China Council for International Cooperation on Environment and Development (CCICED)

Evaluation and Prospects for a Green Transition Process in China

CCICED Task Force Report

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Summary of Key Findings

China has made important progress towards a 'Green Transition' in the past 10 years, with numerous major policy initiatives and growing public awareness. This is reflected in key indicators such as energy intensity, which has continuously improved alongside sustained GDP growth. Yet at the same time, it is clear that China's overall environmental situation has been deteriorating. This is evidenced in phenomena such as the rising air pollution challenge in a growing number of major cities, as well as rapidly increasing fossil energy use and carbon emissions.

The government has mainly relied on administrative controls to tackle pollution, and has yet to expand the use of measures which affect behavior via the market. Some of the primary barriers to China's Green Transition process lie in economic policy settings. Over-investment in heavy industries has led to excessively high levels of energy consumption, compounded by the absence of appropriate market-based instruments. International experience shows that a combination of regulatory and market-based approaches will be most effective. We therefore propose a range of economic and pricing instruments as part of an integrated policy framework to promote the Green Transition.

The imbalance in investment-consumption structure over the past 10 years is one of the major causes of worsening air pollution, because it has led to excessive and wasteful energy consumption. If China can increase consumption whilst slowing investment within an appropriate range, there will be no impact on GDP growth but energy consumption and air pollution will be reduced significantly. A smaller share of investment in GDP growth may even produce stronger GDP growth, due to enhanced demand for green products, efficiency improvements and improved air quality.

At the same time as making this adjustment, it is also critical to ensure that both investment and consumption follow a sustainable path. Investment in China will still be at considerable levels even if the adjustment is made; it should be channeled into the huge and growing opportunities for green growth – including the widespread application of clean technologies in industry, renewable energy, smart grids, construction of efficient cities, ecological protection and public transport infrastructure. Amongst other measures, this will require green reforms in the finance sector. A shift to sustainable consumption is just as important to limit energy demand growth in the medium term, especially in China's cities.

China urgently needs to push forward economic transition toward a new, more sustainable development model. Excessively high saving and investment, as well as various preferential policies to promote industry, have maintained the rapid growth of heavy industries, and stunted development in the service sector which offers larger job opportunities in the future. Meanwhile, overcapacity is undermining the competitiveness of China's heavy industries. The emphasis on physical investment has also led to under-investment in human capital and the education and health sectors, as well as ecological and environmental protection.

China can take great steps towards a Green Transition in the 13th Five Year Plan. Worsening air pollution has greatly increased public awareness about the seriousness of the problems and the need for change. With further growth of the urban middle

class, domestic demand for a better environment is rising. China can draw on lessons from other countries as seeks to ‘decouple’ economic growth from the negative environmental impacts; especially the need for integrated, cross-cutting approaches that tackle the root causes. The Leadership has promised to push forward a new round of institutional reforms. If the government incorporates high quality policies aimed at structural changes and green development, China can continue its 7-8% GDP growth rate over the next few years and boost economic productivity alongside a significant improvement in environmental conditions.

Summary of Main Policy Recommendations

The Task Force strongly recommends that the government focuses on reducing China's tendency to over-invest in physical industrial capacity with its associated excessive energy consumption and air pollution. Based on scenarios developed by the Task Force, an indicative 10 percentage point reduction of the share of investment in GDP and a corresponding increase in the share of consumption in GDP could reduce energy demand by around 13% by 2030, compared to a 'business-as-usual' scenario (BAU). This would promote structural adjustment between heavy industry and the service sectors.

A range of policy adjustments are needed to rebalance the investment-consumption structure, including fiscal and financial sector reforms; measures to address income distribution; and strengthening of the social safety net. These policies will also help ensure that a growing share of investments in China is directed to green sectors, technology and infrastructure. A transformation in government functions is required to reform financial and administrative systems: reducing government investment in heavy industry, and increasing public service and social security spending. A new inter-departmental coordinating mechanism could be introduced to manage this process, involving not only sector ministries but also core departments, such as planning, finance and trade.

A higher resource tax should be imposed on fossil fuels, including coal, as well as environmental taxes on electricity and automobile consumption in cities which face severe air pollution. Scenarios presented to the Task Force suggest that green fiscal policies could reduce fossil fuel consumption by a further 6.1% in 2030, with an 8.4% reduction for higher carbon, highly polluting fossil fuels (coal and oil). This could also provide significant source of revenue for local and the national government.

In recent years, stronger policies on the demand-side have successfully expanded the domestic market for renewable energy in China. With sustained attention and some policy adjustments to reduce uncertainty, scaling up renewables could avoid 5% of fossil energy consumption in 2020, compared to the BAU scenario developed by Task Force members. For other green technologies, policies are still focused on the supply side; clearer demand-side policies should now be applied more broadly, to expand all green technology markets and help address overcapacity in green industries.

Urbanization continues apace in China, and efficient cities and green buildings are critical to manage future energy consumption growth and reduce pollution. Scenarios presented to the Task Force suggest that fully enforcing compulsory building standards for energy efficiency and expanding inter-city and urban rail transport could lower energy consumption by an estimated 5 to 12% in 2030, compared to the BAU scenario. Further savings are possible if China promotes the use of 'zero-energy' buildings.

China is a leader in some areas of 'Green Finance', but broader reforms are needed to ensure the financial system actively facilitates the Green Transition. All financial institutions should incorporate environmental considerations in their profit calculations; ensuring allocation of financial resources reflects environmental factors

and risks, avoiding polluting activities and creating opportunities for green growth. With careful planning and coordination, mandatory 'green credit guidelines' could be introduced and China could establish a 'green bank', funded by green bonds.

We suggest that China adopts a "National Quantity Target Control" system to control energy consumption as soon as possible, with clear distribution of the "caps" for localities and industries. For the energy mix we propose a "three-step" target: 1) Renewable energy should grow faster than other energy sources including natural gas by 2020; 2) Non-fossil energy could grow faster than fossil fuels by 2025 in absolute terms; 3) Fossil energy consumption could peak in the 2030s at 4.6 – 5.2 billion tons of standard coal equivalent (SCE). Consumption of higher carbon fossil fuels could peak between 2025 and 2030 at 4.0 – 4.8 billion tons SCE, and then decline in absolute terms.

According to projections presented to the Task Force, full implementation of the Green Transition policies and reforms proposed in this report could result in a reduction in fossil energy demand of 26% in the 2030s, relative to the BAU scenario. SO_2 and NOx emissions could fall by around 15% in 2020 and around 30% in 2030 compared to BAU. Fossil energy consumption and carbon emissions could peak in 2037 (at around 4.0 billion tons SCE and 9.5 billion tons CO_2 respectively), and then decline. Consumption of higher carbon, highly polluting fossil fuels (coal and oil) could peak by 2020, at around 3.4 billion tons SCE. Coal consumption could also peak by the end of the 13th Five Year Plan in 2020. These goals are more ambitious and challenging than the targets proposed in the previous paragraph, but achieving them would put China firmly on the road to an Ecological Civilization.

Background and Implementation of the Task Force

Over the past decade, China has made important progress towards a Green Transition. The government has formulated the core framework for a Green Transition, including a national development concept, the strategic targets and approach, and a specific implementation plan.

The 13th Five Year Plan is the critical window of opportunity for the Green Transition, and will be the litmus test of China's commitment to pursuing an ecological civilization. Action is urgent, because air pollution and other environmental challenge pose a serious threat to China's development goals. Action is possible, because the economic reform program and the strong response to the air quality crisis present huge opportunities to align environmental and economic policy at the strategic level.

Against this backdrop, it is both pressing and necessary to evaluate and summarize the process of Green Transition in China in the past decade, analyze the obstacles and bottleneck in the transition process, envisage future opportunities and challenges, and propose a new strategic framework to further promote the green transition process.

The report focuses on energy use and 'local' air pollution, rather than carbon dioxide and global climate change. The main consideration behind this framework is that local pollution has become a political lightning rod in China. We aim to use this opportunity to provide policy-makers and other stakeholders with practical solutions.

This Task Force is not focused solely on environmental issues: it is highly concerned with the sustainability of China's future economic development; the impact of structural change on the environment; future structural changes; and the interaction between policies and structural changes. Each of these aspects deserves in-depth studies, but has been given inadequate attention in previous research. Our research focuses on the role of economic policies and measures to regulate and solve imbalances, to sustain economic growth and to improve the environment.

Since the inception of this project in August 2013, five Task Force meetings and an overseas study tour have been organized. Throughout the research, Chinese and international members have had brain-storming sessions and discussed key issues in detail, including the key policy recommendations, findings and conclusions, scenario forecasting work and analytical methodologies and frameworks. The output of this project includes this research report and nine background papers.

Contents

1 GREEN TRANSITION IS AN URGENT PRIORITY FOR CHINA

1.1 Economic performance and the current growth model

China has made tremendous progress on economic development, lifting millions out of poverty in the process. After several decades of growth, China's GDP reached 56.9 trillion RMB (9.2 trillion USD) in 2013, placing it second in the world with about 12% of global output. China is now considered a lower middle-income country; its per capita GDP was 6800 USD in 2013, ranked 77 in the world[1].

An economic structure characterized by dominant state-owned banks, strong state intervention and controls on interest rates has proved remarkably successful in China: it mobilized savings and resources, and allocated capital to key strategic sectors during the economic take-off[2]. Yet this model has also led to over-investment and decreasing returns on capital, as well as widespread over-capacity in China's energy intensive sectors.

Today, China's development model continues to rely heavily on energy and resource consumption. Rapid industrialization and urbanization are accompanied by unprecedented investment in heavy industries, which require a large volume of materials and energy. Industry accounts for around 70% of China's energy consumption, much of it from coal[3]. This lies behind many of the undesirable impacts of China's development, such as severe pollution and the accompanying welfare loss.

The hard truth is that the benefits of this model are fading – and eventually they will be outweighed by the rising associated costs. Yet with development processes far from complete in China, forging a new development path is an urgent and unavoidable task for China's leaders and society. Per capita incomes are still significantly lower than developed countries, and by 2020 another 100 million people are expected to move into China's cities in the next great wave of urbanization – a significant challenge for job creation as well as for infrastructure development and the environment[4]. Meanwhile, China still needs to develop its western regions in a sustainable way.

1.2 Major policy efforts on environmental protection and energy-saving

The downsides of China's development model have not gone unnoticed: its leaders have made considerable efforts to tackle the serious and growing environmental impacts which have accompanied the country's resource-intensive economic development.

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[1] World Bank definition of 'lower middle income country'. GDP figures presented are in current USD. Adjusted for purchasing power parity, GDP per capita in China was 11,904 USD. In PPP terms, China was close to parity with the US in 2013.

[2] World Bank, Development Research Center of the State Council, 2013. *China 2030*: *Building a Modern, Harmonious, and Creative Society,* http://www.worldbank.org/content/dam/Worldbank/document/China-2030-complete.pdf

[3] China Statistical Yearbook gives a value of 71% in 2011. Due to different accounting methods, industry accounts for a smaller share in some international assessments. In the IEA World Energy Outlook 2013, industry is responsible for 48% of final energy consumption in 2011.

[4] Wall Street Journal, March 16th 2014, *China Unveils Urbanization Plan*. Available: http://online.wsj.com/news/articles/SB10001424052702303287804579444112058812626

Laws to encourage environmental protection were gradually put in place from the beginning of the opening up period in the late 1970s, but it was the 11th and 12th Five Year Plan (FYP) periods that saw a significant increase in policy action to tackle environmental problems (Table 1-1). Of the initiatives on energy conservation and environmental protection, perhaps the most important are the Cleaner Production Law and Renewable Energy Law; the mandatory energy intensity targets for local governments and companies; and the newly revised Environmental Protection Law.

Government spending on resource conservation and environmental protection also increased significantly. China has invested approximately 800 billion RMB in major ecological construction projects since 1998, including returning farmland to forests, returning grazing land to grassland and controlling sandstorms that affected Beijing and Tianjin. Ecological compensation capital grants awarded by the government increased from 2.3 billion RMB in 2001 to 78 billion RMB in 2012. Grants for energy conservation and environment protection granted reached 1,014 billion RMB in 2012, having grown at an average annual rate of 24.1% from 2008.

Table 1−1: Major Policy Initiatives on Energy Efficiency & Environmental Protection

Policy or Target	Compliance period	Brief description
Broad goals		
Construction of Ecological Civilization	2013	Includes a strategic plan to promote protection of the ecological environment and proposed a roadmap and timetable for speeding up ecological civilization system construction.
Twelfth FYP Energy intensity target	2011-2015	By 2015, non-fossil energy share of total primary energy consumption should reach 11.4%, the per-unit GDP energy consumption should be reduced by 16% compared to 2010, and carbon dioxide emissions per unit of GDP should be reduced by 17%.
Eleventh FYP Energy intensity target	2006-2010	Required a 20% reduction in energy intensity at the national level, with intensity targets assigned to individual provinces.
Circular Economy Promotion Law	2008	Raising resource efficiency and protecting and improving environment via resource recovery in production, circulation and consumption, amongst other measures.
Construction of Energy-efficient and Environmentally-Friendly Society	2005	Developing recycling economy, protecting the ecological environment, accelerating the construction of resource-saving, environment-friendly society, promoting coordinated development of the economy and population, resources and environment.
Scientific Development View	2003	Adhering to the people-oriented principle, establishing comprehensive, coordinated, sustainable development view, promoting the economic society and people's overall development in accordance with overall urban and rural development, regional development and economic and social development. Enhancing harmonious development between man and nature and opening to the outside world.
Sustainable Development	1992	A formal national development strategy, which organized the implementation of the ‘three rivers, three lakes’ pollution prevention project, the grain to green program, and natural forest resource conservation.
Energy		

Renewable Energy Law	Oct.26, 2009	Putting the development and utilization of renewable energy as priority areas of energy development, taking corresponding measures and promoting the establishment and development of the renewable energy market
Clean Production Law	Oct.28, 2007	Clearly defining energy conservation as the basic national policy, setting up the strategy of "National implementation of conservation and energy development".
Water pollution control		
Law on Prevention and Control of Water Pollution	Feb.28, 2008	By the end of 2010, the state has promulgated more than 80 pieces of local laws and regulations, provincial government regulations and regulatory documents more than 700 pieces. Its scope includes the management of water resources, river basin and water environment protection, etc.
Air pollution control		
Law on the Prevention and Control of Atmospheric Pollution	Sep.1, 2000	The basic law for the prevention and control of atmospheric pollution areas.
Ecological protection		
Environmental Protection Law	1979, Revised 1989 & Apr. 25, 2014	Amongst other measures, the 2014 revision establishes the principle that environmental protection takes precedence; removes the upper limit on fines; imposes fines for each day a breach has occurred; clarifies the right of environmental organizations to initiate lawsuits; strengthens requirements for environmental impact assessments; and increases transparency over environmental data.
Chinese Biodiversity Conservation Strategy and Action Plan	Sep.17, 2010	Incorporating biodiversity conservation into plans for national economic and social development and planning department.
National Ecological Function Regionalization	Aug.14, 2008	The Ministry of Finance issued "national key ecological function areas". In 2010, 451 counties implemented national key ecological function zones.
National Ecological Fragile Zone Protection Plan	Sep.27, 2008	Determining the distribution and state of ecologically fragile areas, and setting principles and tasks for the restoration and reconstruction of ecologically fragile areas.
National Biological Species Resources Protection and Utilization Plan	Dec.10, 2007	Clearing utilization of biological species and resources protection in key area, putting forward strategic tasks.

These top-down long-term strategies, plans and policies have made some headway towards a Green Transition. Energy and carbon intensity[5] both improved by 19% over the 11th Five Year Plan period, while China's considerable economic growth rate was maintained. Energy consumption per unit GDP fell by 52% between 2001 and 2013, and carbon emissions per unit GDP by 43%.

China's economy has also been gradually reducing its overdependence on heavy industry. The share of tertiary sectors in GDP reached 46.1% in 2013, surpassing the contribution of industrial sectors for the first time. Within the industrial sectors there has also been a gradual shift towards less resource-intensive, higher value-added activity: the proportion of high energy-consuming industries fell from 70.5% of output in 2009 to 68.8% in 2012.

