

The Transformation of China's Energy System: Challenges and Opportunities

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Summary

In my testimony today, I will start by discussing both where China is now and its plans for the upcoming five years, and then I will talk about some of the business opportunities this creates for other countries, including the United States, that want to compete in new energy technologies.

Energy, environment and climate policy has become increasingly important in China in the last decade. As with any policy focus, there are a number of interests and drivers involved. The confluence of concerns about energy security, environmental protection, climate change and economic restructuring has strengthened the Chinese government's commitment to both energy efficiency and non-fossil fuel development. Under the 11th Five-Year Plan (2006-2010), China made considerable progress. It came quite close to its energy intensity target, reducing energy intensity over the five-year period by 19.1%, and it increased non-fossil fuel use by 3.1% per year, so that non-fossil energy now comprises 8.3% of China's total energy use.

In March, China's National People's Congress adopted its 12th Five-Year Plan. The plan sets 2015 goals that continue to focus on energy efficiency and non-fossil energy development and set China well on the way to meeting its 2020 goals made at Copenhagen. The five-year goals are to reduce carbon intensity by 17% and energy intensity by 16%, to increase the share of non-fossil fuels in China's total energy mix to 11.4%, and to increase forest cover by 12.5 million hectares and forest stock volume by 600 million cubic meters.

While decreasing as a percentage of total energy used, coal will continue to be an important energy source for many years. To address the greenhouse gas issue, China is actively pursuing a research and commercial scale pilot program looking at carbon capture and storage, a technology China has a strong interest in mastering.

International partnerships with Chinese clean technology companies are growing rapidly. What makes China attractive to U.S. and international investors is the clear policy framework which gives businesses the certainty they are looking for before investing. Companies including First Solar, GE, Duke Energy and American Electric Power have all announced new initiatives in the last year. Increasingly entrepreneurs with new ideas are looking to China to make those ideas become a reality. With a similarly supportive policy environment, the U.S., with its unsurpassed research resources and proven track record in new technologies, could be an unsurpassable winner.

The Transformation of China's Energy System: Challenges and Opportunities

Thank you for the opportunity to contribute to the deliberations of this Committee. My name is Deborah Seligsohn, and I am Senior Advisor to the China Climate and Energy Program at the World Resources Institute. The World Resources Institute is a non-profit, non-partisan environmental think tank that goes beyond research to provide practical solutions to the world's most urgent environment and development challenges. We work in partnership with scientists, businesses, governments, and non-governmental organizations in more than seventy countries to provide information, tools and analysis to address problems like climate change and the degradation of ecosystems and their capacity to provide for human well-being.

I am delighted to speak with you today about the ongoing transformation of China's energy system, and the challenges and opportunities these changes present not only for China, but also for the United States. I will start by discussing both where China is now and its plans for the upcoming five years, and then I will talk about some of the business opportunities this creates and the real challenge this speed of change in China presents for other countries, including the United States, that want to compete in new energy technologies.

Drivers of climate and energy policy

Energy, environment and climate policy has become increasingly important in China in the last decade. As with any policy focus, there are a number of interests and drivers involved. The confluence of these concerns has strengthened China's commitment to policy implementation. The major drivers include:

- **Energy security:** Energy security has been one of China's major historic concerns, going back at least as far as the Sino-Soviet split in the late 1950s/early 1960s, when China was left without a stable supply of imported oil.¹ When China began to import oil in the 1990s it faced a period of global stable prices, and energy security became more of a back burner issue. This began to change in the last decade, as energy prices became more unstable, political instability in source countries became more apparent, and potential conflict with other consumer countries also became a greater concern. At the same time, China became increasingly concerned about security of supply, even from domestic sources. In other words, heavy dependency on coal from a single region leaves China very vulnerable

to natural disasters, such as the blizzards of 2008.ⁱⁱ Diversifying supply both domestically and internationally helps address the multiple energy security concerns. Improving efficiency also reduces these pressures, whether they be logistical, economic, or political.

- Environmental protection: In the past decade the Chinese government and the Chinese public have become increasingly concerned about protecting the Chinese environment, and in particular about the impact of urban air pollution. These concerns have been driven partly by a series of well-publicized disasters, partly by China's demonstrated ability to improve air quality during the 2008 Olympics,ⁱⁱⁱ and partly as a result of increased affluence that has driven public demand for a more comprehensive view of development. Although China's gross domestic product on a per capita basis is still quite modest by global standards, less than \$5000 per capita per year,^{iv} this is still a considerable increase in wealth from just a few years ago. Starting in the early 2000s, there has been a growing sense that China can provide more than just economic growth to its people, that quality-of-life improvements, including social services as well as environmental protection, are also important.
- Climate change: The Chinese in the 1990s viewed the climate discussion purely in terms of external pressure. If there were an opportunity it was perhaps to acquire some additional technology. Today that picture is much more complex. In its latest report on national progress on the climate change issue, China's own National Development and Reform Commission (NDRC) states: "China is one of the countries that are highly vulnerable to the impact of climate change."^v This concern about the impacts of climate change is a driver not only in China's domestic policy formation, but also in China's approach to international climate negotiations and its interest in seeing stronger developed country targets.
- Economic transformation: Chinese policymakers have developed an increasingly sophisticated conception of what they need to do to maintain strong economic growth, and this includes the notion that they need to move away from reliance on heavy industry. As Tsinghua Professor Hu Angang explained in a piece on the development of the 12th Five-Year Plan, its key theme determined early in the drafting process is "transformation."^{vi} Transforming China's economic structure is viewed as

