Asset Reallocation under Cap-and-Trade: Evidence from the U.S. Power Sector

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Abstract

This paper examines how cap-and-trade programs influence asset reallocation in the United States power sector. Using the staggered implementation of the Regional Greenhouse Gas Initiative and California's Cap-and-Trade Program, I show that carbon pricing affects firms not only through operations but also through the market for generating assets. Within regulated states, traditional plants become more likely to be divested, while renewable plants are retained. Firms facing higher exposure intensity adjust more aggressively, although some buyers acquire fossil assets due to superior upgrading ability. Asset reallocation is not confined to regulated regions. Exposed firms reduce fossil ownership and expand renewable capacity in unregulated states, particularly in nearby and economically important markets. Carbon pricing also stimulates green innovation. Overall, the findings highlight asset markets as a key channel through which climate policy reshapes asset ownership and steers investment toward cleaner technologies.

Keywords: Cap-and-Trade; Power Sector; Asset Reallocation; Policy Spillover; Carbon Emissions

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1 Introduction

Climate change has emerged as one of the most significant global economic and environmental challenges of the twenty-first century. Because greenhouse gas emissions are the primary drivers of global warming, policymakers have increasingly relied on market based mechanisms such as cap and trade to reduce emissions. By imposing an aggregate emissions cap and allowing firms to trade allowances, cap and trade programs create financial incentives for firms to reduce carbon output in a cost effective manner.

A growing body of research examines how firms respond to carbon pricing. Much of this work focuses on adjustments in operating behavior. For example, Bartram et al. (2022) document evidence of leakage, which occurs when firms shift production or emissions toward regions with weaker regulation. These findings show that firms can modify their production choices while continuing to rely on their existing asset base. However, there is limited evidence on whether carbon pricing affects the dirty and green assets that firms choose to own, or sell.

This paper examines how asset markets in the power sector respond to cap-and-trade by exploiting two major U.S. programs, the Regional Greenhouse Gas Initiative implemented in 2009 and the California Cap-and-Trade Program implemented in 2013. The power sector provides a particularly suitable setting to study how carbon pricing affects real asset reallocation. First, electricity generation is one of the largest sources of emissions in the United States. According to the EPA,[1] the sector accounts for roughly one quarter of total U.S. greenhouse gas emissions, more than transportation, industry, or buildings. This reflects the sector's continued reliance on fossil fuel combustion, with about sixty percent of electricity in 2022 still generated from coal, oil, and natural gas. Second, the sector relies on long-lived and capital-intensive assets that produce a homogeneous output. One megawatt hour of electricity is identical regardless of which plant produces it. Unlike manufacturing industries

[1]See EPA (2024) "Sources of Greenhouse Gas Emissions" https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions

where firms differentiate products, this uniformity allows changes in firm behavior to be more directly linked to policy rather than shifts in product characteristics. Third, leakage is more limited in electricity than in most industrial sectors. Power cannot be transported long distances without losses, and interregional trade requires costly and capacity-constrained transmission infrastructure. New interstate transmission lines are expensive to build and subject to regulatory barriers.[2] As a result, utilities cannot easily relocate production across regions, making asset reallocation a primary margin of adjustment.

In this paper, I show that carbon pricing affects firms not only through operational behavior but also through the market for physical generating assets. Electricity producers respond to carbon costs by actively reallocating ownership away from fossil-fuel plants and toward renewable generation.

Within regulated states, traditional power plants become significantly more likely to be divested, while renewable plants are retained. The response varies systematically across firms, with those facing higher compliance costs shedding fossil assets more aggressively where regulation is binding. Some producers nevertheless acquire traditional plants, which may reflect heterogeneity in their ability to upgrade facilities and reduce carbon intensity.

Importantly, the effects of cap-and-trade extend beyond regulated regions. Firms with multi-state operations adjust their nationwide portfolios once portion of their asset base becomes subject to carbon pricing. Exposure to cap-and-trade leads producers to reduce fossil-fuel ownership and expand renewable holdings even in unregulated states. Firms facing higher carbon cost exposure shift more strongly away from traditional assets and toward renewables. Firms also appear to anticipate policy diffusion and increase clean investment more in states that are geographically closer to existing carbon markets and in states that are economically important to them. At the same time, carbon pricing stimulates low-carbon innovation and lowers the cost of renewable generation, which facilitates expansion outside regulated areas.

[2]https://www.energy.gov/oe/articles/electricity-transmission-primer

From a broader perspective, the findings underscore the importance of asset markets as a central mechanism through which climate policy affects the real economy. In contrast to leakage concerns documented in other sectors, the power sector exhibits positive spillover effects. Regional carbon pricing accelerates clean investment rather than displacing emissions to unregulated areas. Moreover, these adjustments occur without adverse effects on firm profitability, leverage, valuation, or ESG performance, while firms expand total assets and capital expenditures.

This paper makes three primary contributions to the literature. First, it contributes to our understanding of the asset market for polluting assets. Prior work by Duchin et al. (2025) documents an active market for pollutive industrial plants, showing that firms facing stronger environmental scrutiny tend to divest dirty assets to buyers operating under weaker regulatory constraints. In a related context, Lin et al. (2023) shows that climate-related uncertainty about future electricity demand increases investment in flexible fossil fuel technologies while discouraging investment in inflexible renewable capacity. To the best of our knowledge, this paper is the first to examine how electricity producers adjust their asset holdings in response to climate policy. I find that firms not only rebalance their portfolios between dirty and green assets within regulated regions but also reduce their holdings of dirty assets and increase holdings of green assets in unregulated areas.

Second, the paper contributes to the literature on the external effects of regional policy. Regional interventions often lead to unintended consequences that affect neighboring regions and sectors. Prior studies have documented such effects in the contexts of place-based development zones (Hanson and Rohlin, 2013), housing programs (Rossi-Hansberg et al., 2010), infrastructure investments (Chandra and Thompson, 2000), international trade (Curtis, 2014), and education policy (Ma et al., 2023). Within the context of climate regulation, a common criticism is the risk of leakage. For example, Bartram et al. (2022) shows that financially constrained industrial firms shift production and emissions to unregulated states. However, this paper shows that leakage is not inevitable and depends on the institutional

and technological characteristics of the sector. In the power sector, electricity producers do not relocate emissions or expand fossil fuel generation outside regulated areas. Instead, cap and trade programs lead to additional renewable investment and reduced fossil capacity even in unregulated states.

Third, the paper adds to the understanding of cap and trade effectiveness in the electricity sector. While many studies examine the effects of carbon markets in industrial settings (see Betz and Sato 2010; Ellerman et al. 2010; Laing et al. 2013; Bartram et al. 2022; Ben-David et al. 2021), evidence on electricity producers remains limited. Two recent papers offer initial insights. Bai and Ru (2024) documents national reductions in emissions following the adoption of emissions trading systems. Kumar and Purnanandam (2022) finds that the Regional Greenhouse Gas Initiative reduced carbon emissions and influenced firm-level financial outcomes. Our study confirms the effectiveness of cap and trade in the power sector and provides new evidence on how firms reallocate their physical capital in response to carbon pricing.

2 Background

2.1 Cap and Trade Programs

Cap and trade programs have become a central component of market based climate regulation in the United States. These programs establish a declining cap on total greenhouse gas emissions and allow firms to trade emissions permits. This mechanism provides financial incentives to reduce emissions where it is most cost effective. This paper focuses on two major initiatives implemented in the United States, namely the California Cap and Trade Program and the Regional Greenhouse Gas Initiative, also known as RGGI.

California's cap and trade program was created following the passage of Assembly Bill 32 in 2006. This law mandated that greenhouse gas emissions be reduced to 1990 levels by the year 2020. To meet this target, California adopted a comprehensive approach including

energy efficiency standards, renewable energy mandates, a low carbon fuel standard, and a statewide cap and trade program. The cap and trade program began in 2013. The initial emissions cap was set two percent below 2012 levels and declined by two percent in 2014. It then decreased by three percent each year through 2020. The program covers carbon dioxide and several other greenhouse gases. It includes all electricity producers and large industrial sources that emit more than 25000 metric tons of carbon dioxide equivalent annually. Fuel suppliers were included in the program starting in 2015. By 2015 approximately 450 entities were covered, representing 80 percent of the state's total emissions. Large industrial emitters initially received free allowances based on historical emissions and energy efficiency metrics. Over time a larger share of permits has been allocated through public auctions. Electricity generators received free allowances on the condition that any financial gains benefit utility customers. Permits can be banked for future use and firms may meet part of their compliance obligation by purchasing approved emissions offsets. Permit prices initially fluctuated but eventually stabilized around 12 to 13 dollars per ton of carbon dioxide in 2014.

The Regional Greenhouse Gas Initiative is the first legally binding regional program in the United States to target carbon dioxide emissions from the power sector. In 2005 seven states in the Northeast and Mid Atlantic regions signed an agreement to create a collaborative emissions reduction program. These states were Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont. The program sets a regional cap on total carbon dioxide emissions from power plants with capacity of 25 megawatts or greater. Each state distributes allowances proportional to its share of the regional cap. Unlike earlier emissions trading programs that granted allowances at no cost, RGGI conducts quarterly auctions and sells the allowances directly to power producers. This design both imposes actual financial costs and generates revenue for participating states. Additional states including Massachusetts, Maryland, and Rhode Island joined the program in 2007. New Jersey later withdrew in 2012 and is excluded from our analysis. The first auction was held in September 2008 and the initial compliance period began on January 1 of 2009. The emissions cap is

designed to decline with each compliance period, thereby reducing total emissions over time.

Although the California and RGGI programs differ in their regulatory design and geographic scope, they share a core structural feature central to this study. Both programs directly regulate carbon dioxide emissions from fossil-fuel power plants and implement market-based allowance trading mechanisms to price carbon.

2.2 Institutional Background on the U.S. Power Sector

Electricity generation in the United States relies on a mix of fossil fuels, nuclear energy, and renewables. As of 2022, approximately 60% of electricity was generated from fossil fuels, including natural gas (39%), coal (20%), and petroleum (1%). The remaining share came from renewable sources (21%), led by wind, solar, and hydroelectric power, and from nuclear energy (18%).[3] While fossil fuels still dominate the generation mix, the share of renewables has steadily increased over time. For example, renewable sources accounted for only 10% of U.S. electricity generation in 2010 but rose to 21% by 2022, driven largely by growth in wind and solar capacity.

The capital structure of the power sector is highly intensive, with power plants representing large, long-lived investments. Coal and nuclear facilities, in particular, have historically operated for 40 to 60 years. For instance, the average coal unit retired in recent years was over 50 years old, and many nuclear plants receive license extensions allowing operations for up to 80 years.[4] This slow capital turnover implies that climate policies such as cap-and-trade can materially affect the valuation and strategic management of long-term assets.