[5] Defined here as 'consumption of energy and CO_2 emissions per unit GDP', respectively.

Meanwhile, a new green industry has been emerging in China, ranging from the manufacture of pollution abatement equipment, renewable energy and sustainable transport technology to a wide variety of environmental service companies. The growth rates of investment on sustainable transportation and pollution control reached 53.8% and 41.7% respectively in 2005 and 2007. The government plans to invest $277 billion between 2013 and 2017 in pollution control.

Renewable energy industries have developed rapidly in recent years to the extent that China is now the global leader in and major exporter of renewable technology components and parts (see section 2.3). China is by far the largest investor in renewable energy. New investments in clean energy in China totaled 54.2 billion USD in 2013, and a record 19.3 billion was achieved in the second quarter of 2014[6]. China installed around 12 GW of solar PV in 2013 – roughly a third of the global total.

Emissions of some major pollutants (such as SO_2) have already peaked and chemical oxygen demand (COD) figures also indicate falling levels of organic pollution in water[7]. Investments in pollution control rose steeply in the 11th FYP period, from 111 billion RMB in 2005 to 825 billion RMB by 2012. Overall, SO_2 emissions fell by 11% between 2005 and 2010, due to flue-gas desulphurization in power plants and vehicle technology standards[8]. Among the seven major river drainage basins, the percentage of water quality better than Grade III increased from 41% in 2005 to 64% 2012, while the percentage worse than Grade V declined from 27% to 10.2%.

The newly revised Environmental Protection Law, which will come into effect in 2015, will bring new opportunities to accelerate the Green Transition. Amongst other measures, it will remove the cap on fines that can be imposed on polluters and clarify the ability of environmental organizations to initiate legal action. It also requires greater transparency on environmental data and more rigorous environmental impact assessment processes.

1.3 Environmental-economic problems persist

While these policies and measures have helped address some of the negative impacts of China's growth, they have proved insufficient to shift the country onto a Green Transition pathway. The country faces rising and very serious environmental problems, many of which stem from the use of coal in the energy sector and by heavy industries, as well as the use of oil in the transport sector. Figure 1- 1 shows the rise in energy use and air and water pollution in China from 2001 to 2013.

Continuing urbanization has exposed a growing number of people to air pollution. In urban areas, fog and haze (PM2.5) are increasingly severe. Coal accounts for about two thirds of total primary energy consumption in China, and about 90%[9] of fuel consumed in power generation. As a result, greenhouse gas emissions and associated local pollutants such as sulfides, nitrides and particulates have risen with energy

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[6] Bloomberg New Energy Finance, 15 July 2014, *Global Trends in Renewable Energy Investment*. Presentation available from BNEF website.

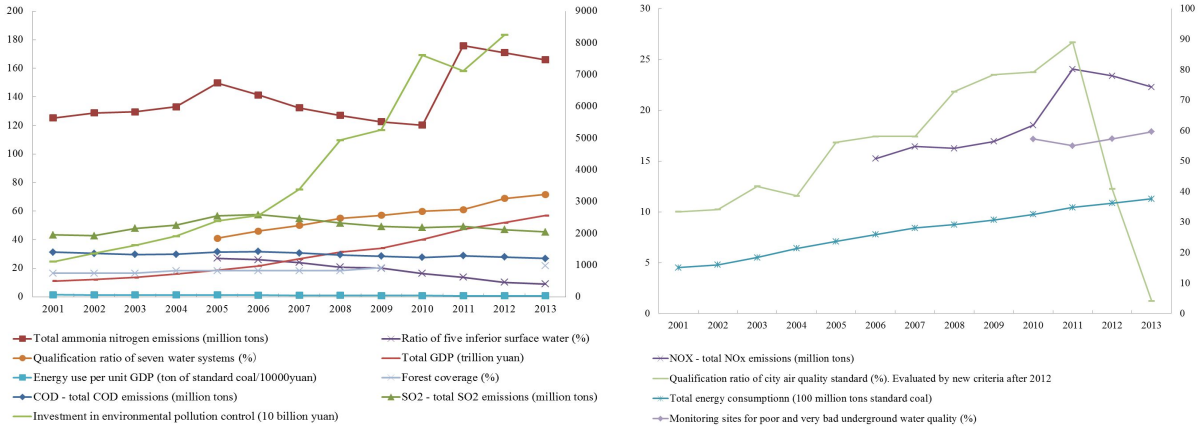
[7] COD is an indirect compound measure of organic pollutants in water.

[8] Qiang Zhang, Kebin He and Hong Huo, 2012, *Cleaning China's Air.* Vol 484 Nature 161-162. Comment Piece. (Improvements in the power sector were offset by an increase in emissions from heavy industry).

[9] The latest figure is 88.2% in IEA, 2014, World Energy Outlook 2013. p620

consumption, not only reducing productivity but also endangering public health.

Figure 1- 1: China's Environmental Status during 2001-2013



In 2013, total energy consumption in China reached 3.75 billion tons SCE (standard coal equivalent), exceeding the US level for the first time. Energy intensity will continue to decrease in the future, but total energy consumption will rise to some degree in absolute terms. Under a business-as-usual scenario, energy consumption in 2030 could be close to double the 2013 level. Such a pathway would clearly be unsustainable for China, and for the world.

The environmental impacts are not restricted to air quality and climate change. Ecological degradation, deforestation, soil pollution, solid wastes and water pollution are also undermining China's future sustainable development. The 'western development plan', for example, is based on shifting industries from eastern to western regions, where the ecosystem is relatively more fragile and ecological damages might be even more costly.

1.4 China needs a new, sustainable growth model

China's great challenges today represent a historic window of opportunity. On the one hand, the very serious health consequences of deteriorating air quality have already led to a new 'war on pollution', backed by a plan to invest 277 USD billion in abatement measures between 2013 and 2017[10]. On the other, the economic reform plans announced at the Third Plenum present important possibilities for delivering green growth.

To seize the window of opportunity and unlock the Green Transition, government should draw on assistance from a broad range of stakeholders in the 13th Five Year Plan. International experience is clear that an effective strategy for private sector engagement is a vital ingredient, and the public will play a key role[11]. Effective

[10]Sue-Lee Wee, ed. Ron Popeski, Jul 24, 2013, China to invest $277 billion to curb air pollution: state media, *Reuters,* http://www.reuters.com/article/2013/07/25/us-china-pollution-idUSBRE96O01Z20130725

[11] For supporting evidence for arguments made on international experience in this report see two background papers for the Task Force: "Latest policies and measures for green transition in the world", by Sheng Fulai, and "Historic review of green transition in selected countries" by Laszlo Pinter.

coordination and clearer incentive structures between government ministries, and between the national and local levels is also critical (see section 2.5).

China is in a race against time to define a more potent mix of regulatory and market-based measures that will effectively, sustainably and most of all quickly address the root causes of local air pollution, greenhouse gas emissions and other environmental challenges. Although the challenges cannot be fixed overnight, the 13th Five Year Plan must chart a clear course to a new sustainable growth model – what we call a 'Green Transition'.

Innovation – whether in technology, in finance or in institutions – will play a critical role. Given China's current phase of economic development and its resource endowment, economic growth will be accompanied with a growth in coal use in the near term unless major technology breakthroughs occur. However, a Green Transition and a low energy, low pollution pathway is possible in the middle and long term, especially if imbalanced development with distorted investment behavior can be corrected. 'Peak coal' could be achieved by 2020 if a range of policy changes are made (see section 2.6).

As this report shows, Green Transition is a viable alternative model that offers a new relationship between the economy and the environment. Through a Green Transition, China can maintain economic growth in coming decades whilst avoiding the risk of serious environmental deterioration. It means a shift of investment away from polluting industries towards green sectors, service industries and social protection, together with a range of policies and measures to change investor and consumer behavior and drive technological and institutional innovation.

A less ambitious, less sustainable pathway closer to 'business-as-usual' would be fraught with unacceptably high risks. First, it would quickly lead to instabilities in economic development, whether due to the environmental shocks, hard water scarcity constraints, the health costs of air pollution or rising fossil fuels imports. Second, it would represent a huge missed opportunity for China, which can remain the world leader in green goods and services as global markets for such products continue to expand. Finally, a high energy consumption pathway would undermine China's contribution to ensuring global climate security, as well its claim to leadership in promoting an ecological civilization.

1.5 'Green Transition' describes a process to deliver Ecological Civilization

In this report, the term 'Green Transition' refers to the change we are proposing for China's growth model, which puts more emphasis on ecologically balanced economic growth. As a developing country, China still needs growth – whether measured in terms of income or material quality of life or employment – but the country has reached a stage where putting a higher value on human and ecological well-being is necessary and desirable.

The concept of Green Transition builds on 'green growth' and 'green economy' studies, but places a stronger focus on the processes of 'structural change' and development 'pathways'. Drawing a historical parallel with the "Great Transformation", we focus on the essential steps to a Green Transition, highlighting in particular the need to restructure our world before reaching the tipping points where

irreversible environmental damages occurs.

The 'Green Transition' concept is proposed as a way to deliver China's 'Ecological Civilization'. This concept was first proposed by President Hu Jintao in his report to the 17th National Congress of the CPC. It is a 'future-oriented' guiding principle based on recognition of the extremely high price China has paid for its economic miracle. Ecological Civilization reflected an important change in the government's understanding of development. Rather than emphasizing economic construction as the core of development as it did in the past, China's leaders have come to realize that development, if sustainable, must entail a list of elements including the right relationship between people and nature.

1.6 About this Task Force report

The Green Transition is a necessary step for China, but it is also a difficult process with great complexity. There are many issues related to the Green Transition, such as water, soil, noise, air, ecological conditions and climate changes. It will require planning over time and involves many different issues and stakeholders.

We are not able to address all potential aspects of the Green Transition in this study, so it is necessary to narrow the scope and choose an approach according to our own specialties. Other experts are examining, for example, the political economy of special interest groups, rule of law and legal enforcement; popular participation and social organization; value systems and morality; education, social responsibility and awareness or consciousness.

This study examines policy issues related to environment protection and Green Transition from an economics standpoint; we consider the impact of "tuning" key economic variables – changes to the structure of China's economy and industrial mix – on the environment. We also focus on how to promote green transition with economic policies and instruments. This includes economic incentives (such as taxation), changes to pricing mechanisms, and new green financial tools. We include demand-side policies and market creation for clean energy technology, as well as absolute national and regional energy consumption targets.

There are many other means available to promote Green Transition, from administrative measures and legal action to investment in innovation and increasing stakeholder participation. There are also important challenges for the enforcement of existing rules and regulations. Collectively, these policy and regulatory tools may be even more important than the economic measures examined in this study. However, as this report shows, wider economic measures can make an important contribution to the Green Transition, and their role deserves further attention from policy makers.

The report focuses on energy use and 'local' air pollution, rather than carbon dioxide and global climate change. The main consideration behind this framework is that local pollution has become a political lightning rod in China. We aim to use this opportunity to provide policy-makers and other stakeholders with practical solutions. Efforts to reduce local pollution will often – though not always – help to reduce greenhouse gas emissions, since the major pollutants such as particulates (PM2.5) and SO_2 etc. are often a by-product of fossil energy consumption.

The study draws on 9 background papers prepared by Task Force members and research support team in their organizations.

Section 2 of this Task Force report explains the root causes that stand in the way of China's Green Transition and highlights opportunities to address these barriers. There is a key role for economic restructuring, but also for greater use of environmental taxation and green finance, as part of an integrated policy framework. International experience highlights the importance of inter-departmental mechanisms to guide systemic changes, as well as key roles for the private sector and the general public.

The section draws on a combination of scenarios analysis, economic calculations and international experiences. The result of scenario analysis is summarized in section 2.6. Methodologies used for the analysis are explained in Appendix 1, and Appendix 2 shows the tables of results.

Section 3 summarizes the key conclusions of the Task Force. China should seize the window of opportunity represented by the political visibility of growing environmental pressures and the range of systemic reforms expected in the 13th Five Year Plan. The key goal is greening China's Great Reform Program: incorporating the Green Transition concept into China's mainstream reform plans, to ensure progress towards ecological civilization. The government should 'level the economic playing field' by reducing the unfair advantages enjoyed by heavy industry, and correct the root causes of environmental externalities. Information plays a critical role in ensuring economic approaches and tools are effective; it will enable the private sector to pursue green innovation and investments.

Section 4 provides a set of policy recommendations.

2 TACKLING THE ROOT CAUSES: TOWARDS A GREEN TRANSITION

2.1 The Structure of Economic Growth

2.1.1 The imbalance in investment and consumption

Too little attention has been paid to the critical role that overinvestment plays in China's environmental crisis. The high energy and resource intensity of China's economy is inseparable from long-term over-investment in heavy industry as well as the long-term distortions in saving behavior[12].

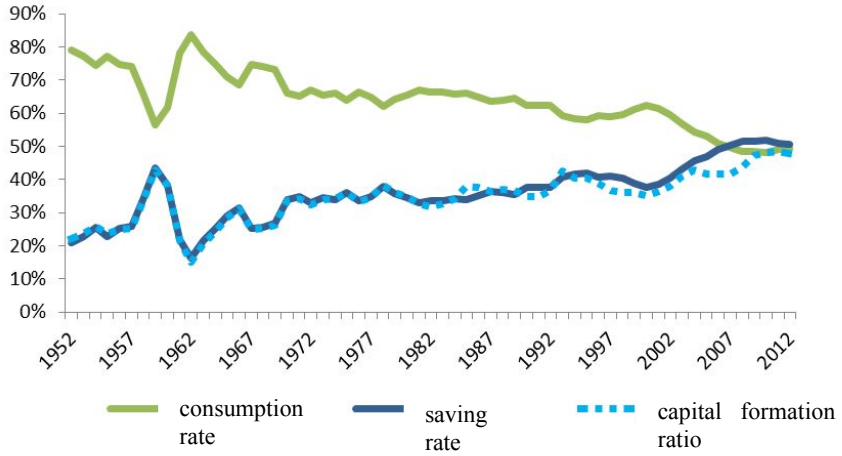
The saving rate and the share of capital formation in GDP have been rising since the 1960s, and the trend accelerated in the last decade. In 2012, China's capital formation ratio was 47.7% of GDP – two-and-half times of the world average (see Figure 2- 1). China's unbalanced income distribution contributes to a decreasing proportion of residential consumption in GDP. Between 2000 and 2013, the share fell by 10 percentage points to 36% of GDP, while total capital formation increased by 12 percentage points over the same period.

In the past these high saving and investment rates have been positive for China's development. The high savings rate made it possible to utilize and satisfy most of the

[12] Cultural factors are also relevant - most East Asian countries have high savings rates (for example, South Korea at 35%), although China's savings rates are even higher.

investment requirements of China's industrialization and urbanization, especially in the early stages, and helped to stimulate and sustain economic growth. Spurred by high savings, cheap finance, low resource prices, and export-oriented policies, China has maintained a high growth rate for three decades, and has been catching up with major western countries when it comes to PPP-adjusted GDP.

Figure 2- 1: China's Consumption Ratio, Saving Rate and Capital Formation Ratio



Data source: calculated based on data from National Statistical Bureau (NBS) website[13]

But the excessively high savings and investments also led to the rapid growth of heavy industries, and stunted the development of services. Due to the emphasis on physical investment there has been low investment in human capital, education and health sectors, as well as ecological and environmental protection[14].

Overcapacity in the industrial sectors, which is driven by excess investment, is also undermining the competitiveness of China's heavy industries. By the end of 2012, capacity utilization in the iron and steel, cement, electrolytic aluminum, flat glass and shipbuilding sectors ranged from 72% to 75% – significantly lower than the international average[15]. With a large amount of idle production capacity, many enterprises cannot generate reasonable returns on investments and are increasingly faced with losses and operational difficulties.