critical not just to reducing the environmental impact of growth, but to ensure that China does not wind up in a “middle income development trap,” in other words, be unable to grow beyond the middle-income developing country status. ^{vii}

As a result of all of these factors, energy policy has grown considerably in importance in national economic planning over this past decade. As someone who has lived in China for much of the last three decades, I can tell you the change is quite visible. In the early part of the 2000s, energy policy was managed by one Vice Premier and one Vice Chairman of the NDRC, and climate change was the purview of scientists and international negotiators. This is no longer the case. Starting in 2007, Premier Wen Jiabao began to weigh in heavily on energy issues, regularly convening meetings of provincial and sectoral leaders. By 2009, President Hu Jintao was addressing not only energy, but also climate change in international fora.

The Five-Year Plans

Energy and environment played a critical role in the 11th Five-Year Plan, China’s national policy for the period stretching from 2006 through the end of 2010. Three key targets were put in the plan: reducing energy intensity per unit GDP by 20%, and reducing sulfur dioxide (a key air pollutant) and COD (chemical oxygen demand, a key water pollution measurement) by 10% each. China actually exceeded both the sulfur dioxide and COD targets, in fact reducing sulfur dioxide by more than 13%. It came quite close to its energy intensity target, reducing energy intensity over the five-year period by 19.1%.^{viii} To get to that energy intensity target required a great deal of heavy lifting, especially in the last year of the plan period. This was particularly true because provinces had been slow to start implementing the plan targets in 2006. The pressure they were under to reach this goal in 2010 should ensure they begin implementation of the next Five-Year Plan with more alacrity.

We already see indications that the provinces are focusing on these energy and environmental goals. Our organization, the World Resources Institute, just hosted a meeting with Provincial Development and Reform Commission officials to discuss improving city-level environmental planning. Twenty-eight of the thirty-one provinces in China sent representatives. In other words, contrary to

popular perception, China has not only set goals for itself in environmental and energy policy improvements, but it has also made significant strides in achieving them. It is in fact heartening that China reported an energy intensity number that fell a little bit shy of the target, showing increased seriousness about measurement and reporting.

This hearing occurs at a particularly opportune moment for discussing where China is heading from a climate and energy perspective. China's 12th Five-Year Plan was adopted at the National People's Congress (NPC) in March of this year. This plan in some areas is quite similar to the previous Five-Year Plan, and in other areas goes well beyond the previous plan.

The most striking advance in the current Five-Year Plan is the attention paid to climate change. While energy and environment were important in the previous Five-Year Plan, five years ago climate change was barely addressed. This time around climate change is the first topic in the environmental portion of the plan, and environment itself has more prominence than ever before. The plan sets 2015 goals congruent with the three commitments that China made at Copenhagen^{ix} and then reaffirmed in Cancun. These commitments were:

- To reduce carbon intensity by 40% to 45% by 2020 as compared with 2005;
- To increase the share of non-fossil fuels in China's primary energy mix to 15% by 2020; and
- To increase domestic forest cover by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 over a 2005 baseline.

Each of these is addressed in the 12th Five-Year Plan:

- The five-year carbon intensity reduction goal is 17%;
- The 2015 non-fossil fuel goal is set to reach 11.4% of China's total energy mix; and
- The 2015 forest goals are to increase forest cover by 12.5 million hectares and forest stock volume by 600 million cubic meters.^x

China also set a goal to reduce energy intensity by 16% over the next five years. And there were key environmental targets as well: both sulfur and COD are targeted for an additional 8% overall reduction and several new air and water pollutants are added with reduction targets of 10% each. The goals for the

three items that were covered in the previous Five-Year Plan, energy intensity, sulfur and COD, are somewhat lower in the 12th Five-Year Plan. This is not surprising, because many of the “low hanging fruit,” the easiest reduction measures, have already been taken.

