The Shifting Finance of Electricity Generation*

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Abstract

Over the 2005–2020 period, domestic publicly listed corporations reduced their ownership of U.S. electric power from 71% to 54% of total generation. Private equity, institutional investors, and foreign publicly listed corporations increased their ownership from 6% to 24%, and as of 2020 owned 60% of wind, 45% of solar, and 28% of natural gas generation capacity. New entrants have increased their share largely through the creation of new plants, as opposed to acquisitions of existing plants. We find only limited support for the leakage hypothesis that new entrants acquire older fossil-fuel power plants from incumbent domestic listed corporations and keep operating these plants. Market deregulation is the main economic factor explaining the heterogeneity in ownership structure and differences in the rates of creation and destruction of new assets at different locations. Deregulated wholesale markets and retail markets attract more capital from new entrants to create new plants as well as stimulate incumbent owners to retire existing assets more quickly. The changing ownership structure has implications for electricity markets as private equity operates power plants more efficiently at lower heat rates and sells electricity for a $1.92 higher average price per MWh. Within markets of a given regulatory structure, time, and technology, private equity owners sell electricity under contracts with shorter duration, shorter increment pricing, and more peak-term periods, especially when selling electricity generated from fossil fuels.

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1 Introduction

The impacts of both competition and financing on promoting innovation have been a significant topic of research for most of the past century. Schumpeter (1942) argued that the canonical firm in an environment of perfect competition has fewer incentives and lesser scope to adopt new technologies compared to larger firms in oligopolistic markets. Implementing innovation also requires investors willing to put capital at risk, so if smaller firms are to disrupt larger ones with new technologies, the smaller firms require significant financing. Arrow (1962) in contrast argued that market power stifles innovation, as firms wish to protect their rents and avoid cannibalization of existing assets, and that market competition spurs competition. The destruction process is also costly as incumbents face legal or regulatory risks associated with legacy technologies and will question whether they should retain "stranded" assets or transfer them to specialized firms.[1] Whether the implementation of innovation comes more from dominant incumbents or smaller new entrants depends on the competitive and regulatory environment, as well as the availability of capital whose owners are willing to bear risk (Shapiro, 2011).

In this paper, we find that in the electricity generation industry, competitive markets attract new owners and facilitate the creation and destruction of assets. The electricity generation industry is well-suited to examine the role of competition and innovation for three reasons. First, power plants are infrastructure assets that can stimulate long-term economic growth through spillovers to other sectors and provision of vital services to the population (Glaeser and Poterba, 2020). Blackouts and pricing volatility in electricity markets can have a profound influence on industrial production, quality of life, and poverty. The 2022 Russian invasion of Ukraine and other global events have also heightened demands for energy independence across countries, a goal that requires substantial new

[1] The term "stranded assets" refers to legacy assets whose values unexpectedly and prematurely decline and expose incumbents to economic losses and risks. In the energy industry, the term refers to older assets using fossil fuels whose value may decline due to technology shifts or regulation promoting green energy.

investments. Second, the energy sector is a capital-intensive sector that has experienced a great deal of innovation, including new renewable technologies using solar and wind energy as well as the shale gas boom (e.g., Gilje, Loutskina, and Strahan, 2016). Implementing these innovations requires large amounts of capital. Third, electric power generation is at the center of government environmental policy and demands for reduced carbon emissions.[2] The electricity generation industry requires substantial investments if its carbon footprint is to be further reduced.

We collect data on the ownership of U.S. power plants and document changes in the ownership of electricity generating assets. Over the 2005–2020 period, the ownership share of domestic listed corporations (DLCs) has declined from 71% to 54%, while total U.S. electricity generation has remained roughly constant at around 4.1 trillion kWh per year. Private equity (PE), institutional investors, and foreign listed corporations have gradually replaced DLCs in the ownership of both renewable and fossil fuel power plants. As of 2020, PE, institutional investors, and foreign listed corporations together owned 60% of wind, 45% of solar, 28% of natural gas, and 11% of coal electricity generating capacity.

We analyze the relative importance of three mechanisms that could drive these ownership changes — creation of new power plants, acquisitions of existing power plants, and decommissioning (shutdown) of power plants — as well as the economic conditions that facilitate ownership transitions. To do this, we compare the role of incumbent owners, which are primarily DLCs, and new owners which include PE, institutional investors, and foreign corporations, in each of the three mechanisms. We then analyze the economic conditions that enable creation and destruction and examine the impact of market competition. Our primary measure of deregulated markets captures whether the wholesale electricity market is administered by an independent balancing authority rather than a traditional

[2] The International Energy Association (2021) calculated that energy investments must rise to $5 trillion per year by 2030 to achieve net zero emissions by 2050. At the 26th Glasgow Conference of the Parties, 450 financial institutions that manage $130 trillion of assets pledged to use their funds towards that goal (Council on Foreign Relations, 2021).

vertically integrated utility.[3] The staggered introduction of "market dispatch" and independent system operators (ISOs) as balancing authorities represents an important source of regional-level variation in market competition (Borenstein and Bushnell, 2015; Cicala, 2022). The ISO-operated wholesale markets were established before our sample period, and before new technologies became competitive, which reduces concerns regarding reverse causality. We also consider other more restrictive measures of deregulation at the wholesale and retail levels.

The first mechanism driving ownership changes focuses on differences in the creation of new power plants. DLCs are the incumbent owners and may have certain competitive advantages for creating new assets, including size, established access to the electrical grid, synergies with existing operations, and the ability to influence government policy (e.g., Chandler, 1994; Autor, Dorn, Katz, Patterson, and Van Reenen, 2020; Kwon, Ma, and Zimmermann, 2023). However, DLCs may prefer to delay the implementation of new technology when they are protected by limited competition and a lack of market discipline (e.g., Arrow, 1962; Bertrand and Mullainathan, 2003; Gutiérrez and Philippon, 2017; Cunningham, Ederer, and Ma, 2021). The incentives to promote innovation may also depend on the firm's ownership structure (Aghion, Van Reenen, and Zingales, 2013; Antón, Ederer, Giné, and Schmalz, 2023).

Consistent with a strong role for new entrants in creating greenfield assets, which we define as the first 12 months of plant operation, we find that PE and foreign listed corporations have financed 25% and 13% of all new power plants, respectively. Conditional on power plant fuel type (i.e., solar, wind, natural gas, coal, and other production technologies) and plant state, PE is 1.33 percentage points more likely to own a given power plant in the greenfield stage than DLCs, which represents an increase of 82% relative to the baseline greenfield share of 1.63%. Foreign corporations are 0.95

[3] The introduction of ISO balancing authorities occurred during the wave of state-level restructurings in the 1990s and early 2000s, before the expansion of renewable technologies and shale gas. The restructuring reform allowed independent power producers to sell electricity to utilities, and new retail service providers to displace utilities' role in procuring energy and billing customers. The wholesale market restructurings are generally associated with production cost reductions (Fabrizio, Rose, and Wolfram, 2007; Davis and Wolfram, 2012; Cicala, 2015).

percentage points more likely to own a greenfield plant than DLCs, an increase of 58% relative to the baseline. Institutional investors are considerably less likely to directly own a greenfield plant, as they seek more mature operating assets with stable cash flows. We show that our results do not merely reflect differences in creation probabilities between regulated utilities and independent power producers (IPPs), as IPPs owned by DLCs are significantly less likely to own greenfield plants.

