation structure (diesel truck pollution control), non-point source control, as well as joint prevention and control in key areas, coping with heavy pollution weather and other aspects, which is of great significance for the prevention and control of atmospheric pollution in various regions.

In 2019, the focus of air pollution control will be on the deep-level improvement of the steel industry. The environmental problems in the steel industry have always been a focus of attention in society. Environmental compliance has become an important factor influencing the production and operation of steel plants. In the new round of blue sky defense war, key areas are subject to strengthened inspection, and steel enterprises' air pollution problems are included as key inspection content. On May 5, 2019, MEE, NDRC, the Ministry of Industry and Information Technology, the Ministry of Finance and the Ministry of Transport jointly issued the Opinions on Promoting Ultra-Low Emissions in the Steel Industry (hereinafter referred to as "Opinions"), which identified the overall ideas, basic principles, main objectives, indicators and requirements, key tasks, policies and measures, and implementation guarantee for advancing ultra-low emission work in the steel industry. The second focus of atmospheric pollution control is to promote the implementation of special emission limits for atmospheric pollutants in key areas, and the third focus is to control volatile organic compounds (VOCs). The work of VOC control is heavy and covers a broad range. The relevant 2019 emission standards will be released one after another, and the relevant rectification and consolidation work will be vigorously promoted.

Local governments' efforts on atmospheric pollution control continue to increase. On February 20, 2019, Beijing issued the 2019 Action Plan for Pollution Prevention and Control in Beijing, and proposed more refined and deeper-level promotion measures, including promoting the low emission of mobile sources, as well as proposing measures of replacement, limitation, inspection and efficiency enhancing, such as speeding up the elimination of the National Phase III high-emission diesel vehicles and promoting the use of new energy vehicles. Clean energy consumption is promoted. On the basis of consolidating the "coal elimination" results in the plain area, the operation and maintenance service mechanism

will be improved to prevent the rebound of bulk coal. The focus will be on the villages surrounding the Winter Olympic Games venue and the International Horticultural Exhibition venue to continue to carry out coal-to-clean energy work. The energy-efficiency renovation of public buildings will be accelerated, and the renovation of existing residential buildings that fail to meet energy-saving standards will be continued. On March 6, 2019, Sichuan Province announced the further expansion of the No. 1 Project on air pollution control, and included the improvement of air quality in Chengdu Plain and southern Sichuan in the No.1 Project, highlighting key points and mobilizing the whole region, striving to add four new cities that meet standards. In 2019, Hebei Province will focus on PM_{2.5} control, and continue to fight the “six tough battles” of industrial structure, energy structure, transportation structure and land structure optimization and adjustment, striving to reduce the average concentration of PM_{2.5} in the province by more than 5% compared with the 2018 level.

4.2 Water pollution prevention and control

2019 is a crucial year for water pollution prevention and control. The newly established MEE will promote the unified supervision of water eco-environmental protection by connecting the ground and underground, shore and water, land and sea, and city and village.

In 2019, the national water pollution control work will focus on improving the quality of the water ecological environment, with a focus on the Yangtze River Economic Belt and the Bohai Rim region. It will comprehensively fight the battle against water pollution, and do a good job at “preventing black and odorous water bodies, improving inferior water quality, controlling pollution, protecting sources and establishing systems,” that is, to win the city’s battle against black and odorous water bodies, by basically eliminating state-controlled sections with a quality inferior to Class V in key regions, strengthening pollution source rectification, protecting drinking water sources, and improving long-term management mechanisms. According to the Key Basin Water Pollution Prevention and Control Plan (2016—2020), by 2020, the country’s surface water environment quality should be improved as a periodic result, and the proportion of water bodies with excellent water quality (at or above Class III) in seven key river basins such as the Yangtze River, the Yellow River and the Pearl River should be over 70%.

On March 28, 2019, MEE, together with the Ministry of Natural Resources, Ministry of Housing and Urban-Rural Development, Ministry of Water Resources, and Ministry of Agriculture and Rural Affairs jointly issued the Notice on Issuing the Implementation Plan for Groundwater Pollution Prevention and Control, and proposed to, by 2020, preliminarily establish a groundwater pollution control law and regulation standard system and a national groundwater environment monitoring system; control the country’s groundwater ratio with

extremely poor quality at about 15%; preliminarily monitor typical groundwater pollution sources and curb the exacerbation of groundwater pollution. The document proposed to, by 2025, establish a groundwater pollution control law and regulation standard system and a national groundwater environment monitoring system; increase the ratio of centralized groundwater-based drinking water with a water source quality at or above Class III in cities at or above prefecture level to about 85%; effectively monitor typical groundwater pollution sources and curb the exacerbation of groundwater pollution. By 2035, we will strive to improve the overall quality of the country's groundwater environment and basically restore ecosystem functions.

In 2019, the water pollution control action plan is continuously promoted, and the river chief system is also implemented. Water eco-environmental protection in key river basins is strengthened. The protection and restoration of the Yangtze River is under solid operation, the Opinions on Strengthening the Protection of Aquatic Organisms in the Yangtze River is issued, and the “three lines and one list” for the Yangtze River Economic Belt (ecological red line, environmental quality baseline, resource utilization upper line and eco-environment access list) is formulated to guide and optimize the industrial layout along the Yangtze River. The environmental improvement in centralized drinking water source areas is driven forward, and the rectification completion rate of 6,251 problems in 1,586 water source areas has reached 99.9%. Special investigations are done to improve black and odorous water bodies. Among the 1,062 black and odorous water bodies in 36 key cities, 1,009 of them have been well improved or basically improved, accounting for 95% ~ 97.8% of the country's industrial agglomeration areas at or above provincial level have built centralized sewage treatment facilities and installed automatic online monitoring devices. The regulation of sewage outlets into the river and the sea is reinforced to promote pollution control in key sea areas such as the Bohai Sea. The full coverage of environmental improvement in administrative villages is promoted and in 2018, 25,000 administrative villages completed integrated environmental improvement.

Locally, on February 18, 2019, Shenzhen City issued the Work Plan for the Year of Decisive Battle against Water Pollution in Shenzhen. In 2019, the city plans to complete nearly 50 billion yuan of water pollution control investment. By 2020, the city will complete a total water pollution control investment of nearly 120 billion yuan to ensure the complete elimination of black and odorous water bodies by the end of 2019. In February, Shandong Province rectified environmental problems in drinking water source areas. In addition, Hubei Province is exploring the establishment of a water ecological compensation mechanism, piloting in 20 counties and cities across the province, and relevant regulations

will be introduced. It is planned that by 2020, Hubei Province will achieve full coverage of ecological compensation in key river basins.

4.3 Soil pollution prevention and control

According to the plan of MEE, in the first half of 2019, the pilot cities should steadily promote the clean land defense war, fully implement the action plan for soil pollution prevention and control, carry out detailed investigation of the soil pollution status of agricultural land, and complete the collection, analysis and testing of all 700,000 agricultural land investigation samples; carry out the investigation and rectification of the risk of cultivated land contamination by heavy metal-related industries, and promote the control of soil pollution risk of construction land.

According to the schedule of the Ministry of Housing and Urban-Rural Development for the classification of domestic wastes, starting from 2019, cities in the country at or above prefecture level should fully start the classification of domestic wastes. By the end of 2020, 46 key cities should basically complete the waste classification and disposal system; before the end of 2025, cities in the country at or above prefecture level should basically complete the waste classification and disposal system.

At the end of December 2018, the General Office of the State Council issued the Work Plan for Piloting “No Waste Cities,” proposing that by 2020, an indicator system for the construction of “no-waste cities” will be established. Through the deepening of the solid waste integrated management reform in pilot cities, a number of “no-waste cities” demonstration models that can be replicated and promoted will be formed. Based on the principle of combining pilots with overall coordinated progress, putting the easy task first and advancing things in a step-by-step manner, about 10 cities with the right conditions, foundations and sizes will be chosen across the country as pilot “no-waste cities.” At the same time, the reduction and reuse of solid waste from the source is under continuous operation, cracking down on the illegal transfer and dumping of solid waste and hazardous waste, and the rectification rate of 1,308 outstanding problems under supervision has reached 99.7%. The ban on the entry of foreign garbage is maintained, and special rectification is carried out in phases against environmental violations of enterprises processing and utilizing imported solid waste. In 2018, the country’s solid waste import volume decreased by 46.5% year on year, of which the import volume of prohibited solid waste was reduced by 51.5% year on year. The waste incineration power generation industry is driven to meet the emission standard, and the waste incineration power plants with problems have all been rectified.

2019 is the first year of the implementation of the Law on Soil Pollution Prevention and Control. A three-year action plan for clean land defense war formulated by Hebei

Province proposed that by 2020, the soil environment quality of the province will be stable and improving, and the exacerbation of soil pollution in key areas will be controlled. The pilot and demonstration of soil pollution control and restoration will achieve remarkable results, and a provincial soil pollution control system led by government, driven by market, borne by enterprise and participated by the public will be established. At the same time, Hebei Province has further strengthened the supervision of cross-province transfer of solid (hazardous) waste to strictly control the transfer of hazardous waste from other provinces. In 2019, Hunan Province will promote the construction of provincial-level soil pollution integrated control pilot areas and heavy metal pollution control projects to ensure the safety of the living environment and agricultural production.

Through the “Waste Elimination Action 2018,” the problem of dirty and messy areas along the Yangtze River and the environmental hazards of illegal dumping and piling of solid waste along the river were basically eliminated. The total investment is nearly 1.898 billion yuan, and more than 37.99 million tonnes of solid waste were removed, and nearly 72 new standardized landfills were built. As an important part of the Yangtze River protection and rehabilitation battle, the “Waste Elimination Action 2019” is expanded to 126 cities in the Yangtze River Economic Belt, achieving full coverage of major river systems such as the main stream, tributaries and key lakes of the Yangtze River.

