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Challenges for climate policy and governance in key emerging countries Series

China: Improving the local-central climate governance nexus

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CLIMATE MITIGATION PLANS: A TOP-DOWN GOVERNANCE

The recent low-carbon policy developments in China have relied primarily on Nationally Appropriate Mitigation Actions (NAMAs) defined by the central government. Along this policy line, subnational governments have been asked to organise, implement and control the response to climate change. Within this framework, 13 pilot programmes for low-carbon provinces and cities have been carried out since June 2010 throughout the country as a key mechanism to achieving China's 2020 GHG emissions reduction target. Central authorities use different instruments to ensure the accountability, assess the performance, and exert administrative control over these programmes.

LOCAL GOVERNANCE: SUCCESSES AND CHALLENGES

Under the 11th FYP (2006-2010), the national target of a 20% reduction in energy intensity by 2020 was disaggregated into provincial targets. Most provinces met this objective, but as level targets were more or less based on the equal-numbers principle, it failed to reflect inter-province disparities. Therefore, a more adapted approach was envisaged for the 12th FYP (2011-2015) in order to provide specific policy incentives and to balance out efficiency and inter-province equity. However, so far, most provincial governments have been using similar policy instruments to achieve energy conservation targets, with little consideration being given to their local circumstances.

LOW-CARBON DEVELOPMENT: A COMPLEX AND CROSS-SECTORAL ISSUE

Beyond governance issues, low-carbon development in China will require significant macroeconomic shifts: innovation-driven technological improvements and structural changes are needed to ensure the effectiveness and efficiency of climate policies. Rebalancing the economy towards an energy-light industry and channelling one of its main drivers, namely urbanisation, will lead to positive impacts in terms of cross-sectoral energy intensity and low-carbon development. Urbanisation always comes along with massive construction and transportation infrastructures, and therefore induces shifts in lifestyle patterns. It is thus a key process to enhance low-carbon development.

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China: Improving the local-central climate governance nexus

Fei Teng (Tsinghua University)

1. INTRODUCTION

China's Nationally Appropriate Mitigation Actions (NAMAs) under the Copenhagen Accord are: to reduce CO_2 emissions per unit of GDP by 40-45% by 2020 compared to the 2005 level; to increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020; and to increase forest coverage by 40 million hectares and forest stock volume by 1.3 billion m^3 by 2020. Moreover, China is currently the world leader in wind turbine and solar panel production, while renewable energy technology plays a key role in the country's rural electrification.

In addition, the Chinese population in both rural and urban areas appears to be increasingly aware of the urgent need to tackle climate change. Initiatives such as 'One Day without Driving' are taking place in various urban communities and in rural communities solar panels are often a key strategy for providing energy to the poor. The municipality of Beijing has launched large-scale solar energy and biogas programmes in the rural areas around the city, and Wuxi City in Zhejiang Province has introduced a solar street lighting programme. However, a significant restructuring of the economy as well as investment in low-carbon innovation will be required to move towards a low-carbon economy in the long term.

China is a centrally controlled state, which could facilitate the introduction and implementation of low-carbon policies compared to other political regimes. At the same time, however, there is evidence that national policies for low-carbon development are not always cost effective at the provincial or local level.

This paper is organised as follows: the second section provides an illustration of low-carbon governance at subnational level in China; the third section looks at an in-depth case studies to analyse low-carbon policy and governance at local level; and the fourth section proposes some conclusions and recommendations.

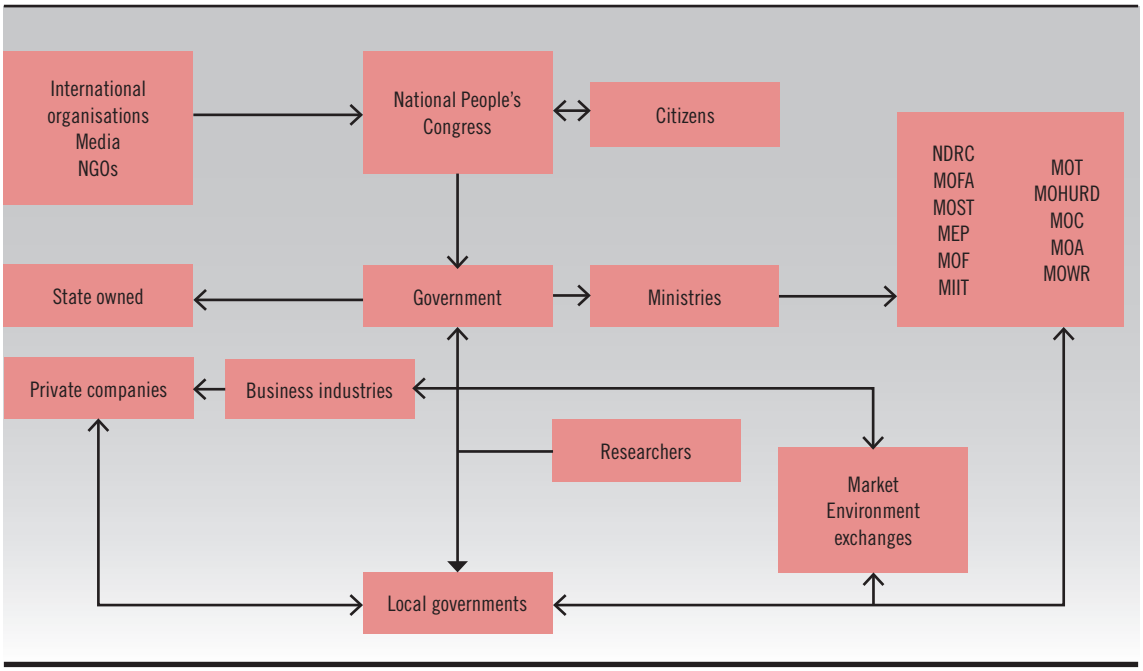
2. CARBON GOVERNANCE AT SUBNATIONAL LEVEL IN CHINA

2.1. Map of the stakeholders

There are broadly four categories of actors involved in the NAMAs adopted by China to address the issue of climate change. These each play different roles, but the most important and powerful role is that assumed by the Government (Figure 1).

- Government, including its affiliated departments and local governments, is the key driver of NAMA implementation. The actors involved mainly execute policies and guidelines and carry out measures to steer the implementation of the NAMAs.
- Business and industries are the entities that implement the NAMAs. The actions or technologies that they adopt result in CO2 mitigation.
- Researchers provide suggestions to policymakers. They get support from government departments and international organisations to engage in research projects on climate change. Their research findings enable them to make suggestions to donors for decision-making purposes.
- International organisations, NGOs, media and citizens can promote and monitor the implementation procedure and results of NAMAs. On the other hand, there is a need to raise public awareness as this too has enormous potential to contribute to climate mitigation.

