

Issue Brief

China's Actions on Clean Power

October 2012

China is experiencing incredible economic growth, resulting in immense demand for electricity. In 2006, China surpassed the United States as the largest emitter of greenhouse gas emissions, and yet in 2011, China led the world in renewable energy technology investments, spending \$52 billion.¹ The purpose of this issue brief is to analyze recent trends and policy directives in China's clean power sector. It also considers future projections about China's energy usage, as forecasted by outside sources, as well as China's stated environmental goals.

Electricity Generation in China

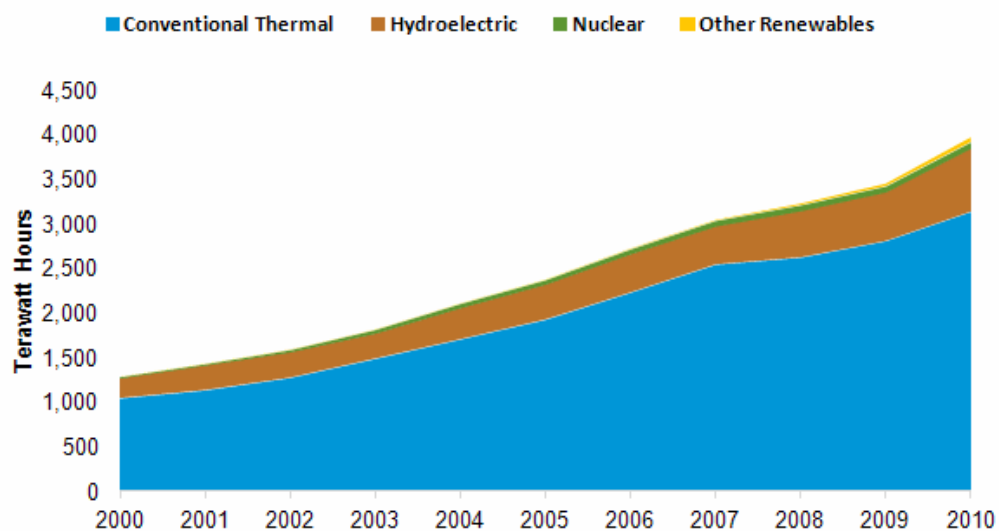
China's installed electricity capacity in 2011 was 1,073 gigawatts (GW) according to the energy analysis firm FACTS Global Energy.² This is the world's largest power capacity and represents an increase of more than nine percent since 2010 – more than double China's 2005 capacity of 519 GW. China is second only to the United States in terms of actual electricity generation. In 2010, net power generation was 3,965 terawatt-hours (TWh) in China³, while U.S. electrical generation was 4,125 TWh in 2010 and 4,106 TWh in 2011.⁴

Change in Electricity Generation over Time

China's rates of electricity generation and consumption have both increased by 15 percent since 2009 and by more than 50 percent since 2005. This is primarily due to increases in both heavy and light industry, which account for over 75 percent of China's energy use.⁵

