China's Pathway Towards a Low Carbon Economy

China Council for International Cooperation
on Environment and Development
中国环境与发展国际合作委员会

PREFACE

The China Council for International Cooperation on Environment and Development (CCICED) was established with the approval of the Chinese government in 1992. Consisting of senior Chinese and international officials and experts, it serves as a high-level advisory body with a mandate to conduct research and to provide policy recommendations to the Government of China on China's environment and development. The Council reports to the State Council and each year meets with a senior leader to discuss its recommendations.

In November, 2009, CCICED's Task Force on Pathway Towards a Low Carbon Economy in China, which was Co-Chaired by Liu Shijin *(Vice President of the Development Research Center of the State Council of China)*, **Sir Gordon Conway** *(Professor, Imperial College, London)*, **and Bjorn Stigson** *(President of World Business Council for Sustainable Development)*, **presented its final report to the Council's 2009 Annual General Meeting.* The Task Force's recommendations contributed to the Council's 2009 policy recommendations on Energy, Environment and Development, which have been submitted to the Chinese Government.**

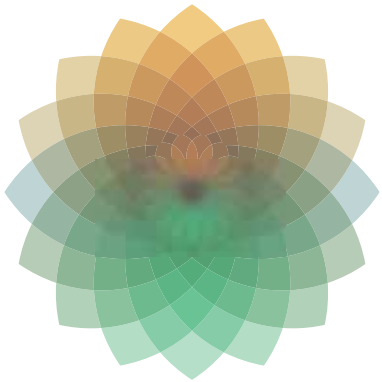
This present publication outlines in brief the roadmap the Task Force proposes for China to successfully make a transition towards a Low Carbon Economy.

** For the full text of the Task Force's Report with a list of its members and the cooperating institutions that assisted in the work, see: http://www.cciced.net/encciced/policyr/Taskforces/phase4/tflce/200911/P020091124512243707328.pdf*

1. INTRODUCTION
Capitalising on the benefits of low carbon transition

China stands to benefit significantly by transforming its pattern of economic development towards low carbon growth pathways. Such a transformation will allow it to capitalise on new growth opportunities as a supplier that can help satisfy the increasing global demand for low carbon technologies. There are other substantial and immediate economic benefits to be gained from improving energy and resource efficiency levels. China has already adopted rigorous policies to realise those benefits: these are important tools for kick-starting a low carbon economy. Growing industrialisation and urbanisation together with China's coal-based energy structure impose tremendous pressure on its resources and environment. China's growing dependence on oil imports raises uncertainties for economic development and also worsens energy security. With global economic imbalances causing financial crises, the pattern of economic growth in China is facing unprecedented challenges.

Without mitigation, global climate change impacts would impede China's long-term development prospects. China is frequently stricken by natural disasters. Unchecked climate change would increase the frequency of climate-related natural disasters in China, threatening economic progress and even domestic social stability and national security. The 2005 drought in Ningxia Hui Autonomous Region alone cost an estimated 1.27 billion RMB – 2% of the province's GDP – and damaged 289,000 hectares of crops.



Box 1: Definition of low carbon economy

A Low Carbon Economy (LCE) is defined by the Task Force as a new economic, technological and social system of production and consumption to conserve energy and reduce greenhouse gas emissions compared with the traditional economic system, whilst maintaining momentum towards economic and social development. "Low Carbon" is shorthand for "low greenhouse gas" – while CO_2 is the main contributor to global warming, the role other greenhouse gases must not be overlooked.

This definition of the LCE is underpinned by three principles:

1. **A LCE would eventually decouple economic growth from greenhouse gas and other polluting emissions, through technological and other innovations and changes in infrastructure and behavioural changes.**
2. **At China's current stage of development, still undergoing industrialisation and urbanisation, "Low Carbon" is a relative rather than an absolute concept. Emissions per unit of economic output are reduced more rapidly under a LCE than would be the case with a continuation of the status quo.**
3. **A Low Carbon Economy achieves many key development objectives including long term economic growth, creation of jobs and economic opportunities, reduction of resource consumption, cleaner air, better environmental health, and enhancement of technological innovation.**

The transition to a low carbon economy is therefore an imperative, not an option. The cost of inaction has been laid chillingly bare. The Stern Review puts the eventual cost of doing nothing to combat climate change at between 5 and 20% of global output: the cost of both World Wars and the Great Depression combined. Economic losses attributable to climate-related disasters reached an unprecedented $185 billion in 2005. The United Nations estimates that extreme weather events alone could cost a trillion dollars per year by 2040 – amounting to 3% of current global GDP. Add to this changing rainfall patterns and the prospect of large swathes of now-arable land becoming unsuitable for growing food, a high-carbon future looks like a grave threat to our prosperity and development.

To avoid dangerous climate change, global temperature increases need to be restricted to no more than 2 degrees C above pre-industrial levels. Cost estimates for getting there vary widely, not least because they depend on uncertain technology costs and fluctuating oil prices. At the global level, the Stern Review estimates that the cost of meeting a reasonable stabilization target could range from 3.4% of world GDP in 2030 to a savings of 3.9% of GDP. The consulting firm McKinsey reckons that mitigation costs will be of the order of 0.6-1.4% of global GDP by 2050.

Some emissions reductions will be cheap, even profitable: McKinsey thinks that one third of abatement opportunities would save money, especially those arising from better energy conservation and efficiency. Others, however, will be expensive: the International Energy Agency projects that limiting atmospheric CO_2 to 450 ppm would require an increase in green technology investment averaging an additional $1 trillion per year up to 2050.

With greater understanding of the higher costs of inaction, many countries at different levels of development have set targets for emissions reductions and started tailoring social-economic policies to move towards a low carbon economy. Sweden, for example, has succeeded at de-linking its economic growth from emissions: since 1990, the country's output has increased by over 30%, while emissions have declined by almost a tenth. However, few developed countries have been able to emulate Sweden's example.

This report argues that a low carbon development pathway is the best way for China to create employment while achieving a resilient and prosperous society, and to build on and enhance national priorities such as the Scientific Outlook on Development. Efforts to maintain a safe climate are in line with the priority of developing a harmonious society and a circular economy. They are also fully consistent with existing Chinese efforts on energy saving and environmental protection. As part of the Eleventh Five-year Plan, Beijing has already set ambitious targets for cutting energy consumption per unit GDP (by 20%), for reducing industrial water use, improving the efficiency of agriculture irrigation, and increasing the reuse of industrial waste.

While developing a low carbon economy is an urgent and necessary task for China, and that the low carbon economy provides a path to the new industrial and economic growth model that China urgently seeks, it faces challenges in the transition. Section 2 argues that these challenges, though real, must be turned into opportunities. Section 3 explores five policy areas – described as pillars – that underpin key interventions in the transition to a low carbon economy.