Although the government has taken many measures to address this situation, new capacity continues to emerge and the 'overcapacity trend' is intensifying. Today, the investment rate continues to rise, while the consumption rate continues to decline. Long-term investment is growing faster than GDP, while household consumption has grown slower than GDP except for the last few years. Under these conditions, there

[13] See http://www.stats.gov.cn/enGliSH/

[14] In the 'China 2030' report, World Bank and DRC find that based on international benchmarks, China may need to increase public expenditures by 1–1.5 percentage points of GDP for education, 2–3 percentage points for health care, and another 3–4 percentage points to fully finance the basic pension pillar and to gradually meet the legacy costs of existing pension obligations... This would bring China's aggregate "social expenditures" by 2030 to near the lower end of the range of high-income countries.

[15] Iron & steel (72%); cement (73.7%); electrolytic aluminum (71.9%); flat glass (73.1%); Shipbuilding production capacity (75%). Source: The State Council, *Guiding Opinions of the State Council on Resolving Serious Production Overcapacity Conflicts,* Oct. 2013.

will continue to be insufficient demand to support a rapid expansion of production capacity. The result is that a large part of China's investments are unproductive, and productivity is in decline (see Box 2- 1).

In addition, if secondary industry continues to make up an excessive share of GDP, and tertiary industry (the service sectors) too small a share, there will be fewer job opportunities in China. The capital intensity of manufacturing is bound to increase over time, while labor intensity is falling. Meanwhile a significant part of the service industry will remain labor intensive. Today, the share of the secondary sector in China's GDP is 8 percentage points larger than the average of upper middle income countries, while the service industry is 11 percentage points lower. The gap with high-income countries is even wider: the share of service industry is 27 percentage points above China's[16].

The key reasons for the structural imbalances in investment, consumption and saving include:

- Government investment has been excessive, and there is a shortage of public service expenditure as a result.
- High income inequality is contributing to the excessively high saving rate, due to diminishing marginal propensity to consume. China's Gini coefficient is now about 0.47.
- The lack of an efficient social security and public service system has encouraged precautionary saving and exacerbates the existing structural imbalance.

It has long been recognized that another significant factor in the high rates of investment in China's heavy industry sectors is the availability of land and energy at preferential rates[17]. As the World Bank and DRC noted in the 'China 2030' report, a large share of state enterprise profits comes from a few state enterprises, where 'profitability is often related to limits on competition and access to cheaper capital, land, and natural resources.' They use Ministry of Finance figures to show that the gross revenue from the sale of state owned land use rights rose to 2.9 trillion RMB in 2010, equivalent to 7.3 percent of GDP[18]. Fossil-fuel subsidies have been gradually reformed in China, but they were still as high as 882 billion CNY in 2010[19]. 'Leveling the playing field' – including incorporating environmental externalities – will therefore make an important contribution to Green Transition, and is in line with China's market-oriented reforms.

Tackling over investment must be an essential part of China's reform plans. But the problems can only be solved through systemic approaches to tackle the root causes: to reduce excessive investment, improve the taxation system, reform social security,

[16] Data from the World Bank, 2012, and the National Bureau of Statistics of China, 2014.
[17] Huang Yiping, 2010, Dissecting the China Puzzle: Asymmetric Liberalization and Cost Distortion, Asian Economic Policy Review, Volume 5, Issue 2, pages 281–295
[18] World Bank and DRC, 2013, The authors of the report note that 'because a substantial share of such revenues is paid out in the form of compensation to displaced residents, the net proceeds from such sales are lower [than 2.9 trillion RMB] but still significant.'
[19] Lin Boqiang and Ouyang Xiaoling , 2014, 'A revisit of fossil-fuel subsidies in China: Challenges and opportunities for energy price reform'. Energy Conversion and Management 82, 124–134.

change the household registration system, rebalance the current investment-consumption structure, alleviate income inequality, continue with land reforms and enhance energy conservation and environmental protection. The far reaching nature of these examples shows that the goal of Green Transition has to be integrated into the heart of the reform program.

Box 2- 1: Overinvestment and the decline in capital productivity

The co-existence of excessive investment and the decline in household consumption rate suggest that even after exports are accounted for, excessive production capacity is created and part of the increased investment becomes ineffective. Table 2-1 shows the growth rate of capital stock, the capital-output ratio and incremental capital-output ratios since 2000. Capital growth increased rapidly from 2000 to 2013, while the GDP growth rate has tended to decline.

The capital-output ratio is the inverse of capital productivity (the higher the ratio, the lower the capital productivity). Between 2000 and 2013, the ratio increased from 2.69 to 4.24, while the incremental capital-output ratio rose from 5.18 to 9.76, indicating an unusually dramatic drop in capital productivity.

Table 2−1: Rapid fall in Capital Productivity

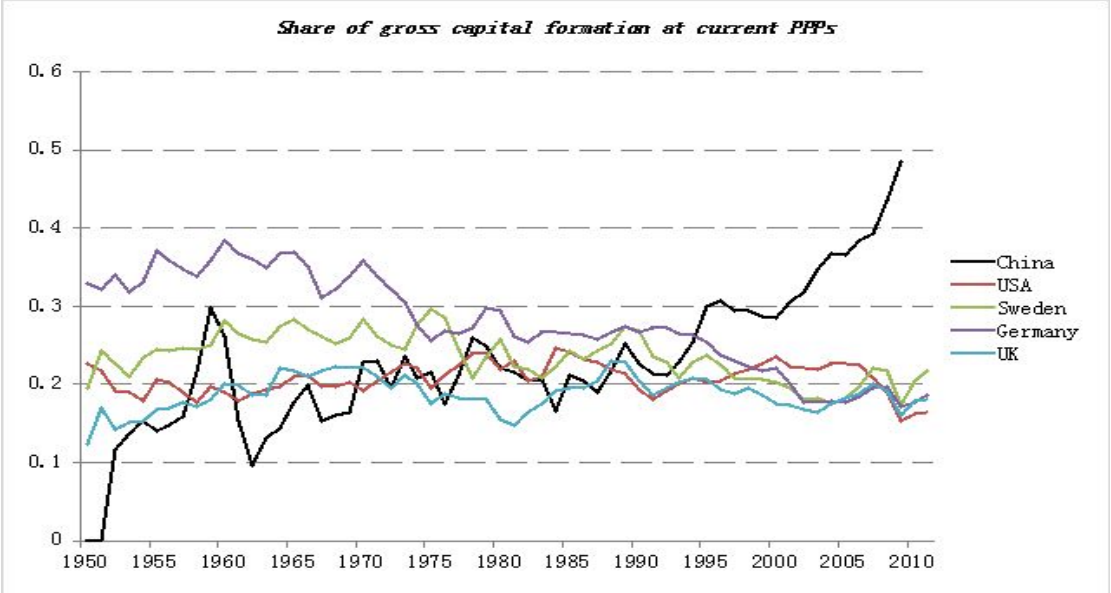
Year	GDP growth rate (%)	Capital stock growth rate (%)	Capital-output ratio	Incremental capital-output ratio
2000	8.4	9.1	2.69	5.18
2001	8.3	9.1	2.81	4.56
2002	9.1	9.8	2.82	2.99
2003	10.0	11.7	2.93	4.27
2004	10.1	12.4	3.05	4.22
2005	11.3	13.2	3.21	4.81
2006	12.7	14.1	3.34	4.31
2007	14.2	14.4	3.37	3.68
2008	9.6	14.0	3.69	18.34
2009	9.2	17.2	3.79	5.08
2010	10.4	17.1	3.93	5.81
2011	9.3	16.3	4.24	9.76
2012	7.7	16.2		
2013	7.7	16.2		

Data source: Calculated based on data from National Statistical Bureau (NBS) website

These rapid increases in the capital-output ratio in China are abnormal compared with past experiences of developed countries. Figure 2- 2 provides a comparison of long-term change in capital-output ratio between China (1952-2011) and the averages of 22 OECD countries (1960-2001).

The average share of gross capital formation of the OECD countries has a stable pattern, fluctuating around 15-30 % over 40 years instead of a constantly increasing trend, while that of China steadily increases from 10 to 50 %. Although China has not completed its process of industrialization, its economy remains unusual in that its capital-output ratio is now higher than that of most OECD countries.

Figure 2- 2: Comparison of share of gross capital formation: China and selected OECD countries



Data sources: Feenstra, Robert C., Robert Inklaar and Marcel P. Timmer (2013), "The Next Generation of the Penn World Table" available for download at www.ggdc.net/pwt. Note: the data source is different from table 3.3, but these differences in value do not affect our trend analysis.

2.1.2 Over-investment and over-capacity contribute to environmental deterioration

Overcapacity of production implies not only the waste of capital, but also a huge waste of energy and raw materials. Based on data for 2011 and 2012, the total added value of the non-metallic mineral products industry, ferrous metal smelting and rolling processing industry and non-ferrous metal smelting and rolling processing industry was only about 5.5% of GDP in total, but their energy consumption accounted for 30% of aggregate energy consumption. Their energy intensity is 5.4 times that of other industries.

The imbalance in the investment-consumption structure over the past 10 years is one of the major causes of worsening air pollution. Driven by the acceleration in investment in fixed assets, fossil fuel consumption increased rapidly in the 2000s (see Table 2-2). Investment grew at 20.8% per year (in constant prices) over this period – much faster than the rate of 13.9% in the 1990s. This led to a rapid expansion of high-energy investment goods, such as steel, cement, flat glass, and non-ferrous metal, imposing a heavy cost on the environment.

In 2013, total energy consumption in China reached 3.75 billion tons SCE, exceeding the US level. Even though energy intensity will continue to decrease in the future, total energy consumption will inevitably rise. Under a business-as-usual scenario it could reach around 1.7 times the 2013 level by 2030, with severe consequences for the environment.

Table 2-2: Acceleration of fossil energy consumption with investment growth

Year	Fossil energy consumption (SCE 100 mil. Tonnes)	Period	Growth of Fossil energy consumption (%)	GDP growth (%)	Growth of investment in fixed assets (%)
1980	5.82				
1990	9.37	1981-1990	4.9	9.3	10.9
2000	13.62	1991-2000	3.8	10.4	13.9
2010	29.70	2001-2010	8.1	10.5	20.8
2013	33.83	2011-2013	4.4	8.2	18.0

Data source: Calculated based on data from National Statistical Bureau (NBS) website

There is still considerable room for industrial development and service sector expansion in China, even if investment levels decline. Enhanced human resources and technical innovation, for example, can greatly increase total factor productivity while capital inputs fall. Our proposed program of structural adjustments and systemic reforms to support Green Transition would help to reduce the bias in income distribution, lower the saving rate and raise the income and consumption level of residents on middle or low incomes.

The headline conclusion is that *if China increases consumption whilst investment slows, there will be a non-negative impact on GDP growth but energy consumption and air pollution will be significantly reduced*. A smaller share of investment in GDP may even produce stronger GDP growth, due to efficiency improvements and improved air quality. These positive effects will be reinforced if the remaining investment is directed to green technology and infrastructure, and if consumption is oriented towards environmentally friendly goods and services (see section 2.4).

2.1.3 Structural changes can make a valuable contribution to Green Transition

Using a combination of macroeconomic forecasting based on statistical analysis, institutional/experiential analysis and CGE modeling, the task force has examined the impact of addressing the challenges outlined in the two previous sub-sections. Details of the methodologies used can be found in Appendix 1.

We use a "business-as-usual" (BAU) scenario as a baseline. In our BAU scenario we assume that basic conditions and economic/environmental policies do not deviate significantly from the past trend. We then forecast the effects of reforms and policy changes on economy, energy and environment, using the methods mentioned above, and impose these effects on the BAU scenario to shed light on the impacts of and contribution to Green Transition.

In the BAU scenario, based on China's historical data up to 2013, we forecast that the high-speed growth of the past three decades cannot be maintained. China will maintain a relatively moderate economic growth rate, but GDP in 2020 and 2030 will still reach 80 and 130 trillion RMB respectively (in 2010 constant price). The industrial structure will change only gradually: the proportion of second industry declining and the share of the tertiary industry increasing. The population will peak at about 1.45 billion in 2030 and decrease thereafter. The urbanization rate will increase to 60% in 2020 and 66% in 2030. Fossil energy consumption and carbon emissions will follow the current trend. The results are summarized in Table 2-3.

Table 2-3: Key simulation results of Business as Usual Scenario

Year	2013	2020	2030	2040	2050
GDP (tn RMB, based on 2010 price level)	50.9	80.4	130.5	184.3	238.3
Annual growth rate of GDP (%)	7.7	6.7	5.0	3.5	2.6
Primary industry share in GDP (%)	10	8.8	7.2	6.2	5.7
Secondary industry share in GDP (%)	43.9	39.9	36.1	34.1	33.1
Tertiary industry share in GDP (%)	46.1	51.3	56.7	59.7	61.2
Population (end of year, 100m people)	13.6	14.1	14.5	14.6	14.5
Urbanization rate (%)	53.7	61.1	67.1	71.0	73.0
Energy consumption(0.1 bn t standard coal)	37.5	48.7	62.6	73.4	81.2
Fossil Energy consumption (0.1 billion t standard coal)	33.8	42.8	53.0	59.6	63.4
Proportion of fossil energy consumption in total energy consumption (%)	90.2	87.9	84.6	81.3	78.0
Total emission (0.1 billion t CO_2)	84	105.2	127.9	142.4	149.4

Data source: Forecasted by authors based on the data of the National Bureau of Statistics of China.

These results are consistent with recent UNEP-sponsored research on China's green economy, although there are small variations related to GDP growth, energy consumption and CO_2 emissions (see Table 2-4 below). The UNEP study has a lower GDP growth rate, especially after year 2025 but higher energy efficiency leading to lower total energy consumption and CO_2 emissions.

Table 2-4: Green economy baseline scenario from a UNEP study

Year	2020	2025	2030	2040	2050
GDP (tn RMB, based on 2010 price level)	85	110	136	193	235
Annual growth rate of GDP (%)	7.1	4.8	4.1	2.9	1.2
Primary industry share in GDP (%)	6.3	5.1	4.4	3.4	2.9
Secondary industry share in GDP (%)	45.6	45.6	43.2	35.7	31.9
Tertiary industry share in GDP (%)	48.1	49.3	52.5	60.9	65.1
Population (end of year, 100m people)	14.1	14.3	14.5	14.3	13.8
Urbanization rate (%)	61	63.5	66.0	70.5	75
Energy consumption(0.1 bn t standard coal)	48.8	54.1	57.3	64.0	66.1
Proportion of non-fossil energy consumption in total energy consumption (%)	11.1	13.3	17.2	21.2	25.6
Total emission (0.1 billion t CO_2)	107	114	115	120	116

Data source: UNEP, modeling China's green economy 2010-2050, 2014

In our 'consumption – investment structure change' scenario, it is assumed that 2015 to 2025 is a period of reform and policy adjustment for structural rebalancing. Reforms of the budgetary and taxation systems, government administration, monopolistic industry administration, social security and public services will take place during this period, in order to improve the patterns of income distribution, government expenditure, and investment-consumption structure. These measures help to raise the consumption rate by 10 percentage points and lower the saving and investment rate by 10 percentage points. The share of total consumption in GDP therefore climbs from 50% at present to 60% in 2025. The share of investment (capital formation) declines from 48% to 38% in 2025.

The results of this forecast show that during the adjustment period, GDP growth slows slightly before recovering, and eventually outpaces the BAU scenario. Meanwhile, there is a far more significant impact on energy use and emissions. Fossil energy consumption and carbon emissions both decrease by 9.7% in 2030 compared to the

BAU scenario. All atmospheric pollutants fall by at least 10% compared to BAU[20]. Meanwhile household consumption will be 30% higher than under BAU, indicating that overall social welfare levels increase significantly (see Appendix 2 for details).

Under the BAU scenario, China's industrial structure will not reach the average level of upper-middle income countries until 2030. The proportion of the first, second and tertiary industries in GDP changes from 10:44:46 in 2013 to 7:36:57 in 2030. But if China adopts market-oriented reforms to reduce hidden subsidies (such as for cheap land, low-price electricity and low-interest loans to secondary industry), removes barriers to entry and improves the market environment for tertiary industry, the rebalancing of industrial structure can be accelerated compared with BAU.