Deregulated wholesale and retail electricity markets have an overall higher proportion of greenfield assets. These markets experience more innovation because they attract investments from new owners. The difference in new power plant creation between DLCs versus PE and foreign corporations is significant only in deregulated wholesale markets. Our results do not support the Averch and Johnson (1962) argument that regulated utilities engage in more capital investments because they receive an artificially high rate of return on capital. Traditional electricity markets exhibit a lower level of asset creation, potentially because state utility commissions adhere to the "used and useful principle" when permitting new investments. Under this principle, electric utilities need to show that a power plant will be used and useful to current ratepayers in order to get the regulator's approval to include a corporate investment in the cost of service.

The second mechanism driving ownership changes focuses on sales of existing power plants by incumbent DLCs to PE, institutional investors, and foreign corporations. PE has experienced substantial inflows in the past decade as institutional investors have increased allocations to alternative asset classes (Ivashina and Lerner, 2018; Andonov and Rauh, 2022). One potential concern is that this transaction mechanism could lead to leakage (reallocation) of older power plants using fossil fuels from DLCs to new owners (Fowlie, Reguant, and Ryan, 2016; Copeland, Shapiro, and Taylor, 2021). Stricter disclosure requirements apply to DLCs, and they are also more likely to be affected by public pressure (Benthem et al., 2022; Bolton and Kacperczyk, 2022).[4] DLCs might therefore

[4]One example of the increased public scrutiny is the 2021 action by activist investor Engine No. 1 in collaboration with several large asset managers to win board seats at Exxon Mobil Corporation. The activist investors then voted to cut oil production at Exxon, and Exxon reportedly sold some oil fields to PetroChina (Rubenfeld and Barr, 2022).

sell their older power plants to owners who are subject to more lenient regulatory and disclosure requirements such as private equity (see Bernstein (2022) for a review) and foreign corporations.[5]

While the sales mechanism is important for the reallocation of ownership of electricity generating assets from DLCs to new ownership types, there is little evidence that this leads to an extension in the lifespan of fossil fuel plant operations. Using multinomial logit specifications for outcomes of power plants owned by DLCs at the start of our sample in 2005, we document three results that do not support the leakage hypothesis. First, the older the plant, the more likely the plant is to be retired by the DLC and the less likely it is to be sold and still operating. Second, DLCs are not more likely to sell power plants located in states where the population has high climate concerns. Third, coal, petroleum, and natural gas plants are 32% more likely to have been retired by the original DLC owner than other fuel types, but no more likely to be sold to other owners and still in operation.

The third mechanism is differences in decommissioning of power plants. If the new owners are more likely to continue operating plants for a longer period than DLCs, their ownership stake will increase. The same differences in disclosure requirements and public scrutiny that affect asset sales could also affect ownership through differences in decommissioning rates. However, DLCs have a marginally higher probability of owning a coal or petroleum power plant that is decommissioned within 12 months and the differences are not statistically significant, although in the most regulated areas they may be less likely to decommission plants. PE has a similar probability of shutting down power plants as DLCs, though is more likely to decommission natural gas and is more likely to shut down plants than institutional investors or foreign corporations.[6] The sales and decommissioning mechanisms are also stronger in competitive electricity markets.

[5]The leakage hypothesis relates to the concerns about outsourcing pollution in international trade (e.g., Antweiler, Copeland, and Taylor, 2001; Cherniwchan, Copeland, and Taylor, 2017; Shapiro and Walker, 2018; Shapiro, 2021).

[6]When investing directly in power plants, institutional investors seem to reduce their exposure to the creation of new assets as well as shut down of old assets, as these activities are associated with higher liability and litigation risks (e.g., Bellon, 2022; Lam, 2022). Consequently, we find that institutional investors do not hold almost any plants in the decommissioning stage but have also very limited overall exposure to power plants using coal and petroleum fuels.

Overall, the majority of changes in ownership of power plants occur through the creation of new greenfield assets and decommissioning of older assets. The sales mechanism has a limited role in explaining the ownership changes. Electricity market deregulation is the main driver of ownership changes. Deregulated markets attract new capital from PE and foreign corporations that implement innovative technologies. In terms of economic factors, the effect of market deregulation on heterogeneity in ownership structures is robust to controlling for climate concerns among the state population, and policy incentives for renewable energy.

Finally, we examine the implications of ownership changes for operational performance, contracting, and pricing in electricity markets. Based on the ratio of fuel consumption relative to electricity generation ("heat rate"), fossil fuel power plants owned by PE, institutional investors, and foreign listed corporations operate more efficiently than power plants owned by DLCs and consume around 4% less fuel per unit of electricity. We also reject an alternative version of the leakage hypothesis, namely that the new owners might operate the older fossil fuel assets more intensively or less efficiently. If anything, PE operates plants at a slightly lower intensity ("capacity factor"), particularly natural gas power plants.

Using the Federal Energy Regulatory Commission (FERC) Electric Quarterly Reports (EQR) data on electricity transactions, we find that PE implements substantially different electricity contracts, though primarily in the non-renewables space. Across all types of electricity generation, private-equity-owned power plants sell electricity for $1.92 higher average price per MWh relative to other producers of the same fuel type in the same state and month. PE owners enter into contracts with more short-term duration, lower length increments, and more peak-period sales, all conditional on fuel type. Direct ownership by institutional investors is associated with longer term contracts and contracts with longer increment lengths, in line with their objective to obtain stable long-term cash flows from infrastructure investments (Andonov, Kräussl, and Rauh, 2021). The results overall indicate that the level of pricing by PE is higher and shorter-duration than pricing by DLCs.

The fact that PE and foreign corporations are now financing a large share of the energy transition may well reflect the reluctance of domestic corporations to cannibalize their existing assets, although there are several alternative explanations. If these incumbent companies engage in a mix of fossil fuel and renewable electricity generation, raising capital given the increasing number of investors with ESG objectives may be more costly. Furthermore, the compliance costs and need for disclosure in public markets may have driven much of the implementation of innovative electricity generation technologies to private firms, where PE is the most important source of finance. Our results on the energy sector, fit into the broader trend of declining number of U.S. listed companies (Doidge, Karolyi, and Stulz, 2017; Ewens and Farre-Mensa, 2020).