Figure 1. Stakeholders involved in the NAMAs and their roles



MITT: Ministry of Industry and Information Technology | MOHURD: Ministry of Housing and Urban-Rural Development of the People's Republic of China | MOT: Ministry of Transport of the People's Republic of China | MOA: Ministry of Agriculture of the People's Republic of China | MOWR: Ministry of Water Resources of the People's Republic of China

2.2. Overall organisation and working mechanisms

So far, all provinces or cities in China have established a leading group in charge of addressing climate change. At the same time, all the provincial departments for development and reform have established their offices to deal with the various tasks related to climate change: they draft and implement the provincial plans to respond to the challenge, as well as other related plans; they organise the implementation of Clean Development Mechanism (CDM) projects; they build the capacities required to achieve appropriate outcomes; and they guide international cooperation on these issues.

Provincial governments undertake various training and learning activities to deepen the local officials' understanding of climate change issues, clarify the areas and tasks of relevant work, and instil a stronger sense of urgency and responsibility on how to address the challenge.

The provinces have also engaged in scientific research and monitoring of climate change and evaluated impacts. They have conducted studies on possible countermeasures in the following domains:

- Development planning and research;
- Environmental protection research;
- Agricultural and forestry research;
- Monitoring of climate change;
- Impact evaluation.

For instance, Tianjin City has organised municipal research institutions and various colleges including Nankai University to pursue research into an indicator system for low-carbon economy and development patterns. One after another, colleges in various localities have established an institution specialised in research into climate change and low-carbon economy, providing scientific support to the local effort to address climate change.

2.3. Issues related to provincial GHG inventories

China has discussed the possibility and need to compile provincial GHG inventories, which would serve as a basis for a comprehensive national GHG inventory. But the proposal was abandoned for the compilation of the first and second National Communications because of the limited capacities of provincial governments, for example:

- provincial governments lack experience in compiling National Communications;
- there are few professional experts to support the compilation work;
- it is difficult for provincial governments to obtain the necessary data at local level.

With their deepening knowledge of climate

Table 1. Subnational Governments' Involvement in China's National Communications

Item	Subnational governments involved	Trends
GHG inventory	No.	Some pilot provinces have begun to compile the provincial-level GHG inventory. Provincial governments have incepted field observation and measures to obtain specific data of GHG emission factors and activity levels to enhance the accuracy of the data.
Measures to fight climate change	No. Regional policies and measures should be included in the National Communication.	Provincial-level governments should also supply policy information about how climate change is addressed. This information also constitutes the data required for National Communication.
Others information related to climate change	No	No detailed information.
Activities to raise public awareness of climate change	No	Provincial governments have paid more attention to public awareness raising through media campaigns.
Capacity building	No	Provincial governments have appointed special organisations and officials to be in charge of climate change.

change, more and more provincial governments are becoming involved in addressing climate change. The National Development and Reform Commission (NDRC) also published 'The Notice for Starting the Compilation of the Provincial GHG Emissions Inventory' on November 5, 2010, which requires local governments to:

- identify a special department to take on responsibility for this task and select experts to carry out the work involved;
- begin to collect related data and information, mainly focusing on energy, industrial production processes, agriculture, land-use changes and forestry, and waste management.

At the same time, Shaanxi, Zhejiang, Hubei, Yunnan, Liaoning, Guangdong and Tianjin were selected to participate in a pilot programme and began to compile their regional GHG inventory in October 2010. Five extensive training programmes were also rolled out to enhance the capacity of provincial governments and lay a solid foundation for the local GHG inventory compilation.

However, there are also many obstacles to compiling the GHG inventory, the most important being the difficulty of collecting data, especially the data on land-use changes and forestry, the double-counting problem, the inflow and outflow of electricity between various provinces and so on.

2.4. Low-carbon development strategy at provincial level

2.4.1. National pilot programme for low-carbon provinces and cities

In July 2010, NDRC issued a notice requiring that a national pilot programme for low-carbon provinces and cities be carried out throughout the country as a key mechanism to achieve China's 2020 GHG emissions target. The provinces of Guangdong, Liaoning, Hubei, Shaanxi and Yunnan and the cities of Tianjin, Chongqing, Shenzhen, Xiamen, Hangzhou, Nanchang, Guiyang, and Baoding were chosen as the first programme participants. These low-carbon provinces and cities will engage in active exploration in five main directions.

1) Compile low-carbon development plans. The provinces and cities must fully integrate the task of addressing climate change into their 12th Five-Year Plans (FYPs), and research and formulate low-carbon development plans. These provinces and cities should explore a model for low-carbon and green development.
2) Formulate matching policies that support low-carbon and green development. The provinces and cities will tap the synergetic effect created by integrating climate change mitigation with energy conservation, environmental protection, new energy development and ecological construction. They will actively look for systems and mechanisms conducive to energy conservation and emission reduction and the development of low-carbon industries. They should also explore how to use market mechanisms that contribute to meeting the GHG emission reduction targets.
3) Accelerate the establishment of an industrial system characterised by low-carbon emissions. By dovetailing the characteristics of local industry and development strategies, they will speed up innovation in low-carbon technologies, advance the research, demonstration and industrialisation of these technologies and actively engage in absorbing and renovating foreign technologies or co-operative research and development with foreign counterparts.
4) Establish a statistical data system for managing GHG emission data. They will work on GHG emission statistics, setting up a comprehensive system for data collection and computation. They will also implement capacity building actions to ensure adequate institutional and personnel capacity.

Table 2. Special Plans and Policies for Addressing Climate Change at Provincial Level

	Yun nan	Chong qing	Hu bei	Hai nan	Qing hai	Hu nan	Ning xia	Hei long jiang	Inner Mon-golia	Guang xi	Bei jing	Fu jian	Liao ning	Zhe jiang	Si chuan	Guang dong	He bei
LC economy plan	√																
Plan for GHG control		√															
Mid/long-term plans for energy conservation			√	√													
Recycling economy plan					√												
Plan for the development of strategic new emerging industries[1]						√	√	√	√	√							
Plan for addressing climate change			√								√						
Opinions on LCD			√	√													
Work plan for energy conservation and emission reduction								√		√		√	√	√	√		
Public institutions for energy conservation				√									√				
Energy conservation promotion																√	
Guiding catalogue of key energy conservation technologies								√					√				
Directive documents or standards for key sectors		√						√					√				
Adjustment of economic structure												√				√	
Recycling economy		√	√											√	√		
Support to service industries														√			
Support to strategic emerging industries									√		√	√					√
Advancing afforestation								√		√				√			

5) Vigorously advocate low-carbon and green life-styles and consumption patterns. They will organise training for leaders in all local government echelons and departments so that they will energetically sponsor media campaigns and educational activities, advocate low-carbon life-styles and popularize low-carbon products, disseminate the concepts of a low-carbon life-style, and encourage the widespread participation and conscientious behaviour of all residents.