In the case of energy intensity, studies by the Lawrence Berkeley National Laboratory show that two programs in particular contributed to the recent energy intensity reduction. The first is the Top-1000 Energy-Consuming Enterprise Program, which focused on improving energy efficiency in China’s largest 1000 companies, responsible for one third of China’s total energy use.^{xi} The second is a program of plant closures, where China closed down the smallest, dirtiest and least efficient factories in a number of heavy industry sectors including power, steel, cement, other metals and paper.^{xii} NDRC Vice Chairman Xie Zhenhua just reported in a speech during his visit to Australia last week that China’s cumulative shutdowns of inefficient electric power plants over the last five years totaled 72 GW or approximately 8% of China’s total installed capacity—that is almost equal to the total installed capacity of electricity in South Korea or Spain.^{xiii} This type of shutdown of inefficient plants is really unprecedented globally and is a significant part of the reason that the Chinese coal-fired power plant fleet is now more efficient than that of the United States.^{xiv}

China has committed not only to a carbon intensity reduction, but to tracking that reduction. At last month’s national People’s Congress, Premier Wen Jiabao stated that China will put in place “well-equipped statistical and monitoring systems for greenhouse gas emissions, energy conservation and emissions reductions” to ensure these policies are tracked and properly implemented. It is worth noting that we also have independent corroboration of some of the results of the 11th Five-Year Plan. In particular, atmospheric scientists at Harvard University have been working with colleagues at Tsinghua and Beijing universities to evaluate both energy efficiency and air pollution results. Using independent monitoring stations they were able to measure a pattern of improving fuel combustion efficiency consistent with the 11th Five-Year Plan goal to reduce energy intensity by 20%.^{xv}

Energy efficiency has provided the major portion of China’s carbon emissions control to date, and the most significant gains have come from this combination of focusing on the largest and the

smallest enterprises. As China moves forward, it will need to expand its programs to the very large number of companies in the middle. Significantly, in the 12th Five-Year Plan the 1000 Enterprises Program is being expanded to a 10,000 Enterprises Program. The essence of this program has been to provide clear guidelines, technology recommendations and benchmarks to the participating companies, so they know specifically what to do to improve their energy efficiency, and then to audit these results.^{xvi}

The 12th Five-Year Plan also encourages new approaches to energy and carbon savings. These include encouraging experiments with market-based mechanisms, such as cap and trade systems and carbon taxes. They also include new approaches to energy efficiency, such as demand-side management and encouraging Energy Service Companies (or ESCOs), a financing mechanism specifically mentioned in the plan.

As is clear from the fact that the energy intensity target is 16% and the carbon intensity target is 17%, efficiency is a critical part of the plan. However, developing non-fossil energy sources is a significant part of China's strategy, and one likely to increase in importance in the years ahead. Non-fossil sources today account for 8.3% of China's total primary energy use, and the goal under the 12th Five-Year Plan is to reach 11.4% in 2015.^{xvii} At the same time Chinese energy officials have also suggested that under the sectoral energy plan, due to come out soon, there will be a total energy cap for 2015 of 4 billion tons coal equivalent (TCE).^{xviii} This total energy cap equates to the 16% energy intensity reduction target at the target GDP growth rate of 7.5% per year. What we can see with a cap is that the goal for non-fossil fuel essentially implies a constraint for fossil fuels, as well. China also has goals to increase natural gas production and use, which further constrains oil and coal growth. Moreover, given China's rather low base of energy use in transportation and its growth rate in oil demand,^{xix} the total cap creates an even more stringent control on coal use—thus, on the most carbon intensive fuel.

Non-fossil development is an important part of China's energy security and environmental protection strategies. Not only do these options reduce greenhouse gas emissions, they are generally domestically available, are supplied from different parts of the country than is coal, and avoid many of the

urban air pollution problems that come from fossil fuels. China's non-fossil strategy includes both nuclear power and renewables.

China has very ambitious nuclear power plans. With about 10 GW of installed capacity currently, the 12th Five-Year Plan set a goal for an additional 40 GW. The goal in the current plan is now under review in light of the nuclear crisis in Japan. Approvals of new plants have been halted, and there is an active discussion of how to address safety concerns and how to add additional non-fossil capacity elsewhere if growth in nuclear power slows.^{xx} China has traditionally moved cautiously in developing nuclear power. During the 1990s it did not meet its nuclear development goals. However in recent years development has speeded up considerably. Analysts I have spoken with expect the most likely outcome of the review to be an enhancement of safety procedures, followed by continued implementation of China's nuclear goals.^{xxi} However there is also already widespread speculation that China will speed up its solar power installation and double the solar power goal in the 12th Five-Year Plan to address the gap in nuclear output.^{xxii}

China is installing renewable energy at an unprecedented rate. Traditionally hydropower has been the main source of renewable power in China, and it will continue to have considerable growth potential through 2020. But the Chinese are actively involved in developing as many different renewable sources as they can. China now not only is the world's largest producer of wind turbines, it also has the world's largest installed wind capacity, just overtaking the U.S. at the end of this last year. It leads the world with 42 GW,^{xxiii} but is about to change the parameters for what is viewed as large wind capacity—its goal for the next five years is 70 GW, which would almost triple its installed capacity. As in most countries, the solar figure is smaller. The goal for the next Five-Year Plan had been 5 GW, but as I mentioned there is now talk of raising it to 10 GW, in other words as much as China currently has in nuclear capacity.