Another defining feature of the power sector is the uniformity of its output. One megawatt-hour of electricity is identical regardless of the fuel source or the firm that generates it. This homogeneity limits the ability of firms to differentiate products and shifts competitive dynamics toward cost efficiency and regulatory exposure. Unlike industrial firms

[3] https://www.eia.gov/electricity/annual/html/epa_03_01_a.html

[4] https://www.nrc.gov/reactors/operating/licensing/renewal/subsequent-license-renewal.html

that can adjust product characteristics or relocate production facilities, electricity producers face high switching costs and constrained geographic flexibility. Electricity cannot be transported over long distances without substantial transmission losses, and regional transmission requires high-voltage infrastructure that is costly, capacity-limited, and tightly regulated. According to estimates from the U.S. Energy Information Administration and the Edison Electric Institute, new interstate transmission lines typically cost between two and four million dollars per mile. [5] Additionally, the national grid is segmented into largely independent Eastern, Western, and ERCOT interconnections that allow for only limited electricity flows across regions.[6] These constraints significantly reduce the feasibility of shifting production in response to regional regulations. While industrial sectors such as cement, steel, or chemicals may respond to carbon costs by relocating to underregulated areas, utilities cannot easily move generation without large-scale, multi-year investments. As a result, asset reallocation becomes the primary channel through which power firms respond to climate policies.

This rigidity is partially offset by the geographic scope of generation portfolios. Many large electricity producers operate plants across multiple states, allowing for some reallocation of new investment in response to differences in state-level policy. For example, holding companies such as Duke Energy, American Electric Power, and NextEra Energy own and operate generation assets in both regulated and deregulated markets across state lines. These multi-state portfolios give firms strategic flexibility when navigating carbon pricing programs, even though production cannot be seamlessly shifted across regions in the short run.

Taken together, the sector's reliance on carbon-intensive assets, standardized output, and limited cross-region production flexibility make it an informative setting for studying how market-based climate policies shape firm-level investment and divestment decisions across regions.

[5] https://www.energy.gov/oe/articles/electricity-transmission-primer
[6] https://www.epa.gov/green-power-markets/us-grid-regions

3 Data and Sample

3.1 Data

The dataset covers all power plants operating in the continental United States from 2001 to 2019, constructed using the U.S. Energy Information Administration's (EIA) EIA-860, EIA-861, and EIA-923 files. These data provide detailed information on each plant's location, unit status, initial operating year, fuel type, direct owner, annual net generation, and nameplate capacity. I classify plants into traditional (coal, oil, and natural gas based) and renewable (hydro, geothermal, solar, biomass, and wind based). [7] Emissions data are sourced from the Environmental Protection Agency's Clean Air Markets Division (CAMD), which covers fossil-fuel generating units with capacity greater than 25 MW.

To identify the ultimate owner of each plant, I use both ownership information from S&P Global Market Intelligence (GMI; formerly SNL Financial) and public listed firms' subsidiary data obtained from SEC filings. While the EIA reports the direct owner, the GMI data provide ownership chains up to the ultimate parent firm. To confirm the accuracy GMI ownership, I further use subsidiary structures from SEC filings to match EIA direct owners to ultimate parents. A firm is recorded as the ultimate owner only when it holds more than 50% equity in the plant, ensuring that the firm exercises effective control.

I supplement these data with state-level controls, including average temperature, GDP, population, Heating Degree Days (HDD), and Cooling Degree Days (CDD), obtained from the National Centers for Environmental Information (NCEI) and the EIA's State Energy Data System (SEDS). Financial statement information for publicly traded utilities is drawn from Compustat.

[7] Nuclear plants are excluded from the analysis because they are neither fossil-fuel-based nor renewable and are typically regulated under different policy and operational frameworks.

3.2 Sample Statistics

Panel A of Table 1 reports summary statistics for the full sample of 10,295 U.S. power plants observed from 2001 to 2019. On average, a plant generates 541,000 MWh of electricity per year and has an installed capacity of 166 MW. The median plant age is 23 years, indicating that many facilities are relatively mature.

Across all plant-year observations, 46% correspond to traditional fossil-fuel plants (coal, gas, or oil), while 54% correspond to renewable plants (biomass, geothermal, hydro, solar, or wind). Among traditional plants, gas-fired units represent the largest share (25%), followed by oil (12%) and coal (8%). Within the renewable category, hydro plants are the most common (24%), followed by solar (11%), wind (10%), and biomass (9%), while geothermal plants account for just 1%.

Traditional plants (3,659 plants) exhibit substantially higher levels of production, generating on average 1,012,000 MWh per year and operating with a mean capacity of 303 MW. These units also tend to be older, with an average age of 32 years. Their average CO2 emissions total 1.97 million short tons, and their mean emissions rate is 2.08 short tons per MWh.

The renewable subsample includes 6,636 plants, which are generally smaller and younger. Their average annual generation is 148,000 MWh, and their average installed capacity is 51 MW, both considerably lower than their traditional counterparts. Renewable plants have a mean age of 30 years.

Panel B of Table 1 presents summary statistics for the 48 continental U.S. states included in our sample. New Jersey is excluded because it joined the RGGI program in 2009 but withdrew in 2012, and I omit it to maintain consistent policy exposure across states. [8]

Across the 912 state-year observations, states generate an average of 82.3 million MWh of electricity per year, with average annual CO2 emissions of 46.3 million short tons. Traditional plants account for the bulk of electricity production, generating on average 56.1 million MWh

[8] Our results are robust to the inclusion of New Jersey in the sample.

with an installed capacity of 16.6 thousand MW. In contrast, renewable plants produce 9.9 million MWh annually and operate with an average capacity of 3.1 thousand MW.

Panel C of Table 1 reports summary statistics for the 510 parent firms of the power plant (electricity producers) in our sample. On average, an electricity producer owns 5.9 power plants with 2.8 traditional plants and 3.2 renewable plants. In terms of scale, the average electricity producer controls 1,371 MW of total generation capacity, of which 1,063 MW is from traditional plants and 149 MW from renewable plants. It is common for electricity producers to operate in multiple states. On average, an electricity producer owns power plants in 1.69 states, and roughly 29% of producers have generation assets in more than one state.

4 The Direct Impact of Cap-and-Trade within Regulated States

4.1 Power Plant Operations within Regulated States

Due to the increase in the operating cost of traditional plants under cap-and-trade, power plants' operational outcomes in regulated states could be altered. To examine the direct effects of cap-and-trade programs on power plant operations, I begin by estimating their impact at the state-year level, exploiting the staggered adoption of carbon trading policies across states. The baseline specification relates cap-and-trade implementation to a range of state-level outcomes:

$$Y_{st} = \beta \, \text{treated}_{st} + Controls_{st} + \mu_s + \lambda_t + \varepsilon_{st}, \tag{1}$$

where Y_{st} denotes the annual outcome of state s in year t. I examine overall CO_2 emissions, total net generation, and the generation and capacity of both traditional and renewable plants. The treatment indicator, treated_{st}, equals one in the year a state implements cap-and-

trade and remains one thereafter. The controls includes states' key economic and climatic fundamentals, such as GDP, population, temperature, heating degree days (HDD), and cooling degree days (CDD). All regressions include state and year fixed effects.

Table 2 Panel A summarizes the state level findings. Columns (1)–(3) show that treated states experience significant declines in total emissions, overall electricity generation, and generation from traditional fossil-fuel plants. Column (1) implies that cap-and-trade reduces state-level CO_2 emissions by 25.5%, an economically meaningful effect. This result is consistent with the broader literature. For example, Bai and Ru (2024) document that countries adopting emissions trading systems reduce their aggregate emissions by about 18.1%. Column (2) implies that cap-and-trade reduces total capacity by 15.3%. In specific, the overall capacity of traditional power plants reduced by 26.4%. In contrast, renewable generation does not decline and shows a positive but imprecise response, suggesting that the overall reduction in output is driven primarily by fossil-based generation.

To further understand how power plants' emissions decline following cap-and-trade, I also estimate a plant-level difference-in-differences specification:

$$Y_{ist} = \beta \, \text{treated}_{st} + Controls_{st} + \mu_i + \lambda_t + \varepsilon_{ist}, \tag{2}$$

where Y_{ist} is the annual outcome of plant i in state s and year t. The outcomes include CO_2 emissions, net generation, and carbon intensity. The plant-level controls include generating capacity and plant age, and the regression includes plant and year fixed effects as well as the state-level economic controls included in equation (1).

Table 2 Panel B shows that traditional plants significantly reduce emissions following cap-and-trade. Column (1) indicates that traditional plant-level emissions decline by 27.8%, closely mirroring the state-level estimates. By exploring the effect of RGGI in (Kumar and Purnanandam, 2022), they find that carbon emission recuded 49.61%.

Since coal- and oil-fired plants emit substantially more carbon than natural gas plants, they are expected to experience stronger responses to carbon pricing. This pattern is con-

firmed in Column (3). The interaction between treatment status and an indicator for dirty-fuel plants is negative and statistically significant, implying that coal- and oil-fired plants reduce emissions by roughly 79% more than natural gas plants.

Plant-level oprational output results exhibit similar patterns. Column (3) shows that traditional plants reduce net generation by approximately 20.0%, with dirty-fuel plants experiencing an additional decline. Figure 2 illustrates the dynamic effects on carbon emissions and traditional generation. The pre-treatment trends of the treated and control groups closely track each other, indicating no systematic differences in emissions or traditional generation prior to cap-and-trade implementation. Following implementation, however, both emissions and traditional generation decline markedly for treated plants, with the effects emerging in years two to three after the policy shock.

Finally, I examine whether plants lower emissions through improvements in efficiency. The results in column (5) and (6) do not show statistically significant changes in carbon intensity, suggesting that cap-and-trade does not induce measurable upgrades in abatement technologies during this period.

Taken together, the evidence demonstrates that cap-and-trade programs significantly reduce power-sector emissions. The decline is driven predominantly by reductions in electricity generation from fossil-fuel plants, especially heavily polluting coal- and oil-fired units. There is little evidence of widespread plant retirements or substantial improvements in emissions intensity.

4.2 Asset Reallocation within Regulated States

Cap-and-trade programs can reduce emissions through multiple channels. Emissions may decline because producers reduce operational output, particularly from high-emitting units. Alternatively, firms may adjust their asset portfolios to mitigate compliance costs. Producers can either retire traditional plants or transfer ownership of these plants to other firms.

Table 3 provides evidence on asset reallocation within regulated states. Panel A shows

that total state-level traditional capacity does not change significantly following policy implementation, nor does the amount of retired traditional capacity. However, transaction activity increases substantially. Column (2) indicates that transacted traditional capacity rises by 37.2% after cap-and-trade adoption. Plant-level results in Panel B corroborate this pattern. Columns (1)–(4) show that traditional plants become more likely to be acquired following policy implementation, with Column (1) indicating a 1.9 percentage point increase in acquisition probability. The effects are stronger for dirty-fuel plants. Together, these findings suggest that firms respond to carbon pricing primarily through ownership reallocation of traditional assets rather than large-scale shutdowns.