Image credit: Energy Information Administration

China's electricity generation by fuel type, 2000-2010



Source: U.S. Energy Information Administration *International Energy Statistics*

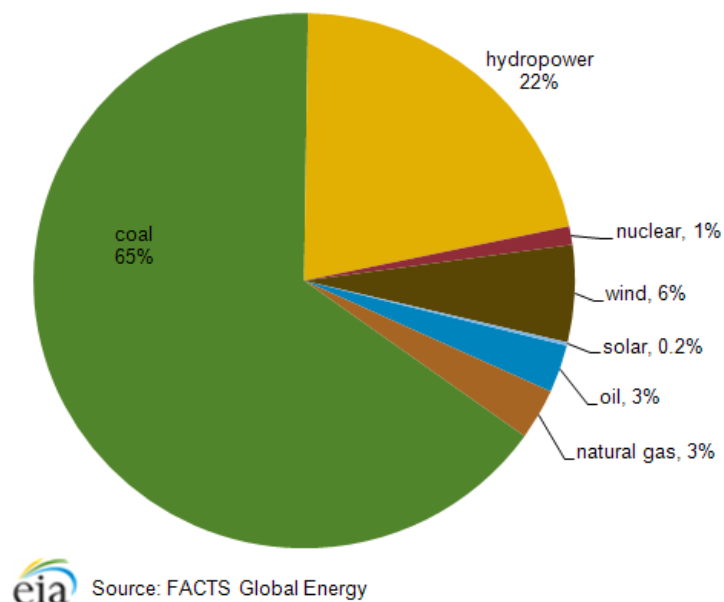
Sources of Electricity Generation

China's electricity generation needs are primarily served by thermal power generation, largely through the combustion of fossil fuels, particularly coal. In 2011, coal represented approximately 65 percent of China's installed electricity capacity. Hydropower also provides a significant share of the country's electricity generation capacity, comprising 22 percent of overall capacity in 2011. Most of the remaining capacity is provided by nuclear and other fossil fuels. A small, but growing amount is generated by renewable energy sources such as solar and wind.⁶

Image Credit: Energy Information Administration

China's installed electricity capacity by fuel, 2011

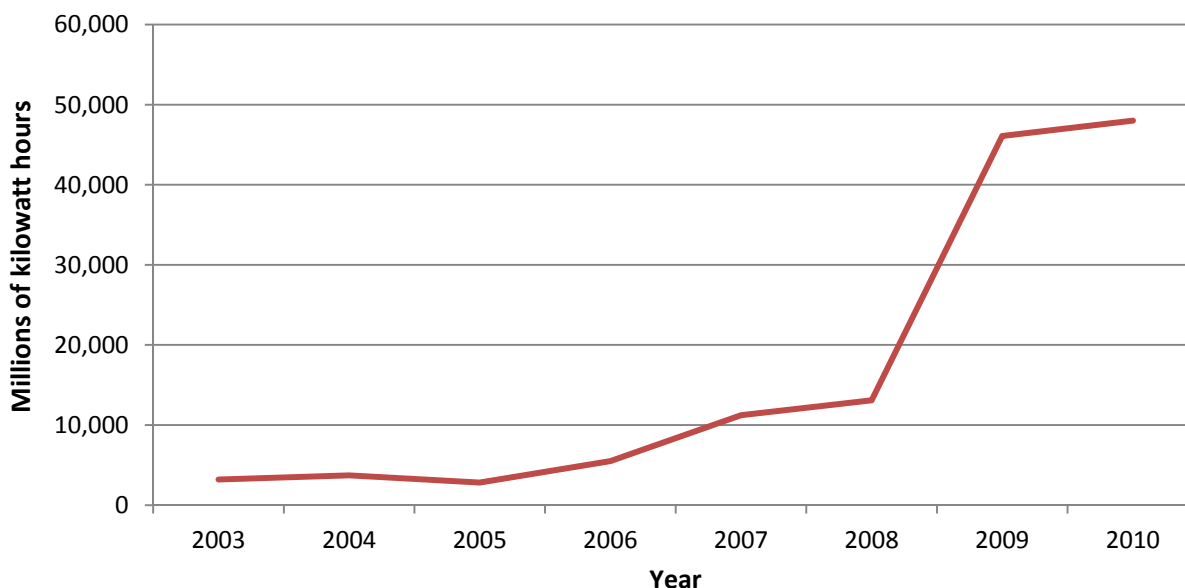
installed capacity: 1,073 gigawatts



Wind Power in China

China is the second largest producer of wind electricity in the world and generated approximately 48 TWh during 2010.⁷ That same year, the country invested more than 300 billion Yuan (\$46 billion) in 378 wind energy projects.⁸ The installed capacity of wind power in China reached more than 62 GW in 2011, the largest in the world. Capacity has approximately doubled every year since 2005. One challenge is the lack of transmission infrastructure to connect the wind power sector to the grid. This has left significant capacity underutilized. At the end of 2011, more than 17 GW, or almost 28 percent, of China's wind capacity was not connected to the grid.⁹

Wind Electricity Generation in China



Adapted from United Nations¹⁰

Solar Power in China

In 2011, approximately 2.5 GW of grid-connected and off-grid solar photovoltaic (PV) systems were installed, bringing cumulative capacity for solar PV to 3.3 GW. The majority of this solar PV capacity, approximately 2.485 GW, is grid-connected.¹¹

The use of solar power for heating water has been important in China as well. In 2008, solar hot water comprised half of China's total renewable energy use. As of 2009, China had installed 177 million square meters of solar water heating, which, with other solar initiatives, offsets more than 50 million tons of coal annually or the equivalent of about 40 coal power plants.¹²