2.4.2. Compile and implement local plans for addressing climate change

As of today, China's thirty-one provinces (or regions or municipalities) have finished formulating their local climate change plans and are now in the phase of implementing these schemes. All provincial-level plans stipulate that the climate change work must adhere to the concept of low carbon, recycling and green development. They must also seek to control GHG emissions and promote low-carbon development, with a focus on the sustainability of economic development, while taking into account technological progress and the enhancement of independent innovation. In addition, they must achieve advances in energy conservation, new energy development and ecological protection and construction. Emphasis must also be laid on raising awareness of climate change among government, enterprises and the general public. Most of the local plans have been effectively enforced, which thus ensured the implementation of the national climate change programme.

2.4.3. Formulate special plans and policies

In order to enhance their ability to address climate change, local governments have formulated special plans targeting energy conservation, development of clean energy and a recycling economy, and they have made sound progress in these areas. Furthermore, they have also researched and drafted a series of directive documents showing their actual situations (Table 2).

Table 3. Low Carbon Development Practices at Provincial or City Level

Guangdong	Advanced the adjustment of industrial structure and the transformation of the economic development model Substituted green industries for the traditional carbon-intensive industries Accelerated the development of strategic emerging industries and the service industry Curbed the non-rationalised expansion of high energy consumption and high-emission industries Improved the energy structure by actively developing a low-carbon industrial system and consumption patterns
Liaoning	Concentrated on structural adjustment Pursued large-scale, clustered, high-end and low-carbon industrial development Speeded up the renovation of traditional industries with low-carbon technologies, developing modern industries and energetically phasing out backward production capacity Facilitated the formation of an economic development model characterized by low-carbon emissions
Hubei	Speeded up technological renovation of the traditional industries Iron and steel Petrochemical Automotive Lowered the energy consumption levels of top energy-consuming enterprises Accelerated the development of certain industries.
Shaanxi	Accelerated the development of the aeronautics and machine tool manufacturing industries, modern agriculture, emerging service industries Implemented the project of 'substituting gas for coal' in Shaanxi, Constructed the key ecological projects to restore farmland to forestland and grazing pastures to grassland Endeavoured to build a new settlement in the west with a good ecological environment
Yunnan	Developed non-fossil energy including hydropower, solar power and biomass energy Promoted tourism as a pillar industry and gave it greater support Engaged in afforestation and forestry operation
Tianjin	Forged a high-end, high quality and hi-tech industrial system, fostered 8 pillar industries Cooperated with Singapore and Japan to build an ecological city and an exemplary low-carbon zone
Chongqing	Integrated a low-carbon experiment into the adjustment of industrial urban planning and construction, and the promotion of technological innovation Expanded the proportion of emerging industries, such as the energy conservation and environmental protection industries Speeded up the development of low-carbon transportation, green building and green lighting Endeavoured to build a 'Liveable Chongqing' and 'Forest Chongqing'
Hangzhou	Accelerated the 'Six-Dimension' construction of a low-carbon city with Low-carbon industries Low-carbon buildings Low-carbon transportation Low-carbon life Low-carbon environment Low-carbon society
Nanchang	Upheld the philosophy of 'Ecological Subsistence, Green Development' Adhered to the concept of 'Development is Valuable, but Environmental Protection is Invaluable" Speeded up the implementation of the action plans to develop low-carbon industries and build a low-carbon city Tried to create an exemplary city based on a low-carbon and ecological economy
Baoding	Achieved rapid development in new energy and energy equipment manufacturing Speeded up the application of new energy in the construction of urban infrastructure and the residents' daily lives
Xiamen	Attached importance to industrial energy consumption and clean production Developed low-carbon buildings and low-carbon transportation
Guiyang	Accelerated the development of a recycling economy Constructed an ecological and civilised city
Beijing	Drew up the 'Green Beijing' action plan Explored the green development path by building the system of green production, green consumption and green environment
Shenzhen	Set up 4 pillar industries Hi-tech Modern finance Modern logistics Culture Constructed a regulatory and policy framework for energy conservation and environmental protection
Shanghai	Explored the green and low-carbon development model for developing Chongming ecological island, Lingang New Town, and Hongqiao Hub.

Table 4. Rate of Progress on the 11th Five-Year Plan Energy Conservation Target

	2005		2010		2015	2006-2015
	Energy intensity (tce/10,000 Yuan)	Target (%)	Energy intensity (tce/10,000 Yuan)	Actual decrease (%)	Target (%)	Target (%)
Beijing	0.792	-20.00	0.582	-26.59	17	39.07
Tianjin	1.046	-20.00	0.826	-21.00	18	35.22
Hebei	1.981	-20.00	1.583	-20.11	17	33.69
Shanxi	2.890	-22.00	2.235	-22.66	16	35.03
Neimenggu	2.475	-22.00	1.915	-22.62	15	34.23
Liaoning	1.726	-20.00	1.380	-20.01	17	33.61
Jilin	1.468	-22.00	1.145	-22.04	16	34.51
Heilongjiang	1.460	-20.00	1.156	-20.79	16	33.46
Shanghai	0.889	-20.00	0.712	-20.00	18	34.40
Jiangsu	0.920	-20.00	0.734	-20.45	18	34.77
Zhejiang	0.897	-20.00	0.717	-20.01	18	34.41
Anhui	1.216	-20.00	0.969	-20.36	16	33.10
Fujian	0.937	-16.00	0.783	-16.45	16	29.82
Jiangxi	1.057	-20.00	0.845	-20.04	16	32.83
Shandong	1.316	-22.00	1.025	--22.09	17	35.33
Henan	1.396	-20.00	1.115	-20.12	16	32.90
Hubei	1.510	-20.00	1.183	-21.67	16	34.20
Hunan	1.472	-20.00	1.170	-20.43	16	33.16
Guangdong	0.794	-16.00	0.664	-16.42	18	31.46
Guangxi	1.222	-15.00	1.036	-15.22	15	27.94
Hainan	0.920	-12.00	0.808	-12.14	10	20.93
Chongqing	1.425	-20.00	1.127	-20.95	16	33.60
Sichuang	1.600	-20.00	1.275	-20.31	16	33.06
Guizhou	2.813	-20.00	2.248	-20.16	15	32.05
Yunnan	1.740	-17.00	1.438	-17.41	15	29.80
Xizang	1.450	-12.00	1.276	-12.00	10	20.80
Shaanxi	1.416	-20.00	1.129	-20.25	16	33.01
Gansu	2.260	-20.00	1.801	-20.26	15	32.22
Qinghai	3.074	-17.00	2.550	-17.04	10	25.34
Ningxia	4.140	-20.00	3.308	-20.09	15	32.08
Xinjiang	Till further assessment				10	18.02

Source: http://www.stats.gov.cn/tjdt/zygg/gjtjjgg/t20110610_402731394.htm
http://www.gov.cn/zwgk/2011-09/07/content_1941731.htm

So far, twenty-seven provinces in the recycling economy experiment have issued plans or implementation schemes to promote a recycling economy. Some provinces and cities, including Hunan, Ningxia, Heilongjiang, Inner Mongolia and Guangxi, have also elaborated plans to develop emerging industries such as the new energy industries. Some provinces, including Beijing, Hubei and Yunnan, have started to draft a special plan to address climate change for the 12th FYP period.