In addition to the literature on the role of new entrants as adopters of technology (e.g., Shapiro, 2011), our findings also relate to research on the role of regulation and market power in the environmental space (Porter, 1996; Jaffe and Palmer, 1997) as we observe that owners with a monopoly on customers, such as incumbent domestic corporations, industrial firms, cooperatives, and government, are the last to adopt new technology (Aghion, Bergeaud, and Van Reenen, 2021). Our results contribute also to the literature on climate finance (e.g., Hong, Karolyi, and Scheinkman, 2020; Giglio, Kelly, and Stroebel, 2021), as we highlight the role of capital expenditures and greenfield investments from new entrants and competitive markets in accelerating the energy transition away from legacy electricity generation technologies. Our results on the limited acquisitions of older fossil fuel power plants by new entrants complement findings that banks also reduce financing of these plants (Green and Vallee, 2022). We show that these reduced financing sources force DLCs to retire older fossil fuel assets, especially in competitive markets.

Our paper relates to the energy economics literature that studies the deregulation of wholesale electricity markets, or more specifically the ceasing of regulating vertically-integrated utilities based on cost-of-service and the impact on market power in deregulated markets (e.g., Borenstein, Bushnell, and Wolak, 2002; Borenstein, 2002) and efficiency gains from markets (e.g., Fabrizio, Rose, and Wolfram, 2007; Cicala, 2015, 2022). Demirer and Karaduman (2023) find that acquired power plants experience efficiency increases. Our contribution is to show that as the regulatory status changes, ownership structure also changes, and new participants, such as PE and foreign corporations, potentially drive efficiency improvements in the deregulated electricity markets.

Finally, our paper relates to the literature on the impact of PE on efficiency, employment, and productivity.[7] We study the creation of new assets and retirement of existing assets, rather than focusing only on changes in ownership through acquisitions. PE plays a major role in adopting new technologies and shutting down stranded assets, but this is not necessarily attributable to PE's business model and high-powered incentives, since foreign corporations also adopt innovative technologies. The creation and destruction seem to be primarily affected by market competition, incumbency status, and pressures specific to U.S. public firms versus their foreign and private counterparts.

2 Power Plants and Electricity Generation

Our sample covers all U.S. power plants reporting to the Energy Information Administration (EIA) over the 2005–2020 period. We use EIA Form 923 to collect data on monthly electricity net generation at the level of a power plant by technology by month, which we call the "power-plant-prime-mover" level. That is, if a power plant in a given time period uses multiple technologies ("prime movers") for generating electricity (e.g., a natural gas plant using a steam turbine, combustion turbine, and

[7] Prior research has examined the impact of PE ownership on operational performance, productivity, employment, and profitability (e.g., Davis et al., 2014; Bernstein and Sheen, 2016; Antoni et al., 2019; Davis et al., 2021); workplace safety, employees health, and employee satisfaction (e.g., Cohn et al., 2021; Lambert et al., 2021); environment and pollution (e.g., Shive and Forster, 2020; Bellon, 2022; Bai and Wu, 2023); customers in regulated industries such as education and healthcare (e.g., Eaton, Howell, and Yannelis, 2020; Liu, 2022).

combined-cycle combustion turbine), it will have multiple observations in that time period. EIA Form 860 provides information on all U.S. power plants with at least 1MW of nameplate capacity. [8]. We aggregate the information from EIA Form 860 for power-plant generators that use the same prime-mover technology and merge both datasets on a power-plant-prime-mover level. Table 1 shows that our sample contains 11,590 unique power plants, 13,282 unique power-plant-prime-mover units, and 1,510,761 monthly observations. Fossil fuel power plants often use multiple prime-mover technologies, while nuclear, hydro, wind, and solar power plants rely only on one prime-mover technology. When we use the term power plant in this paper, we refer to power-plant-prime-mover observations.

Table 1 reports summary statistics on the average power plant characteristics. In our analysis, all values are weighted by power plant nameplate capacity. We present weighted statistics and regression estimates, as the sample of power plants contains many small power plants that contribute very little to overall net generation. For instance, there are 3,941 unique solar power plants in the sample, but they account for less than 3% of electricity generation in 2020. The average power plant (weighted by capacity) has a nameplate capacity of 0.98GW (980MW) and is 30.9 years old.

Based on the EIA data, we construct two measures of the operating performance of power plants. The first measure, the capacity factor, captures the operating intensity and is defined as the ratio of monthly generation to nameplate capacity run over a month (the maximum potential output). Power plants differ in the average capacity factor based on the fuel type. Nuclear power plants operate almost continuously and have the highest average capacity factor of 0.86, while solar power plants depend on the weather and have the lowest average capacity factor of 0.24.[9] The second

[8] For example, if a 1MW rated plant is run at its maximum strength for an hour it would produce 1MWh of electricity. The average US residential utility customer consumed around 10MWh of electricity in a year: [Link]

[9] One limitation of the nameplate-capacity-weighting is that power plants that rely on fuels with lower capacity factors, such as wind and solar farms, will receive disproportionately higher weights than power plants that use fuels with higher capacity factors, such as nuclear energy. In our analysis, we rely primarily on capacity weights within a fuel type, but we also estimate robustness tests without weighting. In these robustness estimations, we limit attention to the subsample of larger power plants with a capacity of at least 20MW. Online Appendix Table A.1 reports summary statistics without weighting the power plants and focuses only on the subsample of power plants with a capacity of at

measure, heat rate, captures operating efficiency and is defined as the ratio of fuel consumption in millions Btu to electricity generation in MWh. We observe the heat rate for fossil fuel and nuclear plants, and lower values imply lower fuel consumption and higher efficiency.

Table 1 also presents statistics on new ("greenfield") and decommissioned power plants. We classify power plants as greenfield assets in the first 12 months of plant operation. Our sample contains 6,111 unique greenfield plants and their first 12 months of operation account for 1.63% of our sample on a capacity-weighted basis. Greenfield plants are concentrated in new renewable technologies, such as solar and wind, as well as natural gas plants built on the shale gas boom. The decommissioned indicator is set equal to one for the last 12 months of plant operation before a plant is shut down. During our sample period, 2,015 unique power plants are shut down, and their last 12 months of operation account for 1.06% of our sample on a capacity-weighted basis. Decommissioned plants are concentrated in fossil fuels, such as coal and natural gas.

We manually collect ownership data of all U.S. power plants based on regulatory announcements, Preqin infrastructure dataset, S&P Global, and newswire articles, and classify the owners into eight categories.[10] The largest category based on ownership stakes is *domestic publicly listed corporations*, or DLCs, which includes both traditional utilities and listed independent power producers (e.g., Duke Energy, Exelon, PG&E, Southern Company, etc.). DLCs are the incumbent owners of power plants as the vast majority originated from vertically-integrated electric utilities.[11]

The other traditional owners of power plants are industry firms, government, and cooperatives. The *industry* category includes power plants owned by industrial companies engaged in energy-intensive manufacturing, such as production of paper, steel, aluminum, and chemical products (e.g., International Paper Co, Dow Chemical Co, Alcoa Corporation, etc.). These industrial firms

least 20MW.

