# Taking Steps to Capture Carbon

## Key Points

- "Carbon capture and storage" (CCS) is one widely-discussed approach to curbing global greenhouse gas emissions. The idea is to capture the carbon dioxide (CO2) produced by power, chemical and steel facilities and then store it underground.
- Both the U.S. and China are interested in CCS because they rely heavily on burning coal to produce electricity. Coal is the source of some 80% of China's emissions of carbon dioxide.
- Collaboration between the U.S. and China on CCS could help speed technology development.
- Cooperation is key to driving down costs for U.S. utilities and taxpayers, and enabling the U.S. to continue to benefit from its vast coal reserves, a source of energy independence and employment.

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## CARBON CAPTURE AND STORAGE (CCS) TECHNOLOGY IN CHINA

China is beginning to look underground for a solution to its climate challenge. As part of a larger effort to curb greenhouse gas emissions, researchers are studying ways to capture carbon dioxide – the major warming gas -- before it leaves the smokestack and pump it underground.

This technology—called "carbon capture and storage" (CCS)—is also getting close scrutiny in the United States and elsewhere. Better international collaboration with China could speed up wide-scale deployment and reduce costs, according to several recent studies.

China and the United States are both interested in CCS because they rely heavily on coal to produce electricity, Kelly Sims Gallagher, a scholar at Tufts University and the Harvard Kennedy School, notes in a 2009 analysis published by the Brookings Institution. The U.S. has an estimated 29% of the world's coal reserves and China 14%. To address climate change, however, both nations will need to dramatically cut the carbon emissions that come from burning coal. Some 80% of China's current emissions, for instance, are linked to coal.[i]

CCS could help curb those emissions, but it is a relatively complex technology. In general, CCS involves three steps: capturing, refining and compressing the gas from a large industrial facility, such as a coal-fired power plant or steel mill; transporting it to a storage site, usually via a pipeline; and then injecting it deep underground into a rock formation engineered to keep CO2 from leaking into the atmosphere.

Some CCS technologies already exist. The oil industry, for instance, already captures and pumps C02 into oil fields to enhance production. And a growing number of coal-fired power plants – including some of the newest plants in China – utilize high-efficiency processes that convert coal into a gas that is burned to produce electricity. These "gasification" technologies both make it easier and cheaper to separate and capture CO2, and help make up for the extra energy CCS requires. Although there are currently no "industrial-scale CCS projects anywhere in the world" that integrate all of the needed technologies, China could help change that, Gallagher and Hengwei Liu of Tufts University conclude in a recent study in the journal *Energy Policy*.[ii]

U.S.-China collaboration on CCS could also help drive down CCS costs. Already, some CCS applications are "relatively economically attractive," the authors note. Studies in the U.S. have found that the first new power plants built to use CCS could do so at a cost of $120 to $180 per ton of avoided carbon dioxide, but costs could quickly drop to $35 to $70 per ton in subsequent plants due to economies of scale. Costs in China could be even lower, due to an array of technical and market factors. And CCS becomes even more cost-effective if the recovered carbon dioxide is used to enhance oil drilling operations.[iii] As costs fall, both countries can benefit.

Historically, the Chinese government was "tentative" about CCS, Gallagher notes, in part because of its costs, and also because some worried that research, development, and demonstration on CCS would be tantamount to accepting a binding target in the international climate change negotiations. Adding to cost concerns, "CCS is perhaps the only energy technology with no 'co-benefits'… such as improvements in human health, reduced acid rain and improved energy efficiency: in other words, there is no reason to invest in the technology unless the goal is to reduce CO2 emissions."[iv] Now, however, China is investing in the advanced coal technologies, such as gasification and poly-generation, that can make power plants more "CCS ready." And its rapidly growing energy industry will provide numerous opportunities to demonstrate and deploy these technologies.

Recently, Chinese energy companies have become engaged in a range of CCS-related pilot projects, some involving the U.S. Department of Energy (DOE) and U.S. companies and universities. West Virginia University and DOE's Lawrence Livermore National Laboratory, for instance, are involved in efforts to assess the feasibility of implementing CCS in a massive new coal-to-liquids plant in Ordos, Inner Mongolia. Europe and Australia are also engaged in joint efforts. Overall, Gallagher reports that China now has at least a half-dozen "serious projects that are sufficiently well developed that they could serve as the basis for a large-scale integrated demonstration project."

## COOPERATION AND SCALING UP

Launching such projects in China will require international collaboration and investment, Gallagher notes, and the U.S. – which already has extensive experience with several key technologies and in injecting CO2 – would be one natural partner. Collaboration on CCS is "in both countries' interests… Cooperation enables both China and the United States to share costs, share risk, increase the speed of unit cost reductions, and accelerate learning about and public acceptance of these technologies."[v] In addition, it could provide companies from both countries opportunities to engage with the market for CCS-related technologies in the other country. The U.S. and China bring complementary strengths to the problem. The U.S. is a leading innovator in CCS technology; China has a rapidly growing power sector in which to test and fine-tune promising approaches. In the future, China will be a vast market for CCS companies with the most successful technologies.