Renewable assets exhibit a different pattern. Panel A shows no significant change in total renewable capacity, retired capacity, or newly established capacity. However, transaction activity declines sharply. Column (6) shows that transacted renewable capacity falls by 96.7%. Panel B provides similar evidence at the plant level: renewable plants become significantly less likely to be acquired, with Column (7) indicating a 69.8% reduction in acquisition probability. This asymmetry suggests that the power plant trading market is supply-driven. Traditional assets become less desirable and are more frequently offered for sale, whereas renewable assets become more valuable and are retained by incumbent owners.

Why do some producers acquire traditional plants despite higher operating costs under cap-and-trade?[9] One explanation is that some buyers have greater ability to upgrade plants or improve operational efficiency. If so, acquired plants should exhibit lower post-transaction carbon intensity. Table 4 provides supporting evidence. Although emissions and generation levels are not significantly different for acquired versus non-acquired traditional plants, carbon intensity declines. Column (3) shows that the interaction between *Treated* and *Acquired* implies that acquired plants experience a 27.7% larger reduction in carbon intensity relative to non-acquired traditional plants following policy implementation.

[9]Another possibility is that exposure to carbon regulation varies across firms, which I examine in subsequent sections. Additional evidence in the appendix shows that independent power producers (IPPs) are 19 percentage points more likely to sell traditional plants after cap-and-trade adoption, relative to investor-owned utilities (IOUs) and public utilities.

5 Spillover Effects of Cap-and-Trade Outside Regulated States

Electricity producers operate across multiple jurisdictions, and their responses to carbon pricing may not be confined to regulated regions. An important question is therefore whether cap-and-trade programs induce firms to reallocate assets in states that are not directly subject to carbon regulation.

Table 5 examines this spillover effects. Using a sample of publicly traded electricity producers, I estimate the following difference-in-differences specification:

$$Y_{jst} = \beta \, \text{Treated}_{jt} + Firm_Controls_{jt} + State_Controls_{st} + \mu_j + \mu_s + \lambda_t + \varepsilon_{jst}, \qquad (3)$$

where Y_{jst} measures the generating portfolio of producer j in state s and year t. The outcome variables include the number and capacity of traditional and renewable plants owned in states outside cap-and-trade regions. Treated_j identifies firms that owned at least one plant in a cap-and-trade state prior to policy implementation. All specifications include firm characteristics, state-level economic controls, and firm, state, and year fixed effects.

Table 5 shows that exposure to cap-and-trade leads to meaningful portfolio adjustments outside regulated regions. Exposed firms hold approximately 0.4% fewer traditional plants and 4.0% less traditional capacity in unregulated states. In contrast, these firms expand their renewable footprint elsewhere, owning 1.8% more renewable plants and 5.9% more renewable capacity. These results indicate that firms do not simply shift carbon-intensive assets to unregulated regions.Instead, they reduce fossil exposure and expand renewables across their broader geographic portfolios. Figure 4 illustrates the dynamic spillover effects on traditional and renewable capacity. The pre-treatment trends of the treated and control groups closely track each other, indicating no systematic differences prior to cap-and-trade implementation. Following implementation, traditional capacity declines markedly for exposed firms, while

renewable capacity increases for treated firms.

Prior research shows that industrial firms may shift production and emissions toward unregulated jurisdictions (Bartram et al., 2022). To examine whether this leakage channel arises in the power sector, Table 6 studies plant-level operational outcomes outside cap-and-trade states. I find no evidence of increased fossil output. Instead, treated firms' traditional plants outside regulated states exhibit 7.8% lower electricity generation and 5.2% lower CO_2 emissions relative to untreated firms. At the same time, renewable generation increases by 16.7% for exposed firms. These patterns suggest that carbon leakage through cross-state production shifts is limited in the power sector.

Where do firms adjust their portfolios? Table 7 explores how spillover effects vary across state characteristics. First, firms expand renewable capacity more in states geographically close to regulated regions. Column (6) shows a 12.8% larger increase in renewable capacity in nearby states, consistent with policy diffusion dynamics. Prior research documents that climate and renewable energy policies cluster regionally, with neighboring states more likely to adopt similar regulations (Matisoff, 2008). Firms may therefore adjust portfolios in anticipation of broader regulatory expansion.

Second, firms adjust more in states where they have a larger market presence. Columns (4) and (8) show that 1% increase in a firm's market share in a state is associated with 3.64% more traditional capacity and 2.17% more renewable capacity relative to untreated firms. This suggests that firms retain operations in core markets while reallocating marginal assets elsewhere.

Third, spillover effects are stronger in deregulated electricity markets. Interaction terms with deregulated states are positive and significant, consistent with the idea that market-based environments facilitate cross-state portfolio adjustments. In contrast, political affiliation does not appear to play a major role. I find no systematic differences in spillover effects between Democratic and non-Democratic states.

Overall, the spillover evidence indicates that cap-and-trade does not induce firms to shift

carbon-intensive activity toward unregulated regions. Instead, firms reduce fossil exposure and expand renewables across their broader portfolios, particularly in nearby and economically important states. These findings suggest that cross-state asset reallocation reinforces, rather than offsets, the emissions reductions achieved within regulated jurisdictions.

6 The Role of Exposure Intensity in Asset Reallocation

Firms exposed to cap-and-trade regulation are not homogeneous. Their incentives to adjust asset portfolios depend on how strongly they are affected by carbon pricing. Table 8 examines whether variation in exposure intensity shapes firms' reallocation strategies, both within regulated states and across unregulated regions.

Exposure strongly predicts asset adjustment within regulated states. Panel A shows that firms with greater pre-policy reliance on carbon-intensive assets reduce traditional capacity more aggressively following cap-and-trade implementation. Column (1) indicates that a 1% higher pre-policy share of traditional capacity in regulated states is associated with a 2.8% larger decline in traditional capacity holdings afterward. Similarly, Column (2) shows that a 1% increase in pre-policy carbon intensity leads to a 0.546% reduction in traditional capacity in regulated states. These results suggest that firms facing higher compliance costs respond by shedding fossil assets where regulation is binding.

In contrast, renewable capacity within regulated states does not respond significantly to exposure. This finding is consistent with earlier results showing limited changes in renewable holdings within cap-and-trade states. Because renewable plants do not incur carbon costs, variation in fossil exposure does not materially alter incentives to expand or contract renewable assets locally.

Exposure also shapes spillover adjustments outside regulated regions. Firms with greater pre-policy fossil exposure outside cap-and-trade states reduce traditional capacity more in those regions as well. Column (1) shows that a 1% higher pre-policy share of traditional

capacity outside regulated states is associated with a 0.4% larger reduction in traditional capacity holdings. Column (2) further indicates that higher carbon intensity outside regulated states predicts stronger divestment from fossil assets. Market presence also matters. Firms with larger outside market shares exhibit greater reductions in traditional capacity, consistent with more intensive optimization of economically important portfolios.

Renewable investment patterns outside regulated states differ markedly from those within regulated regions. While renewable capacity does not respond strongly to exposure within cap-and-trade states, firms with higher fossil exposure expand renewable capacity in unregulated regions. This pattern suggests that firms respond to carbon pricing not only by divesting from carbon-intensive assets, but also by reallocating capital toward clean generation in jurisdictions where expansion is less constrained.

Overall, the exposure analysis highlights that asset reallocation is driven by cost heterogeneity. Firms with greater carbon liability adjust more aggressively, reducing fossil capacity and increasing renewable investment, particularly outside regulated regions. These results reinforce the view that cap-and-trade operates through firm-level optimization of portfolio risk and compliance costs rather than uniform industry-wide responses.

7 Firm Outcomes

I next examine whether cap-and-trade exposure has real effects on electricity producers' financial performance. To do so, I estimate the following specification:

$$Y_{jt} = \beta \, \text{Exposed}_{jt} + Firm_Controls_{j,t-1} + \mu_j + \lambda_t + \varepsilon_{jt}, \tag{4}$$

where Y_{jt} denotes the financial outcome of producer j in year t. Firm controls include lagged financial characteristics to account for pre-existing trends. All regressions include firm fixed effects and year fixed effects.

The results, reported in Table 9, show that exposure to cap-and-trade is associated with

increased green innovation. Column (1) indicates that green patenting activity rises by 9.3% relative to non-exposed firms. This finding suggests that operating under carbon regulation enhances firms' technological capabilities, consistent with the capability learning hypothesis. After facing carbon pricing, producers may accumulate expertise in integrating and managing low-carbon technologies, thereby lowering the marginal cost of deploying renewables in other regions. This interpretation aligns with the literature arguing that well-designed carbon markets stimulate innovation and reduce the long-run cost of abatement (Jaffe et al., 2003; Stavins, 2007).

Beyond green innovation, I find only limited evidence of broader financial adjustments. Exposed firms exhibit modest increases in total assets and capital expenditures, potentially reflecting investment related to portfolio reallocation. However, profitability, leverage, valuation (Tobin's Q), and ESG performance remain largely unchanged. Despite substantial operational and asset-level adjustments, firms' overall financial performance appears stable, suggesting that the costs of carbon regulation are at least partially offset by portfolio optimization, innovation, and strategic reallocation.

Understanding why financial outcomes remain relatively unaffected despite significant operational changes is an important area for future research.

8 Conclusion

This paper studies how cap-and-trade programs reshape asset ownership and investment decisions in the U.S. power sector. Exploiting the staggered introduction of the Regional Greenhouse Gas Initiative and California's Cap-and-Trade Program, I show that carbon pricing affects firms not only through operational behavior but also through the market for physical generating assets. Electricity producers respond to carbon costs by actively reallocating ownership away from fossil-fuel plants and toward renewable generation.

Within regulated states, traditional power plants become significantly more likely to be

divested, while renewable plants are retained. The response varies systematically across firms, with those facing higher compliance costs shedding fossil assets more aggressively where regulation is binding. Some producers nevertheless acquire traditional plants, which may reflect heterogeneity in their ability to upgrade facilities and reduce carbon intensity.

Importantly, the effects of cap-and-trade extend beyond regulated regions. Firms with multi-state operations adjust their nationwide portfolios once portion of their asset base becomes subject to carbon pricing. Exposure to cap-and-trade leads producers to reduce fossil-fuel ownership and expand renewable holdings even in unregulated states. Firms facing higher carbon cost exposure shift more strongly away from traditional assets and toward renewables. Firms also appear to anticipate policy diffusion and increase clean investment more in states that are geographically closer to existing carbon markets and in states that are economically important to them. At the same time, carbon pricing stimulates low-carbon innovation and lowers the cost of renewable generation, which facilitates expansion outside regulated areas.

From a broader perspective, the findings underscore the importance of asset markets as a central mechanism through which climate policy affects the real economy. In contrast to leakage concerns documented in other sectors, the power sector exhibits positive spillover effects. Regional carbon pricing accelerates clean investment rather than displacing emissions to unregulated areas. Moreover, these adjustments occur without adverse effects on firm profitability, leverage, valuation, or ESG performance, while firms expand total assets and capital expenditures.

