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

Development Mechanism and Policy innovation Of China's Green Economy

CCICED Task Force Research Report

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Task Force Report on Development Mechanism and Policy Innovation of China's Green Economy

Abstract

The policy message from China's 12th Five-Year Plan (FYP, 2011-2015) adopted at the National People's Congress (NPC) in March 2011 was resolute and unambiguous: China needs to accelerate the transformation of its mode of economic development, moving from an unbalanced, uncoordinated and unsustainable development towards a green, competitive and inclusive economy.

Drawing on the latest work by the UNEP and the OECD as well as taking into account China-specific characteristics, a green economy is defined as:

An economic development model that regards environmental protection and sustainable resource utilisation as essential conditions for sustainable growth. This new model gives priority to the health and well-being of citizens, minimizes harm of human activities to the environment, adequately recognises and values both natural and human ecosystems for their ability to supply services. It seeks to seize new green growth opportunities, through a combination of continuous innovation and efficient governance.

Despite the progress made in the past years in energy saving and reductions, especially in the 11th FYP, China still faces daunting challenges in the green transformation of its economy. These challenges and barriers are associated with a complex mix of factors, such as the rapid economic growth, the structural characteristics, institutional and regulatory barriers as well as external pressure resulting from globalisation. In particular, the continuous industrialisation, urbanisation, and modernisation of the agriculture sector will remain both challenges and catalysts for transformational changes in the foreseeable future. At the same time, however, there are important favourable conditions and powerful transformational drivers in China that can turn barriers into opportunities, such as strong political commitment, the huge fiscal capacity to support green investments, the sheer market size and China's emerging ambition as a "green innovation hub". In other words, green economy for China is not only about catching-up, cleaning-up and avoiding high resource-intensity and high-carbon "lock-in", but also about seeking its own green development pathway and taking advantage of the unique opportunity of leapfrogging and green growth. Green economy is therefore an inevitable strategic choice that China will pursue in order to curb resource and ecological degradation, and improve economic efficiency as well as social inclusion and stability. As a result, China needs innovative mechanisms and an effective policy mix to facilitate its green transformation, taking into account its specific conditions and also international best practices.

Drawing on China's success and failure in the ongoing transformation process as well as international experiences, the basic conditions required for a successful green transformation include:

- Leadership and strategic planning by the government to provide the political foundation for a green transformation and leapfrogging;
- The right "positioning" of the government and the appropriate role played by the government in the green transformation;
- A well-functioning market as a driver for innovation and sustainability.

Given the sheer size of the Chinese economy as well as the large diversity in regional conditions, there is no "one-size fits all" pathway to a green transformation. Instead, China's future green development will need to rely on a differentiated and regional approach based on regional conditions and characteristics**.**

Strategic adjustment at the macrocosmic level in China is, to a large extent, intertwined with and dependent on the process and outcome of intra- and inter-sectoral adjustments, especially in the agriculture, industry and service sectors. Furthermore, China's economic structural change is also about shifting from an investment- and export-driven growth towards a more domestic consumption-driven growth. Both types of structural transformation – sectoral adjustment and drivers of growth – can potentially reduce the environmental impact and enhance resource utilisation and allocation, while at the same time address domestic and international economic imbalances. However, improvement in resource utilisation efficiency alone will probably not be sufficient to balance out the increase in demand for resources as a result of the income increase and scale effects. Instead, a strengthened demand-side management will be needed to accompany a "cap" on resource use in the consumption-driven growth.

Furthermore, the developmental dimension of China's green transformation – including poverty alleviation, job creation and women empowerment – is also critical. In China's future green growth, job creation and public service provision will likely to be the most effective vehicles for reducing poverty and stimulating social development. Moreover, despite the current structural and social barriers, women have already actively participated in and made significant contribution to China's green development.

Faced with a comprehensive set of challenges and tasks in various sectors and from different structural perspectives, an integrated and coordinated approach is needed. This will require improvement in the current, and introduction of new supporting system and policy measures, particularly in fostering a closer relationship or symbiosis between the government and the private sector. While further enhancement of the legal and regulatory system is needed, administrative measures alone could not solve the daunting challenges faced by China. Furthermore, investments in environmental protection in the past have relied disproportionately on government spending, which is increasingly insufficient in the face of the growing scope, scale and complexity of the environmental problems. Therefore, financial resource**s** for green transformation need to be both strengthened and diversified.

In this context, ten key recommendations are proposed, which encourage policy innovations at national, regional and sectoral levels, and create key enabling conditions:

- Strengthen the functions of the government in public service provision as well as market supervision and management
- Establish a mechanism for ensuring and evaluating policy coherence and impact for promoting green economic development
- Carry out a comprehensive greening of the fiscal policy and tax system
- Avoid unsustainable relocation of backward technologies and production facilities and achieve a coordinated green regional economy.
- Adopt a more concentrated approach to China's green urbanisation
- Develop and strengthen an integrated approach to green the traditional industrial sector
- Promote a green agricultural development in the modernisation process
- Fully leverage the role of the service sector as a catalyst for green transformation
- Make green transformation a more inclusive and empowering process
- Make green innovation a catalyst for China's modernisation and leapfrogging

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INTRODUCTION: THE TASKFORCE AND THE REPORT

Following the industrial and information revolutions, the "green revolution" is another vital catalyst that could transform the global economy. The concept of "green economy" was first proposed in 1989 by the British environmental economist David Pearce in his report "*Blueprint for a Green Economy*" – which shed an illuminating light on **the central role that environment should play in business, economic and public policy decision making.**

The financial crisis in 2008 has accelerated the disillusion with the conventional "black" economic development model that has relied heavily on resource depletion and utilisation of fossil fuels, leading to serious environmental pollution and ecological crisis. As the same time, the crisis also spurred a new wave of change and search for new growth and development opportunities. Consequently, green economy is now seen as a new vehicle for creating economic, social and environmental benefits. The UNEP (United Nations Environment Programme) launched the "**Green Development Initiative**" together with a "**Global Green New Deal"** to mobilise and re-focus the global economy towards investments in clean technologies and "natural" infrastructure. At the G20 London Summit in 2009, the overarching agenda of an **"inclusive, green and sustainable recovery"** was endorsed by the world leaders. The Organisation for Economic Cooperation and Development (OECD) launched its work on the "**Green Growth Strategy**" in 2010, which aimed to provide both a generic conceptual framework and practical policy tools to create new green growth opportunities. The common theme across these international initiatives is the integration of global environmental challenges into everyday economic decision-making, ranging from the macroeconomics to investment and science, technology and innovation. Great emphasis is given to the role of green investment, consumption and innovation, which are deemed the key drivers for a green and sustainable recovery, poverty reduction and long-term growth. From an international business perspective, a **global green race,** which is driven by **an opportunity narrative** (rather than simply a compliance issue), has become the driver of a global green economy. Countries will **compete and collaborate** to become the leading producers and exporters of resource efficient and environmental friendly technologies and solutions. This requires governments to work together with the business sector. The green growth agenda are to transform domestic markets and build strong **domestic demand**, as well as to increase **the share of the global market** for green products and services**.** (The World Business Council for Sustainable Development, WBCSD, 2010).

With a continuous and rapid growth of above 9% since the open-door and reform policy was launched in early 1980s, China surpassed Japan and Germany to become the world's second largest economy and the largest exporter in 2010. However, in the midst of industrialisation and urbanisation, China's growth model still suffers from the problem of **high resource utilisation, high energy intensity, high emission, low recycling and low efficiency.** While "business as usual" and the Western over-consumption lifestyle will not be an option for China, there are no off-the-shelf solutions for the green transformation, given the scale and the complexity of the challenges China faces. China needs economic development, but it also needs to decouple economic development from the increased use of energy and resources as well as from profound ecological and environmental damage. Consequently, China

needs to seek its own pathway towards a green transformation and the "Chinese dream" will need to be a green dream.

As the largest emerging economy as well as an emerging "rebalancing" power, China's transformation towards a green economy will also have far-reaching implications for the global economy. It will fundamentally change the characteristics of China's economy: from the world's workshop to the world's consumer market; from "made in China" to "innovated in China"; and from the recipient of inward investment to the supplier of outward investment. It will also help to preserve resource security, to enable the scale-up of global green technologies and to create new sources for green growth globally.

The policy message from China's 12th Five-Year Plan (FYP, 2011-2015) adopted at the National People's Congress (NPC) in March 2011 was resolute and unambiguous: China needs to **accelerate** the transformation of its mode of economic development, **moving from an unbalanced, uncoordinated and unsustainable development towards a green, competitive and inclusive economy.** In fact, "economic transformation" is **not** a new policy agenda for China and the transformation of its economic mode does **not** need to start from scratch. In 1996 when the 9th FYP was adopted, the key message was that "China's economic policy should give clear emphasis to the transformation of economic growth mode" (转变经济增长方式). In 2003, the Chinese government introduced the **"Scientific Concept of Development"** (科学发展观). Strategic guidelines were subsequently issued to promote **a people-centred scientific development based on a holistic, balanced and sustainable development concept.** The concept of and strategies for developing a **"ecological civilisation"** (建设生态文明) were introduced in 2007 to further integrate and accelerate the process of building a resource- and energy-saving and environment-friendly industrial structure, growth and consumption mode.

Evidently, China has already embarked on the pathway towards a green development since the past decade. The ongoing process of building a **resource-saving and environment-friendly society** as well as the development of **the circular economy and low-carbon economy** has already laid down promising groundwork. The real issues now are how to accelerate and deepen China's green transformation and how to further improve cost effectiveness and governance efficiency, given the scale and the complexity of **the challenges** that China faces. In other words, it is time for China to start **treating the cause and not just the symptom**. At the same time, it is imperative for China to seize **the new green growth opportunities** for modernisation and leapfrogging that the green transformation will bring.

In order to increase the speed, scale and depth of its green transformation under the 12th FYP and beyond, China needs **innovative mechanisms and effective policy mix,** taking into account China-specific conditions as well as making use of international experiences and best practices. The objectives of the Task Force for **"Development Mechanisms and Policy Innovation of China's Green Economy"** are therefore:

- To clarify **conceptual issues** related to China's green economy;
- To outline the **enabling conditions,** with a particular focus on **China-specific challenges and opportunities;**

- To put forward an overall **strategic framework** for developing China's green economy;
- To address **key tasks** of green transformation at both **the regional and sectoral levels;**
- To provide concrete **policy recommendations** that are of strategic importance and viable for quick implementation.

In this report, green economy is seen as the **"integrator" and "synchroniser"** of new development mechanisms and policy initiatives to address multiple economic, environmental and social challenges. The analysis will therefore **go beyond the scope of environment** to produce a **coherent policy framework.**

The report will focus mainly on the development mechanisms and policy tools/mixes. Some of the equally important issues in China's green transformation, such as low-carbon industrialisation and international trade, investment and environment, will not be investigated and addressed in great detail, but will be covered by general discussions based on the results from the previous and/or parallel ongoing CCICED Task Forces.

1. CHINA'S GREEN ECONOMY – BACKGROUND AND RATIONALE

After three decades of unprecedented economic growth with an annual GDP growth above 9 %, China has become the world's second largest economy and the largest exporter. At the same time, it has also become the world's second largest energy consumer and the largest carbon dioxide emitter, and is suffering from serious environmental and ecological degradation. Despite the rapid economic growth, there are still some serious economic structural problems, such as over-reliance on investment and export, income distribution concerns across household, business and government, as well as rural-urban income disparity. Faced with these challenges and the urgent need for a sustainable development, a structural transformation towards a green economy is not an option but an inevitable pathway for China.

1.1 China's economic transformation

From the analyses and estimates of growth factors, there is a broad consensus that both input-driven factors, such as **physical investment** and **human capital**, and Total Factor Productivity (**TFP**) that reflects various efficiency gains (and/or losses) have been important for China economic growth in the past decades.

1.1.1 Drivers for economic efficiency improvement

The most important observation from the growth analysis is that economic efficiency gains (i.e. shown in the positive trend in the TFP growth) are typically related to **better functioning market economy dynamics**, such as increased market openness to both **domestic and foreign private sector.** This induces not only more efficient resource allocation, competition and entrepreneurship, but also significant technology, know-how and management skill transfers and spill-overs.[1] More specifically:

- **The growth of the private sector,** a result of the market-oriented structural reforms in the 1980s and 1990s (measured by the share of the ratio of output by the private sector), has indeed contributed to economic growth and efficiency improvement in the past. There is a great potential to channel existing market incentives, competition, entrepreneurship and not least the private investments to the future green transformation.

- **Urbanisation** has been and will continue to be an increasingly important driver for China's economic development. It is not only important for reallocation of labour from low-productivity to high-productivity activities, but also contributes to favourable conditions for job creation in the **modern service sector** as well as for **avoiding environmental degradation and high-carbon "lock-in**" growth pattern through low-carbon urban planning, building and transport solutions.

- **Infrastructure development** in China, instead of just adding to the capital stock as a form of input-driven factor, has contributed greatly to economic

[1] More details on the methodology specification and discussions on the growth accounting results can be found in "China towards 2020: Growth performance and sustainability", by Fan Gang and X. Wang OECD 2010 and NERI, 2007.

efficiency improvement by removing the bottlenecks for market integration and changing the economic landscape. As both an important element of the modernisation/upgrading process and a means of reducing regional disparity and facilitating the "industrial gradient transfer", infrastructure development will continue to be crucial for China's future growth.

- **R&D** (and innovation) **expenditure** has increased rapidly under the 11th FYP. Despite the fact that China did not actually meet its R&D expenditure target, i.e. 2% of GDP, it nonetheless accounted for 12% of global R&D expenditure in 2010.[2] Moving forward, a more nuanced understanding of both the strength and limitation of its "indigenous innovation", and the incentives and market conditions required for commercialisation and industrialisation (in particular the symbiotic relationship between innovative SMEs and large players) will help China to get ahead in the global green race.

1.1.2 Barriers to economic efficiency improvement

The results from the growth analysis also suggest that long-term efficiency improvement and the "quality" of future growth will ultimately depend on the changes generated from institutional and governance improvement, and the transformation from an investment-driven to a consumption-driven growth – which is implicitly an outcome of the institutional and governance improvement.

- **Consumption-to-GDP ratio** is an increasingly important structural parameter for economic efficiency improvement, and its importance will continue to grow in the future economic structural adjustment. Structural adjustment towards a consumption-driven economy has been under way in the two past decades.[3] However, some structural and institutional barriers, such as social security, labour market related issues as well as income disparity within urban areas and between regions that deter consumption growth need to be addressed.

- **"Government administration cost"** has imposed significant efficiency loss in the past three decades, according to the growth analysis. It is a "proxy" for estimating government's direct intervention in the market, e.g. in the forms of owning, operating and engaging in business as well as interfering with the functions of the market through subsidies and other forms of price distortions. These interventions have led to inefficient resource utilisation allocation despite resource shortage as well as an "irrational" industrial structure. Specifically, it has caused excessive investment and overcapacity building as well as serious resource price distortions.

Two institutional issues that have had great negative impact on structural transformation – and will seriously impede China's future green development if not addressed – are the so-called "**asymmetric market liberalisation**" and **governance paradox of the relationship between central and local governments.**

[2] See McKinsey & Company, 2011: Unleashing innovation in China.

[3] There are also analyses suggesting that the problem of under-consumption in relation to investment and export has been, due to various statistical reasons, overstated. See e.g. "China Economics: China's under-consumption overstated", Morgan Stanley 2009 and "A truer picture of China's export machine" McKinsey & Company, 2010.

The asymmetric market liberalisation refers to the unique pattern of China's market-oriented reform in the past decades: comprehensive liberalisation of the product market (consumer goods) but substantial distortion in the factor market (factor price control and subsidies). Consequently, the prices of labour, capital and natural resources are repressed, which acts as de facto subsidies for producers, exporters and investors. This is probably one of the most fundamental explanations for a consistently strong economic growth and an even stronger export and investment in China.[4] Addressing the incentive structure associated with factor market price distortion will thus target the root causes, rather than just the "symptoms", of the structural imbalances.

Some recent research has quantified the impact of factor price distortions on China's economic growth. Despite methodological constraints, the estimates do indeed provide some indicators on the *relative* size of various distortions and how they have been changed over time. (See Table 1 below).

Table 1. Estimated distortion costs in China, 2000-2009, per cent of GDP

	Labor	Capital	Land	Energy	Environ	Total
2000	0.1	4.1	0.5	0.0	3.8	8.5
2001	0.2	3.9	0.5	0.0	3.5	8.1
2002	0.8	3.9	0.4	0.0	3.3	8.4
2003	1.0	3.8	1.1	0.0	3.3	9.2
2004	2.0	3.1	0.9	0.6	3.0	9.5
2005	2.4	3.0	1.3	1.7	3.0	11.4
2006	2.7	3.1	2.0	1.6	2.8	12.2
2007	3.2	3.6	1.2	1.6	2.4	12.0
2008	3.6	3.4	1.0	0.7	1.9	10.6
2009*	2.7	3.5	0.9	0.7	1.8	9.6

Source: Factor market distortion and the current account surplus in China, Huang and Tao (2010). http://www.mitpressjournals.org/doi/abs/10.1162/ASEP_a_00020?journalCode=asep

Key observations and conclusions suggest that:

- The capital market distortion is by far the most important one, which explains the persistent overinvestment problem and the rapid development of capital-intensive industries in China, despite continued upward pressure on wages in the labour market;

- The factor price of energy fluctuated widely over time, reflecting both price volatilities in the world market, but also domestic price controls when international prices surge rapidly;

- The environmental cost distortion has shown a gradual but consistent improvement – as a result of reduced emission levels (but not the under-pricing of pollution).

[4] See e.g. Huang Y. and B. Wang, 2010: Rebalancing China's economic structure. http://epress.anu.edu.au/china_update2010/pdf/ch14.pdf

1.2 China's environmental transformation

Environmental protection in China has undoubtedly improved, in terms of institutional, policy and capacity development in the past three decades. For instance:[5]

- Since the Environmental Protection Law (EPL) came into effect in 1989, more than 40 regulations, approximately 500 standards and more than 600 other legal documents addressing pollution control, natural resource conservation and product stewardship have been issued. In other words, a comprehensive legal framework has been put in place.

- In term of the institutional framework for compliance assurance, underneath the Ministry of Environment Protection (MEP), there are more than 3000 Environmental Protection Bureaus (EPBs) at sub-national levels that are responsible for enforcement and compliance. However, it is widely acknowledged that, in general, financial and human resources as well as technical capacities of local EPBs are insufficient. In addition, while EPBs receive guidance from the MEP, institutionally and financially they are subordinate to provincial and local governments.

- "Environmental impact assessment", "Three synchronisations (三同时)" and Discharge Permit System (DPS) (which limits both the quantity and concentration of pollutants in a facility's discharge and air emissions since 2003) are the key regulatory instruments to ensure compliance. According to estimates by the MEP, about 557 000 facilities were regulated by China's environmental authorities, around 11200 of which were subject to environment permits. Accordingly, a comprehensive system of pollution charges was established, covering 65 water pollutants and 44 air pollutants as specified by the national discharge standards.

In terms of compliance monitoring and assessment, historically (e.g. Environmental Plans of the 9th and 10th FYP presented to the State Council) the reporting only focused on "input" indictors, while the output/outcome measures – the environmental impact and quality – were generally missing. With a greater public awareness of environmental problems and under the pressure to increase enforcement effectiveness, environmental factors/indicators have been included in the "performance assessment" of the local governments and officials e.g. in the form of **"Environmental Protection Contracts"** that are used to determine career promotion and/or bonuses.

Significant progress has been made under the 11th FYP when China set out to pursue a "resource saving and environmental friendly society". For example, binding targets for energy saving and emission reduction were included in the FYP for the first time. While the 20% energy intensity reduction target was not met (the actual outcome is 19.1%), SO2 emission reduction actually overshot the original 10% target to reach 14,29%.

[5] See e.g. "Ensuring Environmental Compliance – Trend and Good Practice" OECD, 2009.

Table 2. Energy-saving and emission reduction in the 11th FYP period (Index, 2005 =100)

	Energy consumption per unit GDP	SO_2 emission	COD emission
2006	97,26	101,55	101,55
2007	92,36	96,81	97,71
2008	87,56	91,05	93,39
2009	84,32	86,86	90,34
2010	80,94	85,71	87,55

Source: China's emergence as a market economy : achivenment and challenges, OECD, 2011 http://www.oecd.org/dataoecd/27/17/47408845.pdf

Despite progress made in the past decade, in particular in the 11th FYP, the overall environmental situation was summarised in the Macro Strategic Study on China's Environment as: "***partial improvement*** (局部有所改善) ***although overall degradation is still continuing*** (总体尚未遏制); the ***situation remains grave*** (形势依然严峻) and ***pressure continues to increase*** (压力继续加大)".

Box 1. Extracts from China's first pollution census (for 2007)

- Sulphur dioxide emissions: 23.2 million tonnes (91.3% from industry)
- Phosphorus emissions: 423,200 tonnes (67% i.e 284,700 from agriculture)
- Nitrogen oxide emissions: 47,3 million tonnes (30% from vehicles and 57%, i.e. 27,0 million from agriculture)
- Chemical oxygen demand (COD) discharges: 30.3 million tonnes (44% from agriculture, i.e. 13,2 million tonnes)
- Soot: 11.7 million tonnes.
- Solid waste: 3.8 billion tonnes (of which 45.7m tonnes is hazardous)
- Heavy metal discharges: 900 tonnes
- Livestock faeces: 243 million tonnes.
- Livestock urine: 163 million tonnes
- Plastic film on crop fields: 121,000 tonnes (80.3% recycled)

Source: http://www.guardian.co.uk/environment/2010/feb/09/china-farms-pollution

1.3 Green economy is an inevitable strategic choice for China's economic development

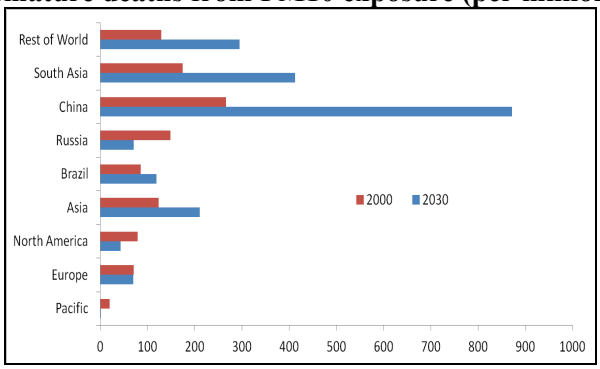
The rapid **industrialisation, urbanisation**, and **modernisation of the agriculture sector** have increased both **the scale and** the **complexity** of the challenges faced by China. At the same time, the growth model characterised by *high resource utilisation, high energy intensity, high emission, low recycling and low efficiency* has created serious resource bottlenecks and resulted in comprehensive environmental and ecological impacts.

In 2010, China's energy consumption was about 3.2 billion tons of standard coal equivalent (tce), which was an increase of 5.9% from 2009.[6] At the same time, the level of energy consumption per capita in China, driven by the effect of increased living standard and urbanisation, has also increased quickly in recent years from 0.87 tons of standard oil equivalent (toe) in 2000 to an estimated 1.60 toe in 2009.[7] According to the International Energy Agency (IEA, 2010), China will add 500 GW of new coal-fired electricity generation capacity between now and 2020. To meet the surge in energy demand, China has become a large net importer of both coal and crude oil, which raises serious concerns for China's energy security. For instance, China's thermal coal net imports amounted to around 100 million tonnes in 2010, making China one of the largest coal net importers. The speed, at which China's coal import has reached an "alarming level", with imports accounting for 52% of the total consumption, adds to the urgency of the situation. According to a report by the Chinese Academy of Sciences (CAS, 2009)[8], 64.5% of China's oil consumption is likely to be met by imports in 2020.

The need for strengthened measures to protect the natural environment – air, water and soil – is also acute and comprehensive, such as:[9]

- High emissions of sulphur dioxide (SO_2) and nitrogen oxide (NOx);
- Ambient air quality in many Chinese cities is bad and has significant negative health impact.
- China's rivers and freshwater lakes are seriously polluted and the depletion of groundwater is also a growing concern;
- Land loss caused by industrial expansion and desertification as well as the loss of farmland productivity caused by the pollution of heavy metals, pesticides and fertiliser threaten both food security and biodiversity;
- Frequent occurrence of environmental accidents and mass protests threaten both environmental and social security.

Figure 1. Premature deaths from PM10 exposure (per million inhabitants)



Source: "Towards Green Growth", OECD, 2011.

[6] Source: National Bureau of Statistics of China (Beijing). 28 February 2011. *Statistical Communiqué of the People's Republic of China on the 2010 National Economic and Social Development* (In Chinese). http://www.stats.gov.cn/tjgb/ndtjgb/qgndtjgb/t20110228_402705692.htm

[7] For more details, see International Energy Agency (IEA, Paris), November 2010.*World Energy Outlook 2010*.

[8] For more details, see CAS 2009. *China sustainable development strategy report 2009-China's approach towards a low carbon future,* Beijing, May 2009.

[9] See Vennemo et al., *Environmental Pollution in China: Status and Trends.* Review of Environmental Economics and Policy, June, 2009.

It is becoming increasingly evident that China has paid a high price for the economic growth. According to the most recent estimates by the Chinese Academy for Environmental Planning (2010), China's economic growth was inflicting more than RMB 1.3 trillion worth of damages on the environment (equivalent to 3.9% of China's GDP in 2008), in the forms of pollution spills, deteriorating soil, and vanishing wetlands. The costs of pollution spills and other environmental damage have risen by more than 74% in the five years running up to 2008; the estimated costs could be even higher if other forms of environmental degradation, such as loss of biodiversity, desertification and soil degradation through over-intensive farming, were also taken into account.[10]

Furthermore, as a consequence of the rapid economic development, large and fundamental social changes have also been taking place. These include urbanisation, migration and increased income inequality, which can be observed both across different regions, within urban areas as well as in the gender gaps. Parallel with the economic concerns, the rationale for the Chinese government to address environmental issues is these social changes in the Chinese society, which have a disproportionately adverse impact on the most vulnerable groups.

A political awareness and consensus has thus emerged that China can no longer afford a continuous "black" economic growth in the face of these serious resource bottlenecks. Environmental issues and social concerns are no longer merely the negative "side-effects" of China's economic growth. China now finds itself in a loop, in which resource bottlenecks, environmental degradation and social discrepancy are causing serious economic problems and preventing a continuous and sustainable economic growth. A green transformation of the Chinese economy is therefore an inevitable strategic choice that aims to curb resource utilisation and ecological degradation, and at the same time improve economic efficiency as well as social inclusion and stability.

1.4 China at a crossroad: an entwined process of economic & environmental transformation

During the 12th FYP period and in the medium term, **structural and systemic solutions** and **institutional improvement** will be crucial for China's future economic stability, sustainability and competitiveness. The following four aspects show how the economic and environmental transformations are linked in a mutually supportive and reinforcing way. However, there are also both strengths and weaknesses in this entwined process.

- **The institutional effect**: The most important observation from the growth analysis of the Chinese economy is that economic efficiency gains are typically related to **better functioning market economy dynamics,** in particular the growth of the private sector, the urbanisation process as well as market-oriented reforms in product markets.[11] In the field of environmental

[10] See e.g. The Guardian (London). 28 December 2010. *China counts £130bn cost of economic growth.* http://www.guardian.co.uk/world/2010/dec/28/china-130-bn-economic-growth

[11] See F. Gang, *China towards 2020: Growth performance and sustainability*, National Economic Research Institute (NERI) 2007 and OECD 2010.

protection, **institutional, policy and capacity development** have also undoubtedly improved in the past three decades. However, direct government intervention in the market, particularly through subsidies and other forms of price distortions in resources-related inputs market, has led to inefficient resource utilisation and an irrational industrial structure. Furthermore, while there is no shortage of standards and regulations, there is an urgent need to improve the **quality** (e.g. a science-based approach to environmental impact and outcome), the **viability** (e.g. ability and potential for compliance by enterprises at different development stages) and the **linkage with technology and innovation** (i.e. the availability of best technological solutions and the potential for stimulating more efficient solutions) of environmental enforcement. Finally, on top of the various administrative and regulatory measures on polluters and regulators, the **intrinsic incentive structure** for both compliance and monitoring needs to be adjusted and improved.

- **The scale versus efficiency effect**: After three decades of economic growth with an annual GDP growth above 9 %, the annual GDP growth target in the 12th FYP period has been set at 7%, which is lower than previous FYPs. According to various estimates and forecasts, China's actual GDP growth rates in the coming decade will probably be again higher than the official targets. However, a slower growth rate (compared to the historical trajectory) will likely be a permanent trend for China's future economic development. This anticipated lower GDP growth in the short and medium term can be considered a direct measure to deal with resource, environmental and ecological constraints, which should have direct effects on energy saving and emissions reduction. Nevertheless, the challenge in terms of improvement of resource efficiency and emission reduction in a slower growth pace is still enormous. For instance, according to the estimates made by the Chinese Academy of Sciences (CAS, 2009), if the environmental quality is to be maintained at a level similar to that in 2000, resource efficiency would need to increase by a factor of 4-5 and the environmental footprint per unit GDP to decrease by 75% in 2020, when the GDP target for 2020 is expected to quadruple compared to the level of 2000.

- **The structural effect**: The structural transformation of the Chinese economy can be observed from two different aspects: 1) Sectoral upgrading with a focus on both intra-sectoral modernisation and "decarbonisation" in the industrial sector, and the expansion and modernisation of the service sector. 2) The shift of the main driver of economic growth from an investment- and export-driven growth towards a more domestic consumption-driven growth. Both types of structural transformation will have the potential to reduce the environmental impact and enhance the efficiency of resource utilisation and allocation, while at the same time address domestic and international economic imbalances. While consumption-driven growth is considered the most important structural change, the question remains whether the efficiency effect will be sufficiently strong to balance out/offset the increase in demand for resources as a result of the income and the scale effects. Therefore, a strengthened demand-side management will be needed to accompany a "cap" on resource use.

- **The technology effect**: Efficiency-driven instead of input-driven economic development requires investments in physical and human resources for technological and innovation capacity building. It will not only help to create solutions to prevent and manage environmental consequences, but also speed up and scale up the innovation and industrialisation processes. In particular, in many low-carbon green innovation fields, the technology and innovation gaps between China and the advanced industrialised economies are relatively narrow, as both are currently at the starting point of the green race. The downside, however, is the substantial uncertainties related to both technological choices (in terms of the possibilities of technological breakthroughs, production and service models) and the feasibility of the scaling-up and commercialisation of new technologies in the Chinese market. Hence, a "green rush", without taking into account the technological and market risks and environmental impact seriously, will not contribute to the development of the infrastructure and innovation environment, but waste financial and land resources.

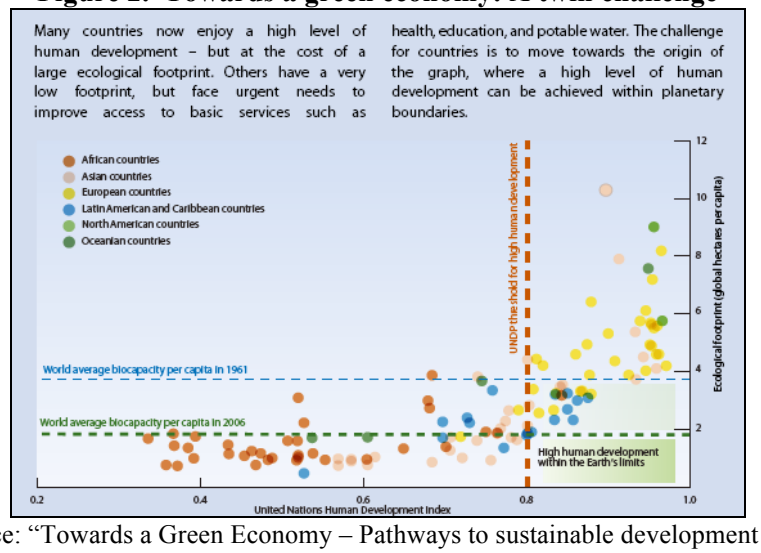
2. GREEN ECONOMY – CONCEPTS AND KEY PRINCIPLES

2.1 UNEP - Green development to tackle a twin challenge

Most economic development and growth strategies in the past decades have encouraged rapid accumulation of physical and financial capital at the costs of the environment and the ecosystem. The natural environment and its resources are particularly important to the world's poor and a secured future for future generations. With the long-term objective of reversing capital misallocation and meeting the twin challenge of human development needs and ecological security, the UNEP defines a green economy as:

"One that results in improved human well-being and social equality, while significantly reducing environmental risks and ecological scarcities. It is a low carbon, resource efficient and socially inclusive economy".

Figure 2. Towards a green economy: A twin challenge



Source: "Towards a Green Economy – Pathways to sustainable development and poverty eradication: A synthesis for policy makers", UNEP, 2011.

2.2 OECD - Green growth to create new economic opportunity

While recognising that "business as usual" is not an option, a new definition of 'progress' and new ways of producing and consuming are needed. In the face of both intensified international competition and greater needs for global joint efforts, green growth is defined in an OECD policy context as:

"… fostering economic growth and development, while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. To do this, it must catalyse investment and innovation which will underpin sustainable growth and give rise to new economic opportunities".

Box 2. Sources of Green Growth

Productivity: Incentives for greater efficiency in the use of resources and natural assets.

Innovation: Spurred by policies and framework conditions that break the "path-dependency" and allow for new ways of addressing resource bottlenecks and environmental problems.

New market: New and greater demand for green technologies, goods and services, and potential for new job opportunities.

Confidence: Boosting investors' confidence through greater predictability and stability around the ways governments deal with major environmental issues.

Stability: More balanced macroeconomic conditions, reduced resource price volatility and supporting fiscal consolidation through, for example, reviewing the composition and efficiency of public spending and increasing revenue through the pricing of pollution.

Source: Towards Green Growth, OECD, 2011.

2.3 China - Green transformation of economic growth mode

In China, the essence of a green economy is a balanced relationship between environment protection and economic development, through which a transformation of traditional economic growth model, improvement of environmental and ecological conditions, and sustainable economic competitiveness can be achieved simultaneously. Drawing on the latest work by the UNEP and the OECD as well as taking into account China-specific characteristics, a green economy is defined by this Task Force as[12]:

An economic development model that regards environmental protection and sustainable resource utilisation as essential conditions for sustainable growth. This new model gives priority to the health and well-being of citizens, minimizes harm of human activities to the environment, adequately recognises and values both natural

[12] For a detailed overview of green economy concept, see UNEP March 2010. *Towards a Green Economy – Pathways to sustainable development and poverty eradication*, and OECD May 2011. *Towards Green Growth*.

