

Household fuels a major contributor to Beijing's infamous air pollution

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China's plans to curb Beijing's health-damaging air by focusing on restricting emissions from power plants and vehicles may have limited impact if household use of coal and other dirty fuels is not also curtailed, according to a new study.

"You cannot have a clean outdoor environment if a large percentage of the population is burning dirty fuels in households several times a day,"

said Kirk Smith, a professor with the University of California, Berkeley's School of Public Health who co-led the study with Tong Zhu of Peking University and Denise Mauzerall of Princeton University. "The smoke may start indoors, but soon leaves the house and becomes a significant part of regional air pollution."

Beijing's polluted air came to international attention before the 2008 summer Olympics. Today, the average daily concentration of the smallest particulates - those that can lodge deeply in the lungs and trigger chronic and acute respiratory illness, heart disease and lung cancer - is more than six times what the World Health Organization regards as safe. Levels of other major pollutants, such as ozone, also rank high.

China developed a five-year plan to reduce emissions, but the researchers concluded that focusing too narrowly on controlling emissions of pollutants just within Beijing and its suburbs, without also reducing emissions from the entire region, including widespread surrounding rural areas, may limit the potential effectiveness of pollution-control efforts.

Their study will be published next week in the journal *Proceedings of the National Academy of Sciences*.

The modeling study is the first to incorporate local and regional datasets on air emissions and to combine these with modeling of weather impacts and atmospheric chemistry in the region to come up with estimates of impacts of household emissions during winter months, when heating demands are greatest.

"We show that due to uncontrolled and inefficient combustion of solid fuels in household devices, emission reductions from the residential sector may have greater air quality benefits in the North China Plain, including Beijing, than reductions from other sectors," the researchers

wrote. Household uses include cooking and heating.

The researchers used the Weather Research and Forecasting Model with Chemistry, a model developed in the United States and used by researchers worldwide, to generate atmospheric simulations using real data from China. They focused on Beijing, Tianjin and Hebei provinces, where more than 100 million people live.

They then made estimates of the relative contributions of emissions sources using data from 2010, and also modeled emissions reductions scenarios to derive estimates for reduction levels of small particulates over the region that would result from different mitigation efforts.

The researchers concluded that eliminating household emissions alone would reduce levels of small particulate pollution in the air over Beijing in winter by about 22 percent, but that eliminating household emissions in all three provinces surrounding Beijing would nearly double the reduction in particulate levels in the city itself.

In other words, Beijing does not have its fate entirely in its own hands, according to Smith, and the results highlight the importance of regional efforts to reduce urban air pollution.

"On a smaller scale, here in the Bay Area, air-quality control is not only focused on San Francisco and Oakland, but also coordinated across nine Bay Area counties through a regional governing body," Smith said. "One might think that, because China has a powerful central government, it would be easy to coordinate regional governing bodies to fight pollution, but that is not necessarily the case."

The researchers did not attempt to evaluate how climate change might be affected by Chinese efforts to reduce household burning of biomass fuel by supplying natural gas. China has begun building plants to convert coal

to "synthetic natural gas," which burns cleaner, but results in more carbon dioxide emissions than direct burning of coal.

Nor did the researchers try to gauge the health benefits of reducing household [emissions](#). However, a Global Burden of Disease study found that direct household exposure to air pollution from solid fuels was responsible for 800,000 premature deaths in China in 2013, about equal to the number of premature deaths from outdoor particulate pollution, Smith said. The work by Smith and colleagues indicates that a significant portion of the ill-health from outdoor [pollution](#) in China should also be attributed to household fuels.

More information: Air pollutant emissions from Chinese households: A major and underappreciated ambient pollution source, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1604537113

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