Overall, the results suggest that cap-and-trade programs play a powerful role in steering capital toward cleaner technologies by reshaping asset ownership rather than only production decisions. By influencing firms' long-lived capital portfolios and generating spillovers across regions, carbon markets may deliver broader and more persistent effects than implied by analyses focused solely on regulated emissions. These insights have direct implications for climate policy design and highlight the potential for regional programs to induce economy-

wide transitions toward cleaner capital even in the absence of full national coverage.

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Figures and Tables

Figure 1: Geographic Distribution of U.S. Power Plants

This figure presents maps all U.S. electric power plants in both 2001 and 2019. Plant locations are shown as colored circles, where each color represents a fuel type (coal, gas, nuclear, hydro, wind, solar, biomass, geothermal, and others) and circle size is proportional to the plant's nameplate capacity.

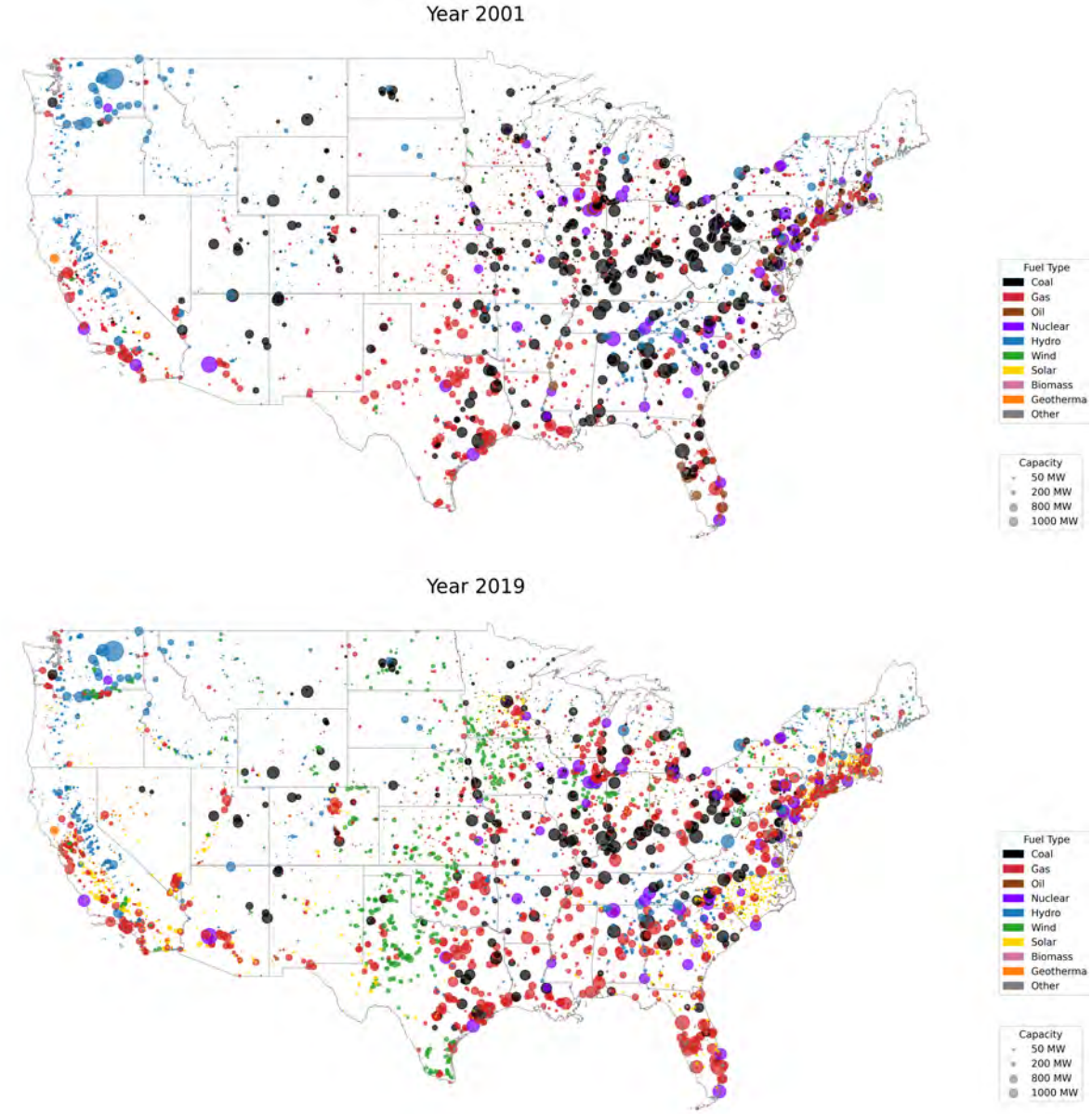


Figure 2: Dynamic Effect of Cap-and-Trade on Power Plant Operations

This figure plots the dynamic differences-in-differences estimates of the effects of cap-and-trade programs on power plant outcomes. The horizontal axis shows years relative to the implementation of cap-and-trade (year 0). The top panel reports the estimated effects on log CO2 emissions, and the bottom panel reports the effects on log electricity generation. Points represent coefficient estimates, and shaded areas denote 95% confidence intervals. All specifications include plant and year fixed effects, and standard errors are clustered at the state level.

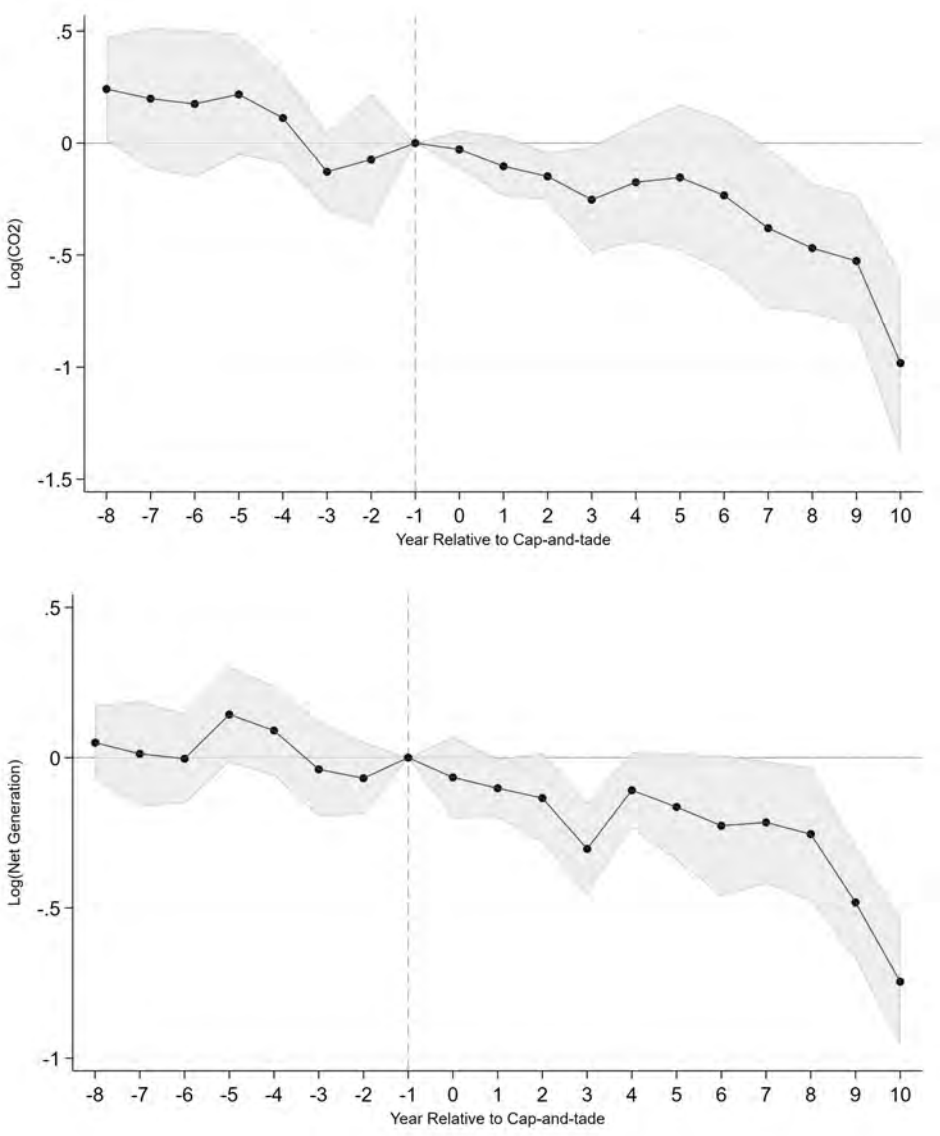


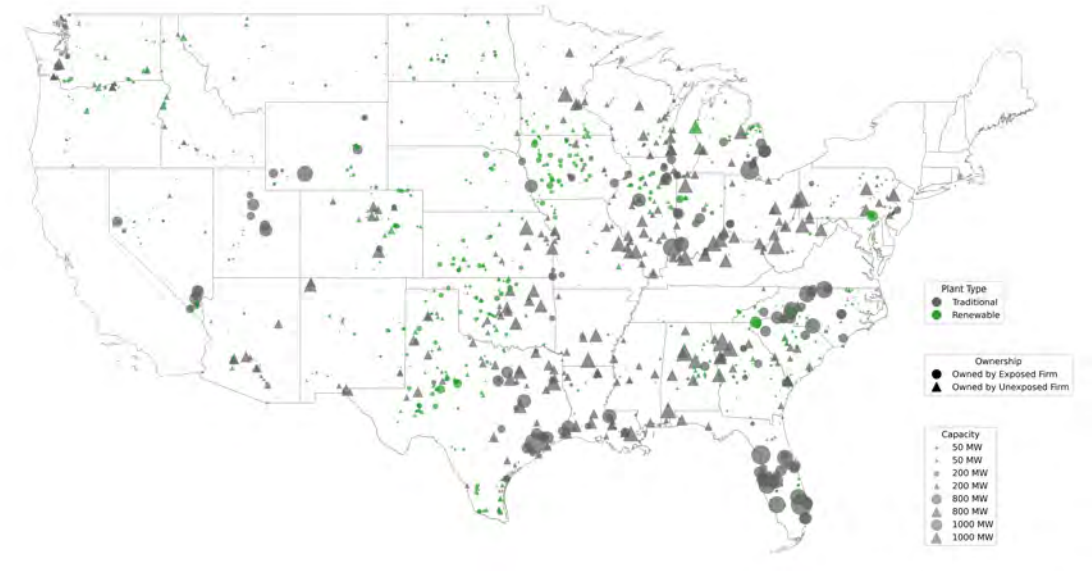
Figure 3: Power Plant Locations and Cap-and-Trade Spillover Effects

This figure maps U.S. power plants owned by electricity producers either exposed or unexposed to California cap-and-trade and RGGI. Traditional and renewable plants are differentiated by symbol type, and marker size indicates nameplate capacity. The pre-treatment map (top) shows the spatial distribution of plants owned by electricity producers either exposed or unexposed before the programs took effect, while the post-treatment map (bottom) illustrates the distribution afterward.

