Aspen Global Change Institute Energy Project

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Putting a Price on Health Impacting Pollutants

It's no secret that our economy has environmental externalities not accounted for in the cost of energy. For years, researchers and economists have honed techniques for calculating the Social Cost of Carbon, which aims to internalize those environmental and health damages caused by greenhouse gases. By plugging the Social Cost of Carbon into various models, researchers have demonstrated its utility in improving energy efficiency, reducing energy consumption, changing energy generation technologies, and reducing airborne pollutants. In a recent study by Brown et al. (2017), researchers have taken this type of experiment one step further by applying damage-based fees to greenhouse gases as well as well as to health-impacting pollutants (HIPs) to see how possible fee structures potentially impact one another.

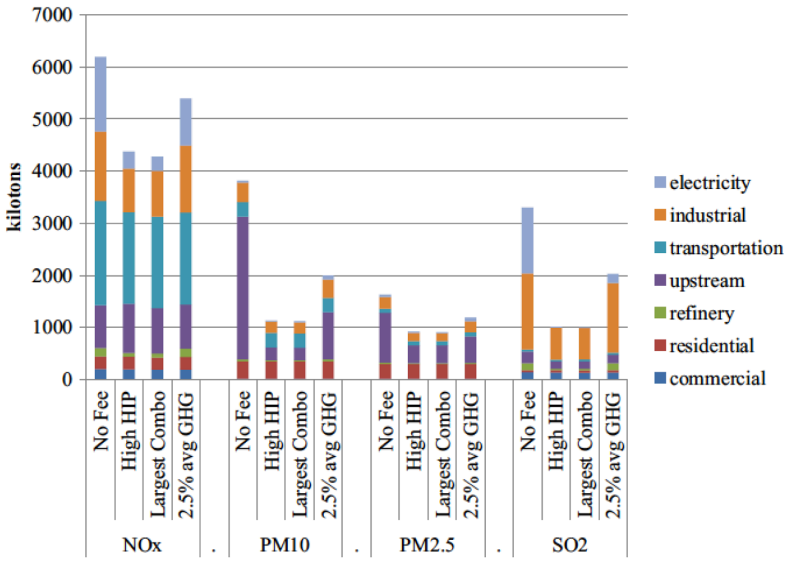

Figure 1. Health-impacting pollutant emissions in 2045 for selected fee cases.

Brown et al. examined fee structures for health-impacting pollutants NO_x, PM2.5, PM10, SO_2 and VOCs. Fees for these pollutants were drawn from recent literature, and population concentration of emissions was also factored into the analysis. Greenhouse gases examined included CO_2 and methane, with the fee based on the US Government 2013 calculation of the Social Cost of Carbon. The MARKAL model period spanned from 2005 to 2055, and incorporated existing regulations and carbon capture and storage (CCS) options, and then compared against a business-as-usual model. The MARKAL model uses linear trends to determine the lowest cost

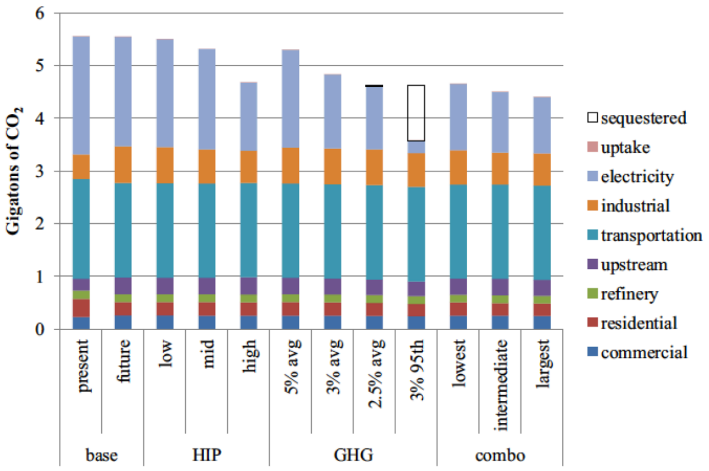

Figure 2. CO_2 emissions by sector in 2045 for various fee cases.

set of generation or conservation technologies to meet end use energy demand. Model runs were completed for fee scenarios on only health-impacting pollutants, only greenhouse gases, and both pollutants and greenhouse gases combined.

