

# Dissertation Abstract:

## Essays on Energy and Environmental Economics

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### **1 Measuring Policy Uncertainty Using Coal Power Plants' Investment and Exit Decisions**

Uncertainty in regulatory policies may reduce durable good investment, thereby leading to poor regulatory outcomes. Mercury and Air Toxics Standards (MATS) is an environmental policy regulating mercury and other air toxics from coal-fired power plants. The policy went through several legal challenges and was subject to high uncertainty before its compliance date. I measure the subjective belief regarding the MATS remaining in place using a modified investment and exit model. The dynamic structural model incorporates a difference-in-differences design to use the coal-fired power plants' investment and exit decisions to reveal the subjective probability of the MATS policy relative to local mercury rules. I estimate that plants believed that the MATS would not be implemented in 2016 as announced with around 17% probability before the compliance year. The result suggests that policy design should take uncertainty into account.

### **2 Emissions from Coal-Fired Power Plant Retirements**

The coal-fired power plant industry is a major polluting source of various emissions, including greenhouse gas (CO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), and nitrogen oxides (NO<sub>x</sub>). Beginning in around 2012, many coal-fired power plants in the U.S. have started to retire, which creates a chance for evaluating their end-of-business-cycle polluting behavior. This paper examined the emission patterns of the coal-fired electric generating units (EGUs) when they approach retirement. I found a 4% efficiency drop in the last year of operation. The emission rates increase as EGUs approach retirement. As a result, in their final year of operation, each EGU on average emits 78.88 million lbs CO<sub>2</sub> (1.6%), 0.88 million lbs NO<sub>x</sub> (10.1%), and 5.01 million lbs SO<sub>2</sub>(16.9%) more than the baseline level in 2012. Controlling for the start-up and shutdown frequency can

explain about 43% of the efficiency lost. The efficiency lost explains almost all CO<sub>2</sub> emission rates increase but only 20% of the increase in the NO<sub>x</sub> and SO<sub>2</sub> emission rates. EGUs under fee-for-service regulation exhibit a sudden efficiency drop in the final year of operation, while their counterpart, the not regulated ones, show lower efficiency in the last three years of operation.

### **3 Electric Vehicles Are Driven Less: selection or substitution? (Ashley Langer, Clifford Winston, Wendan Zhang)**

A great deal of funding is spent on promoting electric vehicle adoption. The benefits of these subsidies depend not only on the cost-effectiveness of the policy in terms of adoption but also on how much mileage is actually substituted away from the traditional vehicles. Davis (2019) shows that electric vehicles are driven much less than traditional cars nationwide, which suggests much smaller environmental benefits than expected. Understanding the underlying mechanism can help improve policy design for promoting adoption and encourage electric vehicle usage. This paper investigates two potential explanations for lower mileage in electric vehicles by exploring the mileage changes in households purchasing electric vehicles. For average households purchasing an electric vehicle, there is no significant change in the mileage of the other cars. However, households incentivized to adopt electric vehicles substitute certain mileage away from other cars in their portfolio. The substitution mainly comes from households adding a car to their portfolio, but not households replacing a car.