More importantly, Gallagher says China needs to start planning for CCS now if it wants to benefit from the technology in the future. That means investing in the research needed to develop the technologies, demonstrating these technologies to make sure they work safely, and making sure power, steel and chemical facilities built today could add CCS later. "Without 'capture readiness,' every new plant built would lock in high CO2 emissions for a generation to come," Gallagher and Liu note in the Energy Policy study, which also outlines one possible roadmap for realizing CCS in China. By 2020, for instance, the scholars believe China could establish pilot projects at power, chemical and steel plants that enable researchers to better assess costs, safety and feasibility, and then move the most promising approaches to early commercial deployment. Between 2020 and 2030, China could move to widely commercialize the most successful, cost-effective technologies and develop a CCS systems industry. After 2030, as CCS costs drop, China could require all large emitters to install CCS equipment, hastening the transition to a lower-carbon economy.[vi]

Executing such a plan, they note, will require "strong political will," adequate funding and clear regulatory incentives to reduce emissions. But the bottom line, they say, is that the benefits of investing in CCS are great for China, and potentially for partners like the United States too. "There is not time to waste," they write, "in getting a major research, development, and demonstration program going."[vii]

*This fact sheet is based on:*

- *Gallagher, Kelly Sims. Key Opportunities for U.S.-China Cooperation on Coal and CCS. The John L. Thornton China Center at Brookings, December 2009.*
- *Liu, Hengwei and Kelly Sims Gallagher. Catalyzing strategic transformation to a low carbon economy: A CCS roadmap for China. Energy Policy 38, pp. 59-74. 2010.*

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

[i] Liu, Hengwei and Kelly Sims Gallagher. Catalyzing strategic transformation to a low carbon economy: A CCS roadmap for China. Energy Policy 38, pp. 59-74. 2010. Page 60.

[ii] Liu and Gallagher, 2010, p. 60.

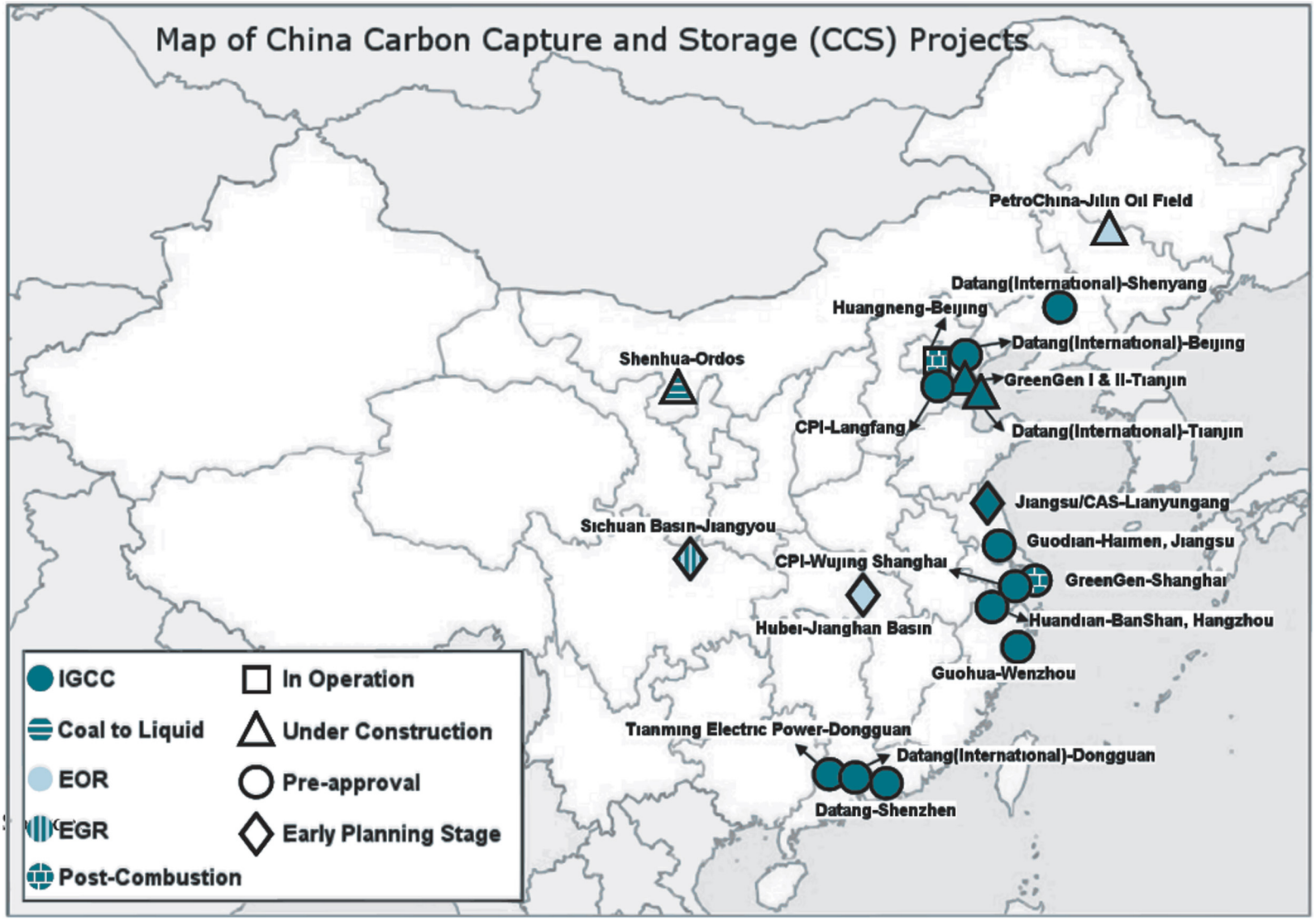
[iii] Liu and Gallagher, 2010, p. 61.

[iv] Gallagher, 2009, p. 6.

[v] Gallagher, 2009, p. 10.

[vi] Liu and Gallagher, 2010, pages 71-73.

[vii] Liu and Gallagher, 2010, p. 72.




*Source: Seligsohn, Deborah, Yue Liu, Sarah Forbes, Zhang Dongjie, Logan West. 2010. CCS in China: Toward an Environmental, Health, and Safety Regulatory Framework. Washington, DC: World Resources Institute. Available online: http://www.wri.org/publication/ccs-in-china.*



v5.5 Published October 20, 2010