Coal is a major challenge for China, because it is dirty to mine, dirty to burn and cumbersome to transport. Thus there is an interest in both improving the efficiency of its use and in substituting other energy sources. Nevertheless, China has a great deal of coal and is directly addressing the challenge of how to burn it more cleanly and mine and burn it more safely. Some of the mine safety issues are being

addressed by encouraging the use of coal mine methane. Methane is also less carbon-intensive than coal. China is actively pursuing a research and commercial-scale pilot program looking at carbon capture and storage, and China has a strong interest in mastering this technology.^{xxiv}

Oil presents other challenges for China, since it not only carries a significant pollution and carbon burden, but also is increasingly imported. 2009 was the first year that China imported more oil than it produced domestically, and given China's limited domestic resources the trend will be for more oil imports. China is addressing this challenge by strongly encouraging the development of electric vehicles.

Technology Innovation and the U.S. Opportunity

In overall terms, Chinese economic strategists recognize that China was late to the industrial revolution and even late to the IT revolution, but it believes it can be a leader in a green revolution. If we think specifically about electric vehicles, they see the existing carmakers as having long since mastered conventional vehicle technologies and even having a significant edge on China with hybrid vehicles. But they see a real opportunity with electric vehicles.

We've seen the same type of advances with rail transport already. China now leads the world in installing high-speed intercity railroad. China already has over 5000 km of high-speed rail. But its plans are much more ambitious. The goal in the next Five-Year Plan is for 35,000 km (almost 22,000 miles) of new high-speed rail linking every major city with a population of over 500,000. The next plan also calls for considerable investment in urban subway systems and regional commuter rail networks.

The clear medium and long-term goals for both energy efficiency upgrades and new technology development have garnered China global interest from investors. The Pew Charitable Trusts just released a new report on clean investment and China's 2010 figure was the highest in the world, \$54.4 billion or 27.5% of total G-20 investment in clean energy. This is \$20 billion more than U.S. investment, which ranked third behind China and Germany.^{xxv} International business has seen the opportunities in China. In just the last year we have seen an increasing number of alliances, involving U.S. companies working with Chinese partners on everything from solar power to algae biofuels. We at WRI are involved in the U.S.-China Clean Energy Research Center (CERC) for clean coal. We have seen business members eager to

work with Chinese partners, because they believe there is information and opportunity that can flow in both directions.^{xxvi} China is now developing many technologies of interest, but this does not mean the U.S. is behind. The fact is that the United States continues to be a hub of innovation. What makes China attractive to U.S. partners is the Chinese companies' willingness to invest and the clear policy framework under which this investment happens. Increasingly, entrepreneurs with new ideas, such as concentrated solar designs and many others^{xxvii} are looking to China to make those ideas become a reality. This is not a problem with Chinese policy – it is a challenge for other countries. With an equally supportive environment, the U.S., with its unsurpassed research resources and proven track record in new technologies, could be an unsurpassable winner.

ⁱ “China’s Energy Diplomacy and Its Geopolitical Implications,” Kent E. Calder, 2005 by the Edwin O. Reischauer Center for East Asian Studies, 2005 http://www.reischauer.jp/pdf/China_Energy_Diplomacy.pdf

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ⁱⁱⁱ “Beijing Olympics Met or Exceeded Green Goals; The U.N. Environmental Programme determines that China's Olympics really were green,” Nathaniel Gronewold, Scientific, American, February 18, 2009. <http://www.scientificamerican.com/article.cfm?id=beijing-olympics-met-or-e>

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^{ix} Letter from Su Wei, Director-General of the Department of Climate Change, National Development and Reform Commission, to Yvo de Boer, Executive Secretary of the UNFCCC, January 28, 2010.

http://unfccc.int/files/meetings/cop_15/copenhagen_accord/application/pdf/chinacphaccord_app2.pdf

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^{xi} “Assessment of China’s Energy-Saving and Emission-Reduction Accomplishments and Opportunities During the 11th Five-Year Plan,” Mark D. Levine, et al, Lawrence Berkeley National Laboratory, 2010.

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^{xiii} Transcript of speech in Canberra, March 30, 2011. International comparison data from the energy information Administration. <http://www.eia.doe.gov/oiaf/ieo/ieoecg.html>

^{xiv} “WRI Policy Brief: China, the United States, and the Climate Change Challenge.”

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