Our next forecast examined the impact of accelerating structural adjustment in China. In this case, the proportion of first, second and tertiary industries would lie somewhere between the upper-middle-income countries level (7:36:57) and high-income countries (1:25:74) – our estimate for China is 5:30:65[21].

Our calculations show that the above industrial structure changes would reduce energy consumption by 6.7% in 2030 compared to the BAU scenario. There is a risk of double counting here, because rebalancing the investment-consumption structure itself affects the industrial structure. Our rough estimate is that this effect accounts for about half of the reduction in energy consumption, and the remaining 3.3% of the energy-saving effect should be attributed to changes in industrial structure alone. Detailed results are provided in Appendix 2.

These results are consistent with International Energy Agency (IEA) analysis. The IEA finds that 'the main contributing factor to energy savings in the New Policies Scenario, compared to the Current Policies Scenario, is the more intense shift in the Chinese economy from energy-intensive industries to light industry and services'[22].

As noted above, a key conclusion from these forecasts is that shifting towards consumption and reducing the role of investment in fixed assets and heavy industry will have a non-negative impact on economic performance in the middle and long-run, but will deliver significant reductions in energy and emissions. These reductions are far from sufficient to shift China onto a green economy by themselves, but they can make a valuable contribution as part of a package of policies and measures.

2.2 Underuse of market-based policies & price-based environmental policy instruments

2.2.1 Lack of effective enforcement of environmental laws and regulations

The benefits of the investment-consumption shift described in the previous section can be reinforced by complementary policies to enhance efficiency, invest in green technology and innovation, adjust China's industrial structure and encourage

[20] Figures for local air pollutant reductions in this report are 'theoretical reductions' excluding the effect of desulfurization and denitration. After desulfurization and denitration the pollution levels will be significantly lower, but predicting these effects is complex and depends on the local situation.
[21] Compared to the BAU scenario, the proportion of secondary industry in 2030 would be 6% lower and the proportion of the service industry 8% higher.
[22] IEA, 2014, World Energy Outlook 2013, p242. Paris: International Energy Agency.

sustainable consumption.

Policy implementation in China faces growing administrative challenges. The bulk of existing policies are based on regulatory approaches, which have a heavy administrative burden. Managing this framework and ensuring compliance has become increasingly costly as the coverage of environmental policy has expanded and deepened and become more complex. In important areas this has resulted in weak enforcement of environmental policies in China, including for local air quality.

The gap between central government policies and their implementation in provinces and cities is another well-known challenge. Slow decision-making and strategic deployment problems among local state sectors are common, due to a lack of capacity but also their concerns about the impact of tough enforcement. Local governments are often more concerned about short-term economic growth than long-term, environmentally sustainable economic development.

One of the challenges the authorities face is that local enterprises have a significant information advantage. These persistent information asymmetries make it difficult to set policies at the appropriate level, leading to cost-inefficiencies as well as uncertain environmental outcomes. In many cases, it is less expensive for enterprises to pay environmental fees than for them to reduce polluting activities (Box 2-2).

Box 2-2: China's pollution levy system

China's pollution levy system started in 1982 and is one of the most extensive in the world, covering atmospheric and water pollutants, solid waste discharge and noise (Yang and Wang, 1998). The central government determines the rates charged and the levy structure, while the local (municipal) environmental authorities (Environmental Protection Bureaus - EPBs) are responsible for collecting the levies from polluting facilities.

Under the pollution levy system, all enterprises are required to self-report their pollution to the local EPB. The EPBs inspect the firms from time to time, and if firms are found to submit false reports they must pay a certain penalty. Since implementation is solely dependent on the enforcement of local authorities and firms' self-reporting, the effective levy rate varies remarkably among firms across the country: some pay 100% of the pollution fees that they are responsible for, while others pay only a small portion. Levy enforcement and the effective levy rate also depend on negotiation between firms and the local EPB, which in turn are influenced by the local pollution situation, prevailing economic conditions and growth objectives (Dasgupta, 1997; Wang and Wheeler, 2000; Want et al., 2003).

Because the effective levy rate is usually lower than the marginal abatement cost, it is economically rational for firms to pay the levy instead of reducing pollution (Wang and Wheeler, 1996, 1998; Florig et. al, 1995; CRAES, 1997). About 70-80% of levy funds are returned to enterprises as 'refunded emissions payments for environmentally beneficial activities', such as purchasing abatement equipment or improved environmental management. The rest are used to meet the EPBs' own administrative costs (Sterner and Coria, 2012).

To address the ineffective nature of the current levy system, China's Ministry of Finance has submitted an environmental tax reform plan to the State Council Legislative Affairs Office, and is currently in a consultation phase[23]. The goal of the reform plan is to shift from a pollution levy approach to taxes. In comparison, the tax scheme is expected to be easier and less costly to enforce, and therefore able to cover a broader range of pollutants. For instance, as a key pollutant in China, sulfur dioxide (SO_2) has been regulated from the 11th Five Year Plan Period. However, the reduction in SO_2 did not bring a

[23] 'Environmental tax proposal completes first round of comments. Carbon dioxide tax is the focus of the debate', finance.ifeng.com, 29 November 2013. http://www.gov.cn/zwgk/2011-10/10/content_1965540.htm

decline in PM2.5 emissions, nor in NOx and other pollutants which act as precursors to PM2.5. Correspondingly, the environmental tax system should have a broad base, covering a range of pollutants.

2.2.2 Expanding the role of economic policy measures

While command-and-control measures remain the most common approach to tackling environmental challenges in China, in recent years, environmental taxation policies have been given a growing role. International experiences in many countries have shown that these market-based economic policies can be more effective in comparison with the administrative control policies – in part because they help address incentive conflicts, but also because they tend to have a lower administrative burden[24].

Economic instruments or policies provide incentives for people to change their energy consumption behavior by adjusting market signals – such as prices. In contrast, command-and-control mandates depend on government targets, technical requirements and permitting. Both have merits and pitfalls: market-based instruments may be less likely to work if the market itself is not mature and transparent or if clarity in property rights and enforcement are lacking; command-and-control may be costly but effective if there is asymmetric information regarding energy conservation, or if there is an alarming environmental situation that requires an immediate response.

China should develop and appropriate framework for green transition that incorporates both market based instruments, other economic measures and regulatory approaches. Other countries have successfully developed policy regimes that combine elements of flexible, market based instruments with well-planned and strictly enforced regulatory measures. This will result in a diverse portfolio of policies, and provides scope for policy experimentation and learning (see section 2.5).

The Task Force has identified three policy areas where economic and pricing instruments could help accelerate Green Transition in the 13th Five Year Plan period: strengthening China's resource tax; encouraging sustainable transportation; and correcting problems in electricity pricing. These examples highlight how economic approaches can help to address the root causes of environmental problems, whilst supporting economic development.

Multiple regulatory instruments are described in this subsection, including mandates, taxes and permit trading. International experience shows that it will be important to clarify the tax base and coverage of each instrument and to design linkage mechanisms between these policies. It will also be important to ensure environmental goals and targets are linked with market based and regulatory policies, with scope for adjustment in case the policy tools chosen do not deliver the required results.

Resource taxes

The Chinese government started to collect 'resource taxes' on coal, crude oil and natural gas in 1984. One of the shortcomings of the current system is that tax rates

[24] Two background papers for the Task Force provide supporting evidence for arguments made on international experience in this section. See: "Latest policies and measures for green transition in the world", by Sheng Fulai, and "Historic review of green transition in selected countries" by Laszlo Pinter.

have been left unchanged for many years. After a long period of double-digit GDP growth, inflation and higher energy prices, the tax rate – which is paid per tonne of production – is now far too low to influence behavior.

Recent reforms for oil and gas shifted these fossil fuels to an ad-valorem tax – 5 percent of the sales price. As well as creating a stronger incentive for energy-saving, this generates a revenue stream for local government. However, considering the very high profit margin in this sector compared with other industrial sectors with full market competition, this tax level is clearly insufficient both to achieve a competitive market and to tackle inefficient energy use.

Coal remains on a unit tax. This is set at 8-20 RMB per tonne for coking coal and just 0.3-5 RMB for other types of coal[25]. Introducing a more effective tax regime for coal in China would have important policy implications for China, as well as for the rest of the world: China accounted for more than half (50.22%) of global coal consumption in 2013[26].

The first and perhaps foremost function of resource taxes is distributional: to ensure that 'extra' benefits generated from the country's resources are taken away from the users of the resources and redistributed across the nation, which is the owner of the resources. A resource tax will however also enhance environment protection if, on resources which cause pollution (such as fossil fuels), it is set at a higher level than required to encourage redistribution alone.

Increasing taxes on fossil fuel sales would increase the energy price in such a way that it is difficult to evade compared to other indirect taxes, thus it may also bring significant fiscal benefits when informal sectors are considered. Bento et al.[27] argue that when considering these effects the optimal tax is higher than the Pigouvian level – whereas earlier analysis had posited that it is less than the Pigouvian level due to negative tax interaction effects[28].

The impact of resource taxes will be limited if exceptions are regularly granted to heavy industry. For example, according to OECD analysis, several oil and gas fields or extraction methods in China currently benefit from reduced rates of resource tax which push the effective rate below the benchmark 5% ad-valorem rate.

Analysis by the Task Force indicates that full implantation of resource tax reforms can have a significant impact on energy consumption and help improve China's energy mix. With an average rate of 13% for coal and oil in 2025, the combination of the price effect and substitution effect (into clean energy) will lead to a reduction of coal

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[25] State Council (2011) 'Decision of the State Council on Amending the 'People's Republic of China resource tax regulations'. State Council Website http://www.gov.cn/zwgk/2011-10/10/content_1965540.htm

[26] BP Statistical Review of World Energy, June, 2013, http://www.bp.com/content/dam/bp/pdf/Energy-economics/statistical-review-2014/BP-statistical-review-of-world-energy-2014-full-report.pdf

[27] Bento, Antonio, Mark Jacobsen, and Antung A. Liu, 2012, *Environmental policy in the presence of an informal sector*. 1-29

[28] Bovenberg, Lans and Ruud A. de Mooij, *Environmental levies and distortionary taxation*, American Economic Review, 1994, 84 (4), 1085–1089; Bovenberg, Lans, *Environmental taxation and employment*. De Economist, 1995, 143, 111–140; Goulder, Lawrence, 1995*Environmental taxation and the 'double dividend': a reader's guide*. International Tax and Public Finance, 2 (2), 157–183.

and oil consumption of 8.9% and 6.2% respectively[29]. In total, this reform could reduce fossil energy consumption by around 6% (the total of coal and oil would fall by around 8.5%). Air pollution and carbon emissions would decrease by 7-8% (see Appendix 2). Moreover, the reforms will have a positive impact on income distribution.

Green taxes in the transport sector

Vehicle emissions have increased significantly in China in recent years due to rapidly rising vehicle ownership, and have contributed to the severe urban smog and haze (PM2.5 emissions). There are several objectives for transport policy which can have different but overlapping objectives, such as reducing fuel use, air quality improvement and reducing congestion. Box 2-3 explains the approach taken in Singapore to limit urban traffic.

Box 2-3: Singapore's vehicle quota system

In Singapore, the authorities use a Vehicle Quota System (VQS) and vehicle ownership tax to moderate the growth of the vehicle population at a rate that can be supported by the domestic road network. Given the country's small size, it was thought that building more roads alone would not be able to ensure smooth flowing traffic. The government also preferred a market-based mechanism as a means of keeping the car population at levels supportable by road infrastructure as well as sustaining planned developments in public transport and traffic management systems.

Under the VQS, anyone who wishes to register a new vehicle in Singapore must first obtain a Certificate of Entitlement (COE), which represents the right to own a vehicle for 10 years, and the number of COEs released onto the market at any time is based on the VQS allocation for that period. COEs are awarded after competitive bidding in a closed auction. In addition, a bevy of taxes such as excise duties and additional registration fees add a significant percentage to the cost of the vehicle.

The VQS has been effective in managing the vehicle population at a sustainable level (at a compounded annual growth rate of about 3% since its implementation) since it was first introduced. However, with the pace of road expansion slowing down by half, the annual vehicle population growth rate has also been reduced by half from 3% to 1.5% p.a. since May 2009 for 3 years to ensure that it is sustainable. The vehicle growth rate was recently reviewed in 2011 and it will be further reduced to 0.5% p.a. from February 2013 to January 2015.

Source: Singapore Ministry of Transport, 2014

To combat pollution and cut China's energy dependence, reforms to the vehicle tax could differentiate between vehicle sizes and technology, for example by imposing a progressive block pricing regime for different vehicle engine size (higher tax for vehicles with 3.0L than 2.0L).

Fuel taxes and congestion fees are alternative incentive-based market policies, designed to increase the price of fuel and incorporate congestion externalities. The policy outcome for a given tax level depends on drivers' elasticities on fuel demand and driving decisions. Fuel demand is determined not only by income and fuel prices, but also by other factors, such as access to public transport and demand for vehicles.

Gasoline taxes may be effective in terms of reducing gasoline use, while less effective

[29] See Background Paper on *Intrinsic Logic and Approach Options for the Current Reform of Resource Tax and Environmental Tax in China* by Fan Gang, Li Quan, Liang Qiang, Lv Dianyao and Ma Jia

in reducing congestion. To address both externalities, therefore, it is important to implement both pricing regimes. A long-running concern in the developed world is that resistance to fuel taxes is partly due to concerns that such taxes have regressive impacts. Using a CGE model we examined the fuel tax reform in 2009: by combining the CGE results with NBS household survey data, we find the total burden of gasoline tax is actually progressive, not regressive as is the case in some western countries.

In terms of political feasibility, a vehicle tax based on engine size is relatively easy to implement given existing legislative and administration structures. In the medium term, international experience suggests it would be more effective to implement a carbon-based fuel tax – perhaps in combination with a road pricing system in major cities that takes into account the environmental standard of vehicles.

Electricity price reform

Electricity pricing in China has recently undergone reforms in both the industrial and residential sectors. On average the electricity price has increased substantially, although it has remained under some government regulation whilst coal prices are liberalized[30].

China's electricity pricing system is a vestige of the planned economy. Prices are set according to the sector: residential, agricultural, large industrial, commercial, non-industrial, general industrial and non-residential lighting. Electricity prices are also adjusted based on the energy intensity of individual enterprises: a system known as Differentiated Electricity Pricing (DEP). Under this policy, firms are grouped into four categories: encouraged, permitted, restricted and eliminated. The goal is to gradually eliminate inefficient enterprises while encouraging efficient ones[31].

Block pricing has been introduced for the residential sector. One study used household data to estimate the electricity elasticity for different income groups. These ranged from -0.60 (median group) to -0.90 (low and high income group)[32]. This indicates that a small price increase will lead to high electricity savings, especially in the long run. The high income group has higher elasticity, suggesting a block pricing regime would perform well and help achieve energy conservation targets.

The problem with the current approach is that tariff revenue goes to the grid company, rather than the general budget. If block pricing currently brings the total revenue of power stations and grid to an equilibrium level, this suggests that further reforms are required so that the consumer price of electricity reaches the equilibrium level.

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[30] Liu, M.-H., Margaritis, D., and Zhang, Y., 2013, *Market-driven coal prices and state-administered electricity prices in China. Energy Economics*. 40, 167-175.OECD, 2010, Taxation, Innovation and the Environment, OECD, Paris.

[31]Chinese central government (2006) Notification of State Council promulgation of Development and Reform Commission advice on improvement of differential pricing policy, SCS No 77 (17 September 2006). http://www.gov.cn/zwgk/2006-09/22/content_396258.htm (Chinese);
Chinese central government (2006) Development Research Center spokesman answers questions regarding the 'Notification of State Council promulgation of Development and Reform Commission advice on improvement of differential pricing policy' on Chinese government website (23 October 2006). http://www.gov.cn/ztzl/yzn/content_479489.htm. (Chinese)

[32] Cao, J., X. Wang, and X. Zhong, 2014, *Did Driving Restrictions Improve Air Quality in Beijing?* China Economic Quarterly, 13(3), 1091-1126 (Chinese).

