Potential Air Pollution, Health and Climate Implications of China's Energy Future

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Facing 1.6 million premature mortalities due to fine particulate air pollution in China in 2013, the country declared a "war against air pollution." However, when it comes to how to fight that war, "They have some choices," said Princeton professor Denise Mauzerall, who spoke in Monday's energy policy seminar. Some options, such as "end of pipe" pollution controls, could reduce particulate pollution and its health impacts without reducing carbon emissions. Other approaches, such as replacing coal with natural gas or renewable electricity, can offer simultaneous health and climate "co-benefits."

Mauzerall and her colleagues, she explained, use an integrated assessment methodology incorporating a baseline emission inventory and a fine-grained atmospheric chemistry transport model of how pollutants change and migrate after they are emitted to project impacts of possible emissions changes on geographic concentrations of air pollutants in China and to predict the likely consequent impacts on human exposure and associated premature mortality.

One of the issues Mauzerall and her colleagues have applied this methodology to is better understanding the impact of emissions of pollutants from the residential sector in China. During the winter, in major northern cities like Beijing, emissions from home heating stoves often burning coal, are a dominant source of air pollution, Mauzerall reported—much bigger than coal plant and transportation emissions, and in many cases are greater than industrial emissions. Using integrated assessment methodology, Mauzerall and her colleagues found that replacing these stoves with either gas or electric heaters could dramatically improve air quality, reduce mortality, and, depending on the source of the electricity, also reduce carbon emissions.

In another example of the kind of analysis made possible by the use of the integrated assessment methodology, Mauzerall and her colleagues have examined possible co-benefits of a number of planned or possible Chinese policies for 2030, including increased solar PV, industrial energy efficiency improvements, displacement of residential solid fuel (primarily coal) use with natural gas, and electrification of the residential and transport sector. All of the possible measures examined resulted in both fewer premature deaths and at least some reduction in CO2 emissions, Mauzerall said, with some approaches, specifically, a combination of vehicle and residential heating electrification with partial decarbonization of electricity production, standing out for providing significant synergies in both premature death and carbon emissions reductions.

Finally, Mauzerall summarized the results of research into whether and how much air pollution reduces the productivity of solar panels. In regions with high levels of anthropogenic air pollution and relatively dry parts of the world, where rain does not regularly clean panels of desert dust, Mauzerall found aerosol impacts on solar panel productivity can be significant, and regular cleaning can be very important. These findings, Mauzerall noted, point to a

“virtuous cycle….Air quality improvements will increase efficiency of solar PV generation. More PV generation and electrification will reduce emissions of air pollutants and CO2, and will improve health.”

Mauzerall spoke as part of the Kennedy School’s Energy Policy Seminar Series, which is sponsored by the Consortium for Energy Policy Research of the Mossavar-Rahmani Center on Business and Government and by the Belfer Center for Science and International Affairs.