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## CUTTING CARBON EMISSIONS FROM COAL-FIRED POWER PLANTS

*Xiao-Yu Wu, Lili Cai, Xuefeng Zhu, Ahmed Ghoniem, and Weishen Yang*

More than a third of the world's electricity comes from coal-fired generating plants — and so does a hefty chunk of carbon emissions. WISE researcher Xiao-Yu Wu and his colleagues set out to make the process greener.

In the next-generation coal-fired plants, integrated gasification combined cycle (IGCC) is used to increase power output. High pressure and temperature is used to convert coal into syngas — a mix of carbon and hydrogen — that is burned to drive turbines. The more carbon you can remove from the syngas, the more cleanly it burns. But current pre-combustion carbon-capture technologies significantly reduce the plant's efficiency.

Wu and his colleagues took a different approach. Rather than scrub the syngas, they broke it down and created clean-burning hydrogen from steam instead.

Their secret is a specialized membrane that lets only certain species, namely oxygen through. The researchers configured the system so that syngas is directed at one side of the membrane. On the other side, they directed steam generated using waste heat from the gasification process.

When the steam encounters electrons and oxygen vacancies on the membrane, it splits into hydrogen and oxygen ions. The hydrogen remains behind, where it can be burned to drive turbines. Meanwhile the oxygen ions cross the membrane. When they reach the other side, they oxidize the syngas into water and CO<sub>2</sub>, which can be captured. That reaction also generates electrons and oxygen vacancies, which pass back across the membrane to continue the cycle.

By integrating syngas oxidation, hydrogen production and carbon capture in a single unit, the system creates more efficiency than other pre-combustion methods of carbon capture (3.6% points higher in the base cases). Experimental results show it can withstand the harsh conditions of coal-fired power plants. And to top it off, the system costs little to produce.



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Researchers: Xiao-Yu Wu, Lili Cai, Xuefeng Zhu, Ahmed Ghoniem, Weishen Yang

Partners: Chinese Academy of Sciences, Dalian Institute of Chemical Physics, National Natural Science Foundation of China, Liaoning Revitalization Talents Program, Exelon Corporation, Massachusetts Institute of Technology

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