An environment tax on electricity could be introduced gradually alongside pricing reform in order to shift all revenues from block pricing to the state budget, and to environmental purposes such as promotion of clean technology or to fund a feed-in-tariff to subsidize renewables. The electricity reform should also be aligned with China's plans to introduce a national carbon trading scheme.

2.2.3 Administrative measures remain important

Although we argue for greater use of economic policies to achieve a Green Transition, command-and-control mandate polices will remain important for achieving government targets. For example, previous CCICED Task Force reports have highlighted the role of technology standards in phasing out outdated industrial capacity in China – a particularly serious problem for the steel, automobile, cement, electrolytic aluminum, stainless steel, pesticide, solar and glass sectors[33].

It is important to recognize that command-and-control policies (such as technology mandates) are still dominant in many developed countries and have led to most of the progress in environmental protection. Historically, market-based instruments have played an important but overall more limited role in environmental regulation in industrialized countries.

In the 12th Five Year Plan, the government set two particularly important administrative targets, for energy intensity and carbon intensity improvements. The State Council issued a draft law in September 2014 indicating that a cap on the quantity of fossil fuels (or total energy) consumed could be introduced in the 13th Five Year Plan[34]. Although the level of the cap has not been announced at the time of writing, this could be a very significant measure, encouraging a shift in energy consumption to alternative energy options and achieving a cleaner energy mix.

A combination of quantity targets, intensity targets and carbon trading schemes can be expected to deliver synergies that lead to additional environmental improvements, in particular for air quality – these effects have not been modeled by this Task Force. Carbon trading schemes are currently being piloted in seven areas, but could be rolled out nationally in the 13th Five Year Plan. When multiple regulatory instruments are introduced, including mandates, taxes and permit trading, it will be important to clarify the tax base and coverage of each instrument.

Statistical analysis for the Task Force indicates that under an 'energy saving' scenario, fossil fuel consumption can be controlled to 3.9 to 4.2 billion tons of standard coal by 2020 and 4.4 to 4.8 billion tons of standard coal by 2030 (see Box 2-4 below). Fossil fuel consumption should peak at between 4.6 and 5.2 billion tons between 2030 and 2040, after which fossil energy consumption will enter a period of decline. The peak for higher carbon, highly polluting fossil energy (oil and coal) consumption is likely to come sooner at about 2025-2030, with total quantity control around 4.0 billion tons of standard coal. After this time, higher carbon fossil energy consumption will decline.

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[33] CCICED Task Force reports on 'China's Pathway Towards a Low Carbon Economy,' 2009 and 'China's Low Carbon Industrialization Strategy,' 2011

[34] The State Council published a draft version of a law on air pollution control using a coal consumption cap on 9th September 2014. The cap was also mentioned by Vice Premier Zhang Gaoli at the UN Climate Summit on 23rd September in New York.

Specific measures are needed to accelerate the transition in the energy sector. First, as described above, government should set long-term caps for national energy consumption and implement them accordingly. Power stations that 'self-supply' industrial areas (rather than feeding power to the grid) should be prohibited in key regions. Projects with new coal consumption should be allowed only if coal consumption is 'offset' by reductions of at least an equal amount of coal consumption elsewhere in the same region.

Second, government should accelerate the development of natural gas. The use of natural gas should be increased in the residential sector as a substitute for coal, and the efficient use of natural gas as distributed generation should be encouraged. Due to the limited supply of natural gas for China, the use of natural gas in chemical projects should be restricted. The use of natural gas power plants as peaking resources may be expanded.

Third, the development and utilization of hydropower, geothermal energy, wind energy, solar energy, biomass energy and nuclear power should be expanded in an efficient and safe manner. The capacity of running nuclear power will reach 50 GW, and non-fossil energy's share in the energy mix will rise to 13% in 2017.

Fourth, increases in the proportion of coal washing and the construction of new coal washing facilities are both required to reduce ash content of coal and enhance efficiency. Existing coal mines should accelerate the pace of their construction, and strengthen coal quality management. Officials currently expect coal washing rates to increase to more than 70% in 2017.

Fifth, government should promote an improvement in oil quality, and strongly encourage refining enterprises to upgrade their production facilities and speed up diesel and oil supplies for grade V (five) standard cars.

Box 2- 4: A scenario analysis of energy saving

China's strategic goal for 2050 is to become a mid-developed economy whilst remaining a beautiful country. An analysis of how to meet these goals should take into account future technological potential and prospects, including economic, energy and environmental governance. We also need to analyze energy demand and structural changes, and understand the supply potential and demand constraints of different energy options.

China's energy efficiency still has significant room for improvement and energy saving policy will continue to bring important benefits. Along with the elimination of outdated technology and accelerating structural upgrading, China's consumption of energy per unit GDP will gradually move closer to the international advanced level. At current exchange rates, China's energy productivity (economic output per unit energy consumption) is about 70-80% the developed world average, and only 50-60% if using purchasing power parity.

With ongoing development and the deepening reform and opening-up processes, China's commodity prices will also gradually align with international prices: that is, the actual number is likely to be in between these two results in the medium term. In our reference case, by 2050 China will become a mid-developed country and energy intensity will drop by about 70% relative to the 2010 level.

Coal: Coal resources are relatively abundant in China, but coal is one of the most polluting energy sources; achieving a 'beautiful China' means addressing coal use. In future, coal will mainly be used in industries like power generation, steel and coal-to-chemicals. Our study indicates that coal consumption will peak between 2020 and 2025 at about 4.2 billion tons, then gradually decline to 3.2 billion in 2050.

Oil: China's potential oil demand growth is huge, but supply is restricted due to limitations in geological reserves and exploration, and the upper limit of domestic supply is about 0.22 billion tons. Therefore, oil security will remain a major policy concern. It is estimated that electric vehicles will enter the market at large scale and gradually substitute for conventional vehicles near 2030. So we expect oil consumption to peak at around 0.8 billion tons between 2030 and 2040, and fall to 0.75 billion tons around 2050.

Natural Gas: With more stringent atmospheric pollution control and energy structure changes, natural gas will develop at a faster pace. We expect its output to peak around 250 billion cubic meters. Other non-conventional gases such as coal gas and shale gas will also develop quickly, and may exceed 130 billion cubic meters. There may also be imports of liquid natural gas from North America. We expect demand for natural gas to reach 580 billion cubic meters in 2050, about four times the level of 2012.

Fossil and non-fossil energy: Nuclear and hydro power will continue to develop rapidly, and other renewables such as wind, biomass, geothermal and others will play an important role in China's future's energy structure.

Under this scenario, consumption of fossil energy and higher carbon, highly polluting fossil fuels (coal and oil) will peak between 2030 and 2040. China's total energy consumption is expected to be 4.8 billion tons of standard coal in 2020, 6.0 billion tons in 2030, and no more than 6.6 billion tons between 2030 and 2040. Fossil energy and higher carbon fossil fuels will peak between 2030 and 2040. China's total energy consumption would be 4.8 billion tons of standard coal in 2020, 6.0 billion tons in 2030, and no more than 6.6 billion tons between 2030 and 2040.

Table 2−5: Energy conservation scenario: energy consumption and mix change

	2012	2020	2030	2040	2050
Energy consumption (0.1 billion t standard coal)	36.2	48.0	60.0	66.0	66.0
Coal (%)	66.6	59.5	50.5	44.0	37.0
Oil (%)	18.8	17.0	16.9	16.8	16.7
Gas (%)	5.2	8.6	11.0	11.6	12.2
Non-fossil energy (%)	9.4	15.0	21.6	27.7	34.1

With the energy structure shifting towards a low-carbon, less polluting pathway, non-fossil energy will gradually become the pillar of energy structure. With the strategic natural gas plan focusing on domestic production and imports, natural gas consumption would reach 450-500 billion cubic meters by 2030, and the share of total energy could exceed 11%. Total non-fossil energy is expected to account for 15% and 21% of total primary energy consumption in 2020 and 2030, and 34% in 2050.

2.3 The need to improve demand-side policies for green technology

2.3.1 Policies for clean and renewable energy have focused on the supply side

Clean technology and renewable energy will make a decisive contribution to China's Green Transition, but today the industry is facing a range of challenges that stem from a lack of demand-side policy support in the past, combined with strong production incentives and a weaker than expected global market.

The extraordinary expansion of renewables manufacturing in China in the past few years was largely the result of a range of supply-side policies, in particular tax incentives and fiscal interest subsidies. Some of the key supply side incentives include:

a) **Tax deduction.** At the national level this includes VAT refunds, tariff deduction and export tax rebates amongst other measures. From Oct 1 2013 to

Dec 31 2015, there is a direct VAT rebate of 50% for solar-energy based electronic products. Imported PV technology and power technology equipment are exempted from import tariffs and VAT.

b) **Low interest loans.** The clean power equipment and construction industry are listed as important industries which are encouraged to develop, so these companies are also eligible to apply for low-interest loans.
c) **Low land prices and other policy support.** A big incentive to attract clean energy industries is provided by local government support with obtaining land at relatively cheap prices. Some local governments even provide direct financial support to PV-related scientific research and technology diffusion, for example.

The demand for renewable energy was largely created by demand-side policies in developed countries – not least the feed-in tariffs in Germany and elsewhere in Europe. With government encouragement, Chinese renewables manufacturing therefore developed to capture the growing export opportunities. China's production capacity of crystalline silicon modules, batteries and polycrystalline silicon took up 70.7%, 70.8% and 38.4% of global production capacity in 2013. Although the market is changing fast, developed countries continue to account for the bulk of solar PV installations[35].

Today, there is widespread over-capacity in solar PV manufacturing, partly because the international market performed less well than expected. Globally, new investment in renewable power and fuels was around $214 billion in 2013, 14% lower than 2012, and 23% below the record high set in 2011[36]. In part, these falls were due to the rapidly falling costs of renewable energy in the past few years, which have added to the competitive pressure for manufacturers. The profit rate of domestic PV firms declined sharply from 139% in 2007 to 20% in 2013. Among the more than 500 domestic PV firms in China, about one third of the small- and medium-sized enterprises operate at just 20-30% of their manufacturing capacity, putting them on the verge of shutting down or suspending production[37].

Whilst the Chinese renewables industry is expected to go through a round of consolidation, over time the excess capacity problem can also be tackled by the expansion of domestic demand. The government has responded to this challenge in the 12th Five Year Plan period, introducing stronger policy support for renewables installations – partly in response to the overcapacity problem but also to help meet targets for clean energy. Solar installations are now encouraged by feed-in tariffs and by regulations to 'ensure that grid companies buy all the solar power produced in their regions[38]. China's targets for installing solar PV have been raised many times, and currently stand at 35GW of PV by 2015.

There has also been a focus on addressing the long-standing problems with grid connection that have affected wind power projects in particular. Due to under-

[35] Bloomberg New Energy Finance, 2014, 'Global trends in renewable energy investment 2014'. Frankfurt School – UNEP Collaborating Centre for Climate and Sustainable Energy Finance.
[36] ibid.
[37] See Task Force background paper on 'Demand-side policy and creating market for increasing use of renewable clean energy'.
[38] Bloomberg New Energy Finance, 2014, 'Global trends in renewable energy investment 2014'. Frankfurt School – UNEP Collaborating Centre for Climate and Sustainable Energy Finance.

investment in the network, grid expansion has struggled to keep up with growth in turbine installation and there was often a lag before wind farms were connected to the grid. Even after a connection is installed, it is sometimes not possible to feed electricity into the grid due to an inability to handle intermittent demand in some areas[39].

As a result of the improved policy environment, and the falling costs of renewable energies, in 2013, new renewable power capacity additions in China surpassed new fossil fuel and nuclear capacity for the first time. Investment in renewables projects in China were at $56bn, larger than the whole of the EU[40]. China installed 12 GW of solar PV capacity in 2013, an increase of 232% relative to the previous year. This is equivalent to 31% of PV capacity added globally, placing China first in the world.

Despite these successes, shifting from a BAU scenario to a Green Transition will require the scaling up of renewables investment in China to continue at a rapid pace. There is still huge potential for expansion: 'new energy' accounted for only 5.2% of total electricity production in 2013. However, there are concerns that demand growth in China to 2020 could be weaker than hoped, due to policy uncertainty and the availability of finance. The IEA noted that 'integration challenges remain for large amounts of new onshore wind, and questions have emerged over whether conditions are favorable for an ambitious planned expansion of distributed solar PV'[41]. One of the features of the Chinese market is that whilst asset finance and spending on distributed systems is strong, there is 'almost no contribution from public markets or venture capital and private equity' (see Section 2.4)[42].

Preliminary estimates by the Task Force indicate that China can overcome these challenges in the 13th FYP through strong and sustained policy support on the demand side. With these policies, the annual increment of the proportion of non-fossil energy in total energy consumption can be increased from the rate of about 0.5% seen in recent years to 0.7%. As a consequence, in 2030 the proportion of non-fossil energy in total energy consumption would increase to more than 21%, whereas under the current pathway it would be around 17%. This could result in a 5 percentage point reduction in fossil fuel consumption, avoiding 230 million tons of standard coal of energy consumption per year compared to BAU (see Appendix 2).

In the medium term, China's manufacturing sector will also benefit from a scaling up of renewables in developing countries, which China can play an important role in encouraging through technical cooperation and investment. At the UN Climate Summit in September 2014, Vice Premier Zhang Gaoli said that China would double its annual financial commitment for its south-south co-operation fund on climate change and pledged an additional $6m for UN efforts to promote UN south-south cooperation on climate change. Cooperation projects are already underway in Ghana, for example[43], and Chinese firms have made investments in projects in South Africa.

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[39] UNEP, 2013, China's Green Long March: A Study of Renewable Energy, Environmental Industry and Cement Sectors, pp. 1-36
[40] Ibid.
[41] IEA , 2014. Renewable Energy Market Analysis and Forecasts to 2020: Medium-Term Market Report 2014.
[42] Ibid.
[43] UNDP, A pact signed to boost South-South cooperation, 8th September 2014, www.gh.undp.org/content/ghana/en/home/presscenter/pressreleases/2014/09/08/a-pact-signed-to-boost-south-south-cooperation/

Box 2- 5: International experience of promoting solar PV demand

PV industry policies in the United States include tax discounts, an initial installation subsidy and tariff for the power network. They also include funding or approval support policies, such as the Business Energy Investment Tax Credit (ITC), Accelerated Depreciation Method (MACRS), 1603 Treasury Program, DOE Loan Guarantee Program, and Renewable Portfolio Standards. Subsidies at state level include cash refund of investment, electricity subsidy, tax discount, green electricity license and so on. The form and degree of subsidies differs across states.

Accompanied with support from US government, the PV industry has created several new financing models to solve the funding problem on the demand side. These models include the Utility-scale Power Purchase Agreement Model, Host-owned Model, and Third-party Financing Model.

Germany's PV industry is another successful model. Between 2004 and 2008, Germany's share of the global PV market was the largest in the world. The rapid development of PV industry in Germany largely benefited from domestic industrial policies. For instance, the Renewable Energy Sources Act (EEG) introduced in 2000 (replacing the Electricity Feed-In Law of 1991) funded Feed-In Tariffs and shifted responsibility for purchasing electricity at premium prices from the utilities to grid operators.

In 2004, the government revised the EEG regime and made adjustment in pricing system. To avoid increasing fiscal expenditure and the burden of national renewable energy surcharge, the German government revised EEG again in 2008 by decreasing the new tariff of electric network by 15% starting from 2009. In 2010 the government lowered the solar power subsidies again. Over time the price of electric network has declined from 4 RMB/kWh in 2000 to less than 1.5 RMB/kWh, but it is still higher than the price in China. In terms of financial support, the German Development Bank also provided a large volume of subsidized loans for investment in the PV industry.

PV industry policies in both the United States and Germany emphasized stimulating the demand side, especially supporting the use of distributed PV power generation. In the United States, demand-side policies have yielded some new successful business models and encouraged various economic agents to participate actively in the PV industry. Germany's fixed tariff policy concentrates more on residents and civil buildings.

