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Amid U.S.-China Energy Tension, "Clean Coal" Spurs Teamwork

China's largest coal-mining firm, Shenhua Group, is implementing a national pilot project in carbon capture and storage technology at this facility in Ordos, Inner Mongolia, the largest in the world for changing coal into liquid fuels such as diesel. Experts say the best hope for "clean coal" technology is U.S.-China cooperation.

Photograph by Wu Hong, European Pressphoto Agency

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When Chinese Vice President Xi Jinping visits the White House on Valentine's Day, he and President Barack Obama aren't expected to exchange words of love over energy.

The world's two largest energy consumers have clashed over their choices for fueling their economies, with solar industry subsidies and China's oil imports from Iran particular sore points. But with Xi's stop in Washington an important one on his path to take over China's presidency later this year, and the two leaders hoping to highlight cooperation, energy offers an opportunity for the two nations to emphasize their collaboration: The deals they've struck on projects to clean up coal.

In China, coal is king. U.S. energy companies, from small start-ups to one of the nation's largest utilities, Duke Energy, have concluded that they must work with China to keep a hand in technology to reduce the greenhouse gas emissions of coal-fired electricity: carbon capture and storage (CCS).

(Related: Out of Thin Air: Hopes for Capturing Carbon Dioxide)

Although the United States has poured billions of dollars into CCS research and development over 25 years, progress has been halting, and several high-profile projects have been abandoned due to high costs. The building of coal power plants has been so slowed by environmental concerns and the rise of natural gas as an alternative that the United States has not proven to be a fertile ground for accelerating CCS.

China, on the other hand, has been building one new coal-fired plant a week on average to stoke its growing economy.

Among those who have been watching CCS closely, there's a growing belief that the best path forward for CCS is a partnership between the two nations that lead the world in both carbon emissions and coal reserves.

China's CCS Opportunity

Electric power CCS would combine a couple of industrial processes that have been used for decades, incorporating them to clean up the emissions of coal power plants. Factories have long captured CO2 for industrial use, and the oil industry injects CO2 underground to enhance recovery of petroleum. Indeed, the world's first demonstration CCS projects, ramped up over the past decade, are oil industry facilities in the North Sea and the Algerian desert.

But the Holy Grail for controlling greenhouse gas emissions is to make CCS work at power plants, because fast-developing nations rely on cheap, abundant, and carbon-intensive coal to fuel their growing needs for electricity.

The coal power capacity that China has added in the past five years exceeds that of all the U.S. coal power plants combined. By 2015, Chinese capacity is expected to triple that of the United States.

(Related Interactive: The Global Electricity Mix)

Both China and the United States sit atop enormous stores of coal, together amounting to about a third of the world's reserves. But lacking the oil and natural gas resources of the United States, China leans far more heavily on coal for energy security. Coal provides 80 percent of China's electricity, compared to 50 percent and falling in the United States.

(Related: Seeking a Pacific Northwest Gateway for U.S. Coal)

China took the lead from the United States as the world's top carbon emitter in recent years, but China deems clean technology a national priority, spelled out in its 12th Five-Year Plan (2011-2015). Big state-owned enterprises, such as the electric generation giant Huaneng Group and Shenhua Group, China's largest coal-mining firm, are investing heavily in technologies, especially coal gasification. Capturing the CO2 from gasified coal has advantages over technologies that aim to capture CO2 after combustion from the power plant flue, where it is mixed with other gases and contaminants. China has been working on both pre-combustion and post-combustion carbon capture, but it's been expensive to develop.

China's fast-growing coal industry, however, has been investing the funds. "Projects of $1 to $2 billion apiece are just noise there," says Armond Cohen, founder of the Clean Air Task Force (CATF), a Boston-based nonprofit that brokers partnerships between U.S. and Chinese clean tech companies. "In the U.S., we could live off the fumes and table scraps" from China's megaprojects, he said.

The United States also brings advantages to the table, including a long history of research. While Chinese companies so far have focused on carbon capture, rather than storage, the United States has developed technology for both. Because carbon capture constitutes three-fourths of the cost of CCS, any cost reductions China can generate would help make the technology more feasible, says Ming Sung, CATF's chief representative for Asia and the Pacific.

