Toxic Hotspots from Market Design in Regional Climate Policy

Brittany Tarufelli

Center for Energy Studies
Louisiana State University

January 23, 2020

Abstract

Electricity industry restructuring has created a patchwork of regional wholesale market designs. Partially overlapping this patchwork of market designs is a patchwork of state-level regional climate policies. Sub-national implementation of climate policy creates a need to understand how the effectiveness of regional climate regulations, for example to decrease toxic emissions, or to increase production of energy from renewable resources, are impacted by differing wholesale electricity market designs. Using an empirical example of the introduction of California's Western Energy Imbalance Market (EIM), I revisit the issue of market design, in light of climate policies that cut across markets, to determine how market design impacts local pollution outcomes.

Pollution outcomes due to market design matter as regional climate policies have emerged in the absence of national climate regulation. When regional policies—such as carbon cap-and-trade programs—increase the cost of fossil-fuel production in a regulated area, production can be shifted to an unregulated area, potentially increasing local pollutants. Electricity market design can further exacerbate local pollutants through its effect on electricity dispatch patterns, for example, if renewable energy imbalances are addressed from fossil-fuel generators in some geographic regions more often than others. Although market design is a potentially important local-pollutant driver, research at the intersection of differing market designs and climate policies is minimal. I aim to address this gap by determining the temporal and spatial effects of the EIM on local pollutants. As the EIM changes regional dispatch patterns to fulfill its goal of reducing energy imbalances from intermittent renewables, is it leading to exacerbated local pollution in some regions?

To capture the temporal and spatial implications of the EIM on local pollutants, I utilize hourly electricity production, emissions, and consumption data to identify the distributional effects of the EIM. Exploiting the EIM's change in market design through difference-in-differences analyses that account for selection bias, I identify how changes in plant dispatch in

the EIM, as well as in response to California electricity demand, and California renewable energy (RE) production create temporal and spatial hotspots across the Western electric region.

Assessing local pollution outcomes under only the assumption of a centralized market design, as is typical in the literature, belies the complexity of market design in the electricity industry. As there is currently an agenda to link regional electricity markets in order to better integrate renewable resources in both the U.S. and Europe, there is a need to understand how producers' heterogeneous power generation decisions and resulting local pollution outcomes are effected when electricity market designs change, and when electricity market designs overlap regions with differing climate policies. As climate policy will likely remain sub-national, driven by regional actors, and electricity market designs vary globally in the electricity sector, second-best policy implications may have broader reach.