Panel A: Exposed by California Cap-and-Trade



Pre-treatment



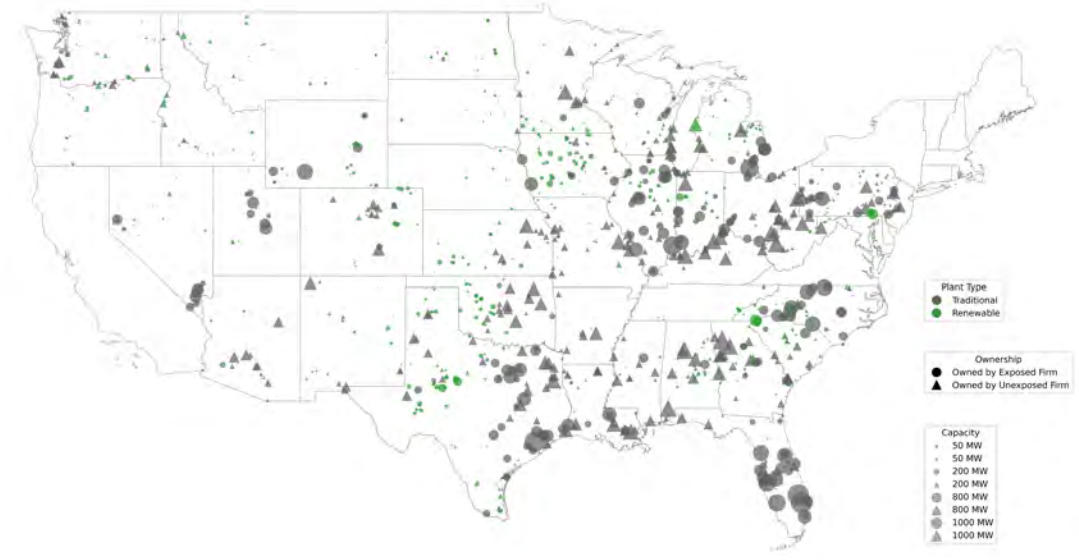
Post-treatment

Figure 3: (continued)

Panel B: Exposed by RGGI



Pre-treatment



Post-treatment

Figure 4: Dynamic Spillover Effect of Cap-and-Trade on Asset Reallocation

This figure plots the dynamic differences-in-differences estimates of the effects of exposed to cap-and-trade programs on producers' power plant portfolios in unregulated states. The horizontal axis shows years relative to the implementation of cap-and-trade (year 0). The top panel reports the estimated effects on producers' traditional capacity, and the bottom panel reports the effects on producers' renewable capacity. Points represent coefficient estimates, and shaded areas denote 95% confidence intervals. All specifications include producer, year, and state fixed effects, and standard errors are clustered at the state level.

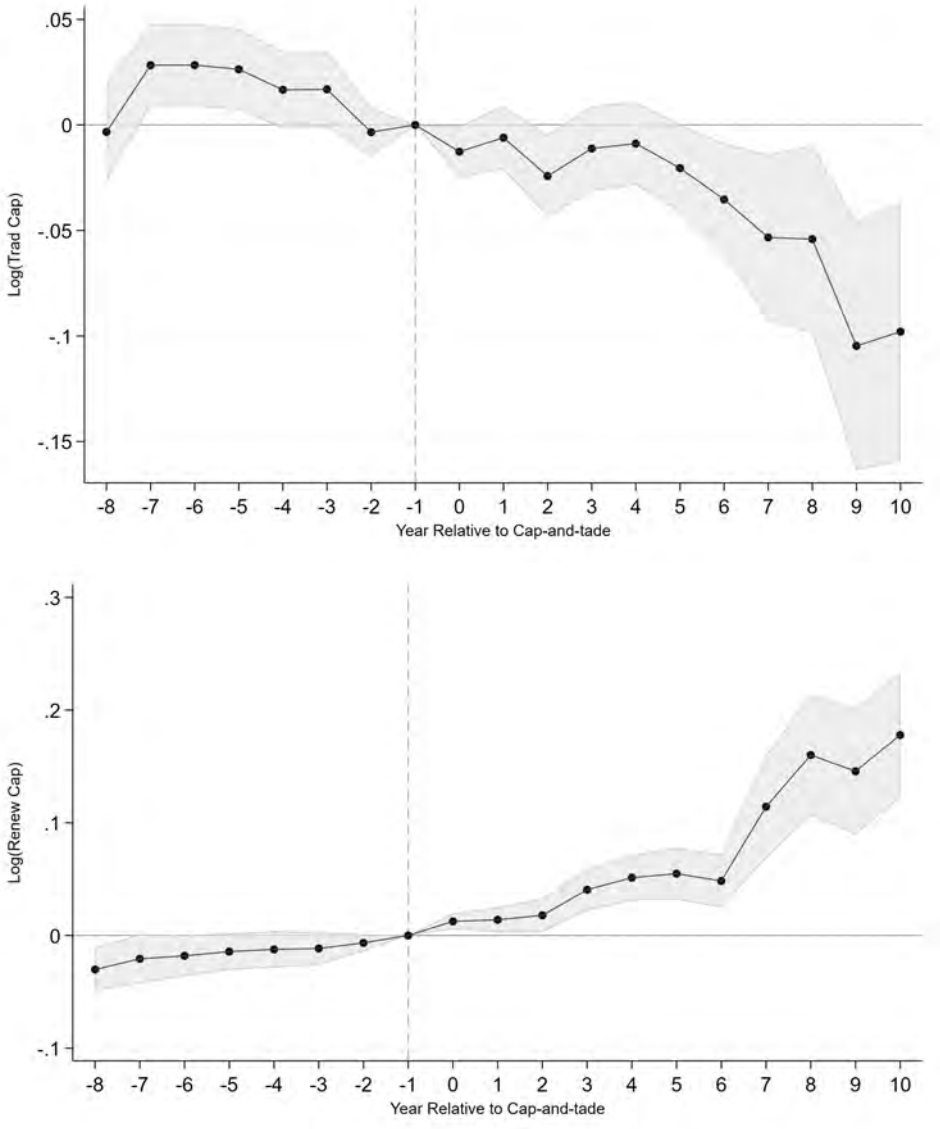


Table 1: Summary Statistics

This table presents a comprehensive summary of the variables employed in this study. Panel A displays the summary statistics for plant characteristics. Panel B provides the summary statistics for state characteristics. Panel C shows the summary statistics for firm characteristics.

Panel A: Power Plant Characteristics

	N	Mean	Std. Dev.	P25	Median	P75
Panel A: All Power Plants (No. Plants = 10,295)						
Net Generation (Thousand MWh)	108639	541.31	1781.15	3.42	26.15	213.63
Capacity (MW)	108639	166.11	395.53	4.10	19.00	107.85
Plant Age	108639	31.21	28.12	7.00	23.00	51.00
Is Traditional	108639	0.46	0.50	0.00	0.00	1.00
Is Oil	108639	0.12	0.32	0.00	0.00	0.00
Is Coal	108639	0.08	0.27	0.00	0.00	0.00
Is Gas	108639	0.25	0.44	0.00	0.00	1.00
Is Renewable	108639	0.54	0.50	0.00	1.00	1.00
Is Biomass	108639	0.09	0.28	0.00	0.00	0.00
Is Geothermal	108639	0.01	0.10	0.00	0.00	0.00
Is Hydro	108639	0.24	0.42	0.00	0.00	0.00
Is Solar	108639	0.11	0.32	0.00	0.00	0.00
Is Wind	108639	0.10	0.30	0.00	0.00	0.00
Panel B: Traditional Power Plants (No. Plants = 3,659)						
Net Generation (Thousand MWh)	49483	1011.62	2463.86	0.34	35.47	622.46
Capacity (MW)	49483	303.29	516.18	9.60	58.00	381.90
Plant Age	49483	32.22	21.63	13.00	29.00	50.00
CO2 Emission (Million Short Tons)	21142	1.97	3.44	0.06	0.52	2.10
CO2 Emission Rate (Short Tons/MWh)	21081	2.08	271.94	0.52	0.72	1.08
Panel C: Renewable Power Plants (No. Plants = 6,636)						
Net Generation (Thousand MWh)	59156	147.90	639.19	5.76	23.08	116.16
Capacity (MW)	59156	51.36	188.46	2.80	8.00	40.00
Plant Age	59156	30.37	32.55	4.00	17.00	52.00

Table 1 (continued): Summary Statistics

Panel B: State Characteristics

	N	Mean	Std. Dev.	P25	Median	P75
(No. States = 46)						
Net Generation (Million MWh)	874	82.33	75.58	34.20	57.92	113.12
CO2 Emission (Million Short Tons)	874	46.30	44.52	15.18	36.23	62.52
Net Generation of Traditional Plants (Million MWh)	874	56.06	58.36	19.28	40.47	78.21
Capacity of Traditional Plants (Thousand MW)	874	16.61	16.98	5.48	11.84	23.50
Net Generation of Renewable Plants (Million MWh)	874	9.92	16.58	1.98	4.46	9.28
Capacity of Renewable Plants (Thousand MW)	874	3.10	5.17	0.65	1.59	2.98
RPS	874	0.49	0.50	0.00	0.00	1.00
Average Temperature (°F)	874	52.79	7.95	46.36	51.63	58.95
GDP (Billion USD)	874	307.40	396.66	79.01	184.92	353.67
Population (Billion)	874	6.16	6.97	1.82	4.22	6.64
Heating degree days (HDD)	874	5170.27	2109.04	3520.00	5360.00	6806.00
Cooling degree days (CDD)	874	1152.29	839.85	518.00	905.00	1651.00

Panel C: Firm Characteristics

	N	Mean	Std. Dev.	P25	Median	P75
(No. Firms = 510)						
No. Total Plants Owned	9690	5.90	19.22	0.00	1.00	3.00
No. Traditional Plants Owned	9690	2.48	6.60	0.00	0.00	2.00
No. Renewable Plants Owned	9690	3.22	15.07	0.00	0.00	1.00
Total Capacity Owned (MW)	9690	1370.58	5499.93	0.00	2.00	118.80
Traditional Capacity Owned (MW)	9690	1062.97	4332.54	0.00	0.00	45.48
Renewable Capacity Owned (MW)	9690	148.96	819.97	0.00	0.00	2.10
Market Value (Billion)	6122	26.16	59.03	1.50	5.63	23.03
Total Assets (Billion)	7285	56.89	179.94	2.52	9.99	35.51
Tobin's Q	6100	2.03	21.87	1.11	1.30	1.68
Leverage	7230	0.43	4.99	0.22	0.32	0.43
ROA	6586	-0.06	4.16	0.01	0.03	0.06
Market to Book Ratio	6100	9.37	575.04	1.30	1.87	2.94
Capex	6520	0.16	0.15	0.08	0.12	0.18
Sale (Billion)	6587	20.26	46.46	1.32	5.26	15.74
No. Operating States	9690	1.69	3.38	0.00	1.00	2.00
Whether Operates in Multiple States	9690	0.29	0.45	0.00	0.00	1.00