(Related: Seeking a Safer Future for Electricity's Coal Ash Waste)

But carbon capture alone won't protect the atmosphere, unless sequestration of the carbon dioxide is part of the solution. That's where cooperation with the United States comes in.

"We will never get to substantial CO2 reductions until the U.S. and China work together," says S. Julio Friedmann, carbon management program leader at the U.S. Department of Energy's Lawrence Livermore National Laboratory in California. When it comes to energy, the U.S.-China relationship has been far more rivalry than collaboration, most notably in the trade dispute over China's subsidies to its burgeoning solar industry. But there may be an opening for the two energy giants to work together on clean coal. Friedmann is now conducting a study of whether the low costs reported at a Huaneng's post-combustion carbon capture plant outside Shanghai could be applied to Duke Energy's largest power plant, its Gibson facility in Owensville, Indiana.

(Related: A Quest to Clean Up Canada's Oil Sands Carbon)

China is just beginning to sell its technology abroad. Vice President Xi's Washington visit could highlight a number of projects that are in the works.

In Good Spring, Pennsylvania, a project spearheaded by EmberClear Corporation, Huaneng's North American licensor, would convert coal to gasoline. A Huaneng gasifier would turn the coal into synthetic gas that would then be converted into gasoline using technology developed by Exxon Mobil. Calgary-based EmberClear also plans to use a Huaneng gasifier at a separate integrated gasification combined cycle (IGCC) plant in Good Spring to gasify coal and use the resulting gases to produce electricity. EmberClear Chief Executive Albert Lin says more deals with U.S. customers are expected later this year. Meanwhile, New Hampshire-based PowerSpan recently teamed up with Huaneng to win a contract to help develop a post-combustion capture project in Norway.

Lin asserts that the Huaneng gasifier is an improvement over U.S. models, using less water than some, gasifying inputs twice, and separating out purer CO2 by using pure oxygen and nitrogen to turn coal into gas. But U.S. competitors say China's technology advantage is not so much its manufactured equipment as its ability to acquire know-how quickly by operating multiple projects in a booming industry.

An Efficient Machine

This year, both Huaneng and Duke Energy are expected to launch separate large-scale IGCC projects. The two companies, which signed a 2009 agreement to cooperate on clean technologies, are expected to announce an expansion of their relationship during Xi's visit.

At GreenGen, a 250-megawatt IGCC plant outside Tianjin, Huaneng will provide the gasifier. At Edwardsport, Indiana, Duke expects this year to complete a 618-megawatt IGCC plant using General Electric technology. The Duke plant's cost estimate has been increased several times, and now stands at $3 billion. It will not be a truly integrated CCS project, but a "capture-ready" facility.

"What's at issue is how to operate these plants," said David Mohler, Duke's chief technology officer. In other words: How can the many systems involved in CCS be integrated to function in a real-world operating environment?

(Related: Carbon Recycling: Mining the Air for Fuel)

Jason Crew, general manager for GE Gasification, says few companies have deep experience integrating a chemical plant with a power-generation plant. "Having a gasifier that works is one level of complexity," he says. "Being able to integrate that with a gas and steam turbine [and] a cleanup system, and have it operate reliably is a completely different order of complexity."

While Crew believes that Duke and GE have the experience to bring Edwardsport online with at least 80 percent reliability during its first year, he says the Chinese will not be far behind because of the sheer number of engineers and the deep pockets they can apply to the challenge. "The Chinese engineering and science machine is in many ways more efficient than others globally," says Crew. "They can digest, experiment, and improve quite rapidly with a lot of patience and a big balance sheet."

(Related: Lighting a Fire Under Clean Coal)

The question is not if, but when, China starts giving Western competitors a run for their money, says Crew. "It's almost a certainty" that Chinese companies will become big competitors to GE as solutions providers, he says. That's why General Electric chose to locate the headquarters for its coal gasification unit in Shanghai. "Part of why I sit in China is the competitors are going to come from here," he says.

This story is part of a special series that explores energy issues. For more, visit The Great Energy Challenge.