[10]We do not classify tax equity investors as owners because tax equity investors do not have decision-making power and acquire different share classes (Shive, 2022).

[11]The domestic publicly listed corporations category includes also YieldCo companies, such as NRG Yield and NextEra Energy, established by U.S. corporations to sell minority stakes and raise capital.

consume most of the produced energy for their own production purposes. The *government* category includes power plants owned by federal, state, and local governmental entities (e.g., Tennessee Valley Authority, U.S. Bureau of Reclamation, Los Angeles Department of Water and Power, etc.). The electric *cooperatives* category covers power plants that are built and owned by the communities they serve (e.g., Basin Electric Power Coop, Associated Electric Coop, East Kentucky Power Coop, etc.).

The new rising owners of power plants are private equity, institutional investors, and foreign corporations. The *private equity* category includes investments made by private equity buyout and infrastructure funds as well as other investment vehicles (e.g., ArcLight, KKR, LS Power, Macquarie, etc.). In this category, we also incorporate a small number of power plants owned by private firms and family businesses (e.g, Caithness Energy, Invenergy, Koch Industries, Tenaska, etc.). The *institutional investors* category covers direct investments of pension funds, insurance companies, and sovereign wealth funds in energy assets. Almost all direct investments come from foreign institutional investors, such as Canadian and Dutch pension funds (e.g., Canada Pension Plan Investment Board, Ontario Municipal Employees Retirement System, Algemene Pensioen Groep, etc.). The *foreign publicly listed corporations* category covers power plants owned by European, Canadian, and Asian energy companies (e.g., EDP Group, Engie, Iberdrola, Itochu Corporation, Kansai Electric Power Co., Osaka Gas, etc.). The final category includes *other* small power plants, which we have not classified yet in one of the other categories.

Table 1 and Figure 1 show that we categorize 99% of the electricity generation in any month over the 2005–2020 period into one of the seven ownership categories, and the remaining other category covers around 1% of the generation. If a power plant is owned by multiple ownership types, we divide the ownership and generation equally across the ownership types (i.e., if a private equity and institutional investor jointly own a power plant, we assume that each ownership type owns 50% of the plant). This adjustment does not matter for most ownership types, as they typically act as sole investors and acquire 100% stake in the power plants, except for institutional investors. Institutional investors typically co-invest with other investors, and they share ownership in more than 93% of their observations.[12] Thus, institutional investors do not lead energy investments but rather provide deep pockets for larger transactions or partial exit to other investors (Fang, Ivashina, and Lerner, 2015; Andonov, Kräussl, and Rauh, 2021; Lerner, Mao, Schoar, and Zhang, 2022).

Figure 1 shows that the percentage of electricity generated by power plants owned by domestic corporations declines from 71% in 2005 to 54% in 2020. Private equity, institutional investors, and foreign corporations replace domestic corporations as their share jointly increases from 6% in 2005 to 24% in 2020. The generation share of governments, cooperatives, and industry firms remains constant. The ownership changes while the total output remains constant. Online Appendix Figure A.1 Panel A shows that U.S. produced around 4.1 trillion kWh of electricity in 2005 and the total output has remained constant over our sample period. Panel B plots the total imports and exports of electricity, which also remain stable over our analysis and are economically marginal as they account for less than 1.5% of the U.S. electricity market.

The ownership structure of power plants differs across fuel types. Figure 2 depicts ownership shares for the six main fuel types: natural gas, coal, nuclear, hydro, wind, and solar.[13] Renewable fuels have a smaller contribution to overall electricity generation, so we scale the y-axis for their plots to 35TWh, while nuclear and fossil fuels account for the majority of generation and we scale y-axis for their plots to 200TWh. Over the 2005–2020 period, natural gas became the main fuel for electricity generation and has replaced declining coal generation. Wind and solar energy are increasing over

[12]For instance, Canada Pension Plan Investment Board co-invested with Energy Capital Partners fund in the buyout of Calpine Corporation in 2018. Alberta Investment Management Corporation established a joint venture with AES Corporation to acquire Sustainable Power Group LLC (Power) in 2017.

[13]The hydro category includes only power plants using hydraulic turbines as a prime mover and excludes plants with pumped storage as a prime mover. The solar category includes only power plants with a photovoltaic prime mover and excludes plants with steam turbines that can use a solar stream. The EIA data covers only utility-scale solar and does not include information on distributed small-scale solar. The nameplate capacity of the small-scale photovoltaic installation is around 33GW in 2021, or 50% of the capacity of utility-scale solar, so the EIA data slightly underestimates the importance of solar energy (EIA Table 4.3).

the sample period and account for the majority of newly created plants. The amount of electricity generation from hydro and nuclear power plants stays relatively stable, despite the decommissioning of some assets, and the ownership structure of these assets also does not exhibit significant shifts. The new types of owners (private equity, institutional investors, and foreign corporations) controlled 58% of the wind, 47% of the solar, and 34% of the natural gas electricity generation as of 2020. DLCs own a large part of the generation in all fuel types, but they are especially negatively affected by the declining coal generation.

Table 1 Panel C presents statistics on the electricity markets. *ISO Balancing* is our main measure of market competition, and it is an indicator for power plants that operate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority. The ISOs provide nondiscriminatory grid access and were formed after the adoption of the Energy Policy Act of 1992 and Federal Energy Regulatory Commission (FERC) orders 888 and 889.[14] In the areas that are not serviced by an ISO, vertically integrated local electric utilities own power plants generating electricity as well as the transmission system and delivery network. These utilities do not adopt a market dispatch mechanism and could potentially exclude independent producers from the market by denying transmission access (Borenstein and Bushnell, 2015; Cicala, 2022). The utilities that serve also as a balancing authority within their exclusively operated territories are typically owned by the government or DLCs. Importantly for our analysis, the ISO-operated wholesale markets were established before our sample period, mostly around 2000, and before the wind and solar technologies became competitive as well as before the shale gas revolution, which reduces concerns regarding reverse causality that ISOs were created to stimulate the adoption of new technologies.

A closely related measure we also consider, *ISO Restructured*, is an indicator for power plants that participate in a wholesale market administered by an ISO balancing authority and are located

[14]Our definition classifies the following balancing authorities as ISO: California Independent System Operator, Electric Reliability Council of Texas, Midcontinent Independent System Operator, ISO New England, New York Independent System Operator, PJM Interconnection, and Southwest Power Pool.

in areas with restructured electric utilities. We identify states that have an ISO balancing authority and restructured electric utilities based on the EIA classification of states that have liberalized retail markets. These states required the break-up of vertically integrated utilities through asset sales. In these cases of forced divestiture, the utilities sold off their generating assets or transferred them to unregulated affiliates (Fabrizio, Rose, and Wolfram, 2007; Cicala, 2015). The forced divestitures were completed by 2002, so they do not drive the ownership changes in our sample period, but these changes created relatively more competitive markets. Thus, *ISO Restructured* is a more restrictive definition of market competition than *ISO Balancing*. Based on Table 1 Panel C, 61% of the power plants participate in a wholesale market that is administered by an ISO balancing authority, while only 37% participate in a wholesale market administered by an ISO balancing authority and are located in areas with restructured electric utilities.[15]

An alternative measure of the regulatory environment captures states which have restructured their retail electricity markets, i.e. marketing and resale of wholesale power to end-use customers (Borenstein and Bushnell, 2015). The *Retail Choice* indicator variable is equal to one for power plants located in an area (typically state level) where residential or business customers have some level of choice of who provides their electricity.[16] These state restructuring initiatives stopped after the California electricity crisis in 2000–2001, and there were no changes after 2003.