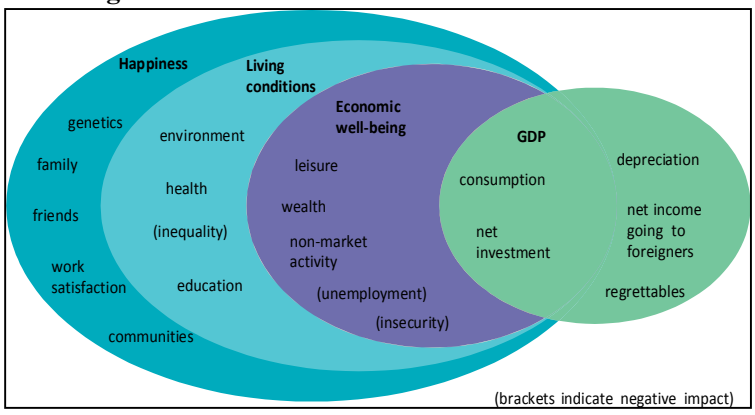
and human ecosystems for their ability to supply services. It seeks to seize new green growth opportunities, through a combination of continuous innovation and efficient governance.

A green economy covers all stages of economic activities (e.g. material extraction, production, distribution, utilisation and end-of-life management) and needs to be an integrated and coordinated development at the national, regional, sectoral and enterprise levels.

It is important to note the underlying notions of **people-centred** green development as well as an enlarged perception of **national wealth**. The total national wealth, which is the ultimate yardstick of a green development, embraces not only the wealth of the current but also future generations. Its emphasis is not only attached to physical wealth, but also to human, institutional and natural resources.[13] In a Chinese context, this broadened conceptualization of national wealth is of great importance as China moves from a low- to middle-income economy, and when millions of Chinese consumers start to pursue a more affluent and consumption-driven lifestyle. A green mind-set should value the richness of invisible assets, such as green values that emphasise a harmonious relationship between nature and the society, as well as a sustainable and healthy lifestyle that goes beyond the narrow focus of material wealth.

To make the first moves towards the "beyond-GDP" mentality, some leading Chinese scholars have advocated a broadened scope of economic development goals, which emphasises economic well-being, living conditions and happiness as the cornerstones of a harmonious society (See Figure 3 below).[14]

Figure 3. What GDP does and does not measure



Source: "Measure of well-being", Deutsche Bank Research 2006.

The transformational and holistic view of national wealth and social values calls for institutional and policy innovations. The following **key principles** will guide China's green economic development, which espouse a progressive view on the relationship between the economy and the environment, and a refined understanding of economic and social progress within the China-specific context. More specifically:

[13] For more detailed discussions, see K Hamilton et al., *Where is the wealth of nations? Measuring capital for the 21st century*. World Bank, 2006.
[14] See e.g. China Dialogue (Beijing), 24 February 2011. *China must measure happiness.* http://www.chinadialogue.net/article/show/single/en/4130--China-must-measure-happiness-

- The essence of a green economy is **a balanced and mutually supportive and reinforcing relationship** between economic development and environment, rather than one of trade-offs and conflicting interests;

- **The speed, efficiency, quality and equity of economic development** are given more equal priorities to reflect a more sustainable and harmonious relationship within the human society and between the nature and the human society for the present and future generations.

- Given the uneven stages of development across the Chinese economy, China has to simultaneously deal with pressures faced by developing and industrialised economies. Green economy for China is not only about catching-up, cleaning-up and **avoiding "lock-in"**, but also about **seeking its own green development path and taking advantage of the unique opportunity of leapfrogging and green growth**.

- Given the size of China's population and continuously increasing income level, **demand-side management and the green transformation of consumption and distribution** will also become more important, at the same time as China seeks a new pathway of green and low-carbon industrialisation and production. Excessive lifestyle in Western society and over-consumption should not, and cannot, be repeated in China's future development in the face of environmental and ecological constraints.

- Given the sheer size of the Chinese economy, there is no **"one-size fits all"** green economy model for China. It requires a **differentiated, coordinated and regionalised approach,** taking into account region-specific constraints and opportunities.

2.4 Circular economy, Low-Carbon economy and Green economy - A conceptual comparison

"**Circular economy**" and "**Low-Carbon economy**" are two eminent policy initiatives that have been important for China's sustainable and green development during the 11th FYP period (2006-2010), and have laid important groundwork for China's transformation towards a green economy. For instance, the development of "circular economy" in China has introduced sustainable practices to both the agricultural and industrial sectors in terms of sustainable resource use and material management. "Low-carbon economy" is key to China's battle against climate change as it addresses China's most challenging obstacle to a low carbon future, i.e. coal-dominated energy structure.

Ecological econmy, differs from other mainsteam economic thinking, by its treatment of the economy as a subsystem of the ecosystem and its emphasis on preserving natural capital. Issues of intergenerational equity, irreversibility of environmental change, uncertainty of long-term outcomes, and "strong" sustainable development are guiding principles of an ecological ecoomny.

While fully recognising the linkages and synergies between these different concepts, the key question is what does a green economy mean to China – is it just a 'recycled concept' or will it bring about new mind-sets and real changes?

Despite the progresses in promoting energy saving and emissions reduction in both the agricultural and industrial sectors, neither the circular economy nor low-carbon economy *alone* can address the depth and the extensiveness of the structural transformation that China urgently needs. While circular economy suffers from its limitation of ("linear thinking" of) resource utilisation (reduce, reuse and recycling), the sole focus on "carbon emissions reduction" in the low carbon economy has been considered too narrow in China's economic, social and environmental contexts.

Instead, there is an emerging consensus that there is a need for a consolidated basis and an integrated approach to generate comprehensive and long-term strategies and actions for China's future economic and environment ambitions. In this sense, "green economy" is seen as the "integrator" and "synchroniser" of new economic models and policy initiatives to address multiple challenges, including climate change, sustainable resource use, biodiversity and ecosystem. In other words, a green economy should be seen as an "inclusive development" empowered by not only technical progress but also changes in economic and social values. **The speed, quality and equity of economic development** are given more equal priorities to reflect a more sustainable and harmonious relationship between the nature and the human society for the present and future generations.

Table 3 Comparison between green economy with related concepts

	Basic concept	**Main characteristics**	**Specifications**
Green Eco.	Balance b/w economic development and environment; Pro-active and people-centred scientific and sustainable development	Stronger incentives to economic development; Improved quality of economic development Stronger emphasis on inclusiveness and equality	Green growth/development strategy Green industries Green innovation (both institutional and technological)

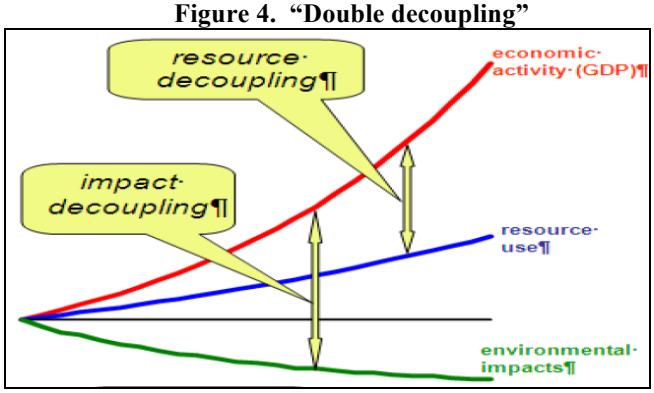
Circular Eco.	Reduce, Recycling, Reuse in the process of production, distribution/transportation and consumption	Closed loop of "resource utilisation-production-renewable resource".	At micro-level: Cleaner production, reuse and recycle of non-hazardous wastes as well as safe disposal and pre-treatment of hazardous wastes. At regional/cluster level: Production chain and integrated resource/waste management in the society. At macro-level: Market-based mechanisms to achieve efficient resource allocation and utilisation as well as waste management.
Low-carbon Eco.	Transformation model for achieving high energy-efficiency, low energy consumption and low greenhouse gas emissions	High productivity Low intensity of greenhouse gas emission Decoupling b/w economic growth and increase in energy consumption	Low-carbon industries Low-carbon products Low-carbon technologies Low-carbon energies
Ecological Eco.	Economic development model that secures economic growth and environmental and ecological sustainability within the limit of ecological bearing capacity.		Eco-industry Eco-Rehabilitation Eco-protection

Furthermore, the green economy is not simply about "adding-up" all ongoing initiatives that try to solve an aggregate of mutually isolated environmental problems. Instead, by taking an **integrated and holistic approach**, inclusive and innovative solutions as well as cost-effectiveness can be achieved. For instance:

- The green economy implies conciliation, instead of conflicts, between higher and greener standards of production processes and products and economic performance – it is about a transformation from passive and end-of-pipe pollution control to active pursuance of eco-efficiency, eco-effectiveness and eco-competitiveness along the product chain/production stages, starting from the sources.

- The transformation towards a green economy also implies a departure from the "command-and-control approach focusing on single pollutant, single medium, single pathway and technology-driven solutions" towards an integrated approach with a focus on "integrating mobile and stationary sources; coordinating urban and rural areas as well as co-managing conventional and GHG emissions" (Dudek D., 2010). The integrated approach is the key to address **cost-effective co-benefits** (e.g. environmental, climate and health co-benefits; water, energy and climate co-benefits) and to achieve an **outcome-focused "double decoupling"** – decoupling of economic activities from resource utilisation and from actual negative environmental impact.

Figure 4. "Double decoupling"



Source: Green economy and economic motivation, Reng Yong, 2010[15]

3. STRUCTURAL TRANSFORMATIONS AND GREEN INITIATIVES – INTERNATIONAL EXPERIENCE

3.1 Structural transformation – Policy insights in OECD countries

Since the World War II, the major industrialised and advanced economies have experienced a continuous and gradual process of structural changes. This was driven by a complex combination of internal and external factors that affect their economic structure, international competitiveness as well as the development of their human resources/skill and social values.

3.3.1 Fundamental lessons learned

The driving forces behind these structural changes include a combination of the following: ***resource constraints*** (e.g. oil crisis and raw material shortage), ***technology revolution*** (e.g. information and communication technology (ICT revolution), and last but not least, ***globalisation*** in terms of trade, investment and to an increasing extent, mobility of human resources.

[15] For more details, see http://www.cciced.net/encciced/events/roundtm/roundmeeting2010/pptdownload/201004/P020100406553485256944.pdf

Alongside with these structural changes, there is also a gradual process of re-thinking and re-defining of the ***relationship between economic growth on the one hand, and environment and ecosystem on the other, not only for the current but also future generations***, which has created the necessary and fundamental changes in mindset for a more sustainable and greener growth and development. More recently, energy security, climate change and loss of biodiversity have further strengthened the sense of urgency as well as the needs for global joint efforts to promote a green economy.

3.3.2 Country/region-specific experience

The trajectories of structural transformation and modernisation, particularly reflected in the economic and industrial structure, vary from country to country. Some examples are illustrated below, highlighting the most prevailing driving forces for the structural changes:

- Technology-driven, combined with knowledge- and service-driven productivity enhancement, e.g. USA;
- From technology- and trade-driven economic growth to enhanced knowledge- and innovation-based competitiveness in trade and investment, e.g. Japan and advanced EU member states;
- From resource-intensive to both resource- and innovation- and knowledge-intensive competitiveness, e.g. Nordic countries;
- From labour- and capital-intensive economic growth to technology- and knowledge-intensive economic growth, e.g. four dragon economies in Asia, including South Korea;
- Transition economies moving away from resource- and labour-intensive industrial and trade structures due to intensified industrialisation and an ICT-dominated global economy, e.g. less developed economies in Asia and Latin America.

3.3.3 The role of technology and innovation –a typical case of ICT revolution

The role of technology and innovation has been considered the key driver of structural transformation and modernisation. The most representative example in the modern history is the ICT revolution. The scope and the speed that ICT has changed the way of production and consumption throughout the world, and in turn led to economic growth through new industries and new jobs have created both fascination and inspiration.

The ICT revolution has thus become both a source of inspiration and a "benchmark" for the ongoing development of "green technology" and "green innovation".

Box 3. Fostering green innovation – the experience from ICT revolution

- One major factor in the strong growth resulting from ICT was (and remains) the **rapid decline in the real prices** of information and communication technologies. Green technologies have not yet experienced such a massive price decline and their future impact will rely on the extent to which prices can be brought down.

- Much of the impact and job creation resulting from new technologies did **not come from technology production or manufacturing, but rather from its applications throughout the economy, notably in the service sectors.** Economy-wide diffusion of green technologies is hence vital to growth.

- The impacts of ICT were heavily dependent on **complementary changes in work practices, skills and organisations.**

- The experience with ICT also suggests that the ultimate applications and uses of technologies are virtually **impossible to predict**, as are the areas of growth and decline – this is generally true about green innovation.

Source; Towards Green Growth, OECD, 2011

3.3.4 Policy insights from OECD countries

There is currently no ready-made "policy package" and/or governance guideline to achieve a green economy. However, some general and common lessons from previous major structural reforms and policy processes that have contributed to change (and those which failed to do so) are both relevant and important for the current and future policy-making to promote the green economy (OECD, 2011):

Policy insight 1: Transparency as well as effective communication to explain the benefits of reform and structural adjustments are key to mobilising public support.

For instance, in cases such as tax increase in fossil fuels and congestion charges in the transport sector, revenue neutrality may appear to be a requirement for getting public and political support. Transparency and accountability in revenue use is particularly important to gain public support and acceptance.

Policy insight 2: Relevance and responsiveness between policy orientation and corporate behaviour are necessary conditions for structural changes.

Even among OECD countries, there is no "one-size-fits-all" prescription for implementing strategies for green growth. The strategy for delivering and the trajectory towards a green transformation will vary from country to country, depending on national circumstances and country-specific economic and environmental policy settings. However, one constraint/challenge that is likely to be common to all countries is **regulatory certainty and market signal clarity.**

From a business viewpoint, the following government support is of particular importance for involving the business sector in the green transformation:

- Clear and long-term market signals, notably price signals to both producers and consumers in energy- and resource-related fields, such as energy efficiency;
- Financial market that addresses: 1) risk, 2) rate of return and 3) size of market;
- Public-private partnership, especially for technology development and diffusion.

Policy insight 3: Institutional capacity and governance structure for cross-government and cross-societal coordination are key success factors.

In OECD countries, the primary focus in green growth will also need to be on establishing **governance structures at the highest levels** of government and on **ensuring co-ordination between different areas and levels of government.** The ultimate goal will be to **integrate green growth into policy processes, rather than to create stand-alone policy documents or agencies.**

In designing and implementing green growth strategies, governments need to find satisfactory compromises not only among conflicting objectives of different strands of society, but also within the government itself. Green growth strategies cannot be implemented **through a single type of policy. Instead, getting the right policy mix requires a rare degree of coordination** among ministries that may no be used to working together.

Policy insight 4: Being fiscally neutral is NOT enough to address distributional concerns associated with structural adjustment and changes.

Major policy reforms have frequently paid insufficient attention to **distributional concerns**. From previous experiences in OECD countries, claiming that policy changes will be "fiscal neutral", as in many climate-related initiatives, is insufficient. Managing the distributional consequences is crucial to the success of reforms in terms of generating support and ensuring fair and positive outcomes. To achieve this, **targeted compensatory measures** will need to be introduced (e.g. in forms of targeted/ direct cash transfer and/or (green) tax shifts).

Policy insight 5: The issue of economic and sectoral 'competitiveness', as well as the impacts on economic efficiency and environment, as a result of economic transformation need to be addressed using an evidence-based approach. This is to prevent unfounded "competitiveness concerns" thwarting the reform effort.
The competitiveness concerns are closely associated with the relative stringency of domestic policy and the potential negative impacts on domestic (energy-intensive) industries and firms whose competitiveness are undermined. These concerns have proven to be one of the most important obstacles to ambitious environment and climate policies in many OECD countries. However, the lessons from the OECD analysis show that:

- Adverse competitiveness impacts (or the so-called "carbon leakage") from climate change policies are generally **limited to a small number of sectors, representing a small share of economic activities in any national context.**

- In addition to their effectiveness in addressing competitiveness concerns, the measures to safeguard competitiveness of domestic energy-intensive industries also need to be scrutinised in terms of their impacts on **economic efficiency and incentives for GHG reduction as well as on developing countries. Furthermore, their significance on domestic political economy and the practicality of implementation also need to be taken into account.**

3.2 New green initiatives and their key elements

At both the inter-governmental and national level, a broad range of new green initiatives have been launched in the aftermath of the financial crisis in 2008-2009. Their objectives are to achieve sustainable economic recovery in the short run and to create new competitiveness and new jobs from a long-term strategic perspective.

The UNEP has launched the **Green Economy Initiative** and **Global Green New Deal**, where green investments have been identified as the key to economic recovery and creating green jobs while reducing environmental pressure. Supported by and combined with policy and institutional reforms, green investments will lay the foundation for a green economy of the 21st century. In 2009, out of the USD4.5 trillion fiscal stimulus packages announced by G20 countries in response to the financial and economic crisis, at least 15 per cent was allocated to what was broadly categorized by HSBC as the "green" sectors. In China, out of the USD586 billion stimulus package, USD200 billion was categorized as green stimulus.[16] More importantly, beyond the short-term responses to the financial and economic crisis, UNEP's Green Economy Initiative also encouraged the integration of green investments into the medium and long-term economic planning and development strategies. According to the UNEP's estimate, investing 1-2 percent of the global Gross Domestic Product per year from 2010 till 2050 in greening ten environmentally and socially significant sectors would be highly competitive vis-à-vis investing the same amount in a business-as-usual scenario in terms of outputs and jobs, on top of environmental gains.[17]

Box 4. Five Priority Sectors in the Global Green New Deal

- Clean energy and clean technologies including recycling
- Rural energy, including renewables and sustainable biomass
- Sustainable agriculture, including organic agriculture
- Ecosystem Infrastructure
- Reduced Emissions from Deforestation and Forest Degradation (REDD)

Source: "Towards a Green Economy – Pathways to sustainable development and poverty eradication: A synthesis for policy makers", UNEP, 2011.

At a general level, the **OECD green growth strategy** addresses the most fundamental policy elements in a green transformation, which includes:[18]

- The integration of the **natural asset base** into everyday market and policy decision making;
- **Environmentally-motivated and growth-oriented fiscal/tax reforms** to align economic and environmental policy objectives;

[16] See e.g. HSBC Global Research (London), 31 March 2009. *More Green Money on the Table.* http://www.endseurope.com/docs/90401c.pdf

[17] For more details, see UNEP March 2010. *Towards a Green Economy –Pathways to sustainable development and poverty eradication*.

[18] For more details, see OECD May 2011. *Towards Green Growth*.

- Both **technological and non-technological changes and innovations** are instrumental in driving green growth.

Box 5. Green Growth initiatives in OECD countries

- **Green Investment Bank (UK, 2010):** It will be launched in 2012 with an initial capital injection of GBP 3 billion of public money to provide funding for low-carbon projects.
- **Tomorrow's Agriculture (Denmark, 2009):** High-level environment, nature and climate protection with modern and competitive agriculture and food industries.
- **National Green Growth Plans 2009-2013 (Korea, 2009)**: A comprehensive policy framework for green growth and a designated spending of 2% of annual GDP on green growth programmes and projects.
- **Green Innovation (Japan):** to create JPY 50 trillion environment-related market and 1.4 million new environment-related jobs.
- **Green Growth Advisory Group (New Zealand):** Ministers of Finance, Economic Development and Environment jointly established a high-level private sector advisory group for green growth policy consultation.

Source: "Towards green growth- A summary for policy makers", OECD, 2011

In addition to the inter-governmental green initiative, the World Business Council for Sustainable Development (WBCSD) has launched the "**Vision 2050",** which is an overarching roadmap for green growth. It features a strong engagement with the business sector and is built on close private-public partnerships. The vision aims to more efficiently mobilise financial resources from the private sector and facilitate uptake and diffusion of green technologies, through which new and sustainable business opportunities as well as greater social values can be created.

Box 6. Vision 2050

In 2050, around 9 billion people ***live well*** and ***within the limits*** of the planet.

9 key elements of the vision:

- **Value and behaviour**
- **Human development**
- **Economy**
- **Agriculture**
- **Forest**
- **Energy and power**
- **Buildings**
- **Mobility**
- **Material**

Source: World Business Council for Sustainable Development (WBCSD), 2010.

From a business viewpoint, the above green policy initiatives will bring huge shifts in terms of regulation, market, consumer preference, the pricing of inputs and the measurement of profit and loss – of all which will impact business decision and business behaviour *(*Source: WBCSD, 2010).

Consequently, there are real philosophical differences or basic assumptions between conventional and new and green business, resulted from the green growth and development, such as:

- The "guiding truth" will be based on the **limits of the planet** and what it takes to live well **within the limits*;***
- New solutions will be found in the global and local market place with **true value of costs**.

In the context of the global green business agenda, Chinese companies are playing an increasingly active role. Some Chinese companies, in particular those in the traditional "black" and "brown" sectors, already embarked on the process of upgrading and transforming their business practices. Through further interaction and collaboration with the international business community, Chinese companies can share best practices and knowledge as well as create common platforms for the global low-carbon and green transformation.

Box 7. Chinese companies' participation in Cement Sustainability Initiative (CSI)

The Cement Sustainability Initiative (CSI) is a global effort by 23 major cement producers with operation in more than 100 countries, including 5 Chinese companies: China Resources Cement Holdings Limited (CRC), China National Buildings Material Group Corporation (CNBM), Sinoma, Tianrui group and Yatai Group. The companies' participating in the CSI have all signed the CSI Charter, with the following commitments for climate protection:

- Use the tools set out in the CO_2 protocol to define baseline emissions and make them public;
- Develop a climate change mitigation strategy and publish targets and progress;
- Report annually on CO_2 emissions in line with the protocol;
- Participate in the Getting the Numbers Right (GNR) global cement CO_2 and energy information database;
- Contribute agreed datasets to the GNR database.

CSI is an important international business platform for Chinese companies as it offers opportunities to learn from internationally and commonly applied methodologies and approaches as well as to bring China-specific experience into the debate. With the support from international groups participating in the CSI, joint workshops and training sessions are organized in China to develop the knowledge and know-how about sustainable production practices. For instance, CRC and Lafarge held training on health and safety - an issue becoming increasingly important for Chinese companies. Joint workshop on co-processing and alternative fuels in cement kilns was also organized and hosted by Holcim and Chinese cement companies.

Source: The Cement Sustainability Initiative (CSI),WBCSD, 2011

3.3 Some key observations from the current green growth/development

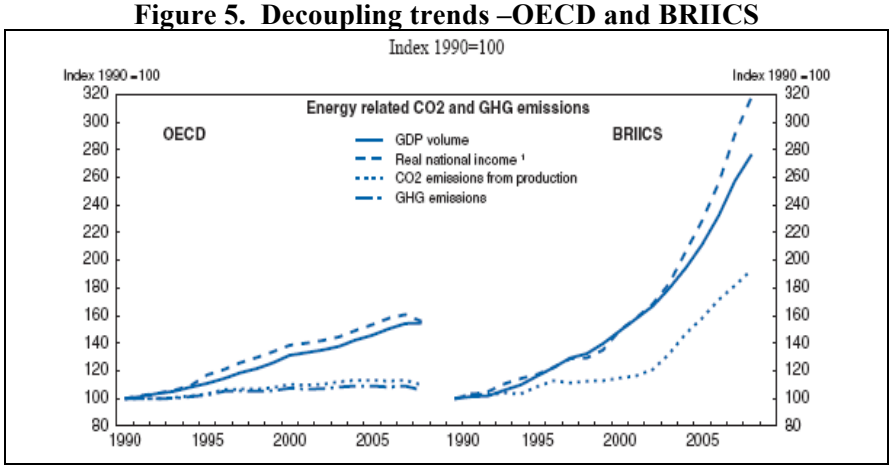
3.3.1 Absolute versus relative decoupling

One of the key observations from the previous and on-going green progress made in OECD countries is that, although absolute "decoupling" has indeed occurred in some OECD countries and in some areas, it is less prevalent than relative decoupling. The

underlying implication is therefore that rising environmental productivity is a **necessary,** but not a **sufficient,** condition for green growth in OECD countries. The rising productivity should be accompanied by absolute declines in environmental services.
Furthermore, the rise in environmental and resource productivities can be partly explained by the **displacement effect** (See Figure 5 below). The decrease in the amount of CO_2 emission per unit GDP in many OECD countries is at least partly as a result of the import of goods with relatively high carbon footprint from other countries, notably China.

In other words, the historical "decoupling" has been a combined outcome of **technological, structural and international trade/investment effects.** Accordingly, decoupling energy use and CO2 emission from GDP growth needs to be considered in an international context, rather than in the narrow context of individual countries (OECD, 2008).

Figure 5. Decoupling trends –OECD and BRIICS



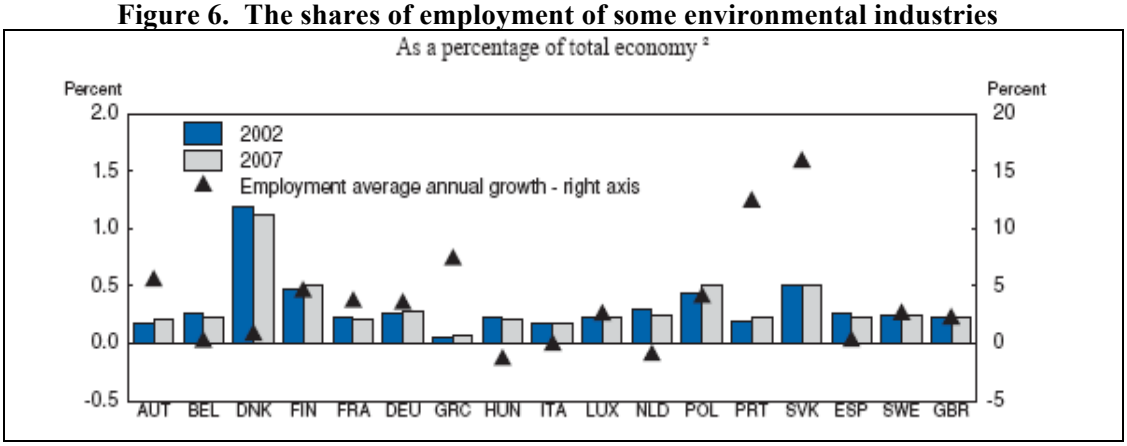
Source: "Towards Green Growth", OECD, 2011

3.3.2 "Green sectors" – potential and scope

"Green sectors" and "green jobs" are the key focus areas and top priorities in most OECD and emerging economies. As a share of GDP or employment, environmental-related goods and service industries are still comparatively small, i.e. around 1-2% of the total private sector in 2007 across OECD countries (See Figure 6 below). This, however, should be seen in the overall context:

- A significant and rapid growth potential in the green sectors is foreseen, in particular in the emerging economies;
- The size of the "green sectors" depends very much on how exactly "green industries" is defined.
- Much of the environmental and many of the growth effects are likely to be associated with **greening the economy** as a whole, independent of whether particular products are put to environmental use.

Figure 6. The shares of employment of some environmental industries



Source: "Towards Green Growth", OECD, 2011

3.4 Policy relevance and lessons for China

For China, green transformation is about learning from mistakes of the unsustainable development model as well as searching for a new development model that both internalises and creates economic, social and environmental benefits. Consequently, the important policy lessons for China from international experiences in structural transformation can be summarised as the follows:

- The role of the market in allocating resources is essential for the most efficient utilisation of resources; at the same time, the government also plays a crucial role in creating the favourable market conditions. Green transformation needs to be based on a "**dual driving force**" – neither the government nor the market force alone, can drive the green transformation;

- **Green industry transformation and upgrading is the key pillar of a green economy**. A green industry policy should be formulated in accordance to the macro-economic environment in order to promote the greening of industrial structure. In particular, economic policy instruments (e.g. financial support and tax incentives) should be fully utilised to promote (and accelerate) industrial structural adjustment;
- **Science, technology and innovation** are the most important driver for inter- and intra-sectoral green transformation and upgrading;

- The shift of **backward production capacities and industries to less developed or developing countries** through outward foreign direct investment and international trade has been an integral component of the structural transformation in advanced industrialised economies. It is imperative that China does not repeat the mistakes of industrialised countries where the 'greening' of economy relied largely on the outsourcing of 'brown' and polluting industries to less developed countries.

4. ENABLING CONDITIONS: CHINA-SPECIFIC CHALLENGES & OPPORTUNITIES

4.1 Basic conditions for green transformation and development

Drawing on both China's success and failure in the ongoing transformation process as well as international experiences, some basic conditions, i.e. the necessary policy and market conditions required for a successful transformation in the near future, are identified as follows:

1) Leadership and strategic planning by the government as the political foundation for a green transformation and leapfrogging:

- A **"beyond-GDP" mentality,** not only at the national but also the regional and local level policy-making and governance;
- Make **structural transformation and institutional innovations** new drivers for green development;
- **Mainstreaming** green development into **an integrated policy-making framework,** in the fields of macroeconomic, regional, industrial, environmental and innovation policies;
- Manage the **transitional and adjustment costs** of greening the economy, including employment and social consequences, with a particular focus on the most vulnerable groups and in the traditional "black" and "brown" sectors.

2) The right positioning of the government and the appropriate role played by the government in the green transformation:

- Avoid direct intervention in economic development and business activities; instead, focus should be on strengthening the **responsibility of the government in providing public services;**
- Avoid excessive intervention (in pricing, resource allocation and competition) that impedes green transformation; instead, priority should be given to **setting an appropriate regulatory framework, sending out clear price signals and establishing an effective incentive structure**;
- Avoid replacing the role of the business sector in investment and innovation; instead, focus should be given to **creating and supporting an enterprise-centred green transformation process**. **Private-public partnerships** should be established to promote technology innovation, development and diffusion – a concerted effort is needed when price signals and market forces alone are not enough.

3) A well-functioning market as a driver for innovation and sustainability:

- **Enterprises** are the main drivers and implementers in the **enterprise-centred green innovation system and transformation process.** In particular, the development of **innovation-based SMEs** should be emphasised and encouraged as a key driver for an enhanced innovation capacity and a new market dynamics in China's green economy;
- **"Right" pricing mechanisms for resources and environmental assets need to be established,** to reflect both the scarcity and the polluter pays principle.

Innovative market mechanisms, such as emission trading and eco-compensation schemes should be introduced, based on **well-defined environmental and natural resources-related property rights,** such as exploration rights, mining rights and various emission rights/permits;

- The development of **financial sector** to both raise the efficiency and quality of capital-input by leveraging green investment from the private sector and stimulating efficiency improvement through better financing models/mechanisms for green innovation and entrepreneurship;

- Combine **supply-side** with **demand-side management** to maximise the efficiency and benefits of green production and consumption. Consumers should be encouraged to shift towards and benefit from a greener lifestyle and consumption pattern.

4.2 Key challenges and barriers faced by China in the green transformation

Despite the progress made so far, China will inevitably face daunting challenges in the transformation towards a green economy. These challenges and barriers are associated with a complex mix of factors, such as the rapid economic growth, the structural characteristics, institutional and regulatory barriers as well as external pressure resulting from globalisation.

4.2.1 Institutional barriers and "green governance paradox"

The "dislocated" (错位) and "excessive"(越位) role of the government in the market, is still an important source of structural imbalance, market distortion and inefficiency, which will need to be adjusted and corrected. Typical examples are the capital market distortion that led to the persistent overinvestment problem and the rapid development of capital-intensive industries in China; and factor price distortion in the form of various energy price subsidies. As many leading energy policy analysts pointed out, energy price subsidies are inefficient use of public financial resources and also send out the wrong price signals. As a result, they not only act as disincentives to energy saving and efficiency efforts, but also make little sense in terms of adjusting income distribution.[19] On the other hand, the government's role in market supervision needs to be strengthened, particularly in relation to the control of natural resource exploration, pollution and emission and food safety, where current government supervision is inadequate or even completely absent.

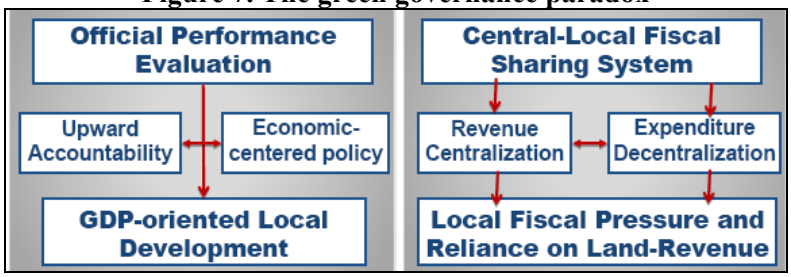
Policy lessons from the previous regional development programmes show that over-emphasis on economic growth needs to give way to a more balanced focus on socio-economic and sustainable development – this is particularly true if real progress towards a co-ordinated and balanced regional development is to be accelerated under the 12th FYP and beyond. Under "business-as-usual", investments in large-scale heavy industries and infrastructure projects by SOEs or multinationals are often undertaken at a significant cost to the environment, with a lower-than-expected positive impact on people's welfare and regional development.

[19] Source: Zhou Dadi "How can the energy price reform be carried out in China?", World Energy and Finance Net (WEFN),5 September, 2008. http://www.wefweb.com/news/200895/0809291137_0.shtml

More recently, the development of the emerging and strategic industries has also become a key priority at the regional level. Regional and local governments are devoting substantial resources to develop regional development plans and strategies as well as to establish strategic industrial parks. However, there are some underlying problems with the blind pursuit of "green development" at the regional level. It is not uncommon that many regional and local government officials have limited understanding of the nature of these strategic emerging industries and the physical environment and human resources required for the development of these industries. The development of some of the industrial parks involve large-scale, duplicate investments and many have become a front for speculative real estates investments, leading to huge financial and resource waste. If not managed properly, it can lead to a widespread "green wash" of future green transformation and production activities, which would counter the original intention of the 12th FYP.

To overcome the "GDP obsession" and to prevent a "green rush" especially at the regional level, the **"green governance paradox**" needs to be addressed (See figure below). According to some Chinese scholars, there are two dimensions, personnel and fiscal, in the central-local government relationship that have contributed to the green governance paradox – ambitious targets and tightened regulations at the national level have led to limited progress and policy outcomes at the regional and local level as a result of poor quality in implementation and enforcement.[20]

Figure 7. The green governance paradox



Source: Qi Ye, "Institutional building for low-carbon cities: balancing development and environment", 2008 AWI Climate Change Workshop, Beijing, 27-29 April, 2008.

The personnel dimension

The **officials accountability system**, which is the evaluation system for government officials' performance and career promotion, is an integral part of the incentive mechanism for driving regional development. Under this top-down system, concrete tasks and targets are issued by the central government to lower levels of government. Until now, the evaluation criterion have typically been based on how quickly local governments could expand their economy, hence tempting local government officials to pursue economic growth at all cost. This usually resulted in environmental disasters and severe health problems. In recent years, an environmental dimension has been added to the personnel evaluation in the form of "environmental protection contracts". However, so far local government officials have not been sufficiently motivated to ensure effective enforcement of environmental targets – economic growth remains the overriding concern of most government officials.