Challenges & Future Trends

China had the highest renewable energy investment in the world during 2009 and 2010, with \$36.4 billion and \$48.9 billion respectively. Although it maintained its position in 2011 with \$52 billion, its level of investment began to decline in comparison to other developed and developing countries such as the United States and India.¹³

China expects to continue increasing its installed generation capacity over the next decade to meet growing demand. Urban areas in the eastern and southern regions of the country are likely to fuel this demand. FACTS Global Energy predicts that China's installed capacity will increase to 2,390 GW by 2030 and its electricity consumption will increase to 9,600 TWh by 2035. The additional electricity demand is predicted to be satisfied largely through increased natural gas-fired generation.¹⁴ However, as described below, the government also has plans to heavily invest in hydroelectric and other renewable generation.

China's Coal Usage

China is both the world's top producer and consumer of coal. Coal production in 2011 totaled more than 3.8 billion short tons. Coal extraction occurred in 27 Chinese provinces, but particularly in the Northern provinces of Shanxi and Inner Mongolia. Approximately half the world's coal consumption – four billion short tons of coal – is attributable to China. Coal accounted for approximately 70 percent of China's total energy consumption of 90 quadrillion British thermal units (Btu) in 2009. For reference, U.S. total energy consumption in 2011 was 97.3 quadrillion Btu, 82 percent of which was from fossil fuels.¹⁵ Despite a decline in coal consumption seen in China during the late 1990s, consumption has approximately tripled since 2000. Over half of China's coal consumption is used for electricity and heat generation. Steel and construction are among the largest industrial consumers.

Formerly a net coal exporter, China has been a net coal importer since 2009. In 2011, total coal imports were 240 million short tons, the majority of which came from regional Asian and Oceanic suppliers, such as Indonesia and Australia. There are several reasons for the increase in Chinese coal imports, including higher costs for domestic coal, transportation bottlenecks in the regional distribution of coal, environmental and safety concerns, as well as greater industry efficiencies.¹⁶

Environmental Impacts of Coal Usage

It has been estimated that 70 percent of smoke dust emissions, 90 percent of sulfur dioxide emissions, 67 percent of nitrogen oxide emissions and 70 percent of carbon dioxide emissions in China are a result of coal combustion. Industrial air pollution from coal emissions also contains mercury. The mercury is deposited into oceans and other bodies of water leading to bioaccumulation and contamination in the food chain. The impact of coal, particularly its impact on climate change, crosses China's border to affect the rest of the world. Locally, the burning of coal and the resulting air pollution leads to acid rain and is implicated in increasing the incidence of a number of respiratory diseases such as lung cancer.¹⁷

Water Usage Related to Mining and Combustion of Coal

According to the Union of Concerned Scientists, a typical 500-megawatt (MW) coal-fired power plant requires about 2.2 billion gallons of water each year, which often comes from local bodies of water. This is enough water to support a city of 250,000 people.¹⁸ Potential water shortages are highlighted in a Greenpeace report examining the impact of the 16 proposed coal power bases that China plans to build and operate as part of its current Five Year Plan for development (2011-2015). According to the report, by 2015 these coal bases will require at least 10 billion cubic meters of water annually. As a result, arid Northwestern provinces, including Inner Mongolia, Shaanxi, Shanxi, and Ningxia, in which 11 of these coal bases are situated, will see their water supply capacity severely challenged within three years.¹⁹

Status of Renewable Energy Manufacturing

Solar Energy

China's solar photovoltaic (PV) industry has grown rapidly since 2003. In 2011, eight of the world's top solar cell manufacturers were Chinese or Taiwanese companies. Chinese firms produced 13 GW of PV cells in 2011, an increase of 68.4 percent from the year before. Chinese manufacturers also supplied approximately 60 percent (21 GW) of the global PV market, a 141 percent increase from the prior year.²⁰ Industry revenue was over 300 billion Yuan (\$47 billion). A national feed-in tariff of 1.15 Yuan (\$0.18) per kilowatt-hour (kWh) of electricity generated was announced for the solar PV industry in August 2011, along with additional subsidies to help meet solar project costs and speed up deployment.²¹ The national feed-in tariff decreased to 1.00 Yuan (\$0.16) per kWh in 2012.