Table 2: The Direct Impact of Cap-and-Trade on Power Plant Operations

This table reports the estimated effects of cap-and-trade programs on power plant operations. Panel A presents state-level CO_2 emissions, total electricity generation, traditional plant electricity generation and capacity, and renewable plant electricity generation and capacity. Panel B reports plant-level estimates for traditional plants, including CO_2 emissions, electricity generation, and emissions intensity. *Treated* is an indicator equal to one in the year of an cap-and-trade implementation and all subsequent years, and zero otherwise. *Dirty Fuel* refers to coal- and oil-fired plants. Plant control variables include the logarithm of plant capacity and plant age. State control variables include an indicator for *RPS State*, the logarithm of GDP, population, temperature, heating degree days (HDD), and cooling degree days (CDD). Fixed effects are used and indicated in each column. t-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

Panel A: State Level Outcomes

	Log(Total CO2)	Log(Total Gen)	Log(Trad Gen)	Log(Renew Gen)
	(1)	(2)	(3)	(4)
Treated	-0.255***	-0.153**	-0.264**	0.283
	(-3.19)	(-2.40)	(-2.16)	(0.31)
RPS State	-0.033	0.003	-0.016	0.747
	(-0.78)	(0.09)	(-0.23)	(1.61)
GDP	0.080	0.165	-0.176	-0.170
	(0.47)	(1.35)	(-0.92)	(-0.07)
Population	0.453	0.728*	1.285**	4.142
	(0.86)	(1.96)	(2.12)	(0.68)
Temperature	-0.269	-0.119	0.512	1.180
	(-0.58)	(-0.25)	(0.85)	(1.11)
HDD	-0.125	-0.069	-0.197	1.006**
	(-1.14)	(-1.05)	(-1.59)	(2.17)
CDD	0.067*	0.022	0.040	-0.082
	(1.97)	(1.06)	(0.89)	(-0.71)
Year FE	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes
Obs.	874	874	874	874
Adj. R^2	0.99	0.98	0.99	0.79

Panel B: Traditional Power Plant Level Outcomes

	Log(CO2)		Log(Gen)		Log(CO2 Intensity)	
	(1)	(2)	(3)	(4)	(5)	(6)
Treated	-0.278***	-0.139*	-0.200***	-0.109*	0.035	0.043
	(-3.48)	(-1.78)	(-3.00)	(-1.79)	(1.54)	(1.29)
Dirty Fuel		0.530***		-0.268***		0.425***
		(4.47)		(-2.83)		(9.01)
Treated × Dirty Fuel		-0.786***		-0.393***		-0.015
		(-6.69)		(-3.52)		(-0.29)
Plant Cap	1.181***	1.194***	1.567***	1.551***	-0.278***	-0.252***
	(13.31)	(13.63)	(11.89)	(11.35)	(-5.62)	(-5.59)
Plant Age	0.514***	0.457***	0.391***	0.391***	0.013	-0.018*
	(8.79)	(8.01)	(6.71)	(6.40)	(1.25)	(-1.75)
RPS State	-0.003	-0.005	-0.087	-0.084	-0.009	-0.013
	(-0.05)	(-0.09)	(-1.22)	(-1.20)	(-0.66)	(-0.95)
GDP	-0.318	-0.443	-0.491	-0.519	-0.107	-0.153*
	(-1.02)	(-1.39)	(-1.22)	(-1.29)	(-1.27)	(-1.87)
Population	-0.564	-0.420	0.691	0.666	0.054	0.109
	(-0.91)	(-0.67)	(0.75)	(0.73)	(0.30)	(0.65)
Temperature	2.123***	2.267***	1.285**	1.276**	-0.109	0.020
	(3.72)	(3.94)	(2.15)	(2.19)	(-0.53)	(0.10)
HDD	0.133	0.185*	0.148	0.191	0.006	0.014
	(1.18)	(1.89)	(0.98)	(1.45)	(0.12)	(0.27)
CDD	0.416***	0.401***	0.433***	0.425***	0.000	-0.006
	(4.15)	(4.01)	(5.26)	(5.22)	(0.01)	(-0.26)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	20,507	20,507	44,377	44,377	20,369	20,369
Adj. R^2	0.90	0.90	0.94	0.95	0.72	0.73

Table 3: The Direct Effect of Cap-and-Trade on Asset Reallocation

This table reports the direct effects of cap-and-trade programs on asset reallocation. Panel A presents state-level capacity of total plants, acquired transacted, retired plants, and newly established plants. The dependent variables are in logarithmic form. Panel B reports plant-level estimates of the probability that a plant experiences an ownership change in year t+1. *Treated* is an indicator equal to one in the year of an cap-and-trade implementation and all subsequent years, and zero otherwise. *Dirty Fuel* refers to coal- and oil-fired plants. *VHR* denotes renewable plants using solar, wind, or hydro technologies. Plant and state controls are included. Fixed effects are used and indicated in each column. *t*-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

Panel A: State Level Outcomes

	Trad Plant				Renew Plant			
	Total Cap	Cap Trans	Cap Retired	Cap Estab	Total Cap	Cap Trans	Cap Retired	Cap Estab
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	-0.014	0.372*	-0.580	0.320	-0.227	-0.967**	0.174	-0.005
	(-0.40)	(1.84)	(-1.35)	(0.97)	(-0.68)	(-2.48)	(0.79)	(-0.01)
RPS State	-0.028	0.098	0.298	0.352	0.391	0.761*	0.047	0.917***
	(-1.13)	(0.81)	(0.90)	(0.99)	(1.68)	(1.96)	(0.32)	(2.72)
GDP	-0.152	-0.129	-0.867	4.296***	0.991	2.037	0.023	0.575
	(-1.45)	(-0.38)	(-0.65)	(3.30)	(1.21)	(0.97)	(0.04)	(0.40)
Population	1.235***	-0.900	-5.255*	-3.613	-0.917	5.077	1.901	3.368
	(4.38)	(-0.82)	(-1.75)	(-1.19)	(-0.40)	(1.32)	(1.17)	(1.14)
Temperature	-0.156	0.727	-3.390	9.016**	0.388	-4.287	-0.020	-6.385
	(-0.83)	(0.79)	(-0.58)	(2.14)	(0.56)	(-1.22)	(-0.01)	(-1.33)
HDD	0.068	0.381*	-1.427	1.185	0.301	-0.493	-0.910	-2.078**
	(1.29)	(1.83)	(-1.01)	(1.00)	(1.31)	(-0.69)	(-1.13)	(-2.29)
CDD	0.016	-0.091	0.492	-0.050	-0.058	0.114	-0.276	-0.268
	(0.84)	(-1.21)	(0.77)	(-0.11)	(-0.67)	(0.31)	(-0.78)	(-0.57)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	874	874	874	874	874	874	874	874
Adj. R^2	1.00	0.91	0.90	0.70	0.31	0.33	0.51	0.50

Panel B: Power Plant Level Outcomes

	Ownership Changed in $t+1$							
	Trad Plant				Renew Plant			
	LPM		Logit		LPM		Logit	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	0.019*	0.009	0.110	-0.006	-0.028**	-0.121***	-0.698***	-1.689***
	(1.90)	(0.96)	(0.72)	(-0.03)	(-2.44)	(-5.26)	(-2.62)	(-5.03)
Dirty Fuel		0.037***		1.038***				
		(2.97)		(4.46)				
Treated × Dirty Fuel		0.042**		0.506*				
		(2.14)		(1.76)				
VHR						0.065		1.417**
						(1.23)		(2.17)
Treated × VHR						0.113***		1.434***
						(4.16)		(3.36)
Plant Cap	-0.040*	-0.038*	-0.687	-0.603	-0.008	-0.003	-0.080	-0.034
	(-1.75)	(-1.70)	(-1.09)	(-1.00)	(-0.50)	(-0.21)	(-0.28)	(-0.12)
Plant Age	-0.003	-0.003	-0.258*	-0.280*	0.014*	0.017**	0.189	0.236
	(-0.50)	(-0.50)	(-1.66)	(-1.81)	(1.70)	(2.07)	(1.24)	(1.54)
RPS State	-0.003	-0.003	-0.047	-0.057	-0.023	-0.023	-0.589	-0.625
	(-0.41)	(-0.52)	(-0.33)	(-0.40)	(-0.97)	(-0.96)	(-1.15)	(-1.19)
GDP	-0.050	-0.049	-1.219	-1.271	-0.123	-0.130	-2.869	-2.829
	(-1.19)	(-1.16)	(-1.44)	(-1.45)	(-1.58)	(-1.66)	(-1.51)	(-1.57)
Pop	-0.174**	-0.165**	-5.112***	-4.887***	-0.028	0.003	-0.515	0.595
	(-2.41)	(-2.34)	(-3.34)	(-3.37)	(-0.22)	(0.02)	(-0.16)	(0.18)
Temp	-0.212*	-0.208*	-4.340*	-4.085	-0.192	-0.205	-2.769	-3.399
	(-1.77)	(-1.73)	(-1.65)	(-1.56)	(-1.07)	(-1.11)	(-0.82)	(-0.97)
HDD	-0.036	-0.040	-0.733	-0.735	-0.014	-0.019	-0.119	-0.397
	(-1.00)	(-1.15)	(-1.43)	(-1.46)	(-0.38)	(-0.52)	(-0.18)	(-0.60)
CDD	0.008	0.009	0.041	0.054	0.012	0.012	0.253	0.294
	(0.45)	(0.52)	(0.14)	(0.18)	(0.58)	(0.59)	(0.52)	(0.60)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	48,642	48,642	21,860	21,860	54,620	54,620	19,886	19,886
R^2	0.49	0.49	0.04	0.05	0.60	0.60	0.04	0.05

Table 4: The Direct Impact of Cap-and-Trade on Acquired Traditional Plants

This table reports the direct effects of cap-and-trade programs on acquired traditional plants. The dependent variables are the logarithm of carbon emissions, electricity generation and carbon intensity. *Treated* is an indicator equal to one in the year of an cap-and-trade implementation and all subsequent years, and zero otherwise. *Acquired* is an indicator equal to one in the year a power plant is acquired by another owner and in all subsequent years, and zero otherwise. Plant and state controls are included. Fixed effects are used and indicated in each column. t-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