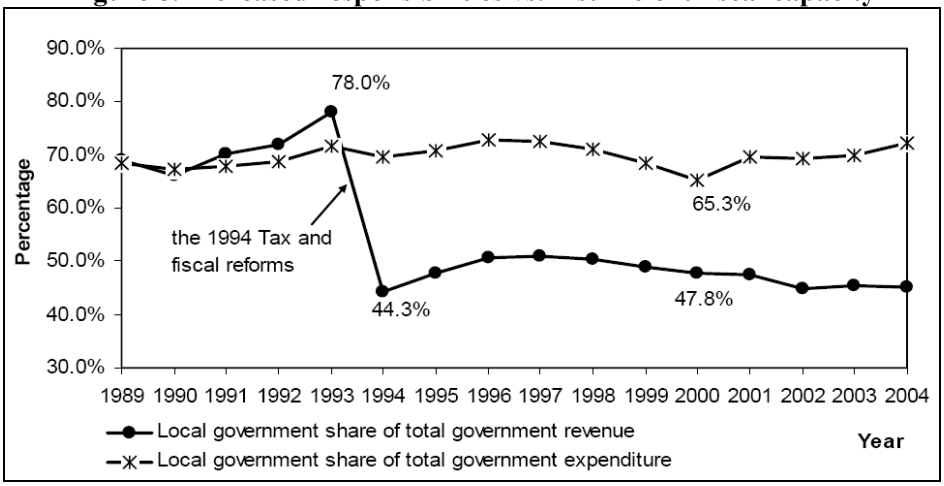
[20] For more detailed discussions, see ANUE E Press (eds.) China: *The next twenty years of reform and development.* Canberra, Australia, 2010, pp53-72. http://epress.anu.edu.au/china_20_citation.html

To overcome this problem, it is imperative to create a more balanced relationship between the central and local government in terms of the incentive structure; in particular, green development needs to be included in the core policy outcomes and resources need to be allocated accordingly. Furthermore, enhancing public participation in the performance evaluation system will strengthen its legitimacy and help to ensure that government programmes are meeting the social and human development needs. Some progress has been made towards this direction under the 12th FYP through a revised evaluation indictor system for different regions.

The fiscal dimension

In addition to the accountability system, current fiscal revenue sharing arrangement between the central and local government also creates strong incentives for regional governments to seek higher GDP growth. Since the adoption of the Tax Sharing System (TSS) in China in 1994, major tax revenues (e.g. VAT and income tax) were split between the central government and local government; for example, 75% and 60% of VAT and income tax revenues respectively go to the central government. This resulted in a huge increase in central government's revenue but an immediate and significant drop in local governments' shares of the total government revenue (See figure below). For instance, in 2008, the local governments' revenues accounted for only 46,7% of the total government revenue; however, local governments' expenditure accounted for 78,7% of the total government expenditure in China.

Figure 8. Increased responsibilities vs. insufficient fiscal capacity



Source: Qi Ye, "Institutional building for low-carbon cities: balancing development and environment", 2008 AWI Climate Change Workshop, Beijing, 27-29 April, 2008.

Consequently, it led to insufficient expenditure on social and public spending at the local level, including spending on energy-saving and environmental protection. On the other hand, it was also driving local governments to expand local production and investments in order to increase their revenue through a range of local taxes, such as development, contract, and land occupation taxes. This is partly the reason why a lot of the recently documented environmental disasters and land acquisition abuse cases involved businesses and investments directly affiliated to local government. Furthermore, given the tax revenue split between the central and local government, some national energy price reforms, e.g. electricity price increase for energy-intensive industries (introduced by the NDRC from 2006), have failed to take off – many local

governments simply did not have the incentive to collect the increased tariff as the additional revenues would go the central government.

As a result, an increase in tax autonomy as well as an enlargement of the tax base at the local level is potentially the solution to the "incentive and fiscal asymmetry" problem, in particular in less developed regions that have relied heavily on the transfer payments from the central government. Under the 12th FYP and in the medium term, the introduction of an environmental tax, as well as the reform of resource tax and eventually the reform of property tax, can potentially have significant and positive effects on the current "green governance paradox". For instance, environment tax can be designated as a local tax, which means that local government will keep 90% of the tax revenue (following the current distribution of environmental charges between the local and the central governments). .

To summarise, reforms in the accountability and fiscal revenue sharing systems are needed to resolve China's green governance paradox – a more effective incentive structure at the local level will improve implementation and enforcement of environmental and other social regulations.

4.2.2 Weakness in legislation, regulation as well as coordination and enforcement

To facilitate China's green transformation, an **integrated legislative framework** and **governance structure** should evolve to **enhance implementation and coordination** across government entities and between different levels of government, as well as between the government and the populace. For instance, large-scale technology development and diffusion and green investments in infrastructure and public services cannot possibly be driven and managed by stand-alone agencies. Instead, it requires a specific policy mix, a rare degree of coordination among ministries and an exceptional level of openness and creativity in private-public partnership. However, the following key weaknesses in legislative and regulatory policy tools need to be addressed to enhance enforcement and coordination.

- **Legislation and regulation:** 1) There are already a considerable number of laws and regulations related to the development of a green economy. However, they are currently relatively fragmented and an integrated legislative framework for the green economy is lacking; 2) Many of the laws and regulations lack operative values and can hardly provide support for promoting green economy in practice; 3) Due to the problems of local protectionism and various conflicts of interests, weak coordination and implementation will hamper China's green transformation.

- **The fiscal inputs for promoting green economy:** In addition to **the low level** of investment in environmental protection (especially in comparison to the magnitude of the problems), the **structure** of environmental investments needs to be improved. Investment in urban environment infrastructure facilities, despite being the main component of environmental investments, does not necessarily have a strong linkage with the improvement in the overall environmental standard in China. On the other hand, the increase in the investment in treatment of industrial pollution has been moderate. This is not compatible with the corresponding need for such investments in the industrial

sector and the need to accelerate the process of greening energy- and pollution-intensive industries. The government needs to increase its support not only through subsidies, but also stimulating industries to move away from the end-of-pipe approach towards the 'reduction at source' measures, which are more environmental friendly and cost-efficient.

- **Environmental tax system:** A profound but gradual "green tax reform" needs to be a key element in China's green transformation under the 12th FYP. Currently, China lacks a genuine "environmental tax base" that can help establish various market mechanisms for accelerating and deepening energy-saving and emissions reduction actions.
- **Finance mechanisms:** China has recently become a global leader in "green investments". This achievement, however, is largely driven by government support. This raises serious concerns about the sustainability of such development in the long run. There is a large amount of private capital available in the Chinese capital market; however, the challenge is how to channel private capital to green investments and green sectors. The key is to make green investments more attractive and profitable than the "conventional" investments, which impose large ecological footprints and environmental impacts.

4.2.3 Increasing influence comes with greater responsibility – international pressure

As China continues to be the engine for global economic recovery and future economic growth, both the expectations and scrutiny on China from the international community are also increasing. In other words, China's increasing influence comes with greater responsibility.

- **"Green protectionism" – a key challenge for China in its deepened integration in the globalised economy.** The transition towards a green economy requires that trade and investment are not only open, but also green and fair. How to balance between green trade and investment with "green protectionism" will be a common political and economic challenge for China and other main industrialised economies. At the same time, this should also be seen as a positive pressure on China to upgrade its technological and environmental standards and to move away from the "race to the bottom" trend. Winning the "green race" will bring China long-term economic and social benefits, and avoid the high price of environmental and ecological degradation.

- **China's trade and Foreign Direct Investment (FDI) structure** has led to an "environment deficit", as a result of energy- and resource-intensive processing based exports as well as FDI in heavily polluting and energy-intensive sectors.

- **International climate change policies and actions impose pressure on China.** China's high-level energy demand and heavy reliance on fossil fuels have made it the world's largest CO2 emitter. Therefore, energy-saving and emissions reduction are not only important for China's green transformation, but also for China's international image and long-term competitiveness.

Instead of having a defensive mind-set and regarding these issues as a threat to China's continued economic growth, embarking on a transition to a green and low-carbon economy will provide the opportunity for China to engage as a constructive and active partner in dealing with these globally shared concerns.

4.3 Favourable conditions for and new growth opportunities in China's green transformation

The most important favourable conditions and powerful drivers that can turn barriers into opportunities in China's green transformation are **strong political commitment, the considerable fiscal capacity to support green investments, the sheer market size** and China's emerging ambition as a "**green innovation hub**".

4.3.1 Political commitment – the core driving force for green transformation

A green strategic framework – the 12th FYP

"**Green development**" has become one of the most important strategic policy themes in the 12th FYP, which aims to accelerate the structural transformation of China's growth pattern to achieve an **inclusive, green and competitive economy.** In terms of **policy and market signals**, a total of 24 guiding (non-binding) and binding targets have been outlined in the 12th FYP. Key targets related to an inclusive, green and competitive economy are presented in Table 1.

Table 4. Selected targets in the 12th FYP (by 2015)

Target	Specification*	
Growth- and structure- related	• Annual average GDP growth of 7%. • Service sector value-added to reach 47% of GDP (up by 4% points). • Urbanisation rate to reach 51.5% (up by 4% points).	**Guiding**
Energy-, climate- and environment related	• Energy consumption per unit GDP reduced by 16%. Carbon emission per unit GDP reduced by 17%. • Non-fossil energy as a proportion of primary energy consumption to reach 11.4% (from the current 8.3%) • Water consumption per unit of value-added industrial output reduced by 30%. • SO_2 and COD emissions reduced by an additional 8% (these were reduced by 14.3% and 12.5% respectively during the 11th FYP). • NOx and ammonia nitrogen emissions reduced by 10%. • Heavy metal from industry will also be regulated although no specific target is given yet. • Forest coverage to reach 21.66% of the landmass and forest stock to be increased by 600 million m^3. • Arable land to be maintained at 1.8 billion acres.	**Binding**
Competitiveness related	• Percentage of R&D expenditure of GDP to reach 2.2% (from the current 1.8%).	**Guiding**
Inclusiveness related	• More than 45 million jobs to be created. • Urban registered unemployment to fall below 5% 2015.	**Guiding**

Source: The Outline of the 12th FYP for National Economic and Social Development 2011-2015 (in Chinese). State Council, March 2011. *Base year for the targets in the 12th FYP period is the end of the 11th FYP, i.e. by the end of 2010.

In terms of sector-specific targets in the 12th FYP, the details are presented in Table 2.

Table 5. Sectoral strategies to promote green development in the 12th FYP

Sector	Selected key priorities
Agriculture	• Develop a "modernised" agriculture where food security is of the highest priority. Structural adjustment and improvement to achieve high output, good quality, high efficiency, ecological friendly and safe products. • Increase the income and living standards of the agriculture population.
Industry	• Upgrade traditional manufacturing sectors in terms of technological and innovation capacity, energy efficiency and environmental performance as well as industrial structure and regional distribution, and the development of SMEs. • Foster and develop "emerging and strategic sectors", i.e. Energy saving and environment protection, next generation information and telecommunication technology (ICT), internet of things (物联网), Alternative energy, biotechnology, high-end and advanced equipment manufacturing, new materials and clean energy vehicles. These emerging and strategic sectors are expected to account for 8% of China's GDP by 2015.
Service	• Accelerate the development of manufacturing related service sectors, e.g. financial service, logistics and ICT-related high-tech services. • Accelerate the development of services in the commercial and tourism sectors. • Improve the policy framework for supporting service sector in the fields of energy and water pricing, taxation, and public procurement.

Source: The Outline of the 12th FYP for National Economic and Social Development 2011-2015 (in Chinese). State Council, March 2011.

Broadened and deepened actions for energy saving and emissions reduction

In the 11th FYP, binding energy-saving and emissions reduction targets were included in the national economic and social development strategies for the first time. In the 12th FYP, China faces more arduous tasks and daunting challenges, which at the same time also present strategic opportunities for transformation.

In relation to energy-saving and emissions reduction, the guideline advocates an integrated approach to achieve China's more ambitious environmental targets – **the government provides a guiding role; enterprises act as key implementers; market-mechanisms act as effective drivers and, strong support from the society/ the public through broad participation**. In the recently released "*Comprehensive Energy-Saving and Emissions Reduction Work Programme for the 12th FYP*" (State Council, 2011), a total of 50 policy measures were specified, covering 12 different policy fields.

Box 8. Eight key areas of energy-saving and emissions reduction in the 12th FYP

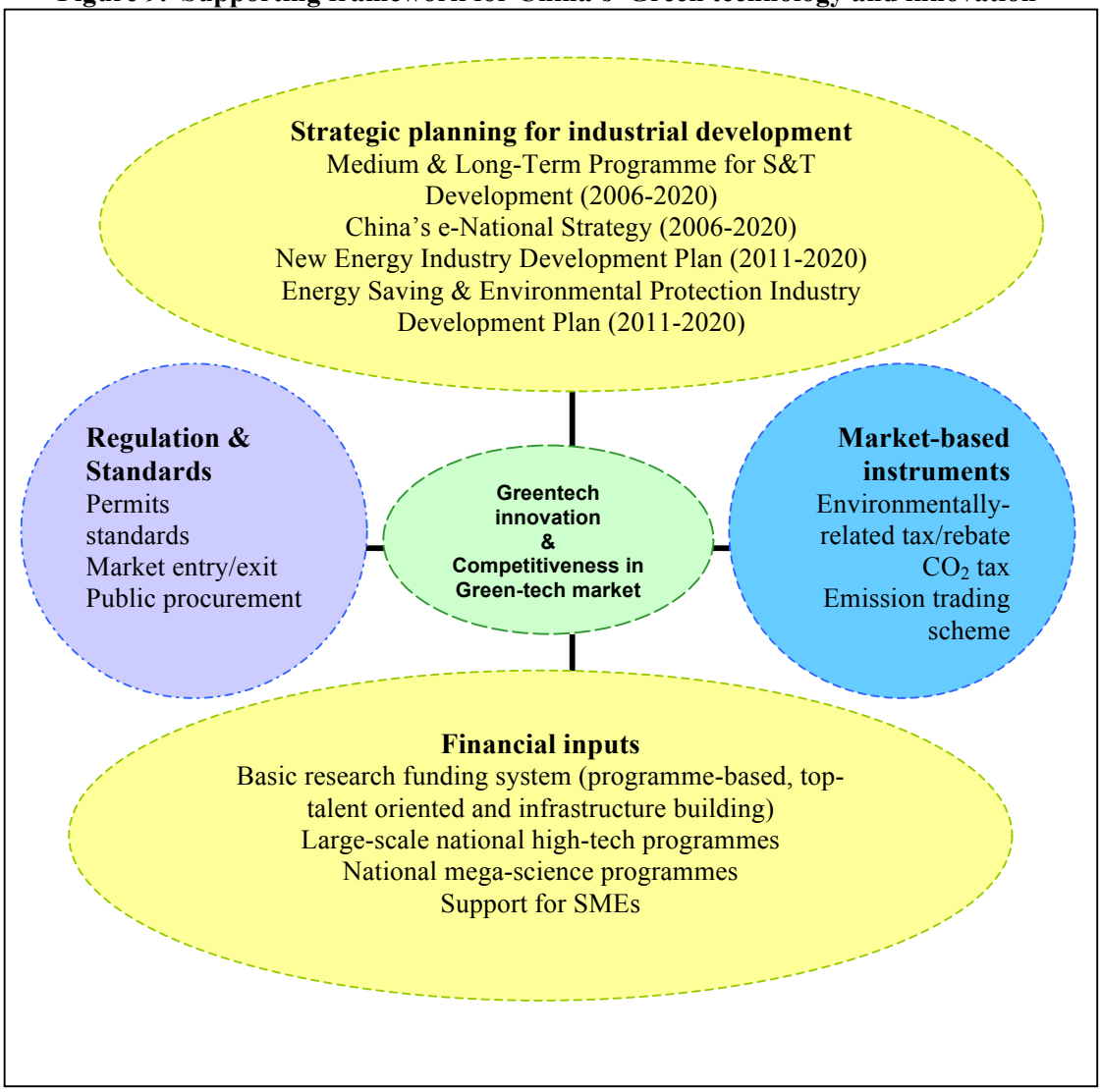
- **Control the total volume of energy consumption**. Energy-saving assessment in the approval of fixed assets investment projects should be used as a key instrument to control total energy consumption at the regional level;
- **Strengthen energy management of major energy-consuming entities,** especially entities with an annual energy consumption above 10000 tonne sce, and to introduce the "Top 10,000 Energy-Saving and Low-Carbon Enterprises Programme";
- **To further strengthen industrial energy-saving and emissions reduction.** Key sectors include: power generation, coal mining, steel, non-ferrous metals, petroleum, petrochemical, chemical, building material, paper and pulp, textile, printing and dyeing, and food processing.
- **Promote energy-saving in buildings.** Develop and implement a Green Building Action Plan, covering all areas of decision-making – (city) planning, regulations, technology, standards and design.
- **Promote energy-saving and emissions reduction in the transport sector.** Intensify the development of public transport in cities, carry out special low-carbon transport programmes and accelerate the elimination of outdated transport modes.
- **Promote energy-saving in the agricultural sector and in countryside,** with a strong focus on the treatment of non-point source pollution, integrated rural environmental management and implementation of agricultural clean production programmes;
- **Promote commercial and residential energy-saving.** Implement energy–saving and emissions reduction in the business (such as retail) and tourism sectors. Promote the use of energy efficient appliances and lighting products, and encourage the purchase of environmental friendly and energy-saving vehicles by households. Reduce the use of disposal products and excessive packaging.
- **Strengthen public sector energy-saving and emissions reduction.** Stricter building codes should apply to new buildings and retrofitting of public office buildings for energy-saving should be accelerated.

Source: Comprehensive Energy-Saving and Emissions Reduction Work Programme for the 12th FYP (in Chinese), State Council, 2011.

A comprehensive policy framework for green innovation capacity building

The strategic focus on and planning for the emerging and strategic industries will have profound implications for the development of China's green economy – not only for the development of new industries, but also for the modernisation of traditional industries. In this context, green innovation capacity building will be of great strategic importance, and is simultaneously driven by market, institutional and regulatory factors. China is on the way to create a well thought out "green technology and innovation strategy" (See Figure 9 below).

Figure 9. Supporting framework for China's Green technology and innovation



The macro environmental protection strategies

Faced with the daunting challenges, the objectives of China's ongoing environmental transformation are straightforward: to close the implementation and enforcement gaps and to create a **new pathway to environmental protection (环境保护新道路)**, which is cost-efficient, economically viable/beneficial, low-emission and sustainable (代价小、效益好、排放低、可持续). The key elements of the framework for the new environmental protection pathway include:

- To develop a strategic environmental system that fits China's conditions
- To set up an overall defense system for pollution prevention and controll
- To set up an effective environmental governance system
- To improve environmental policies, regulations and standards
- To build a full-fledged environmental management system
- To create a system for public participation in environmental protection

Box 9. China's Environment Macro Strategy

Overall objectives:

Environmental protection should focus on overall improvement of national environmental quality and integrity/stability of ecosystems, promoting coordinated development of environmental protection and socio-economic development, strengthening the capacity of sustainable development, providing people with clean water, air and safe food, ensuring a sound environment for people to live in, ensuring public health, and realising environmental quality objectives that are compatible with a strong modern socialist country.

Phased objectives (2020 -2050)

- **Two "effectiveness" by 2020 (两个有效):** Effective control of major pollutants discharge and effective safeguard of environmental security.
- **Two "comprehensiveness" by 2030 (两个全面):** Comprehensive control of total discharge of pollutants and comprehensive improvement of environmental quality.
- **Two "compatibility" by 2050 (两个适应):** Environmental quality compatible with people's increasing living standard and with the status of a strong modern socialist society

Source: Chinese Academy of Engineering and Ministry of Environmental Protection, 2010

4.3.2 Considerable fiscal capacity to support and leverage green investments

According to official statistics, a total of 215.1 billion RMB from the central budget were allocated to energy saving and emission reduction actions and to phasing out backward production capacity under the 11th FYP. This in turn leveraged 1.6 trillion RMB worth of investment from the private sector. The total investment in the treatment of environmental pollution increased by an annual average growth rate of 15% since 2000, and the share of environmental investment in GDP reached 1.33% by 2009. The total amount of government investment will continue to increase in the 12th FYP period.[21]

Under the fiscal stimulus plan introduced in 2009, a large amount of spending was allocated for investments in energy efficient buildings, renewable energy, rail transportation and electric vehicles. This provided a strong basis for a greener infrastructure and urbanisation process as well as for scaling up and diffusing green technologies and innovations. The Chinese energy-saving and emission reduction sector is also expected to grow by 15%-20% during the 12th FYP period and China aspires to become the largest market for energy saving and emission reduction technologies and services.

In the field of renewable energy, with the investments up by more than 50% and reaching $34.6 billion in 2009, China led the world in renewable energy investment for the first time in 2009. It is also leading the world in terms of the market size for renewable energy and production of certain renewable energy technologies. For instance, in 2009 alone, China added 37 GW of renewable power capacity, and produced 40% of the world's solar PV supply, 30% of the world's wind turbines (up

[21] For more details, see State Council, 5 March 2011, *Report on the work of the government.* http://online.wsj.com/public/resources/documents/2011NPCWorkReportEng.pdf

from 10% in 2007) and 77% of the world's solar hot water collectors.[22] With 226 GW (including large hydropower) of total renewable power generation capacity by the end of 2009, China has the world's largest installed renewable energy capacity, (See Table 6 below)

Table 6. Cumulative Renewable Electric Power Generation Capacity, 2009.

Technology	World Total	Developing Countries	EU-27	China	United States	Germany	Spain	India	Japan
					GW				
Wind power	159	40	75	25.8	35.1	25.8	19.2	10.9	2.1
Small hydropower <10 MW	60	40	12	33	3	2	2	2	4
Biomass power	54	24	16	3.2	9	4	0.4	1.5	0.1
Solar photovoltaic-grid	21	0.5	16	0.4	1.2	9.8	3.4	~0	2.6
Geothermal power	11	5	0.8	~0	3.2	0	0	0	0.5
Concentrating solar thermal power (CSP)	0.7	0	0.2	0	0.5	0	0.2	0	0
Ocean power	0.3	0	0.3	0	0	0	0	0	0
Total renewable power capacity (including small hydropower)	**305**	**110**	**120**	**62**	**52**	**42**	**25**	**14**	**9**
Total hydropower (all sizes)	980	580	127	197	95	11	18	37	51
Total renewable power capacity (including hydro-power of all sizes)	**1,230**	**650**	**246**	**226**	**144**	**51**	**41**	**49**	**56**

Source: Renewable 2010: Global Status Report, pp 55

4.3.3 An emerging global "green innovation hub"…

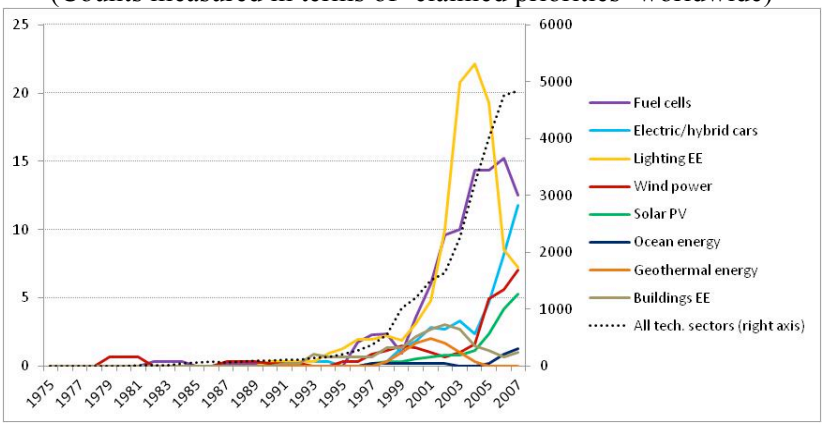
In terms of international knowledge and know-how transfer, **the market size, manufacturing capacity, and increasingly also the local innovation environment and infrastructure** have made China an attractive destination for patent filing and know-how transfer. China thus has a unique opportunity, not only to green the Chinese economy but also to accelerate the global green transformation – from being a fast follower to a scale-up enabler and green innovation leader.

Despite the fact that China did not actually meet its R&D expenditure target, i.e. 2% of GDP, it nonetheless accounted for 12% of global R&D expenditure in 2010.[23] In recent years, considerable research efforts have gone toward environmental innovation in China and the rate of growth of patented environmental inventions has been remarkable (See Figure 10).

[22] Source: Renewable 2010: Global Status Report.
http://www.ren21.net/Portals/97/documents/GSR/REN21_GSR_2010_full_revised%20Sept2010.pdf
[23] See e.g. Gordon Orr, *Unleashing innovation in China,* McKinsey & Company, January 2011. https://www.mckinseyquarterly.com/PDFDownload.aspx?ar=2725

Figure 10. High-Value Patents in China Climate: Mitigation Technologies[24]

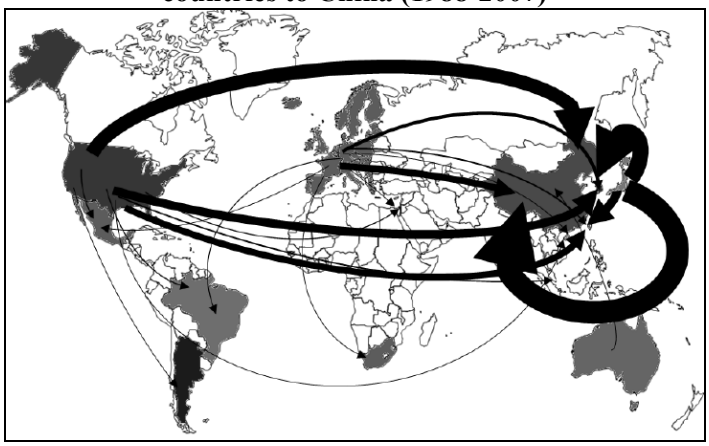
(Counts measured in terms of 'claimed priorities' worldwide)



Source: Data provided by the OECD, 2011.

Furthermore, China has already become the most important recipient among emerging economies of patent applications from OECD countries in the fields of solar PV and wind power (See Figures 11 and Figure 12 below).[25]

Figure 11. International flow of patent applications of solar PV technology from OECD countries to China (1988-2007)

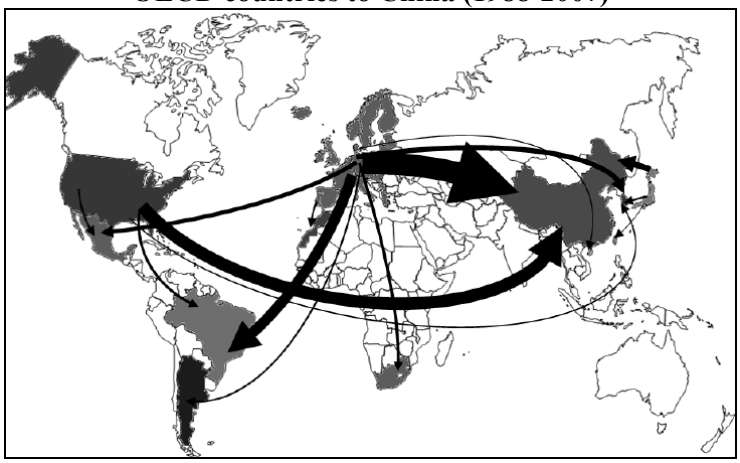


Source: Climate policy and technological innovation and transfer : an overview of trends and recent empirical results. OECD, 2010. http://www.oecd.org/dataoecd/54/52/45648463.pdf

[24] For a detailed methodology discussion, see http://www.oecd.org/officialdocuments/publicdisplaydocumentpdf/?cote=ENV/EPOC/WPNEP(2009)1/FINAL&docLanguage=En

[25] More details can be found in "Climate policy and technological innovation and transfer: An overview of trends and recent evidence" (2010). OECD. http://www.oecd.org/dataoecd/54/52/45648463.pdf

Figure 12. International flow of patent applications of wind power technology from OECD countries to China (1988-2007)



Source: Climate policy and technological innovation and transfer : an overview of trends and recent empirical results. OECD, 2010. http://www.oecd.org/dataoecd/54/52/45648463.pdf

The enhanced innovation capacity and the rapid development of the green technology market in China are now attracting all kinds of foreign R&D capacities. Despite frequent complaints about lax intellectual property protection, foreign invested companies accounted for more than 7% of China's R&D spending in the 11th FYP (Mckinsey, 2011).

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Multinational R&D centres in China were one of the first to take advantage of the globalisation of low-carbon/green technologies and investments. Low carbon technology R&D activities undertaken by multinationals, together with domestic enterprises and R&D institutions of various sizes, are gaining a solid ground in China. For these multinational R&D centres, China's market size creates favourable conditions for the acceleration of R&D, small-scale testing, large-scale demonstration and real-life modelling of various green technologies. The direction of R&D development by multinationals is broadly in line with the international trend where huge investments are put into low-carbon and green technologies. While the global dimension in China's overall national innovation system still needs to be further developed, the existing global green innovation networks in China are an important stepping-stone, leading to an accelerated pace and a broader international perspective in the green transformation and modernisation. Inclusiveness and openness are thus the key elements of China's "green" innovation system – not least because of its ambition to become the hub of green technology and innovation for both the domestic and global market. Globally, the green race needs both fierce competition and strategic collaboration in order to produce, not one, but many winners.

Global knowledge sourcing and collaboration will become even more important in the future when global innovation alliances become more common – especially

collaboration between actors from both the research community and the business sector. This calls for a modernised basic research system that can better monitor, organise and perform multi- and inter-disciplinary research, in both the domestic and global contexts. It is therefore important that public research programmes also have a global perspective in terms of both research support and public-private partnership building. From example, in Canada, the government is working to create a strong regional knowledge hub in certain prioritised areas (e.g. **Canada Excellence Research Chairs** (CERC, www.indsurycanada.ca). Similarly, many 'sustainability-focused' "**Centres of Excellence**" in the EU member states have both a strong global focus and a regional development dimension – in terms of science-industry linkage, research capacity building and job creation. Furthermore, the EU's **Joint Technology Initiatives** (JTIs), which support large-scale multinational (among EU member states) research activities built on strong private-public partnerships, have also played an important role in building up EU's competitiveness in strategic areas.

These examples could provide a useful model for China's green technology and innovation capacity enhancement. This could include setting up manufacturing (and service in the future) clusters for energy and environmental technologies across China, which will be an important step towards upgrading many of the "low-cost manufacturing" clusters to knowledge-driven and globally connected innovation clusters.

In addition, the issue of Intellectual Property Rights (IPR) has increasingly become an important political agenda in international technology transfer and collaboration. It is now widely accepted that in order to facilitate global knowledge sourcing and sharing, a more inclusive and effective IPR regime is needed to establish new multidisciplinary and private-public-partnership based knowledge transfer initiatives. An increasingly globalised research environment, with strong science-industry linkage, can provide a pragmatic and creative platform for developing new approaches and models for technology and innovation development and diffusion to address global challenges as well as strengthen both partnership and competitiveness.

4.4 Cost-benefit analysis of the green industry transformation

China's green development requires a significant amount of investments and extensive technological supports. As the industrial sector is currently the largest energy user and the most polluting (including GHG emissions) sector, a green industrial development will also have a considerable impact on China's socio-economic development. A quantitative cost-benefit analysis on the green transformation of China's industrial sector has been carried out (see Table 7). The bottom line is that, **despite the short- and medium-term costs, the long-term economic, environmental and social benefits will be the most important incentive for China to pursue a green development.**

Table 7. The green transformation of China's industrial sector - A cost-benefit analysis (RMB)[26]

Costs	12th FYP	13th FYP
Energy-saving & environment protection investments	5.77 trillion	6.83 trillion
Job losses in energy- and emission-intensive sectors	952 100 (head count)	2.9 million
Potential macroeconomic loss	More than 100 billion	
Compensation to adversely affected poor population	Depending on scope and strength of polices	
Benefits	**12th FYP**	**13th FYP**
Lower energy cost	1.43 trillion	5.47 trillion
Development of energy-saving & environmental protection industries	Total output: 6.35 trillion Increased GDP 8.08 trillion	Total output: 7.51 trillion Increased GDP 9.56 trillion
Green jobs created	10,6 million	12,5 million
Positive health effects/ avoided negative health impact	more than 1% of GDP	
Avoided technological lock-in and improved trade condition and environment	qualitative analysis	

5. STRATEGIC FRAMEWORK AND INDICATOR SYSTEM

5.1 Strategic Framework –conceptual rationale & framework design

The development strategy for China's green economy involves setting **development priorities**, defining **key tasks** as well as establishing **a supporting (and enabling) system** (See Figure 13). The strategic framework follows a "three-tier structure":

Tier 1: 'Objectives' level:

- Two key strategies:
  1) **Transformation** of the growth model and the role of the government, with an emphasis on the "labour division" and the need for partnership between the public and the private sectors;
  2) **Innovation** in terms of technology as well as institutional governance structure and policy mix.

- Two key objectives: Overcoming **resource and environmental constraints** and improving **people's livelihood**.

Tier 2: 'Key tasks' level:

[26] The estimates are produced by the Institute of Industrial Economics, Chinese Academy pf Social Science (CASS) which is one of the research teams of the CCICED, Green Economy Taskforce.