These include:

Low carbon sustainable industrialisation: China's explosive industrial development has brought many economic benefits, but has placed great pressure on the consumption of energy and other resources, which in turn drive greenhouse gas emissions and other environmental problems, not least the availability of clear water and air. The solutions range from accelerated action on energy efficiency to reducing the share of heavy industry in China's economic structure. Carbon capture and storage could also play a key role in future for sectors such as steel and cement.

Urbanisation and transport: China continues to experience a rapid demographic shift from rural to urban areas. The scale of infrastructure development is unprecedented and creates both risks (of locking in a high-emissions future) and enormous opportunities if planning can be appropriately reformed. Energy efficient buildings will play a key role, as will low carbon transport; within urban areas as well as links with the countryside.

Low carbon energy: The large share of coal in China's energy mix is one reason why greenhouse gas emissions have climbed so sharply in recent years. Driving up the efficiency of older power stations is a key part of the solution, as are opportunities to switch to natural gas and upgrade the transmission grid – but a rapid increase in the share of renewable energy and nuclear power in the coming decades will be essential.

Low carbon consumption: Individuals will play a key role in the transition to a low carbon economy. Quality of life will improve during this process, but lifestyles will also change in important ways – from where people live to the way they travel. Through education and via the fiscal system, an early step will be to encourage consumers to purchase lower carbon, sustainable goods.

Rural land use: Rural areas are already a priority for China in achieving balanced development, and this will only be strengthened in a low carbon economy. Sectors such as forestry and agriculture will continue to play a key role by taking carbon out of the air and locking it into vegetation and soils. At the same time, great potential exists for the use of biofuel in transport, biomass in electricity generation, and biogas for heating. Second generation technologies are needed, however, so that the full potential can be realized without threatening food production.

This report suggests that success in each pillar will rest on three fundamental bases: appropriate institutions, markets and pricing reforms, and technology and innovation. These bases inform the design of recommendations by the Task Force to embed low carbon development at the heart of economic and social planning.

Section 4 outlines strategic recommendations for China's 12th Five Year Plan, which will cover the period 2011-15. This report includes proposed targets for energy and carbon intensity improvements out to 2020 and 2050.

The proposed priorities, targets and timescales are underpinned by extensive analyses undertaken by the Task Force and supporting institutions. Detailed energy and emissions scenarios were produced to highlight the types of technology that will be required over different periods if the calculated emissions and energy demand curves are to be significantly changed. The scenarios show that low carbon transition is not only feasible, but also affordable for China (see Box 2).

2. UNDERSTANDING CHALLENGES AND OPPORTUNITIES

China is already taking significant action towards a low carbon future. Stepping up the pursuit of a low-carbon economy would undercut many long-term threats to growth in China. The country is already a world leader in critical low carbon technologies such as solar power, heat and wind turbines, and is rapidly developing key technologies for electric vehicles. Existing policies are set to ramp up the investment in renewable energy.
China added more new wind power capacity than any other country in 2009 and progress is on track for nearly 40 million households to use biogas by 2010.

By acting now on R&D and commercialization activities, China can take a leading role as a supplier of equipment and know-how to rapidly growing international markets for low carbon technologies, goods and services. It can become a leading innovator in a sector in which the world's leading economies are currently competing to establish a foothold. These changes will reinforce China's aims of becoming less dependent on exports of heavy energy-intensive goods, and becoming a market leader in higher value-added technology- and information-based goods and services. Choices made in China will shape the global markets for such goods. In addition to building the foundation for future growth and industrial progress, moving to a low carbon economy could also help China pre-empt the threat of climate-motivated tariffs from key export markets.
In short, the economic dividends would hardly be limited to less frequent disasters, preserved market access, or a more sophisticated industrial production and export profile. A low carbon shift would dramatically improve long-term returns on investment. By acting now, China can avoid sinking financial resources into inappropriate, polluting capital stock. A failure to invest in advanced technologies, equipment, and infrastructure would mean two things: either China would be 'locked in' to decades of energy-intensive pollution, or these old-fashioned investments would have to be expensively scrapped before the end of their normal economic lifetimes. By building policy and institutional frameworks with incentives and support for energy conservation; the development and introduction of green technologies, and better urban and rural development, coupled with penalties for carbon-intensive energy use, China could reap many additional benefits. It could achieve energy security and create a more sustainable and prosperous new developmental model. There are also significant co-benefits - cleaner air, and a healthier environment.

China, however, also faces challenges in the transition to a low carbon economy. Despite unprecedented growth in clean energy sectors in China, its manufacturing sector remains dominated by heavy industry. Its exports tend to trade primarily on China's role as a low-cost manufacturer. It remains a developing economy, with low per capita income. Regional variation in capacity and income levels is considerable. It is critical to understand the current constraints in order to overcome them.

Industrial structure A large share of China's economy is in a stage of industrial evolution marked by heavy chemical industries, the development of iron and steel, vehicle and ship manufacturing, and mechanical engineering industries. These industries are bastions of the national economy and have high associated employment pressures. But they all require a large volume of materials and energy. The development of tertiary or services industry, with lower energy intensity, lags significantly behind the world average. An additional complication arises from the fact that the level of industrial development varies dramatically from region to region.

Building sector China's building sector currently accounts for about 28% of the country's total energy consumption. Some 20 billion square metres in new residential space is slated to be built by 2020 – an amount equal to the current housing stock in the EU 15. This presents a risk of massive high carbon lock in, but also an opportunity to avoid it. Part of the solution is to expand long-term fiscal and tax incentives for energy-saving in the construction sector. Such incentives are currently lacking.

Transport sector Globally, the transport sector is the largest and fastest-growing emitter of CO_2. In China, the sector's energy consumption and emissions are likely to increase significantly in the coming years. A policy priority should be to decrease the rate of emissions growth in the short term, and to develop alternative technologies and modes of transport in the meantime. The introduction of stricter vehicle emissions standards (grams of CO_2/km) has been shown to significantly increase average efficiency. Rural areas need to be better connected to urban ones; care should be taken to ensure that this new transport infrastructure is sustainable. Behavioural changes could also bring considerable gains: changed driving habits, such as driving more slowly and evenly could help, as would car-pooling and a switch to public transport for those that can afford cars. Some of these measures require relatively simple measures, such as changing speed limits or greater public awareness.

Innovation and R&D Insufficient technological innovation capacity is a weakness of China's economy. The country's average economic output per unit of resource consumed is less than 10% of that of developed countries. Only a tenth of its exports are accounted for by home-grown brands and intellectual property. China must attach great importance to R&D, focusing on medium and long-term strategic technologies. It needs to support the rapid diffusion and use of existing commercial low carbon technologies, rationalize venture investment and financing to encourage companies to develop new low carbon technologies, and enhance international cooperation to promote technology transfer from developed countries to China.

