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# Gasification of coal and biomass: a net carbon-negative power source for environment-friendly electricity generation in China

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## Abstract

Realizing the goal of the Paris Agreement to limit global warming to 2 °C by the end of this century will require most likely deployment of carbon-negative technologies. It is particularly important that China, as the world's top carbon emitter, avoids being locked into carbon-intensive coal-fired power generation technologies and undertakes a smooth transition from high- to negative- carbon electricity production. We focus here on deploying a combination of coal and biomass energy to produce electricity in China using an integrated gasification combined cycle system with carbon capture and storage (CBECCS). Such a system will also reduce air pollutant emissions, thus contributing to China's near-term goal of improving air quality. We evaluate the bus-bar electricity-generation prices for CBECCS with mixing ratios of crop residues varying from 0% to 100%, as well as associated costs for carbon mitigation and co-benefits for air quality. We find that CBECCS systems employing a crop residue ratio of 35% could produce electricity with net-zero life-cycle emissions of greenhouse gases (GHGs), with a levelized cost of electricity (LCOE) of no more than 9.2 US cents per kWh. A carbon price of approximately $52.0/ton would make CBECCS cost-competitive with pulverized coal power plants. Therefore, our results provide critical insights for designing CBECCS strategy in China to harness near-term air quality co-benefits while laying the foundation for achieving negative carbon emissions in the long run.

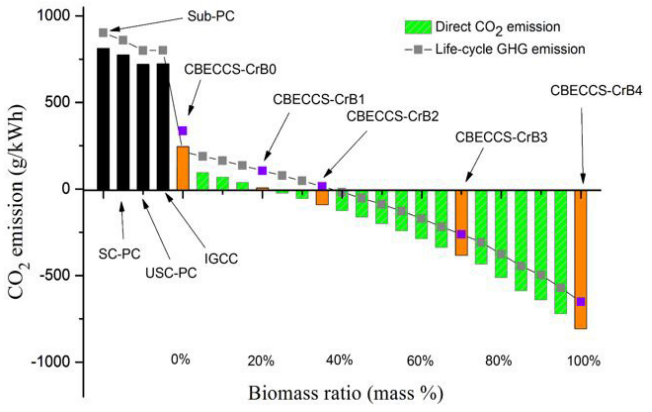


Figure 1 Performance of CBECCS systems with mass mixing ratios of biomass varying from 0 to 100%

**Recent Publications**

1. **Xi Lu***, Liang Cao, Haikun Wang, Wei Peng, Jia Xing, Shuxiao Wang, Siyi Cai, Bo Shen, Qing Yang, Chris P. Nielsen, Michael B. McElroy*, Gasification of coal and biomass: a net carbon-negative power source for environment-friendly electricity generation in China, ***PNAS***, 2019, 116 (17), 8206-8213.

2. Haikun Wang*, Yanxu Zhang, Hongyan Zhao, **Xi Lu***, Yanxia Zhang, Weimo Zhu, Chris P. Nielsen, Xin Li, Qiang Zhang, Jun Bi*, Michael B. McElroy , Trade-driven relocation of air pollution and health impacts in China, ***Nature communications***, 2017, 8(1), 738.

3. **Xi Lu***, Michael B. McElroy*, Wei Peng, Shiyang Liu, Chris P. Nielsen, Haikun Wang, Challenges faced by China compared with the US in developing wind power, ***Nature Energy***, 2016, 6(1). (**front cover**)

4. Michael B. McElroy*, **Xi Lu (**joint first author**),** Chris P. Nielsen, Yuxuan Wang , Potential for Wind Generated Electricity in China, ***Science***, 2009, 325 (5946), 1378-1380. (**front cover**)

5. Xi Lu, Michael B. McElroy* and Juha Kiviluoma, Global Potential for Wind-Generated Electricity, ***PNAS***, 2009, 106:10933-1093

As indicated by The United Nations Framework Convention on Climate Change, the Paris Agreement's primary objective is to fortify the worldwide reaction to the danger of environmental change by keeping the worldwide temperature rise this century underneath 2 degrees Celsius above pre-modern levels. Numerous situations have been explored for meeting this objective, however a typical component over every one of them is that huge scope use of carbon-negative innovations, particularly bioenergy with carbon catch and capacity, will be vital.

"This is actually the basic accord in the field," said Wei Peng, right hand teacher in natural building and global issues at Penn State. "Up to this point, there have not been that many negative-outflows advancements that are being conveyed on a business scale."

Peng and her associates accept that an incorporated gasification cycle framework joined with carbon catch and capacity (CCS) would be one of the most reasonable net carbon-negative innovations in specific areas around the globe, particularly in China, the world's top carbon producer. The technique consumes coal and harvest buildup biomass together utilizing a gasifier (coal and biomass co-burning with CCS, or CBECCS), which makes a spotless stream of carbon dioxide that would then be able to be caught and put away in profound topographical arrangements.

So as to additionally examine this innovation, the specialists assessed the cost exhibition, carbon relief potential and air-quality advantages of organization of CBECCS frameworks utilizing crop deposits in China. In light of reproductions of the CBECCS frameworks utilizing Aspen Plus, vitality stream and carbon impressions were assessed. The group at that point surveyed the cost intensity contrasted and coal-fueled plants under different

carbon costs. What's more, they estimated the air-quality advantages of sending CBECCS frameworks in territory China dependent on the anticipated size of future plant increments, which uses about 24.3 percent of accessible yield deposi