The key tasks cover the main strategic directions of China's green economy, such as

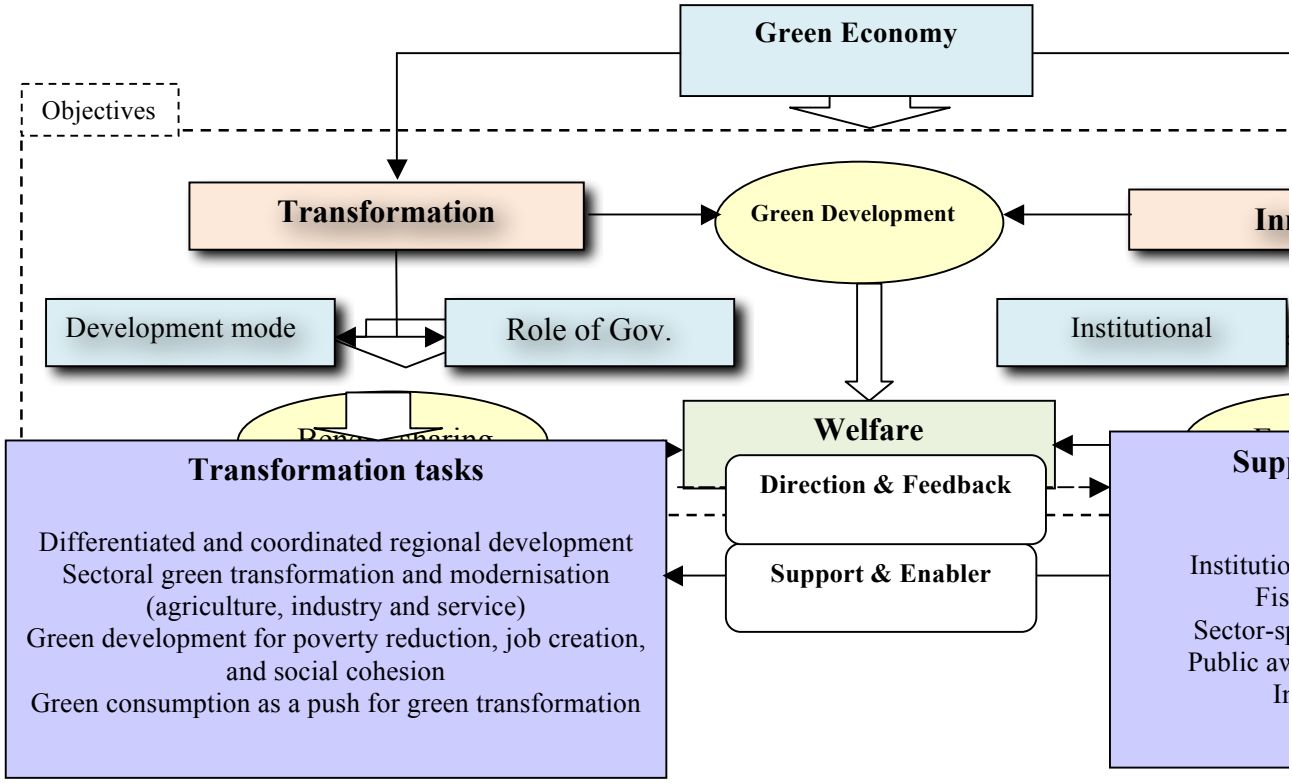
- Inter-sector structural adjustment,
- Intra-sectoral adjustment and modernisation,
- Coordinated regional development
- Domestic demand-driven economic development
- Social development for a harmonious society
- Innovation capacity development for enhanced competitiveness

Tier 3: 'Supporting (and enabling) system' level:

The supporting system consists of the necessary institutional setting, governance structure, regulatory and policy mix that enable key tasks to be implemented and achieved, such as:

- Law & legislations
- Institutional setting/market mechanisms
- Fiscal policy and tax system
- Sector-specific regulation & promotion
- Public awareness and behavioural change
- International cooperation

Figure 13. Strategic Framework of China's Green Development



5.2 Measuring the green transformation process – the indicator system

The new conceptualisation of green economy as well as the new strategies for developing a green economy require appropriate and adequate information and

comparable data for monitoring and policy-making purposes. However, in both academic research and more practically oriented policy work, the indicator system for measuring the green transformation process is still in the early stages of "learning-by-doing" and "learning- by-debating".

The OECD green growth indicators and two domestic examples of regional and city-level sustainable development monitoring are presented. The objectives are to illustrate the key elements and policy implications of the ongoing work on green economy related indicator systems.

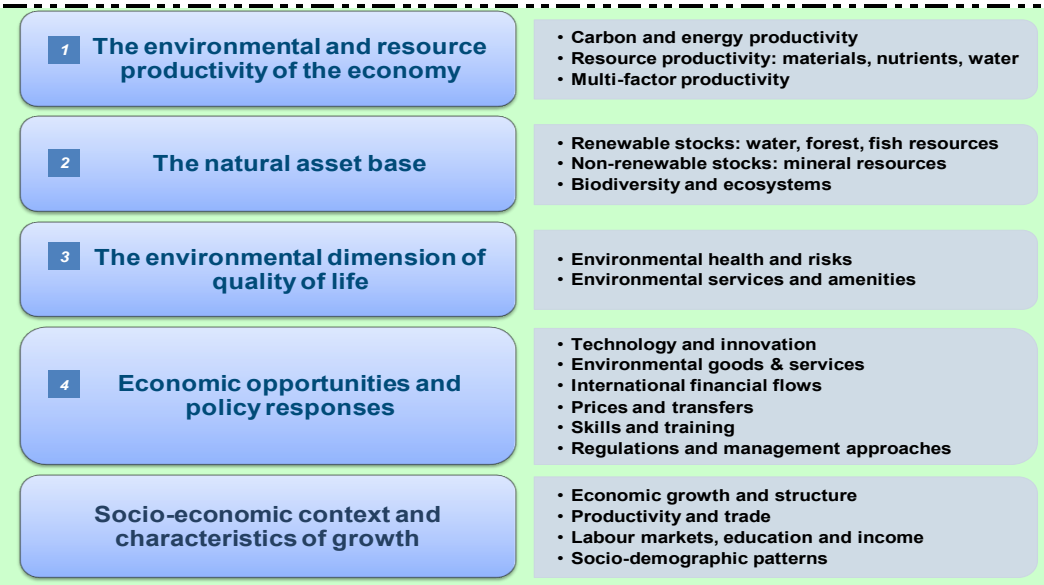
5.2.1 OECD Green Growth indicators

The OECD framework for monitoring progress towards green growth explores four inter-related groups of indicators, reflecting a holistic and an integrated view on the key drivers and foundation of a green growth (See Box 10). The work to date suggests that environmental and resource productivity has risen. However, improved environmental productivity is not necessarily accompanied by an absolute decrease in environmental pressure or the sustainable use of some natural assets.

Box 10. Monitoring Progress towards Green Growth –OECD indicators

Moving towards green growth requires appropriate information and comparable data to support policy analysis and to track progress, including at international level. The OECD framework for monitoring progress towards green growth explores four inter-related groups of indicators on:

- **Environmental and resource productivity**, to capture the need for efficient use of natural capital and aspects of production which are rarely quantified in economic models and accounting frameworks.
- **Economic and environmental assets**, to reflect the fact that a declining asset base presents risks to growth, and because sustained growth requires the asset base to be kept intact.
- **Environmental quality of life**, capturing the direct impacts of the environment on people's lives, through for example access to water or the damaging effects of air pollution.
- **Economic opportunities and policy responses,** which can be used to help discern the effectiveness of policy in delivering green growth and where the effects are most marked.



For each group, a list of indicators is proposed on the basis of existing OECD work and experience. The list constitutes work in progress and will be further elaborated as data become available and as concepts evolve.

Source: "Towards green growth- A summary for policy makers", OECD, 2011

5.2.2 Regionalised performance assessment system

Taking into account the large regional diversity and following the "main functional zones" strategy, a new differentiated and regionalised performance assessment system has been launched by the State Council (see Table 8). In the context of the "green governance paradox", this new performance assessment system is an encouraging step towards removing the GDP obsession and achieving effective implementation of green regional development that takes into account regional characteristics and potentials.

Table 8. Functional zones performance evaluation system

Functional Zone	Key focus areas	Key assessment indicators	Assessment indicators de-prioritised or downgraded
Optimized Development	**Transformation of economic development mode**	• Share of service sector, new and high-tech industry in total value-added • Share of R&D in total output • Per unit output water and energy use, key emissions and CO2 emission • Reduction of total volume of key emissions	• GDP growth • Investment growth • Export growth

		• Water and air quality • Absorption of migrant labour	
Key Development	**Industrialisation and urbanisation** Integrated performance assessment, taking into account: • Economic development • Absorption of migrant labour • Quality and efficiency of economic development • Economic and industrial structure • Resource utilisation • Environmental protection • Public service provision to migrant labour	• GDP growth • Employment of non-agricultural population • Fiscal revenue as a share of GDP • Per unit output water and energy use, key emissions and CO2 emission • Reduction of total volume of key emissions • Water and air quality • Absorption of migrant labour	• Growth rate of investment In the Western and Central regions: • Growth rate of FDI • Growth rate of export
Restricted Development	**Agricultural production security** **Ecological protection**	• Production capacity • Income of farmers • Water and air quality • Recovery and treatment rate of land degradation and desertification • Forestry coverage rate • Biodiversity	• GRP growth • Investment growth • Industrial output • Local fiscal revenue • Urbanisation rate
Prohibited Development	**Specific to protected areas and objectives**	• Zone-emission of pollutants	• Revenues from tourism and other economic indicators

Source: "The guideline and strategies for the implementation of main functional zones in the 12th FYP" (in Chinese), State Council, 2011.

5.2.3 Urban Sustainability Index

As a result of rapid urbanisation, there are serious concerns about resource use efficiency and environmental quality for current and future green transformation. The Urban Sustainability Index was developed to provide a snapshot of the status of cities in term of sustainability performance along side with economic development, using indicators that are readily available in and relevant for China (and other emerging and developing economies).

Box 11. Urban Sustainable Index

Categories	Definition	Indicators	Description of the indicators
Basic needs	Access to safe water, living conditions, education and health services	Water supply Housing Health Education	Water access rate (%) Living space (sq.m per capita) Doctors per capita Student teacher ratio (primary school)
Resource efficiency	Efficient use of energy, power and water; waste recycling	Power Water demand Waste recycling % GDP from heavy industry	Total electricity consumption (kwh per GDP) Water consumption (Liters per capita) Rate of industrial waste recycled and utilized (%) Heavy industry GDP/ Total GDP (bln RMB)
Environmental cleanliness	Clean air and water Waste management	Air pollution Industrial pollution Waste water treatment Waste management	Concentration of SOx, NOx, PM10 (mg/cu.m) Industrial SO2 discharged per GDP (T/ RMB) Wastewater treatment rate (%) Domestic waste collected & transported (10,000 T per capita)
Built environment	Dense, transit-oriented, green, efficient design	Urban density Mass transit usage Public green space Building efficiency	Persons per square kilometer of urban area Passengers using public transit (bus, trolley) Public green space per capita (sq.m per capita) Building heating efficiency
Commitment to future sustainability	Investment in human and physical assets	Green jobs Investment on environmental protection	# of environmental professionals per capita Amount of environmental sanitation funds per GDP

Source: "The Urban Sustainability Index: A new tool for measuring China's city". Columbia University, Tsinghua University and McKinsey & Company, 2010

The sustainability performance of 112 cities that were earmarked in the 11th FYP as the focus of sustainable development efforts was assessed for the period 2004-2008, using the Urban Sustainability Index system. Key policy lessons from the sustainability performance assessment include:

- Most of the critical indicators that drive sustainability such as mass transit usage, waste water treatment and environmental investment were unaffected by the level of economic development.

- "Sustainable growers" are becoming more sustainable while also achieving above-average rates of economic growth. They are "all-rounders" who do well across many dimensions, not just on a small set of indicators.

- Sustainability initiatives require extensive coordination across various government agencies and functional units. "Top-level" priority and vision need to be combined with incentives that encourage cooperation and coordination among agencies.

- Best sustainability performing cities demonstrate not only execution and coordination capacity built on transparency and accountability, but also an unwavering focus on industrial restructuring, environmental-based planning, and use of efficient policy mix including both market-based mechanisms and regulatory measures.

6. KEY TASKS 1 – A GREEN REGIONAL DEVELOPMENT

Given the sheer size of the Chinese economy as well as the large diversity in regional conditions, the planning of China's green economy transformation needs to go beyond the scope of macro-economy and national policy. Having recognised that there is **no "one-size fits all" pathway to a green transformation** and the structural drawbacks of the "**one-rule for all**" policy approach, China's future green development will need to rely on a **differentiated and regional approach based on regional conditions and characteristics**. For instance, under the 12th FYP, the government will implement the "**main functional zone**s" (主体功能区) – where development priorities of the different regions are defined according to their level of economic development, ecological endowments as well as the need to protect and preserve these endowments. In short, a regionalised and differentiated approach will assist and encourage individual regions to achieve their self-sustaining endogenous development – through tapping the underutilised potentials in these regions, utilisation of appropriate market-based mechanisms, and collaboration across different levels of government.

6.1 Promoting green urbanisation[27]

6.1.1 Retrospect of urbanization policy

Over the last few decades China's urbanization has been a tremendous success. Since 1990, China's cities have not only coped with an increase of almost 400 million people, they have quintupled urban GDP per capita. As China's urbanization rate has climbed from 22% to 47%, its cities have absorbed an unprecedented 360 000 new inhabitants per week.

Moreover, in its leading cities – Beijing, Shanghai, Guangzhou and Shenzhen – China has created economic powerhouses. Their local GDP has risen from around 100 billion RMB in 1990 to above 1 trillion RMB today, outstripping developing metropolises like Istanbul and Rio. Beyond economic development, China's cities have successfully become focal points of the world, whether staging world-class events like the Beijing Olympics and Shanghai World Expo or completing the most advanced architecture and infrastructure projects.

Now, and over the next two decades, China's cities will need to surmount two intertwined challenges: first, the continued, unprecedented scale of urbanization, and with it the pressures of social change and resource constraints; and, second, the need to meet the rising aspirations of China's leaders and citizens for a better quality of life. These challenges can also be an enormous opportunity – leapfrogging to forge a new path for urbanization, one that can serve as an inspiration to other developing metropolises from India and the rest of Asia, to South America and Africa.

[27] The contents of this section are based on the analysis and the draft by the experts from McKinsey & Company's Great China Office. For more details, see Jonathan Woetzel et al., *Preparing for China's Urban Billion*, McKinsey Global Institute, March 2009.
http://www.mckinsey.com/mgi/publications/china_urban_billion/

For the scale of China's urbanization will continue to be immense. China's urban population will reach almost a billion people by 2030, representing one quarter of all urban growth in this period and an increase in population greater than the United States. A further seventy-three cities will grow past one million inhabitants – only thirty-five such exist in Europe today – while another eighteen will pass the five million inhabitants mark. The share of migrants in the urban population will rise from around 25% in 2010 to almost 40% by 2030.

This scale – along with a continued rise in living standards – will generate enormous pressures. Many if not all of these impacts are highly regressive as they affect the jobless and the weak disproportionately. Four pressures on cities stand out:

- **Land and spatial development—**the addition of more than 350 million urban residents over the next 20 years will require unprecedented construction. This will threaten extensive urban sprawl, further intensive land development, and extreme congestion. Pressure will continue to bear down on the availability of arable land, which could decline by as much as 20 percent in the worst-case scenario. At the same time larger cities will face crippling congestion pressures (Shanghai's traffic could outstrip its projected road capacity threefold by 2025). There will be intense tension between the loss of arable land on one hand and cities' dependency on land sales for revenues to finance urban development on the other hand—a phenomenon that has thus far afforded China added flexibility in its funding of urbanization.

- **Resources and pollution—**demand for resources from urban China will double. Energy demand will rise from 60 quadrillion British thermal units (QBTUs) to between 123 QBTUs and 142 QBTUs. Water use is very likely to be a severe challenge, particularly for the megacities in the north that will need national water-transfer projects to meet their needs. No matter what, pollution will be severe. Today 59 percent of China's river water is already below international potable standards, and if the amount of wastewater generated relative to GDP stays at today's level in midsized and smaller cities, urban water pollution could rise almost five times. Air pollution, in particular NO_x, could reach critical levels in larger cities.

- **Skills and jobs—**while migrant labor may still be plentiful, aspiring city officials will face challenges in finding sufficient university graduates. As costs go up, it will be important to create higher-value jobs necessary for top-line growth. China's stock of university graduates will more than triple by 2025, theoretically meeting the growing economy's demand for skills. However, these people will spread out unevenly across the country as larger cities offering greater opportunities and benefits will more easily attract them. This shortage of skilled labor and talent will pose a serious threat to China's aspiration to move quickly toward increasingly higher-value-added economic activity.

- **Funding—**cities will face increased costs in providing services. An important factor will be gradual pressure to extend the provision of services to migrant populations (consistent with recent policy announcements). By 2025 an additional 1.5 trillion RMB or almost 2.5 percent of urban GDP will be required to extend public services and benefits including health care and

education to migrants across China. This new cost for Chinese cities, piled on top of increasing needs for capital to build infrastructure, will place strains on the entire public-funding system. Although the overall public-funding requirement for urbanization will grow only slightly relative to GDP, the allocation of funding among different cities and geographies is an issue that will have to be resolved. If it is not resolved, there are likely to be marked imbalances across the nation. Small and medium-sized cities have found—and will continue to do so—that it will be increasingly difficult to fund their ongoing needs as well as to finance necessary infrastructure. And funding is going to be more difficult going forward than it was in the past when revenues from land sales helped to mitigate tightness in financing. Relying on this source of funding is set to become more difficult now that the central government is enforcing tighter restrictions on additional land acquisitions.

6.1.2 Policy choices – the urban decision-making framework

China's national leaders have recognized these challenges, and signalled their desire for structural adjustment. Much change, however, will have to take place 'on the ground' and be the responsibility of China's city leaders.

Decision making in China is relatively decentralized. Most tax revenues are retained locally. The local government can take decisions on everything from industry subsidies to retail licensing, subject mainly to "negative control" by Beijing. Traditionally Beijing has relied on, and indeed incentivized, the entrepreneurial nature of local bureaucrats to identify and pursue growth opportunities. Urbanization is local—policy choices enacted at the level of individual cities, under the overall guidance of the national government, have strongly influenced China's urban growth. At the same time there is a powerful national framework for urbanization that fundamentally influences the degrees of freedom available at the local level. National decisions on land policy, location of strategic infrastructure, the process and limits of investment approval authority among other areas, define the level of local authority. Differential treatment of local municipalities can tilt the playing field across cities as well.

Land policy has played a unique role in China's rapid urbanization thus far because of the unique property rights system in place. Cities have been able to sell land—bought cheaply in the first place—to investors at preferential rates, a significant driver of industrialization and expansion. As cities have used land as an incentive to businesses, so, in turn, they have attracted more migrant workers seeking new companies and factories. The sale of land has allowed China's cities to be proactive in funding and building infrastructure. The freedom that China's cities have had to acquire land—and subsequently sell it for development—has been one of the key ingredients of China's urbanization story and distinguishes China from other countries such as India. Indeed, the tool of land acquisition is one of the primary reasons China has been able to urbanize without creating massive slums. In 2005 China had 29,637 million square meters of "constructed" or built-upon land—an increase of more than 150 percent over the 11,608 million square meters of constructed land in 1990. At the same time, sales of acquired land account for roughly (and unofficially) 10 percent to 50 percent of local governments' revenues. There is no doubt that without this source of revenues China's urbanization would not have been so rapid, although this phenomenon has

also led to depletion of arable land, urban sprawl, and social tensions. Conversely, greater enforcement of policies and tighter restrictions on further acquisition of land by cities would have a great impact on slowing growth, particularly in less-developed urban centers—most of which depend heavily on land sales to fund urban development.

The center's power to approve projects and grant greater local autonomy to particular regions also plays a role in defining urbanization. The pattern of transport and other network infrastructure plays a major role in the distribution of growth and therefore in the overall shape of urbanization. Government can promote the development of a highway grid or a road system focused on megacities and/or hubs. Likewise the strategic siting of heavy infrastructure such as refineries and ports, and the development of national educational institutions can make a big difference to regional economic development. The central government also has the option of determining different levels of local autonomy for cities to encourage a certain urbanization outcome. The recent establishment of Chongqing as a directly reporting municipality is an example of this. The government has also encouraged cities that are already in close proximity to each other to coalesce into larger metropolitan areas within a single political unit.

Center-municipal fiscal policy is another key lever. Beijing has made it incumbent on cities to develop and execute their own economic plans, while saddling cities with the bulk of the social expenditures China's citizenry incur. In turn it is cities' own efforts to develop their local economies, notably through attracting business investment, preferably shifting to high-value-added industries as cities develop which determines how quickly they will grow. China's cities are very often in stiff competition with each other in attracting not only business investment but also talent, and financing of urban development can be tight particularly for small and medium-sized cities. One response to these challenges has been for cities to seek deeper economic ties with neighboring cities, sometimes in hub-and-spoke clusters with a larger urban center in their region (e.g., the cities of the Yangtze and Pearl River Deltas), which is proving to be a sustainable and effective model of urbanization for China. In the future, establishing national standards for the provision of services to all segments of the population, including low-cost housing and education for migrants, in and of itself will place an additional and significant financial burden on smaller cities. Combined with the requirement that cities maintain balanced budgets, this would in effect make it challenging for smaller cities to pursue aggressive labor-intensive growth policies.

There are opportunities at both the national and local level to shape urbanization towards a more positive outcome than the current path. At the national level, Beijing can drive urban shape through its power of approvals. It can also set the standards for a greener urbanization (e.g., on pollution, land policy, and enforcement mechanisms). Fostering best practice transfer for example through encouraging pilots, and accelerating country wide reforms such as in healthcare could further support local initiatives, as would restructuring of the incentive system for government officials**.** The current system explicitly promotes city-level GDP growth with the effect of favoring dispersed growth. Local governments meanwhile must be the ones accountable for moving beyond simple compliance to shift towards a more productive urban system. This includes using land more strategically to build more attractive and functional cities.

6.1.3 The case for concentrated growth

At the national level, broadly speaking, China faces a choice between a dispersed and a more concentrated pattern of growth. According to recent research by McKinsey & Co.[28], under a "supercities" scenario, a small number of very large cities—with populations of 20 million or more—could emerge. Alternatively, under a "hub and spoke" scenario, clusters of medium-sized and small cities could develop around larger ones. Under a "distributed growth" scenario, on the other hand, a large number of cities with populations of 1.5 million to 5 million would spread throughout China. Other nations around the world have applied all these options. All are open to China; all are subject to current public and political debate.

While trendline projections are not identical in population distribution to any of the four scenarios, their outcomes are closer to the potential implications of dispersed growth scenarios (distributed growth and townization). In these scenarios, midsized cities, which will have the largest share of middle-class consumers, will emerge as the engines of growth over the next 20 years. And although each scenario presents a largely distinct set of opportunities and challenges, the concentrated growth scenarios could be the most optimal. Concentrated growth would have many positive economic implications linked to higher productivity and efficiency. If China were to adopt a strategy of fostering more concentrated urbanization, the results would include:

- **Highest per capita GDP**— The evidence shows scale effects and productivity gains tend to be larger in concentrated urbanization scenarios.
- **More efficient use of energy**—energy productivity could be almost 20 percent higher in concentrated models of urbanization.
- **Lowest rate of loss of arable land**—more concentrated models of urbanization could reduce the loss of arable land to only 7 percent to 8 percent of the current total
- **More efficient mass-transit**—concentrated urbanization scenarios would attain the necessary public-transport capacity with lower costs and higher chances of successful execution. In a supercities scenario, China would need to expand its current subway system eight times. But under distributed growth the light-rail system would have to grow nearly 300 times.
- **More effective control of pollution**—although megacities that develop in a supercities scenario would face extremely serious peak pollution problems (e.g. NO_x), enforcement of measures to regulate pollution is more widespread and effective in larger cities than in smaller cities.

Box 12. An efficient and concentrated green urbanisation path

Rapid urbanization has yet to reach its peak in China. In little more than two decades, two-thirds of all Chinese – one billion people – will be living in the cities. Broadly speaking,

[28] The following is drawn from MGI, *Preparing for China's Urban Billion*, 2009

China faces a choice between a dispersed and a more concentrated pattern of growth:

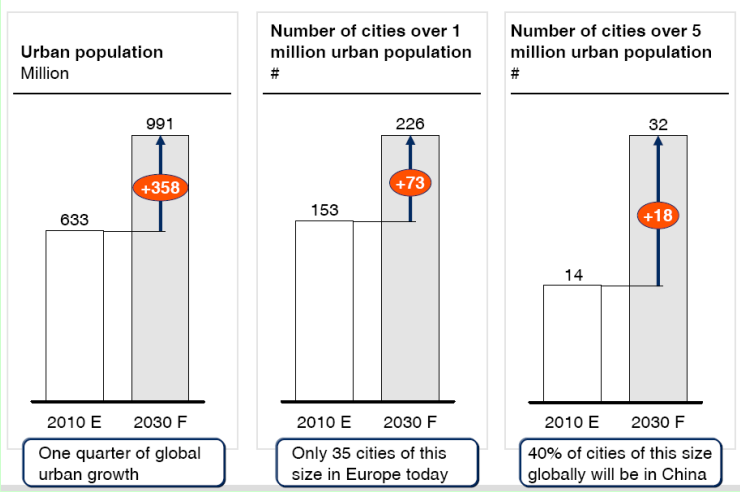
Two concentrated urbanisation scenarios:

- **Super-cities**: This represents a highly concentrated model of urbanisation with a small number of truly global mega-cities with populations of 20 million-plus.
- **Hub and spoke**: This model comprises of city clusters with one or two cities act as the "hub" while the neighbouring cities are "spokes", which are closely linked to the hub(s) through well-developed transportation connections and, more importantly, deep economic ties.

Two dispersed urbanisation scenarios:

- **Distributed growth**: This scenario envisions the continuation of today's urban growth pattern, but with a heightened emphasis on middle sized cities and underdeveloped regions. It implies an accelerated growth of a large number of cities with populations of 1.5 million to 5 million.
- **Townisation:** This model represents a deliberate boost of urbanisation at the grassroots level, with the parallel growth of many small cities with populations between 500,000 and 1,5 million.

China's scale of urbanisation – in a global context



Source: "Preparing for China's Urban Billion" McKinsey Global Institute, 2009

6.1.4 City-level urban policies to support a green economy

Regardless of urban shape, it is possible to encourage the adoption of an "urban productivity" agenda for local governments. The prime objective of this would be to move towards a productivity-based approach that would incentivize the efficient use of inputs such as energy, water, and land; would focus cities on matching sufficient skilled labor to higher-value-added activities; and would improve the provision of public services. Urban productivity initiatives have the potential to reduce future funding pressures, producing outcomes that are both cost-effective and beneficial to the overall quality of urban life.

Innovative city governments are already enacting many effective policies but there is a major opportunity to expand, replicate, and coordinate these, as well as to measure their performance. If cities were to implement urban productivity policies across the board in a market as large as urban China, they would open up unprecedented

opportunities for innovation in areas such as energy conservation, water recycling, and clean technology.

Restructure industrial and energy sectors

Chinese cities are currently seeing a shift from the old model of industrialization where most industry was clustered along major transportation facilities in the urban core. Such plans were designed to facilitate a production-based economy and decrease transportation costs. For example, from the 1950 through the 80s, some cities near the Yangtze River Delta took a "layered-cake approach": chemical factories along the urban edge, electroplating dotting the middle layer, and water-intensive industries located near the resources in the core. Today due to the inability to adhere to tighter national environmental standards (i.e. SO2 emissions standards), many heavy industries formerly located in urban cores are closing down or relocating to new industrial parks, development and economic zones in the suburbs. In Tianjin, smokestack industries are moving East from the city center into some parts of the Binhai New Development Zone. In Qingdao, manufacturing industries are relocating across Jiaozhou Bay and out toward the Northwestern rural regions. Shenyang, too, has successfully removed all traces of heavy industry from its core in the past three years.

Though it may be too early to tell, it seems that on the whole, the benefits of consolidation result in economies of scale, which are large enough to offset the costs of bringing in sophisticated infrastructure retrofits and equipment, even without considering the substantial environmental benefits from the reduction of SO2 emissions and that of other pollutants. Industry also appears to becoming more efficient in its use of environmental inputs, which can balance temporary shifts in industrial structure. Leaders are increasingly concerned with consequences of resource consumption and urban efficiency, with many of these concerns manifesting themselves in the form of cyclical economy projects where different stages of an industrial supply chain are connected in order to maximize local resource efficiency.
While cities simultaneously shift heavy industry out of the core and create new industry clusters, many are thinking up ways to promote the new industrial zones as energy-efficient areas. Tianjin's Binhai New Area, for example, started with two very ambitious desalinization cyclical economy projects as the industrial base and has gradually formed an industry cluster around the provision of desalination equipment. Beijiang power plant links water, power, seasalt production, waste reuse and land conservation into an elegant solution- desalinization. Tianjin's Dagang Power Plant is another successful cyclical economy project that has provided 100,000 100,000 m^3/d of industrial grade and potable water to urban residents. It is one of the first major environmental projects carried out by a foreign private developer in China and the largest reverse-osmosis seawater desalination plant in the country with an impressive ultrafiltration seawater treatment system.

Qingdao, too, has recognized the significance of resource constraints, and recently approved a 25-year contract to build a 100,000 m^3/d capacity desalinization plant. One of Qingdao's most well-known enterprises, Tsingtao Brewery, recently partnered with a local university to study methods to reutilize brewery wastewater and waste. Two techniques were tested: One of the techniques, bio-contact oxidation, treats high volumes of bio-solids efficiently by adding live cultures into the wastewater which results in the clumping of waste. Through this method, COD and BOD removal rates

reached 80% and 90% respectively from 2005- 2008. The other technique separates waste and water using a churning wheel. This method of treating high organic content wastewater is becoming really popular in Hangzhou, Zhejiang and Shenyang breweries because methane generated in the process can be piped to domestic households for cooking use, while the remaining waste is used as fertilizers and animal feed.

Local governments can also influence energy policy. Small, inefficient generating units, which tend to lack sophisticated emissions-control equipment, historically dominate power generation in Chinese cities. Shenyang provides an example of how to creatively manage power supply. In the past five years, Shenyang has managed to consolidate distributed heating into one central heating plant in addition to hosting underground heat source projects covering 642 households over 500 million square meters. The powerful combination has reduced 3.36 million tons of coal, 80 million tons of SO2, and 150 million tons of industrial dust in the city. Electricity generated from the underground water pump decreases coal dependency for central heating. Currently, there has been a pause on using underground water due to its effects on soil composition, but city officials hope to find technologies that will further its use in the future.

Shenyang is experimenting with alternative energy sources. In 2005, in order to upgrade waste management infrastructure, the city initiated a project to extract methane from Laohuchong garbage site. The annual energy output of the project exceeded 4,000 million kwh and provided electricity for over 35,000 Shenyang residents. In addition to biomass, Shenyang has invested in wind power as its primary source of alternative energy. In 2009, wind power installation was 8.2% of all power installation, and 26 new wind power stations were built in Kangping and Faku counties. Shenyang is pushing smart grid applications as well. By the end of the 12th 5 Year Plan, Shenyang plans to have every resident on the urban grid monitored on a smart meter network. For rural areas, the smart meter will cover industries over 100kVA (relatively the size of a small restaurant). Shenyang has been gearing up for this ambitious plan in recent years by changing old meters and transformers.

Plan for integrated and dense development

The freedom that China's cities have had to acquire land—and subsequently sell it for development—has been one of the key ingredients of China's urbanization story and distinguishes China from other countries such as India. There is no doubt that without this source of revenues China's urbanization would not have been so rapid. The purchase and sale of land has allowed China's cities to be proactive in funding and building infrastructure. Built-up land in China has increased by 150 percent over the past 15 years and sales of acquired land account for 10 percent to 50 percent of local governments' revenues. We believe that the tool of land acquisition is one of the primary reasons why China has been able to urbanize without creating massive slums.[29] Yet aggressive land acquisition has also caused horizontal development—urban sprawl—and the depletion of arable land.

[29] Population control and land reform are two other important factors.

In the years ahead, China has the option of building denser, more productive cities. Denser cities tend to produce lower demand for energy—up to 20 percent lower in the case of energy for transport translating to up to four QBTUs in energy savings per year. They also tend to support an economy with a larger share of high-value activities due to the availability of more skilled labor. While national land policy will play a role in managing land-related pressures, there is a range of policies that cities themselves can adopt to contain urban sprawl, and by doing so improve the quality of life of urban residents, cut energy demand, and optimize the use of land.
In some cities, industrial restructuring has produced abandoned or inefficiently used sites in the urban core where heavy industry was formerly housed. Such brownfields provide large-scale opportunities for Chinese urban planning because they often offer sizeable tracts of land in high-value, inner-city locations. For example, Shenyang has taken this opportunity to convert, redevelop and ultimately revitalize the industrial brownfields in Tiexi District. The improvement of this district has largely enhanced the city's urban image and driven economic development through real estate investment. In 2003, with tightening of industry standards, regulations, and stricter zoning, Shenyang effectively moved factories out of the urban core within five years, causing the gentrification of Tiexi District with an influx of mid to high-end commercial and residential development. The Tiexi case provides a potentially valuable precedent to other Chinese cities that are looking to restructure old industrial brownfields in their transition out of the old industrialization model of development. In this case, as in many others, setting a quantitative target can be effective to help Chinese cities measure and manage improvement. One method can be a percentage target, such as the one issued by the UK government aiming for at least 60% of all residential developments be built on brownfields within a flexible period of ten years. Depending on how Chinese cities would want to define brownfields (i.e. according to contamination level or waste hazard), and how they would execute assessment and remediation, the percentage target would be very different.

Demand-led transit planning and transit-oriented development responds to the consumer by going beyond efficiency to create livable spaces. An appreciable bus ridership in Chinese cities indicates a potential demand for transit-oriented development. For example, Qingdao has increased the number of transit choices in order to decrease the demand for private transportation. In the past 4 years, the number of passengers using public buses has increased by 17%. By monitoring flow and congestion at particular nodes in the city, Qingdao transportation engineers have redirected traffic to one-way flow in the old district and increased the length of pedestrian lanes to encourage non-motorized forms of transportation. Qingdao has also rezoned former industrial space into commercial areas and started to build many mixed-use residential and lifestyle developments along major transit nodes. Officials believe that transit-oriented housing and continued dense development along major urban arteries will decrease transportation costs in the longer term.

In order to create this type of dense development, cities will also need—possibly within the framework of a comprehensive strategic land-development plan—to focus on maximizing the effectiveness of their transportation infrastructure, on holistic congestion-fighting strategies, and on urban planning that uses land strategically—for instance by developing integrated, mixed-use areas; pursuing transit-oriented development; and increasing floor area ratios (FARs), which regulate building height. New York City, for instance, has long used FARs to guide strategic development,

encouraging taller buildings and therefore density around key transportation nodes. In contrast, today many Chinese cities set FARs on an ad hoc, project-by-project basis. This creates inefficiencies such as the location of residential buildings on the outskirts of cities that are much bigger than those in the center and that do not enjoy optimal connections with the main city transportation systems. The result is increased traffic (with a consequent loss to overall productivity) and major difficulties in implementing mass-transit solutions.

Restructuring of national-level land policy will be a critical enabler of a denser development strategy in cities. Today land use is geared to protecting farmland, but often does so at the cost of fragmenting the urban periphery. Agricultural land close to built-up areas may not be developed while non-agricultural but distant areas are incorporated into urban space. Allowing for land use conversion rights to be allocated on a market basis would go a long way towards incentivizing denser, and thus more value-creating development.