2.4.4. Practice low-carbon development

All provinces and cities have increased the pace of implementation of their sustainable development strategy and the public at large has gradually become more familiar with the green development concept. The Government of China set the 2020 target for GHG emission reduction in November 2009, and local governments have undertaken voluntary actions to implement central government decisions. The main steps that they have taken to put low-carbon development into practice include promoting low-carbon industries, building low-carbon cities, advocating low-carbon life-styles and actively investigating experiences in green and low carbon development.

The low-carbon pilot provinces have actively explored the low-carbon development model in light of their actual situations (Table 3).

2.5. Energy intensity targets and provincial achievements under the 11th Five-Year Plan

China has disaggregated the energy conservation targets for the 11th FYP period and assigned them to various provinces and municipalities directly under the central government, and has instituted a system of objectives and responsibilities to ensure the accountability of local government officials for attaining their assigned targets. The State Council issued '*The Notice on Making Even Greater Efforts to Ensure the Fulfilment of the Energy Conservation and Emission Reduction Targets for the 11th Five-Year Plan Period*' and has carried out performance assessments, and published the findings, of thirty-one provincial-level governments and one thousand top energy-consuming enterprises with respect to the attainment of their energy conservation targets and the implementation of energy-conserving measures. The State-owned Assets Supervision and Administration Commission under the State Council formulated '*The Interim Measures for Supervising and Administering Energy Conservation and Emission Reduction of the Enterprises Managed by the Central Government*', which further tightened the administrative control of the top energy-consuming enterprises in the area of energy efficiency. By the end of 2010, all of the provinces except Xinjiang had reached their target

The progress made under the 11th FYP shows that most provinces achieved their energy intensity target. But this is mainly because the economic growth under the 11th FYP was far higher than expected. China conducts a economic census periodically and revises its GDP and energy consumption data according to the data obtained. This census is much more comprehensive than the annual statistical surveys. Indeed, the National Bureau of Statistics (NBS) conducts wider surveys of medium and small-sized enterprises, particularly in the service sector, for the census, while the annual surveys for these enterprises are carried out on a sampling basis. After the second economic census was completed in 2009, the Government of China revised its GDP and energy consumption accordingly, including data from the year 2005. In 2011, NDRC used this new data as a basis for calculating the achievement of targets. The revision of the base year data explains why, despite the fact that almost all provinces achieved their intensity target set for the 11th FYP, energy intensity at national level was reduced by only 19.1%, which is slightly lower than the 20% target.[1] The experience under the 11th FYP also shows that unexpected economic growth is always a risk that is difficult for government to manage. An intensity target can help government to deal with this type of unmanageable risk and to find a compromise between economic growth, energy saving and mitigation.

Under the 11th FYP, the national target of a 20% reduction in energy intensity was disaggregated into provincial targets based on negotiations between central government and local governments. These provincial-level targets were more or less based on the equal-numbers principle, which failed to reflect inter-province disparities. In fact, the provinces differ considerably in terms of their levels of economic and social development, their economic structure and technological performance (Figure 2). In the 11th FYP period, virtually all the provinces adopted the same policy framework to reduce energy intensity: economic structural adjustment, energy conservation regulation and incentive-based polices including a differential electricity tariff. As these policies did not fully take into account the differences between provinces, they may not always have been cost-effective. As a result, a more adapted approach was envisaged in order to balance out efficiency and inter-province equity.

Thus, for 12th FYP, a more tailored methodology was adopted for allocating energy intensity and carbon intensity targets among the provinces. One

1. For more in-depth data see Appendix 1.

reason for this is that the experience of the 11th FYP revealed that the burden-sharing framework for energy conservation targets needed to be enhanced for the sake of economic efficiency and equity. In addition, a target-allocation methodology tailored to reflect inter-province differences could provide diversified and adapted incentive policies at local level. However, so far, most provincial governments in China use similar policy instruments to achieve their energy conservation targets with little consideration being given to their local circumstances.

During the 12th FYP period, China also shared out its energy intensity target to the provinces and cities. The targets are divided into five catalogues according to the local resources and varying stages of economic development of the provinces and cities (cf. Table 5).

Table 5. Local Level Target Distribution

Target	Regions
18%	Tianjin, Shanghai, Jiangsu, Zhejiang, Guangdong
17%	Beijing, Hebei, Liaoning, Shandong
16%	Shanxi, Jilin, Heilongjiang, Anhui, Fujian, Jiangxi, Henan, Hubei, Hunan, Chongqing, Sichuan, Shannxi
15%	Inner Mongolia, Guangxi, Guizhou, Yunnan, Gansu, Ningxia
10%	Hainan, Xizang, Qinghai, Xinjiang

Source: http://www.21cbh.com/HTML/2011-3-16/3NMDAwMDIyNjg3NQ.html

2.6. Drivers of intensity reduction

Analysis at both national and provincial level confirms that the reduction in energy intensity is mainly due to the improvement of energy efficiency within sectors rather than to a shift from high energy-intensive sectors to lower intensity sectors. At national level, most scientific research suggests that it is structural factors that increase the energy intensity, thus producing a negative effect. If we look at different provinces, a diversified picture can be observed at local level. For most provinces, technological factors dominate changes in energy intensity, while structural factors lead to a negative contribution. For some provinces with a higher urbanisation rate (e.g. Beijing, Tianjin and Shanghai with urbanisation rates of more than 70%), structural change does in fact help to reduce energy intensity.

These differences among provinces can be explained by the relationship between urbanisation and a change in the economy mix. Practically, the process of urbanisation follows a flat S shape, with time plotted along the horizontal axis, and can be divided into three stages. In the first stage, below 30% urban, rural-based economy is mostly driven by the primary sector. In the second stage, urbanisation rate between 30% and 70%, the process of urbanisation is always accompanied by industrialisation as a major driver of economic growth. During the third stage, however, when the urbanisation rate exceeds 70%, the major contributor to economic growth will be the service sector. Most provinces in China are in the second stage of this curve, during which the industrialisation process raises the share of secondary industry and leads to a negative impact on energy intensity. Structural factors only play a positive role in those provinces that are engaged in the third stage.