The deployment of low carbon technology Many – though not all – of the technologies to enable a rapid, transformative change in the way energy is produced, transported and used are already available, but not adequately deployed. Energy efficiency gains will only be achieved by a concerted effort across all sectors of society to ensure purchasing and investment decisions on the entire operational life of appliances, not only on upfront costs.

Supply chain bottle-necks Changing engineering standards and the materials used in the manufacture and use of goods can have widespread implications for supply chains. In particular, the meeting of higher efficiency standards for buildings have been hampered by shortages of specific energy-efficient materials. Overcoming these bottlenecks require measures including clear medium and long-term targets that facilitate R&D and investment; financial incentives for investment in new production facilities; increased co-operation and knowledge sharing to enable leapfrogging to the best available technology; and stricter penalties and regulation to avoid usage of redundant or soon to be redundant technologies.

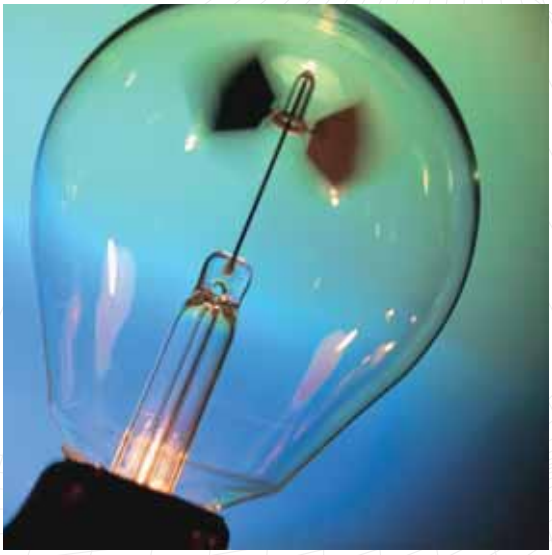
Rural sectors China is experiencing rapid urbanisation and industrialisation, placing huge pressure on land and water resources. As a food security measure, the 11th Five Year Plan set a minimum land area for grain production in China out to 2020; keeping above this "red line" is an increasingly difficult challenge, and climate change impacts will require an expanding range of adaptation measures. At the same time, agriculture and forestry have great potential to contribute to emissions reduction, through the sequestration of carbon in forests and soil (which has increased in recent years) and through the production of sustainable biomass, while avoiding competition with food crops. Further improving water management practice will be key to maximising the potential from rural sectors, but this is a significant challenge.

Table 1

Challenges facing the deployment of energy efficient technologies and practices

Challenges	Why?	How to overcome the challenges?
Low energy prices	• Subsidies • Prices do not include environmental costs	• Eliminate perverse subsidies • Provide aid to those who need them most through alternative mechanism • Put a price on carbon
High upfront costs and long pay back periods	• Most consumers value the present cost of consumption	• Fiscal incentives (e.g. tax reductions) to decrease upfront cost • Encourage financial institution participation
Slow diffusion of technologies	• Lack of skills, knowledge and support on the use of technologies • Fragmented and non integrated industry structures (e.g. building sector)	• Technology standards
Entrenched business models	• Lack of incentives for energy companies to reduce customer demand	• Internalize carbon prices in energy services • Financially reward energy efficiency measures • Promoteenergy service companies • Encourage and incentives energy companies to promote cleaner energy, technologies and energy efficiencies
Diversity of consumers and energy needs	• No single solution fits all	• Promote voluntary sectoral initiatives and negotiated agreements
Information failures	• Lack of product performance information and EE alternatives • Uncertain future energy prices and development	• More effective technology standards (e.g. building codes) • Product energy labeling • Products energy performance information and labelling • International EE standards benchmark and local standards enforcement • Encourage the 'smart meter' development
Split incentives (principal agent problem)	• Those making decisions on EE do not benefit (e.g. building owners and tenants)	• Provide clear information and incentives (e.g. tax rebates, mortgage discounts, rebates, preferential loans)
Uncertainties on investment and risks	• Uncertainties add a premium to investments	• Economic incentives that cover those risks • Develop robust energy and carbon markets
Consumer behaviour	• Low priority of energy efficiency investments • Lack of awareness and information on energy consumption and costs	• Develop carbon markets • Incentives to remove and replace old equipment • Raise education and awareness on energy efficiency (for example through community-based initiatives)
Investment costs higher than expected	• Don't include all transaction costs	• Boost best practice sharing and energy efficiency education

Source: Adapted from WBCSD and its member companies (2009)



Box 2:

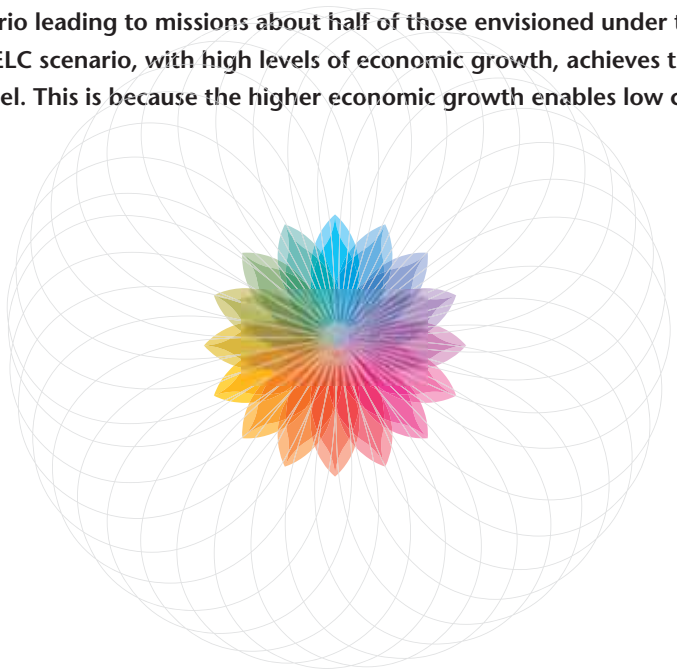
Scenarios for Low Carbon Economy up to 2050

What would a low-carbon future look like for China? How would it differ from the country's current trajectory? A low-carbon Chinese economy would be characterised by a high level of efficiency in the use of energy and resources. Emissions per unit of GDP or of industrial production would be low. Factories, offices, and residential buildings would be highly energy efficient. Low-carbon modes of transportation would prevail. Low carbon industrial production and exports would be a driver of Chinese growth.