Online Appendix Table A.2 shows how many power plants in each state operate under a deregulated wholesale and retail market. This table shows that the *ISO Balancing* measure is broader as it covers also states that did not restructure their utilities but agreed to operate in a competitive wholesale market. On the other hand, the vast majority of power plants located in an

[15]Our definition of *ISO Restructured* classifies mainly the following balancing authorities as restructured markets: Electric Reliability Council of Texas, ISO New England, New York Independent System Operator, and PJM Interconnection.

[16]The *Retail Choice* variable is equal to one for states that offer full retail choice (e.g., Illinois and Pennsylvania) as well as limited retail choice (e.g., California and Michigan). We construct this indicator based on the EIA classification of state electric industry restructuring as of 2003 (EIA summary and map: link) and verify the status of the electricity market using regulatory legal documents and energy industry reports, such as National Renewable Energy Laboratory, ElectricChoice, PowerSuite, and American Coalition of Competitive Energy Suppliers.

area that offers a *Retail Choice* participate in an *ISO Restructured* wholesale market. While there is significant overlap between the ISO Restructured and Retail Choice, a number of western states such as California, Nevada, and Oregon retain the structure of vertically integrated utilities while also offering retail choice.

Based on the Yale Climate Opinion Maps, we collect information on climate concerns on a state level over time (Howe, Mildenberger, Marlon, and Leiserowitz, 2015). The Yale Climate Survey was created in 2014 and then rerun in 2016, 2018, and 2021.[17] The comparison of responses within a state over time is limited by changes in the survey design, but we focus on cross-sectional differences across states measured in the same survey year. Our *Climate Concern* variable is based on the percentage of the state population who think that global warming is happening, and it is defined as the percentile ranking between zero and one of the state where the plant is located. The percentile rankings of states based on climate concern over time are very stable and, therefore, we merge the survey ranking in 2014 with our data on power plants over the 2005–2014 period. We make similar adjustments with the later survey waves.

We use the Database of State Incentives for Renewables & Efficiency from the N.C. Clean Energy Technology Center to collect information on the policy incentives introduced by different states to stimulate the transition to renewable energy sources. We split the policy initiatives into three types of tax incentives: Renewables Corporate Tax, Renewables Property Tax, and Renewables Sales Tax; and two types of production incentives: Renewables Production and Renewables Tariffs.[18] In our analysis, we include a *Renewables Incentives* index, which aggregates the three tax indicators and the two production indicators. Online Appendix Table A.3 presents the average value of the five

[17]The Yale Climate Opinion Maps data has been used by Bernstein, Gustafson, and Lewis (2019) and Baldauf, Garlappi, and Yannelis (2020) to examine the relation between climate change beliefs and real estate prices.

[18]Renewables Corporate Tax Incentives capture programs that provide a corporate tax credit, corporate tax deduction, and corporate depreciation. Renewables Property Taxes capture programs offering property tax exemption or reduction. Renewables Sales Taxes incentives offer an exemption or reduction from sales and use tax for equipment, generation, etc. Renewables Production incentives offer monetary compensation per KWh that can differ by fuel type and plant capacity. Renewables Tariffs incentives capture primarily feed-in tariffs, which offer long-term contracts with an above-market price to renewable energy producers.

indicators and aggregate renewables incentives index by state over the 2005–2020 period. The index varies from 0.00 in Arkansas to 3.91 incentive types in Vermont.

Figure 3 shows that the trend in ownership changes is similar across all U.S. states, but domestic corporations decrease their ownership share relatively more in states with deregulated energy markets. In the states with liberalized competitive energy markets, such as Ohio and Pennsylvania, especially private equity increases the ownership share. Institutional investors almost did not exist as energy owners in most U.S. states in 2005, but they increase their share across all U.S. states. The ownership stake of foreign corporations in 2005 was almost exclusively based on the acquisition of PacifiCorp by Scottish Power, but foreign corporations owned power plants almost in all states in 2020. Thus, the ownership changes are broad and affect the entire U.S. electricity market.

We merge the EIA power plant data with information on pricing and contracting of electricity sales from the Federal Energy Regulatory Commission (FERC) Electric Quarterly Reports (EQR) data on electricity transactions. The FERC EQR data is available from July 2013 to December 2020, and we convert the quarterly reports into monthly data.[19] The FERC regulatory requirements affect (larger) power plants located in states that are interconnected with power plants in other states. This requirement implies that power plants located in Alaska and Hawaii do not complete the FERC EQRs. Moreover, power plants operating in the Electric Reliability Council of Texas (ERCOT) are also not interconnected with power plants in other states and are not required to report to FERC.[20]

The two main products that power plants sell are capacity and electricity. The capacity sales are used in some wholesale electricity markets to pay power plants for being available to meet predicted electricity demand in the future. The objective of capacity markets is to cover the fixed costs of building and maintaining power plants and ensure having sufficient capacity to produce electricity

[19] If an electricity transaction in the FERC dataset continues over multiple months, we split the quantity and transaction charges across the months based on the number of days contracted in each month.

[20] The FERC EQR data has been used by Lin, Schmid, and Weisbach (2021) to study pricing and liquidity management.

in the future. However, capacity sales do not represent a commitment to produce electricity. Power plants sell electricity to meet consumers' demands using separate spot-market or long-term contracts.

Overall, we merge 306,160 monthly observations owned by domestic publicly listed corporations, private equity, institutional investors, and foreign publicly listed corporations with FERC data on contractual terms and pricing. We do not analyze electricity transactions of power plants owned by government, cooperatives, and industrial firms as they typically do not transact on the wholesale market, but rather use their electricity generation for their own consumption within an area that they exclusively serve.[21] Panel A of Table 2 shows that the average electricity price is $33.57 per MWh, while the median price is $31.08 per MWh.

We classify electricity transactions based on contractual terms in three ways. First, we distinguish between short and long-term contract duration. Electricity sales transactions with contract durations of one year or greater are classified as long-term, while transactions with shorter contract durations are classified as short-term. Second, we split the transactions into short, medium, and long based on the increment pricing terms. Transactions with short increments use 5-minute, 15-minute, or hourly increments (up to 6 hours) to determine the price. Medium transactions have daily increments (6 to 168 hours). Long transactions use monthly or yearly increments (longer than 168 hours). Third, we classify transactions into full-period, peak, and off-peak based on the peaking terms. Full-period transactions cover both peak and off-peak periods.