The model runs revealed that not only did emissions of pollutants and greenhouse gases go down when they had their respective fees applied, but emissions also declined when the other fee was in place (i.e., lower pollutant emissions with greenhouse gas fees in place, and lower greenhouse gas emissions when pollutant fees were applied). When both fees were applied in combination, the reductions were even more pronounced.

The largest responses to the fee scenarios were seen in the electricity sector, including the mix of electricity generation technologies. In both the pollutant fee and greenhouse gas fee scenarios, coal production dropped dramatically, often replaced with natural gas combined cycle generation. Depending on how high greenhouse gas fees were, renewables played more of a role in displacing coal generation. In all cases, demand for electricity went up substantially. Other sectors were less affected by the fees: The transportation, residential, and commercial sectors were relatively unresponsive to fee scenarios, although they collectively generated hundreds of billions of dollars in revenue. Based on this finding, the authors acknowledge that while a fee structure may be an appropriate policy recommendation for the electricity sector, it may not be the most effective regulatory structure in the other sectors.

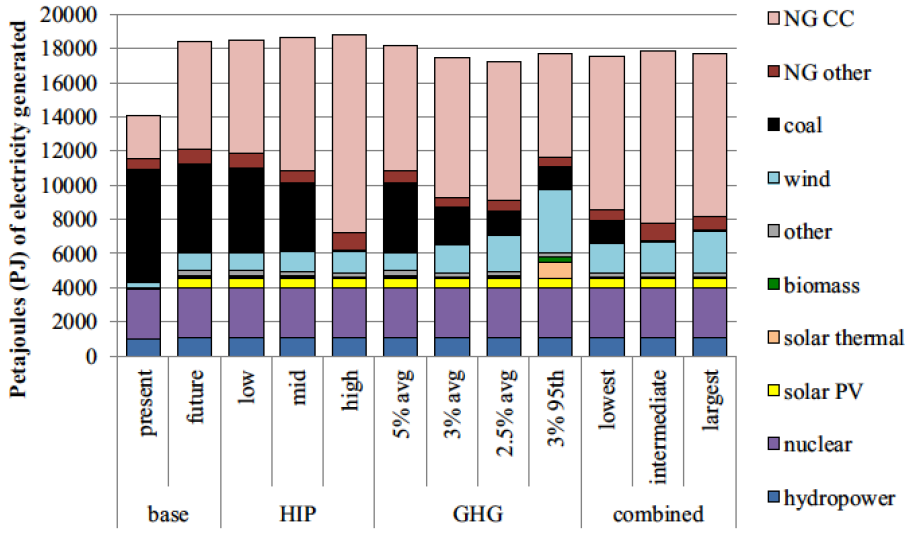

Figure 3. Fuels and technologies used to generate electricity in 2045 based on all fee cases.

The authors note that the Clean Power Plan's goal of reducing CO_2 emissions 32 percent by 2030 could be achieved through several of their test scenarios—either through a greenhouse gas fee of between three and five percent, or through their mid and high pollutant fee scenarios. They also note that in many sector-specific cases, the reductions in emissions were driven more by availability and generation technology price, rather than fees. This underscores the importance of continuing to drive down renewable energy technology prices.

In summary, Brown et al. illustrate that damage-based fees are effective at decreasing emissions, but their study underscores how that reduction is not a linear trend, and that reductions sometimes rely on certain threshold fees. CCS methods often diminished co-benefits of a greenhouse gas fee because of the additional inefficiency CCS introduced to the electricity generation process, ultimately resulting in more non-CO_2 pollutants. On the whole, targeting all pollutants with fees was more effective than relying on co-benefits of greenhouse gas fees alone. Finally, the authors encourage future model studies as we come to know more about the true cost of our energy system and its externalities.

Brown, K.E., D.K. Henze, J.B. Milford. 2017. How accounting for climate and health impacts of emissions could change the US energy system. Energy Policy. 102(2017): 396-405.