- **Business as Usual under high growth rate (BAU)**: This is characterized by rapid growth driven by global investment, with high consumption, and local pollution control without national coordination. It is a scenario that could be described as pollute first, mitigate later -- with huge investments in technology upgrades.
- **Low Carbon Scenario under high growth rate (HLC)** In this scenario, concerns about sustainable development, energ security, and economic competitiveness drive a medium-level investment in the low-carbon economy. High energy saving standards are introduced, renewable energy and nuclear power generation investment increased, and carbon capture and storage (CCS) technology deployed.
- **Enhanced Low Carbon Scenario under high growth rate (HELC)** This scenario assumes global cooperation to stabilize atmospheric GHG emissions at a low level. With worldwide emissions restraints in place, and the resulting shifts in incentives for production and consumption, mitigation technologies would be more sophisticated. Their costs would decrease faster. This projects high investment in low-carbon technologies, in which Carbon Capture and Storage (CCS) would be used to a much larger scale.
- **Low Carbon Scenario under low growth rate (LLC)** The low carbon, low growth path that China can achieve, considerin the requirements for low carbon development from China and the demand for global emission reduction.

As can be seen in Figure 1 energy demand increases in all four scenarios, due to the growth in the economy. However, there is a significant difference – about 25% – between the low growth low carbon and BAU scenarios for energy demand.

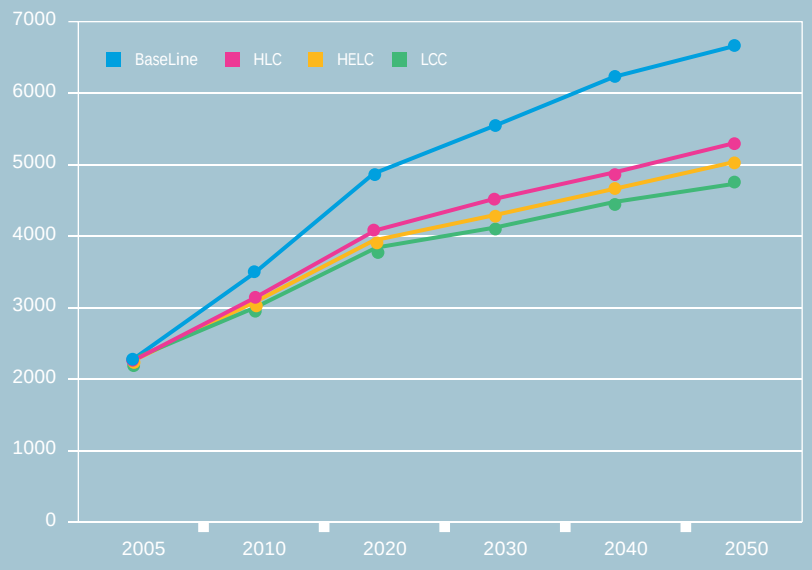
The difference for emissions is far more dramatic: changing the energy mix can slash emissions sharply, with the enhanced low carbon scenario leading to missions about half of those envisioned under the BAU trajectory. One crucial finding is that the HELC scenario, with high levels of economic growth, achieves the same levels of emissions cuts as the low growth model. This is because the higher economic growth enables low carbon technologies to be introduced at a faster pace.



Energy efficiency savings in the high growth low carbon scenario (HLC) and enhanced low carbon scenario (HELC) more than offset the need for additional investment in advanced technology in the energy sector. Earlier large-scale deployment of advanced technologies in HELC makes this more investment-heavy than HLC. Yet in both these high growth low carbon scenarios, lower total investment is needed in the energy sector than in the reference scenario over the next few decades. Business as usual would not just be bad for the environment; it would be the worst for China's budget.

Figure 1
Energy consumption and carbon emission under different scenarios

Primary Energy Demand



CO_2 Emissions

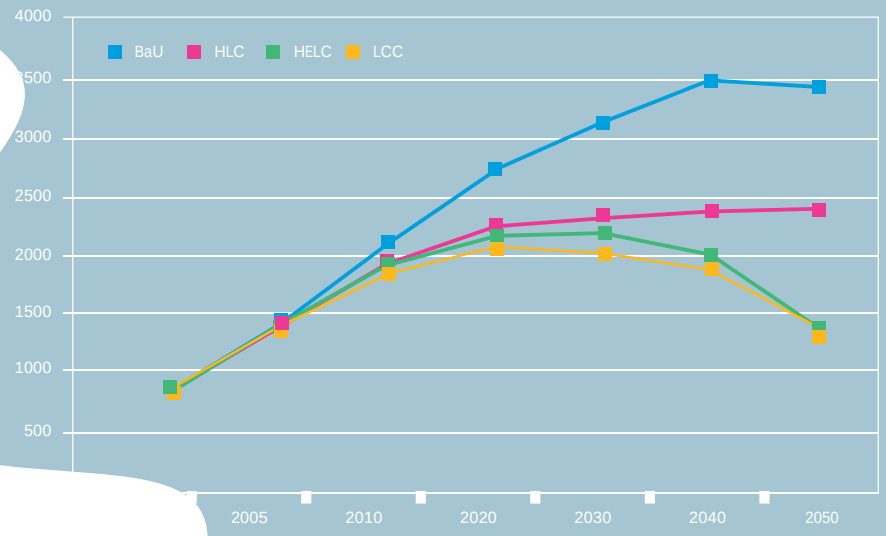


Figure 2

Total investment needs in energy sector (billion Yuan)

