WILL SHUTTING DOWN ALL COAL-FIRED POWERPLANTS IN BEIJING MAKES A REAL DIFFERENCE? AN INTEGRATED ASSESSMENT

[Shihui Zhang, Tsinghua University, +86 18810669156, ritazhang9414@gmail.com]
[Can Wang, Tsinghua University, +86 10 62794115, canwang@tsinghua.edu.cn]
[Wenjia Cai, Tsinghua Universtiy, +86 10 62792509, wcai@tsinghua.edu.cn]

Overview

Beijing, where air pollution and the associated health impacts has become the major concerns for the local government, has shut down its last coal-fired power plant in March, 2017. With that, Beijing became the first city in China to rely entirely on cleaner energy sources like natural gas for its electricity generation. Previous studies have suggested that the marginal damage caused by the air pollutants vary acorss space, which is affected by the location of the sources. However, few studies have estimated the marginal damages from the power plants in China, and the spatial distribution of the health impacts. To fill this gap, this study builds an integrated assessment model to estimate the maringal damages of PM2.5 emissions from all power plants in and around Beijing (Beijing-Tianjin-Heibeijing area, which will be referred to as BTH area in the following text). Then, based on the marginal damages estimation, the aggregate benefits of this coal power elimination actions will be calculated. Meanwhile, suggestions on which are the coal-fired power plants to be shut down in the next stage of actions will be provided.

Methods

To capture the linkage between emissions and the damages, an integrated assessment model called Integrated Air Pollution Impact Assessment Model or China (APIAC) has been developed. The model consists of four modules: an emission inventory, an air quality module, an exposure and effects module and an valuation module. APIAC begins with an emission inventory of all power plants and other import air pollution sources in BTH area. Then a air quality model based on Gaussian plume model is used to model the transport of emissions across space. Next, the expostures and health impacts to humans of each pollutants are calculated. And finally the physical effects are expressed in dollar terms using results from non-market valuation studies in the economics literature.

To obtain the marginal damages of each source, we have two runs of the model experiments. In this study, APIAC is first fun using the current levels of emissions in the BTH area to calculate the background level of damages. We then add a small stream of emissions over time at a specific source and recalculate aggregate damages. Because all other factors in the model are held constant, the change in damages is strictly attributable to the change in emissions from the source. We perform this experiment for every source in BTH area.

Results

The marginal health effects of all coal power plants in BTH area are shown in Figure 1. Each of the circule represents a coal-fired power plant, and the size of the circule represents the magnitude of the marginal health impacts from the emissions at that source. The larger the circule, the larger the marginal health impacts. As is shown by the figure, the coal power plants that are shut down have the largest marginal health impacts. Among all the 38 coal-fired powerplants in BTH area, the marginal health effects ranges from 282 $/tons to 1534 $/ton. And the coal-fired powerplants with the larger marginal health effects are mostly located near Beijing, where the population density is high.

The spatial distribution of the health impacts from emissions by power plants that are shut down in Beijing are shown in Figure 2. Apparently, people who live in Beijing and other areas that are upwind direction of Beijing will benefit most from the action.

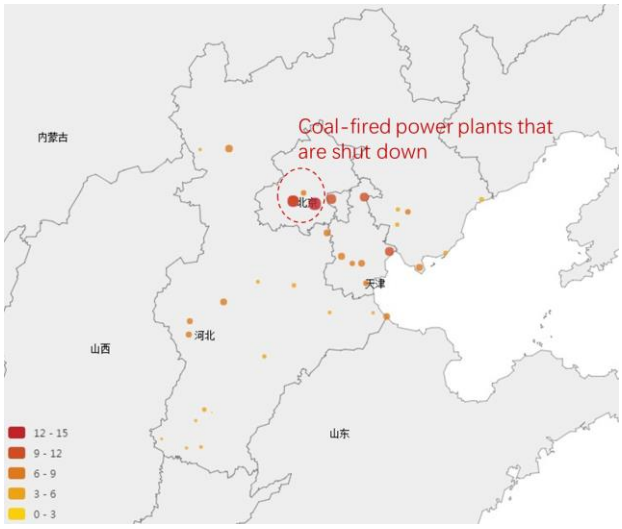

Figure. 1. The marginal health impacts of all coal power plants emissions in BTH area

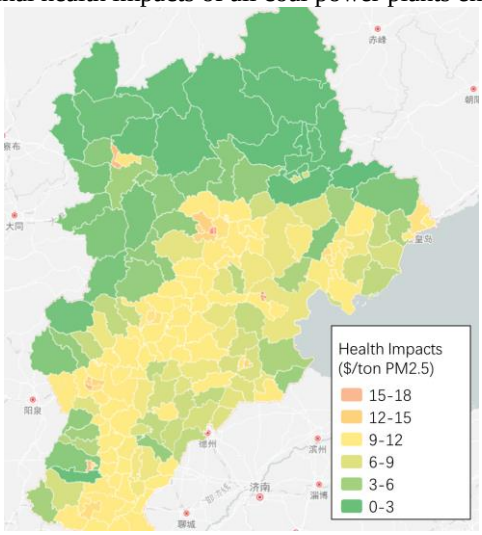

Figure. 2. The spatial distribution of the health impacts for power plants that are shut down in Beijing

Conclusions

According to the marginal health impacts estimation, the six power plants shut down in Beijing are actually the largest marginal health impacts contributor, due to their proximity to the urban areas where population density are high and their downwind locations. The marginal health impacts for the six powerplants that are shut down are respectively 1350, 994, 644, 1534, 1133 and 1462 $/ton PM2.5 emission. People who live in Beijing and the upwind direction of Beijing will benefit most from the action. And other power plants with high marginal health impacts, including Sanhe Power Station, Panshan Power Station, Shalingzi Power Station will be recommended to be shut down in the next round of actions so that the local residents will benefit most.

References

[1] Muller, Nicholas Z., and Robert Mendelsohn. "Efficient pollution regulation: getting the prices right." The American Economic Review 99.5 (2009): 1714-1739.

[2] Tong, Daniel Q., et al. "Integrated assessment of the spatial variability of ozone impacts from emissions of nitrogen oxides." (2006): 1395-1400.