These observations have important policy implications. First, the urbanisation process is crucial for low-carbon development. Urbanisation is always accompanied by massive construction of buildings and transportation infrastructures and by a shift in life patterns (e.g. from a rural to urban area, consumer energy consumption patterns will change substantially). Low-carbon urbanisation is the key to low-carbon development. Second, different provinces should consider different policy mixes in order to achieve their targets in a more efficient way. For those provinces with higher urbanisation rates, the policy focus should be to promote a structural shift from manufacturing industries to services, whereas for provinces still in the second stage of rapid urbanisation, the priority should be improvement of technology standards.

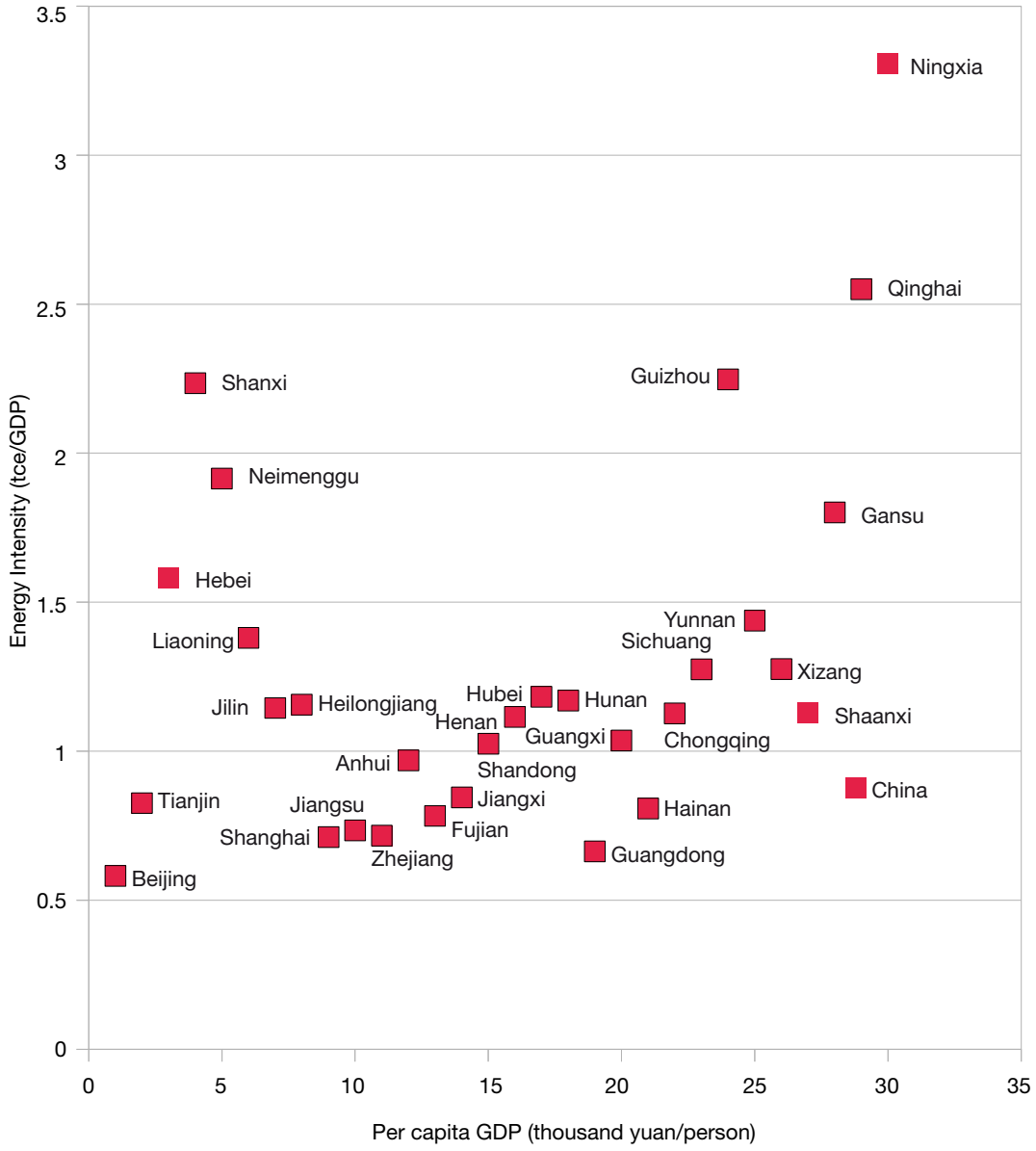
3. CASE STUDIES

3.1. Shanghai

For its 12th Five-Year Plan (2011-2015), Shanghai has included among its key targets the economic development goal of an 8% annual growth rate of GDP, with the service sector accounting for about 65% of total GDP. Within this framework, the Shanghai government has also set its energy saving and pollutants mitigation targets for 2011:

- Energy consumption and CO_2 emission per 10,000-yuan unit of GDP should decrease by 3.6% in 2011;
- The total increment of energy consumption will be controlled at under 5 million tce;
- Energy consumption per 10,000-yuan unit of GDP should decrease by 3.6%, and the total increment of energy consumption will be controlled at under 2.7 million tce in the industrial sector;
- Energy consumption increment controlled at under 1.5 million tce;

Figure 2. Energy Intensity and GDP Per Capita of Each Province (2007)



- Energy consumption per 10,000-yuan unit of GDP should decrease by 2% in the construction sector, and by 2.5% in commercial sector;
- Energy consumption per unit of building area should decrease by 1% in the hotel sector;
- Energy consumption of government institutions should decrease by about 4%;
- Energy consumption per unit of building area should decrease by 1% at the level of sanitation systems.

To exceed targets, the Shanghai government has implemented a package of policies and measures to achieve energy conservation and GHG mitigation.

3.2. Tianjin

For its 12th Five-Year Plan (2011-2015), Tianjin has included in its key targets the economic development goal of an 8% annual growth rate of GDP, with the service sector accounting for 65% of the total GDP. Within this framework, the Tianjin government has also set its energy saving and pollutant mitigation targets:

- Energy consumption and CO_2 emission per 10,000-yuan unit of GDP should decrease by 18% between 2011 and 2015;
- Forest coverage should increase to 23%;
- The share of non-fossil energy in total primary energy should increase by 2%.

To achieve the above targets, the Tianjin government has implemented a package of policies and measures to achieve energy conservation and GHG mitigation.