China has started to explore the role of demand side policies. Early industrial policies to encourage PV development included the 'demonstration project of solar PV building application' and 'Golden sun' demonstration project. Both provided subsidies on the demand side of PV markets. Between 2012 and 2014, a new series of policies were gradually issued to support the PV industry, with a greater focus on stimulating demand. This included establishing a solar power benchmark price, specifying the duties and obligations of power grid enterprises, and using legal action to force power grid enterprises to help PV projects link with the grid.

2.3.2 Other green sectors could be developed with stronger demand side policies

Many 'green technology' sectors could benefit from lessons learned in China's renewables sector and from international experience on the important role of demand side policy incentives – such as green tax incentives, technology performance standards and targeted public procurement. This section is not designed to be comprehensive, but provides some examples of important clean technologies, especially in the context of China's ongoing urbanization.

Policies to promote highly efficient or 'near-zero emissions' buildings are some of the most critical for supporting China's Green Transition[44]. There is huge potential for achieving energy saving in the medium term, with another 100 million Chinese

[44] Jiang Kejun, 2011, China's Investment Pathway to 2030, Energy Research Institute (ERI). www.e3g.org/docs/Annex_A_China%E2%80%99s_Investment_Pathways_to_2030.pdf

expected to move to cities by 2020, and outdated infrastructure also being replaced over this period. Buildings already account for about a quarter of all energy consumed in China[45], and this is likely to gradually move towards the global average of 40% as cities and incomes grow, and the role of heavy industries becomes less prominent.

There are huge opportunities to develop a world-class green buildings sector, not least due to the large investment needs: according to modelling by the Energy Research Institute, China would need to invest 670 billion RMB per year by 2030 under their low carbon scenario. Yet at present, despite a range of certification schemes, voluntary standards and some mandatory standards for public buildings, most green buildings in China are in demonstration projects[46]. Demand-stimulating policies such as buildings and technology standards can help deliver scale up the construction of green buildings and catalyze domestic markets for the associated technologies and services.

The Light Emitting Diode (LED) lighting industry in China has faced similar challenges to renewables, with huge overcapacity and quality control problems. Domestic incentives to switch to LED bulbs have so far proved insufficient, and around 60-70 per cent of LED manufacturing capacity in China is currently geared to exports[47]. In October 2012 China started to phase out traditional incandescent bulbs, following the example set by the EU, the United States and Japan[48]. Nevertheless, China's lighting market could rise to a value of $20 billion in 2015, about 18% of the global market – incentives and standards are needed to ensure that lighting is predominantly from highly efficient LEDs[49].

For electric vehicles, there are challenges for both supply and demand in China. Support for production has not yet led to successful technology breakthroughs, and demand has been weak – partly due to cost, but also because charging infrastructure is not widely available in China's cities. There were around 40,000 electric vehicles on the road in March 2013 – and four-fifths of these were used for public transportation[50]. It has been reported that China is considering spending 100 billion RMB on electric-vehicle charging facilities in order to stimulate demand for clean cars[51].

Experiences in developed countries, in particular in Europe, show that developing inter-city and intra-city rail transport systems has very significant impact on energy-saving and pollution-reduction, because this is much more energy-efficient than private vehicles. China should make great effort to develop these systems as early as

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[45] Christina Nelson, April 1, 2012, China's Green Building Future, http://www.chinabusinessreview.com/chinas-green-building-future/

[46] Yifei Li and Julia Currie September 2011, Green Buildings in China: Conception, Codes and Certification, , Institute for Building Efficiency , an initiative of Johnson Controls,www.institutebe.com/InstituteBE/media/Library/Resources/Green%20Buildings/Issue_Brief_Green_Buildings_in_China.pdf

[47] Charlie Zhu, Feb 8, 2013, Analysis: Failing firms cloud China's LED lighting vision, *Reuters,* http://uk.reuters.com/article/2013/02/08/us-china-led-idUSBRE91701H20130208

[48] Xinhua, October 18, 2012 , China moves to phase out incandescent bulbs, China.org.cn http://www.china.org.cn/environment/2012-10/18/content_26829256.htm

[49] LEDinside: China's Lighting Market to Reach $20B by 2015, http://lighting.com/china%E2%80%99s-lighting-market-20b/

[50] Jack Perkowski, 6/24/2013, The Reality Of Electric Cars In China, *Forbes,* Business, http://www.forbes.com/sites/jackperkowski/2013/06/24/the-reality-of-electric-cars-in-china/

[51] Aug 27, 2014 , China Weighs $16 Billion Car-Charging Fund, http://www.bloomberg.com/news/2014-08-26/china-said-to-consider-16-billion-ev-charging-funding.html

possible.

Preliminary estimates by the Task Force show that fully implementing buildings standards and expanding large scale inter-city and intra-city rail transport system could reduce energy consumption of around 5% - 12% in 2030, compared to a BAU scenario (see Section 2.1.3 for details of BAU). Although this indicates that buildings standards are important, it was not possible to do a detailed analysis, so these potential savings are approximate and may well be an underestimate[52]. There are clearly even larger opportunities available by promoting stronger standards. China could join the EU and Japan, for example, in requiring new buildings to be 'near-zero' energy from 2020 or as soon as possible[53].

2.4 Financial sector reform and Green Finance

2.4.1 Towards green investment and sustainable consumption

China has overinvested in heavy industry and infrastructure, but this does not mean that all investment should be scaled back to support the Green Transition. In the words of the Global Commission on the Economy and Climate, 'tackling the challenge of strong, equitable and sustainable growth will require huge new investments and shifts in resource use' in all countries[54]. There is a clear rationale for urgent policy action in China to unwind misallocation of resources toward more efficient and sustainable uses.

The Commission notes that low-carbon forms of infrastructure 'are essential to reduce current emissions and energy-use trajectories,' and that investment in energy efficiency has huge potential to reduce demand, especially in buildings, transport and better urban design. How these changes are managed will shape future patterns of growth, productivity and living standards, especially in fast-growing countries like China. Preliminary analysis by the Task Force suggests that efficient buildings and expansion of intercity and intra-urban rail infrastructure could save up to 12% of total energy demand in 2030, compared to a BAU scenario[55].

For many countries, as the Commission argues, the additional investments in infrastructure needed to make the transition to a low-carbon economy will be modest and will lead to medium term benefits. Since investment levels in China are already too high, the goal should be to direct part of the excess investment into the infrastructure and technology required for Green Transition – such as capital intensive renewable energy, grid expansion, energy efficiency and sustainable transportation. Investments in these areas will need to be around 2.83 trillion RMB ($453 billion) each year by 2030 under a low carbon scenario, according to modelling by the Energy

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[52] In the latest IEA scenarios for China, compared to 'current policies' savings in buildings are responsible for an 8% drop under new policies scenario, and 22% in the '450ppm' scenario. Source: WEO, 2013.

[53] In the EU, all new buildings must be 'near-zero energy' by 2020. In Japan, new public buildings must be net zero by 2020, and new commercial buildings by 2030. http://online.wsj.com/articles/japan-pushes-zero-energy-structures-1411745117. The US is focused on rolling out 'zero-energy buildings' by 2025. See: http://www.nrel.gov/docs/fy06osti/39833.pdf

[54] The Global Commission on the Economy and Climate, September 2014, Better Growth, Better Climate: The New Climate Economy Report

[55] As for buildings efficiency above, this result is an estimate rather than a detailed assessment.

Research Institute[56] One study identified a further 1.2 trillion RMB of investment needs in other environmental sectors such as wastewater treatment and soil remediation (see Table 2−6). In addition, large investments are needed in natural capital – including in sustainable agriculture and forestry, ecological conservation and the national parks system.

In other words, the quality and composition of investment is of great importance for the Green Transition. China will need to invest in a new generation of capital: in clean technology, in natural capital, in green skills for human capital and job creation. There will be a key role for investment and lending guidelines and institutions, to ensure that projects that support the transition are financed, whilst phasing out lending to unsustainable activities at home and abroad.

Table 2−6: Investment demand for environmental protection industry (RMB bn)

	Investment demand	Operating cost of new projects	Operating costs of all facilities
Urban wastewater treatment	436	33	57
Contaminated soil remediation	315	N/A	N/A
Desulfurization and denitration	135	42	103
Urban garbage disposal	94	12	87
Environmental regulation and emergency capacity	70	30	30
Other	151	44	63
Total	1202	161	342

Source: Wang et al., 2010, in UNEP[57]

Likewise, although a structural shift away from intensive industry and towards consumption will tend to reduce energy use and emissions, China's Green Transition risks being undermined by unsustainable consumption in the medium term. Choices made in urban design, buildings and lifestyles, for example, will have a huge impact on future energy use in China[58]. The energy consumed by urban residents has already reached 13% of total consumption. Today, urban residents use 3.7 times as much energy as rural residents, while their power consumption is 4.6 times higher[59]. Meanwhile, the disposable income of urban citizens has risen from RMB 6280 to RMB 19109, an increase of 170%[60]. Much of this has been spent on larger living spaces and on energy consuming technologies, as well as food[61].

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[56] Jiang Kejun, 2011, China's Investment Pathway to 2030, Energy Research Institute (ERI). Annex A of: Amal-Lee Amin, Shin Wei Ng and Ingrid Holmes 'China's Low Carbon Finance and Investment Pathway' E3G Policy Paper
www.e3g.org/docs/Annex_A_China%E2%80%99s_Investment_Pathways_to_2030.pdf

[57] UNEP, 2013, China's Green Long March: A Study of Renewable Energy, Environmental Industry and Cement Sectors, pp. 1-36

[58] This paragraph is based on report of the CCICED Task Force on *China's Low Carbon Industrialization Strategy*, 2011.

[59] Data provided by China's NBS and Agricultural Department

[60] The per capita net income of rural residents was just 30% that of urban citizens in 2010

[61] The per capita housing area increased from 20.3m^2 in 2000 to 31.6m^2 in 2010. Family cars owned by every 100 families increased from 0.5 to 13; air conditioners from 31 to 112 and refrigerators from 80 to 97.

2.4.2 Finance sector is not fully supporting Green Transition

China has made significant steps towards introducing 'green finance', with notable success in renewable energy and energy efficiency. Yet the broader financial sector still requires deep reforms; finance currently plays a critical role in deterring the Green Transition by allocating financial resources to polluting activities. At present, China also lacks the range of accessible financial tools that private sector new entrants will need to spur innovation and green investment (see Box 2- 6).

Reforms are needed to encourage financial institutions to take environmental considerations into their profit calculations, ensuring more financial resources to green industries and less to polluting activities. From an economic perspective, such reforms would correct distortions arising from the fact that green investment – which has a positive externality – is under-developed, while investments in polluting activities with negative externalities are over-developed. Such distortions cannot be fully resolved by market pricing mechanisms at present, because China's current pricing system does not fully reflect the positive externality of green projects. Continued efforts to reduce fossil fuel and other subsidies for heavy industry[62] and successfully establishing a national carbon trading scheme in the 13th Five Year Plan period[63] would help to correct this situation.

The *Green Credit Guidelines* released by China Banking Regulatory Commission (CBRC) require banking financial institutions to develop standards for environmental and social risk assessment, and conduct dynamic assessment and classification on the environment and social risks of customers. The results could serve as an important basis for credit rating, credit access, management and exit. Banking financial institutions should also take differentiated risk management measures with respect to the 'three checks': loans, loan pricing and economic capital allocation. However, at present the guidelines lack legal effect, and they have not been properly implemented by the vast majority of commercial banks.

Inadequate or expensive environmental impact information is a major bottleneck for many institutions interested in green investment. The government should provide publically available data to quantify the environmental costs of companies and projects arising from air pollution emissions, water consumption and waste generation, and to assess the scale of "externalities" not reflected in the current market price. This system should ideally include a complete and constantly updating database about environmental cost of major sectors, companies, and products. In addition to policy makers, the information system provides a reference for all investors, including banks, non-bank financial institutions, private equity funds, and non-financial corporations in the analysis and investment decisions.

Because of the huge social benefits, we suggest that the work is undertaken by Chinese institutes (such as the Chinese Academy for Environmental Planning or Environment and Development Research Center of the Chinese Academy of Social Sciences) and/or a network of investors commissioned by the authorities through

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[62] Lin Boqiang and Ouyang Xiaoling, 2014, 'A revisit of fossil-fuel subsidies in China: Challenges and opportunities for energy price reform'. Energy Conversion and Management 82, 2014, 124–134.

[63] Kathy Chen and Stian Reklev, Aug 31, 2014, China's national carbon market to start in 2016 –official, *Reuters,* http://uk.reuters.com/article/2014/08/31/china-carbontrading-idUKL3N0R107420140831

government procurement of services. The database should be publically available at low or no cost.

A new Platform for Green Finance has recently been proposed to enhance integration between the financial reform process and policies for pollution control and low carbon development. Such a platform could be modelled on the Conference of Chinese Banking Industry on Settlement of Excessive Capacities and Practice of Green Credit, which was sponsored by China Banking Association and involved experts from the Ministry of Environmental Protection, the International Finance Corporation (IFC) and WWF alongside the CDB, ICBC and CIB[64].

One reason for convening such a platform is that careful planning is required before mandating "green investments" among commercial banks. They will need sufficient clarity on and capacity to implement the rules, to identify enough bankable projects that satisfy the criteria as "green" and are financially viable. In addition, defining "green" projects without clear guidance is not straightforward and project sponsors will have incentives to "green wash" projects. If the government provides guarantees for "green" projects that have high risk in terms of financial viability, this may cause a moral hazard problem, as market discipline is lost and banks do not have incentives to conduct proper due diligence. Due to these concerns, without careful planning, mandating "green investments" could lead to inefficient use of public resources.

Box 2- 6: Green financial instruments and institutions

Green Loans. Green loans occur when banks provide low interest loans for projects that are environmentally friendly and abate negative environmental effects. For the consumer-client oriented loan business, green loans include mortgage debt, loans for green vehicles and green credit card services. For corporate-client oriented businesses, green loans include loans for clean technology and energy, and for commercial construction of green buildings. Green loans policy is at a preliminary stage in China. Current policies focus on restricting loans to high-pollution and high-energy consumption enterprises, but rarely involve loans to environmental protection and environmentally friendly industries. At the end of 2012 green loans accounted for only 1.5-2.5% of the national loan balance sheet, so there is much room for expansion.

Green Private Equity and Venture Capital. From 2007 to the first half of 2013 there were 694 investments of VC/PE in the field of clean energy, amounting to 8.2 billion dollars. The amount was highest in 2011. Many enterprises are now listed in domestic and overseas markets[65]. In the last two years PE/VC hit bottlenecks in China (see section 2.3.1) and direct investment in clean energy consequently declined.

Green ETF and Mutual Funds. In foreign financial markets there are many green financial products with good liquidity, such as ETF indexes and funds and derivatives of carbon emissions. The most well-known international green indexes include the S&P Global Clean Energy Index, Nasdaq Clean Edge US Index, WilderHill New Energy Global Innovation Index and FTSE Japan Green Chip 35 Index. In China, the Green ETF and mutual funds were recently established, but there are only a few fund products in the A-share market (i.e. denominated in RMB), such as A-share Wells Fargo Low Carbon Fund and the Zhonghai New Energy Fund. They are relatively small, and investment is not strictly restricted to environment protection.

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[64] See: Lee Amin, Shin Wei Ng and Ingrid Holmes, 20 November 2013, 'China's Low Carbon Finance and Investment Pathway' E3G Policy Paper. www.e3g.org/library/financing-chinas-low-carbon-investment-agenda

[65] Task Force analysis based on: Zero2IPO Research Center, China PE Annual Report, 2007-2012, China VC Annual Report, 2007-2012. See Task Force background paper on *Green Financial Policy and Practice*.

Green Bonds. 'Green Bonds' are fixed-income debt securities issued by governments, banks, multilateral development banks, corporations and projects in order to raise the necessary capital for an asset which contributes to Green Transition[66]. Globally, 75% of climate bonds have an implicit or explicit backing from a government entity[67]. China is the largest single country for Green Bonds, according to HSBC, due to the inclusion of China Railway Corporation. To help ensure corporate green bonds have environmental integrity, CICERO (Center for International Climate and Environmental Research – Oslo) has established a network of organizations to provide independent assessments[68].