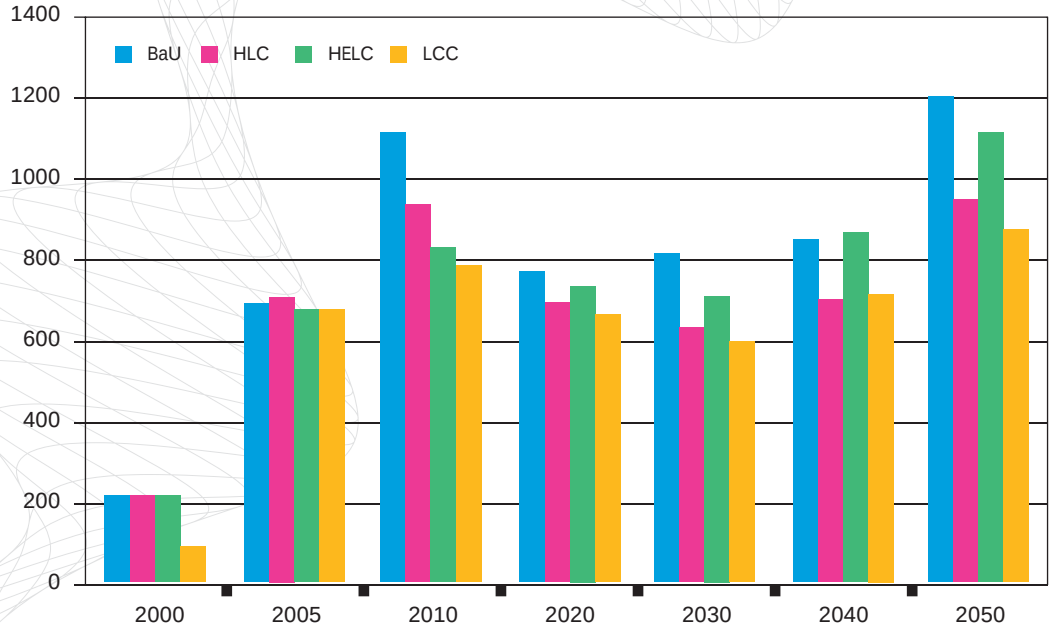
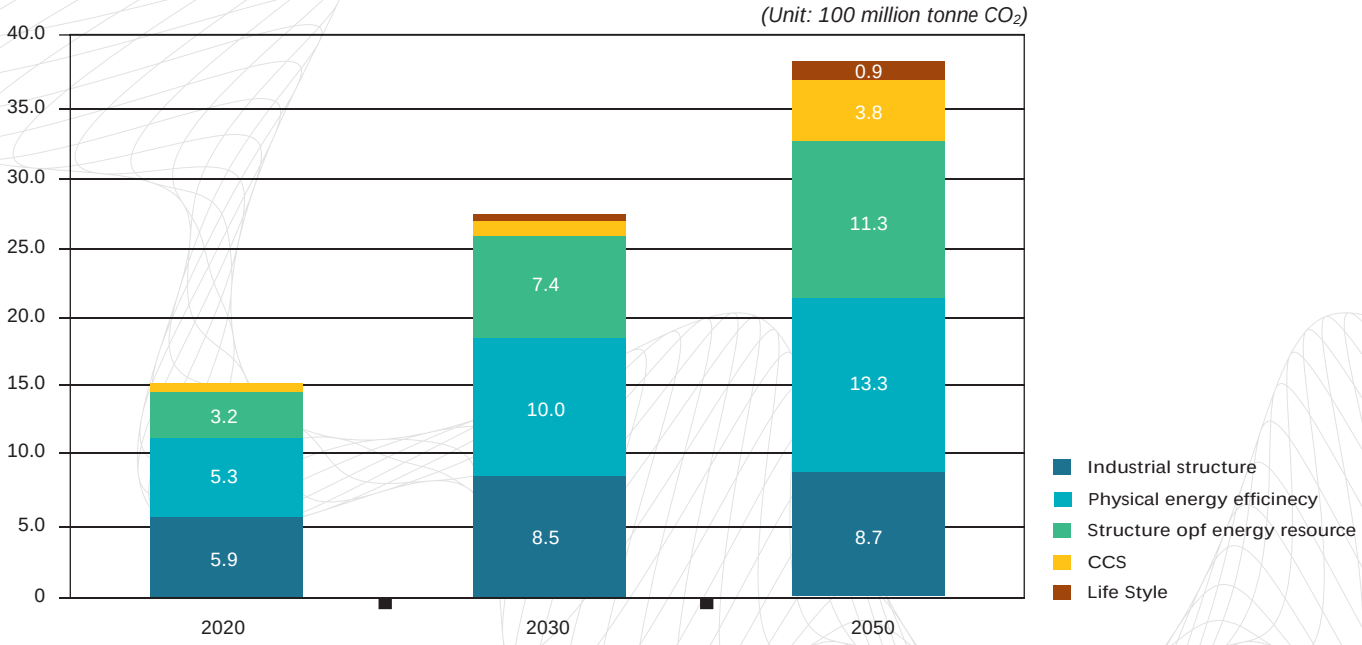


Figure 3

Contribution to emissions reduction under high growth low carbon scenario



If China does not change its economic growth pattern, by the year 2030 its per capita CO_2 emissions will reach 8 tonnes per capita, comparable to the figures in some European countries today. More than 80% of petroleum will be imported from foreign countries. In contrast, by taking a low carbon development pathway, China will be able to blunt its energy consumption trajectory by 20% over the same period, a saving equivalent to 4.47 billion tonnes of coal. Per capita carbon dioxide emissions could be limited to 5.9 tonnes in 2030. Beyond that year, emissions could stabilize, or even decrease. With global action to combat climate change, low carbon technologies would come online earlier and become cheaper more rapidly. In this enhanced low-carbon scenario, carbon dioxide emissions would decrease to 5.12 billion tons by 2050, lower than their level in 2005.

Emissions reduction in the low carbon scenario would be driven by the factors shown in Figure 3. Industrial restructuring and efficiency gains would account for the majority of carbon emissions reductions: together, they would be responsible for 60% of reduced emissions by 2020, 62% by 2030 and 57% by 2050. The development of new energy sources also makes a great impact – from 16% by 2020 to 24% by 2030 and 30% by 2050. Contributions from carbon capture and storage (CCS) are projected to begin from 2030.

3. ROADMAP FOR CHINA'S LOW CARBON DEVELOPMENT – FIVE PILLARS

Projections for reduced emissions are well and good. But in order to achieve low carbon development, industrialization, and urbanization, China will need a clear vision for how to get there. In China's low carbon future, economic and social development would have the following characteristics:

=> **Industrial production** is highly efficient, which means low emissions per unit of output.
=> **Energy conversion** is highly efficient, which means lowemissions per unit of electricity and distance travelled.
=> **Renewable energy sources** and clean energy take a larger proportion of energy supply
=> **High energy efficiency** and low emissions in transportation
=> **Domestic and commercial buildings** are energy efficient
=> **Reduced exports of products** of products with high energy consumption and/or associated emissions; increased exports of low-carbon goods.
=> **Public transport** takes precedence over private transport; people use bicycles and feet more frequently, even when they can afford not to.
=> **Industrial structure** is optimized; low carbon industry has become a new focus of economic growth
=> **Agriculture, forestry and other land** uses are managed to encourage carbon sequestration

Five policy areas – described here as pillars – underpin the prospects for realising the vision set out above. These include low carbon industrialisation; low carbon urbanization; sustainable consumption; low carbon energy and sustainable land use. Success in each will in turn rest on three fundamental bases: appropriate institutions, markets and pricing reforms, and technology and innovation. These bases inform the formulation of specific recommendations in Section 4. While this report focuses primarily on recommendations for the 12th Five-Year Plan, which will run from 2011-15, the roadmap below could serve to guide the decarbonisation of Chinese economic growth and development for decades to come.