4.4 Marine eco-environmental protection

The 2018 CCICED Policy Recommendations proposed to strengthen legal protection of marine and coastal ecosystems; establish high-tech monitoring systems; and develop national plans to restore the functions and services of the marine ecosystem.

On November 30, 2018, MEE announced at its press conference that it will improve the domestic marine eco-environmental protection laws and regulations system and standard system; take the improvement of eco-environmental quality as the basic goal of measuring marine eco-environmental work, accelerate integrated management of sea areas, speed up the improvement of the basic monitoring and evaluation capability; strengthen government supervision and accountability system, and effectively use powerful tools such as the “five-step method” to strengthen supervision; accelerate the promotion of innovative regulation methods such as random inspection and pollutant discharge permits, and further drive enterprises to fulfill their responsibility for both production and environmental protection.

MEE will also revise the Marine Environment Protection Law and strengthen its connection with the Environmental Protection Law and the Water Pollution Prevention and Control Law. On this basis, it will promote the revision of the regulations on sea dumping management, the prevention and control of marine environment pollution and destruction

by marine projects and other relevant laws, regulations and regulatory documents, and form a legal system compatible with new duties, new positioning and new institutions as soon as possible; promote the rectification of international new marine environmental issues and the preparation of the National Marine Litter Prevention and Control Action Plan.

On December 11, 2018, MEE, NDRC and the Ministry of Natural Resources jointly released the Action Plan for the Integrated Management of the Bohai Sea (hereinafter referred to as “Action Plan”) and proposed a timetable and a roadmap for this tough battle. The Action Plan proposed that through three years of integrated management, by 2020, the proportion of coastal waters of the Bohai Sea with excellent water quality (Class I and Class II) will reach about 73%, the natural shoreline retention rate will maintain at around 35%, the scale of coastal wetland remediation will be no less than 6,900 hectares, and the shoreline restoration will increase by about 70 kilometers.

The Action Plan identified four major actions: a) Land-based pollution control action. Implement pollution control of state-controlled rivers flowing into the sea, and promote the pollution control of other rivers entering the sea; investigate the source of the outlet into the sea to achieve stable and compliant direct discharge of industrial pollutants into the sea, and remove illegal and unreasonable outlets into the sea; eliminate and control scattered, unregistered and polluting industrial enterprises, and control agricultural and rural pollution and urban domestic pollution; reduce land-based pollutants into the sea through integrated management of land-source pollution. b) Marine pollution control action. Implement mariculture pollution control, and clean up illegal mariculture; implement ship and port pollution control, strictly implement the Discharge Standard for Water Pollutants from Ships, drive ports to build ship pollutants receiving and disposal facilities to realize good connections among ship, port and city facilities, and carry out comprehensive improvement of the fishing port environment; fully implement the bay chief system. c) Ecological protection and restoration action. Implement ecological protection in coastal zones, delineate and strictly safeguard the red line for marine ecology protection in the Bohai Sea, ensure the proportion of the red line area in the sea area governed by the three provinces and one city reaches about 37%, implement the most stringent management of sea reclamation and shoreline development, and strengthen the selection and demarcation of protected areas and the protection of coastal wetlands; implement ecological restoration, strengthen integrated management and improvement of estuary, bay, shoreline and beach; implement conservation of marine biological resources, and gradually restore the fishery resources in the Bohai Sea. d) Environmental risk prevention action. Prevent the risk of sudden land-source environmental incidents, and conduct risk assessment of sudden environmental incidents in the Bohai Rim

region; prevent the risk of marine oil spill, and complete special risk inspections of offshore oil platforms, oil and gas pipelines, and land terminals; establish a marine red tide (green tide) disaster monitoring, early warning, emergency response and information release system in the high-risk areas of marine ecological disasters, key bathing beaches and coastal tourist areas.

At the same time, MEE will strengthen ecological supervision, accelerate the establishment of a marine ecology supervision system based on satellite remote sensing and other technologies, and focus on strengthening the supervision of three types of areas (marine protected areas, marine ecological protection red line areas, and marine ecological restoration implementation areas); step up land-source supervision and introduce Measures for the Management of Pollutant Discharge Outlets into the Sea and other regulatory documents as soon as possible, and strengthen interim and ex-post supervision of the outlets; reinforce offshore supervision, build a whole-process supervision system including ex-ante, interim and ex-post supervision, and accelerate the cancellation and power delegation for items subject to government approval; strengthen supervision by Party committees and governments, strengthen the supervision of marine eco-environmental protection, and drive local Party committees and governments to fulfill the responsibility for marine eco-environmental protection; reinforce enterprise regulation and build a supervision system with pollution permit and “the oversight model of random inspection and public release” at the core.

4.5 Environmental governance and rule of law

4.5.1 Major changes in the property right system for natural resource assets

In April 2019, the General Office of the Central Committee of the Communist Party of China and the General Office of the State Council printed and issued the Guiding Opinions on Promoting the Coordinated Reform of the Property Right System for Natural Resource Assets (hereinafter referred to as “Opinions”) with a view to solving long-standing problems such as unclear inventory of natural resource assets, omission of owners, ambiguous rights and duties, failure to implement rights and interests, and imperfect regulatory and protection systems, which have led to frequent property right disputes, inefficient resource conservation, extensive exploitation and utilization and serious ecological degradation. In order to further promote ecological progress, the property right system for natural resource assets must be perfected.

The basic idea underlying the reform of the property right system for natural resource assets is to perfect the property right system for natural resource assets and the realization forms of all-people and collective ownership of such assets. The overall goal is that by 2020, a property right system for natural resource assets featuring clear ownership, explicit

rights and duties, strict protection, smooth transfer and effective regulation will be basically established, with the efficiency of exploiting and utilizing natural resources and the intensity of conservation significantly enhanced, thus providing strong support for improving the system for promoting ecological progress, safeguarding national ecological security and resource security, and promoting the formation of a new pattern of modernization featured by harmonious development of human and nature.

Box II-1 List of Major Tasks

The property right system for natural resource assets should be perfected. The system should fit in with different attributes of natural resources and meet the needs of national economic and social development, dovetail land space planning and use control and facilitate the separation between the ownership of and the right to use natural resource assets. A scientifically classified property right system for natural resource assets should be built at a quicker pace to solve problems such as rights crossing and absence. The relationship between the ownership of and the right to use natural resource assets should be properly dealt with, and new ground should be broken in the realization forms of all-people and collective ownership of natural resource assets.

The subject of property rights of natural resource assets should be clearly defined. This is the key to the reform. In consideration of problems such as absence of explicit provisions on the subject of property rights of natural resource assets, omission of owners, failure to implement owners' rights and interests, "tragedy of the commons" due to ambiguity in the subject of property rights and unreasonable income distribution mechanism, the Opinions proposes to study and establish a resource inventory and management system where the competent authority of natural resources under the State Council shall exercise the ownership of natural resource assets owned by all people.

Unified survey, monitoring and evaluation of natural resources should be carried out. This is a fundamental part of the reform. For a long time, unclear inventory and even crossed statistics of some natural resources exist for reasons such as management of natural resources by several departments and differences in the definition, classification, standards for survey and evaluation and cycle of various natural resources. To solve these problems, the Opinions puts forward "three-pronged unity" for natural resources, namely unity of classification standards, survey, monitoring and evaluation system as well as implementation of national survey.

Unified registration of the ownership of natural resources should be quickened.

This is another fundamental part of the reform. Given the absence of unified standards, unclear inventory and subject of resources, obscure boundary and unclear ownership, the Opinions sets forth perfection of ownership registration measures and rules based on a summary of the experience in pilot unified registration of the ownership of natural resources.

Overall conservation of natural resources should be strengthened. This is an important goal of the reform. In consideration of uncoordinated planning, weak planning and control, decentralized ecological restoration and protection, imperfect ecological protection compensation mechanism and other problems arising from management by several departments in the past, the Opinions proposes to formulate and implement land space planning, delimit and observe red lines for ecological protection and control lines for permanent basic farmland and urban development boundary, establish and improve the land space use control system, management specifications and technical standards, control land space in a unified manner and strengthen overall protection of mountains, rivers, forests, farmland, lakes and grass.

Intensive exploitation and utilization of natural resource assets should be pushed forward. This is another important goal of the reform. With regard to problems such as imperfect pricing mechanism for natural resource assets, failure to bring into full play the decisive role of the market in allocation of resources, unsound system for paid use of some natural resource assets and unsmooth transfer of natural resource assets in the market, the Opinions proposes to expand competition-based transfer by means of improved pricing mechanism, give play to the decisive role of the market in allocation of resources and better exert the control role of the government through total amount control and intensity control.

Restoration of and reasonable compensation for the natural ecosystem should be promoted. This is also an important goal of the reform. In view of problems such as a lack of ecological restoration planning, insufficient systematicness and comprehensiveness of restoration and imperfect ecological and environmental damage compensation system, the Opinions presents formulation and implementation of ecological restoration planning for national land space, and establishment of a sound mechanism for restoration and comprehensive treatment of mountain, river, forest, farmland, lake and grass systems.

The regulatory system for natural resource assets should be perfected. This is an important way to accomplish the reform. In view of imperfect regulatory system for property rights of natural resource assets, absence of relevant management, appraisal and evaluation system and underplaying of social supervision, the Opinions proposes

to exert the supervisory role of the people's congresses, administrative, judicial and auditing agencies and the public, break new ground in management methods and make concerted regulatory efforts.