Manage demand for, not just supply of, resources

Cities should manage demand for resources rather than simply focusing on building the supply infrastructure needed to keep pace with demand. For example, boosting energy productivity—the level of output we achieve from the energy we consume—is largely a "pain-free," measurable, "low-hanging fruit" option. China's cities would generate positive returns from future energy savings, freeing up resources for investment elsewhere.[30] Urban China has the opportunity to abate energy demand growth by 30 QBTUs, including the potential to reduce oil demand by just over four million barrels of oil per day. In tandem, China would be able to cut urban water demand by close to 40 percent by 2025.

To reap the full benefits of higher energy productivity, standards and incentive programs backed up by rigorous monitoring and enforcement at the national level will be important. Nevertheless policy and implementation at the local level will be crucial. Among the effective tools at cities' disposal will be the use of incentives to encourage investment in energy-efficient industrial equipment such as regasification technology; standards-based regulations such as establishing energy efficiency in building codes and improved insulation; the deployment of the latest technologies; and "resource saving" pricing schemes.

Shenyang for instance has taken various pricing initiatives to phase out heavy industry from the urban core and reduce power per GDP. In 2006, when the NDRC issued a policy to eliminate high energy consuming companies, Shenyang Cement Plant was the only company in Shenyang on the list. In order to disincentivize the company from using so much power, the electricity price was set to be 5 cents higher than standard price. In 2007, the price was doubled to 10 cents above the standard price. As a result of increasing costs, the company was unable to maintain competiveness and was gradually eliminated from the market. On the flip side, the local DRC has also given preferential policies to large heavy industries that generate lots of revenue

[30] For a full analysis of energy productivity and the investment needed to capture available opportunities, see *Curbing Global Energy Demand Growth: The Energy Productivity Opportunity*, McKinsey Global Institute, May 2007; and *The Case for Investing in Energy Productivity*, McKinsey Global Institute, February 2008. www.mckinsey.com/mgi

to try to encourage them to become more efficient. Such an example would be increasing the energy price from 0.435 to 0.455 for an anonymous petrochemical SOE. Peak hour pricing strategies are also used for industries using over 100kwhs.
Combating pollution will require further efforts in tightening standards and requiring technology upgrades. For instance, to control PM_{10} emissions cities could mandate the use of methods such as the water-based suppression of dust on construction sites—as in some parts of Shanghai. Cities could also increase vehicle emission standards and implement "clean" regulations on city fleets that could not only save energy but also provide greater benefits in terms of mitigating pollution. An example of this is Chengdu's aggressive roll-out of a taxi and bus fleet that runs on compressed natural gas. Enforcement will again be crucial to increase wastewater treatment especially in smaller cities where the current level of compliance is relatively low.

Progress on environmental indicators can be attributed to a high level of political commitment, commitment from adequate administrative capacity to roll out new initiatives rapidly, and an adjusted accountability system that links implementation to performance assessment of local officials. Superior environmental supervision and strict monitoring of digital information places cities like Qingdao at the top of environmental performance in China. Part of the reason for Qingdao's consistent performance in wastewater treatment is due to provincial-level pressure. Shandong Province manages the top 1000 high-polluting enterprises in the region by identifying the companies on a public listing and setting aggressive waste-reduction targets. By 2008, the province monitored over 1000 enterprises and 170 wastewater treatment plants and set requirements for enterprises to provide digital feedback on a regular basis.

Such policy enforcement from the province-level has effectively placed cities in a healthy competition. However, the top-ranking cities take this competition to another level. For example, when Shandong set a regulation to digitally monitor and report water quality every two hours, Qingdao, wanting to maintain its status as Shandong's leading city, shortens its monitoring frequency to every half hour. In addition, Qingdao sends human resources from the Environmental Monitoring Department to manually check the accuracy of the data reported every 10 days to a month, depending on where the industry ranks on the Top 1000 list. Since policy execution and monitoring consistency is fairly people intensive, a high level of commitment from municipal leaders is crucial in order to motivate an adequate workforce to roll out implementation.

6.1.5 Policy execution and coordination

Whether or not a city succeeds in the execution of sustainable development is largely due to the level of administrative coordination within city governments themselves. There is ample knowledge of how to make cities more effective, the main limitation being the lack of means to facilitate coordination with appropriate organization support. In order to overcome the challenge of interdepartmental coordination within Chinese cities, governments must develop a method to incentivize cooperation. There seem to be two approaches that work:

- Evaluation: One method is to strengthen coordination mechanisms and communications channels by linking success of implementation to an overall

evaluation program. Often no harmonized policies and programs exist between environment, planning integration, human resources, water resources, housing, health, social affairs, and technological development departments. By formalizing the channels through which departments communicate and set targets on how often information exchanges should take place, municipal governments can better foster a sense of unity amongst departments.

- Approval: Another method is to include coordination evaluation in the final approval process. In Shenyang, there is a department directly affiliated with the State Council that all projects need to pass through for approval. If the project successfully passes, it means that the collective bureaus - environmental, urban planning, social and economic planning, etc. - have met the bar in coordination. This standardization of coordination has worked quite well for Shenyang's execution of projects at the district, county and city level.

6.2 A coordinated regional development

A "**co-ordinated development**" has been the driving theme for China's regional development policy since the 9th FYP. It aimed to encourage more horizontal co-ordination and collaboration between different regions and to exploit the potential synergies between them. For instance, the high growth coastal region tends to lack resources (including energy and raw materials) and cheap labour that are abundant in the less developed central and the western regions, while the latter are short in financial resources and human capacity. To reduce regional gaps in the socioeconomic development, some region-specific development strategies have been implemented during the 10th and 11th FYPs (See Table 9 below).

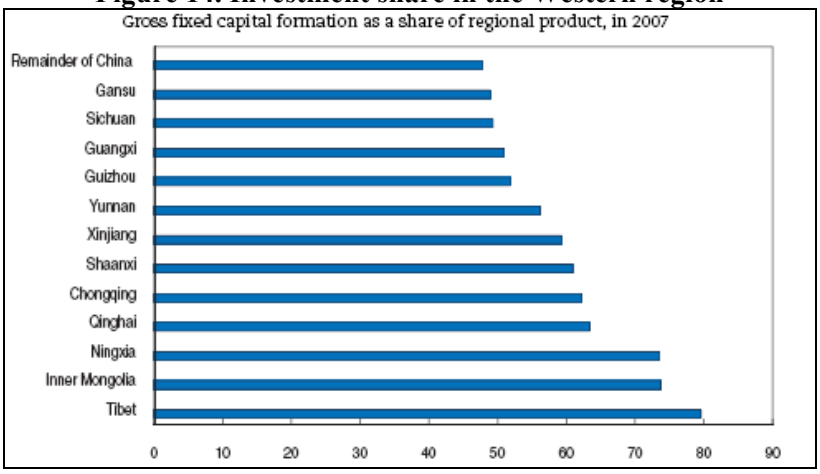
Table 9. Regional development programmes (10th and 11th FYPs)

Region	Regional development programme	Programme/development focus
Coastal region (10 provinces)	-	Foreign and domestic direct investment High technology development
North-Eastern region (3 provinces)	**"North-East Rejuvenation" programme**	Structural adjustments and diversification of ownership of industrial enterprises. Attracting foreign and domestic capital to reform existing state-owned enterprises Creation of new labour-intensive industries to absorb surplus labour
Central region (6 provinces)	**"Promotion of the Fast Rise of the Central Region" programme**	Constructing new "social" villages Development of regional comparative advantages in energy, minerals and raw materials
Western region	**"Western Development"**	Infrastructure construction and

(12 provinces)	**programme:**	investment Infrastructure construction in the agriculture sector and improvement of farmers' living standard Development of regional economy in accordance with their resource endowment

The Western Development Programme, which has been one of the most important national initiatives for regional development since the 10th FYP (2001-2005), can help shed some light on why regional development strategies have failed to work so far. Total investment under the Western Development Programme under the 10th FYP amounted to 1,4% of China's national GDP. Infrastructure and energy projects carried out under the Programme injected large sum of gross fixed capital in the Western region, which accounted for over half of the regional product by the end of the 10th FYP (See Figure below). However, in contrast to the large physical investments, spending on public service provision and social objectives was only a small fraction of the total government outlays. According to some estimates, the shortfall in public spending on education in the West is severe – an increase in public-sector spending on education equivalent to 0,6% of national GDP would be needed to bring outlays per pupil in line with the spending in coastal areas. If the gap in private expenditure on education relative to the coastal areas is also included, the total spending increase required would need to be of the same order of magnitude as the infrastructure investments under the Western Development Programme. One of the key reasons behind the under-investment in public service provision is that social spending comes predominately from local funding, which lies outside the ambit of the Programme; this also reduces the scope for national policy to influence regional policy outcome (OECD, 2010).

Figure 14. Investment share in the Western region



Source: OECD Economic Survey: China 2010, pp 131

Despite the government's ambition and efforts to achieve a 'co-ordinated development', however, regional disparity, in particularly per capita income level and human resource development, has continued to increase over the past decade. The underlying problem was that although the overall objective was to reduce poverty,

government programmes had mainly involved large capital-intensive projects designed to secure cheap resources from the Western region for the Eastern region. In other words, these projects often have national, not regional, goals such as national resource and energy security.

In order to achieve a "co-ordinated" green regional development, supporting policies for the "**Western Development programme**, "**North-East Rejuvenation programme**" as well as the "**Promotion of the Fast Rise of the Central Region programme**" need to be further improved in the 12ht FYP and beyond. These improvements should aim at coordinating the transformation process as well as increasing benefit-sharing and alleviating imbalance across regions. More specifically, the government needs:

- To fully explore the potential and utilise the capacity of the **Eastern region**, in the fields of industry clustering, S&T and innovation capacity, environmental protection as well as financial services.

- To take advantage of the improved transport infrastructure and abundant human resource endowment in the **Central and the Western regions**, and turn them into China's new manufacturing bases when production shifts from the Eastern region.

- To take advantage of the resource abundance (e.g. natural, land and human resources) as well as the richness of biodiversity and ecosystem in **the Western region** to develop sustainable mining, equipment manufacturing and new energies as well as to create new growth opportunities, in the fields nature-based tourism and traditional Chinese medicine industry.

Box 13. Pitfalls of regional development: The OECD experience

Most OECD countries have long had policies to develop poorer regions. These efforts often have limited success and they highlight pitfalls in the once popular development strategies:

- Reliance on large government transfer to regions with severe market distortions or where co-ordination is inadequate tends to waste resources and is of limited benefits;
- Infrastructure investments made without adequate assessment of future demand tend to be inefficient;
- Growth pole strategies, although once favoured, have not been very successful in practice;
- Fiscal resources need to be concentrated on promoting development rather than supporting or protecting declining industries;
- Policies need to take into account the characteristics of the regions and should not be simply replicated from other more advanced regions.

Source: OECD Review of regulatory reform: China. OECD, 2009

6.3 A sustainable industrial gradient transfer

In the midst of industrialisation and urbanisation, the industrial sector will remain the basis for China's economic growth as well as be an important source of employment for a long period of time. However, the geographical distribution/landscape of China's

industrial structure and manufacturing capacity is undergoing profound shifts, which will have significant impacts on the current and future regional development. During the 11th FYP period, **"industrial gradient transfer"** from the eastern coastal region to the less-developed interior and western regions generated a second "investment wave", driven by a combination of various factors. Firstly, in recent year, the manufacturing sector in the richer regions has experienced a double-digit increase in labour costs. In addition to the cost factor, under the pressure of increasingly stringent energy and environmental protection targets and land resource constraints, the eastern coastal region is trying to limit the expansion of the 'three-high' (high energy consumption, high pollution and high emissions) industries. Finally, the production shift is also part of the development and modernisation strategies of the eastern coastal region, which is facing the need to upgrade its industrial and economic structure. These factors have prompted businesses to look for new investment venues in the interior and western regions, and led to a rapid GDP growth in these regions, in particular in the heavy chemical, mining and building material sectors.

The structural shift of the "three high" industries has added complexity to the green economic development landscape in the less-developed interior and western regions. The main difficulty lies in the increasing reliance on the heavy industry, making an upward trend in energy consumption in the short term inevitable. Consequently, the gap between the pressure to save energy and reduce emissions on the one hand and rapid GDP growth on the other is becoming wider. At the same time, rapid and large-scale industrial expansion has also led to excessive investments and overcapacity building in many cases.

From an overall green development perspective, the relocation of these 'three-high' industries will not solve the problem and will only exacerbate the environmental and energy problems in the western and interior regions, if it is not managed properly. As China continues to industrialise and urbanise, the 'three-high' industries will most likely remain a major force of development especially in these resource-rich, but less developed regions. Consequently, the key issue for these regions is how to avoid a high-carbon and high-pollution lock-in as well as how to modernise and transform these 'three-high' industries through technology innovation and breakthrough. At the same time, it is important to highlight that these regions are often rich in ***both*** traditional fossil fuels and renewable energy resources, and many are also in the process of modernising their industrial and agriculture sectors. Green transformation in these regions – in particular using green development to overcome the problem of resource-curse – requires creating the right incentives for the desired mode of development and to strengthen human resources and governance capacity. It is important that the up-and-coming regions do not repeat the past mistakes of the coastal region of aimless expansion of low-quality and 'destructive' development.

In the process of industrial gradient transfer, coordination between the central, regional and local governments are particularly important. The ultimate objective is to achieve a coordinated regional development and to increase benefit-sharing and alleviating imbalance across regions. More specifically:

- Industrial gradient transfer needs to take place in a sustainable way. The key is to strengthen **supervision and monitoring** and to strictly **enforce the related legislations and regulations**. For instance, obsolete and highly polluting

equipments in the eastern coastal regions must be decommissioned locally and are strictly forbidden to be transferred to less developed region for re-use. Investment projects in the interior and western regions that do not meet the environmental standards and industrial regulations should also be strictly forbidden.

- The differentiated green regional development needs to be supported by **fiscal transfer schemes** and **innovative market mechanisms**. For instance, the fiscal transfer system between the national and regional governments can be adapted to facilitate the process of "differentiating" various functions and development objectives in different regions, such as developing ecological functional zones, securing food security, restructuring traditional manufacturing bases and promoting sustainable industrial gradient transfer.

- The development of specific **green regional development strategies** based on region-specific green development potentials and the need for environmental and ecological protection.

7. KEY TASKS 2 – TRANSFORMATION TOWARDS A GREEN AGRICULTURE

7.1 Green transformation of agriculture – definition

A green agriculture is defined as an agriculture that aims to promote food security and safety as well as ecological and resource security, relying on advanced science and technology, modern agricultural machinery and management concepts/systems. A green agriculture is an efficient and sustainable way of achieving the industrialisation of agriculture production and the standardisation of agricultural production process and products.

A green agriculture can meet the need for sustainable development, to secure food safety and to enhance the international competitiveness of agricultural products. It is in line with the market economic system as well as the increased global economic integration. A green agriculture also promotes a sound socioeconomic development that meets the need of consumer demand on the one hand and the need to increase farmers' income on the other.

Key characteristics of a green agriculture include:

- **Security**: Improvement in production capacity through technological advancement and material input to increase food security.

- **Standardisation:** Standardisation of production process and market rules through the adoption of technical standards and effective inspection and monitoring system to achieve food safety.

- **Sustainability**: Sustainable use and effective protection of agricultural resources and ecology, including adequate control of agro-chemicals use, to

ensure ecological balance and diversity. In particular, the agricultural resource security mainly refers to water and arable land security.

- **Efficiency:** high production and economic efficiency through optimal allocation of agricultural resources, and increased economic returns as well as enhanced international competitiveness.

7.2 Green transformation of agriculture – key elements

- The transformation of the **overall objectives** of agriculture development A shift from *quantity security* to *quality security* (food safety) of agricultural products, through which green agriculture gradually becomes China's leading model of modern agriculture.

- The transformation of **agricultural development policy**: A reorientation from an agricultural surplus/survival-focused policy to a development-based policy.

- The transformation of **agricultural production organisation:** A transformation from a household/family-based model to a diverse two-tiered management model.

- The transformation of **agricultural technical services**: A shift from a solely government-based technical service provision to a more market-oriented diversified model with a wider scope of stakeholders, including professional service providers/organisations and leading agribusiness and collective.

- The transformation of **agricultural management system:** A transformation from a "command-and control" approach to a system that combines regulatory, administrative and economic management measures.

7.3 China's green agriculture development – Overall objectives

The overall objectives of China's green agriculture development are to achieve:

- **Food security and food safety**
- **Agricultural resource security**, e.g. land use and soil quality problem associated with chemical fertilisers overuse.
- **Agricultural environment safety** e.g. water pollution, GHG emission and the negative impact of chemical use on the ecosystem.

In the field of green agricultural products, the objective is to accomplish a green agricultural products led green agricultural system in 50 years. A more detailed roadmap is provided in Table 10 below (Source: Green Food, 2008):

Table 10. The roadmap of green agricultural products 2011-2050

Time period	Milestone
2011-2030	• Green farmland will reach 26,7 million hectares; • The output of green agricultural products will yield 180 million tonnes and the revenue from green agricultural products will reach 1 trillion RMB.

2030 -2050	• China will become one of the largest producers of green agricultural products and a sustainable development in the agricultural sector will be preliminarily achieved; • The revenue of green agricultural products will account for 2/3 of the total of agricultural products; • The income level of Chinese farmers will reach the average income level of farmers in developed countries.

At present, there are more than 80 counties as well as some leading agricultural enterprises in 20 provinces (municipalities and autonomous regions) all over China have produced detailed planning and implementation measures to get prepared for "green economy" pilots/practice.

Box 14. Framework conditions for China's green agriculture transformation

Supply, Demand Factors and Supply-Side Constraints

Demand changes	Supply responses	Resource & structural constraints
Population growth	Land use management	Arable land and water shortage
Per capita income growth	Fertilizer nutrient management	Extreme weather
Ongoing urbanisation	Manure management	Environmental factors: o Land loss o Nitrogen o Salinisation o Eutrophication o Pests
Increased protein consumption	Irrigation	
Diversified diet/ changed seasonal pattern of consumption (vegetable, fruits)	Biotechnology	Carbon constrained economy/urgent need for emissions reduction
Increased demand for biofuels	Machinery	Food price control
	Industrial farming	Energy price increase
	Localised production	Infrastructure: o Irrigation o Transport & logistics
		Access to o Market o Finance/insurance o Technology

7.4 Immense challenges for the green transformation- the Chinese context

China is a large agricultural country and 60% of its population still resides in the countryside. Based on its medium and long term economic development plans, the primary sector will still account for 13% of its GDP and employ 40% of its workforce by 2020.

7.4.1 Resource constraints

Limited and decreasing arable land

According the official statistics (See e.g**.** China Land and Resources Statistical Yearbook, 2009**)**, China's arable land has decreased from 1,94 billion acres in 1998 to1,83 billion in 2008. As a result, China has set up the target to maintain 1.8 billion acres of arable land after the continuous and rapid decline in the 1990s and the rate of land degradation has been declining in the recent years.

Farm land pollution

Beyond the resource shortage, **soil quality/land productivity has also decreased** because of excessive use of fertilizers, pesticides, pollution and climate change. More specifically:

- **Soil contamination has been exacerbated in recent years**. According to official statistics, about 150 million mu[31] of arable land were, to various degrees polluted by 2006. The main causes of contamination include waste water irrigation (32,5 million mu) and solid waste (2 million mu). This accounts for more than 1/10 of China's (120 million hectare of) farm land and is highly concentrated in the economically developed regions.

- **The soil pollution has caused huge damages and economic losses, in particular associated with industrial pollution in the form of heavy mental discharge.** According to official estimates, 12 million tonnes of grain are polluted by heavy mental discharges and the direct economic loss exceeds 20 billion RMB annually. According to statistics from the Ministry of land and resources of China, by 2010, nearly 17% of China's farm land had been affected by heavy metal discharges/leaks. Contaminated soil accumulates harmful substances, which can enter the human body through the food chain, causing various diseases and ultimately damaging human health. Soil contamination also directly affects the ecosystem as well as the structure and function of soil, which eventually poses a serious risk to the ecological security.

  As the world's top consumer and producer of lead, China has been struggling to restrain polluting industries. In a recent announcement from the Ministry of Environmental Protection (MEP), the Chinese government will aim to cut pollution in key regions and industries, including cutting pollution from lead-acid battery manufacturing and lead smelting by 15% of 2007 level by 2015.

- **The foundation and the capacity for soil pollution prevention and control are weak.** At the present, the information regarding the scale, the geographic distribution and the degree of soil contamination is neither complete nor clear. Consequently, the measures that have been taken to deal with soil pollution are not sufficiently targeted and efficient. Furthermore, both the regulatory framework and the technology standards for soil environment protection are in their "infancy". Moreover, both financial support and soil science research are insufficient. The last, but not the least, A relatively large part of the general public and the business community are not sufficiently aware of or lack an understanding of the seriousness and the damage associated with soil

[31] 1 mu ≈ 0,0667 hetares.

pollution.

Land degradation

Soil erosion, land degradation and desertification are serious resource concerns faced by the development of China's agriculture. According to official statistics from the Ministry of Water Resources of China, at the end of 2010, the area of soil erosion had reached more than 3.6 million km^2 and nearly 2 million km^2 are in urgent need for treatment and restoration. 646 counties all over China suffer from severe soil erosion. The economic loss caused by soil erosion is estimated to amount to over 2,2% of GDP and the environmental and ecological loss is far more extensive with long-term negative impacts. The soil erosion thus poses a "serious hidden danger" to China's security and its capacity for sustainable development.

According to a report from the State Forestry Administration of China, at the end of 2009, the total desert land area was 2,6 million km^2, of which more than 1,7 million km^2 was caused by desertification (resulting from over-cultivation, over-cultivation, logging and droughts, etc) However, there has been some signs of improvement in the past years. For instance, in the past five years to 2010, the area of desertification is estimated to have shrunk by a total of 8587 km^2 , or by an annual average of 1,717 km^2 (This was 40% better than the results from 2000-05 and the first in China's history to ever show a gain).

The desertification has, to an extent, been stabilised but recovery efforts need to be stepped up. At the same time, deserts continue to expand in some regions (because local officials ignore restrictions on land reclamation and water use as well as due to the climate change).

Grassland degradation

90% of China's usable grassland suffers form degradation to various degrees. According to official estimates, at least 70% of China's grassland is in medium or severe degree of degradation, reaching around 4 billion mu. While some small-scale and local improvement has been achieved, the overall degradation trend is still hard to reverse.

As the number of livestock continues to increase, this leads to a chronic overloading of grassland, with an overload ratio ranging from 48%-100% in six pastoral regions of China. This poses a serious threat to the national ecological security.

Large water use in agriculture

The Chinese agricultural sector has been a large water user. The water use in the Chinese agricultural sector reached more than 370 billion cubic meters in 2009, accounting for more than 60% of total water use in China and this ratio has remained in the range of 60-70% since 1997. However, it is also important to note that there is also a large regional variation across regions.

Table 11. Water use in agricutre in selected years

	1997	2001	2007	2009
Total water use (100 million m^3)	5566.0	5567.4	5818.7	5965.2
Water use in agriculture (total, (100 million m^3)	3919.7	3825.7	3599.5	3723.1
Water use in agriculture (share of total, %)l)	70.4	68.7	61.9	62.4

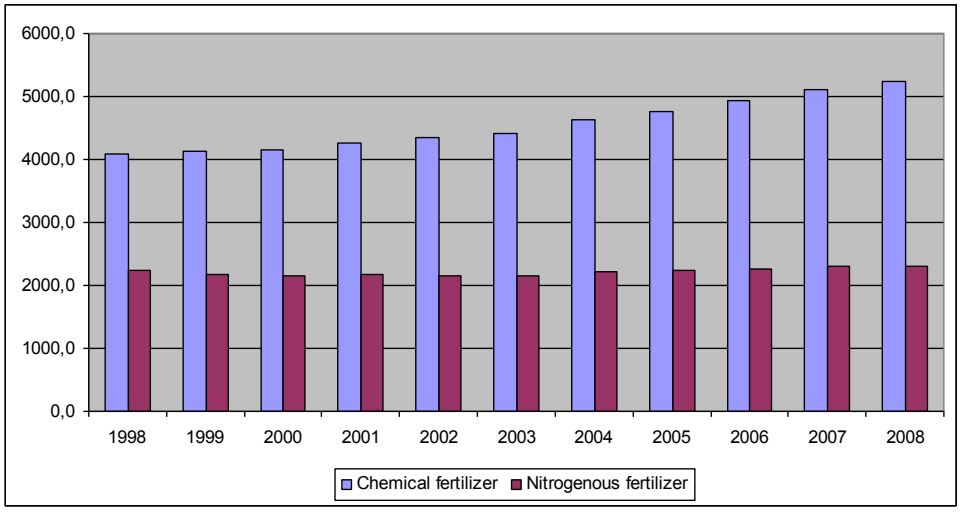
7.4.2 Pollutions in the agricultural sector

Overuse of chemical fertilisers

Given China's limited opportunity for expanding the area under cultivation, the increase in food production in the past 30 years came largely from land use intensification based on greater irrigation, improved crop varieties and a substantial increase in the use of synthetic nitrogen fertilizer. As shown in Figure below (See Figure).

From 1998 to 2008, the amount of chemical fertiliser has been continuously increasing, from around 41 million tonnes in 1998 to around 52 million tonnes in 2008, with an annual increase of 3%. The average fertiliser use per unit of land has also increased from 315 kg/ha to 430 kg/ha in the same period. A large proportion of the increase has been driven by a decline in nitrogen use efficiency (NUE).

Figure 15. Consumption of Chemical fertilizer in the Chinese agriculture[32]
(1998-2008, 10,000 Tonnes)



Source: China Statistical Yearbook, 2009 Table 12-6.

[32] Other chemical fertilisers include: phosphate, potash and compound fertilisers.

Much of the excess nitrogen is lost to the environment as gases or in water draining from the soil. Nitrogen lost from the soil as nitrate is one of the major causes of nitrate contamination of drinking water supplies and of eutrophication, algal blooms and red tides in lakes and coastal water, which lead to serious impacts on human health. The massive dependence and the overuse of chemical fertilisers thus waste energy and other resources, as well as add to water pollution and greenhouse gas emissions.

For instance, in the current practice of cultivation using nitrogen fertiliser, the total nitrogen loss is estimated to be about 70%, with the largest portion lost into water, about 20% returns to the atmosphere and a small number of residuals concentrates in the soil. According to some research, the loss/overuse of nitrogen fertiliser on grain and vegetable crops is estimated to be at least 9 million tonnes annually out of the total annual use of above 20 million tonnes. Using a 46% nitrogen content in urea and a unit price at 1500 RMB per tonnes as a benchmark, the direct annual economic loss caused by the overuse of nitrogen fertiliser can be estimate to about 30 billion RMB.

One of the important policy issues related to the overuse of nitrogen fertiliser in the Chinese agriculture is technology standard setting for the cultivation practice. According to the "Production Technology Guideline for Green Agriculture", the total amount of inorganic nitrogen use should not exceed 300 kg per hectare and year. In an international comparison, the highest nitrogen use, including inorganic and animal manure, is limited to 300 kg per hectare and year in Germany. Thus, the standard of green agricultural production in China is still very low.

Dealing with the overuse of fertilisers is therefore an illustrative example of reconciling the objectives of food security and safety and the urgency of tackling various environmental pressures. The key objective is to help farmers use less nitrogen fertiliser without lowering crop yields and risking food security.

To achieve a "win-win-win" situation, i.e. income gains for farmers, food security and reduced environmental impact through the reduction of nitrogen fertiliser overuse would require better information and technical support to the farmers to improve nutrient management as well as institutional changes to correct the existing "market and policy failures" (See more detailed discussion in Section 5: Subsidies on fertilisers in the Chinese agricultural sector).

Highly toxic pesticides and low-quality plastic use

- **The pollution caused by toxic pesticide: The pesticide use was 1.2 million tonnes in 1998 and increased to over 1.7 million tonnes in 2008.** The unsustainable use of pesticides creates serious pollution by toxic chemicals in soil and water, in particular in the form of Persistent Organic Pollutants (POP). For instance over the past 30 years, the cumulative use of HCB (hexachlorobenzene) and DDT reached about 5 million tonnes. Today, DDT can be found in most soil and water sources, such as, rivers, lakes, sediments and coastal waters in China.

- **The "white pollution" caused by the use of plastic film:** The use of plastic film was 1.2 million tonnes in 1998 and increased to 2 million tonnes in 2008. The farm land covered by plastic film increased from 9.7 million hectares in

1998 to 15 million hectares in 2008. China has thus become the world's largest producer and user of agricultural plastic films. However, as the large amount of residuals of the plastic films in the soil is difficult to break down/degrade naturally it causes serious "white pollution" and threatens environmental security as well as affecting crop growth adversely.

- **The pollution caused by low-quality fodder and fodder with toxic heavy metals:** The fodder industry in China has grown steadily since 1980 with a production increase from 1.1 million tonne to 156 million tonnes in 2010. The value of the industrial output has also increased largely from 20.7 billion RMB in 1990 to 500 billion RMB in 2010. While the rapid development of the fodder industry has contributed to the development of Animal husbandry, the extensive use of feed additives causes serious damage on aminal and human health as well as deep-rooted and long-term and environmental och ecolgoical problems.

  In recent years, the widespread use of additives with a high level of Cu and Zn and As contents has caused serious concerns. For instance, using an annual production of 100 million tonnes of fodders and 10 million mixed fodders as a benchmark, this production level will consume 330 000 tonnes of copper sulphate, of which 320 000 tonnes will discharge into the environment. For another illustration, a pig farm in China with a capacity of raising 10,000 pigs, will, on average emit 4200 kg Cu (copper) and 140 kg As (arsenic) annually, wasting both resources and causing serious damages.

The impact of industrial pollution on agriculture

The impact of industrial pollution on agriculture can take place in the form of pollution to the atmospheric environment, water and soil. In the process of industrialization, in particular in the ongoing process of the industrial gradient transfer across regions, the agricultural impact resulting from the transfer of industrial pollution is increasing. More specifically:

- Industrial emissions into the atmosphere, which leads to excessive concentration of heavy metal and other pollutants in crops and vegetables;
- Industrial emission to water, which causes serious pollution and damage to fish and fishery ecology;
- Inappropriate treatment of industrial solid waste, which pollutes soil and threaten food quality and security.

7.4.3 Food security pressure

Weak capacity in agriculture products safety monitoring and management

Specific weaknesses related to the monitoring and management capacity include:

- The development of a food safety monitoring and management system is still at an early stage, especially in relation to the specification of the scope and content of the monitoring and control system.

- The small scale as well as fragmented food production structure in China make it difficult to establish a regular, standardised and organised/institutionalised food safety monitoring and management system.

- The lack of coordination between different monitoring and management agencies. Food security monitoring and management also needs the collaboration of both the government and non-governmental actors using a mixture of tools and economic instruments.

7.5 Analyses of overuse of fertilisers in the Chinese agricultural sector

7.5.1 Factors related to excessive supply of fertilisers

One of the important contributing factors that have stimulated the excessive supply of fertilisers is the preferential policies that the Chinese fertiliser industry has been benefited from which in turn reduce their production costs and spur excessive production.

During a long time period, fertiliser producers in China have been eligible for various types of subsidies, such as price rebates in electricity and gas consumption and transport cost compensation. The amounts of subsidies vary significant across different regions of China. For instance, calculated by the differences of electricity prices that by the fertiliser producer and that paid by other large-scale industrial enterprises, the government in Anhui province provided 1.14 billion RMB annually as electricity price rebates and the amount of the same type of subsidy in Jiangsu province reaches 2.24 billion RMB. To top up the subsidies at the national level, the Chinese government provides around 10 billion RMB every year to the fertiliser industry.

The average level of subsidies to the medium- and small sized fertiliser producers in the form of electricity price rebates is 0.208 RMB/kwh in 2009. The highest level can be found in the most developed regions, such as Zhejing, Shanghai, Jiangsu, where the subsidy is 0.35 – 0.39 RMB/kwh, while the lower level is in the less-developed regions with the subsidy level is around 0.20-0.25 RMB/kwh or below.

The key observation here is that the electricity price subsidy is higher in the East region compared to the central and west regions and that the subsidies are higher in non main crop-production zones than in main crop-production zones.

In terms of the natural gas price, the prices paid by the fertiliser producers are, on average, only 87% of the prices for the industrial sector as a whole. For instance, while the average natural gas prices for fertiliser producers has been 656 RMB/m^3, the average prices in the industrial sector was 753 RMB/m^3.

Regarding transport costs, the transport cost (by rail) for fertilisers has been on average 0.024 RMB/tonne/km, which is 0.062 RMB/tonne/km cheaper compared to the transport cost of other chemical products. According to estimates made by Green Peace, the transport costs of the fertiliser industry have been reduced by 6.19 billion RMB annually because of the transport subsidy.

7.5.2 Factors related to overuse of fertilisers

The overuse of fertilisers is attributed to both technology and market factors, which can be summarised as follows:

- The inefficient use of fertilisers in terms of both the way fertilisers distributed over the arable land and the composition of various fertilisers.
- The weak substitution between chemical fertiliser and organic fertiliser. The industrialisation of livestock farming has led to increased availability of organic fertilisers. However, due to both inefficient organisation of organic fertiliser utilisation and increased labour costs in the agriculture, the organic fertiliser has not become a sufficient substitute for chemical fertilisers. On the contrary, in the competition with chemical fertilisers, the use of organic fertilisers has actually decreased, which leads to both soil pollution associated with the overuse of chemical fertilisers and increased pollutions caused by inefficient treatment of animal wastes and biomass waste.

- Excessive water use in irrigation which leads to both the waste of water resources, fertilisers and results in salination of arable land.

- Lack of agricultural insurance and risk management. In the absence of a comprehensive and functioning agricultural insurance and risk management system, the use of fertilisers acts as a "yield insurance" for Chinese farmers. The Chinese Academy of Sciences (CAS) carried out a pilot to encourage the farmers to use less chemical fertilisers by the promise of compensating the eventual yield and income losses. However, the result was disappointing as the involved farmers were not willing to take the risk of reduced crop yields and reduce their use of fertilisers.

Box 15. Agri-environmental Policy Design – lessons learned from fertilizer use in OECD countries

To achieve an intended objective, a plan and means to reach it are required. The desired objective should be defined for both environmental and economic (cost-effectiveness) goals. OECD (2010) has developed some general policy design parameters. These can be illustrated with the example of policies that influence fertilizer use in OECD countries. The starting point here is that in the absence of policies, farmers may use too much fertilizer given the harmful environmental effects of overuse are not all borne by the farmer.

A fundamental question is to whom the fertilizer policy should be applied. Policies should generally, though not always, be directed at those who are directly responsible for environmental harm or who are most capable of providing environmental enhancements. Monitoring, enforcement and environmental protection costs are important considerations. However, this is complicated by the uncertainty about how farm-level actions, for example on fertilizer use, will translate into environmental improvements.

