Waigaoqiao: World Class in Clean Coal

As China's economy grows sharply, so too does its energy consumption. While it is impossible not to rely on its main source of energy – coal – supercritical and ultra-supercritical power plants all over the country, including the two in Waigaoqiao profiled here, are global leaders in meeting the challenge of making coal clean.

By James Klegman

In the past three decades, China has experienced an unparalleled economic upswing. China's GDP has increased dramatically in the past 30 years with an average annual GDP growth rate above 10 percent. This wealth increase has been driven by a booming economy that is powered largely by coal. In 2009, the black fuel generated two-thirds of China's electricity, and for good reason: Coal is the country's most abundant fuel. So it will remain in the nation's future energy mix.
As the economy keeps growing at record speed, so will demand for power. In the past five years, electric generation grew on average by over 10 percent. Coal plants are responsible for almost one-half of China's carbon dioxide emissions and nearly three-fourths of its sulfur dioxide. China's economic success is impacting its environment. In response, China is greening its energy. By 2020, renewables may reach 16 percent in the total energy mix of China. Above all, wind and solar photovoltaic will see major boosts, while the proportion of hydro and nuclear power will also grow. It is a clear target of the Chinese government that it will reduce the intensity of its emissions per unit of gross domestic product by 40–45 percent from 2005 levels by 2020. Still, there is no getting around coal: Coal will continue to be the country's energy backbone, and to satisfy the environment, it must become cleaner.

Efficiency Expert

One way to reduce coal-plant pollution is gasification (see sidebar on p. 29). Another approach consists of making a plant more efficient. The global average efficiency for coal-powered electricity is roughly 28 percent. With high-end equipment from Siemens Energy, that can rise significantly above 45 percent.
New combustion systems for pulverized coal – utilizing supercritical and ultra-supercritical technology (SC/USC)

Normally seen as a "dirty" fuel, coal can be made to burn cleaner.

Photo: Getty Images

The Waigaoqiao III Power Plant: a model of efficiency and environmental performance.

– operate at ever higher temperatures and pressures; so they achieve higher efficiencies than conventional units. An outstanding example of state-of-the-art, ultra-supercritical technology is the Waigaoqiao III Power Plant in Shanghai. In 2005, Siemens' Chinese partner Shanghai Electric Corporation won the contract for the turbine-generator set, which was built using Siemens technology. Siemens did the engineering and supplied key components of the turbines and the complete generator for Unit 1. Waigaoqiao III Power Generation Company has implemented many innovative projects, and developed a series of special technologies of energy saving and emission reduction. Thus it greatly promoted the efficiency and enhanced the overall performance of the units. Since start-up in 2008, Waigaoqiao III has, compared to an average Chinese coal-fired power plant, saved 900,000 metric tons of raw coal and reduced CO_2 output by 1.9 million metric tons annually. The plant reaches an efficiency of up to 46 percent, making it the most efficient coal plant in the world. In 2009, Siemens Energy and the Waigaoqiao III Power Generation Company Shenergy won the Asia Power Gold Award for Best Environmental Performance Power Plant of the Year. Its older relative – Waigaoqiao II, in operation since 2004 – was the first 1,000-MW-class supercritical/ultra-supercritical power plant in China. Its units reach 42 percent efficiency, saving 520,000 tons of raw coal and about 1.1 million tons of CO_2 per year. Thanks to its success, construction of such units in China has boomed; Siemens and its partner SEC hold a 54 percent share of this market.

Things Can Only Get Better

"China is making significant progress toward achieving environmentally compatible and highly efficient power generation by adopting the most cutting-edge power-generating technologies in the world, such as ultra-supercritical technology," says Andreas Matthe, Executive Vice President of Siemens China and President of Siemens Energy Sector North East Asia. "Together with our partner Shanghai Electric, Siemens is fully committed to delivering the most modern and clean power generation technologies to China." The Waigaoqiao power plants' combined capacities are 5 GW, one-third of Shanghai's total. They are making a significant contribution to ecological sustainability of power generation in the country. As the visit of Chinese Prime Minister Wen Jiabao to Waigaoqiao II in 2004 illustrates, Chinese authorities are taking the development of clean coal energy very seriously. "Coal sustains 75 percent of China's power generation," says Feng Weizhong, General Manager of the Waigaoqiao III Power Plant. "So we must find ways to realize highly efficient and environmentally friendly coal-based power generation. I am very proud that Waigaoqiao III has set the benchmark for efficiency and environmental performance for coal-fired power plants worldwide."

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Photos: Siemens

Further Information

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Dash for Gas

Despite its reputation as a "dirty" fuel, coal will continue to play an important role in world energy supply. One solution to coal's emissions of greenhouse gases is to make power plants more efficient (see main story). Another way to cut emissions is to turn dirty coal into clean gas. By gasification, coal is converted into so-called synthesis gas. One application is in integrated gasification combined cycle (IGCC) power plants with CCS technology, where CO_2 can be separated from the synthesis gas before it is combusted. The sequestered CO_2 can then be geologically stored – i.e. injected into empty gas or oil fields – where it no longer is a burden to the climate. With CO_2 capture rates up to 90 percent, IGCC plant emissions can be significantly lower than that of a natural gas-fueled plant.

"Achieving dramatic reductions in emissions is vital to combating climate change," says Michael Suess, CEO of the Fossil Power Generation Division of Siemens Energy. "Siemens is glad to contribute to this." Gasification is part of the Siemens environmental portfolio, the world's largest eco-friendly technology business. Last year the portfolio generated revenues of nearly 23 billion euros, about 30 percent of Siemens' corporate total.

The Waigaoqiao III Power Plant: a great benchmark for utilizing coal in a more efficient and cleaner way.