The legal system concerning property rights of natural resource assets should be perfected. This is an important guarantee for the reform. Given existing problems such as imperfect legal system for natural resource assets, insufficient coordination by the property right dispute resolution mechanism and failure to meet the needs of economic and social development, ecological progress and rule of law, the Opinions proposes to fully check up laws and regulations concerning the property right system for natural resource assets, put forward specific opinions on abolishing or amending provisions against ecological progress and the protection of property rights of natural resource assets and promote the enactment, amendment, abolishment and interpretation of various laws and regulations on natural resource assets according to the progress in the reform of the property right system for natural resource assets.

Note: The above is abridged due to space limitations.

4.5.2 Abstention from the one-size-fits-all approach in environmental governance

In September 2018, MEE issued the Guiding Opinions on Further Deepening the Reform to Delegate Power, Streamline Administration and Optimize Government Services in Ecology and Environment and Promote High-Quality Economic Development, a document with respect to the one-size-fits-all approach, which sets forth relevant requirements for banning the approach and instructs local governments to abstain from the approach in environmental protection. Meanwhile, environmental inspection and enhanced supervision should target two aspects, namely omissions and delays as well as abuses of power. Omissions and delays mean failures to do whatever should and can be done; and abuses of power mean conducting raids instead of regular inspections and acting incorrectly. Each case should be investigated and corrected immediately after it is known or reported and then disclosed to the media and the public, so that it can serve as a warning. Additionally, in the course of central ecological and environmental inspection and enhanced supervision, if an enterprise is found to have any problems, the competent local government should take over the job and the local environmental authority should consult with the enterprise and allow reasonable rectification time for the enterprise based on the reality. The government should actively provide services for enterprises. For example, in the reform of the discharge permit system, permits may be issued to projects built before approval or those failing to meet relevant discharge standards for the time being, but such permits should indicate a rectification period according to actual

conditions. Enterprises will not be punished unless they fail to obtain the approval or meet relevant standards when such rectification period expires. The government should prevent problems caused by the one-size-fits-all approach in 2019 by “calling upon rectification,” “standardizing and investigating the acts of the government” and “setting an example.”

In 2019, MEE should manage the following two jobs: firstly, standardizing environmental administrative law enforcement, especially the application and supervision of discretion; secondly, strengthening the awareness and level of services, providing assistance whilst supervising, excluding difficulties for enterprises by standing in their shoes, solving environmental problems faced by enterprises in the production and strengthening the awareness in this regard. It should listen to individual and differentiated demands of enterprises when serving enterprises and balance strict regulation and active services in its work. Also, it should have due regard to how to deal with the relationship between the government and businesses; and how to establish a clean and fresh government-business relationship remains a problem to be solved by environmental authorities with attention.

In January 2019, the Opinions of the Ministry of Ecology and Environment and All-China Federation of Industry and Commerce on Supporting and Serving Green Development of Private Enterprises was officially printed and issued. The document proposes to encourage private enterprises to actively participate in the critical battle of pollution prevention and control, help private enterprises solve difficulties in environmental governance, improve green development capacity, create a market environment of fair competition, upgrade service guarantee, improve economic policies and measures, and form a long-acting mechanism supporting green development of private enterprises. Private enterprises should also be guided to push transformation and upgrading through ecological and environmental protection, and be actively benchmarked against high-quality development.

On April 18, 2019, MEE issued a notice on soliciting public opinions on the Opinions on Effectively Guiding Enterprises to Observe Environmental Laws (Exposure Draft), which proposes to further enhance regulation and law enforcement for ecological and environmental protection, optimize ways of regulation and law enforcement, implement enterprises’ primary responsibility for ecological and environmental protection, guide self-discipline among enterprises and push law-abiding to be a normal.

4.5.3 Ecological and environmental inspection and its transformation

The Central Environmental Inspection Group, established under the leadership of the Ministry of Environmental Protection (MEP) and composed of leaders of the CPC Central Commission for Discipline Inspection (CCDI) and the Organization Department of the CPC Central Committee, inspects environmental protection carried out by Party committees and

governments at the provincial (autonomous region and municipality) level and departments concerned on behalf of the CPC Central Committee and the State Council. Over the three years or so since its establishment, the Central Environmental Inspection Group has been carefully performing its duties, acting pragmatically and efficiently to play hardball and crack the hardnuts; within less than two years, it completed a full inspection of the ecological and environmental problems in the 31 provinces, autonomous regions and municipalities nationwide. Central environmental inspection has proven effective in that a number of long-standing ecological and environmental problems have been solved and quite a lot of things that should have been done have been put into practice, and has promoted the improvement of local ecology and environment. After the completion of the first round of inspection, the Group organized a “review.” Central ecological and environmental inspection, as the “chief inspector” of the central strategic five-sphere integrated plan, is gradually shifting from the stage with the main task of urging local authorities to strengthen the awareness of redlines for ecological and environmental protection, foster the concept of green development, bolster weaknesses in ecological and environmental protection, and firmly resist violations of ecological and environmental laws to the one with main tasks such as stressing consolidation of the ecological and environmental foundation, improving green development capacity and obtaining room for sustainable development. As the systems become increasingly perfect and its implementation gets deepened, the key role of central ecological and environmental inspection is increasingly recognized. The central ecological and environmental inspection system is an important part of the socialist ecological and environmental rule-of-law system.

In early 2019, the second round of the four-year central ecological and environmental inspection was launched to inspect provincial (autonomous regional and municipal) Party committees and governments, departments concerned under the State Council and central enterprises, and every effort will be made to complete this round of inspection nationwide and a “review” within four years. This round of inspection includes the following tasks: field inspection of ecology and environment; inspection of groundwater pollution; supervision of wastewater pollution control; field inspection of sources of noise pollution; inspection of waste gas pollution; field inspection of environmental inspection and corresponding emergency plans; field inspection of sources of solid waste pollution; supervision of the investigation into environmental violations by environmental authorities, among others.

4.6 Regional and international engagement

4.6.1 Practices of greening the Belt and Road Initiative(BRI)

The 2018 CCICED Policy Recommendations states that as BRI focuses on infrastructure construction, ecological, environmental and climate impacts of BRI projects must be

considered carefully.

Under the Belt and Road Initiative: Progress, Contributions and Prospects released on April 22, 2019, China has taken a number of mutually accepted measures to increase financial support for relevant countries and expand the channels of diversified financing. Specifically, China and relevant countries have endorsed the guiding principles on financing for the BRI to jointly promote the establishment of a long-term, stable, sustainable and risk-controllable financing system. Asian Financial Cooperation Association (AFCA) already has more than 100 members, and its earmarked loans equivalent to RMB 380 billion has provided strong support for infrastructure, capacity and financial cooperation within the framework of jointly building the BRI, while the Silk Road Fund has received new capital of RMB 100 billion.

The 2018 CCICED Policy Recommendations also states that the BRI should be aligned to the Paris Agreement, the 2020 Global Biodiversity Targets and the 2030 UN Sustainable Development Goals. An international coalition for green development on the Belt and Road should be founded.

Six categories of 283 deliverables have been made during the 2nd Belt and Road Forum for International Cooperation on April 25—27, 2019. Among them, those concerning green BRI include are listed in Box II-2.

Box II-2 List of Deliverables in Promoting the Greening of BRI

- China and leading financial institutions in the UK, France, Singapore, Pakistan, the UAE, Hong Kong and other relevant countries and regions which are members of BRI International Green Development Coalition, have endorsed the Green Investment Principles for the Belt and Road Initiative.
- Chinese Academy of Sciences has launched the “Silk Road Environmental Project” and jointly studied the path and scheme to build a green Silk Road with scientists from countries along the Silk Road.
- The Chinese government will continue to implement the Green Silk Road Envoys Program, which will train 1,500 environmental officials from BRI countries over the next three years. The website of the BRI Environmental Big Data Platform has been officially launched. MEE has set up the Belt and Road Environmental Technology Exchange and Transfer Center.
- NDRC has launched the Belt and Road Green Lighting Initiative jointly with the United Nations Development Programme (UNDP), the United Nations Industrial Development Organization (UNIDO) and the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), and launched the Belt and Road Green Cooling Initiative

with the UNIDO, ESCAP and the Energy Foundation.

- Industrial and Commercial Bank of China Limited (ICBC) has issued the first green bond of the Belt and Road Inter-bank Regular Cooperation Mechanism (BRBR) and jointly released the BRI Green Finance Index together with BRBR members such as European Bank for Reconstruction and Development (EBRD), Calyon Bank and Mizuho Corporate Bank to deepen the BRI green finance cooperation.
- China and leading financial institutions in the UK, France, Singapore, Pakistan, the UAE, Hong Kong and other relevant countries and regions have endorsed the Green Investment Principles for the Belt and Road Initiative.
- China Everbright Group and financial institutes in relevant countries have jointly initiated and set up the “Belt and Road” Green Investment Fund.

The 2018 CCICED Policy Recommendations proposes to create a network of partnerships among countries along the Maritime Silk Road to promote sustainable ocean governance.

In recent years, China has been actively carrying out exchanges and cooperation in marine spatial planning with Bangladesh, Pakistan, Madagascar, Malaysia and other countries along the “21st Century Maritime Silk Road,” contributing Chinese wisdom to ocean governance and planning, and promoting the BRI construction. As the first marine spatial planning prepared by China for another country along the “21st Century Maritime Silk Road,” China-Cambodia Marine Spatial Planning has been highly recognized by Cambodia. Through the cooperation with Cambodia, China has found a new pattern of international cooperation in marine spatial planning. On this basis, substantial progress has been made in China-Thailand cooperation in this regard.

With respect to responsible investment, the Third Meeting of the UK-China Green Finance Taskforce was held in London on November 30, 2018, during which the Green Finance Committee (GFC) of the China Society for Finance and the City of London’s Green Finance Initiative (GFI) jointly issued the Green Investment Principles for the Belt and Road Initiative.