Figure 4
Roadmap of China's low carbon development

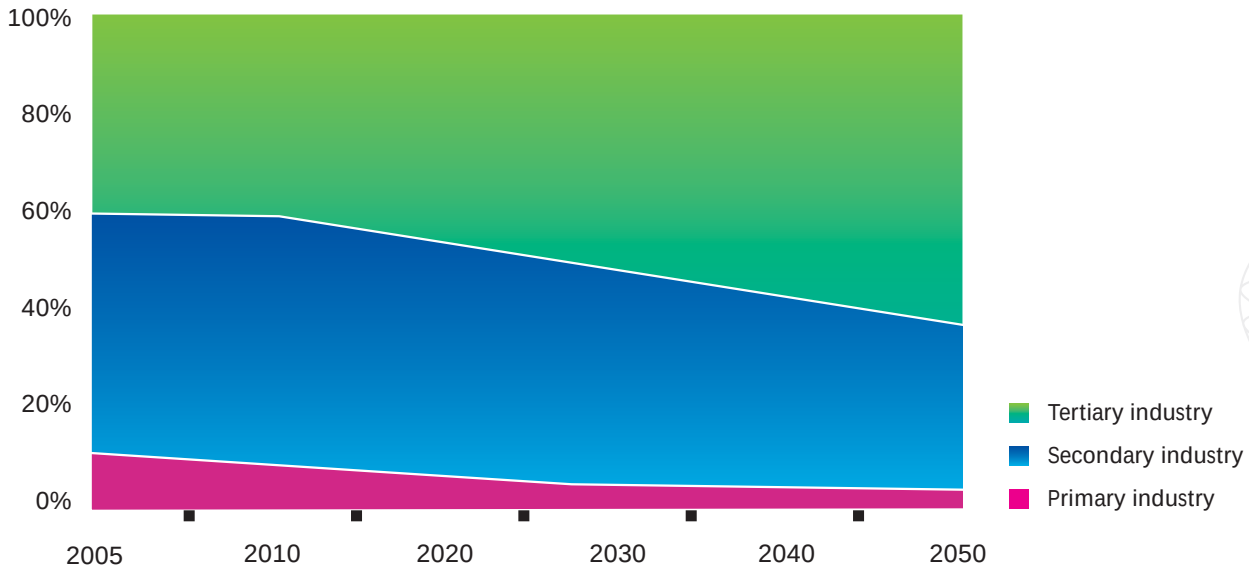
Pillar 1 - Low carbon sustainable industrialisation

No country has had a low-carbon industrialisation process. It would be good for China – and good for the world – for China to become the first. This would entail:

• **Upgrade China's industrial structure** to increase the proportion of tertiary industry while cultivating and developing emerging high-tech and energy-saving environmental industries.

Figure 5

Change in China's industrial structure in the high growth low carbon scenario



• **Develop a 'circular economy': efficient resource utilization, low energy consumption, and low emissions.** In the near term, China should vigorously encourage resource conservation for energy, raw materials and water in key industries, particularly steel and cement in the construction sector. It should promote advanced technologies and processes to improve the recycling rate of mining and smelting. strengthen pollution prevention, and generally move towards 'zero waste' production.

• **Improve energy efficiency, and promote the application of advanced technology.** Physical energy efficiency in China is currently 20-40% lower than that in developed countries. This must be rectified. With a view to the future, China should also act to speed up the development and commercialization of new low carbon technologies, by supporting new generations of technologies from the basic research phase through to demonstration and large-scale application. Table 3 below is a blueprint for technological development in China.

Table 2

Blueprint of low carbon technology innovation and application

	Phase I (12 FYP)	Phase II (2010-2030)	Phase III (2030-2050)
Large-scale application	Current, proven, and advanced energy efficiency technology, energy saving building, solar thermal applications, combined heat and power generation, heat pump, ultra-supercritical boiler, wind power, second generation nuclear power, hybrid electric vehicles	Third nuclear power, wind power, next generation solar PV and concentrated Solar Power, electric vehicle, Integrated Gasification Combined Cycle (IGCC)	Fourth nuclear power, carbon capture and storage (CCS), solar electrical energy generation, second generation bio-fuel
R & D and promote commercialization	Third generation nuclear power, wind power advanced components, electric vehicle, IGCC, solar photovoltaic	Fourth generation nuclear power, CCS, second bio-fuel	Nuclear fusion, third bio-fuel, advanced materials
Basic research	Fourth generation nuclear power, CCS, solar thermal generating, second generation bio-fuel, advanced materials	Nuclear fusion, third bio-fuel, advanced materials	

Pillar 2
Urbanisation and Transport – A New Approach for Low Carbon Cities in China

In OECD countries, the energy utilised in urban buildings and transport accounts for two thirds of final energy consumption. The figure has been growing rapidly in China, from 35.9% in 2000 to 41.9% in 2007. Given the breakneck pace of urbanization, avoiding building sector lock-in is critical for China's low carbon development.

China should:

- Ensure **compact urbanization**, as compact cities have lower emissions. China should develop an urbanization strategy that maintains a certain level of urban density, and develops city groups based on mega-cities and city centres
- **Expand public transport and improve urban transportation**. Cities could curb the growth rate of private cars by promoting public transport including intra-city railways and expressways as well as imposing mandatory fuel efficiency standards on conventional motor vehicles while developing alternatives such as hybrid and electric vehicles
- **Reduce energy use in buildings**. Energy efficiency standards and labeling systems could be introduced for all construction to step up the use of energy-saving technology in buildings. Efforts to improve the energy efficiency of existing buildings should also be expanded, alongside increasing R&D for energy saving building materials. Incentives should be provided to developers and consumers to invest in low carbon buildings
- **Improve urban energy supply modes**. First, encourage the development of distributed energy sources such as combined heat and power (CHP) generation, which has an integrated energy efficiency of 70%-80%. Second, household based heating metering would provide incentives for personal energy saving. Third, improve the rate of electrification and the rate of urban gas utilisation to increase the proportion of high quality clean energies.
- **Strengthen urban energy management**. In China, large scale public buildings account for about 5% of all built-up surface area. But they consume as much power as all urban residential buildings! A system should be created to supervise energy consumption by large commercial buildings; it would be a useful vehicle for demonstrating energy auditing and how energy saving performances can be improved.






Pillar 3 – Low Carbon Energy – Optimizing China's Energy Structure

About 90% of China's greenhouse gas emissions come from the burning of fossil fuels. Improving the energy structure and developing more low carbon energy will be central to the pursuit of a low carbon economy. Under the high growth, low carbon scenario, the energy sector will reduce CO_2 emissions by in 2020, 2030 and 2050 by 380 million tons, 830 million tons and 1.59 billion tons respectively, ultimately accounting for two-fifths of total reductions.

Specifically, China's approach should involve the following:

- **Intensive and effective use of coal.** The first step is to control the rate of growth of coal. By 2020, coal growth will have peaked; its share in energy consumption will have been reduced from about 70% at present to about 55% (the high growth, low carbon scenario has it dropping to about 33% in 2050). The next goal should be to extract more usable energy from the coal that is used. In 2020, the aim should be to reduce coal consumption in power generation to 320 g/kWh; new thermal power units will mainly adopt ultra-supercritical generating technology and IGCC.
- **Switching to lower carbon fuels through developing** Great efforts should be made to develop low carbon transport such as electric vehicles; sustainable bio-fuels and the development of public transport. China should strive to limit petroleum consumption to under 550 million tons in 2020 and 700 million tons in 2030.
- **Large-scale deployment of low carbon energy** including hydropower, nuclear power, and wind-power facilities, and to promote the commercialization of solar power. By 2020, low carbon power generation will reach 800-900 million tons standard coal equivalent, amounting to 20% of energy consumption. Half of new installed capacity will be low carbon by 2030 and, by 2050, all new installed capacity will be low carbon. China's energy will be cleaner and more diverse by 2050: coal 33%, oil/gas 33% and low carbon energy sources 33%. China would not be dependent on imported oil.