3.3. Liaoning

For its 12th Five-Year Plan (2011-2015), Liaoning has included in its key targets the economic development goal of an 11% annual growth rate of GDP, with the service sector accounting for 42% of the total GDP. Within this framework, the Liaoning government has also set its energy saving and pollutant mitigation targets for 2011 to 2015:

- Energy consumption per unit of GDP should decrease by 17%
- CO_2 emission per unit of GDP should decrease by 18%
- Forest coverage should increase from 38% in 2010 to 42% in 2015
- The share of non-fossil energy in the total primary energy consumption should increase to 4.5%

To achieve the above targets, the Liaoning government has implemented a package of policies and measures to achieve energy conservation and GHG mitigation.

4. POLICY RECOMMENDATIONS

As demonstrated in this paper, policy is implemented through governmental agencies and institutions, which means that the efficiency and effectiveness of low-carbon policy is partly constrained by the efficiency and effectiveness of low-carbon governance. On the other hand, government also plays an extremely important role in policy-making, as is clearly stated in the following statement made by the National Resources Defence Council (NRDC):

'The government plays the most important and powerful role.'

It is thus crucial to understand the low-carbon policy cycle.

The National Development and Reform Council (NDRC) is the government department in charge of LCD planning, strategy and implementation. However, addressing climate change and driving low-carbon development is a complex and cross-sectoral issue requiring the collaboration of multiple actors.

In this paper, we have reviewed low-carbon governance in China and carried out case studies on several provinces to illustrate the relationship between central and local government in terms of low-carbon governance. There are some conclusions to be drawn from above discussion:

- the structure of low-carbon governance in China involves various stakeholders including government, enterprises, researchers and civil society;
- the level of participation of the different stakeholders in policy making is uneven; the participation of enterprises and civil societies is increasing but still insufficient;
- central government plays a role in policy formulation, whilst local government is responsible for implementing policy at local level;
- a dedicated governmental agency within NDRC has been set up to coordinate climate change policies. This institution plays a crucial role in synergising policies and mainstreaming climate policies into development policy;
- a measurement, reporting and verification (MRV) system is crucial for low carbon governance. The key factors in the Chinese MRV system are a legislative framework, a process for data collection and information disclosure, a quality control system and the necessary infrastructure;
- as local conditions are not fully reflected in policy formulation in China, most policies are symmetrical across the provinces (see Figure 3).

Table 6. Shanghai's Low-Carbon Development Policies and Practices 2011

Policy Area	Policy tool	Contents
Industry	Energy consumption limits and standards	Energy consumption limit per unit of glass epoxy
		Energy consumption limit per unit of tempered glass
		Energy consumption limit per unit of ferrous metal products
		Energy consumption limit per unit of nonferrous metal products
		Energy consumption limit per unit of petrochemical products
		Energy consumption limit per unit of textile products
	Administration standard	Establish Shanghai energy audit technology guideline
		Establish Shanghai energy benchmarking management guideline
		Establish energy saving audit and calculation methodology for boiler systems, motor systems and air compressor systems
		Establish standards for energy-saving management, methodology, monitoring and evaluation
	Adjust and phase out backward capacity	Complete 600-700 phasing-out projects to achieve energy conservation of 600 to 700 thousand tce
		Adjust complete reform of the leather industry
		Continue the reform in metal industry enterprises
	Energy conservation audit, monitor and verification	Implement 'Shanghai energy audit management methodology'
		Implement energy audit on 80 enterprises whose annual energy consumption exceeds 50 thousand tce
		Complete energy consumption audit of 11 government buildings, 69 hospital buildings, 177 school buildings, 10 commercial buildings, 19 hotel buildings
		Improve management of the energy efficiency monitoring platform for Shanghai's industrial sector
Buildings	Energy consumption limits and guidelines	Investigate reasonable energy consumption methodologies, and implement guidelines for government buildings, schools, hospitals, hotels, and commercial buildings.
	Energy saving standard for building design and construction	Energy conservation design standard for public buildings
		Energy conservation design standard for residential buildings
		Energy conservation reformation guideline for existing buildings
		Research and set energy consumption limits for building construction
Transportation	Energy consumption limits and reasonable guidelines	Research on standard framework system for energy conservation in transportation sector
		Research on complete energy consumption limit standard for per unit of port throughput
		Research on fuel consumption limit standard for operational marine vessels
		Research on fuel consumption limits for civil transportation enterprises
		Establish fuel consumption limit standard for taxis
		Establish fuel consumption limit standard for buses
		Establish reasonable fuel consumption guideline for rail traffic
Households	Renewable energy	Pilot project to integrate renewable energy into buildings, covering 1.2 million m^2 of building area
		Install solar water heaters on buildings no higher than 6 floors
		Encourage enterprises and residents to buy 'green electricity'
	Standard and reform	Construct 600 thousand buildings according to new high energy conservation standard
		Reform existing buildings representing about 500 thousand m^2
Waste	Recycling	Harmless disposal of industrial solid waste and resource utilisation
		Domestic waste sorting collections and source reduction
		Improve the re-use of kitchen waste and organic waste and complete recovery system for 'renewable resources'
		Encourage appropriate packaging
		Build waste incineration power plant

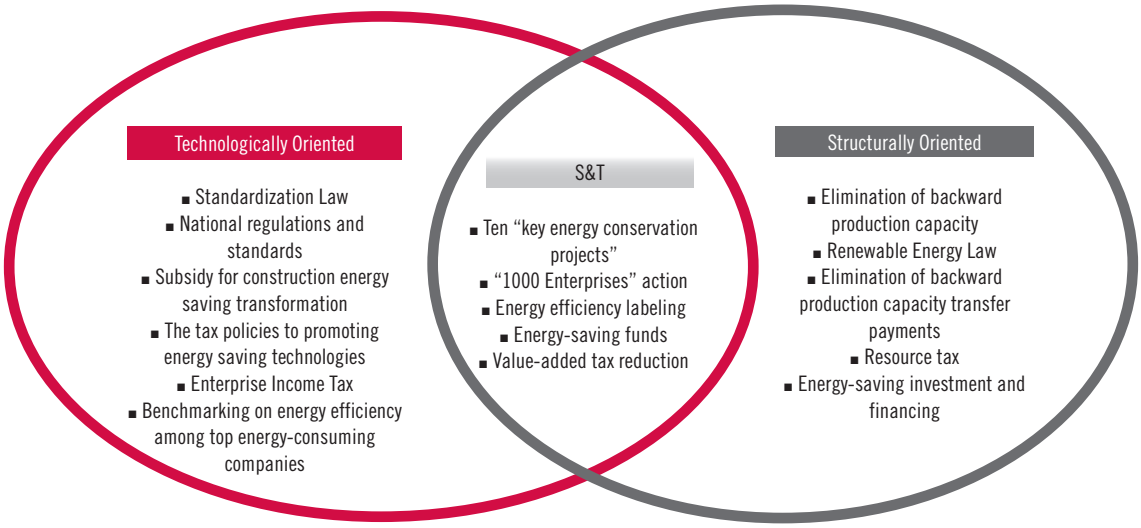
Table 7. Tianjin's Low-Carbon Development Policies and Practices (2006-2010