On April 16, 2019, ICBC successfully issued the world’s first green Belt and Road Inter-bank Regular Cooperation bonds (“BRBR bonds”). This issue, made in renminbi, dollars and euros and with an equivalent amount of USD 2.2 billion, consists of both 3-year and 5-year options, and the funds raised will be used to support the construction of green BRI projects. Following international and Chinese principles for green bonds, the bonds are issued by Singapore Branch of ICBC and underwritten by 22 financial institutes from more than 10

countries and regions along the “Belt and Road,” of which about 80% are BRBR members. The issue of bonds is popular in the international bond market. To break it down, offshore renminbi bonds have a size of RMB 1 billion and non-banking investors account for 33%, showing high market recognition; two-year dollar bonds have a size of USD 1.5 billion, showing favorable scale and prices; euro bonds have a size of EUR 500 million, the largest ever issued by Singaporean financial institutions since the beginning of 2019. This issue is also popular among central banks and sovereign fund investors, which account for 48% and 40% respectively among those buying three-year floating-rate dollar bonds and three-year fixed-rate euro bonds.

In Adama, Ethiopia, the African second largest wind farm has been completed and put into operation. As the first of its kind in Ethiopia, the wind farm has supplied 2.6 billion kW·h of electricity to power grids since it was brought into operation, which equals reduction of 810,000 tonnes of standard coal and of 2,158 tonnes of dust, SO₂ and NO_x emissions. It is China’s largest overseas wind power project in terms of overall export of Chinese capital, technology, standards and equipment.

Over the past five years, key BRI regions have witnessed a remarkable decrease in ecological and environmental problems and an increase of the mine environmental governance and ecological restoration rate from 50% to more than 85%; the reclamation rate of the land for temporary use damaged by infrastructure construction has reached nearly 100% and China has established meteorological, resource, environmental, marine, Gaofen and other earth observation satellites and application systems, built 31 ecological and environmental remote sensing databases regarding land cover, vegetation growth, agriculture, marine environment and other aspects of the countries participating in the BRI. China has been leading and participating in the preparation of an increasing number of international norms and standards.

4.6.2 Firm leadership of international collaboration on addressing climate change

The United Nations Climate Change Conference Katowice (COP24) was held on December 2, 2018. Participants have endorsed rules for the implementation of the Paris Agreement upon negotiation. The international community should further intensify its efforts to promote global green and low-carbon transformation.

With the vision of building a community of shared future for mankind, China has undertaken the responsibility for promoting green, clean and sustainable development of all humans, practically showed Chinese contributions to fighting climate change and fulfilled its solemn commitments to protecting the Paris Agreement and other global multilateral governance frameworks. China has been gradually fulfilling the responsibility a great power

should fulfill in terms of policy announcement and implementation. China has also made substantial headway in energy conservation and emission reduction and has become the world's largest consumer of new and renewable energy resources, and ranks No.1 in terms of clean energy investment for nine consecutive years. Moreover, China actively makes contributions to boosting international climate cooperation, with a large number of new energy cooperation projects gradually settled in BRI countries. China is also energetically pushing innovations in economic development featuring energy conservation and emission reduction, exploring development ideas and paths of green finance and establishing the world's largest carbon trading market. The Action Plan for Promoting the Implementation of the Paris Agreement via Global Energy Interconnection jointly released by the China-initiated Global Energy Interconnection Development and Cooperation Organization and the Secretariat of the United Nations Framework Convention on Climate Change (UNFCCC) is intended to guide the integration of global energy interconnection into the course of energy conservation and emission reduction. During the COP24, China was also actively promoting joint efforts to enhance exchanges and interconnection of energy conservation and emission reduction, hosted 25 side events with different themes, enriched the connotation of the COP24, and made substantial contributions to building a consensus and exploring ways of cooperation.

During the Second Belt and Road Forum for International Cooperation in Beijing on April 25—27, 2019, China announced that it would work with relevant countries to jointly implement the Belt and Road South-South Cooperation Initiative on Climate Change. As a responsible country, China successfully lowered the carbon intensity by about 46% in 2017 compared with that of 2005, attaining the goal of reducing the carbon intensity by 40% ~ 45% by 2020 over 2005 three years ahead of schedule. China is both thinking and acting as a great power does.

4.6.3 Active participation in global ocean governance

The 2018 CCICED Policy Recommendations states that studies should be strengthened on emerging marine environmental problems of global concern. Priorities include ocean acidification, ocean plastics and microplastics, oxygen deficit in hot spots and other emerging marine environmental problems of global concern.

As a major plastics producer and consumer, China witnesses a large number of ocean microplastics in offshore, estuarine and marine organisms. According to related survey results in recent years, China's ocean microplastic pollution is medium. China sees rapid progress in marine microplastic studies, especially the project of "Research on Marine Microplastic Monitoring and Ecological and Environmental Effect Assessment Technologies," a national

key research and development program launched by Ministry of Science and Technology in 2016, which is one of the earliest heavily invested research projects regarding microplastic pollution in the world. China is an international leader in marine microplastic studies.

Meanwhile, China has also been actively participating in international cooperation and actions to deal with marine plastic waste pollution within the UN and regional cooperation frameworks and leading regional international cooperation. Although China has no specific laws and regulations on the control of marine plastic pollution, legislation on plastic wastes has a long history. At present, China is advancing amendment and enactment of laws on plastic wastes and vigorously promoting urban and rural garbage classification and environmental governance. All these measures will lead to a significant fall in the quantity of future plastic wastes.

The 2018 CCICED Policy Recommendations also proposes to make full use of partnerships and unite relevant countries and regions to cope with plastic pollution. The Chinese government has also established international cooperation with relevant countries in the control of marine plastic pollution. On November 14, 2018, Premier Li Keqiang and Canadian Prime Minister Justin Trudeau jointly issued the Joint Statement of the Government of the People's Republic of China and the Government of Canada Marine Litter and Plastics during the third annual dialogue between the Chinese and Canadian Prime Ministers. The two sides agreed to adopt a more resource-efficient approach to the full lifecycle management of plastics, improve efficiency and reduce environmental impact.

On December 4—5, 2018, the First UK-China Symposium on Marine Plastic Pollution and Control was held in Guangzhou and Shandong. A number of policy makers, experts and representatives of the plastic industry and the plastic disposal industry as well as representatives of non-governmental organizations from both China and the UK attended the Symposium and discussed relevant issues, including the situation of plastic pollution and protection of marine environment. After the symposium, British experts and Chinese organizations such as MEE, MOHURD and plastic industry associations held a policy discussion.

In the Joint Statement of the People's Republic of China and the Republic of France on Upholding Multilateralism and Improving Global Governance released on March 26, 2019, China and France have reached 37 consensuses, among which those regarding international cooperation in marine pollution prevention and control involve the following: firstly, the two promise to strengthen communication and cooperation with respect to marine biodiversity conservation and sustainability beyond their respective jurisdictions within the UN framework and make positive contributions to reaching relevant agreements. Secondly, the

two agree to maintain exchanges on the conservation and sustainable use of marine biological resources in the South Pole, including the establishment of an Antarctic marine reserve. The two are strong proponents of international actions against marine and land plastic pollution by strengthening existing mechanisms, especially the Basel Convention.

4.7 Conclusions

Since the 2018 CCICED Annual General Meeting held in early November last year, China has been advancing its ecological construction and environmental governance in depth under the guidance of Xi Jinping's thought on ecological progress, resulting in profound changes in governance methods, working methods and the intensity of efforts and further improvements in governance effectiveness. However, environmental governance is increasingly challenging. The pace at which environmental quality is improved is lower than expected and the administrative governance system has to gradually shift to a phase featuring a combination of market-oriented and administrative governance. How to achieve more economical and efficient ecological restoration and environmental improvement when ecological and environmental protection is a rigid constraint becomes a task to be studied and solved in the new stage. Advanced, applicable, efficient and low-cost environmental technologies and services appear to be more urgently needed.

Over the past six months or more, many CCICED policy recommendations continue to be highly valued by the Chinese government and incorporated into policy practice and exploration in varying degrees in the new year. Some prospective policy recommendations have important implications on future efforts to promote ecological progress. A review of the environmental and development policies of the Chinese government over the past half year indicates that mechanisms and management systems centered on ecological progress and targeting a "Beautiful China and Clean World" are taking shape rapidly. China's ecological and environmental protection work is comprehensive, unified and coordinated, and the broad coalition for green development established by the government, the public, and responsible enterprises is maintaining the strongest ever cohesion to overwhelmingly boost green and high-quality development in China. At the same time, China continues to see the high-level development of international environmental cooperation, including in its ecological and environmental cooperation with countries along the "Belt and Road" and with African countries. New measures have been taken to solve problems of global concern, such as protection of marine ecology and environment, response to global climate change, and biodiversity conservation. China's ecological progress is becoming firm and there is strong support for global sustainable development. Innovations in systems, mechanisms,

measures, and means that promote ecological progress have enriched the UN 2030 Toolkit for Sustainable Development and represent new contributions made by China to world ecological conservation and environmental governance—even fighting climate change in the new era.

As indicated by the experience of the developed world, outstanding ecological and environmental debts over the past decades cannot be paid off overnight, and it may even take several decades of continuous efforts to fundamentally improve some environmental problems. This means that solving problems with ecological construction and environmental governance requires dozens of years of unflagging efforts, more social input and more time given to the “fight against pollution,” which China should guarantee by establishing and constantly improving laws, regulations, systems, and mechanisms within the “framework of ecological progress” and by resolutely curbing new ecological destruction and environmental pollution. Also, China should establish rigid ecological and environmental constraints, so that “law-abiding” becomes the conscientious willingness of enterprises, green lifestyle become preferred by the public and the concept of green development goes deep into the hearts of the people. All these require unremitting work over a long period. The second half of 2019 is expected to be an arduous transitional period of “protracted seesaw battles” for ecological protection and environmental governance. The improvement of deeper-level environmental problems rests still with creative ideas, methods, and solutions.