Table 3 International comparison of China's low carbon energy targets for 2020

	Proportion of low carbon energy in energy consumption 2020	Proportion of low carbon power generation in total installed capacity
China	20%	35%
America	20% renewable energy plus approximately 15% nuclear	N/A
United States	15% renewable energy plus approximately 5-10% nuclear electricity	30-50 GW of renewable energy, 1-5 GW of nuclear from a total installed capacity of 100-120 GW
European Union	20% renewable energy and approximately 30% nuclear electricity	Approximately 350-400 GW of renewable energy, 100 GW of nuclear from a total installed capacity of 1000 GW

* In North America and Europe, there are no targets for the use of energy, therefore the figures are based on trend analyses

- **Building a strong, smart grid.** The growth of electricity production from low carbon sources will place additional demands on infrastructure and grid management. In response, China should construct a strong grid framework and enable the transmission of electricity from new sources such as wind and nuclear power. Secondly, distribution networks must receive support to help them better manage variable supply and demand. Management for the demand side will also be necessary, not least because electric vehicles are projected to become a major source of demand for electricity. Local renewable energy should be promoted.
- **Implementing carbon capture and storage storage (CCS) in a focused manner.** Before 2020, China should focus on research and development, experiments and demonstration. It could also undertake some low cost CCS carbon capture and storage by integrating with petroleum exploitation. Later, China's IGCC plants and some industrial processes are expected to employ CCS.

Pillar 4 - Sustainable consumption patterns

A low carbon transition will be impossible without a shift to low carbon consumption. The right policy environment would help make that shift happen:

- **Improved institutional framework:** A "Sustainable Consumption Act" and "Green Procurement Act" should be enacted in the near term. Research on carbon emission standards on the consumption side should be conducted. In the medium and long term, a "Solid Waste Disposal Act" should be enacted, and consumption side carbon emission standards should be implemented.
- **Increasing tax and fiscal stimuli:** Fiscal support for consumers of green products would increase in the short term. Subsidies will be provided for products that use electricity efficiently, new energy automobiles, etc. Green consumption credits will be studied. In the medium and medium to long term, a carbon emission tax and environmental tax will be designed and implemented, and the proportion of green consumption credit will be increased. In the long term, combination with wider tax reform is necessary to realize transition to a nationwide green tax system.
- **Establishing a system for green information sharing and monitoring.** Informed consumer decisions cannot happe without adequate information. In the near term, China should establisha public information system covering laws, standards, administrative proceedings, technology and products. In the medium and long term, it should promote a "carbon footprint" calculating formula for all of Chinese society, ultimately moving to build real time information and monitoring mechanisms to reveal carbon emissions.
- I**ntensifying public education.** A national publi awareness plan about low-carbon consumption will be explored in the near term, which includes programmes with schools, communities, and companies. Family based education will be encouraged, and citizen awareness of green consumption will be rewarded by a national merit award scheme.

Pillar 5 – Rural Land Use – Carbon Sinks and Improved Land Management

Carbon sequestration is an important part of the low carbon economy. In recent years, the amount of carbon stored in China's terrestrial ecosystems has increased by 190-260 million tons annually. Better land management, which is closely linked to water resource management, could increase this even more.

- **Increasing carbon sequestration in forests and grassland.** Forests are an important store of carbon in China. In recent years the amount has grown by 150 million tons of carbon annually. In order to increase sequestration in forests, China should seek to recover degraded ecosystems, establish an agriculture-forestry system, and strengthen forest management.
  For grasslands, grazing density should be reduced alongside the planting of new areas and the restoration of degraded ones.
- **Increasing carbon sequestration in arable land.** Arable soil makes an important contribution to the total carbon sequestration in terrestrial ecosystems as well as the most active sink. The relatively low organic carbon content of China's arable land (0.8%) leaves considerable potential to increase its carbon storage.

4. POLICY RECOMMENDATIONS

The following recommendations have been developed to provide practical policy advice for decisions makers in China in preparation for the 12th Five Year Plan and beyond. While the recommendations focus on targets that are achievable within the timeframe of the 12th Five Year Plan, they would also help set the stage for success in the years beyond it. These recommendations are interrelated and mutually supportive, reflecting the holistic approach that is necessary for low-carbon growth.

1. **Start the development of a low carbon economy as early as possible, incorporate the concept into the 12th Five Year Plan, and introduce CO_2 emission intensity as a binding target in the Plan.**
   An early transition to a low carbon economy is better – and more cost-effective – than a late one.
   A Low Carbon Economy should be included as a key principle in the 12th Five Year Plan.

   - **The plan and its programmes for implementation should identify the main methods and sectors for the pursuit of a low carbon economy.** At the same time, it can spell out how low carbon economy targets and tasks can be devolved to the regional and sectoral level, increasing enthusiasm for the development of energy from new sources.

   - Make low carbon industrial development and technological innovation important parts of the **plan's programme for structural adjustments and technological innovation.** The plan should provide for the promotion of low carbon innovation and industrial innovation through support for project construction, industrial development, and technological innovation.



2. Reform energy pricing to reflect market demand and supply, resource shortages and environmental costs

Gradually reform of energy pricing is a key lever for meeting low carbon objectives. Three areas have been identified: First, gradually realise competitive price setting in the energy sector, with clear supervision of natural monopolies. Second, reflect the external costs and resource consumption of energy development, processing and use in the price of energy products. Third, cross-subsidies should be made transparent and later be eliminated, with any subsidies for energy consumption being provided from public finances.

- Specifically, pricing for **coal, electricity**, and **oil and natural gas** must be reformed. For instance, coal prices should reflect production, administration, and environmental costs, and electricity and oil and gas should move towards market-based pricing, calibrated with resource taxes.

- Centralised heating provision and more efficient combined heating-cooling projects should be promoted and encouraged, along with better pricing based on 'pay for what you use' systems.

3. Build a green tax system and increase fiscal expenditure for the development of the low carbon economy

Incorporate costs of environmental damage and resources depletion in energy pricing through adjusting taxes and fees during early resource exploration. The "polluter pays" principle should implemented, with pollution fees replaced by resource taxes collected as a percentage of the market price. Export tax rebates for energy-intensive products should be reduced – indeed extra tariffs could even be imposed – in order to reduce the export of energy in this form.

