

# ChinaFAQs

## The Network for Climate and Energy Information



# Getting Smarter About Electricity

## ELECTRIC POWER GENERATION AND TRANSMISSION IN CHINA

China is aiming to make one of the world's largest electrical grids bigger and more reliable – but also a little smarter. A recent move to pour billions of dollars into new high voltage electric transmission lines and “smart grid” technologies is part of a larger effort to dramatically improve the nation's use of electricity – and curb its emissions of greenhouse gases.

China is the world's second largest consumer and producer of electricity, behind the United States, with 793 gigawatts (GW) of installed generating capacity at the end of 2008.<sup>i,ii</sup> By 2020, China is expected to more than double its generating capacity to about 1,600 GW.<sup>iii</sup>

About 80% of China's electricity is generated by burning coal, a major source of greenhouse gases. The remainder comes from hydropower and other renewable sources and nuclear power.

To move electricity from generators to consumers, China uses a grid of power lines more than 40,000 miles long.<sup>iv</sup> The grid includes main trunk “transmission” lines – which typically move bulk power at high voltage – and less hefty “distribution” branches, which carry smaller loads to end users.

## PROBLEMS WITH CHINA'S ELECTRIC GRID

As in the United States, however, China's power grid hasn't kept pace with population growth and economic development, resulting in periodic blackouts and hampering efforts to exploit new renewable power sources, such as wind farms. Among the problems:

- China doesn't have enough high-voltage, long-distance transmission lines to reliably move adequate power from major coal and hydropower plants in the west and northwest to distant urban consumers in the east and south.
- The nation's six regional grids are not well connected, making it difficult to transfer power from “power rich” regions to the “power poor” (5 of China's regional grids are managed by the massive State Grid Corporation, which serves more than 1 billion people; one southern grid is managed by the South China State Grid Corporation).<sup>v</sup>

### Key Points

- China has embarked on a major effort to develop more reliable and “smarter” electric power grids by 2020.
- A smarter grid will help China curb greenhouse gas emissions by reducing electricity losses during transmission, connecting more renewable power sources (such as wind), and improving end-user efficiency.
- An emerging technology globally, smart grid technologies are an important area for U.S.-China cooperation.

- The grids are inefficient: by some estimates, China loses 8% of its electricity during transmission – meaning power plants have to burn more coal to make up for the losses.<sup>vi</sup> In contrast, industrialized countries lose an average of only 2.5% in transmission.<sup>vii</sup>

## A STRONGER & SMARTER ELECTRIC GRID

To solve such problems, China is moving to make its electric power grid bigger, stronger and smarter. To make the grid stronger, for instance, China has begun building nearly 4,000 miles of new ultra-high voltage (UHV) transmission lines that will connect regional grids and carry power over long distances. The initiative will double China’s UHV network, and could cost nearly \$90 billion between now and 2020.<sup>viii</sup>

Grid companies are also moving to replace more than 150,000 outdated and inefficient transformers, which move electricity from transmission to distribution lines. Current transformers can cause power waste of up to 3%; new “amorphous metal distribution transformers” are expected to reduce those losses by about 70%.<sup>ix</sup>

These improvements are expected to help pave the way to a smarter grid equipped with computerized sensors, meters and other devices that will improve reliability and efficiency. The Chinese government has

committed \$30 billion to develop smart grids by 2020 and, in May 2009, State Grid Corporation announced a three-step plan for deploying smart technologies.<sup>x</sup> Initially, it will focus on upgrading transmission, not distribution, lines.<sup>xi</sup> The plan calls for:

- Setting technical and operational standards and rolling out a pilot project by 2010.
- Deploying new high-voltage lines and initial smart grid control technologies by 2015.
- Upgrading grids by installing state-of-the-art technologies by 2020.<sup>xii</sup>

Overall, some analysts estimate the effort could ultimately reduce power consumption by up to 10%, and cut demand during peak hours by up to 50%.<sup>xiii</sup>

Those savings could come thanks to advances in information technologies that, when married to an array of electrical systems, can give grid operators insight into how power is being generated and used – or wasted. Sensors and computerized control centers, for instance, can allow grid operators to switch off more-polluting power plants when they aren’t needed, or reroute power when blackouts threaten.