Targeting producers on the basis of environmental compliance costs can also be complicated by uncertainty on the part of the regulatory agency about farmers' costs. Farmers generally have better knowledge of their compliance costs than policy makers. This ***asymmetric information*** creates a problem that is referred to as ***adverse selection***,

which limits the policy marker's ability to tailor policy instruments to address individual producers' circumstances. Some types of instruments can perform better than others in the presence of this uncertainty, so that asymmetric information about compliance costs can be a fundamental driver in the choice of one instrument over others.

What is the appropriate measure or basis of compliance at the farm level? Compliance measures can be broadly differentiated between those relating to farmers' input and technology choices (input-based) or to environmental outcomes (performance-based). An input-based approach could target directly the price/quantity or quality of fertilizer, whilst a performance-based approach could focus on nutrient run-off. In OECD countries, the first-generation environmental policies (i.e. those enacted in the late 1960s and 1970s) were largely input-based. Currently, fertilizer levies are applied in Italy, Sweden and some states of the United States.

There is however ample evidence that input-based policies overtly limit the flexibility of farmers to choose cost-effective options for reducing their own emissions. The result is reduced efficiency and, in some cases, failure to achieve the objectives. Therefore, there is increasing emphasis on performance-based instruments that focus on ends than means. Performance standards can promote farm-scale cost-effectiveness by allowing producers the flexibility to meet mandated environmental outcomes in any way they choose.

Source: Guidelines for Cost-effective Agri-environmental Policy Measures. OECD, 2010

7.5.3 Policy measures to tackle overuse of fertilisers

Dealing with the overuse of fertilizer is an illustrative example of reconciling the objectives of food security and safety and the urgency of tackling various environmental pressures. The key objective is to help farmers use less nitrogen fertiliser without lowering crop yields and risking food security.

Some international experiences, e.g. from the Netherlands, provide useful insight for China when dealing with the economic, environmental and social issues related to the fertiliser. The key measures taken by the Netherlands since the 1980s were 1) to instigate specific legislations for the control of fertiliser utilisation 2) to promote integrated resource management to increase the efficiency of fertiliser utilisation.

In the Chinese context, the following measures should be taken into consideration:

- **To remove subsidies of fertiliser production and liberalise fertiliser prices:** both the subsidized production costs and subsidized retail prices of fertilisers contributed to overuse of fertilisers. In 1998, the Chinese government made attempts to liberalise fertiliser prices through departing from the price ceiling set and regulated by the government towards a more market-oriented price setting. In 1995, the Chinese government took several steps forwards and proposed reforms to remove the price ceiling and preferential policies in the fertiliser industry. Instead, the subsidies to fertiliser producers were diverted to subsidies directly to farmers. However, due to the sharp increase in fertiliser prices in 2005, the Chinese government was forced to slow down the pace of the reform. In 2009, the Chinese government once again removed fertiliser price ceilings and adjusted import and export taxes on fertiliser.

- **To increase subsidies to crop production:** 74.1% of the total fertiliser utilisation is used in crop production, where chemical fertilisers are the dominate part. There is a close connection between the reduction of chemical fertiliser use, the concern with food security and the fluctuation of farmers' income. Therefore, the removal of price ceilings and the increase of fertiliser prices need to be balanced with the increase of subsidies to crop production. Instead of providing subsidies to fertiliser producers, the subsidies should be directly provided to farmers. The level of subsidies to farmers should be in accordance with the increases in fertiliser prices and the fluctuation in food prices to secure both farmers' incentives for crop production and the stabilisation of production of other agriculture products.

- **To improve the efficiency of fertiliser use through technical support and capacity building for farmers.** The coverage of the practice of "soil testing and formulated fertilisers, where the formulation is based on the soil and crop demands needs to be increased (instead of on raw material prices and economic effectiveness as the practice of many Chinese compound fertiliser producers). Other more scientific and sustainable agriculture practices which should be promoted and encouraged are integrated irrigation and fertilization management, replacement of chemical fertilisers with organic fertilisers and straw manuring as well as integrated soil fertility management. The policy support and subsidies should be in place to encourage the service providers and consultancies that are engaged in promoting the practice of "soil testing and formulated fertilisers" and other sustainable agriculture practices.

- **To improve the production and utilisation of organic fertilisers:** The key bottleneck to increase organic fertiliser use is that the production of organic fertilisers has not reached a large-scale and industrialised production process, despite the increased amount of animal and biomass wastes resulting from the industrialised livestock production. Therefore, to develop the industrialised organic production in connection with the industrialised livestock production, which is similar to the concentrated and large-scale waste treatment in industrial parks, will be a necessary and efficient way of developing a "circular economy". The subsidies to the chemical fertiliser industry should be diverted to the organic fertiliser production instead.

Finally, it is important to note that the problems of China's agriculture sector go far beyond excessive fertiliser use. The main challenges, such as post harvest crop loss, inefficient irrigation and food waste (the avoidance of which could reduce the need for increased production/pressure on land) all call for policy support and immediate actions.

Box. 16 Key tasks for the green agriculture transformation

1. To improve the geographical and strategic planning for agricultural production
2. To strengthen the development of green agriculture bases and to promote sustainable industrialisation of the agriculture sector

- To enhance production technology and supervision at key green agriculture bases
- To promote the development of leading green agribusiness enterprises
- To promote the development of modern agriculture through accelerated technological

innovation
To establish a green agriculture information network

3. To strengthen non-point source pollution control and to promote an integrated approach to rural/farm environment management

- To improve the standards of green agriculture bases development;
- To strengthen agricultural non-point source pollution control

8. KEY TASKS 3 – GREEN TRANSFORMATION OF THE INDUSTRIAL SECTOR

8.1 Contents and strategic importance of China's green industry transformation

In the industrial sector where its factor endowment structure and technological characteristics are important elements of a green economy, a green industry transformation is defined as:

"a new pathway of industrialization that seeks to 'green' the whole industrial production process and to achieve the co-benefits of economic and environmental efficiency, guided by the principle of resource saving and environment friendly and the core strategy of green innovation"

In essence, the green industry transformation is a process of achieving:

- Efficiency in the use of energy and resource;
- Reduction in emission of pollutants;
- Mitigation of environmental impact;
- Improved labour productivity;
- Enhanced capacity for sustainable development.

In the past three decades, China's industrial sector has achieved the most rapid growth as well as has been subjected to the most profound reform and degrees of market openness. Consequently, it has made a significant contribution to China's continuous economic growth and enhanced China's international status.

However, China's growth and industrialization have relied heavily on a resource-intensive pathway, which is characterized by "high-inputs, high-consumption, high-pollution, low-quality, low-efficiency/profitability, and low-output". Similarly, a "first pollute, treatment later" approach has been adopted when it comes to environmental protection.

The financial crisis has had a severe impact on China's industrial sector. Nevertheless, with the support of the stimulus package and the "Top Ten Industries Revitalisation Plan" introduced by the Chinese government, the industrial sector has managed to adjust and adapt, and continues to drive China's economic recovery.

Currently, China is at a critical juncture – it is half way through its industrialization process and is in the process of upgrading its consumption structure. On the one hand, as the backbone of the Chinese economy, the industrial sector should still have a huge development space in both the domestic and the international markets. On the other

hand, the (continuous) expansion of its heavy industry, which resulted in resource waste, environmental degradation and structural imbalance, imposes serious constraints on China's sustainable development.

The 12th FYP period (2011-2015) hence presents a crucial turning point for China's growth mode; it will also bring important strategic opportunities for the green transformation in China's industrial sector. In a fast-changing domestic and international context, China needs to accelerate the change of its development mode and the green transformation in its industrial sector. This is an inevitable strategy for China to continue the expansion of its manufacturing sector and to achieve a more sustainable international competitiveness.

8.2 Priority areas in the green transformation of the industrial sector

8.2.1 Strategic and emerging industries

The 12th FYP sets out the goal to "foster and develop the strategic and emerging industries into the leading, pillar industries". The strategic and emerging industries stand for the strategic and long-term objectives of greening and upgrading of the Chinese industrial sector. At the same time, these sectors will also be the focal point of competition in the global market in the near future. The strategic significance attached to, as well as, the regulations and policy instruments introduced to promote these sectors are attracting an increasing amount of investments from various sources. In other words, there is a growing investment boom in these strategic and emerging industries.

However, the difficulties as well as the uncertainties of achieving this strategic objective should not be underestimated. A few examples are given below:

Technology and investment uncertainty

In the fields of new energy, new material and new energy vehicles, there are uncertainties in relation to both technological choices (in terms of the possibilities of technical break through, production and service models) and the feasibility of the scaling-up, industrialisation and commercialisation of new technologies in the Chinese market. For instance, before the smart-grid technology has become mature and is widely applicable in the Chinese market, it will be difficult to deploy and diffuse some of the distributed and small-scale renewable energy technologies (such as solar electric panels and small-scale solar power stations). This is compounded by the current standard of living and household behaviour in Chinese cities.

Although the new energy industry is now attracting investments from various sources in China encouraged by the incentives of government subsidies, the above uncertainties will impose considerable investment risks, which may discourage investments from the private sector (the non-government sectors) in the strategic emerging industries.

The "green rush "at the regional and local levels

The development of new and emerging industries has also become the key priorities at the regional level in the 12th FYP period. Regional and local governments have devoted substantial resources to develop regional development plans and strategies as well as to establish new and emerging industrial parks. However, there are some problems with the blind pursuit of "green development" at the regional level. It is not uncommon that many regional and local government officials have limited understanding of the nature of these strategic emerging industries and the physical environment and human resources required for the development of these industries. The establishment of some of the "new strategic industries industrial parks" has become a front for speculative real estates investments. This not only will not contribute to the development of infrastructure and innovation environment necessary for the development of new industrial clusters, but also wastes huge financial and land resources.

A new pattern of labour-division along the production and value chain?

Currently, international division of labour for strategic emerging industries (as defined by the Chinese government) has yet to fully-established. Given the greater technological and resource needs of these industries, the government will play a particularly important role in the development of these industries through the creation of a favourable policy environment and market mechanisms. Consequently, labour-division along the production and value chain in these strategic emerging industries will not necessarily be defined by the comparative advantage in production factor prices alone, but will also be influenced by the extent of government's support. The new division of labour in the strategic emerging industries may even lead to a new mode of international competition (and collaboration).

On the one hand, novel technological choices, ways of production and types of service provision in the fields of new energy and new material are leading to fundamental changes in technology development and innovation model of existing industries. This will in turn create new industrial dynamics where the market dominance of incumbent industrial leaders is becoming less stable and new entry and growth opportunities are open to new actors.

Against such a backdrop, the technical and innovation gap between the emerging economies (such as China) and the industrialised economies is relatively narrow, as both are currently at the closer starting point in the green race.

In China, the substantial technical capacity and capital accumulated in the past three decades as well as the sheer market size have laid down a solid foundation for China to achieve breakthrough in the strategic emerging industries. In some new energy fields, in particular in wind and solar energy, the manufacturing capacities and the market shares in international markets of Chinese producers have already imposed significant competitive pressures on their competitors in advanced industrialised countries.

On the other hand, limited knowledge and experiences, lack of core technologies and know-how, problems with industrial standard-setting and weak capacity to participate in international rule-making will constrain the international competitiveness of Chinese companies. Consequently, it will be particularly challenging for strategic

emerging industries to lead China's new green growth in the 12th FYP period. In the long term, if the problems of lack of core technology and know-how persist, China will continue to lag behind in the development of strategic industries and in the transformation towards a green and low-carbon economy.

8.2.2 Greening and transformation of traditional industry

Despite the weakening of China's comparative advantage associated with low labour cost, the traditional labour-intensive manufacturing sector is, and will still be, the core/ pillar of China's industrial sector in the foreseeable future. Over the past three decades, a large number of enterprises and entrepreneurs have accumulated rich market experience and manufacturing capacity. By having strong incentives to respond to the fast-changing market conditions and ambitious visions regarding the global market, these enterprises will create a dynamic market force to propel China's transition towards a greener manufacturing sector. Furthermore, faced with the financial crisis and increased labour and raw material costs, there is a strong willingness among export-oriented manufacturing enterprises in the eastern and costal regions to transform and upgrade their production and products. On the one hand, there is an accelerated shift of labour-intensive manufacturing to China's inland and central western regions, and to Southeast Asia, Africa and Latin America to make room for structural upgrading and technical advancement in China's coastal and eastern regions (the strategy of "emptying the bird cage for a new bird". On the other hand, these enterprises are also investing in new technology and process innovation to increase the degree automaton, which will help to reduce the production costs and to achieve higher value-added.

In energy-intensive industries, through stringent energy-saving and emission reduction targets and extensive programmes to eliminate backward production capacity, the greening of the power, steel and cement sectors has been accelerated. Some of the industrial standards have reached, and even exceeded, the standards in advanced industrialised economies. For instance, the recently released "Emission Standards for Coal-Fired Power Plants" outlines emission standards that are more stringent than many OECD countries. Advanced SO2 and NOx abatement equipment and technologies have also been introduced and deployed. In the cement sector, energy-saving technologies such as the new dry-process cement production and waste heat utilisation have also been widely deployed. As a result, several key technology indicators, such unit energy consumption of clinker, have reached and even exceeded the levels in some advanced OECD countries.

Given China's current industrial structure and industrialisation stage, there is a huge scope for the green transformation of the traditional industries, which will also set the pace of China's future green development as a whole. However, the challenges and difficulties in the green transformation are also apparent. For instance, the labour-intensive manufacturing sector is dominated by small and medium-sized enterprises that often have difficulties in obtaining government support for their technological upgrade and innovation. At the same time, access to support and services provided by the financial sector (e.g. bank loan, financial services, etc.) by small- and medium-sized enterprises is also limited.

8.2.3 Manufacturing-related services

Since the beginning of the 21st century, manufacturing-service integration has become an increasingly prevalent global trend in the development of a modern and advanced manufacturing sector. In particular, for many multinational enterprises in the high-tech sectors, services have become the main sources of revenue. At the same time, driven by globalisation and the development of information and communication technologies (ICT), the links between manufacturing and service along the value chain have also become increasingly differentiated and diversified. This creates a great development potential for the manufacturing-related service sector. As the most profitable and competitive element along the value chain, manufacturing-related services have also become a key driver of the development of service sector in advanced OECD countries.

As China experiences structural upgrading, deepened specialisation in the manufacturing sector as well as the geographic shift of its manufacturing bases to the central and western regions, manufacturing-related services will become a key priority area in the 12th FYP and even in the longer term. It will be an important strategic development, through which the value chain can be extended, productivity can be improved and new and green jobs can be created.

In recent years, the Chinese government has actively supported the service 'insourcing' sector and the development of service 'insourcing' centres/cities. These state-supported service insourcing centres include eastern coastal cities such as Beijing, Shanghai and Dalian, and also cities in the western region with relatively rich human resource endowment such as Chengdu, Xian and Wuhan. These centres have managed to attract many world's largest software development and ICT multinationals. In contrast with traditional industrial parks, these centres are driving the so-called 'office-based' or 'building' economy, which can more easily be turned into low carbon industrial clusters. By having high output/value-added and low energy consumption per unit of land use, and being more environmental friendly and resource-efficient, these service insourcing centres will facilitate green transformation at the local level and create new employment opportunity for university graduates.

However, due to the backward production process as well as the overall low skill level in the service sector, the development of manufacturing-related services in China is still at its infancy with low degree of commercialization and growth capacity. Currently, there are few linkages between foreign-invested companies and domestic manufacturing-related services. In addition, regional cluster and coordination is still weak and private investments in manufacturing-related services are still limited In particular, traditional manufacturing-related services such as finance and logistics still face serious bottlenecks, including low degree of product differentiation, low management efficiency, high operating costs and low skill level of employees. For "high-end" service sectors such as R&D and technology consultancy, small-scale firm sizes, low level of market penetration and lack of support and promotional mechanisms are the main constraints. As a consequence, in the 12th FYP period, the manufacturing-related services sector faces not only the challenges of how to support the transformation of the industrial sector, but also how to improve its own capacity to provide green services.

8.3 Key tasks of the green industrial transformation

To promote the transformation of industrial energy consumption through improvement of the energy supply structure

The basis of the green economy transformation is to improve the efficiency in energy use and to promote the development and utilisation of renewable energy. More specifically:

- **To build up a clean, stable, secure and diversified energy supply system:** This should be achieved by reducing the use of fossil fuels as much as possible and by making great efforts to develop renewable energies, such as solar, wind and biomass as well as through the development of nuclear power;

- **To further strengthen the binding targets of energy saving and emission reduction:** Technology standards and energy saving related regulations need to be improved, and market-based mechanisms as well as "stick-and-carrot" incentive structure need to be continuously strengthened. Advanced energy-saving technologies and products need to be developed to promote energy-saving and emission reduction in the industrial sector.

- **To further consolidate the power generation capacity:** Small-scale and low-efficiency power generation capacity should be replaced by large-scale and high-efficiency combustion units that have less environmental impact.

- **To use fiscal policy (e.g. subsidies) and tax measures to encourage the development of alternative energy vehicles**, including vehicles powered by electricity, solar power or natural gas, through which the use of fossil fuels can be reduced.

To realise/accomplish technological green transformation through strengthened indigenous innovation capacity

- **To enhance R&D and indigenous innovation capacity in the industrial sector in a comprehensive way.**
- **To improve the quality of technology introduction and absorptive capacity.**
- **To draw useful international experience:** New standards for green technology, design and products at the sector level and standard management practices need to be set up as soon as possible. Existing system to formulate standards needs to be amended or revised at the same time as new standards are being set up to accelerate the promotion and diffusion of new technologies and new products.

To build a green industrial system and to promote green structural transformation

- **To continue the process of eliminating backwards production capacity in the energy- and emission-intensive sectors.**

- **To continue industrial consolidation and re-structuring** with technology

upgrading and structural improvement as a starting point;

- **To develop emerging and strategic industries** which can form the basis of a breakthrough in the green industry transformation;

- **To develop a service system to support green industrial transformation** in the fields of green logistics, green finance as well as manufacturing related services, such ICT service, R&D service and business services, etc.

To promote the green transformation of industrial products export through the adjustment of domestic and international demands (as a key driver of economic development)

- **To encourage exporting enterprises to accelerate the process of upgrading and transformation:** Exporting enterprises need to extend their production value chain, enhance the image of their brands and enlarge the scope and/or scale of products with indigenous technologies. This will help to enhance the international competitiveness of "Made in China" products.

- **To continuously improve the systems of export quotas and export tax refunds:** The exports of scarce resources as well as "high energy-consumption, high-pollution and high emission" products need to be strictly controlled in order to optimise the international trade structure.

- **To apply a strategy of "import diversification**": Great efforts should be made to introduce advanced green technologies and core equipments (and to strengthen the exploration and utilisation of overseas resources and energies).

To accelerate the green transformation of consumption pattern by broadening participation (especially of the public).

Concrete measures that can be proposed include:

- **To initiate green public procurement programmes:** A "green purchase list" should cover the majority of green products. The green public procurement standards should be improved to guide and stimulate green consumption and lifestyle.

- **To carry out information dissemination and educational activities for both the supply and the demand sides of a "green market**": Enterprises should be encouraged to take their social and environmental responsibilities seriously. Green commerce practices should be promoted and standardised. At the same time, ideals and (social) values associated with green consumption should be advocated.

- **To promote green Product Life-cycle Management (PLM)**: The concept of green consumption needs to be extended to include green PLM practices, through which a product's environmental impact can be minimized throughout its entire lifecycle, i.e. from transport/distribution, storage, packing to end-of-life management.

Attracting foreign and domestic capital investments and participation in China's green industrial transformation

Both green technology RD&D (research, development and deployment) and the development of emerging strategic industries require large amount of green investment. In a market economy, the government should play only a guiding role and public funds should be channeled to strategic areas and core technologies; the majority of green investments should come from private sources.
Therefore, the Chinese government should provide more supporting policies, such as bank loans and credit guarantee, to encourage the flow of private capitals into green industries such as new energy, new energy vehicles and smart grid.

At the same time, in a globalised world, China needs to further open up its market for new green industries and service sector, and should attract foreign technology and know-how through foreign direct investment. In order to do this, China needs a more open and sophisticated green transformation-oriented investment and response system.

Robust implementation of the concept of green economy and creation of a green management and social monitoring system along the whole industrial value chain.

As shown from experiences in developed countries, voluntary readjustments and actions by the business and industrial sectors could help accelerate the process and reduce the cost of green transformation. Therefore, the dominant role of businesses and enterprises in green transformation should be emphasized and enhanced.

At the same, the role of the civil society, including the general public and non-governmental organisations, should be encouraged and fully utilised, particularly in promoting the concept of green consumption and lifestyle. This will help build a more robust social monitoring system for green development and stimulate demand for green production, products (and service).

Box 17. Key tasks for transformation towards a green Industrial structure

1. To accelerate industrial structural upgrading and to establish a green industrial structure

- To accelerate industrial adjustment and to raise the overall level of industrial 'greening'
- To balance export growth and to further optimise international trade structure.

2.To promote green transformation of traditional industrial sectors through industrial upgrading and modernisation

- To intensify the elimination of backward production capacity
- To strengthen technological innovation.

3.To vigorously develop the emerging strategic industries to lead green economic growth.

To strengthen strategic planning to foster new green growth

- To identify key industries and priority areas using scientific methods, taking into account key local characteristics and condition
- To actively foster and support core technologies, core competences and key actors for

the emerging strategic industries. In particular S&T and innovation capacities of SMEs and the role of SMEs in the national innovation system should be strengthened.
- To accelerate green innovation to achieve breakthrough in core technologies

4. To encourage green innovation by enterprises and enhance their core competitiveness
- To enhance the overall industrial technological R&D and indigenous innovation capacity
- To improve the quality of (foreign) technology introduction and absorptive capacity
- To develop a set of industrial standards and management rules for green technology, design and products.

5. To increase energy saving and emission reduction efforts and to strengthen corporate environmental responsibility
- To strengthen and further improve the system of data collection, monitoring and performance assessment for energy saving and emission reduction, and to set up a "responsibility and accountability" system
- To promote comprehensive and integrated use of different measures to incentivise enterprises to take energy saving and emission reduction actions.
- To strengthen environmental responsibility management of China's overseas foreign direct investment

9. KEY TASKS 4 – CREATE A GREEN SERVICE SECTOR

9.1 The strategic importance of service sector in China's green transformation

The role of structural adjustment, i.e. an overall structural shift from the capital-intensive and heavy industry-dependent growth to a more labour-intensive and knowledge/skill-driven economy, has been moderate under the 11th FYP. For stance, the service sector, in terms of its share of the overall value-added in the GDP and its share in the total employment, did not meet the targets set out in the 11th FYP. In other words, green service, which so far has been an underutilised catalyst for green transformation needs to be developed, with greater speed and scope.

In this context, the development of a vibrant service sector will have a strategic importance for the 12th FYP from at least three perspectives:

- From a **macroeconomic perspective**: to achieve a green transformation while at the same time "**securing economic growth, expanding domestic demand** and adjusting economic structure" is *not* a straightforward task. For instance, according to the estimates from DRC, if China's annual growth rate is to be sustained at 8,5% while the growth rate of exports is to be decreased by 5% compared to the average growth rate during the period of 1978-2008 (which was around 20-25%), this would require an additional annual increase in domestic demand of 1,4 trillion RMB under the 12th FYP in order to fill the annual "growth gap" of around 2,4%. The key issue here is what kind of "domestic demand" China will have. Some sceptics have already warned of the risk of substituting one environmental threat (in the form of industrial pollution) with another (excess consumption of goods).

- From a **medium- and long-term labour market** perspective: one of most important roles that the service sector will play is green job creation. Rapid and continuing urbanisation in China, triggered by the migration of the rural population to urban areas, is putting a high job creation pressure on future labour market.[33] Currently there are 10 million new entrants to the labour market annually. At the same time, however, China's working population is expected to peak around 2015-2017. Its labour market thus faces two major challenges: to continue to create a large number of jobs for new entrants (including addressing the issue of matching demand with supply), and to scale-up labour productivity rapidly as a result its aging population.

- From **an energy saving and emission reduction perspective**: The integration of manufacturing with the service sector and R&D has become a key trend in the traditional but advanced manufacturing sector in OECD counties. As China experiments with a green industry transformation through the development of "emerging strategic sectors", similar "product-service-innovation" integration is a high priority. Using services to green the "product economy" will be critical for China to achieve long-term sustainability as well as to climb up the value-chain.

To summarise, the service sector will play a strategic role in China's green transformation, not only in filling in the short-term "GDP- gap" and creating new green jobs but also being a catalyst for China's long-term structural adjustment, competitiveness and sustainability.

Recognising the immediate as well as the long-term strategic importance of the service sector, the development of the service sector will be given a greater importance in the structural transformation process in the 12th FYP. Specific tasks are defined as:

- To accelerate the development of manufacturing related service sectors, e.g. financial service, logistics and ICT-related high-tech services.

- To accelerate the development of services in the commercial and tourism sectors.

- To improve the policy framework to support the service sector in the fields of energy and water pricing, taxation, and public procurement.

9.2 Barriers in service sector development

Despite the great strategic importance and growth potential in the service sector, the current scale of China service sector is small in relation to the size of its population and the increased income level in past few years. The development of the service sector in China has been slow due to the following limitations:

[33] According to the estimate from DRC, there are around 240 million immigration workers at present and only 123 million entered residence and labour market registry in urban areas.

- From a demand point of view, generally the level of "service consumption" compared to "goods consumption" is still low at a time when Chinese households' incomes are increasing. At the same time, as a result of increased income disparity, while some Chinese households indulge in excessive consumption, a large proportion of households still consider "service" a luxury that is beyond their affordability.

- From the supply side, the development of the service sector is so far highly concentrated and limited to private services catering for consumers and households, while industry-driven business-to-business as well as government-initiated business-to-government services are still underdeveloped.

9.3 Potentials in service sector development

Overall, there is a great potential in China's service sector because of its market size and the scope and scale of its energy and environmental challenges.

9.3.1 Energy-saving and environmental protection service

Under the 11th FYP, the energy saving service sector, including energy management contract system and energy management companies (ESCOs), has taken off although its scale is still somewhat limited. For instance, the amount of energy saved through energy management service amounted to 22,4 million tonnes of standard coal equivalent (sce) in the 11th FYP, which accounted for only 4,5% of the total 490 million tonnes of energy saved in the same period.

In 2007, the overall turnover of the environmental protection industry reached 702,5 billion RMB, of which 7,1% came from the environment protection service sector. This service sector alone involved more than 3 million jobs and accounted for 2,6% of the total GDP.

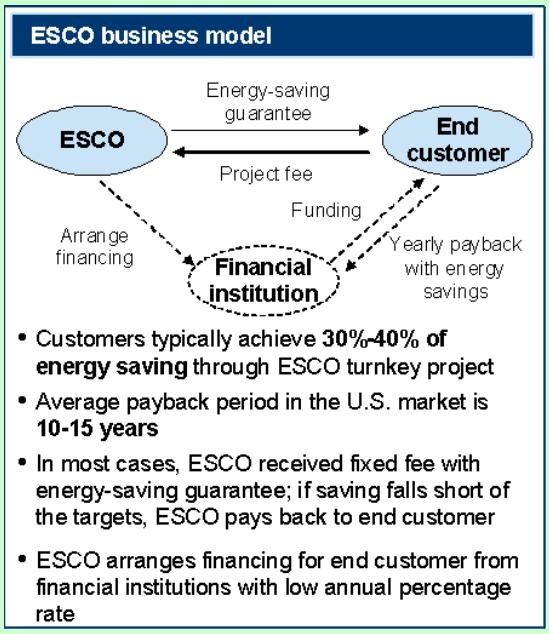
Some strong policy signals and policy improvements have already been introduced to stimulate the development of a modern and green service sector, with a clear focus on enhanced technology and skill contents of services delivered. For instance, under the 12th FYP, the remit of emissions reduction is extended from SO_2 and COD to include NOx and heavy metals; the emphasis on energy-saving is expanded from the industrial sector to the public and commercial buildings and transport sector. Furthermore, both the central and local governments will increase fiscal incentives (e.g. 2 billion RMB in 2010) for energy management and efficiency improvement.[34] A VAT reform has been proposed to make it more favourable to Energy Service Companies (ESCOs). In addition, energy-saving targets for public and commercial buildings are refined and strengthened by moving away from an intensity-based (i.e. energy consumption per unit sales) to an absolute target (i.e. energy consumption per m^2).

[34] Fore more details, see e.g. The Ministry of Finance and the National Development and Reform Commission, June, 2010, "*Interim Measures on management of financial incentive funds for energy management contracting projects*" (In Chinese).

As a result, the development of ESCOs in both the building sector and industrial environmental management service sector in China will be of high priority for China's green transformation.

Box 18. ESCOs in the US and in China

Energy Service Companies (ESCOs) are a key lever for enhancing energy efficiency. ESCOs provide development, installation, and financing for projects designed to improve energy efficiency and maintenance costs for corporate, public and residential facilities. ESCOs provide energy solutions with activities ranging from system design and consulting to project management, equipment installation, equipment consumption monitoring and rate analysis. The ESCO business model is to provide an energy-savings guarantee to an end-customer and arrange financing through a third party in exchange for a performance fee and a share of the savings from energy efficiency.



ESCOs also play an important role as a channel for implementing government energy efficiency policies and as a channel for the sale of high efficiency energy consuming equipment such as air conditioners, lighting and solar PV. The U.S. and Europe are the major ESCO markets driving the growth of ESCO market up to approximately $26bn in 2012. In the US the public sector accounts for 80% of ESCO activity, while in the EU, public sector and industrial each account for 40% of activity.

US Experience

In the US as elsewhere, energy efficiency is the most efficient way of delivering needed energy. Most energy efficiency investments cost less than USD$4 per MMBTU while the average price of all fuels is almost USD$14.Of the theoretical total of 9100 trillion BTU of energy efficiency potential most is industrial (40%), residential (30%) and commercial, including government buildings (25%). Delivering the potential for US energy efficiency would require spending over $50 billion annually, or approximately 4-5 times what is currently spent.

Upgrade of lighting and HVAC are the major services provided by ESCOs primarily to public sector facilities, especially schools, usually achieving a 30 to 45% savings

potential. ESCOs often work on a turn key basis generating many kinds of equipment sales. Around one-third of total project investment goes to ESCOs when they are engaged. ESCOs can generate 5%-10% of additional revenue with maintenance contract which is high profit, but requires a large overhead for maintenance infrastructure. Equipment players have recently begun to acquire ESCOs as they are an effective channel. ESCOs typically play regionally with customer segmentation by region, not by verticals. Only about 10 ESCOs mostly equipment players or utility-based ones except Ameresco, have a national footprint. Every player's top-priority vertical segment is schools and all of them are focused on public sector buildings. The Department of Energy (DOE) has recently designated 16 Super ESCOs to facilitate federal agencies' use of ESCOs. These 16 Super ESCOs are exclusively allowed to market energy-saving performance contracts to federal agencies (up to $5bn for each ESCO). The DOE supports ESCO selection, contract development, project monitoring, and post-project management. Government "stimulus package" will be an important source of financing ($4.5bn for federal).

Structural issues account for ESCO lack of penetration into commercial and residential markets in the US. Owners are the one to make investment decision but they do not pay for energy consumption. Commercial and residential sectors often request less than three-year payback period, which makes large improvement unattractive. Financial instability in nonpublic sector causes higher cost financing versus public jobs. Most of the government's building-energy-efficiency improvement mandates are focused on public buildings. Commercial and residential buildings are small-scale compared with public buildings, especially for schools and federal government buildings.

Nonetheless government initiatives are supporting the development of residential ESCOs. In many municipalities, the government provides educational programs to increase awareness, certification programs for auditors and contractors to ensure quality of work, and financial incentives/subsidies, especially at beginning of program, to develop the market. Houston's neighborhood sweep program uses a two-tiered approach to tailor in-home measures and client income level to different funding stream requirements. Grouping homes by income level allows different funding streams to cover different homes. Residential Energy Efficiency Program (REEP) Basic homes receive only highest "bang for the buck" measures (e.g., weather-stripping, window caulking, attic insulation, energy efficient light bulbs, ductwork evaluation)that can be potentially funded by utilities, or designed to require resident fund matching. REEP Plus homes (i.e., of residents with below a set income level) receive deeper retrofit packages including all the Basic measures plus Energy Star ceiling fans, window air conditioning units and solar screens, potentially funded by the government. In the commercial sector, the Empire State Building in New York is a landmark of ESCO implementation in the US.

China Situation

In China energy services are growing based on trends to increasing outsourcing of non-core activities, the need for energy efficiency, desire for security and low-cost of energy supply, and efficiency improvement in energy usage. The regulatory environment supports energy savings and emission abatement targets through the 11th and 12th Five Year Plans and the Energy Conservation Law. Within energy services many services are offered such as cogeneration, utilities, industrial maintenance, energy management, district heating, facility management, and residential boiler maintenance.

It is currently a very fragmented market, with local small niche players dominating.

However, competition is going to get even more fierce as strong SOE utilities and equipment manufacturers join in the battle field. Customer access, superior energy savings and rigorous risk management are key success factors. Industry consolidation is likely to happen in the future as competition heats up. Specialized ESCOs may be most successful in the near-term as they provide low cost solutions, are close to customers with better local access, have certain technology edge in particular areas, and some have established cooperation with equipment suppliers. However, large SOEs will deploy their capital to build service businesses over time.

Financing is a principal barrier to development of ESCOs in China with less than 1% of loans going to energy savings. Poor risk assessment and lack of collateral hinder bank appetite for lending. Local governments can work with policy banks to overcome this by providing technical assistance, education on green sectors and greater transparency in financial reporting on energy requirements. Providing a guarantee for SME lending and risk sharing would further open up the market.

Source: Inputs provided by McKinsey & Company's Great China office to CCICED Green Economy Task Force, 2011.

9.3.2 Green Finance

Green finance consists of financial services (such as public and private investments, capital markets, venture capital, insurance, guarantees, asset management, banking and lending) that support environmental focused activities and industries. Green finance is the key to promoting and accelerating the transformation of China's green industry, agriculture and economy.

The role of green finance to support environmental focused activities and industries has also received more attention. Various "green credit" and "green finance" regulations and support measures were already introduced under the 11th FYP. Policy banks, together with related ministries and government agencies, played a guiding role in supporting and encouraging commercial banks to fund environment-friendly investments and innovations. For commercial banks, green credits and green investments are increasingly seen as win-win financial products for reducing both financial and environmental risks. This development needs to be further promoted and strengthened under the 12th FYP, where the role of enterprises, especially SMEs, is emphasised and supported.