- **Guide consumption and behavior through an energy tax to increase costs.** We suggest increasing the respective taxes of 1 RMB and 0.8 RMB per litre on petrol and diesel at an appropriate time, and introducing other energy taxes.

- **Preparations for a carbon tax should start soon in order to send a stable price signal for low carbon innovation and large-scale commercialisation.** It should not be set too high at the onset, but as the economy further develops and societal acceptance deepens it should be adjusted upwards.

- **Strengthen fiscal support for energy saving, renewable energy and low carbon technological innovation.** Budgets should plan subsidies and tax incentives for promoting energy-saving, renewable energy, and low-carbon research and development. Energy efficiency should also be factored in togovern ment procurement. In the mid- to long-term, these sustainable development funds could come from the revenue raised by additional fuel, energy and carbon taxes.

4. Using market mechanisms to promote low carbon development

In addition to setting a price for carbon through a carbon tax, China should use market mechanisms to encourage low cost carbon abatement.

- **In the long term, China should establish a carbon trading scheme. In the near term, a voluntary carbon trading scheme would help build capacity and accounting systems.** Participating firms would propose emissions reduction against baseline emissions, with the government organising emissions trading among the companies. Companies could register at the existing environmental asset exchanges, allowing the trading, settlement and auditing platforms there to be used, establishing emissions auditing, reporting and operating methods. At the same time, third-party certification agencies would confirm emissions baselines and reductions, with confirmed surplus emissions rights and those already confirmed by international authorities traded at the exchange. Appropriate subsidies or loan support should be used to encourage firms to carry out voluntary emissions reductions.

- Within a global framework to reduce carbon emissions, China should make use of international financing mechanisms. This is not only about attracting carbon finance but making use of the mechanisms like the Clean Development Mechanism (CDM) to encourage the deployment of energy saving technologies. In addition, China can gradually introduce a carbon banking system, establishing carbon accounts for regional and major enterprises.

5. Aggressive support for technological innovation, diffusion and international cooperation

China should step up its efforts to create a policy environment that encourages technological innovation and diffusion, through a combination of direct support, tax incentives, and institutional support.

- **Public research-and-development institutions and testing platforms** will have a hugely important role in systems supporting technological innovation. We propose establishing a new, open national energy research institution with the ability and facilities to carry out research; deliver pilot projects; and carry out trials, testing and certification. The institution will be open to businesses, universities and other research institutions, and work to make up for the lack of common technology in the new energy sector.

- **Flanking policies to foster innovation.** should continue to be implemented, such as self-reliance programs and requirements for equipment in major projects to be sourced domestically, to promote localisation. As soon as possible, these should be complemented by detailed rules for implementing plans to adjust and reinvigorate the equipment manufacturing industry, as well as risk compensation mechanisms for new domestically produced equipment. Insurance companies should be encouraged to insure these projects.

- The government should also **implement preferential tax policies for technological innovation**, and support efforts by firms to cooperate on research and the domestic production of key components.

6. Improve legislation and regulations, and strengthen enforcement of laws and standards.

China should engage in an across-the-board improvement of the laws and regulations related to carbon emissions, and also strengthen their improvement.

- **Strengthen laws on energy production and transfer, energy-saving.** The Energy Law should be legislated and implemented as soon as possible, and the Coal Law, Electricity Law, Energy Saving Law and Renewable Energy Law should be reformed to further encourage the development and use of clean, low carbon energy sources.

- Decarbonising the economy is not a matter of energy policy alone. **Regulations governing agriculture, forestry, and land management should be improved to to improve productivity and increase the carbon storage of their ecosystems.** Policies to prevent the destruction of natural forests, grasslands and farmland should be strengthened. Rules for solid waste management should be revamped to encourage reduced emissions. More broadly, the regulations for implementing the Law on Promotion of the Circular Economy should be improved.

- **Strengthen the entire spectrum of energy-related standards to encourage energy saving.** This would range from design norms in the main energy-consuming industries to building standards and energy-efficiency standards for industrial equipment, automobiles, and consumer goods. China could also consider emulating Japan's Top Runner programme, which stipulates that the most efficient model on the market should become the standard within a certain number of years.

- **Enforcement.** Standards are only useful when adhered to, which calls for greater enforcement. The evaluation and auditing of industrial projects should also examine energy-efficiency standards. New or expanded fixed-asset projects should be subject to carbon-emission reduction evaluations and auditing, with approval refused for those that do not carry out, or fail. Completion procedures for major public buildings and commercial residential housing should similarly be denied if they fail to pass an energy efficiency test.

- **Introduce a "carbon footprint" labelling system** encourage the public to shift consumption to low carbon products (and therefore encourage firms to develop those products).

7. Improving the quality of energy and carbon statistics and measurement

- **Improve energy statistics and systems –** including survey and auditing methods to increase the scientific nature of statistics gathered. Strengthen and standardise energy statistics activity at the grassroots level, to increase accuracy. Also, establish statistics agencies below the city level to strengthen the foundation of statistics gathering.

- **Verify the emissions of energy and emission intensive products and equipment in key industries.** Businesses shouldbe encouraged to calculate their greenhouse-gas emissions according to international standards. This information will inform emissions standards and emissions reduction targets for both industries and products.

- **Establish a carbon footprint measuring system.** The authorities should organize experts to research methods of calculating carbon footprints and labeling standards. A supervision and certification authority should be formed to establish criteria as well as to train personnel and carry out measurements. Carbon footprint measurement should be included in the Statistics Law. In future, the Statistics Bureau should begin to collect carbon emissions data and make relevant data publicly available on a regular basis.

8. Include the requirements of the low carbon economy in urban planning, and run demonstration projects.

- **Include requirements for "low emissions, high efficiency" in urban planning and rural development planning**, for example when determining zoning, industrial structure, public transport and land use.

- **Launch low carbon urban development projects in suitable cities in the near future,** using economic and incentives to achieve energy-savings in the transport and building sectors. New cities should include low or zero-carbon communities, industrial zones or ecological cities. Common standards for measuring low carbon development should be developed and agreed.

- **Low carbon development should be taken into consideration when choosing winners of national ecological, environmental and liveable city competitions.** This would be a departure from the current criteria, under which the victors might be environmentally friendly in some aspects, but still have high carbon emissions overall.

- **The rural dimensions of China's future low carbon economy should not be overlooked.** Sustainable approaches to agriculture, forestry and bio-energy can make a major impact on greenhouse gas emissions. Increasing the amount of carbon stored in terrestrial ecosystems would create important opportunities for carbon finance in rural areas. China is already seeking to achieve balanced urban-rural development. The low carbon economy can make a major contribution to this objective.

Notes

[1] "Low Carbon" is shorthand for "low greenhouse gas" – while CO_2 is the main contributor to global warming, the role other greenhouse gases must not be overlooked

China Council for International Cooperation
on Environment and Development
中国环境与发展国际合作委员会