Annual Review of Low-Carbon Development in China (2011-2012)

Chapter Summaries

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About CPI

Climate Policy Initiative (CPI) is a policy effectiveness analysis and advisory organization whose mission is to assess, diagnose, and support the efforts of key governments around the world to achieve low-carbon growth.

CPI is headquartered in San Francisco and has offices around the world, which are affiliated with distinguished research institutions. Offices include: CPI at Tsinghua, affiliated with the School of Public Policy and Management at Tsinghua University; CPI Berlin, affiliated with the Department for Energy, Transportation, and the Environment at DIW Berlin; CPI Rio, affiliated with Pontifical Catholic University of Rio (PUC-Rio); and CPI Venice, affiliated with Fondazione Eni Enrico Mattei (FEEM). CPI is an independent, not-for-profit organization that receives long-term funding from George Soros.

Part I: China's low-carbon performance

Part 1 of the review describes China's overall progress in low-carbon development during the 11th Five-Year Plan period (2006-2010). Chapter 1 provides key metrics of China's transition to green growth. Chapters 2 and 3 discuss technological developments and changes in the economic structure, which supplied the greatest contributions to low-carbon development.

Chapter 1: China's economic transformation during the 11th Five-Year Plan

As reported in CPI's first "Annual Review of Low-Carbon Development in China 2010," during the period of the 11th Five-Year Plan (FYP), China reversed the trend of increasing energy intensity (defined as energy use per unit of economic output or GDP) that it experienced during the 10th FYP period and achieved a 19.06 percent reduction in energy intensity against the 2005 energy intensity baseline.[1] This reduction is equivalent to an energy intensity improvement of 630 Mtce and a CO_2 emissions reduction of 1550 Mt. While energy-efficiency improvements were a major driving force for CO_2 emissions reduction, contributing to 87 percent of the total, China's total energy intensity improvement was driven primarily by technological development (69 percent contribution) and structural adjustment (23 percent contribution).[2]

Although China's emissions intensity declined during this period, its total emissions volume increased by 33.6 percent. As a result, China overtook the United States in 2007 to become the world's largest emitter. This led to intensified international pressure and a renewed interest within China to focus on carbon reduction.

During the 11th FYP period, China implemented a series of policies to drive energy efficiency, renewable energy development, and climate change adaptation. This diverse set of policy instruments involved large-scale government investment and focused on key actors in the transition to low-carbon development, e.g. major industrial enterprises, provincial and local governments, and the public. Although large energy-consuming enterprises made significant progress, the carbon reduction efforts of small and medium enterprises remained weak. Local governments explored low-carbon development strategies but often treated them as less pressing than strategies for economic growth. Meanwhile, energy consumption in the residential and transportation sectors increased rapidly, posing a major challenge to China's future low-carbon development.

Since 2005, many high energy-consuming enterprises have moved from eastern China to western China. As a result, the structure of industry in the East has become less energy-intensive, while large-scale industrialization in central and western China has locked in a high-emissions economic structure that will be difficult to alter in the future.

[1] This Review reports changes in the energy and emission intensity of China's economy relative to a 2005 baseline. Absolute energy savings and emission reductions are calculated using a rolling year baseline: 2005 energy and emission intensity provides the baseline for 2006 improvements; 2006 actuals provide the baseline for 2007, and so on.

[2] Calculation residuals account for the remaining 8% contribution.

In the middle of the 11th FYP, the global financial crisis slowed the growth of some high energy-consuming industries. In 2008, however, the central government responded to the crisis with a four trillion yuan economic stimulus package that successfully maintained high economic growth rates. These growth rates will make the energy saving targets under the 12th FYP more difficult to achieve.

Chapter 2: Low-carbon technology development

During the 11th FYP, China focused on several technology areas to improve carbon and energy efficiency: higher-efficiency coal-fired power plants; energy efficiency improvement in the industrial and building sectors; wind and solar energy; and carbon capture, utilization and storage (CCUS). In general, China has emphasized the advancement of clean energy technology and end-use energy utilization technology, as well as the further investigation of CCUS and alternative fuel vehicles. Applications of low-carbon technologies during the 11th FYP are characterized by 1) large market size, 2) rapid growth, and 3) significantly improved end-use energy utilization rate.

Using policy incentives and financial support to encourage the deployment of economically efficient low-carbon technologies, China experienced rapid improvements in the energy efficiency of the industry and building sectors. In particular, China achieved significant progress in renewable energy and higher-efficiency coal technologies. Not only did the use of these technologies increase, but China's domestic capacity for the manufacturing of the equipment used in low-carbon technologies grew as well. In particular, domestically-manufactured supercritical and ultra-supercritical power generating units and circulating fluidized bed boilers have now met advanced international standards. In short, through increased domestic technology upgrades and updates, the technological gap between China and developed countries has narrowed.

It is important to note, however, that despite this considerable progress, the penetration rate of some of these technologies remains low. In addition, a number of core technologies, such as advanced materials and new wind turbine models, remain to be mastered. China needs to strengthen its scientific research capacity and encourage innovation efforts by enterprises.