Policy Area	Policy tool	Contents
Industry	Adjust and phase out backward capacity	From 2006 to 2010, phased out backward capacity including: 2.55 million tons of cement; 5.9 million tons of steel, 25 million metres of dyeing and printing, 1.5 million boxes of flat glass, 18 thousand tons of alcohol, 75 thousand tons of paper
		Close down 300 thousand kW of small-scale thermal power capacity
		Invested 5 billion on 289 key energy conservation reform projects
	Energy conservation audit, monitoring and verification	Implement 'Tianjin energy conservation examination procedure and standard'
		Carry out energy audit on 50 top energy-consuming enterprises
		Complete energy consumption audit on enterprises whose annual energy consumption exceeds 5 thousand tce.
		Improve management of the energy efficiency monitoring platform in Tianjin industrial sector
Buildings	Energy consumption limits and guideline	Investigate reasonable energy consumption methodologies, and implement guidelines for government buildings, schools, hospitals, hotels and commercial buildings.
		The temperature is fixed at 26 in summer in government buildings
	Energy saving standard for building design and construction	Energy conservation design standard for public buildings
		Energy conservation design standard for residential buildings
		Energy conservation reformation guideline for existing buildings
		Research and set energy consumption limits for building construction
Transportation	Energy consumption limits and reasonable guideline	Reformed over 30 thousand buses, resulting in a 5% decrease in fuel consumption
		Research on complete energy consumption limit standard for per unit of port throughput; energy consumption per unit of port throughput decreased by 23%
		Encourage fuel-saving driving measures
		Public transportation priority development strategy
		Develop clean energy buses
		Public transportation share rate to reach above 30% by 2015
Households	Renewable energy	Pilot project to integrate renewable energy into buildings, covering 1.2 million m^2 of building area
		More than 400 thousand households installed with solar water heaters
		Built 100 straw gasification stations, 30 thousand biogas pools
		10 million m^2 of building area supplied with geothermal heating
	Standard and reform	Constructed 120 million m^2 of domestic buildings according to new high energy conservation standard, representing 62% of total urban residential buildings
		Implement 'Tianjin heating supply metering methodology for residential buildings'. Heating supply metering implemented on 30 million m^2 building area in Tianjin, resulting in a heating consumption level 11% lower than average level.
		Distribute 7 million high-efficiency lamps
Waste	Recycling	Built the first waste incineration power plant in Tianjin

Table 8. Liaoning's Low-Carbon Development Policies and Practices

Policy Area	Policy tool	Contents
Industry	Energy consumption standard	Energy consumption per unit of production: Steel: 0.64 tce/ton (2010); 0.60 tce/ ton (2015) Non-ferroalloy: 4.5 tce/ ton (2010); 4.0 tce/ ton (2015) Oil refining: 12 kgoe/ ton (2010) 11 kgoe/ ton (2015)
		Energy consumption per unit of cement, flat glass deceased by 20% between 2006 and 2010, and a further 10% decrease is targeted between 2011 and 2015
	Administration standard	Implement 'Adjustment of industrial structure guideline'
		Implement national industrial entry standard in 13 industries, such as steel, ferroalloy and coke
	Adjust and phase out backward capacity	Reform low-efficiency coal-fired boilers/furnaces
		Adopt high-efficiency motors, turbines, pumps
		Implement the re-se of waste pressure and waste heat
		Phased out backward capacity by the end of 2010: Iron: 3 million tons; steel: 5 million tons; small-scale thermal power: 1 GW; ferroalloy: 240 thousand tons; coke: 1.6 million tons; calcium carbide: 240 thousand tons; paper: 850 thousand tons; alcohol: 1 million tons; cement: 7 million tons
	Energy conservation audit, monitor and verification	Implement 'Liaoning energy conservation monitoring methodology'
		Provincial monitoring department to monitor the energy conservation of enterprises whose annual energy consumption exceeds 100 thousand tce, City monitoring department to monitor energy conservation of enterprises with annual energy consumption of between 2 and 100 thousand tce.
		Complete energy consumption audit of 11 government buildings, 69 hospital buildings, 177 school buildings, 10 commercial buildings, 19 hotel buildings
		Verification institutions to evaluate the reasonableness of enterprises' energy consumption (annual energy consumption beyond 3000 tce or electricity consumption beyond 3 million kWh).
Energy	Renewable energy[2]	Installation capacity of wind power increased beyond 1.5 GW in 2010, 6 to 10 GW in 2015
		Installation capacity of hydro power increased beyond 1.5 GW in 2010
		Installation capacity of solar power to increase to 300 MW by 2015
		Installation capacity of nuclear power to increase to 4 GW by 2015
		300 large and medium-scale biogas projects were built in 2010
Buildings	Energy consumption limitation and guideline	Implement national energy-saving standard for buildings
		New buildings should increase energy conservation by 65%
		Rural regions residential buildings should increase energy conservation by 50%
	Energy-saving standard for building design and construction	Implement national energy-saving standard for buildings
		Encourage energy-saving reform for commercial buildings with an area over 10,000 m^2
		10 pilot projects for low energy consumption and green buildings
		30 pilot projects for renewable energy utilisation in buildings
		Popularise 5 million high-efficiency lamps through bulk purchase
		High-efficiency lamps supplied 60% of lighting in 2010; the goal is to achieve 100% by 2015
Transportation	Energy consumption limitation and reasonable guideline	Encourage the development of public transportation
		Establish city public transportation system pillar with bus and rail traffic
		Encourage the utilisation of energy-saving vehicles and hybrid vehicles[3]
		Implement fuel consumption limitation standard for passenger cars and light commercial vehicles
Households	Renewable energy	Disseminate solar water heaters to be installed in rural areas Solar heating and cooling technology to be demonstrated in urban regions
		Water source heat pump and ground source heat pump supplied heating for more than 110 million m^2 of buildings
		Biogas supplied energy for 6,000 thousand households
	Standard and reform	Energy-saving reform for 10 million m^2 of existing residential buildings
Waste	Recycling	Built 99 sewage disposal works additionally
		Improve grey water re-use, enhance re-use rate of grey water
		Improve the re-use of kitchen waste and organic waste; complete recovery system for 'renewable resources'
		Encourage appropriate packaging system
		Build waste incineration power plant
		Rate of harmless disposal of waste to reach 85% by 2015

Figure 3. Framework for Policy Formulation in China



Recommendations

The following are some recommendations for support and national action in China and other developing countries in both the short and longer terms.