A country characterized by an underdeveloped economy; uncoordinated development of eastern, central and western regions; insufficient wealth accumulation; a large poverty-stricken population; and intensified aging is faced with unprecedented pressure and challenges to put forward and explore ways to promote “ecological progress.”

CCICED, which undertakes a special mission, should lay more stress on grassroots work in future policy research and put forward policy recommendations that remain predictive and strategic whilst containing more “innovative” and “inspiring” research results and findings. On the other hand, as a two-way international cooperation platform, CCICED should set up a BRI-oriented international communication and exchange platform, and sum up systems, mechanisms and arrangements into which China has been probing for “ecological progress.” It should embody system and policy designs of “Beautiful China” construction, legal systems, policy orientations, public opinions, institutional arrangements like central environmental inspection, and the innovative green finance and taxation policies of fiscal and financial departments. These environmental governance systems based on China’s actual conditions might be conducive to the construction of a beautiful homelands in other countries and regions.

Appendix II-1: Overview on the Relevance of China's Environmental and Development Policies and CCICED Policy Recommendations over the Past Half Year

Field	Time of Release of Policy	Policy Progress (2018—2019)	Contents
Planning for Environment and Development	December 2018	NDRC held a symposium on the preparation of the 14 th FYP. The symposium mainly discusses the mid-term evaluation of the 13 th FYP, the connotation and characteristics of the 14 th FYP strategic opportunity period, development theme and main line during the 14 th FYP period, major issues that need to be highlighted during the 14 th FYP period and the basic idea of the 14 th FYP	The 2018 CCICED Policy Recommendations proposes to coordinate and unify actions against climate change and attain strategic goals in different areas in a balanced manner by formulating and implementing short-term plans (e.g., the 14 th FYP), mid-term plans (e.g., the revised 2030 China's Intended Nationally Determined Contributions and Beautiful China 2035) and long-term plans (e.g., the "Mid-21 st Century Strategy" by 2050)
	April 2019	A workshop on the national 14 th FYP for ecological and environmental protection was held to probe into how to maintain and implement the concept of "ecology first and green development" based on the strategic positioning of ecological and environmental protection in national economic and social development during the 14 th FYP period; by 2035, ecological and environmental quality should be fundamentally improved and the "Beautiful China" strategic goal should be basically attained; efforts should be made to actively plan strategic tasks reflecting environmental quality improvement	
	January 2019	The State Council officially approved the Master Plan for Xiongan New Area in Hebei Province (2018—2035). Xiongan New Area, as the bearer of Beijing's non-capital functions, forms, together with the sub-center of Beijing, the new two wings of Beijing, which can offer an effective solution to "big city malaise" and represents a new attempt of optimized development in densely populated developed areas	The 2012 CCICED Policy Recommendations proposes to establish a regional green coordination and cooperation mechanism
	January 2019	The State Council approved the Detailed Regulatory Plan for the Sub-Center of Beijing (for Blocks) (2016—2035), which sets forth focus on coordinated development of Beijing, Tianjin and Hebei and emphasis on ecological protection, continuation of the historical context, safeguard and improvement of people's wellbeing and integration of multiple plans	
	March 2019	NDRC promulgated the Key Tasks of New Urbanization 2019, which sets forth working requirements in 2019. It also puts forward that new urbanization should take into full consideration of the actual bearing capacity of resources and the environment, stress coordinated development, make full use of intelligent IT means, conduct lean management and coordinate with the control of air pollution and other environmental problems	The 2018 CCICED Policy Recommendations proposes to shift traditional thinking, fully integrate green standards into green urban planning and bring forward innovative solutions in combination with local realities

Field	Time of Release of Policy	Policy Progress (2018—2019)	Contents
Planning for Environment and Development	December 2018	The Central Economic Work Conference proposes to be serious with the critical battle against pollution, hold fast to the position and consolidate the achievements, focus on the fight to keep our skies blue, increase efforts and input, take a holistic approach and prevent handling things in a simplistic and crude way. The government should strengthen its service awareness and assist enterprises in making environmental solutions	The issue regarding how environmental authorities actively serve enterprises is not covered by CCICED policy research
	March 2019	The Report on the Work of the Government reads that “we will continue the critical battle of pollution prevention and control and produce more effective results in our work to prevent and control pollution” and the main task of pollution prevention and control in 2019 is to consolidate the gains made in the fight to keep our skies blue. This year, sulfur dioxide and nitrogen oxide emissions will be cut by 3%, and there will be a continuous decline in fine particle (PM _{2.5}) concentrations in key areas. Upgrading in steel and other industries will be promoted to achieve ultra-low emissions. Stricter emission standards will be applied and standard compliance within a definite time will be pursued. Dynamic development clean energy will be promoted. A special campaign will be organized to control unregulated emissions from diesel trucks and ships, and continuous efforts will be made to eliminate old vehicles. Water and soil pollution prevention and control will be deepened. Comprehensive measures will be taken to improve the environment in key river basins and sea areas and to clean up black, malodorous water bodies. The construction of sewage disposal facilities will be enhanced and charge policies will be improved	Specific tasks of the critical battle of pollution prevention and control are not included in CCICED macro research
	December 2018	The Action Plan for the Critical Battle of Conservation and Restoration of the Yangtze River, <ul style="list-style-type: none"> • which sets forth the following main tasks: strengthening management and control of ecological and environmental space, strictly observe the red lines for ecological protection. Lean management of the river basin by control units will be implemented. Efforts should be made to adhere to systematic governance of mountains, waters, forests, farmland, lakes and grass, advance water ecological and environmental protection by river basin, strengthen the management of water quality targets in water function zones, break down control units, define assessment sections, designate responsibilities for ecological and environmental protection in the river basin to administrative divisions at different levels, implement the river (lake) chief system and establish a control unit management system mainly intended to improve ecological and environmental quality. By the end of 2020, 11 provinces and municipalities along the Yangtze River should complete the division of control units and determine assessment sections of control units and objectives of ecological and environmental control 	The 2004 CCICED Policy Recommendations suggests adopting comprehensive measures to manage river basins, determining and preserving ecological service functions by starting with the Yangtze River

Field	Time of Release of Policy	Policy Progress (2018—2019)	Contents
Ecosystem and Biodiversity Conservation	2018—2019	<p>As of the end of 2018, 15 provinces have preliminarily delimited the red lines for ecological protection, including Beijing-Tianjin-Hebei Region, the Yangtze River Economic Belt and Ningxia Hui Autonomous Region, and Shanxi and other 15 provinces have basically finalized a delimitation scheme. Delimitation of the red lines for ecological protection should be fully completed by 2020. At present, MEE is preparing the Measures for Administration of the Red Lines for Ecological Protection, building a national monitoring platform for such red lines and including the delimitation and implementation of the red lines for ecological protection into central environmental inspection. Local Party committees and governments should take primary responsibility for delimiting and strictly observing the red lines for ecological protection and should hold any violators accountable, so as to ensure the effectiveness of such red lines</p> <p>“Green Shield 2019” carries on and continues to deepen ecological and environmental protection and governance, which has proven successful in the first stage</p>	The 2014 CCICED Policy Recommendations states that the State Council should enact the Measures for Administration of the Red Lines for Ecological Protection as early as possible, which should contain provisions on the definition and connotation of red lines for ecological protection, method of delimitation and management system
	June 2018	The Chinese government is actively fulfilling its commitments to biodiversity conservation. The national conservation network has been basically established as early as 2015 and the area of various land reserves accounts for about 18% of China’s total landmass, indicating that China has attained the target of 17% by 2020 as set forth in the Convention on Biological Diversity five years ahead of schedule. Provinces and municipalities nationwide, including Chongqing, Sichuan, Yunnan and Guangxi, have unveiled action plans for biodiversity conservation. Yunnan has even enacted the national first local regulations for biodiversity conservation	The 2018 CCICED Policy Recommendations proposes to actively promote the performance of the Convention on Biological Diversity and play a strong leading role in the preparation of global biodiversity conservation targets following 2020
Energy and Climate	January 2019	NDRC and NEA released the Notice on Actively Promoting the Work Concerning Grid Parity of Wind Power and Photovoltaic Power Without Subsidies. The Notice suggests that areas with high-quality resources, low-cost construction and favorable investment and market conditions have basically witnessed conditions for grid parity with coal-fired benchmark feed-in tariffs (without subsidies from the state). With respect to the establishment of new policies for renewable energy, NEA indicates that new policies will be developed for wind power and PV power projects approved after the end of 2020 based on technological progress and cost reduction then	The 2018 CCICED Policy Recommendations proposes to enhance coal use control, promote the penetration of renewable energy and expand the increase in energy efficiency. Outstanding subsidies for renewable energy should be paid off and a new supportive policy system should be established for renewable energy