Chapter 3: Changes in economic structure

Changes in China's economic structure during the 11th FYP period resulted in an energy intensity improvement of 143 Mtce over the 2005 baseline, accounting for close to 23 percent of the total energy intensity improvement during this period. As the industrial sector grew to represent a larger proportion of the economy, that sector's energy consumption increased by 50.8 Mtce. At the same time, changes in the mix of industries contributed to a 77Mtce reduction in energy intensity relative to the 2005 baseline. This result was primarily due to the sustained rapid growth of low energy-consuming and high-value added industries compared with a drop in high-energy consuming, low value-added industries. Another change within the industrial sector was the shift from the production of raw materials to the manufacture of processed products, leading to an additional energy intensity improvement of 117 Mtce.

Many enterprises responded to the new government energy efficiency and renewable energy

policies by improving their production efficiency and using equipment upgrades, mergers, and reorganization to reduce energy consumption. These improvements were achieved, in part, by the general trend of increasing the scale of production equipment. In addition, many high energy-intensity industries consolidated to form a smaller number of large enterprises, as these typically have lower energy intensities than small and medium-sized enterprises and are more often the direct targets of government energy intensity regulation.

The geographic reallocation of industries during the 11th FYP period caused a significant change in the regional economic development pattern. Driven by the influx of energy-intensive industries, economic growth in western and northeastern China was more rapid than growth in eastern China, resulting in a relative energy intensity increase of approximately 0.5 percent. The western and northeastern regions attracted more investments, however, which supported the advancement of equipment and technology, in turn building energy efficiency capacity in these regions. In the East, while the departure of energy-intensive industries has created a less energy-intensive sectoral structure, the expanded production capacity has challenged the gains made by the improved economic structure.

PART II: Laying the foundation for low-carbon development

Part II describes China's key efforts to achieve low-carbon development during the 11th FYP. Chapter 4 provides an overview of the policies implemented, Chapter 5 describes new implementation mechanisms that supported low-carbon development, and Chapter 6 describes investment and financing support.

Chapter 4: Low-carbon development policy

During the 11th FYP, China established a low-carbon development policy framework that focused on boosting new and renewable energy development, reducing energy consumption, and increasing carbon sinks. In addition, policy instruments such as pricing, financing, and taxation were applied alongside government investment. The impact of these low-carbon policies during the 11th FYP period was significant: administrative instruments reduced carbon emissions by 473 $MtCO_2$ compared to the baseline; incentive instruments resulted in a reduction of 777 $MtCO_2$; and market instruments resulted in a reduction of 15 $MtCO_2$. Policy support has also resulted in a virtuous investment cycle led by the central and local governments, which has encouraged participation by various sectors of society. Unfortunately, China's reliance on command and control policies and a lack of market instruments may have had the unintended result of increasing the cost of policy implementation.

During the 11th FYP, the central government's efforts to implement low-carbon development policy were intensive, diversified, and backed by significant funding. The attainment of energy policy goals was made mandatory for local and provincial officials, with their job evaluations and career advancement opportunities contingent—in part—on successful results. Decision-making

at all levels was facilitated and streamlined by China's socialist political framework and unified political system. Nonetheless, to accelerate the clean energy transition in a cost-effective way, further policy coordination improvements and the inclusion of market instruments may still be necessary.

Chapter 5: New implementation mechanisms to support low-carbon development

The energy conservation target accountability system, energy performance contracting, and the renewable energy development mechanism are three examples of implementation mechanisms that supported low-carbon development in China during the 11th FYP. The energy conservation target accountability system leverages China's administrative hierarchy by 1) holding local governments accountable for meeting energy intensity improvement targets set by regional and national government structures, 2) ensuring effective implementation of national policies, and 3) facilitating policy innovation at the local level.

During the 11th FYP, various levels of government also adopted energy performance contracting as an innovative, market-based mechanism to promote low-carbon development. This mechanism, recently introduced in China, allows contracted private enterprises to pay upfront for and profit from energy intensity improvements resulting from energy efficiency measures. Contracting thus eases the financing challenges faced by medium and small enterprises in adopting energy efficiency technologies.

The Renewable Energy Law, an administrative measure, established five systems for renewable energy development that clearly assigned the renewable energy obligations of government agencies, enterprises, and the public. These five systems helped to solve the problems of grid connection, financing, and cost distribution for renewable power and ultimately facilitated the development of the renewable energy industry.

Chapter 6: Investment in and financing of low-carbon development

Over the course of the 11th FYP, China's investment in renewable energy and energy efficiency improvements surpassed the amount invested during any previous Five-Year Plan period and made China the global leader in terms of investment. During the same period, the investment of the United States – the world's second-largest investor – was equivalent to 86% of China's. Cumulatively, China invested 1.73 trillion yuan (USD 266.6 billion, Euro 192.6 billion) in new energy and renewable energy between 2006 to 2010. The country's investments in these areas include 621.8 billion yuan (35.9 percent of all investment in renewables) in hydropower, 469.9 billion yuan (27.1 percent) in wind power, 366.8 billion yuan (21.2 percent) in nuclear power, 199.7 billion yuan (11.5 percent) in solar photovoltaic power, and 74.9 billion yuan (4.3 percent) in biomass.