Green Banks. In 2012, the United Kingdom founded the first investment bank in the world dedicated to accelerate transition to green economy: the UK Green Investment Bank. It funds green projects, on commercial terms, in areas such as offshore wind, waste recycling, energy-from-waste and non-residential energy efficiency. Currently the bank can invest through debt, equity and bond guarantees, but does not offer soft loans, venture capital or subsidies. Third parties are able to make joint investments.

A more established mechanism for raising funds for green infrastructure is State Revolving Funds. In the US, the Clean Water State Revolving Fund (CWSRF) helps communities in meeting targets of the Clean Water Act. Through the CWSRF program, each state maintains revolving loan funds to provide independent and permanent sources of low-cost financing for a wide range of water quality infrastructure projects. Funds to establish the CWSRF are provided through federal government grants and state matching funds. Today, building on a federal investment of over $26 billion, the CWSRFs has provided more than $100 billion in funding to support water quality infrastructure projects.

Green Insurance. Green insurance is a tool for environmental risk management, which can help enterprises by providing financial compensation and environmental remediation if unforeseen accidental pollution incidents arise. In addition, mandatory green insurance is one way to cover future environmental costs, and to help enterprises internalize the externality of environmental risks – eliminating potential costs from excessive environmental risks. Even without a mandatory system, clarifying liability for environmental damages would encourage the development of green insurance.

2.5 Insufficient integration and participation

2.5.1 Cross-cutting responsibility for the Green Transition

Today, China's "environmental federalism" acts as a barrier to its Green Transition. Central government drafts major policies and pollution control targets, but local governments typically have less incentive to implement the measures due to pressure for higher GDP growth. They often divert resources to support energy intensive sectors at the expense of environmental protection.

Meanwhile, ensuring environmental quality has largely been seen as the responsibility of the Ministry of Environmental Protection (MEP) and its local agencies. Since this Task Force is focused on economic measures and instruments, many of its key proposals would fall under the remit of economic and finance ministries. Yet there are important implications for many other parts of government – industrial policy, resource extraction, trade, innovation and education are among the issues discussed in this report.

One of the benefits of more market-based approaches (see section 2.2) could be a

[66] Kaminker, C., et al., 2013, *Institutional Investors and Green Infrastructure Investments: Selected Case Studies*, OECD Working Papers on Finance, Insurance and Private Pensions, No. 35, OECD Publishing.
[67] HSBC, 2014, *Bonds And Climate Change: The State Of The Market In 2014*.
[68] 27th November, 2013, CICERO Second Opinions on Green Bond Investment Frameworks, http://www.cicero.uio.no/webnews/?id=11984

reduction in the administrative burden for issuing permits, monitoring progress and checking compliance, which would free up resources and provide more flexibility to innovate with policy making. It would also generate new revenue streams for central and local government. China should learn from the challenges faced by other countries when implementing economic levers, such as fiscal policies and 'emissions trading' schemes.

There will be a vital role for the private sector in the Green Transition, with government playing a guiding role. In addition to regulating the heavy industry and stimulating 'green technology' sectors, more policy attention should be given to sectors which have a small direct footprint but can strongly influence China's development pathway. As described in section 2.4, the finance sector is perhaps the most important case. Information technology, the new materials industry and urban planning are other relevant examples.

Individuals and communities will play an important role in China's Green Transition, through their lifestyles and through their consumer choices. Their contribution can be made more effective through greater transparency over the environmental impacts of products and investment projects, and greater access to information on environmental quality, in line with the principle of 'open government information'[69]. Reducing such information asymmetries can also help ensure that market-based incentives (such as those proposed in this report) have the desired effect.

2.5.2 Need for integrated approaches

The range of economic, financial, institutional and sector-specific measures required to support a Green Transition strongly suggest that action is required across a range of departments which have not traditionally pursued green approaches. The responsibility for delivering the transition cannot lie with the Ministry of Environmental Protection alone, although it will play a key role in environmental enforcement and coordination.

The need for better coordination of policy implementation between China's central and provincial governments has been well documented, but it grows more urgent as environmental pressures build. Top-down laws and regulations have not always been fully implemented at the provincial level, undermining national progress towards a Green Transition. Some of this can be addressed by strengthening institutional capacity for delivery – and by introducing policy measures that require less bureaucratic effort and shift incentives, such as the economic measures discussed in section 2.2.

It may be necessary to redefine the incentive structures for local government. Pursuing short term economic growth without due regard for environmental problems has had immediate term air quality consequences, but also threatens to constrain medium term development goals and undermines progress towards ecological civilization. In order to ensure local governments are able and willing to implement policy, their ability to raise the necessary financing may need to be strengthened.

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[69] 'Li Keqiang: There are hundreds of millions of micro-blog users. Government information must be disclosed in a timely manner'. sina.com.cn, 26 March 2013 http://news.sina.com.cn/c/2013-03-26/193226648402.shtml

Given the enormous complexity of China's environmental problems, there is a clear need to move towards integrated approaches rather than 'issue specific' measures, and towards wider stakeholder involvement (see section 2.5.3). Otherwise, the risk is that narrowly focused, non-integrated policies will be unable to take cross-sector implications, tradeoffs and synergies into account.

As other countries have found, this can mean that environmental action is weaker than intended, or alternatively the problem is shifted elsewhere – to other regions or to the future – without addressing the root cause. While China's policy arsenal includes integrated approaches in some areas, such as the Circular Economy Law, in practice many of the policy responses are reactive and integrated policies remain weakly implemented.

2.5.3 Responsibilities of individual industries, companies and consumers

The green transition will require strong leadership and policy guidance from central government, but it will also involve a wider range of stakeholders and a key role for the private sector, in line with China's market-oriented reforms.

Coalitions between the government and key industrial groups often lie at the center of other countries' strategies for Green Transition. Depending on how this relationship is managed, it can either constrain or facilitate environmental policy, since existing market players often have a strong interest in maintaining the status quo. In some cases a very close relationship between government and business (such as in South Korea or the Netherlands) has been a factor in delayed responses, due to high costs and reluctance to recognize liabilities.

Getting this relationship right, however, can unlock investment and innovation. In the case of the Netherlands, government and businesses with similar problems formed clusters to collaborate in finding common solutions. Business participation was catalyzed by understanding that no progress would draw mandatory measures and government found that involving business was less confrontational. Formalized voluntary agreements or 'covenants' played a key role in fostering trust in government-business communication in this case.

Encouraging small and medium-sized enterprises (SMEs) and foreign firms to make green investments will be ever more important. It is critical to remove barriers to entry that are based on the size or geographical origins of companies, and to encourage companies with technology prowess and strong environmental performance[70]. As this report argues, government can encourage private sector activity through economic and other incentives, as well as by supporting green finance (see Section 2.4.2), but it will also need to persist with structural changes and regulatory measures, to address the dominance of state owned enterprises.

The general public has an important role to play in catalyzing the Green Transition, but so far their role has been limited. Government could require public release of environmental information associated with products; and it could publish disclosed data on polluting and resource intensive firms, as well as highlighting firms with a

[70] LCIS Task Force, 2011, 'China's Low Carbon Industrialization Strategy', Report of the Task Force for the China Council for International Cooperation on Environment and Development.

positive ecological footprint. The management of sustainable consumption would be made more open and transparent, and the public would take up a supervisory role. Non-government institutions such as the media and NGOs will also play an important role in guiding and promoting the idea of sustainable consumption.

Strong accountability measures such as those described above, can help secure government and private-sector commitment to policy implementation and to achieve agreed outcomes[71]. They can help secure support and commitment from individuals, communities and cities. Finally, they will also help address the information asymmetries which undermine the utility of some economic policy instruments.

2.6 Summary of calculations

In this section we summarize the different measures described in this report and how they would support China's Green Transition. We add up five the effects of the five scenarios one by one and compare them with the BAU scenario.

These scenarios are based on a combination of macroeconomic forecasting based on statistical analysis, institutional/experiential analysis and CGE modelling. Note that the scenarios are not the outcome of a single modeling result. Please see Appendix 1 and 2 for methodologies and further explanation.

- Promoting structural rebalancing of investment-consumption and lowering investment rate as well as raising consumption rate by 10 percentage points will reduce energy consumption by 9.7% in 2030.
- Accelerating industrial structure rebalancing can further reduce fossil energy consumption by 3.3% in 2030 (after double counting with the investment-consumption rebalancing has been removed).
- Promoting resource tax reform and electricity price reform reduces fossil energy consumption by 6.1% in 2030, but high-carbon fossil energy (coal and oil) consumption will decrease by 8.4%.
- Demand-side policy incentives to promote renewable energy development decrease fossil energy consumption by 5.1% in 2030.
- Urban and inter-city rail transportation systems and fully implementing mandatory building energy saving standards lead to a reduction of 5-12% in fossil energy consumption in 2030 (estimated at a conservative 5% here).

The above measures result in a combined reduction in energy consumption of 20% compared to BAU in 2030, or from 6.26 billion tons of standard coal to 5.01 billion tons of standard coal. Fossil energy consumption reduces by 26% relative to BAU – a reduction from 5.3 billion tons SCE to 3.92 billion tons SCE. The reduction in high-carbon (coal and oil) fossil energy consumption is larger, at 28% (from 4.58 billion tons SCE to 3.30 billion tons SCE).

CO_2 emissions decrease from 12.8 billion tons to 9.4 billion tons, with a reduction of 3.4 billion tons, or 27%. The theoretical emissions (before desulfurization, denitration, dust and other pollution reducing measures) of atmospheric pollutants (sulfur dioxide,

[71] Najam and Halle, 2010, Global Environmental Governance: The Challenge of Accountability. Sustainable Development Insights paper. Available: http://www.bu.edu/pardee/files/2010/04/UNsdkp005fsingle.pdf

nitrogen oxides, total suspended particulates and respirable particulate matter) is estimated to have a reduction of not less than 27%[72].

In combination, these measures would have a major impact on China's future energy consumption, carbon dioxide and local air pollutant emissions. Without such measures, fossil energy consumption and carbon dioxide emissions will continue to rise, and may not peak before 2050. In 2030, fossil energy consumption will reach 5.3 billion tons of standard coal, and in 2050 will exceed 6.3 billion tons of standard coal. Carbon dioxide emissions in 2050 will reach 15 billion tons, and both will continue to rise.

If all the proposed Green Transformation policies are put in place, China's fossil energy consumption and carbon dioxide emissions is estimated to peak around 2036 - 2037 (at about 4 billion tons of standard coal), after which time it is expected to decline in absolute terms. High-carbon fossil energy consumption could peak significantly earlier – at around 3.36 billion tons in 2019 (coal also peaks around 2020). This is because the transition process expands the consumption of the relatively clean natural gas resource, but slows down the coal and oil consumption. These results are illustrated in Figure 2- 3 below.

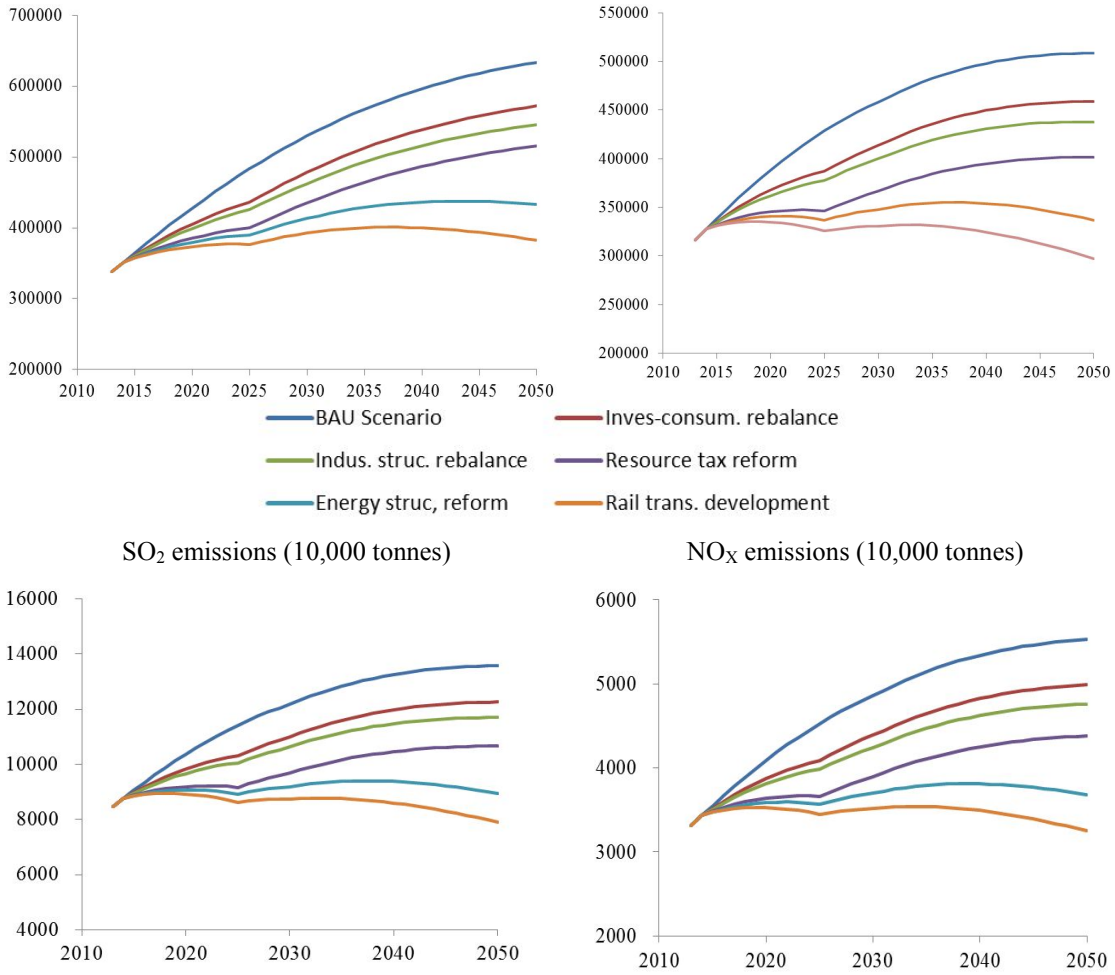
In each scenario, there is a turning point of both fossil energy consumption and carbon emissions at around 2025, after which there is a slight rebound. This is because we assume that the investment-consumption structure rebalancing and resource tax reform will be implemented during the next 10 years, and completed in 2025. So in the period after 2025, the 'transforming efforts' may be smaller. However, this situation is only a theoretical assumption, which may not necessarily happen; there may also be new transformation factors (such as energy conservation and emissions reduction due to technical innovation).

It also should be noted that, the five kinds of transformation scenarios listed here do not include all possible transformation measures, only the important and measurable policies we have identified. We cannot rule out the possibility that through the efforts in other aspects and additional efforts of the above aspects, the pace of green transformation will further accelerate, bringing about the earlier arrival of peak fossil energy consumption, carbon emissions and pollution emissions, followed by a decline in absolute terms.

Figure 2- 3: Combined effect of Green Transition Policies on energy & pollution

Fossil energy demand (10,000 t SCE) CO_2 emissions (10,000 t)

[72] Figures presented for local air pollutants (SO_2 and NOx) exclude the effect of desulfurization and denitration. After desulfurization and denitration pollution levels will be significantly lower, but predicting these effects is complex and depends on the local situation.



3 CONCLUSIONS

Seizing the window of opportunity

The 13th Five Year Plan is the critical window of opportunity for the Green Transition, and will be the litmus test of China's commitment to pursuing an ecological civilization. Action is urgent, because air pollution and other environmental challenge pose a serious threat to China's development goals. Action is possible, because the economic reform program and the strong response to the air quality crisis present huge opportunities to align environmental and economic policy at the strategic level.

In other countries, environmental crises have played a key role in 'tipping the scales' of the governance system towards systemic and comprehensive action. The London Smog of 1952 in the UK prompted the passing of the country's first Clean Air Act. In Germany, specific pollution events at home, such as fish kills in the Rhine, as well as overseas events such as the Chernobyl disaster, were pivotal moments. In Japan, Minamata disease triggered environmental action at local and national levels in the 1970s, as did Cadmium contamination related health problems in the Onsan region in South Korea.