Field	Time of Release of Policy	Policy Progress (2018—2019)	Contents
Energy and Climate	March 2019	<p>As clearly indicated in the Report on the Work of the Government in March 2019, the energy efficiency index of 2019 is an about 3% cut in energy consumption per unit of GDP. In 2018, China saw a 3.1% cut</p> <p>National Government Offices Administration suggested at the Conference of Central State Organs on Promoting the Key Work for Energy and Resource Conservation and Ecological and Environmental Protection in March 2019 that efforts should be made to further improve the network of energy conservation work by taking advantage of the reform of organizations; complete the formulation of energy consumption quota norms for central state organs and push the management of energy consumption quota management towards a higher level; make good use of the energy conservation monitoring system, and make energy conservation management leaner and IT-based; continue to develop the awareness and habit of energy conservation and environmental protection, organize inspirational activities like garbage classification volunteers</p>	The 2018 CCICED Policy Recommendations proposes to enhance coal use control and expand the increase in energy efficiency
		The 2019 Conference of National Public Institutions on Promoting the Key Work for Energy and Resource Conservation and Ecological and Environmental Protection proposes to complete the selection of 200 leading public institutions in energy efficiency by the end of 2019 and complete the establishment of 1,500 energy conservation-oriented demonstration public institutions by the end of October 2020. Pilot formulation and management of energy consumption quotas should be carried out in Tianjin, Shandong, Jiangxi, Ningxia Hui Autonomous Region and Guangdong, and pilot energy performance contracting project (EPCP) should be organized and carried out in 29 counties (districts) in a unified manner	The 2018 CCICED Policy Recommendations proposes to enhance coal use control and expand the increase in energy efficiency
	April 2019	Public opinions have been solicited for the Interim Regulations on the Administration of Carbon Emission Permit Trading	The 2018 CCICED Policy Recommendations proposes to enhance coordinated management of tackling climate change and improving ambient air quality. The coordination between tackling climate change and solving other environmental problems should be strengthened in system designs such as enactment of laws and regulations and information disclosure, monitoring, law enforcement, regulation and accountability

Field	Time of Release of Policy	Policy Progress (2018—2019)	Contents
Pollution Prevention and Control	December 2018	Air pollution prevention and control. MEE and other 11 ministries and commissions including NDRC released the notice on printing and releasing the Action Plan for the Critical Battle of Control of Pollution from Diesel Trucks, which reads that by 2020, the rate of emissions from diesel trucks that meet relevant standards will greatly increase, the quality of diesel and vehicle urea will be significantly improved, NO _x and particle emissions from diesel trucks will decrease sharply, NO ₂ concentrations in air in cities in key areas will gradually decline, the regulation over motor vehicle emissions will be dramatically improved, volume of railway freight will increase remarkably nationwide and a green, low-carbon, clean and efficient transportation system will preliminarily take shape	The 2013 CCICED Policy Recommendations proposes to concentrate on practically solving prominent environmental problems such as air, water and soil pollution, and meet the basic demand of the public for good environmental quality
	February 2019	Air pollution prevention and control. MEE specially printed and issued the Priorities of National Air Pollution Prevention and Control 2019, which sets forth the overall goal for atmospheric environment, i.e., in 2019, annual average PM _{2.5} concentrations in cities that have not met relevant standards across the country will decrease by 2% year on year and the average proportion of days with excellent and good air quality in cities at the prefecture level and above will reach 79.4%; total SO ₂ and NO _x emissions will drop by 3% year on year. In 2019, deep regulation over the steel industry will be a key part of air pollution prevention and control. Local governments have also released their respective action plans of the year. For example, Beijing has promulgated the 2019 Action Plan for the Critical Battle of Pollution Prevention and Control, which sets forward measures such as “replacement, traffic control, inspection and legislation.”	The 2014 CCICED Policy Recommendations proposes to strengthen coordinated control of multiple sources and multiple pollutants. Pollutants such as SO ₂ , NO _x , primary PM _{2.5} , VOC and NH ₃ will be controlled in a coordinated manner, and comprehensive control will be carried out over industrial sources, civil and rural non-point sources, vehicles and non-road machinery
	March 2019	Water pollution prevention and control. MEE, together with MNR and other ministries and commissions, printed and issued the Notice on Printing and Issuing the Implementation Plan for Groundwater Pollution Prevention and Control, which states that by 2020, a system of regulations and standards on groundwater pollution prevention and control and national groundwater environmental monitoring system should be preliminarily established; the rate of extremely poor groundwater quality nationwide should be controlled at around 15%; typical groundwater pollution sources should be preliminarily monitored and the aggravation of groundwater pollution should be preliminarily controlled. By 2025, the system of regulations and standards on groundwater pollution prevention and control and national groundwater environmental monitoring system should be established; the overall rate of centralized groundwater sources of drinking water whose quality reaches Class III or above in cities at the prefecture level and above should reach approximately 85%; typical groundwater pollution sources should be effectively monitored and the aggravation of groundwater pollution should be effectively curbed. By 2035, the nationwide groundwater environmental quality should be generally improved and ecosystem functions should be basically restored	

Field	Time of Release of Policy	Policy Progress (2018—2019)	Contents
Pollution Prevention and Control	2018	Water pollution prevention and control. According to the requirements of the Plan for Water Pollution Prevention and Control in Key River Basins (2016—2020), by 2020, the national surface water environmental quality should be periodically improved and the overall rate of good water quality (reaching Class III or above) in seven key river basins, including the Yangtze River, the Yellow River and the Pearl River should reach over 70%. “As the time node for the acceptance of water pollution prevention and control in 2020 approaches, the year of 2019 will be a critical year for attaining the planned targets of water pollution control.”	
	March 25, 2019	Water pollution prevention and control. The First Plenary Meeting of the Water Pollution Prevention and Control Law Enforcement Inspection Group under the Standing Committee of the National People’s Congress was successfully held. The meeting officially launched the inspection of the enforcement of the Water Pollution Prevention and Control Law and stressed that the rigid constraints of the legal system should be brought into play to push fundamental control of water pollution and promote continuous improvement of ecological and environmental quality	
	March 28, 2019	Water pollution prevention and control. Five ministries, including MEE and MNR, jointly printed and issued the Notice on Printing and Issuing the Implementation Plan for Groundwater Pollution Prevention and Control. The Notice sets forth technical requirements for groundwater pollution prevention and control zoning, requirements for verification of seepage-proofing gas stations construction, technical requirements for release of the list of groundwater pollution sites and the implementation plan for groundwater pollution prevention and control. Under the Notice, by 2020, a system of regulations and standards on groundwater pollution prevention and control and a national groundwater environmental monitoring system should be preliminarily established, the rate of extremely poor groundwater quality nationwide should be controlled at around 15%, typical groundwater pollution sources should be preliminarily monitored and the aggravation of groundwater pollution should be preliminarily controlled. By 2025, the system of regulations and standards on groundwater pollution prevention and control and national groundwater environmental monitoring system should be established; the overall rate of centralized groundwater sources of drinking water whose quality reaches Class III or above in cities at the prefecture level and above should reach approximately 85%; typical groundwater pollution sources should be effectively monitored and the aggravation of groundwater pollution should be effectively curbed. By 2035, the nationwide groundwater environmental quality should be generally improved and ecosystem functions should be basically restored	

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Pollution Prevention and Control	December 2018	The State Council printed and issued the Work Program for Construction of Pilot “Zero-Waste Cities”	The solid waste problem is not covered by CCICED policy research in 2018
	2019	<p>The first year of enforcement of the Soil Pollution Prevention and Control Law. The Law defines enterprises’ primary responsibility for protecting soil from pollution, strengthens polluters’ responsibility for pollution control, makes clear regulatory responsibilities of the government and departments concerned, establishes systems for agricultural land classification management and construction land access management and increases punishments on environmental violations, thus providing strong rule-of-law guarantee for firmly advancing the “campaign to protect soil from pollution.”</p> <p>MEE will accelerate the enactment of supporting policies, urge local governments to perform the responsibility for regulating prevention and control of soil pollution and safe use of soil, assist departments concerned to implement the systems for agricultural land classification management and construction land access management, so as to control soil pollution risks</p>	The 2010 CCICED Policy Recommendations proposes to fully promote soil environmental protection and safeguard public health and ecological and environmental safety. A specific law for soil pollution prevention and control and soil conservation should be made
		Solid waste. The Waste Cleanup Action 2019 is carried out. And 126 cities within the Yangtze River Economic Belt are covered	The solid waste problem is not covered by CCICED policy research in 2018
	November 2018	Marine environmental protection. According to the MEE press conference, MEE will improve and perfect the system of domestic laws, regulations, standards and norms on marine ecological and environmental protection; carry out the work on marine ecology and environment towards the basic goal of ecological and environmental quality improvement, quicken comprehensive governance of sea areas and accelerate the improvement of basic monitoring and evaluation capacity; enhance environmental supervision and accountability, and make full use of “five steps” to enhance environmental supervision and other effective tools; expedite the application of innovative regulatory means such as random check and pollutant discharge permit, and further facilitate enterprises to fulfill the primary responsibility for “both production and environmental protection.”	The 2018 CCICED Policy Recommendations proposes to strengthen legal protection for marine and coastal ecosystems; establish a high-tech monitoring system; and restore the national plan for marine ecosystem functions and services
	December 2018	MEE, NDRC and MNR jointly printed and issued the Action Plan for the Critical Battle of Comprehensive Environmental Governance in Bohai, which sets forth that, through three years of comprehensive environmental governance, the rate of excellent and good offshore water quality (Class I and II) should reach around 73%, the retention rate of natural coastlines should stay at 35% or so, the scale of remediated and restored coastal wetland should be no less than 6,900 hectares and the length of newly remediated and restored coastlines should reach approximately 70 km by 2020	