	Log(CO2)	Log(Gen)	Log(CO2 Intensity)
	(1)	(2)	(3)
Treated	-0.202	-0.285*	0.083**
	(-1.45)	(-1.87)	(2.56)
Acquired	0.010	-0.003	0.013
	(0.22)	(-0.07)	(1.29)
Treated × Acquired	-0.101	-0.042	-0.059***
	(-0.72)	(-0.30)	(-3.06)
Plant Cap	1.171***	1.448***	-0.277***
	(12.87)	(15.47)	(-5.59)
Plant Age	0.504***	0.492***	0.012
	(9.03)	(8.94)	(1.12)
RPS State	0.001	0.011	-0.010
	(0.01)	(0.19)	(-0.70)
GDP	-0.286	-0.181	-0.106
	(-0.99)	(-0.58)	(-1.26)
Population	-0.703	-0.754	0.051
	(-1.26)	(-1.26)	(0.29)
Temperature	1.772***	1.888***	-0.117
	(4.11)	(3.69)	(-0.57)
HDD	0.112	0.105	0.007
	(0.97)	(0.93)	(0.13)
CDD	0.426***	0.425***	0.001
	(4.34)	(3.76)	(0.05)
Year FE	Yes	Yes	Yes
Plant FE	Yes	Yes	Yes
Obs.	20,369	20,369	20,369
Adj. R^2	0.91	0.90	0.72

Table 5: The Spillover Effect of Cap-and-Trade on Asset Reallocation

This table presents regression estimates examining whether producers adjust their power plant portfolios in unregulated states when exposed to cap-and-trade programs. Panel A reports spillover effects on the number of traditional plants, traditional capacity, and traditional electricity generation. Panel B reports spillover effects for renewable plants, renewable capacity, and renewable electricity generation. The dependent variables are in logarithmic form. *Treated* equals one for producers operating in states adjacent to cap-and-trade states prior to the implementation of the program, and zero otherwise. Firm and state controls are included. Fixed effects are used and indicated in each column. t-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

	Log(No.Trad Plants)		Log (Trad Cap)		Log(No.Renew Plants)		Log (Renew Cap)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	-0.004**	-0.004**	-0.040***	-0.040***	0.018***	0.018***	0.059***	0.059***
	(-2.67)	(-2.67)	(-3.89)	(-3.89)	(5.28)	(5.28)	(4.85)	(4.86)
Market Value	-0.000	-0.000	-0.005**	-0.005**	-0.000	-0.000	-0.001	-0.001
	(-0.90)	(-0.90)	(-2.05)	(-2.05)	(-0.38)	(-0.38)	(-0.65)	(-0.65)
Total Asset	0.005***	0.005***	0.029***	0.029***	0.006***	0.006***	0.026***	0.026***
	(4.10)	(4.10)	(4.95)	(4.95)	(5.32)	(5.32)	(6.42)	(6.42)
Tobin's Q	0.000	0.000	0.001**	0.001**	0.000	0.000	0.001***	0.001***
	(1.22)	(1.22)	(2.45)	(2.45)	(1.14)	(1.14)	(3.00)	(3.00)
Leverage	-0.002***	-0.002***	-0.008***	-0.008***	-0.004***	-0.004***	-0.015***	-0.015***
	(-4.04)	(-4.04)	(-5.11)	(-5.11)	(-6.43)	(-6.43)	(-5.90)	(-5.90)
ROA	-0.004***	-0.004***	-0.020***	-0.020***	-0.008***	-0.008***	-0.030***	-0.030***
	(-4.22)	(-4.22)	(-5.18)	(-5.18)	(-5.70)	(-5.70)	(-5.20)	(-5.20)
Market To Book	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(4.18)	(4.18)	(4.69)	(4.69)	(4.55)	(4.55)	(3.27)	(3.27)
CAPEX	0.001	0.001	0.011*	0.011*	0.005***	0.005***	0.019***	0.019***
	(1.35)	(1.35)	(1.94)	(1.94)	(3.53)	(3.53)	(4.06)	(4.06)
Sale	0.000*	0.000*	0.000***	0.000***	0.000	0.000	0.000*	0.000*
	(1.94)	(1.94)	(3.13)	(3.13)	(1.44)	(1.44)	(1.98)	(1.98)
RPS State	0.001		0.009		0.007**		0.025**	
	(0.87)		(0.91)		(2.22)		(2.04)	
GDP	0.001		0.009		-0.003		0.023	
	(0.18)		(0.22)		(-0.20)		(0.49)	
Population	0.008		0.048		0.086**		0.217	
	(0.46)		(0.44)		(2.44)		(1.64)	
Temp	0.001		0.005		-0.014		-0.003	
	(0.09)		(0.10)		(-0.67)		(-0.05)	
HDD	-0.002		-0.016		-0.005		0.006	
	(-0.58)		(-0.82)		(-0.85)		(0.24)	
CDD	-0.002**		-0.009**		0.001		-0.001	
	(-2.42)		(-2.49)		(0.68)		(-0.12)	
State×Year FE	No	Yes	No	Yes	No	Yes	No	Yes
State FE	Yes	No	Yes	No	Yes	No	Yes	No
Year FE	Yes	No	Yes	No	Yes	No	Yes	No
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	236,837	236,837	236,837	236,837	236,793	236,793	236,837	236,837
Adj. R^2	0.07	0.07	0.09	0.09	0.08	0.08	0.09	0.09

Table 6: The Spillover Effect on Power Plant Operations

This table reports the spillover effects of cap-and-trade programs on producers' operational outcomes in unregulated states. The dependent variables include the logarithm of electricity generation by owned traditional plants and renewable plants, and carbon emissions by owned traditional plants. *Treated* equals one for producers operating in states adjacent to cap-and-trade states prior to the implementation of the program, and zero otherwise. Firm and state controls are included. Fixed effects are used and indicated in each column. t-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

	Log (Trad Gen)		Log (Trad CO2)		Log (Renew Gen)	
	(1)	(2)	(3)	(4)	(5)	(6)
Treated	-0.078***	-0.078***	-0.052***	-0.052***	0.167***	0.167***
	(-3.48)	(-3.48)	(-2.92)	(-2.92)	(5.22)	(5.23)
Market Value	-0.008	-0.008	-0.015**	-0.015**	-0.004	-0.004
	(-1.32)	(-1.32)	(-2.66)	(-2.66)	(-0.70)	(-0.70)
Total Asset	0.062***	0.062***	0.045***	0.045***	0.074***	0.074***
	(4.49)	(4.49)	(4.86)	(4.86)	(6.68)	(6.68)
Tobin's Q	0.001**	0.001**	0.001**	0.001**	0.002**	0.002**
	(2.03)	(2.03)	(2.60)	(2.60)	(2.56)	(2.56)
Leverage	-0.017***	-0.017***	-0.016***	-0.016***	-0.042***	-0.042***
	(-3.79)	(-3.79)	(-5.88)	(-5.88)	(-6.02)	(-6.02)
ROA	-0.040***	-0.040***	-0.035***	-0.035***	-0.085***	-0.085***
	(-4.06)	(-4.06)	(-5.27)	(-5.27)	(-5.26)	(-5.26)
Market To Book	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(4.36)	(4.36)	(3.65)	(3.65)	(3.65)	(3.65)
CAPEX	0.020	0.020	0.021**	0.021**	0.052***	0.052***
	(1.38)	(1.38)	(2.37)	(2.37)	(3.47)	(3.47)
Sale	0.000***	0.000***	0.000	0.000	0.000*	0.000*
	(3.25)	(3.25)	(1.66)	(1.66)	(1.92)	(1.92)
RPS State	0.017		0.021		0.073**	
	(0.88)		(1.15)		(2.33)	
GDP	0.030		-0.014		0.001	
	(0.36)		(-0.21)		(0.01)	
Log(Pop)	0.056		0.054		0.780**	
	(0.25)		(0.37)		(2.32)	
Temperature	0.115		0.004		-0.000	
	(1.32)		(0.04)		(-0.00)	
HDD	-0.018		-0.026		-0.001	
	(-0.52)		(-0.74)		(-0.02)	
CDD	-0.019**		-0.004		0.007	
	(-2.29)		(-0.74)		(0.46)	
State×Year FE	No	Yes	No	Yes	No	Yes
State FE	Yes	No	Yes	No	Yes	No
Year FE	Yes	No	Yes	No	Yes	No
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	223,695	223,695	223,739	223,739	223,670	223,670
Adj. R^2	0.08	0.08	0.09	0.09	0.14	0.14

Table 7: The Spillover Effect on Asset Reallocation by States

This table reports the heterogeneous spillover effect spillover effects of cap-and-trade programs on producers' power plant portfolios in unregulated states. *Treated* equals one for producers operating in states adjacent to cap-and-trade states prior to the implementation of the program, and zero otherwise. *Nearby State* indicates whether the state is located geographically close to cap-and-trade states. *Deregulated State* indicates whether the state belongs to a deregulated electricity market. *Democratic State* indicates whether the state is a democratic state. *% State Cap* measures the percentage of capacity operated in the state by the firm. Firm and state controls are included. Fixed effects are used and indicated in each column. *t*-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

	Log (Trad Cap)				Log (Renew Cap)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	-0.048***	-0.055***	-0.044***	-0.104***	0.049***	0.037***	0.050**	0.008
	(-2.97)	(-3.36)	(-2.80)	(-4.97)	(3.15)	(3.23)	(2.51)	(0.65)
Treated × Nearby State	0.094				0.112**			
	(0.81)				(2.12)			
Treated × Deregulated State		0.092*				0.128**		
		(1.75)				(2.32)		
Treated × Democratic State			0.014				0.027	
			(0.40)				(0.96)	
Treated × % State Cap				3.640***				2.170***
				(5.98)				(4.25)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	223,739	223,739	223,739	223,739	223,739	223,739	144,892	144,892
Adj. R^2	0.09	0.14	0.09	0.14	0.09	0.14	0.38	0.24

Table 8: The Role of Exposure Intensity in Asset Reallocation

This table examines how exposure shapes both the direct and spillover effects of cap-and-trade programs on producers' power plant portfolios. The dependent variables include the logarithm of traditional and renewable capacity owned by the producer. *Treated* equals one for producers operating in states adjacent to cap-and-trade states prior to the implementation of the program, and zero otherwise. *% Trad Cap*$_{reg}$ measures the percentage of producer's traditional capacity over total capacity in cap-and-trade states. *CO2 Intensity*$_{reg}$ measures the the carbon intensity of producer's power plants in cap-and-trade states. *Cap Exposure*$_{reg}$ measures the percentage of producer's total capacity in cap-and-trade states over producer's total capacity in all states. *Trad Cap Exposure*$_{reg}$ measures the percentage of producer's total traditional capacity in cap-and-trade states over producer's total traditional capacity in all states. *% Trad Cap*$_{unreg}$ measures the percentage of producer's traditional capacity over total capacity in unregulated states. *CO2 Intensity*$_{unreg}$ measures the the carbon intensity of producer's power plants in unregulated states. *Cap Exposure*$_{unreg}$ measures the percentage of producer's total capacity in unregulated over producer's total capacity in all states. *Trad Cap Exposure*$_{unreg}$ measures the percentage of producer's total traditional capacity in unregulated states over producer's total traditional capacity in all states. Firm and state controls are included. Fixed effects are used and indicated in each column. *t*-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