While the green technology sector is expected to grow to over $2 trillion annually by 2020 – nearly $1.5 trillion increase from 2007 – financing of green technology and innovation is still one of the most serious constraints on China's future green economic development. Through international cooperation in the past few years, China has gained some valuable experience on innovative finance mechanisms. These new mechanisms are instrumental for technology fund raising as well as the development of institutional capacity and human capital. The development of the Clean Development Mechanism (CDM) market in China is a typical example.

When the CDM market took off in 2006, "multifunctional" big project developers (e.g. Camco International, Eco Securities etc), who were familiar with the international climate policy as well as had the financial expertise and technological know-how, were able to provide full turn-key services and therefore dominated the Chinese CDM

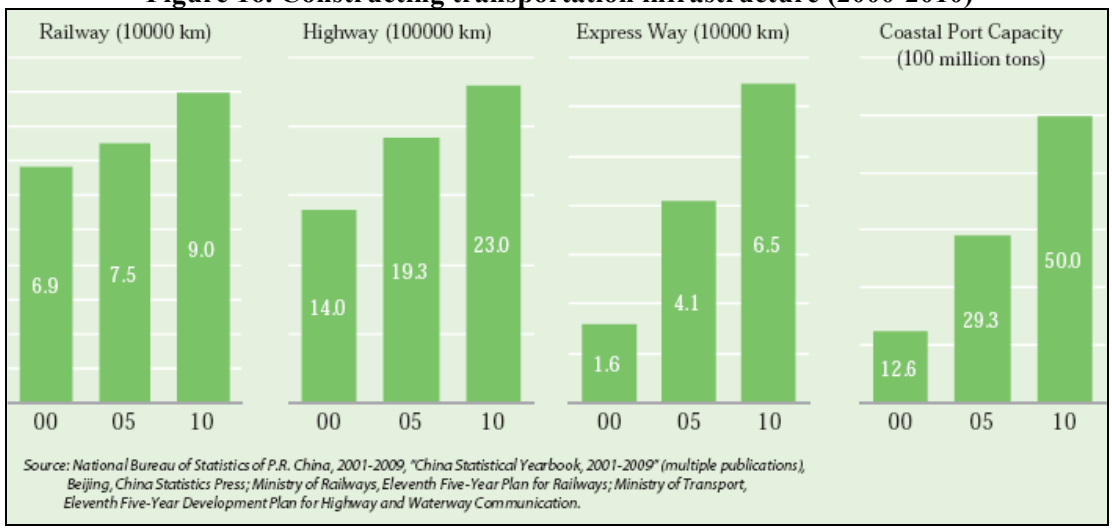
market. Within just a few years, domestic actors caught up quickly and a group of Chinese project developers emerged, including academic institutions, regional CDM service centres and newly established domestic (or joint venture) consultant companies.

9.3.3 Green logistics and transport

The main objective of logistics is to co-ordinate activities in a way that meets customer requirements while keeping the cost minimal. In the past, this cost has been defined in purely monetary terms. As concern for the environment rises, companies must now take into account the external costs of logistics **associated mainly with climate change, air pollution, noise, vibration and accidents.** Green logistics aims to examine ways of reducing these externalities and achieving a more sustainable balance between economic, environmental and social objectives.

In 2007, the gross turnover of the logistics sector reached 75,2 trillion RMB while its value-added was 1,7 trillion RMB, which accounted for 17,5% of the total value-added of the service sector and 6,9% of GDP in China. With the already large investments in railway and road infrastructure and the rapid urbanisation process, green logistics has a great potential in China.

Figure 16. Constructing transportation infrastructure (2000-2010)



Box 19. Key tasks for creating a green service system

1.To clarify priority/key areas and to accelerate the development of a green service system. Key areas include:

- Green finance
- Green logistics
- Energy saving and environmental service
- Green commerce
- Green catering sector
- Green tourism

2.To promote the 'greening' of traditional service sector through regulations and

guidance .

- Establish specific planning programmes for green service transformation
- Promote green transformation of the service sector through green technology and innovation.
- Increase public investments (and government support) to enhance the 'greening' of the traditional service sector
- Foster a favourable environment for green transformation of the service sector through the creation of market for green products and services

3. To use green services trade policy as a lever to fully integrate into the global service sector green transformation process .

- Fully implement service sector green transformation in order to stimulate the 'greening' of service companies
- Promote green transformation by reducing pollution from the service sector
- Adopt economic instruments and market-based measures
- Strengthen pollution prevention and control as well as environmental management
- Promote green recycling action plan and to explore the development potential of carbon-related services

10. KEY TASKS 5 – GREEN DEVELOPMENT AND WOMEN EMPOWERMENT

10.1 The developmental dimension of China's green transformation

10.1.1 China's progress towards the Millennium Development Goals

Two decades ago, 60% of China's population lived in absolute poverty; by 2010, the number had fallen to 10% (World Bank, 2010). In absolute terms, the decrease had been even more impressive. Since 1990, China has accounted for four-fifth of the global decline in the number of people living in absolute poverty. According to China's progress report for the Millennium Development Goals (MDGs) submitted to the United Nation in 2008, China was on course to achieve all the MDGs by 2015. However, the promotion of gender equality and women empowerment (which is discussed in more detail in 7.2), and the reverse of environmental and resource degradation by 2015 were two goals that would require additional attention and actions (See Table 12 below).

Table 12. China's progress towards the MDGs

GOALS / Indicators	Will the goal or target be met?	State of national support
MDG1: Eradicate extreme poverty and hunger		
1a) Halve, between 1990 and 2015, the proportion of people whose income is less than one dollar a day	Already met	Strong
1b) Achieve full and productive employment and decent work for all, including women and young people	Potentially	Strong
1c) Halve, between 1990 and 2015, the proportion of people who suffer from hunger	Already met	Strong
MDG2: Achieve universal primary education		
2a) Ensure that, by 2015, children everywhere, boys and girls alike, will be able to complete a full course of primary schooling	Already met	Strong
MDG3: Promote gender equality and empower women		
3a) Eliminate gender disparity in primary and secondary education, preferably by 2005, and in all levels of education no later than 2015	Likely	Strong
MDG4: Reduce child mortality		
4a) Reduce by two-thirds, between 1990 and 2015, the under five mortality rate	Already met	Strong
MDG5: Improve maternal health		
5a) Reduce by three quarters, between 1990 and 2015, the maternal mortality ratio	Likely	Strong
5b) Achieve, by 2015, universal access to reproductive health	Potentially	Good
MDG6: Combat HIV/AIDS, malaria and other diseases		
Target 6.A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS	Likely	Strong
Target 6.B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it	Potentially	Good
Target 6.C: Have halted by 2015 and begun to reverse the incidence of malaria and other major diseases	Likely	Good
MDG7: Ensure environmental sustainability		
Target 7.A: Integrate the principles of sustainable development into country policies and programmes	Likely	Strong
Target 7.B: Reduce biodiversity loss, achieving, by 2010, a significant reduction in the rate of loss	Potentially	Good
Target 7.C: Halve, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation	Likely	Strong
MDG8: Develop a global partnership for development	-	-

Source: China's progress towards the Millennium Development Goals, United Nations, 2010.[35]

Furthermore, despite the significant progress achieved in the past decades, uneven regional development and increased income disparity in urban areas require continuous and enhanced actions to promote poverty reduction and social "harmony". As a result, **'people-centered scientific development**' has become the key policy agenda to reverse the "high economic growth, slow social development" divergence.

The 12th FYP gives a strong emphasis to the improvement of people's livelihood and to ensure that the "fruits of economic growth" are widely and fairly shared by the

[35] For more details, see http://www.un.org.cn/public/resource/China_MDG_Progress_report_2010_e.pdf

people. In other words, "development inclusiveness" will become the guiding principle of China's future green growth. This imposes twin challenges to China's green transformation – higher human development, in terms of improved living standard including better access to clean water and energy as well as better health and education, needs to be achieved within the constraints of natural resources and the limits of ecosystem to avoid excessive ecological footprints.

At the same time, the development dimension of the green transformation is also about various developmental "co-benefits" and new opportunities, such as cleaner energy and better health, and stronger ecosystem conservation that also generates new green job opportunity. These co-benefits are particularly important for people living in the poor and rural areas, and are crucial to achieve stronger inclusiveness.

10.1.2 Job creation and public service provision

In China's green transformation process, the job creation and public service provision will likely to be the most effective vehicles that reduce poverty and stimulate social development. Indeed, green job creation, has already demonstrated strong positive developmental effects in the poor and rural areas, especially in the forestry and renewable energy sector.

Employment effect of the forestry sector is particularly prominent due to the labour-intensive nature of the sector. For example, the Chinese government has introduced an ambitious afforestation project, which has created many employment opportunities for agricultural workers in the rural area. According to the estimate by Chinese Academy of Social Sciences (CASS, 2011), the forestry sector employed as many as 1.8 million full-time workers in 2010 alone, or an average of 1.6 million workers annually during the 2005-2010 period. To achieve its 2020 gaols of increasing newly afforested area by 29.60 million hectares and forest cover to 23.46 percent of the total land area, forestation activities could offer as many as 1.1 million direct and indirect jobs annually during 2011-2020. In addition, managing the newly added forest areas during this period would add another 1 million jobs (See Table 13 below).

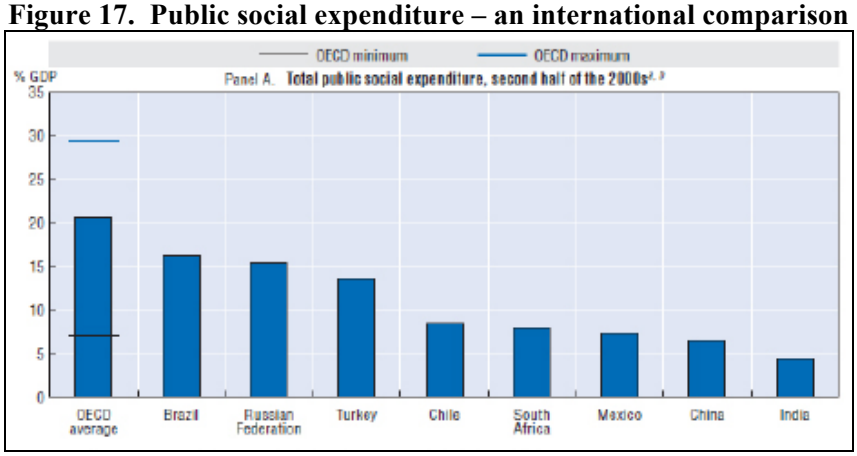
Table 13. Green job creation in the forestry sector in China, 2005-2010

				Job creation from forest management	
Year	**Annual Forestation area** Million hectares	**Working days needed** Million	**Direct job creation** Million year-long position	**Annually added forest area** Million hectares	**Direct job creation** Number of full-time positions
2005	3.6	377	1.3	3.6	24 251
2006	3.8	397	1.3	3.8	25 592
2007	3.9	405	1.4	3.9	26 051
2008	5.4	554	1.9	5.4	35 699
2009	6.3	648	2.2	6.3	41 749
2010	5.3	549	1.8	5.3	35 333
Total			**9.9**	**28.3**	**188 675**

Source: Green economy and green jobs in China, Worldwatch report, 2011

Poor economic conditions have led to poor public service provision in the less developed areas. The improved employment prospect and new green development opportunities will need to be accompanied by government support for public service provision. In an international comparison, public social expenditure in China is still rather low (see Figure 17 below).

Figure 17. Public social expenditure – an international comparison



Source: Tackling Inequality in Brazil, China, India and South Africa, OECD, 2010

While public service provision in cities has improved dramatically, it still remains hugely inadequate in the rural area. The 12th FYP aims to accelerate the provision of basic public service in the rural area through various fiscal reforms, such as improved and increased fiscal transfer schemes to less developed regions as well as resource-related tax reforms.

Furthermore, poor economic conditions have led to poor public service provision in the less developed areas. The improved employment prospect and new green development opportunities will need to be accompanied by the increase in government support for public services. In China's green transformation, job creation and public service provision will likely to be the most effective vehicle for reducing poverty and stimulating social development. Therefore, the green development tasks include:

1) Promote a job-generating green development instead of a jobless growth:

- Promote green job creation with strong positive developmental effects in the poor and rural areas, especially in the forestry and renewable energy sectors. China is already leading the world in the implementation of ambitious reforestation and renewable energy programmes;

- Promote labour-intensive and high-quality manufacturing jobs in the process of greening and modernising China's traditional industries and manufacturing-related service sector;

- Accelerate the development of new and "green" sectors, in particular the energy-saving and environmental protection sector to create both manufacturing and service jobs;

- Enhance resource- and eco-efficiency, so that green growth, efficiency improvement and job creation are mutually reinforced and the job-generating potential of the economy as whole is strengthened.

2) Reduce the economic gaps and discrepancies in growth potentials between developed and less developed regions through improvement in job prospect and enhanced public service provision:

- Attach great emphasis on an inclusive and coordinated green development and more equitable sharing of the fruits of the green development. Therefore, a more equitable provision of basic public services (including education, healthcare, public facilities and services) should be one of the ultimate objectives of the green development;

- Attach strategic importance to people's livelihood under the green development, and implement concrete policy measures and financial support through regional policy and fiscal transfer schemes.

10.2 The role of women in China's green transformation

Women's participation in economic activities in China has steadily increased in the past few decades. According to the recent statistics, out of China's total working population of 758 million, 337 million, or 44.8% of the total are female. Women's labour market participation rate increased to 46% in 2009, although it was still 13.5% lower than their male counterparts (All-China Women's Federation, 2011[36]). Overall, despite the progress, women in principle still belong to the vulnerable and disadvantaged groups in the labour market in terms of poverty alleviation as well as equal opportunity.

10.2.1 The relationship between gender, environment and structural adjustment

The combination of climate, energy and economic crises has made the problem of poverty even more complex. Unfortunately, the "female face of poverty" has also become more prevailing.

Poverty, which is closely related to ecosystem degradation and resource exhaustion, has a disproportionately adverse impact on women. There is a clear linkage between gender, environment and poverty. Workload for women in the poor rural areas has become increasingly heavier due to both energy and water shortages as they now have to spend more time and energy obtaining these basic resources (See Box below). Also, due to heavy reliance on biomass fuel (e.g. wood, dung, crop residues etc) and bad agricultural practice, women in the poor rural areas suffer from acute respiratory infections caused by in-door air pollution and other chronic health damages associated with excessive use of chemical fertilisers and pesticides.

As a result of economic structural adjustments in the past decades and the recent global economic downturn, gender equality has deteriorated to a certain extent. For

[36] More details can be found at http://www.womenofchina.cn/html/report/131344-1.htm

instance, due to the global financial crisis, a large number of female migrant workers (who came from rural areas) in the export-oriented processing industry and service industry have been laid-off. In addition, due to the economic downturn, female university graduates experienced even greater difficulty in entering into the labour market. While economic contraction has made career development prospect for female professionals less favourable in the private sector, the large physical investment focused stimulus package had a gender-biased outcome in terms of job creation and retention, which was unfavourable to the female labour force.

10.2.2 "Gender bias" in green job creation

For typical "green job" sectors, such as building, energy and transport, the participation of women is rather low (See Table 14 below). There are substantial barriers for female workforce to enter into these sectors because of the skill requirement and social perception of what male and female occupations are.

Table 14. Share of female employees in "traditional" green sectors (%)

Building	Urban transport	Fishery	Waste collection & Recycling, R-manufacturing		Forestry	Water Management
13.9	29	28.1	33.2	40	31.9	27.8

Source: Chinese labour force survey, National Bureau of Statistics, 2008

In China, female workers are more commonly found in sectors such as the agriculture and service sector, which are associated with low skill, low payment and poor working conditions (e.g. long working hours and physically exhausting).

As a consequence, the gender issue is often neglected in green development policy-making as "green jobs" are often not considered "female jobs". At the same time, there is also a lack of awareness and incentives for women to engage.

Furthermore, women workforce need to upgrade its skills and knowledge in order to take advantage of the technology- and innovation-driven green development, and to move into the high-end labour market. However, in practice, "gender segregation" in the higher education sector makes this difficult. For instance, although the percentages of male and female undergraduate and graduate students are not too different i.e. 50.4% and 47.0% respectively, the share of female students in science and engineering at Chinese top universities such as Tsinghua University is much lower comparatively at around 30%.

10.2.3 Women in green development –not only victims, but also drivers for change

Despite the current structural and social barriers, women have a great potential to contribute to the green development. As a matter of fact, women have already actively participated in and made significant contribution to the current green development.

The role of woman in the green agriculture transformation

By the end of 2006, the agricultural labour force included around 270 million male workers and around 260 million female workers. As a result of migration to the urban areas, more than 84 million male workers and 47 million female workers have left the agriculture sector. This made female workers the key remaining labour force in the agriculture sector (All-China Women's Federation, 2011). Women not only shoulder the main responsibility for agricultural production but also generate nearly half of the total household income.

Capacity building and technical support for women in the fields of **sustainable agriculture practice**, e.g. use of fertilizer and pesticides, thus play an important role for the green agriculture transformation. According to the survey conducted by All-China Women's Federation, more than 0.7 million female workers in the Chinese agriculture have received various forms of technical training in sustainable agriculture by 2010, which is a promising start for more active and comprehensive engagement of women in the green agriculture transformation in the future.

Forest resource management is another area where women have played a significant role, supported by government funding programmes. For the period between 1993 and 2008, The State Forestry Administration of China (国家林业局) has provided 30 million RMB for the development of the "Green Demonstration Base", with a specific focus on women-driven forest resource management practices. As a result, around 120-150 million female agriculture workers participated in voluntary tree planting and small-scale water management projects. More than 11 million households engage in large-scale economic activities in the fields of forestry recovery and fruit trees planting, with women as the driving force.

Finally, in the development of **renewable energy**, in particular small-scale/household biogas, women have not only been active participants but also beneficiaries. By replacing the traditional and highly polluting stoves with biogas, both the environment and living standard have been improved significantly.

Women as a driver for green consumption

Women can also lead China's green transformation through green consumption, especially in the urban areas. According to a survey conducted in 2005 in 8 major Chinese cities, more than 77% of women made the key choices and decisions on the households' consumption goods (e.g. food, cloth and home appliance).

In a more recent survey in 2009, the awareness of environmental impact of the products was already higher among the surveyed female consumers compared to the surveyed male consumers. (China Development Brief, 2009[37]). Furthermore, female respondents also showed a stronger awareness of "green food", "green transport" and green home appliance". This has laid a solid foundation for further promoting green consumption among Chinese consumers.

[37] More details can be found at http://www.chinadevelopmentbrief.org.cn/newsview.php?id=534&page=0

To summarise, in order to enhance the social as well as economic aspect of China's green transformation, the development of women needs to be an integral objective in the overall green development. This involves not only general poverty alleviation, but also further improvement in gender equality to ensure that women have access to equal and new opportunities in the green transformation.

In this process of closing the gender gap in the green transformation, women must not simply be seen as "victims". Instead, women are the underutilised potential and new driving force for a more equal and more sustainable livelihood. Concrete and effective measures need to be put in place to encourage the participation of women in the green transformation in relation to:

- Institutional and policy support in green economy decision making where the gender dimension is taken into account;
- Provision of capacity building and technical training related to "green colour" and decent jobs that enhances the accessibility of women;
- Provision of welfare services in the fields of health care, childcare and eldercare – to enable women to combine career and family life;
- Support for the civil society and NGOs that play a key role in the green economy transformation, with a specific focus on empowering women's status and contribution.

11. POLICY MEASURES TO SUPPORT AND TO ACCELERATE CHINA'S GREEN TRANSFORMATION

An integrated and coordinated approach at all levels of government and sectors is needed to achieve a green transformation. This will require improvement in the current and introduction of new supporting system and policy measures, particularly in fostering a closer relationship or symbiosis between the government and the private sector. While further enhancement of the **legal and regulatory system** is needed, **administrative measures** alone – which suffer from ineffective enforcement and inability to induce enduring behavioural changes and long-term impact – could not solve the daunting challenges faced by China. Furthermore, investments in environmental protection in the past few years have relied disproportionately on **government spending**, which is increasingly insufficient in the face of the growing scope and scale of the environmental problems. Therefore**, financial resources** for green transformation need to be both strengthened and diversified. Against this backdrop, the key focus areas for future improvement are discussed below.

11.1 Improve regulatory and legal system

China's legislative and legal system has made progress in the area of environmental and ecological preservation and protection, which provides a legal basis for China's green development. For instance, the "crime against environmental protection" has been included in China's "Criminal Law". Meanwhile, various regulatory measures, such as standards for emissions, products and production have also been tightened, with specific purposes of environmental protection, emission control as well as improving industrial structure and economic growth pattern. The following supporting measures and improvement will further strengthen and accelerate the development of the legislative and legal system:

1) **Strengthen government's responsibility at all levels** through the amendment of the "Environmental Protection Law" – strong emphasis should be given to regulating the government's decisions and actions affecting the environment, and enhancing the effectiveness of government's environmental oversight.

2) **Strengthen environmental civil liability** by exploring the possible environmental pollution/damage compensation related laws and regulations – improving the legislative framework for the protection of environmental rights of the public.

3) **"Greening" of the legal system** through coordination and harmonisation of environmental protection related legislations with others, such as the Civil Law, Commercial Law, Economic Law and Criminal Law – improving the effectiveness of the legal system in protecting China's environment.

4) **Strengthen the enforcement of green economy related legislations and regulations** through enhancing law enforcement supervision system and capacity building – improvement in institutions, procedures, staff quality and standardised system of law enforcement.

11.2 Strengthen fiscal policy and deepen tax reforms

11.2.1 Substantially increase fiscal inputs.

1) **Establish support mechanisms that secure a stable increase in financial support for green development.** The government at all levels should increase budgetary spending to support green economic development. Green economy-related key projects, in the fields of energy-saving and emission reduction, clean energy development and technological innovation, should be included in the (national and regional) economic and social development plans. The budgets for such projects should increase on a year-to-year basis to enhance the policy support for green economic development.

2) **Consolidate existing special funds at the central government level.** At present, various special funds have been set up, such as the special fund for energy-saving and emission reduction as well as the special fund for renewable energy. However, to increase the efficiency of fund utilisation and to avoid fragmented efforts, these existing funds need to be consolidated to create a unified large scale *green economic development special fund*.

3) **Innovative fiscal measures should be introduced.** A diverse mix of fiscal measures, such as budgetary spending, special funds, subsidies, fiscal incentives, interest discount and (loan) guarantee should be introduced to maximise the effects of government fiscal inputs. This should take into account the different nature and characteristics of various policy instrument as well as the needs of various areas of green development. Some specific innovative measures/adjustments are shown below:

- In terms of the target of subsidies, it is necessary to shift from solely **production-oriented** subsidies towards a mixture of **production- and consumption-oriented** subsidies. One example is the subsidy given to buyers of electric cars;

- In terms of the type of subsidies, **indirect subsidies** such as bank loans and guarantee should be more widely used, which can mobilise investments by other banks and the private sector. This will maximise the leverage effect of government financial inputs;

- In the future the government also needs to vigorously support the development of the (credit) guarantee industry, including 1) providing public finance while also attracting private capital to set up guarantee agencies/companies 2) providing public finance to set up financial risk compensation funds.

4) Put emphasis on efficiency of government spending.

5) Establish **a multi-tier co-finance/co-funding mechanism** with joint effort by the national and local governments.

6) Fully mobilise investments from the business sector and other actors in the society through bank loan subsidies, interest rebate and extended loan duration.

11.2.2 Effectively promote the tax reforms

Using the definition of Environmental Related Taxes by the OECD, the following categories can be considered as "environmentally related taxes" in China (see Table 15 below):

Table 15. Environmental Related Taxes in the Chinese System

Tax category	Objectives	Design
Resource tax	To control extraction of natural resource. To adjust income and profit level in the mining industry.	Seven tax items: crude oil (14-30 RMB/ton), natural gas (7-15 RMB/1000 m^3), coal (0,3-5/ ton), non-metal ores (0,5-20 RMB/ton or m^3), ferrous metal ores (2-30 RMB/ton), non-ferrous metal ores(0,4-30 RMB/ton), and salt (solid: 10-60 RMB/ton, liquid: 2-10 RMB/ton)
Consumption tax (on product oil)	To control fuel consumption A form of fiscal consolidation	Differentiated tax rates based on product type: Lead-free gasoline: 1.0 RMB/litre Leaded gasoline: 1.4 RMB/litre Diesel & fuel oil: 0.8

		RMB/litre
Vehicle tax	To control road traffic volume A form of fiscal consolidation	Annual and differentiated tax rates, ranging from 60 to 660 RMB per vehicle, according to the size of passenger vehicles. Annual and differentiated tax rates, ranging from 16 to 120 RMB per net tonnage according to the size of goods vehicles. (the total number of vehicles in China has reached 199 million in 2010)
Vessel tax	To control marine traffic volume. A form of fiscal consolidation	Annual and differentiated tax rates, ranging from 3 to 6 RMB per net tonnage (motorised vessels), according to the size of vessel.
Purchase tax on vehicles	To control the increase of passenger vehicles To encourage purchases of fuel-efficient vehicles A form of fiscal consolidation	Differentiated tax rates ranging from 1% to 40%, according to the size of engine.

Source: Research on the environmental tax reform, Sun Ming and Xu Weng, 2010.

Environmentally related tax revenue has increased rapidly in China in the past few years as a result of the rapid growth in the number of vehicles and fuel consumption. In 2008, the total revenue reached 242,3 billion RMB, which was an increase of almost 60% compared to 2005. The largest increases were **fuel tax and vehicle purchase tax**, which accounted for 74% of the total revenue from environmental taxes and charges. The fuel tax reform in 2009 drove a real surge in the amount of fuel tax revenue, which increased by 165,3 billion RMB from 2008 to 2009. On the other hand, environmental charges from the discharge of waste, sewage, noise and other industrial pollutants accounted for only 8% of the total revenue in 2008 (See e.g. Sun Ming and Xu Weng, 2010)

Tax system innovation and reform in a green transformation will need to focus on the following aspects:

1) **To accelerate the reform of resource tax.** The design of resource tax is criticised as it is, to a certain extent, based on "non-environmental concerns" and can even have the opposite effect of protecting and preserving natural resources. Adjustments or improvement can be carried out in the following areas: 1) To adjust the method of tax collection, through a combination of price-based and quantity-based methods. For natural resources with both high

market price and price volatility, e.g. crude oil, coal, natural gas and metallic mineral products, the tax will be collected on a price-based basis, according to the total sales; 2) To appropriately increase the tax rates/levies on scarce resources, high-polluting and high energy-consuming mineral products. At the same, the price setting mechanism for resource-based products will also be adjusted in accordance with the adjustment in energy prices and the reform of the fee system (of pollutants and emissions); 3) To carry out a comprehensive reform of the resource fee and tax system; for example some resource fees will be included in the resource tax system where appropriate.

2) **To adjust consumption tax**. The adjustments will include: 1) extension of consumption tax to high energy- and resource-consuming products that do not meet the energy-saving standards and which have so far been exempted from consumption tax and; 2) increase in the current tax levies on fuel and other high energy-consuming products; 3) decrease in the tax levies on low-emission vehicles and motorcycles, and consumption tax rebates for certain energy-saving products that meet the energy-saving standards.

3) **To adjust vehicle and vessel taxes.** Improvement should include: 1) adjustment of the basis for tax collection – differentiated tax rates based on the emission volume/displacement of vehicles and on the net weight for heavy trucks and vessels; 2) increase in tax levy generally and differentiated tax rates.

4) **To introduce environmental tax or environmental protection tax (including carbon tax).** Unlike the OECD countries and the EU that use mainly a tax-based system to regulate emissions and pollution control, the current Chinese system relies heavily on a fee-based system. In the face of global climate change, a tax on carbon dioxide emissions has become an important element in the environmental tax system in many countries. However, China does not yet have a carbon tax in its tax system. Some examples of environmental charges to regulate emissions and pollution control in China are given below:

Box 20. Political economy of CO_2 tax in OECD countries

The two main 'obstacles' to the introduction of CO_2 taxes (like other environmentally related taxes that could raise a major amount of revenue) are fears of negative impacts on the sectoral competitiveness of certain industries and fears that certain households (*e.g.* low-income households, elderly people, or people living in certain regions) would be in particular negatively affected. While these concerns should be considered in the context of a tax reform, there are several ways that they can be address in ways that maintain the intended environmental impacts of such taxes.

In France, the situation was somewhat special. The Parliament had adopted a proposed CO_2 tax, which included various mechanisms to compensate households that could otherwise have been negatively affected. However, the law was found unconstitutional by the Constitutional Court, because different tax payers were treated differently: The tax exempted sectors covered by the European Union's Emission Trading System, and the Court noted that the firms in question had received their emission allowances for free. Unfortunately, the Court seemingly

didn't understand that including these sectors in the carbon tax would not have had any impact on (EU-wide) CO_2 emissions, as other firms would have purchased the allowances that would be 'freed up' if these firms were subject to the tax.

Countries like Ireland and Iceland have introduced CO_2 taxes in recent years with an explicit aim of increasing public revenues, as a way of addressing the need for fiscal consolidation, in the aftermath of the economic crisis. Greece does not have a fully-fledged CO_2 tax, but has similarly increased its taxes on motor fuels significantly. The effect of the taxes on purchases of fossil fuels doesn't much depend on whether or not the tax was introduced as part of a revenue neutral reform or not.

An important lesson for China is that it is possible to overcome the 'obstacles' to introducing a CO_2 tax. A number of countries (Denmark, Finland, Norway, Sweden, United Kingdom …) have had such taxes in place for up to 20 years, without this having a negative impact on their economic development.

Possible negative impacts for low-income households can *e.g.* be addressed via increases in various social contributions, such as old-age pensions.

In Sweden, it was decided a couple of years ago to gradually increase the tax rates applied for fossil fuels used by industry (outside the EU ETS) over the period up to 2015. Given the 'lead-in' time this provided to the sector, opposition to this tax increase has been very modest.

In the United Kingdom, energy-intensive firms can get an 80% reduction in the tax rate of their Climate Change Levy (in return for entering a negotiated agreement on emission reductions). A case study made for the OECD documents that the firms that faced the full tax rate had at least as good economic development as those facing the reduced rate – and that they were innovating more.

Source: Inputs provided by the OECD to the CCICED Green Economy Task Force, 2011

Fees and charges are levied on the discharge of various pollutants from ***industrial productions***, such as waste water, waste gas, solid waste and noise (see Table 16 below).

Table 16. Examples of Environmental Charges in China

Charge item	Standard
Waste gas	0,7 RMB /kg
Waste water	0,6 RMB/ m^3
Solid waste	In the range of 5-30 RMB/ton depending on different categories of solid wastes
Hazardous waste	1000 RMB/ton/collection
Noise	Progressive charges ranging from 350 -11,200 RMB/month, when exceeding the control standard (exceeding 116 dB or above).

Source: Research on the environmental tax reform, Sun Ming and Xu Weng, 2010.

One of the key problems with the current system is the low level of charges/fees for industrial discharges. According to some estimates, pollution charges may only amount to 50% of the (marginal) treatment cost, using the operating costs of pollutant treatment equipment as a proxy. In some cases, the fee for industrial discharge was

lower than 10% of the treatment cost.[38] Consequently, most enterprises would rather pay the fees than taking serious actions to treat industrial discharges. The problem is further aggravated by weak enforcement at the regional and local levels, which resulted in either heavily discounted payment or delayed payment. It is important to note that weak enforcement is closely related to, and could be a consequence of, the fact that that business income tax and industrial turnover tax are the most important sources of local government fiscal revenue.

As a result, central to China's "green tax reform" is the **transformation from a fee-based to a tax system**. At the same time, the scope of environmentally related **tax** should be broadened and an environmental tax should be introduced as an independent tax category.

From a long-term perspective, the scope of China's environmental tax should cover pollutants such as waste water, waste gas, solid waste, noise and CO2 emission. Following China's tax reform principles of "simplifying tax system, broadening tax base, lowing tax rate and strengthening enforcement", all the above-mentioned pollution-related tax items can be included in an overarching category of "environmental tax".
In addition to environmental tax that is directly related to energy use and pollution, there are other categories of taxes that also have an indirect effect on emissions and pollution reduction in the production processes and product development in the business sector (See Table 17 below).

Table 17. (Indirect) Environmental Related Corporate Taxes

Tax category	Objectives and Design
VAT	Tax rebates in various forms, such as VAT reduction and accelerated depreciation allowance to encourage enterprises to: • Deploy advanced energy-saving and emissions reduction technologies. • Undertake environmental protection projects, such as waste water treatment, material reuse and recycling. • Undertake product development and innovation to create environment-friendly and resource-efficient products and services
Enterprise Income Tax	
Import & Export Tax	To discourage exports of "high energy consumption, high pollution and resource-intensive" goods, through: • Increased export tax • Removal of export subsidies To courage imports of advanced environmental technologies through: • Reduction or exemption of import tax.
Business Tax	Exemption of business tax to encourage environmental technology transfer and diffusion.

Source: Research on the environmental tax reform, Sun Ming and Xu Weng, 2010.

[38] Source: http://crifs.org.cn/crifs/html/default/keyandyuxueshu/_history/2866.html

To facilitate and accelerate green transformation and innovation, various business tax–related reforms will need to be implemented: 1) VAT reform that will gradually replace business tax with VAT, starting in the transport, logistics and building sectors. 2) Tax rebates in emerging and strategic industries and the service sector to encourage green investments, green renovation and green innovation. 3) Tax rebates for SMEs, in particular S&T and innovation based SMEs, to encourage their innovation activities as well as to overcome financial barriers.

Box 21. key consideration
when introducing environmental and carbon tax in China

The environment tax and carbon tax will be most likely to be introduced in the 12th Five-Year plan. The key considerations in the ongoing discussions include:

- **How high will the environmental tax be?** When moving from a charge/fee to a tax system, the level of the tax needs to be determined by two key factors: 1) the level of the tax should be high enough to create an economic incentive for emission reduction (instead of the current fee system, which is too low to have any effects on abatement) 2) The level of tax should not be too high to threaten the survival of enterprises and, in turn, to increase the unemployment pressure faced by the Chinese economy. Taking the charge for SO_2 as an example, the current fee is 0.63 RMB per kg which is too low while the estimated average abetment cost is 3.0 RMB, which many enterprises can not afford. The new environment tax on SO_2 should thus be somewhere between 0.63 and 3.0 RMB to achieve emission reduction, but not threaten jobs.

- **A local or a national tax?** The environment tax can be a local tax, i.e. 90% of the tax revenue will be kept by the local government and 10% will be collected by the national government. The division of tax revenue between the local and the national governments follows the current fee system. The carbon tax can probably be a national tax, of which 70% is collected by the national government.