2012 has proven to be a difficult year for Chinese solar cell manufacturers. The European market, which has formed the backbone of China's solar photovoltaic industry, has seen reduced demand due to a decrease in national clean energy incentives in countries such as Germany and Spain. Tariffs of about 15 percent levied on most Chinese PV imports to the United States²², designed to combat product 'dumping,' have also reduced China's export opportunities. The Chinese government has made the revitalization of this industry a priority and asked individual provinces to submit plans to increase the percentage of solar power in the domestic electricity grid.²³

It is anticipated that production of solar water heaters will reach a nominal value of 180 billion Yuan (\$28.6 billion) by 2015 and 380 billion Yuan (\$60.5 billion) by 2020. Annual exports of solar water heaters are expected to reach 500 million Yuan (\$79.5 million) by 2015 and 1 billion Yuan (\$159.1 million) by 2020.²⁴

Wind Power

China's wind turbine manufacturing sector has grown rapidly to meet the domestic wind power generation goal of an additional 78 GW of capacity by 2020. It is estimated that China's wind turbine manufacturing industry created approximately 40,000 jobs annually between 2006 and 2010.²⁵ Between 2011 and 2020, it is predicted that an additional 34,000 green jobs will be created every year. About one million indirect jobs were created annually through the wind industry supply chain between 2006 and 2010, and it is projected that the supply chain will create 86,000 jobs annually from 2011 to 2020.²⁶

Climate Policy Under 12th Five Year Plan

The President of the People's Republic of China, Hu Jintao, stated during the 2009 United Nations Climate Change Summit that, "Global climate change has a profound impact on the existence and development of mankind and is a major challenge facing all countries." During the summit, he also referred to climate change as a "development issue."²⁷

The 12th Five Year Plan for development is the first to mention climate change and the topic appears at the top of the document's environmental section. The Plan calls for an increase in non-fossil fuel use to satisfy 11.4 percent of electricity demand. This figure includes nuclear energy as well as renewable sources such as solar, wind, and hydropower. It also calls for reductions in energy use and carbon emissions intensity per unit of gross domestic product (GDP) from 2010 levels by 16 percent and 17 percent, respectively. At the Copenhagen Climate Change Summit in 2009, the government signaled its intent to reduce the country's carbon emissions intensity per unit of GDP by 40-45 percent from 2005 levels by 2020.²⁸

To help accomplish the aforementioned goals, the Five Year Plan calls for the construction of new onshore, coastal and offshore wind power projects, leading to an additional installed capacity of at least 70 GW.²⁹ If the wind projects are constructed, this would represent a 225 percent increase of wind capacity over 2010 levels. The Plan also envisions new solar power projects with a total installed capacity of over five GW, a 715 percent increase over 2010 levels. These projects will focus on Tibet, Inner Mongolia, Gansu, Ningxia, Qinghai, Xinjiang, and Yunnan. Hydropower generation will be increased by 120 MW.³⁰ In addition, China announced that it may cap total energy use from all sources at 4.2 billion tons coal equivalent by 2015.³¹

The Chinese government also released three other documents related to climate change during the second half of 2011. These included the *White Paper of China's Policy and Actions in Responding to Climate Change*, the *Comprehensive Working Plan for Energy Conservation and Emission Reduction*, and the *Working Plan to Control Greenhouse Gas Emissions*. The *White Paper*³² was intended for the international community and describes China's efforts to mitigate and adapt to climate change both domestically and internationally in concert with other nations. Strategies to mitigate climate change include international cooperation and reducing emissions. Adaptation strategies include readying the country's agricultural and public health sectors. The other documents are not believed to be publicly available in English, but provide further details regarding the government's plans to combat climate change as outlined in the 12th Five Year Plan.³³

Carbon Pricing

Although not mentioned in the 12th Five Year Plan, it has been reported that the Chinese government is preparing to levy a carbon tax on major energy consumers before the end of the Plan. Although several proposals have been submitted for review in 2012, it is anticipated that the tax would begin at a rate of 10 Yuan (\$1.59) per ton of carbon dioxide emitted. This rate would gradually increase depending on a company's emissions levels; however, details are not yet available about how large the increases would be.³⁴

In addition, five cities and two provinces are preparing pilot emissions trading schemes to commence in 2013. The Chinese government ordered that the cities of Shanghai, Beijing, Shenzhen, Tianjin, and Chongqing, and provinces of Guangdong and Hubei set greenhouse gas emissions control targets and then implement emission trading schemes to achieve these targets.³⁵ The pilot projects are a crucial learning step, as China plans to implement a national emissions trading scheme by 2015.³⁶

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