Panel A: Direct Exposure Intensity

	Log (Trad Cap)				Log (Renew Gen)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	0.028**	0.024**	0.016	0.018*	0.021	0.022	0.022	0.021
	(2.50)	(2.20)	(1.59)	(1.87)	(1.38)	(1.54)	(1.56)	(1.37)
Treated × % Trad Cap$_{reg}$	-0.152***				-0.019			
	(-4.44)				(-0.72)			
Treated × CO2 Intensity$_{reg}$		-0.546***				-0.166		
		(-3.78)				(-1.10)		
Treated × Cap Exposure$_{reg}$			-0.002				-0.026	
			(-0.04)				(-1.10)	
Treated × Trad Cap Exposure$_{reg}$				-0.042				-0.023
				(-0.74)				(-0.51)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	183,424	183,424	183,424	183,424	183,424	183,424	183,424	183,424
Adj. R^2	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12

Panel B: Spillover Exposure Intensity

	Log (Trad Cap)				Log (Renew Gen)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	0.004	-0.005	-0.004	-0.002	0.058***	0.035***	-0.015***	0.020**
	(0.44)	(-0.82)	(-0.54)	(-0.35)	(4.29)	(3.52)	(-2.83)	(2.27)
Treated × % Trad Cap$_{unreg}$	-0.100***				0.003			
	(-3.85)				(0.22)			
Treated × CO2 Intensity$_{unreg}$		-0.245***				0.170***		
		(-3.63)				(3.80)		
Treated × Cap Exposure$_{unreg}$			-0.078***				0.162***	
			(-3.63)				(6.03)	
Treated × Trad Cap Exposure$_{unreg}$				-0.086***				0.089***
				(-3.61)				(4.71)
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	223,739	223,739	223,739	223,739	223,739	223,739	223,739	223,739
Adj. R^2	0.09	0.09	0.09	0.09	0.14	0.14	0.14	0.14

Table 9: The Effect of Cap-and-Trade on Firm Outcomes

This table reports the effects of cap-and-trade regulation on firm outcomes. *Treated* equals one for firms operating in states adjacent to cap-and-trade states prior to the implementation of the program, and zero otherwise. The dependent variables include green patenting activity, firm size , capital expenditures, ESG score, profitability, leverage, and Tobin's Q. Control variables are with one-year lags. Fixed effects are used and indicated in each column. t-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

	Log(Green Patent)	Log(Total Asset)	CAPEX	ESG Score	ROA	Leverage	Tobin's Q	%Self-Gen
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treated	0.093**	0.025*	0.018*	-0.167	0.014	-0.007	-0.021	-0.010
	(2.20)	(1.89)	(1.94)	(-0.53)	(0.12)	(-0.07)	(-0.05)	(-1.50)
Total Asset$_{t-1}$	-0.006	0.761***	-0.031***	-0.162	2.338	-2.103	-9.615	0.007
	(-0.16)	(30.96)	(-2.70)	(-0.60)	(1.37)	(-1.38)	(-1.44)	(1.63)
Tobin's Q_{t-1}	-0.071**	0.048***	0.013***	0.092	2.271	-2.061	-8.003	0.001
	(-2.49)	(3.45)	(2.77)	(1.34)	(1.28)	(-1.28)	(-1.23)	(0.74)
Leverage$_{t-1}$	0.019	-0.163***	0.009	0.051	-6.593**	6.451***	23.065**	0.003
	(0.53)	(-4.14)	(0.50)	(0.06)	(-2.45)	(2.63)	(2.42)	(0.99)
ROA$_{t-1}$	-0.260**	-0.072	0.099***	-0.570	2.779	-2.540	-9.715	0.007
	(-2.57)	(-0.97)	(3.68)	(-0.91)	(0.90)	(-0.91)	(-0.87)	(1.31)
Market To Book$_{t-1}$	0.000**	-0.000	-0.000	0.006*	0.000*	-0.000*	-0.000*	0.000
	(2.11)	(-0.90)	(-0.13)	(1.84)	(1.76)	(-1.85)	(-1.83)	(0.25)
Market Value$_{t-1}$	0.063**	0.066***	0.015**	0.041	-1.301	1.174	5.768	-0.006
	(2.05)	(4.32)	(2.36)	(0.22)	(-1.38)	(1.39)	(1.41)	(-1.61)
CAPEX$_{t-1}$	-0.041	0.087**	0.186***	1.006	-0.737	0.878	2.337	0.001
	(-0.75)	(1.97)	(3.93)	(1.16)	(-0.67)	(0.74)	(0.59)	(0.45)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	4,747	4,664	4,378	3,163	4,391	4,657	4,378	4,747
Adj. R^2	0.86	0.99	0.44	0.52	0.60	0.67	0.57	0.74

Appendix A. Additional Tables

Table A.1: Transactions of Power Plants Across Owner Types

This table presents regression estimates examining how cap-and-trade programs affect transactions of power plants across different owner types within regulated states. Panel A reports results for traditional plants, while Panel B reports results for renewable plants. Each column represents a different seller–buyer ownership pair, including investor-owned utilities (IOUs), government-owned utilities, and independent power producers (IPPs). The dependent variables are indicators of whether the buyer(seller) is a certain type. *Treated* is an indicator equal to one in the year of an cap-and-trade implementation and all subsequent years, and zero otherwise. Plant control variables include the logarithm of plant capacity and plant age. State control variables include an indicator for *RPS State*, the logarithm of GDP, population, temperature, heating degree days (HDD), and cooling degree days (CDD). Fixed effects are used and indicated in each column. t-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

Panel A: Transactions of Traditional Power Plants

	Seller Is IOU	Seller Is Gov	Seller Is IPP	Buyer Is IOU	Buyer Is Gov	Buyer Is IPP
	(1)	(2)	(3)	(4)	(5)	(6)
Treated	-0.062	-0.004	0.190**	-0.042	-0.010**	0.106
	(-0.76)	(-0.61)	(2.07)	(-0.57)	(-2.07)	(0.87)
Plant Cap	0.023	-0.001	-0.030**	0.032*	-0.001	-0.027*
	(1.42)	(-0.59)	(-2.16)	(1.82)	(-1.07)	(-1.92)
Plant Age	0.089***	-0.002	-0.035*	0.050**	0.003	-0.015
	(4.98)	(-1.55)	(-1.69)	(2.57)	(1.16)	(-0.64)
RPS State	0.146	-0.004	-0.145	0.057	-0.014*	-0.046
	(1.02)	(-0.59)	(-1.10)	(0.37)	(-1.79)	(-0.27)
GDP	-0.351	-0.091	0.958	-0.082	-0.101	0.789
	(-0.46)	(-1.06)	(1.06)	(-0.11)	(-0.99)	(0.88)
Population	1.562	-0.019	-1.460	1.401	0.062	-1.803
	(1.05)	(-0.14)	(-0.97)	(0.91)	(0.44)	(-1.33)
Temperature	-4.160	-0.226	5.422**	-1.310	-0.431	1.829
	(-1.36)	(-0.60)	(2.12)	(-0.65)	(-0.96)	(0.94)
HDD	-0.727	-0.224**	0.872**	-0.522	-0.194*	0.848**
	(-1.59)	(-2.25)	(2.32)	(-1.58)	(-1.88)	(2.69)
CDD	0.142	0.018	-0.492**	-0.122	-0.023	0.156
	(0.70)	(0.64)	(-2.32)	(-0.62)	(-0.45)	(0.71)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	820	820	820	820	820	820
Adj. R^2	0.38	0.10	0.35	0.39	0.07	0.32

Panel B: Transactions of Renewable Power Plants

	Seller Is IOU	Seller Is Gov	Seller Is IPP	Buyer Is IOU	Buyer Is Gov	Buyer Is IPP
	(1)	(2)	(3)	(4)	(5)	(6)
Treated	-0.034	-0.070**	-0.034	0.030	-0.070**	0.060
	(-0.49)	(-2.62)	(-0.25)	(0.33)	(-2.62)	(0.38)
Plant Cap	-0.008	0.001	-0.011	-0.007	0.001	-0.002
	(-0.89)	(0.48)	(-0.59)	(-0.81)	(0.48)	(-0.13)
Plant Age	0.044**	0.005	-0.020	0.046**	0.005	-0.023
	(2.43)	(1.49)	(-1.06)	(2.45)	(1.49)	(-0.95)
RPS State	0.001	-0.023	-0.020	0.033	-0.023	-0.225**
	(0.01)	(-1.10)	(-0.17)	(0.48)	(-1.10)	(-2.49)
GDP	-0.103	0.244*	-0.591	-0.200	0.244*	-0.946
	(-0.26)	(1.81)	(-0.83)	(-0.54)	(1.81)	(-1.26)
Population	0.309	-0.350*	2.808***	0.189	-0.350*	3.292***
	(0.42)	(-1.76)	(2.88)	(0.25)	(-1.76)	(2.73)
Temperature	-2.586	1.418	5.490**	-3.442**	1.418	5.148**
	(-1.47)	(1.59)	(2.03)	(-2.03)	(1.59)	(2.46)
HDD	-0.394	0.309	1.001**	-0.582*	0.309	1.036**
	(-1.37)	(1.54)	(2.41)	(-1.85)	(1.54)	(2.67)
CDD	0.216	-0.051	-0.028	0.162	-0.051	-0.319
	(1.35)	(-0.83)	(-0.09)	(0.93)	(-0.83)	(-1.08)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	830	830	830	830	830	830
Adj. R^2	0.33	0.12	0.21	0.50	0.12	0.34

Table A.2: The Impact of Cap-and-Trade on Electricity Market

This table reports the effects of cap-and-trade programs on electricity market outcomes. The dependent variables are the logarithm of electricity sales, electricity revenue, and electricity price. *Treated* is an indicator equal to one in the year of an cap-and-trade implementation and all subsequent years, and zero otherwise. State control variables include an indicator for *RPS State*, the logarithm of GDP, population, temperature, heating degree days (HDD), and cooling degree days (CDD). Fixed effects are used and indicated in each column. t-values are reported in parentheses. Statistical significance is denoted by *, **, and *** for the 10%, 5%, and 1% levels, respectively.

	Log (E-sales)		Log (E-revenue)		Log (E-price)	
	(1)	(2)	(3)	(4)	(5)	(6)
Treated	0.026	0.039	-0.123***	-0.107***	-0.149***	-0.146***
	(0.65)	(1.01)	(-4.44)	(-4.01)	(-3.49)	(-3.01)
RPS State		0.043		-0.005		-0.048
		(1.66)		(-0.23)		(-1.32)
GDP		0.450***		0.500**		0.050
		(3.07)		(2.36)		(0.36)
Population		-0.068		-0.044		0.024
		(-0.28)		(-0.13)		(0.05)
Temperature		0.001		-0.015		-0.016
		(0.00)		(-0.11)		(-0.08)
HDD		0.081**		0.084*		0.003
		(2.46)		(1.78)		(0.04)
CDD		0.021*		0.041**		0.020
		(1.96)		(2.43)		(1.28)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	874	874	874	874	874	874
Adj. R^2	0.99	1.00	0.99	0.99	0.84	0.84