In general, smart grid technologies can make it easier to:

- **Connect “intermittent” sources of power, such as wind and solar, to the grid.** Although windpower is

booming in China, virtually all major producers report that they have had at least some trouble connecting their turbines to the grid due to technical problems or lack of know-how.<sup>xiv</sup>

- **Utilize small-scale power generators.** By enabling a smooth two-way flow of electricity, smart grids could send power generated by household solar panels, wind turbines or hydropower projects into the grid.
- **Reduce transmission losses.** Less lost power will help curb greenhouse emissions.
- **Deploy electric vehicles.** Smarter grids could open the way to the widespread creation of charging stations for electric cars and scooters.
- **Help consumers save energy, and money.** “Smart meters” can give consumers real-time information on consumption and prices, helping them decide when they want to use power.

To move forward, Chinese officials and companies will need to develop and adopt technical standards that will guide those building smart grid components, from software and meters to sensors and charging devices. China could develop its own standards, or join international standards-setting efforts (which could enable it to sell its products and expertise overseas).

Officials will also have to decide how much China will collaborate with other governments and foreign companies. Recently, the U.S. and China have signed Memoranda of Cooperation (MOC) establishing joint clean energy and smart grid research centers. On November 17th, 2009, Presidents Obama and Hu announced a U.S.-China Renewable Energy Partnership including an Advanced Grid Working Group that would seek to modernize the energy grid in both countries in order to build capacity for scaled-up renewable energy deployment. Other government agencies and private sector companies have also begun cooperation on S&T regarding clean energy deployment and grid technology.

China's experience will be watched closely, if only because it will require an unprecedented level of effort to create a new backbone for a cleaner, more efficient, energy system.

This fact sheet is a product of ChinaFAQs, a joint project of the World Resources Institute and experts from leading American universities, think tanks and government laboratories. Find out more about the ChinaFAQs Project at: <http://www.ChinaFAQs.org/>.

## Notes

<sup>i</sup> Generating capacity is the total amount of power that can be generated at one time; output and end-user consumption is smaller. The 2008-09 economic crisis, for instance, has reduced output at many of China's power plants.

<sup>ii</sup> People's Daily Online. China's power output up five percent in 2008. February 5, 2009. See: <http://english.people.com.cn/90001/90776/6586677.html>.

<sup>iii</sup> SmartGrids China 2009 Conference. Introduction. See: <http://www.smartgridschina.com/en/dy.asp>.

<sup>iv</sup> Zhang, Chi & Thomas C. Heller. Reform of the Chinese Electric Power Market: Economics and Institutions. Working Paper #3 (Revised). January 2004. Stanford University Program on Energy and Sustainable Development. See: <http://pesd.stanford.edu>.

<sup>v</sup> Li, Jerry. From Strong to Smart: the Chinese Smart Grid and its relation with the Globe. Asia Energy Platform News. Article 00018602, September 2009.

<sup>vi</sup> Liu, Kexin. Wising Up: Smart Grid as New Opening for U.S. China Energy Cooperation. The Wilson Center, Washington DC, 2009. See: [http://www.wilsoncenter.org/index.cfm?topic\\_id=1421&fuseaction=topics.documents&doc\\_id=548785&group\\_id=233293](http://www.wilsoncenter.org/index.cfm?topic_id=1421&fuseaction=topics.documents&doc_id=548785&group_id=233293).

<sup>vii</sup> Zhang, A. and Zhao, X. "Efficiency Improvement and Energy Conservation in China's Power Industry." HM Treasury, Accessed at: [http://www.hm-treasury.gov.uk/d/final\\_draft\\_china\\_mitigation\\_power\\_generation\\_sector.pdf](http://www.hm-treasury.gov.uk/d/final_draft_china_mitigation_power_generation_sector.pdf).

<sup>viii</sup> Li, Jerry. 2009. Ibid.

<sup>ix</sup> Li, Jerry. 2009. Ibid.

<sup>x</sup> Liu, Kexin. Wising Up: Smart Grid as New Opening for U.S. China Energy Cooperation.

<sup>xi</sup> Stone, Andy. China Sprouts Green Energy Opportunities. Forbes.com, July 16, 2009. See: <http://www.forbes.com/2009/07/16/china-green-energy-business-energy-china.html>.

<sup>xii</sup> Li, Jerry. 2009. Ibid.

<sup>xiii</sup> Joint US China Co-operation on Clean Energy (JUCCE). Road towards Smart Grid – When to Plan? – Now or Future? December 18, 2007. See: [http://www.jucce.com/documents/Consumer%20Awareness/Electrical%20Grid/SmartGridFutureGrid\\_JUCCE.pdf](http://www.jucce.com/documents/Consumer%20Awareness/Electrical%20Grid/SmartGridFutureGrid_JUCCE.pdf).

<sup>xiv</sup> Liu, Kexin. Wising Up: Smart Grid as New Opening for U.S. China Energy Cooperation.

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