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Environmental Governance and Rule of Law	April 2019	The General Office of the Central Committee of the Communist Party of China and the General Office of the State Council printed and issued the Guiding Opinions on Promoting the Coordinated Reform of the Property Right System for Natural Resource Assets with a view to solving long-standing problems such as unclear inventory of natural resource assets, omission of owners, ambiguous rights and duties, failure to implement rights and interests, and imperfect regulatory and protection systems, which have led to frequent property right disputes, inefficient resource conservation, extensive exploitation and utilization and serious ecological degradation. In order to further promote ecological progress, the property right system for natural resource assets must be perfected	The 2016 CCICED Policy Recommendations proposes to deepen the reform of the system to promote ecological progress, remove the administrative contradictions in resource and environmental management, and incorporate the concept of ecological civilization in urbanization, rural land management and exploitation and utilization of water resources
	January 2018	MEE printed and issued the Guiding Opinions on Further Deepening the Reform to Delegate Power, Streamline Administration and Optimize Government Services in Ecology and Environment and Promote High-Quality Economic Development, which resolutely opposes formalism and bureaucratism and proposes to make and implement management and control measures in a scientific manner based on key fields, regions and periods of time for pollution prevention and control and in light of the actual needs of pollutant discharge/emission performance and environmental management, so as to effectively reduce pollutant discharge/emission, promote green business development and industrial transformation and upgrading, and abstain from the one-size-fits-all approach	Not covered by CCICED policy research in 2018
	January 2019	The Opinions of the Ministry of Ecology and Environment and All-China Federation of Industry and Commerce on Supporting and Serving Green Development of Private Enterprises was officially printed and issued, which proposes to encourage private enterprises to actively participate in the critical battle of pollution prevention and control, help private enterprises solve difficulties in environmental governance, improve green development capacity, create a market environment of fair competition, upgrade service guarantee, improve economic policies and measures, and form a long-acting mechanism supporting green development of private enterprises. Private enterprises should also be guided to push transformation and upgrading through ecological and environmental protection, and be actively benchmarked against high-quality development	

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Environmental Governance and Rule of Law	April 2019	MEE released a notice on soliciting public opinions on the Opinions on Effectively Guiding Enterprises to Observe Environmental Laws (Exposure Draft), which proposes to further enhance regulation and law enforcement for ecological and environmental protection, optimize ways of regulation and law enforcement, implement enterprises' primary responsibility for ecological and environmental protection, guide self-discipline among enterprises and push law-abiding to be a normal	The 2014 CCICED Policy Recommendations proposes to accelerate the construction of the system to promote ecological progress and the reform of the ecological and environmental protection system, and improve environmental governance capacity
	Early 2019	The second round of the four-year central ecological and environmental inspection was launched to inspect provincial (autonomous regional and municipal) Party committees and governments, departments concerned under the State Council and central enterprises, and every effort will be made to complete this round of inspection nationwide and a "review" within four years. Ecological and environmental inspection is a key system to promote ecological progress and a major measure of the reform. The first round of central environmental inspection has proven effective in that a number of long-standing ecological and environmental problems have been solved and quite a lot of things that should have been done have been put into practice, and has promoted the improvement of local ecology and environment. After the completion of the first round of inspection, the Group organized a "review." With the improvement of the work, environmental inspection has also transformed	
Regional and International Engagement	April 2019	The Belt and Road Initiative: Progress, Contributions and Prospects, under which the Chinese government has taken a number of mutually accepted measures to increase financial support for relevant countries and expand the channels of diversified financing. Specifically, China and relevant countries have endorsed the guiding principles on financing for the BRI to jointly promote the establishment of a long-term, stable, sustainable and risk-controllable financing system. AFCA already has more than 100 members, and its earmarked loans equivalent to RMB 380 billion has provided strong support for infrastructure, capacity and financial cooperation within the framework of jointly building the BRI, while the Silk Road Fund has received new capital of RMB 100 billion	The 2018 CCICED Policy Recommendations states that as the BRI focuses on infrastructure construction, long-term ecological and environmental impacts and climatic impacts of BRI projects must be considered carefully
		The 2nd Belt and Road Forum for International Cooperation was held, with six categories of 283 deliverables made, including, among others, the establishment of the International Coalition for Green Development on the Belt and Road and launch of the BRI Environmental Big Data Platform and the Belt and Road Environmental Technology Exchange and Transfer Center	The 2018 CCICED Policy Recommendations states that the BRI should be aligned to the Paris Agreement, the 2020 Global Biodiversity Targets and the 2030 UN Sustainable Development Goals

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Regional and International Engagement	September 2018	ICBC successfully issued the world's first green Belt and Road Inter-bank Regular Cooperation bonds ("BRBR bonds"). This issue, made in renminbi, dollars and euros and with an equivalent amount of USD 2.2 billion, consists of both 3-year and 5-year options, and the funds raised will be used to support the construction of green BRI projects. Following international and Chinese principles for green bonds, these bonds are issued by Singapore Branch of ICBC and underwritten by 22 financial institutes from more than 10 countries and regions along the "Belt and Road," of which about 80% are BRBR members	The 2015 CCICED Policy Recommendations proposes to pay high attention to environmental risks posed by "Going Out" and jointly build green "Belt and Road" through consultation. Efforts should be made to include green finance in the financing mechanism for the BRI, propel investment enterprises "Going Out" to lay emphasis on ecological and environmental protection and actively perform their social and environmental responsibilities
	November 2018	The Third Meeting of the UK-China Green Finance Taskforce was held in London, during which GFC and GFI jointly issued the Green Investment Principles for the Belt and Road Initiative	
	2017—2019	In recent years, China has been actively carrying out exchanges and cooperation in marine spatial planning with Bangladesh, Pakistan, Madagascar, Malaysia and other countries along the "21 st Century Maritime Silk Road," contributing Chinese wisdom to ocean governance and planning, and promoting the BRI construction. As the first marine spatial planning prepared by China for another country along the "21 st Century Maritime Silk Road," China-Cambodia Marine Spatial Planning has been highly recognized by Cambodia. Through the cooperation with Cambodia, China has found a new pattern of international cooperation in marine spatial planning. On this basis, substantial progress has been made in China-Thailand cooperation in this regard	The 2018 CCICED Policy Recommendations proposes to accelerate the construction of cooperation platforms, including International Coalition for Green Development on the Belt and Road. A network of partnerships should be created among countries along the Maritime Silk Road to promote sustainable ocean governance
	December 2018	The Katowice Climate Change Conference was held. China is unswervingly committed to tackling climate change. China is fully complementing the concept of innovative, coordinated, green, open and shared development, accelerating green and low-carbon development and promoting ecological progress. China ranks No.1 in terms of renewable investment. As a responsible country, China successfully lowered the carbon intensity by about 46% in 2017 compared with that of 2005, attaining the goal of reducing the carbon intensity by 40% ~ 45% by 2020 over 2005 three years ahead of schedule. China is both thinking and acting as a great power does	The 2018 CCICED Policy Recommendations proposes to strengthen actions to mitigate climate change and increase China's contributions to global climate governance

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Regional and International Engagement	December 2018	The First UK-China Symposium on Marine Plastic Pollution and Control was held in Guangzhou and Shandong. A number of policy makers, experts and representatives of the plastic industry and the plastic disposal industry as well as representatives of non-governmental organizations from both China and the UK attended the Symposium and discussed relevant issues, including the situation of plastic pollution and protection of marine environment. After the Symposium, British experts and relevant Chinese organizations such as MEE, MOHURD and plastic industry associations held a policy discussion	The 2018 CCICED Policy Recommendations proposes to make full use of partnerships and unite relevant countries and regions to fight against plastic pollution
	March 2019	The Joint Statement of the People’s Republic of China and the Republic of France on Upholding Multilateralism and Improving Global Governance: firstly, the two countries promise to strengthen communication and cooperation with respect to marine biodiversity conservation and sustainability beyond their respective jurisdictions within the UN framework and make positive contributions to reaching relevant agreements; secondly, the two agree to maintain exchanges on the conservation and sustainable use of marine biological resources in the South Pole, including the establishment of an Antarctic marine reserve. China and France are strong proponents of international actions against marine and land plastic pollution by strengthening existing mechanisms, especially the Basel Convention	

Appendix III: CCICED Phase VI Composition (as of January 2020)

Members

Mr. HAN Zheng	Chairperson of CCICED Vice Premier of the State Council, People's Republic of China
Mr. LI Ganjie	Executive Vice Chairperson of CCICED Former Minister, Ministry of Ecology and Environment, People's Republic of China
Ms. Catherine McKenna	Executive Vice Chairperson of CCICED Former Minister of Environment and Climate Change, Canada
Mr. XIE Zhenhua	Vice Chairperson of CCICED China's Former Special Representative on Climate Change; Former Deputy Director, National Development and Reform Commission of China (NDRC)
Mr. ZHOU Shengxian	Vice Chairperson of CCICED Former Minister of the Ministry of Environmental Protection
Mr. Achim Steiner	Vice Chairperson of CCICED Administrator, the United Nations Development Programme
Mr. Vidar Helgesen	Vice Chairperson of CCICED Special Envoy to the High-level Panel on Building a Sustainable Ocean Economy; Former Minister, Ministry of Climate and Environment of the Kingdom of Norway
Mr. Erik Solheim	Vice Chairperson of CCICED Advisor, World Resources Institute; Former Executive Director, the United Nations Environment Programme
Mr. ZHAO Yingmin	Secretary-General of CCICED Vice Minister, Ministry of Ecology and Environment, People's Republic of China
Mr. LIU Shijin	Chinese Chief Advisor Deputy Director, Committee for Economic Affairs of the National Committee of the Chinese People's Political Consultative Conference; Vice Chairman, China Development Research Foundation; Former Deputy President, Development Research Center of the State Council
Mr. HAN Wenxiu	Vice Minister, the Office of the Central Financial and Economic Affairs Commission