Short-term measures:

- enhance policy coordination at national level to mainstream climate policy. Coordination between local and central government should be also enhanced to reflect local priorities and characteristics;
- train decision-makers and legislators on best practices of climate change policy making, critical analysis of the current system in China and options for future policy;
- enhance the stakeholders' participation in the policy making process so as to better understand their concerns and the barriers to implementation;
- share information about international policy making and implementation practices, policy lessons and best practice to inform new policy and to embark on the reform of existing policies;
- undertake capacity building, as well as funding and technology sharing, at the enterprise level, including measurement systems and the necessary supporting hardware or infrastructure;
- develop a standardised reporting system to collect emissions data, as well as energy data, and cover both small and large firms;
- establish a robust domestic policy assessment system based on mandatory energy auditing by external parties, as in the financial sector; this should reduce conflicts of interest faced by the company staff responsible for energy and emissions reporting and improve the quality control of data.

Many policy challenges still need to be addressed in the future. The first challenge is how to promote low-carbon urbanisation during phases of economic development. About two-thirds of China's emissions are due to investment projects and final domestic consumption. Most investments are closely linked to urbanisation, while domestic consumption relates to changing life patterns due to a rise in income as well as to urbanisation. Thus, the question of how to reduce the carbon footprint in the urbanisation process is not only a challenge for China, but also for all developing countries. Secondly, structural change will be the major driver enabling most Chinese provinces to reduce their energy intensity in the 12th FYP period. However, it is still not clear whether there is an effective policy in place that provides appropriate and sufficient incentives to shift from an economy based on energy-intensive industry to one based on energy-light industry, without carbon leakage occurring between provinces. This type of policy toolkit should be further developed at both national and local levels. Thirdly, market-based policy will draw greater attention over the next few years but, as yet, there is no clear roadmap at national level to guide investors and consumers. This roadmap should be developed and implemented as soon as possible on the basis of international experiences and national circumstances.

APPENDIX

Table 9. In-Depth Analysis of Provincial Targets and Achievements and the Impact of the Census

	2005		2010		2015	2006-2015	2005[4]	
	Energy intensity	Target	Energy intensity	Actual decrease	Target	Target	Energy Intensity	Target
	(tce/10,000 Yuan)	(%)	(tce/10,000 Yuan)	(%)	(%)	(%)	(tce/10,000 Yuan)	(%)
Beijing	0.792	-20	0.582	-26.59	17	39.07	0.8	-27.3
Tianjin	1.046	-20	0.826	-21	18	35.22	1.11	-25.6
Hebei	1.981	-20	1.583	-20.11	17	33.69	1.96	-19.2
Shanxi	2.89	-22	2.235	-22.66	16	35.03	2.95	-24.2
Neimenggu	2.475	-22	1.915	-22.62	15	34.23	2.48	-22.8
Liaoning	1.726	-20	1.38	-20.01	17	33.61	1.83	-24.6
Jilin	1.468	-22	1.145	-22.04	16	34.51	1.65	-30.6
Heilongjiang	1.46	-20	1.156	-20.79	16	33.46	1.46	-20.8
Shanghai	0.889	-20	0.712	-20	18	34.4	0.88	-19.1
Jiangsu	0.92	-20	0.734	-20.45	18	34.77	0.92	-20.2
Zhejiang	0.897	-20	0.717	-20.01	18	34.41	0.9	-20.3
Anhui	1.216	-20	0.969	-20.36	16	33.1	1.21	-19.9
Fujian	0.937	-16	0.783	-16.45	16	29.82	0.94	-16.7
Jiangxi	1.057	-20	0.845	-20.04	16	32.83	1.06	-20.2
Shandong	1.316	-22	1.025	22.09	17	35.33	1.28	-19.9
Henan	1.396	-20	1.115	-20.12	16	32.9	1.38	-19.2
Hubei	1.51	-20	1.183	-21.67	16	34.2	1.51	-21.7
Hunan	1.472	-20	1.17	-20.43	16	33.16	1.4	-16.4
Guangdong	0.794	-16	0.664	-16.42	18	31.46	0.79	-15.9
Guangxi	1.222	-15	1.036	-15.22	15	27.94	1.22	-15.1
Hainan	0.92	-12	0.808	-12.14	10	20.93	0.92	-12.2
Chongqing	1.425	-20	1.127	-20.95	16	33.6	1.42	-20.6
Sichuang	1.6	-20	1.275	-20.31	16	33.06	1.53	-16.7
Guizhou	2.813	-20	2.248	-20.16	15	32.05	3.25	-30.8
Yunnan	1.74	-17	1.438	-17.41	15	29.8	1.73	-16.9
Xizang	1.45	-12	1.276	-12	10	20.8	1.45	-12.0
Shaanxi	1.416	-20	1.129	-20.25	16	33.01	1.48	-23.7
Gansu	2.26	-20	1.801	-20.26	15	32.22	2.26	-20.3
Qinghai	3.074	-17	2.55	-17.04	10	25.34	3.07	-17.0
Ningxia	4.14	-20	3.308	-20.09	15	32.08	4.14	-20.0
Xinjiang	Till further assessment				10	18.02	2.11	

1. In China, strategic emerging industries include energy saving and environment protection, next-generation IT, biology, high-end equipment manufacture, new energy, new materials and new-energy vehicle industries. These industries could bring high value-added with low energy consumption, which means that the development of strategic emerging industries could decrease the energy intensity and carbon intensity of GDP—this has been a significant measure to address climate change in China.
2. There are 27 large state-owned electricity generation companies in China, which account for 70% of national total installed capacity. Generally, they set up sub-companies in the provinces and cities. The fact that renewable energy is indicated in the table for Liaoning province does not mean that Liaoning government has a province-owned power company. The reason it appears is simply because Liaoning has a wealth of renewable energy resources, which were intended to constitute an important pathway for controlling carbon emissions.
3. The limits set on small-displacement (motor) vehicles travelling in a stipulated region or for a certain time were revoked by Liaoning government.
4. This column is based on the announcement approved by the State Office in 2006. http://www.gov.cn/gongbao/content/2006/content_443285.htm These data are based on statistics for 2005. The GDP data and energy consumption data were revised after the second census was completed in 2009. In 2011, when NDRC announced the attainment of intensity reduction targets, they shifted the base data to revised 2005 data after census. If we use original data prior to the census as the base year data, then nine provinces fail to reach their targets allocated in year 2006 (although, for some of them, this is only a slight shortfall). The revision of GDP and energy consumption data on the basis of the most recent information is a common practice worldwide.

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