Panel A of Table 2 reports the average percentage of transaction charges for electricity sales by different contractual terms, while Online Appendix Table A.4 presents the average percentage of the quantity of electricity sold by different contractual terms. Around 58% of the electricity charges in our sample are for sales under contracts with short durations and 50% of the transactions use short increments to determine the price. Transactions covering the full period account for 39% of

[21]Sections 205(c) and 201(f) of the Federal Power Act define who must submit EQRs to FERC. The reporting provisions do not apply to the United States, a state, or any political subdivision, as well as electric cooperatives. The reporting requirements also do not apply to utilities that make less than 4,000,000 MWh of annual wholesale sales.

the quantity sold and charges. Peak period sales are more expensive as they account for 31% of the quantity and 35% of the charges, while off-peak sales are smaller and cheaper. Power plants using fossil fuels, such as coal and natural gas, are more flexible to adjust operation hours so they rely relatively more on short-term contracts, short increment pricing, and peak-term production for electricity sales. Solar and wind power plants depend on weather conditions and have limited flexibility in operating hours, so they use relatively more long-term contracts, long increment pricing, and full-period contractual terms for electricity sales.

Panel B of Table 2 presents summary statistics on capacity sales. The number of power plants that receive compensation for maintaining available capacity in the future is smaller than the number of power plants selling electricity, as not all wholesale markets have a capacity market and power plants must submit bids on competitive auctions to receive compensation for maintaining capacity. Power plants using renewable technologies, such as solar and wind, are significantly less likely to make capacity sales. Around 85% of the capacity sales are made under long-term contracts with a duration of longer than 1 year, while 15% of the capacity sales are based on short-term contracts with a duration of less than one year. There is very limited variation in the increment and peaking period terms as almost all capacity sales use long-term increments and cover the full-period.

3 The Determinants of Ownership Changes

Figure 1 shows that the ownership share of DLCs has declined from 71% in 2005 to 54% in 2020. Private equity, institutional investors, and foreign publicly listed corporations have gradually replaced DLCs in the ownership of both renewable and fossil fuel power plants. These changes in ownership over time can occur through three mechanisms: creation of new power plants, sales of existing power plants, and decommissioning (shutdown) of power plants. In this section, we examine the relative importance of the three mechanisms as well as the economic conditions that stimulate ownership changes.

3.1 Creation of New Power Plants

The first mechanism examines differences in the probability to create and own new power plants. Energy markets experienced substantial innovation over our sample period, and we analyze which owners are more likely to implement innovative technologies as well as whether the ownership types display different sensitivity to the economic conditions. Creating new power plants is risky as it exposes the owners to risks related to connecting the plant to the electric grid and establishing sales contracts with customers.

One potential hypothesis is that DLCs, which are the traditional incumbent asset owners in our setting, may have competitive advantages for creating new assets. Their advantages are size, established access to the transmission network, synergies with existing operations, and ability to impact government policy. However, an alternative hypothesis is DLCs may instead prefer to delay the implementation of new technology (Arrow, 1962), especially under the protection of market power (Bertrand and Mullainathan, 2003; Cunningham, Ederer, and Ma, 2021).

In terms of economic factors, our focus is on the role of energy market regulation. Figure 4 Panel A shows that deregulated markets with an ISO balancing authority manage to attract significantly more capital to adopt innovative technologies and investments in creating new greenfield power plants. On average, greenfield power plants represent 1.77% of the total nameplate capacity in markets with an ISO balancing authority and 1.35% of the total nameplate capacity in markets with a traditional balancing authority, and the difference increases over time.

Panel B of 4 shows that private equity, institutional investors, and foreign listed corporations are more likely to own a greenfield power plant as compared to their overall ownership share. For instance, private equity owns on average 24.6% of the greenfield power plants versus 10.9% of all power plants. Appendix Figure A.2 shows that most of the newly created power plants use wind and solar technology, but there is also a significant share of new natural gas power plants which were supported by the shale gas boom (see Gilje, Loutskina, and Strahan (2016) for discussion on the rapid growth of shale gas production). This figure suggests that ownership structures could differ in their relative importance in the creation of both renewable and natural gas power plants.

Based on the figures, we cannot disentangle how much the new ownership structures create new assets from what may be a general preference to invest in certain fuel types (e.g., preference for renewable energy). In Table 3, we examine the probability of creating greenfield power plants across fuel types and compare the sensitivity of different ownership types to economic conditions and regulatory incentives. We estimate pooled OLS regressions where the unit of observation is at the plant-prime-mover-month level. The dependent variable is binary and captures whether a plant is a greenfield plant or not; it is set at one for the first 12 months of plant operation. In the pooled OLS regressions, we weigh the power plants by nameplate capacity which assigns a higher weight to larger power plants. The OLS regressions are more suitable for our setting than nonlinear logit regressions as our focus is on the marginal effects rather than the latent index variable (Angrist and Pischke, 2009; Bertrand et al., 2007). Online Appendix Table A.5 shows that our results are robust to using logit specifications instead of pooled OLS, and without weighting the observations by nameplate capacity. However, we rely more on the OLS specification as the weighted coefficients are economically more relevant, and they include a more saturated set of fixed effects.

To distinguish willingness to create new assets from preferences to invest in certain technologies, we interact several fixed effects. The fuel type fixed effects capture the baseline level that a solar or natural gas power plant is greenfield, while state fixed effects capture differences in weather conditions or available natural resources affecting plant location. In our analysis, we saturate the specifications by including fully interacted fuel-type, state, and year-month fixed effects. When including this saturated set of interacted fixed effects, the estimates rely only on variation in ownership and probability of creating greenfield assets across power plants using the same fuel, located in the same state, and at the same moment of time.

The unconditional probability equals 1.63% which captures the proportion of power plants that are in their first greenfield level in any given month. We find that DLCs are significantly less likely to own a given greenfield power plant. Based on Column (1), DLCs have a 1.09 percentage points lower probability of owning a greenfield plant than the omitted ownership types, which are PE, institutional investors, and foreign corporations. This coefficient corresponds approximately to a 67% decrease relative to the baseline unconditional probability. Column (2) shows that private equity and foreign listed corporations have a 1.33 and 0.95 percentage points higher probability of owning a greenfield power plant (or 82% and 58% increase relative to the unconditional probability), respectively. For institutional investors, we find that they have a significantly lower probability of owning greenfield power plants after controlling for interacted fixed effects, even though Figure 2 shows that they own a substantial share of the newly created wind and solar power plants. Thus, institutional investors seem to prefer to hold renewable energy assets, but are less willing to create these as new power plants. Institutional investors prefer to co-invest in established operational assets. In the analysis, we control but do not report the coefficients on government, cooperatives, and industrial firms. These ownership structures are less likely to create new power plants.