China also invested a total of 859.2 billion yuan to improve energy efficiency during the 11th FYP. Funding from central and local governments totalled 126.1 billion yuan, accounting for 14.7 percent of the total investment; private investment totaled 733.1 billion, accounting for 85.3 percent of the total. In addition, the industry sector contributed 551.1 billion yuan, representing 64.1 percent of the overall investment; the building sector accounted for 259.3 billion yuan,

representing 30.2 percent of the total; and the other remaining sectors totalled 48.8 billion yuan.

Direct government funding and bank loans were China's chief sources of financing during the 11th Five-Year Plan period. Large, state-owned enterprises found it easier to obtain these funds and loans than did medium and small private enterprises. To support China's low-carbon development in the long run, more diversified financing channels and more innovative financing approaches need to be established.

PART III: Actors in low-carbon development

Chapter 7: Local governments' behavior

Local governments undertook a range of low-carbon development efforts during the 11th FYP:

1. China achieved a 19.1 percent reduction in emissions intensity by assigning targets to various levels of government. To meet their targets, local governments raised awareness about energy saving goals, created energy saving agencies, further assigned accountability for meeting targets, and formulated strategies for decarbonising resource allocation.

2. Local governments also accelerated economic development and city expansion. Some of their activities, such as developing energy intensive industries, conflicted with the goal of low-carbon development. In general, some local governments still consider low-carbon development to be a hindrance, rather than a contributor, to economic growth.

Chapter 8: Enterprises' response

During the 11th FYP period, energy-intensive enterprises improved their energy efficiency. The target accountability system, industrial policies, the reform of the energy management system, and higher energy prices all made enterprises more aware of energy efficiency and encouraged them to take energy-saving actions.

As a result, industrial enterprises substantially reduced their energy consumption per unit of production, leading to a reduction in energy use of 342 Mtce compared with the baseline. In particular, the largest energy-intensive enterprises, known as the Top 1,000, saved 150 Mtce, which accounted for 43 percent of the total energy intensity improvement achieved by the industrial sector.

The dual pressure of energy conservation policies and inflated energy prices forced enterprises to change their management methods. In addition, the promotion of energy efficiency technologies and the availability of external financial support enabled enterprises to improve their capacity.

China's energy saving policies focused on large enterprises; small and medium enterprises received less support and thus had difficulty improving their energy efficiency. The extension of energy saving projects from the Top 1,000 to smaller energy-intensive firms in the 12th FYP

period may mitigate this problem.

Chapter 9: Influence of public behavior on low-carbon development

Carbon emissions include direct emissions from building operation and transportation and indirect emissions from the construction of buildings and infrastructures and the production of materials and consumer goods. Direct emissions accounted for approximately 30 percent of China's total carbon emissions in 2010, an increase of 41 percent from 2005, which is more rapid than the growth of total emissions during the same period (36 percent). This increase resulted in the rapid growth of indirect emissions as well. Energy use for building construction and building material production accounted for another 13.5 percent of China's total carbon emissions in 2010.

China is challenged by constraints on its energy supply and increasing pressure to reduce its carbon emissions. Meanwhile, the public's consumption behaviors are undergoing a dyanmic transformation. Therefore, to make the transition to a low-carbon economy, China needs to guide the public's behaviour toward a lower-carbon emission model as consumer income levels rise. Government efforts during the 11th FYP period include the establishment of a housing and transportation policy framework was initiated to balance the goals of industrial development and energy saving and carbon reduction.

PART IV: Low-carbon future

Chapter 10: Outlook of 12th Five-Year Plan

The energy-related targets of the 12th FYP (16 percent reduction in energy intensity, 17 percent reduction in carbon intensity, and 11.4 percent share of non-fossil energy in total primary energy consumption) are ambitious and chart a new strategic course for China's economy. However, it will be challening to attain these targets for several reasons:

- The nation's rapid pace of industrialization, urbanization, and economic growth creates a powerful trend of increasing total energy consumption, which will be difficult to slow down.
- As a result of the country's continued growth in energy demand, it will be difficult to increase the share of renewable energy and other low-carbon sources in the nation's total energy structure.
- Much of the "low-hanging fruit" in energy efficiency savings has already been picked, so the marginal costs of energy conservation and carbon reduction will continue to rise.
- Many local and provincial governments appear to view rapid GDP growth as a more important goal than the national targets for energy and carbon intensity.

To slow its trend of rapid emissions growth and to make a historic transformation to a low-carbon development economy, China will need to carry out several difficult tasks simultaneously.

The country will need to encourage further technology penetration, explore additional market-based policy instruments, and extend support to small and medium-sized enterprises. The key challenges in coming years include containing the growth of energy-intensive industries, particularly in the West and Northeast, accelerating growth through low-carbon development, and redirecting increasing energy-intensive consumer behaviour.