Mr. YANG Weimin	Deputy Director, Committee for Economic Affairs of the National Committee of the Chinese People's Political Consultative Conference
Mr. ZHANG Jun	China's Permanent Representative to the United Nations
Mr. XIN Guobin	Vice Minister, Ministry of Industry and Information Technology
Mr. LIU Wei	Chairman, China's National Council for Social Security Fund
Mr. WANG Hong	Member, the Leading Party Group of the Ministry of Natural Resources, Director of State Oceanic Administration
Mr. WANG Shouwen	Vice Minister, Ministry of Commerce
Mr. ZHOU Wei	Chief Engineer, Ministry of Transport
Mr. CHEN Yulu	Vice Governor, the People's Bank of China
Mr. CHEN Li	Member, the Overseas Chinese Affairs Committee of the 13 th National People's Congress
Mr. WANG Feng	Member, Supervisory and Judicial Affairs Committee of the National People's Congress
Mr. XU Xianping	Counsellor, the State Council; Specially-appointed Professor, Guanghua School of Management, Peking University
Mr. QIU Baoxing	Counsellor, the State Council
Ms. LI Xiaolin	Former President, the Chinese People's Association for Friendship with Foreign Countries
Mr. TANG Huajun	President, the Chinese Academy of Agricultural Sciences; Academician, the Chinese Academy of Engineering
Mr. ZHANG Yaping	Vice President, Member of the Leading Party Group, Academician, the Chinese Academy of Sciences
Mr. CAI Fang	Vice President, Chinese Academy of Social Sciences
Mr. HAO Jiming	Professor, Department of Environmental Engineering, Tsinghua University; Academician, the Chinese Academy of Engineering
Mr. SHU Yinbiao	Chairman, China Huaneng Group Ltd.; Chairman, International Electrotechnical Commission
Mr. FU Yuning	Chairman, China Resources (Holdings) Co., Ltd.
Mr. QIAN Zhimin	Chairman of the Board, State Power Investment Corporation Limited
Mr. WANG Xiaokang	President, China Industrial Energy Conservation and Clean Production Association; Former Chairman, China Energy Conservation and Environmental Protection Group
Mr. WANG Tianyi	Executive Director and the Chief Executive Officer, China Everbright International Limited
Ms. Maqorie YANG	Chairman, Esquel Group
Mr. Scott Vaughan	International Chief Advisor Former President and CEO, International Institute for Sustainable Development

Mr. Joachim von Amsberg	Vice President, Asian Infrastructure Investment Bank
Ms. Inger Andersen	Executive Director, The United Nations Environment Programme; Former Director General, International Union for Conservation of Nature
Mr. Peter Bakker	President, World Business Council for Sustainable Development
Mr. Francesco La Camera	Director-General, the International Renewable Energy Agency
Mr. Srun Darith	Secretary of State, Ministry of Environment, Cambodia
Mr. John J. DeGioia	President, Georgetown University
Mr. Hans Friederich	Former Director General, International Network for Bamboo and Rattan
Ms. Kristalina Georgieva	Managing Director, International Monetary Fund
Mr. Stephen P. Groff	CEO, National Development Fund of Saudi Arabia; Former Vice President, Asian Development Bank
Ms. Kate Hampton	CEO, Children's Investment Fund Foundation
Mr. Arthur Hanson	Senior Advisor and former president of International Institute for Sustainable Development
Mr. Eric Heitz	Former CEO and Co-founder, the Energy Foundation
Mr. Stephen Heintz	President, the Rockefeller Brothers Fund
Mr. Nuritdin Inamov	Director, Department for International Cooperation, Ministry of Natural Resources and Environment of the Russian Federation
Ms. Naoko Ishii	CEO and Chair, Global Environment Facility
Mr. Rodolfo Lacy	Director for the Environment Directorate, Organization for Economic Co-operation and Development
Mr. Marco Lambertini	Director General, World Wide Fund for Nature
Mr. Yong Li	Director General, the United Nations Industrial Development Organization
Mr. Ajay Mathur	Director General, the Energy & Resources Institute of the Republic of India
Mr. Michael McElroy	Gilbert Butler Professor, Environmental Studies, Harvard University
Ms. Kathleen McLaughlin	Chief Sustainability Officer and President, Walmart Foundation
Mr. Hideki Minamikawa	President, Japan Environmental Sanitation Center
Mr. Oliviero Montanaro	Directorate General, Nature and Sea Protection, Ministry of the Environment, Land and Sea, Italy
Ms. Nosipho Ngcaba	Director-General, Department of Environmental Affairs of the Republic of South Africa
Ms. Lidewijde Ongering	Secretary-General, Ministry of Infrastructure and Water Management of the Kingdom of the Netherlands
Mr. Félix Poza Peña	Chief Sustainability Officer, Inditex Group
Mr. Finn Pratt	Former Secretary, Department of the Environment and Energy of the Commonwealth of Australia
Mr. Jonathan Pershing	Director of Environment, Hewlett Foundation
Ms. Diane Regas	President and Chief Executive Officer, the Trust for Public Land
Mr. Frank Rijsberman	Director General, Global Green Growth Institute

Ms. Asa Romson	Expert in environmental law & policy, IVL Swedish Environmental Research Institute; Former Deputy Prime Minister and Minister for Climate and the Environment, the Kingdom of Sweden
Ms. Gwen Ruta	Executive Vice President, Environmental Defense Fund
Mr. Ahmed M. Saeed	Vice President (Operations 2), Asian Development Bank
Mr. Andrew Steer	President and CEO, World Resources Institute
Mr. Mark Tercek	Former CEO, the Nature Conservancy
Mr. Frans Timmermans	First Vice President, European Commission
Mr. Jan-Gunnar Winther	Specialist Director, Norwegian Polar Institute
Mr. Seung-Joon Yoon	Professor, Seoul National University; Former President, Korea Environmental Industry & Technology Institute

Special Advisors

Mr. FAN Bi	Invited Research Fellow, China Center for International Economic Exchanges
Mr. LI Junfeng	Former Director General, National Center for Climate Change Strategy and International Cooperation
Mr. LI Pengde	Deputy Director General, China Geological Survey
Mr. JI Yongjun	Deputy Director General, Department of American and Oceanian Affairs of the Chinese People's Association for Friendship with Foreign Countries
Mr. HU Baolin	Honorary Dean of Research Institute of China Green Development of Tianjin University; Former Deputy Director, Executive Office of The Three Gorges Project Construction Committee of the State Council
Ms. DONG Xiaojun	Deputy Director, Division of Economics of the Chinese Academy of Governance
Mr. ZHANG Yongsheng	Deputy Director, Institute for Urban and Environmental Studies, Chinese Academy of Social Sciences
Mr. ZHANG Yuanhang	Dean, College of Environmental Sciences and Engineering of Peking University; Academician of the China Academy of Engineering
Mr. HE Kebin	Dean and Professor, School of Environment, Tsinghua University; Academician of the China Academy of Engineering
Mr. ZHAO Zhongxiu	President, Shandong University of Finance and Economics
Mr. YE Yanfei	Senior Inspectorate Advisor, Policy Research Bureau of the China Banking and Insurance Regulatory Commission
Mr. CHEN Xinjian	Vice President, Industrial Bank
Mr. MA Jun	Former Chief Economist, Research Bureau of the People's Bank of China
Ms. LIU Kun	General Manager, Medical and Health Division, China General Technology (Group)

Mr. LIU Tianwen	Founder, Chairman and CEO, iSoftStone Holdings Ltd.
Mr. ZHAI Qi	Executive Secretary General, China Business Council for Sustainable Development
Mr. Iskandar Abdullaev	Deputy Director, Central Asia Regional Economic Cooperation Institute
Mr. Knut Halvor Alfsen	Former Head Research Director, Center for International Climate and Environmental Research
Mr. Howard Bamsey	Chair, Global Water Partnership; Former Executive Director, Green Climate Fund Secretariat
Mr. Manish Bapna	Executive Vice President and Managing Director, World Resources Institute
Mr. Dimitri de Boer	Chief Representative, ClientEarth China
Mr. Guilleimo Castilleja	Senior fellow, the Gordon and Betty Moore Foundation
Ms. Galit Cohen	Deputy Director General for Policy and Planning, Ministry of Environmental Protection of the State of Israel
Mr. Stephan Contius	Commissioner for the 2030 Agenda for Sustainable Development, the Federal Ministry of the Environment, Nature Conservation and Nuclear Safety, Germany
Ms. Lisbeth Jespersen	Former Head of International Partnerships and Fundraising, IDH, the Sustainable Trade Initiative
Mr. Johan C.I. Kuylenstierna	Vice Chair, Swedish Climate Policy Council; Adjunct Professor, Stockholm University
Ms. Bernice Lee	Research Director-Global Economy and Finance, Chatham House
Mr. Zafar Makhmudov	Executive Director, the Regional Environmental Centre for Central Asia
Ms. Jane McDonald	Executive Vice President and Chair of the IISD Experimental Lakes Area Board, the International Institute for Sustainable Development
Ms. Désirée McGraw	President and Head, College of Pearson College UWC
Mr. Keith Mclea	Chief Executive, the Institute of Environmental Science and Research of Crown Research Institute, New Zealand
Mr. Hans Mommaas	Director-General. PBL Netherlands Environmental Assessment Agency
Mr. Ismo Tiainen	Director-general, Administration and International Affairs. Ministry of the Environment, the Republic of Finland
Mr. Hau Sing Tse	Executive Director, African Development Bank for Canada, China, South Korea and Kuwait
Mr. Dominic Kailash Nath Waughray	Head of Centre for Global Public Goods, Member of the Executive Committee, World Economic Forum
Mr. ZHANG Hongjun	Partner, Holland & Knight
Mr. ZHANG Jianyu	Vice President, Environmental Defense Fund; Chief Representative of Environmental Defense Fund Beijing Representative Office
Mr. ZOU Ji	CEO & President of Energy Foundation China