The probability that private equity and foreign corporations create new power plants is not equally distributed across all U.S. states. Our analysis of the economic conditions that could affect the decision to finance a greenfield power plant focuses on market competitiveness as it affects the ability of a power plant to operate and sell electricity. Deregulated electricity markets may attract relatively more capital from new investors as the transmission is not operated by a monopolist utility that is also involved in electricity generation. We use the indicator for power plants participating in a wholesale market administered by an ISO balancing authority as our main indicator for deregulated electricity markets. The interaction term of DLC and ISO balancing authority in Column (3) of Table 3 shows that DLCs are especially less likely to create new power plants in states with deregulated competitive wholesale electricity markets. The baseline coefficient on DLCs in Column (3) is insignificant which implies that DLCs are almost equally likely to create a given greenfield power plant in states with traditional markets as PE and foreign listed corporations. The interaction term of DLCs and ISO balancing authority implies that DLCs are around 1.10 percentage points less likely to own a given greenfield plant in states with liberalized markets than in states with traditional markets. These results suggest that the existence of a liberalized wholesale electricity market is the main economic condition that attracts investments by PE and foreign listed corporations in new power plants.

Column (4) considers an interaction term between DLC and our alternative more restrictive measure of wholesale market deregulation, *ISO Restructured*. Here the results are even stronger, with DLCs 1.53 percentage points less likely to own a given greenfield plant in states with an ISO balancing authority and restructured electric utilities. Column (5) includes an interaction term of DLCs and with *Retail Choice* variable. This can also be seen as a restriction on the ISO balancing measure, as only some areas that are administered by an ISO balancing authority offer electricity supplier choice to residential and business customers. This interaction term is economically even more significant and suggests that DLCs are 2.75 (=0.91+1.84) percentage points less likely than the alternative new owners (PE, institutional investors, and foreign corporations) to own a given greenfield plant in states that offer a competitive retail choice to customers.

One potential concern is that the differences in the probability to own newly created power plants between domestic corporations and new entrants may just reflect the differences in the probability of creating new power plants between regulated electric utilities and independent power producers

(IPPs). DLCs operate both as regulated electric utilities as well as IPPs, while the new entrants operate predominantly as independent power producers. This alternative hypothesis would predict that traditional regulated electric utilities should be less likely to own greenfield power plants because they need approval from the state public utility commissions to make new investments and to adjust their rate base. Under this alternative hypothesis, we would expect that the baseline coefficient on IPPs in Table 3 Column (6) should be positive and significant, while the interaction term of DLC $\times$ IPP should not be significant, as this would suggest that IPPs create more power plants and the ownership of IPPs does not matter. However, we document that the baseline coefficient on IPPs is not economically and statistically different from zero, while the interaction term DLC $\times$ IPP is negative and significant. This interaction term suggests that ownership structure matters as within the universe of IPPs domestic corporations are 1.98 percentage points less likely to own a greenfield power plant.

Figure 5 Panel A reports the coefficients of a subsample analysis instead of including interaction terms in the specifications. This figure confirms that PE and foreign publicly listed corporations are the two ownership types that are more likely to create greenfield power plants in states with deregulated electricity markets. PE and foreign publicly listed corporations are more likely to own greenfield power plants in wholesale markets administered by an ISO balancing authority and in areas offering retail choice to customers.

In Table 3, we show that the role of market deregulation in explaining the heterogeneity in ownership structure across greenfield power plants is robust to two other economic factors. First, states where the population displays higher climate concerns may attract more investors through increased demand for new renewable or efficient power plants. The higher climate concern among the population could also incentivize relatively more new investors to commit capital to greenfield projects as they could expect politicians in these states to adopt stricter regulation and licensing of old power plants. Second, states implement various tax and production-based incentives to stimulate the transition to renewable energy and different owner types may respond to different incentives. We find that the interaction term of domestic corporations and the above-median climate concern indicator variable is mostly insignificant suggesting that the differences in probability to finance new power plants are not driven by stronger sensitivity of private equity and foreign publicly listed corporations to climate concerns among the population. The differences in ownership of greenfield plants are also not captured by differences in the sensitivity of DLCs, PE, and foreign corporations to renewable energy policy incentives.

In Table 3, we report the coefficients on interaction terms of DLC with *Renewable Incentives* index, which aggregates five separate renewable policy indicators. One potential concern is that the aggregate index is broad and only some specific policy measures explain the heterogeneity across ownership types to own greenfield power plants. In Figure 5 Panel B, we present the coefficients of two specifications that include separate interaction terms of DLC with the three indicators if a state has corporate tax, property tax, and sales tax incentives for renewable energy as well as separate interaction terms of DLC with the two indicators if a state has production or feed-in tariffs incentives for renewable energy. These specifications confirm that DLCs are significantly less likely to own greenfield power plants in areas with deregulated electricity markets and these results are robust to controlling for climate concerns among the population and renewable policy incentives. Market competition seems to be the key economic factor in explaining the heterogeneity in the ownership structure of new power plants.

In Online Appendix Table A.6, we estimate a robustness test by limiting attention to the subsample of power plants with a nameplate capacity above 20MW as we cannot weigh the observations by power plant capacity instead of weighting power plants by nameplate capacity. In this test, we want to test that the results are not driven by a few large newly created power plants (we also do not include all power plants to avoid that the results are driven by micro solar plants). The unconditional baseline probability in this unweighted subsample equals 2.75% as compared to 1.63% in the weighted broad sample, which shows that the newly create power plants tend to be on average smaller than the existing power plants. The results confirm that DLCs are less likely to create new power plants than private equity and foreign corporations. The difference in the probability to create new electricity generating assets is concentrated in states with deregulated wholesale and retail electricity markets.

In Table 4, we consider heterogeneity by fuel type in the greenfield ownership results. The specifications focus on greenfield plants using solar, wind, and natural gas fuels as they account for the vast majority of newly created power plants. We define the binary dependent variable as greenfield wind and solar plants in Columns (1) to (4), and as natural gas plants in Columns (5) to (8), leaving out of consideration the small number of new plants that use other technologies. The baseline probability for greenfield solar and wind plants is 0.75%, while the baseline probability for natural gas plants is 0.82% (which together add up to 1.57% out of the 1.63% shown in Table 3). This decomposition of the greenfield dependent variable by fuel type enables us to also decompose the coefficients on the ownership variables and interaction terms.

Based on Columns (1) and (5) in Panel A, DLCs have a 0.61 percentage points lower probability to own greenfield solar and wind power plants, and 0.41 percentage points lower probability to own greenfield natural gas power plants. Thus, their aggregate coefficient of 1.09 percentage points lower probability of owning a greenfield plant (Table 3 Column (1)) is somewhat more due to their lower probability to create renewable power plants. Columns (2) and (6) of Table 4 Panel A show that both PE and foreign listed corporations are more likely to own greenfield solar and wind power plants, but only PE is more likely to create new natural gas power plants. The coefficient on foreign listed corporations in the specifications focusing on natural gas power plants is statistically not different from DLCs.