The question for China is whether it can turn the risks and costs associated with environmental events into opportunities for strategic renewal. Responses to these

challenges elsewhere were most effective when they combined regulatory might, economic measures and political will with recognizing and engaging major stakeholders. Key elements of successful strategies included well-managed relations with industry; integrated, long-term planning around acceptable outcomes; and building the legal and institutional infrastructure necessary not only to establish but also to systematically monitor and enforce laws.

Greening China's Great Reform Program

The 13th Five Year Plan will define China's approach to a market-oriented and innovation-led economy. This is a unique opportunity to put Green Transition principles at the center of the country's economic program and institutional reforms.

As this report shows, some of the primary barriers to China's Green Transition process lie in economics: they are closely related to economic factors and economic policy issues, from the excessively high level of energy consumption resulting from over investment to the absence of appropriate market-based instruments. At the same time, there is little doubt that slow progress on this agenda will bring many economic risks. The latest assessment places the cost of China's air pollution at 10% of GDP, the highest in the world[73].

We show that policies to accelerate a shift in the economy away from investment and towards consumption are effectively growth-neutral, but they lead to positive environmental and employment benefits. We also identify a set of key economic policies and financial tools that would support green investment and accelerate innovation whilst cutting unnecessary energy use and emissions. The environmental and resource taxation schemes proposed in this report could also generate significant revenue.

These are by no means the only policies that China has at its disposal, and by themselves they will not be sufficient to deliver a green transition. We argue that China should make more use of economic and pricing policies, but as part of a comprehensive, integrated strategy. In particular, there remains a vital role for strong regulatory intervention, due to imperfect information flows, the role of state owned enterprises in the economy and the continuing need to tackle outdated production capacity.

In many areas, policy implementation is hampered by poor coordination and competing incentives. In line with the experience of other countries, China will need stronger inter-departmental coordinating mechanisms to ensure that Green Transition principles are integrated into key economic, finance and planning decisions.

Leveling the economic playing field

Subsidies enjoyed by heavy industries in the form of land, energy, water and cheap finance stand in the way of Green Transition; they lead to excessive energy use and emissions; they increase barriers to entry for more innovative small and medium size enterprises; and they would blunt the effectiveness of the green economic policies we propose. Subsidies for clean technologies should also be phased out once they are

[73] The Global Commission on the Economy and Climate, September 2014, Better Growth, Better Climate: The New Climate Economy Synthesis Report. p21

fully market competitive.

Information flows can help fuel the green transition. First, information asymmetries often favor incumbent firms which have an interest in the status quo. This hampers effective decision making and target-setting, and increases costs for local authorities. Second, better information would help investors to identify green business opportunities and enable innovators to spot new market opportunities. Third, it would help consumers to select firms with high environmental performance. Finally, making environmental costs and risks transparent is necessary to ensure that enterprises are valued appropriately, avoiding systemic risks.

4 POLICY RECOMMENDATIONS

The Task Force has identified six sets of concrete policy recommendations. These priorities are designed to seize the window of opportunity and steer China onto a Green Transition pathway during the 13th Five Year Plan period and beyond.

Recommendation 1: improve economic structure with less and better targeted investment

Within China's reform program, government should prioritize institutional reforms and policy adjustments which rebalance China's economic structure. Over investment in heavy industry is a major cause of China's air pollution problem. An adjustment in the order of a 10 percentage point increase in the share of consumption in GDP by 2025 is proposed, with a corresponding decrease in the share of capital formation in GDP. This will not slow GDP growth, but it will reduce pollution as well as wasted capital and energy. A target could also be set and gradually increased for the proportion of capital investment spent on green sectors including renewable energy, low-carbon infrastructure and construction and ecological protection.

Government should ensure that the performance management system for all ministries reflects a new responsibility to accelerate Green Transition, with appropriate monitoring and reporting. We also recommend introducing a strong inter-departmental coordinating mechanism, involving not only sector ministries but also core departments, such as planning, finance and trade. There will be a key role for MEP to ensure the environmental integrity of Green Transition policies. Investments in capacity building and training will be required to ensure that government officials can become leaders and innovators of the green transition.

Government should remove the unfair advantages currently enjoyed by industrial sectors. China should phase out preferential policies for heavy industry, including cheap land, low electricity prices, low interest loans and tax incentives. Such support has contributed to over-investment in the industrial sectors. Once different renewable energies become fully cost-competitive, subsidies should also be gradually phased out for these sectors. These measures will help eliminate resource allocation distortions caused by preferential policies, realizing fair competition as part of the Green Transition.

Recommendation 2: promote a shift in resource use via green taxation

Government should increase the use of economic tools and measures to achieve an ecological civilization, focusing on resource taxation and electricity pricing reforms. We recommend the following measures to incorporate environmental externalities and help to reduce excessive resource use. These resource taxes and environment taxes represent a major source of fiscal revenue under a Green Transition.

Resource tax. The unit based tax for coal should be replaced with an ad valorem resource tax, and the tax rate raised to at least 10 and preferably 15% in three steps by 2025, applying the same rate to imports. For oil, the ad valorem tax on domestic and imported fuel should rise from 5% to 10-15%. For natural gas, the rate can be maintained at 5%, and imported natural gas should be exempted.

Electricity price reform. Except for household electricity and the agricultural electricity quotas, all electricity should be sold at the same price, and the price should be set by the market without any exceptions. A new electricity tax should also be levied through a tiered pricing system, based on the amount of consumption.

Automobile tax. Introduce a new tax based on engine size, as larger engines tend to have higher emissions.

Recommendation 3: financial sector reforms to catalyze Green Transition

Ministry of Finance, in coordination with NDRC, MEP and other ministries and regulatory bodies, should introduce a new framework for green investment. The goal is to ensure that the finance sector accelerates the Green Transition by efficiently allocating resources to green projects and firms, and ceases to support polluting activities. Drawing on existing investment guidelines (such as the green credit guidelines of CBRC), rules could be established via legislation; and a single appropriate supervisory body could be given a clear mandate to enforce the rules. Within this framework, it is critical that all economic actors are able to participate, and in particular to ensure SMEs have access to finance and can operate effectively.

Regulators should ensure that lenders, insurance and rating agencies fully reflect the potential risks of unsustainable investments: to ensure firms' long term viability but also to protect China's medium term development pathway from potential dislocations due to environmental pressure or resource price volatility. 'Environmental risk factors' should be incorporated into Banks' and Rating Companies' project evaluation methodology, as part of the framework described above. 'Environmental risk insurance' should be mandatory in the 'forced insured' industries of offshore oil exploration and inland waterway transportation, as well as other industries like oil and gas exploration, petro-chemistry, and steel and plastics.

The government should establish a Green Investment Bank for China. There is an urgent need to accelerate investments in green infrastructure – such as smart grids, green buildings, mass transit and charging infrastructure for electric vehicles. Green bonds (and in future, carbon trading revenues) should be the primary financing source. As an alternative to setting up a new institution, the government could explore turning China Development Bank into a bank responsible for Green Transition. In collaboration with the Green Bank, government departments should cooperate with regulators and financial institutions to fast-track support for green projects.

Recommendation 4: stimulate demand for clean tech via targeted policies

Government should maintain and reinforce demand side policies to support renewable energy industry roll out. The framework has been improved in the 12th FYP period to accelerate demand for renewables: to increase the share in the energy mix, but also to address overcapacity in the renewables sector. However further attention is needed to capitalize on the potential for growth in the 13th FYP. This includes further improving grid capacity; strongly encouraging the installation of solar technology in industrial and public buildings; and expanding the range of green finance instruments (see recommendation 3).

Full implementation of existing building energy efficiency standards will make a key contribution to energy saving, and will also support rapid development of the green buildings technology sector. The government should also consider adopting a new target for a percentage of new buildings to be 'near-zero energy' in 2020, meaning that buildings are highly efficient and also generate their own energy from renewables. This would help to drive domestic demand for efficient building technologies and ensure Chinese firms are ready to benefit from global business opportunities. Large-scale development of city and intercity rail transit systems is another opportunity to make major energy savings and air pollution improvements, compared to passenger vehicles.

As well as expanding the domestic market for clean technology, China could scale up cooperation with developing countries to expand their markets for green goods and services. Facilitated by MOFCOM, NDRC and key financial institutions such as CBRC, China EximBank and the BRIC bank, this could include joint ventures with local firms to manufacture abroad and technical cooperation. This would deliver on China's commitments to help countries in Africa and elsewhere move up the value chain, as well as providing medium term growth opportunities for Chinese firms.

Recommendation 5: stringent caps on fossil fuel consumption

A 'National Quantity Target Control' system for total energy consumption should be introduced as soon as possible in the 13th Five Year Plan period. If our policy proposals are successfully implemented, consumption of higher carbon, highly polluting fossil fuels (coal and oil) could peak by 2020 at 3.4 to 4.0 billion tons SCE. Coal consumption (separately) could also peak by 2020. Total fossil energy consumption peaks later in the 2030s at 4.6 – 5.2 billion tons SCE, reflecting an expanded role for gas. Greenhouse gas emissions level off after 2020, so that the peak in the 2030s is just above the 2020 level. Given the urgency of Green Transition, China would benefit from implementing targets at the ambitious end of these ranges.

The national energy 'cap' should be broken down to regional quotas (supplemented by certain industry quotas), and appropriate administrative measures and legal means should be in place to enforce such practice. Targets should be set each year, with reference to the existing energy and carbon intensity targets.

Recommendation 6: enhance information flows to stimulate investment and innovation

MEP and the ministry of Finance should develop a constantly updated database

on the environmental impacts of major sectors, companies, and products, including for air pollution, water consumption and waste generation. The database should be publically available, at low or no cost. This database system would provide a reference for all investors, including banks, non-bank financial institutions, private equity funds, and non-financial corporations in their analysis and investment decisions. For small firms in particular, it would reduce barriers to entry and enable them to capture green business opportunities.

Enhanced information availability would also help to reduce the administrative burden on local government, and improve the capacity of local and national institutions and regulators to properly guide the Green Transition. Finally, enhanced information is important for the general public to be able to make green consumer choices, and to better understand the environmental performance of different firms.

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I. General methodologies

Scenario analysis in this report is based on several different analytical methodologies: macroeconomic forecast based on statistical analysis, institutional/experiential analysis and CGE modelling. The CGE results are generally consistent with other result in the *direction* of the effects, however, we found it overestimated the cost of green transition and underestimated the benefits, for the following reasons:

1. Model forecasts on future economic growth and energy consumption are based on a long term trend of past growth, but have not fully incorporated recent changes, such as China's slower economic and energy consumption growth, and more rapid growth of renewable energies, which we believe indicate a new trend.

2. The CGE model is based on a pre-assumption that the economy is in a general equilibrium situation, which is not fully consistent with the real situation of the Chinese economy given the structural imbalances.

3. The policy adjustments we recommend in the report are based on a wide range of institutional reforms, which beyond the scope of a CGE model. The model can only simplify these changes as external shocks, which unavoidably result in some efficiency losses in the estimated outcomes.

With consideration of these facts, we mainly adopted the results of macroeconomic forecasting based on statistical analysis, combined with some useful outcomes from the modelling analysis.

II. Scenarios

1. 'Business-as-usual' scenario

In the economic forecast, we considered the recent trends of less rapid economic growth and acceleration of renewable energy growth between 2008 and 2013 to be the 'new normal. We predict lower GDP growth rates in the future (6.7% for 2014-2020, and 5.0% for 2021-2030). Thus the estimated 2030 GDP is 130 trillion RMB (2010 constant prices) instead of 161 trillion RMB from the CGE model, and total energy consumption 6.3 billion tons (standard coal equivalent) instead of 8.2 billion from the CGE model.

Further economic analysis indicates that higher GDP and energy consumption is not achievable. For reference, this growth forecast is close to, but slightly lower than, the forecast by the World Bank and Development Research Center of the State Council (2012): *China in 2030*.

2. Investment-consumption rebalance scenario

The rate of capital formation (to GDP) in China is 2.5 times the world average, and 20 percentage points higher than the average of middle-income countries. As indicated by estimates of current capital inefficiency, we estimate that a 10 percentage point reduction of capital formation in GDP and a 10 percentage point increase in consumption in GDP by 2025 will generally have a non-negative effect on economic

growth, and will result in a 9.7% reduction of fossil energy consumption, according to calculations using the national input-output table data.

Compared to this, the CGE model gives a 4%-7% energy reduction (and also a 2%-4% reduction of GDP) as the 10 percentage point reduction in capital formation is not fully reached due to auto-readjustment of the model. The result of GDP reduction is an overestimation of the transitional cost, as the model does not include the effect of efficiency increases in the transition. These problems are due to the limitation of the model setting, as stated earlier. The former outcome is therefore adopted.

3. Industrial structural rebalance scenario

Changes in industrial structure are forecasted based on previous changes in China, with more emphases on recent changes in the past decade. The scenario for acceleration of structural rebalance is based on both international experiences and our analysis of possibilities in China. The effect on energy saving is calculated using China input-output table parameters.

4. Resource tax reform scenario

The result of our economic forecast is also more effective than the CGE modeling result, as we found the latter underestimated the substitution effect between fossil energy and renewable energy. It is therefore the former outcome which is adopted. In the statistical analysis, we use 0.35 for both the price elasticity of demand and the price elasticity of supply for fossil energy. There are different estimations of price elasticity in the literature, and some are greater than 0.35. Greater price elasticity of demand means greater demand response to tax-price changes, therefore greater effect on energy saving. Therefore our estimation may be relatively conservative.

5. Rail transportation system and energy-saving building scenario

There is insufficient data to support the scenario analysis for development of urban and inter-city rail transportation systems and fully implementing mandatory building energy saving standards. The 5%-12% reduction of fossil energy by 2030 is estimated based on experience in developed countries and newly-industrialized countries.

Appendix 2: Tables of results

Additive Effect of Green Transition Policy on Total Energy Consumption (0.1 billion t standard coal)

	2013	2020	2030	2040	2050
BAU	37.5	48.7	62.6	73.4	81.2
Investment-consumption structure rebalancing	37.5	46.1	56.6	66.3	73.4
Industrial structure rebalancing	37.5	45.4	54.7	63.5	70.0
Resource tax reform	37.5	44.5	52.8	61.4	67.9
Rail transport-building energy saving	37.5	43.7	50.1	56.3	60.0
Aggregated energy consumption reduction	0.0	5.0	12.5	17.1	21.3

Data source: Forecasted by authors based on the data of National Bureau of Statistics of China

Additive Effect of Green Transition Policy on Fossil Energy Consumption (0.1 billion t standard coal)

	2013	2020	2030	2040	2050
BAU	33.8	42.8	53.0	59.6	63.4
Investment-consumption structure rebalance	33.8	40.5	47.8	53.9	57.2
Industrial structure rebalance	33.8	39.9	46.2	51.6	54.6
Resource tax reform	33.8	38.5	43.5	48.6	51.5
Energy structure reform	33.8	38.0	41.3	43.6	43.3
Rail transport-building energy saving	33.8	37.4	39.2	40.0	38.2
Aggregated energy consumption reduction	0.0	5.5	13.8	19.7	25.1
Degree of reduction, with benchmark as 100 (%)	0.0	12.7	26.0	33.0	39.7

Additive Effect of Green Transition Policy on CO2 Emission (0.1 billion t)

	2013	2020	2030	2040	2050
BAU	84.0	105.1	127.9	142.4	149.4
Investment-consumption structure rebalance	84.0	99.5	115.5	128.6	134.9
Industrial structure rebalance	84.0	97.9	111.6	123.2	128.7
Resource tax reform	84.0	94.1	104.1	115.0	120.4
Energy structure reform	84.0	92.8	98.8	103.1	101.0
Rail transport-building energy saving	84.0	91.3	93.8	94.5	89.2
Aggregated CO2 emission reduction	0.0	13.8	34.1	47.9	60.2
Degree of reduction, with benchmark as 100 (%)	0.0	13.1	26.7	33.6	40.3