- **Environmental tax as both stick and carrot:** The environmental tax will be differentiated to take account of the impact on international competitiveness and enterprises' effort to reduce emission. A tax rebate will be offered to enterprises that achieve an abated level higher than the national standard through technological innovation. However the setting of technical standard will remain a key issue that needs to be solved.

11.2.3 Continue to enlarge the scope of green public procurement

1) **To enlarge the scale of China's public procurement.** In the OECD countries, public procurement accounts for 30-40% of total government fiscal expenditure. Using this as a benchmark, public procurement in China should reach 1,8 -2,4 trillion RMB. In 2008 government procurement in China only amounted to 599 billion RMB, which accounted for 9,6% of its fiscal expenditure. This shows that the level of public procurement is still relatively low in China despite the rapid growth, and that China's public procurement still has a large scope for expansion.

2) **To further increase the scope and share of "green" public procurement.** The mandated **government procurement** of energy efficient products was expanded from central and provincial governments purchases in 2005 to all government levels by 2007. By the end of 2010, green procurement covered 30 product categories and involved around 500 suppliers, which provided more than 14 000 products. However, the potential for expansion is still great.

3) **To improve government procurement budget management and to increase the transparency of the procurement process.**

11.3 Develop green finance through a concerted effort by the government, finance and business sectors

Green finance has recently received substantial attention from a broad range of governmental agencies as well as positive response from the financial and business sectors. Since 1995, a series of policies and regulations have been introduced (See Table 18 below). For instance, the Ministry of Environmental Protection (MEP) and the People's Bank of China have established an information sharing mechanism, which included details of 15 000 environmental law violations by businesses into a database that is available to commercial banks.

Table 18. Policy and regulatory measures for supporting the development of green credit

Agency	Policy documents	Key measures/messages
People's Bank of China	The circular on issues related to bank credits and strengthening of environmental protection.	Protection of ecological resources and prevention of pollution as a key factor in approval of bank loans.
NDRC, People's Bank of China China Banking Regulatory Commission (CBRC)	The circular on issues related to credit risk control through coordination between industrial policies and credit policy.	Differentiated evaluation and support, according to the impact on natural resources and environment.
MEP China Development Bank	Development Finance Collaboration Framework Agreement.	Provision of 50 billion RMB bank loans as long-term and stable financial support to key projects and large enterprises in the environmental protection sector in the 11th FYP.
MEP People's Bank of China	The circular on issues related to business environmental information disclosure	Starting from information on violations of environmental law, to gradually set up a business environmental information disclosure system for credit approval, including information of environmental impact assessment, clear production audit etc.
People's Bank of China	Guidelines for improving and enhancing financial services to support energy-saving and emissions reduction.	Differentiated evaluation and support, according to the impact on natural resources and environment
People's Bank of China, MEP CBRC	Suggestions on environmental protection enforcement and prevention of credit risks	Tighten project and credit approval of new projects. Strictly prohibit bank loans to

		new projects that seriously violate environmental protection.
CBRC	Guidelines for credit approval for energy-saving and emissions reduction.	Control the total amount of credits approved. Optimise the credit structure with the objective of promoting a sustainable and coordinated development between the economy and the financial sector.
MEP CBRC	Agreement on information exchange and sharing.	Establish an information sharing mechanism between MEP and other macroeconomic governmental agencies for the first time.
People's Bank of China, MEP CBRC	The circular on issues related to full implementation of green credit policy and further improvement in information sharing.	Establish a regular information submission and exchange mechanism at national, regional and local levels.
People's Bank of China, CBRC China Securities Regulatory Commission (CSRC) China Insurance Regulatory Commission (CIRC),	Guidelines for further improving financial services for supporting the revitalisation of key industries and controlling production over-capacity building.	Further strengthen financial support for energy-saving and ecological protection; Strengthen financial support for the development of low-carbon economy; Encourage the financial sector to develop innovative low-carbon financial products; Enhance green credit support for projects and enterprises that meet energy-saving and emission reduction requirement/standards.

Source: "China Green Credit Report, 2010". Policy Research Centre for Environment and Economy (PRCEE), Ministry of Environmental Protection of China, 2011.

In the 12th FYP, various green financial instruments/schemes, in particular "green credits" and "green security", will become important instruments to support energy-saving and emissions reduction and to spur green innovations. More specifically:

- More financial institutions will provide green credits and other financial instruments (e.g. bank loans, interest rebate etc) to support projects, investments and innovation in the fields of energy-saving and emission reduction;

- Financial institutions will penalise (such as higher interest rates and refusal or cancellation of bank loans) applicants with poor environmental compliance records and/or with serious environmental violations;

- Financial institutions will use green credits to supervise and guide the use of bank loans in order to reduce environmental risks and promote corporate

social responsibility, as well as mitigate the financial risks undertaken by the financial institutions themselves.

Government policies in the traditional environmental protection sector as well as the emerging and strategic industries will help to develop green credits in China. Combining government policies with flexible market-based approaches and an increasing interest of the financial sector in green investments, this will be a concerted effort between the government, finance and business sectors. The use of green credits will require greater openness and transparency, consisting of more information disclosure by the governmental agencies and financial institutions as well as closer monitoring by the general public. To further accelerate the development of green credits and other related green finance instruments, the following supporting measures will be important:

1) **Strengthen technical support to financial institutions when green finance regulations and policy measures are introduced.** To make green credits more feasible and operational, the financial sector will need access to detailed and targeted technical information. This can be achieved by developing industry- and region-focused practical guidelines/information tools on environmental and safety standards.

2) **Further strengthen the collaboration between governmental agencies and financial institutions in the field of environmental protection.** In particular, the current one-way information disclosure system – governmental agencies providing information to commercial banks – needs to be upgraded to a mutual and open information sharing process, where information related to environmental and financial risks can be more easily shared between stakeholders.

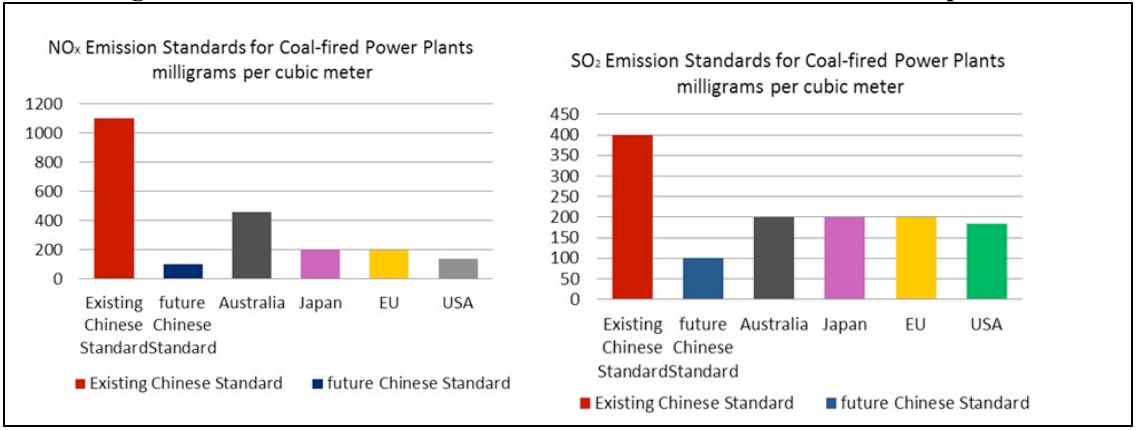
11.4 Create a new catalyst by combining environmental policy & green innovation

Despite the exciting and new progress in China's S&T and innovation policy, significant policy gaps in China's national (and regional) innovation system still exist and need to be addressed urgently in order to prepare the ground for large-scale green innovation. For instance, there is an urgent need to modernise the basic research, human resource and skill development to increase the responsiveness of public research to the opportunities and challenges in the green development. Furthermore, to increase the speed and scale of China's green technology transformation and to enhance its competitiveness, the gap between research (both basic and applied) and technology commercialisation and industrialisation need to be bridged quickly. Moreover, in alignment with environmental standard setting and the development of "green public procurement", **"regulation-induced innovation"** will also become more important.

In the international context, using environmental policy as an efficient tool in conjunction with investment in green R&D to spur green innovation has become one of the key focus of green growth policy-making. In the Chinese context, the ambitious plans for the emerging and strategic industries, a demand–driven economy and energy efficiency and environmental protection have created favourable macroeconomic

conditions and regulatory environment for green technology and innovation. Under the 12th FYP, emission standards of SO_2 and NOx will be revised to bring China to be in line with international standards (see Figure 18).

Figure 18. Chinese SO_2 and NOx standards in an international comparison



Source: "The China greentech report 2011", pp 66. Reproduced in the CCIECD Green Economy Task Force report.

The experience of NOx emission charge in Sweden provides a useful example regarding the use of stringent environmental standards to spur innovation and reduce abatement costs (See Box 22). This can be a useful reference case for China when introducing NOx emission reduction target and in relation to the reform of its environmental charge/fee system. With a "smart" policy mix, comprising of stringent environmental standards, government support for research and incentives for innovation (both public and private), there is a real potential for China to solve the **double market failures, i.e. "innovation undersupply and pollution oversupply".**

Box 22. The innovation effect of Sweden's NOx emission charge

The NOx emission charge was introduced in 1992, covering all stationary combustion sources producing at least 50 MWh of useful energy annually. The objective was to reduce the overall NOx emission by 30% between 1980 and 1995. The NOx charge was a ***complementary instrument*** to the quantitative limits (on an individual plant basis) introduced in 1988 to attain more effective reduction.

The NOx charge started at a high level (40 SEK per kg NOx) with a unique design. Under the system, plants paid this fixed charge per kg Nox emitted and the revenues were (almost) entirely refunded to the paying plants, in relation to their respective fraction of total useful energy produced.

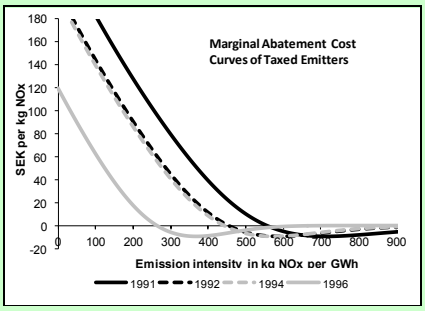
The refund mechanism served the purposes of 1) minimising the distortion in competitiveness between the large regulated and the smaller unregulated plants; 2) facilitating a charge level high enough to achieve the desired effects on emission while avoiding political resistance from emitters.

From a technology point of view, the NOx charge created a strong incentive for the **immediate adoption of existing abatement technologies** (e.g. SCR, SNCR and trimming).

More interestingly, the NOx charge system has also **spurred innovation**, which could be observed from:

- The significant **increase in the patenting** of NOx technology in Sweden during 1988-93, exactly when the charge was discussed and implemented. There was also some indication that inventions first intended for t**he regulated Swedish market** later spilled over to **the broader international market;**
- **Continuous decline in the average emission intensity** as a result of innovation in both **physical mitigation technology** (e.g. investment in new equipment) and **non-physical mitigation technology** (e.g improved combustion process and/or cleaner production process).

- The **downward shift of the marginal abatement cost curve** (see figure below) – as a result of the adoption of innovation in abatement technologies which has made it possible to produce energy with less NOx emission without increasing costs.



Source: Taxation, Innovation and the environment. OECD, 2011

12. KEY CONCLUSIONS AND KEY RECOMMENDATIONS ON PROMOTING CHINA'S GREEN ECONOMY

China has embarked on the pathway towards a green economy in the past years. The resolute and unambiguous policy messages from its 12th Five-Year Plan (2011-2015) have not only reinforced this strong political commitment and leadership, but also called for more integrated, innovative and effective strategic frameworks and actions.

While "business as usual" is not an option, there are no off-the-shelf solutions to help China accelerate its **move from an unbalanced, uncoordinated and unsustainable development towards a green, competitive and inclusive economy.** China needs to seek its own pathway, in the face of the distinctive scale and complexity of multiple challenges in terms of ecological, resource, economic and social security concerns. The growth model characterised by high resource utilisation, high energy intensity, high emission, low recycling and low efficiency has created serious resource bottlenecks and resulted in comprehensive environmental and ecological impacts. Also, the continuous industrialisation, urbanisation, and modernisation of the agriculture sector will remain both challenges faced by China and catalysts for transformational changes in the foreseeable future. At the same time, China needs to seize the unique green growth opportunity, and to achieve the 'first mover and fast mover' advantages by promoting green investment, green innovation and green job creation beyond those defensive interests.

The 12th FYP represents a critical juncture in China's development – as China scale up and speed up its economic, environmental and social transformations. Fundamental changes towards a green mind-set as well as innovative strategic policy-

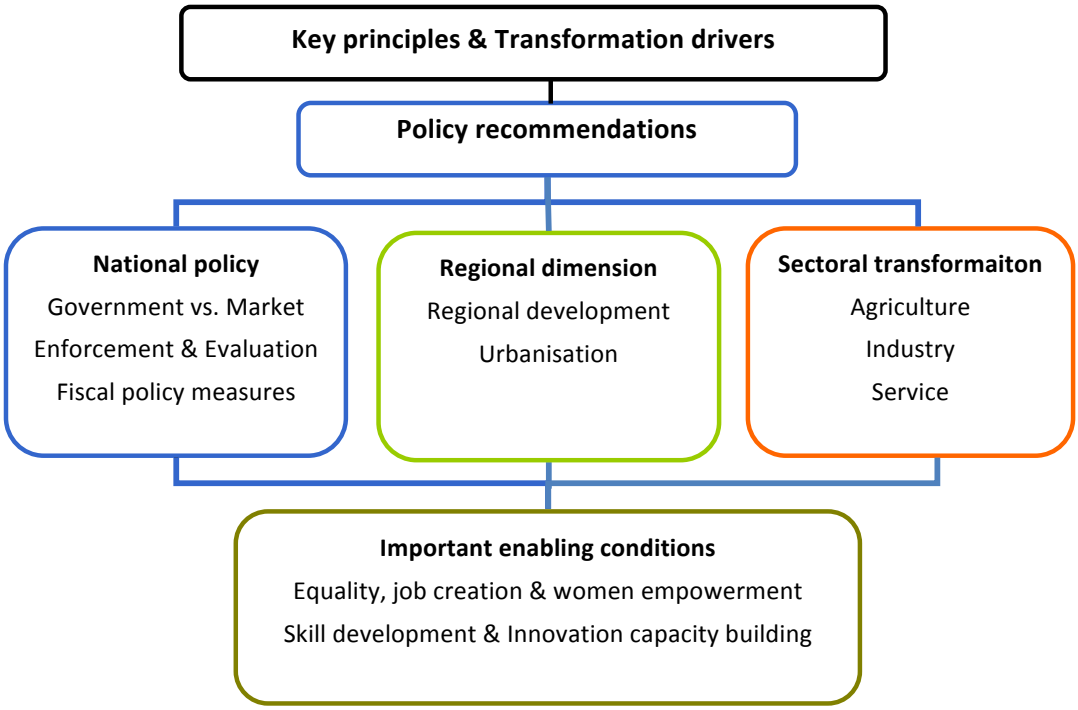
making and effective implementations towards greener economic and industrial structures will be the key to treating the cause, instead of the symptoms. The "trial and error" and learning-by-doing process of achieving a green transformation in both the public and the private domains will require an exceptional level of openness and creativity as well as co-ordination and partnership. The success in the 12th FYP will lay a solid foundation for even more swift and forceful transformational changes in the 13th FYP (2016-2020) as China faces ever greater environmental and resource challenges. China's successful first steps towards a green economy will also have repercussions on the global economy in both the short and the long terms. Instead of being a source of resource exhaustion and unsustainable growth, China can become a promoter of resource conservation, a green technology enabler (especially in North-South-South technology transfer and diffusion), and a strong driver for new sources of green growth – overcoming the "environmental and equality deficits" and moving away from a jobless growth trajectory.

Key principles that will guide China's green economic development need to be progressive in nature, including a **balanced and mutually supportive and reinforcing relationship** between the economy and the environment, and a refined understanding of economic and social progress within the China-specific context. In other words**, the speed, efficiency, quality and equity of economic development** will need to be given more equal priorities.

Therefore, new values, skills, governance and incentive structures will be the most important **transformational drivers** for China's fundamental and structural changes toward a green economy, especially in relation to policy making, market development and their inter-dependency:

- **Fundamental change in values and behaviour** – from national, regional, local to individual levels, concerning wealth including natural assets and social cohesion as well as how wealth is created, moving away from GDP obsession, unsustainable lifestyles and over-consumption at the expense of the environment and a harmonious society;
- **Transformation of the role of government and its relation with the business sector,** through improvement in the quality and effectiveness of policy implementation and being a strategic leader, a facilitator of a well-functioning market and an efficient public service provider;
- **Transformational and innovative incentive mechanisms and structure** – to encourage green production, investment and green consumption, as well as to remove distortions resulting from both policy- and market failures;
- **Skills development and innovation capacity building** based on a strategic understanding of the new and multidisciplinary skill profiles that the green economy requires – towards a more labour-intensive, equality-based and service-driven economy.

To address the existing structural issues at the national, regional and sectoral levels as well as to create favourable enabling conditions for the future green economic development, the Task Force propose key recommendations, according to the following structure:



12.1 Key recommendations on national policy

Key recommendation 1: The transformation of the government's functions to create favourable institutional and market conditions for the green economy

In the transformation towards a green economy, enterprises are the key implementers. The role of the government and its relation with the market and the private sector need to be modified and balanced, in order to improve economic and resource efficiency. A sound policy and regulatory framework, efficient market monitoring and oversight as well as appropriate incentive mechanisms are the keystones of a well-function market, which can make green investment and green business more attractive, viable and profitable. Accordingly, the government should accelerate the transformation of its functions. Priorities should be given to strengthening the regulatory role of the government and environmental oversight of economic activities, while reducing the government's direct interventions in market behaviour and operation.

1) Reduce government interference in the market and efficiently utilise the fundamental role of the market to allocate resources. Instead of over-relying on administrative measures and public spending, conducive institutional framework and market conditions are key to attracting and allocating resources more efficiently towards a green transformation. More specifically:

- The government should avoid creating **barriers to market entry** for green investment and businesses and clamp down on the **local protectionism** that prevents **fair competition and market access;**
- The government should avoid market distortion through excessive use of administrative measures, which leads to **interference in price setting and market operation.** These interventions would in turn send misleading and distorted market signals related to environment and resources;

- **The autonomy of the private sector**, in terms of decision-making in project investment and business development, should be respected, instead of being overtaken by the government decision and involvement;
- The **crowding-out of private investments** due to excessive and redundant public investments in the name of various demonstration projects should be strictly controlled.

The role of the government should be more clearly defined by targeting these areas. The corresponding monitoring mechanisms for decision-making and enforcement should be established and strictly followed.

2) Clarify the responsibilities of the government and strengthen its role in market supervision and public service provision. Short-sighted and unsustainable business practices are the result of both biased price signals and misaligned incentives as well as the weakness of market supervision and regulation. Therefore, key government priorities for green transformation should include clearly defined government regulatory responsibilities and accountability as well as improvements in compensation mechanisms and public service provision. This is particularly important for key sectors such as environmental protection, resource conservation, safety management and fair competition. Neither economic growth nor local interests should hinder the enforcement of laws and regulations related to environmental protection and resource utilisation. More specifically:

- Strictly control and firmly combat illegal business practice. This is the bottom line for securing a fair market competition and sustainable development;
- Backward production capacity should not be protected for the sake of local economic interest. Law and regulations related to environmental protection should be strictly enforced;
- A compensation mechanism and accountability system for environmental damages should be established to provide effective remedies for both private and public environmental damages. The focus of environmental supervision and enforcement also needs to be gradually changed from imposing penalty for exceeding environmental standard/cap to providing compensations for environmental damage caused by infringements of law and regulations;
- From a legal perspective, the government's regulatory responsibility should be clarified;
- A strict accountability system and a comprehensive performance evaluation should be established, accompanied by effective and regular market oversight and management;
- Strictly follow the law and encourage public disclosure of information concerning the government's supervision and management to facilitate public participation and media scrutiny.
- Good governance based on the rule-of-law, transparency and equitability on all levels of the government should be the crucial guiding principles for an effective green transformation.

3) Utilise the economic policy tool box in a targeted and integrated way to guide the transformation towards green investment, green business practice and green consumption. More specifically, public funding, taxes and various financing instruments should be used as levers to accelerate the green transformation through

their influence on prices and demand-supply conditions, and to enhance financial resources for green investments and green innovations.

Key recommendation 2: Establish a comprehensive evaluating system to ensure coherence and effectiveness of green economic development policy and decision-making

In order to facilitate the green economic transition, policy coherence and mutual supportiveness are vital, while the creation of new problems in the process of solving existing ones must be avoided. For instance, many investment projects focus only on economic efficiency while ignoring the environmental impact; some environmental protection measures that concentrate on achieving emission reduction targets are highly energy intensive; and finally, many renewable energy and energy efficiency projects lead to substantial environmental and ecological impacts. Given the great diversities between regions in terms of the level of development and region-specific conditions, the "one-rule-for-all" approach of target-setting and evaluation system will fail to meet the differentiated needs and address the real problems.

1) **Establish a comprehensive evaluation system/mechanism for key development initiatives and projects.** In particular, the government should set up expert groups to carry out both ex-ante evaluation and evidence-based ex-post impact assessment on key policy and investment initiatives related to energy, environment and resources, in order to scrutinise their overall economic, environmental and social impact.

1) **Establish a comprehensive environmental risk assessment system - taking into account region- and industry-specific conditions and characteristics.** The purpose is to set up specific and differentiated objectives and targets for environmental management in the regional green economic development and industrial upgrading and modernisation. When setting up these targets, regional conditions and industrial characteristics must be taken into account to avoid a "one-rule-for-all" approach.

Key recommendation 3: Carry out a comprehensive greening of the fiscal policy and tax system

Generally, the market force alone cannot solve issues related to resource use and environment. Therefore, the role of the government in guiding the economic reforms through various public supports, taxes and pricing mechanisms should be strengthened. Comprehensive fiscal policy reforms should have a strong focus on improving the incentive structures – to encourage green investment, green business and production practices, and entrepreneurship as key drivers in accelerating the green transformation. Furthermore, while China is already leading the world in green investments, future investments need to be both strengthened and diversified – with a stronger participation of both domestic and foreign actors from the private sector. Moreover, being fiscally neutral is not enough to address distributional concerns associated with structural adjustment and changes. Targeted compensatory measures are needed to compensate the adversely affected and the most vulnerable groups.

1) **Establish support mechanisms that secure a stable increase in financial support for green development.** To establish a multi-tier and co-ordinated co-finance/co-funding mechanism with joint efforts by the national, regional and local government. Coordination mechanisms for various policy instruments, such as taxes, finance and prices should be established.

2) **Deepen tax reforms and further strengthen resource-related price reforms that are favourable to green economic development, such as:**

   - Accelerate the reform of resource taxes;
   - Adjust the consumption tax in line with polices related to energy-saving and emissions reduction; introduce environmental taxes or environmental protection taxes, including carbon tax;
   - Reform and reduce some of the business taxes to promote the development of emerging and strategic industries, a modern service sector and entrepreneurship as key drivers in accelerating the green transformation;
   - Remove environmentally harmful subsidies, with removing subsidies for fertilizer production as one of the priority areas;
   - Deepen the pricing reform for key resources, e.g. water, electricity, oil and gas so that prices can better reflect resource scarcity as well as the polluter pays principle, etc.

3) **Promote the development of green finance** which has a particular strategic focus and importance for the development of S&T and innovation-based SMEs. Support enterprises' energy-saving and emissions reduction actions, as well as reduce environmental and financial risks of enterprises and financial institutions through green credits and other innovative financial instruments.

12.2 Key recommendations on a differentiated green regional development

Key recommendation 4: Avoid unsustainable relocation of backward technologies and production facilities and achieve a coordinated green regional economic development

As the result of the "industrial gradient transfer" from the eastern coastal region, the less-developed interior and western regions have grown rapidly during the 11th FYP, while their transition from a resource-based development model to a modern industry-based development model has proceeded relatively slowly. To avoid these regions from being locked in a low-quality destructive development, the "industrial gradient transfer" needs to be managed properly and take place in a sustainable way, through better coordination between the central, regional and local governments and stricter monitoring and control.

1) **Tighten and/or enforce the environmental standards for project/investment approval to prevent pollution transfer (from developed to less developed regions):**

   - Strengthen and enforce the environmental impact assessment and the "three-simultaneity" principles;
   - Set up an information system for the re-allocation or transfer of highly polluting enterprises;

- Monitor and supervise local decommissioning of obsolete and highly polluting equipment.

The key to achieve a co-ordinated green regional development is to define economic development priorities of different regions according to their level of economic development and ecological endowments as well as the need to protect and preserve these endowments. Through the public transfer schemes and market-based compensation mechanisms, both burden-sharing and benefit-sharing mechanisms can be implemented to reduce imbalance across regions. This is particularly relevant and important for the development of compensation mechanisms for green transformation in resource-exhausted regions and cities.

2) **Encourage the development of green regional development strategies based on region-specific green development potentials,** such as:

- Fully explore the potential and utilise the capacity of the **Eastern region**, in the fields of industry clustering, S&T and innovation capacity, environmental protection as well as financial services;
- Take advantage of the improved transport infrastructure and human resource endowment in the **Central and the Western regions**, and turn them into China's new and green manufacturing bases;
- Take advantage of the resource abundance as well as the richness of its biodiversity and ecosystem in **the Western region** to develop sustainable mining, equipment manufacturing and new energies as well as to create new growth opportunities, e.g. eco-tourism.

Key recommendation 5: Adopt a more concentrated approach to China's green urbanisation

In the rapid ongoing process of urbanisation, cities are playing an increasingly critical role in driving economic and environmental impact. China has yet to decide on which model of urbanisation is best for its future. However, some clear empirical evidence suggests that, two **concentrated growth scenarios,** i.e. **super-cities and hub and spoke** are preferable to a dispersed urbanisation scenario. The advantages include higher per capita GDP, less loss of arable land, more efficient energy use, mass-transit and pollution control. A plan pushing China toward a more concentrated approach to urban development can thus deliver the optimal trade-off between benefits and burdens of urbanization. Such a policy, however, would require a deliberate shift from the current development pattern of disproportionate growth in middle sized urban areas.

1) **Encourage concentrated growth nationally:** Municipal government collects taxes and makes many decisions, such as granting industry subsidies and retail licenses that have a direct economic impact. These local decisions have a strong and irreversible effect on the quality of Chinese urban life. The central government, however, can guide local actions, set common standards and monitor enforcement by cities to move the country away from the current trend of dispersed urbanisation and toward a more concentrated approach.

2) **Use infrastructure approvals to shape clusters:** The central authorities should also encourage infrastructure investments that focus on super-cities or hub-and-spoke clusters. Capital projects such as refineries, ports, and large universities could be placed strategically to spur the growth of the largest cities.

3) **Use land conversion processes to spur density:** Land conversion rights are governed nationally and central officials have already tightened the quota for land that can be developed for urban use. Violations are rampant, however, and current land use policy fragments the urban periphery. By recognizing the role of market mechanism in more efficient resource allocation and in managing the national land conversion process, municipalities can be encouraged to seek breakthrough concepts that do not reduce agricultural land in total while maximizing its value as urban infill.

12.3 Key recommendations on a green transformation at the sectoral level

Key recommendation 6: Develop and strengthen an integrated approach to greening the traditional industrial sector

China's industrialisation process faces daunting challenges and also important strategic opportunities under the 12th FYP, which requires a multifaceted, innovative and open industrial transformation. At the same time, an integrated approach is needed to set up effective and efficient pollution prevention and control system and energy efficiency management in the industrial sector. Related policies and regulations, such as emission standards, should increasingly aim at reducing emission and promoting resource and energy utilisation at the industry-wide level, rather than dealing with single pollutants and pollutant sources.

1) **Enforce and accelerate the phasing out of backward technologies and production facilities**:
   - Introduce market exit mechanisms for backward and highly polluting enterprises. Regulations and standards for compensations for capacity elimination should be set up.
   - Encourage and facilitate voluntary elimination of backward production capacity or technology innovation and upgrading of highly polluting enterprises through a combination of carrot and stick measures.

2) **Undertake integrated pollution prevention and control and energy efficiency measures, striving for co-control and co-benefit:**
   - Better utilisation of waste heat from industries;
   - Treatment and recycling of external waste using industry facilities, e.g. waste treatment in cement kilns;
   - Limit the exploitation of natural gypsum and enhance utilisation of industrial by-product gypsum.

Key recommendation 7: Promote a green agricultural development in the modernisation process

While the Chinese agricultural sector is undergoing a rapid process of industrialisation and modernisation, it is important to seize the opportunities of efficiency gains from

economies of scale and more advanced production processes while at the same time deal with the new environmental challenges. In particular, the large-scale production and utilisation of renewable energy and organic fertilisers are important for both economic and resource efficiency and reduction of non-point source pollution in the agricultural sector.

1) **Support large-scale and industrialised production process of organic fertilisers**:
   - Develop an industrialised production of organic fertilisers in conjunction with the industrialisation of livestock production to increase organic fertiliser use;
   - Improve the efficiency of fertiliser use through technical support and capacity building for farmers.

2) **Encourage large-scale and industrialised livestock and production of farm products:**
   - Provide special funding and subsidies for the setting up of waste treatment facilities according to the scale of waste treatment and the efficiency in emissions reduction;
   - Promote concentrated and large-scale waste treatment.

Key recommendation 8: Fully leverage the role of the service sector as a catalyst for green transformation

The role of the service sector in the structural adjustment – from capital-intensive and heavy industry-dependent growth to a more labour-intensive and knowledge/skill-driven economy has been underutilised. The contribution of the service sector to a greener economy is at least twofold: 1) a larger share of the service sector in GDP and a less energy- and resource-intensive economy through a greener service sector; 2) technology services can help improve the environmental performance of the industrial sector. In relation to the latter, services can help transform not only the manufactured products (including their re-processing, re-use, recycling or disposal) but also the production processes, such as more efficient engineering design and energy and pollution management. These types of manufacturing-related services and R&D have become key drivers for the development of the service sector, and are a key source of revenues and jobs along extended value chains in many OECD countries. However, due to the backward production capacity as well as the overall low skill level in the service sector, these developments have only just begun in China.

1) **Develop a strong manufacturing-service linkage as a driver for upgrading in both sectors.** This needs to be supported by the development of manufacturing-service green skills, capacity building and job profiles, e.g. education of designers, planning of density-driven infrastructure and integrated resource management for the manufacturing sector.

2) **Incentivise the re-allocation of capital and investment to drive employment in the service sector.** This development is dependent on at least two key factors: 1) reform in the financial sector to engineer a shift towards investments in more dynamic and innovative service companies, instead of making redundant investments in less productive and less efficient industrial enterprises; 2) the development of skill- and innovation-based SMEs.

12.4 Key recommendations concerning important enabling conditions

Key recommendation 9: Make green transformation a more inclusive and empowering process

China has made remarkable progress in its effort to alleviate poverty in the past three decades. However, a combination of the climate, energy and economic crises has made the problem of poverty more complex, which in turn exacerbated the female face of poverty. A green economy needs to be inclusive and empowering for all actors in the society, especially women who generally tend to fare worse than men. Hence, green economy is not only about development but also a driver of women's empowerment. China has already made good progress in creating new green jobs in its poor and rural areas through ambitious programmes in forestation and renewable energy development, which has also benefited its female work force. Furthermore, as the proportion of women in its urban and rural work force continues to increase, women have become an important driving force in China's green development, instead of only being victims. Nevertheless, developmental co-benefits and new opportunities – in particular in terms of job creation which is the most effective vehicle in reducing poverty and creating social cohesion – should be further explored:

1) **Make green economy a job-generating, instead of a jobless growth,** with a clear focus on:

    - Green job creation with strong positive developmental effects in the poor and rural areas;
    - Promoting labour-intensive and high-quality manufacturing jobs in the process of greening and modernising China's traditional industries and manufacturing-related service sector;
    - Accelerating the development of green sectors, in particular the energy-saving and environmental protection sector to create both manufacturing and service jobs;
    - Enhancing resource- and eco-efficiency, so that green growth, efficiency improvement and job creation are mutually reinforced and the job-generating potential of the economy as a whole is strengthened.

2) **Make the green job creation process an empowering process for women and enhance the accessibility of women.** The Chinese government should focus its efforts on improving women's job opportunities in both traditional green sectors (environmental protection, resource management, handcrafts, building and transport, etc.) and in non-traditional sectors, particularly in new and high-tech sectors.

Key recommendation 10: Make green innovation a catalyst for China's modernisation and leapfrogging

Green innovation can be a new and important catalyst, not only for turning China's environmental problems and energy bottlenecks into new growth opportunities in resource efficiency and renewable energy, but also for modernising China's national innovation system on a broad front - from the basic research system to high-end manufacturing. The development of the emerging and strategic industries outlined in

the 12th FYP opens up a new window of opportunities for the modernisation and leapfrogging in an innovation-driven industrial sector. The market size, manufacturing capacity, and increasingly, also the local innovation environment and infrastructure have made China an attractive destination for international technology and know-how transfer, and increased its potential to become a global green innovation hub. However, to fully unleash and utilise its innovation potential, significant capacity, skill and policy gaps need to be filled and the scope of collaboration needs to be enlarged:

1) **Undertake a green innovation oriented modernisation of China's basic research, S&T and human resource development system, with a specific focus on:**
   - The multidisciplinary, interdisciplinary and intersectoral nature of green technology, R&D and innovation;
   - Stronger links between cutting-edge basic research and large-sale technology uptake/commercialisation in the market.

2) **Strengthen the mechanisms of regulation-induced innovation through the alignment of environmental policy tools, as such standard setting, green public procurement and incentives for innovation.** This will be a strong lever for developing knowledge- and skill-intensive and cost-efficient energy-saving and emissions reduction actions.

3) **Make the development of SMEs an integral part of the development of emerging and strategic industries.** Public-private partnerships as well as public-public partnerships with an international dimension to support technology transfer and mutual market and skill development for both Chinese and foreign SMEs.

4) **Enhance the openness of the national green innovation system for creating pragmatic and creative platforms and approaches for technology innovation, deployment and diffusion to strengthen partnerships and competitiveness.** This can take the forms of:

   - A green technology innovation and investment platform, with an international dimension and a focus on supporting large-scale science-industry collaboration initiatives, built on strong private-public partnerships. Some of the international experience, e.g. sustainability-focused **Centres of Excellence** in the EU member states and the EU's **Joint Technology Initiatives** (JTIs) could provide a useful model for China's green technology and innovation capacity enhancement;

   - A "protect-and-share" IPR regime, technology development, transfer and diffusion mechanism to facilitate China's bridging role in North-South-South green technology and innovation collaboration.

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