Panel B shows that the heterogeneity in ownership of new wind and solar farms does not seem to be concentrated only in states with competitive electricity markets, but other states also attract capital from private equity and foreign corporations to finance the creation of new renewable power plants. The baseline coefficient on domestic listed corporations remains economically and statistically significant in Columns (1) to (3) even after we include interaction terms with indicators for restructured wholesale and retail markets. The differences in ownership probability of greenfield solar and wind plants are only partially determined by market deregulation as the interaction term of DLCs with retail choice equals -0.46 and is marginally significant. In addition, the differences in ownership probability of greenfield solar and wind plants are also concentrated within the universe of IPPs. This interaction term in Column (4) suggests that DLCs are 0.63 percentage points less likely to own an IPP greenfield solar and wind power plant.

Columns (5) to (7) of Panel B show that the difference in the probability to create new natural gas power plants between DLCs and new entrants is entirely concentrated in states with deregulated electricity markets. The interaction term between DLCs and ISO balancing authority or retail choice captures the entire lower probability of domestic corporations owning new natural gas power plants. Based on Column (5) of Table 4 Panel B, DLCs are 0.94 percentage points less likely to create a new natural gas plant in states with restructured wholesale markets as compared to states with traditional wholesale electricity markets. Thus, the interaction effects between domestic corporations and market competition shown in Table 3 are largely driven by the location and ownership of new natural gas power plants.

Overall, PE and foreign listed corporations are significantly more likely to create new power plants and their willingness to provide capital to new power plants that use innovative technologies contributes significantly to the changing ownership structure. The market organization driven by liberalization restructurings affects the extent to which PE and foreign listed corporations actively finance new fossil fuel and renewable power plants as compared to DLCs, which have traditionally dominated electricity markets. We can conclude that the higher degree of creation in restructured electricity markets is driven by the ability of these markets to attract additional capital flows from PE and foreign listed corporations into new greenfield projects.

3.2 Sales of Power Plants

The second mechanism of ownership transition focuses on sales of existing power plants by incumbent DLCs to new ownership structures, such as PE, institutional investors, and foreign corporations. This mechanism has received significant attention in prior research on cross-border mergers and acquisitions (see Erel, Jang, and Weisbach (2022) for a review), and private equity leveraged buyouts (see Bernstein (2022) for a review).

To assess the relative importance of the sales and acquisition mechanism we start by focusing on all power plants that were owned by DLCs at the beginning of our sample in January 2005, when domestic corporations accounted for 71% of the electricity generation and before their share declined to 54%. We classify all power plants that were owned by DLCs into four potential outcomes based on the latest observation in our dataset. The latest observation is either the shutdown date or December 2020 for plants that are not decommissioned. These are the four potential outcomes: *Still Own & Operating* covers plants that did not change ownership and are still operated by domestic corporations; *Owned & Retired* captures plants that did not change ownership, but were retired by domestic corporations during the sample period; *Sold & Operating* captures plants that were sold to other ownership type and are still operated by these new owners; and *Sold & Retired* covers power plants that were sold to other ownership types and were retired by these new owners during the sample period.

Table 5 presents the baseline probabilities for all these four outcomes weighted by nameplate capacity. We observe that domestic publicly listed corporations retain ownership and continue operating 1,122 out of 2,202 power plants or around 64% of their initial nameplate capacity. The sales mechanism is economically similar to the decommissioning mechanism. DLCs retired 16.4% and sold 19.7% (= 17.8% + 1.9%) of their initial nameplate capacity. These statistics highlight that decommissioning of power plants by traditional and new owners is relevant, and sales of power plants are not the predominant form of ownership transitions in the energy industry.

The main concern regarding the sales mechanism is that DLCs transfer older polluting power plants to other owners. Based on this leakage hypothesis, DLCs face a higher degree of regulatory pressure and public scrutiny (Benthem et al., 2022; Bolton and Kacperczyk, 2022). PE and foreign corporations are subject to more lenient regulation and lower reporting requirements so they may be willing to own and operate older power plants for a longer period of time. Thus, the leakage hypothesis would predict that private equity and foreign corporations should be more likely to continue operating older fossil fuel plants and postpone their decommissioning.

In Table 5, we compare the characteristics of power plants that are sold and retired by DLCs. We report the marginal effects of multinomial logit regressions on the four potential outcomes: still own & operating, owned & retired, sold & operating, and sold & retired. The main control variable is power plant size, measure as nameplate capacity, as domestic corporations seem to own and operate larger power plants for a longer period of time to ensure the security and stability of the energy system. The specifications also control for electricity market restructuring status and fuel type fixed effects. From these fixed effects, we report the coefficients on the fixed effects for coal, petroleum, and natural gas fuels.[22]

We find three results that provide evidence against the leakage hypothesis. First, we observe

[22] In this table, we include Coal & Petroleum as a joint indicator variable for power plants that use coal, waste coal, petroleum coke, or residual petroleum fuel to simplify the interpretation and cover the impact across a broader set of fuels. In all other tables, we include separate fuel fixed effects for these four fuel types.

that DLCs are more likely to retire older power plants. DLCs are less likely to continue operating older power plants and less likely to sell older power plants to other owners, such as PE, institutional investors, or foreign corporations. For instance, based on Column (5), a one unit increase in the natural logarithm of plant age is associated with 9.9 percentage points lower probability that a power plant is sold and still operated by a new owner, which is a substantial economic magnitude relative to the unconditional probability of 17.8%.

Second, we document that DLCs are not more likely to sell fossil fuel power plants to other owners. Based on Column (3), domestic corporations are more likely to retire their own coal, petroleum, and natural gas power plants. The results in Column (7) show that even if coal and petroleum power plants end up being sold to new owners, these new owners are more likely to retire these plants soon rather than to continue operating them until the end of our sample period.

Third, DLCs are not more likely to sell power plants located in states where the population has high climate concerns and might put relatively more pressure on the DLCs. Our analysis focuses essentially on sales of fossil fuel power plants as solar and wind power plants barely existed at the beginning of our sample period, in January 2005 (See Figure 2). In states with high climate concerns, DLCs seem to be more likely to shut down plants, but importantly we do not observe a statistically and economically significant increase in the probability to sell these assets to new ownership types.

In addition, in line with our results on the role of market regulation in creating new power plants and adopting innovative technologies, we also observe that DLCs are more likely in deregulated electricity markets to sell power plants to new owners, such as PE, institutional investors, and foreign corporations. Based on Column (5), if a power plant is in a wholesale market that is administered by an ISO balancing authority, DLCs have a 17.6 percentage points higher probability to sell this power plant to new owners. Column (6) shows that this relation is also significant in states offering a retail choice to customers. If a power plant is in an electricity market with a retail choice, DLCs have a 16.5 percentage points higher probability to sell this power plant to new owners.

Overall, the sales mechanism explains only one-third of the ownership transitions. While in other industries transactions account for the vast majority of ownership changes and privatization reforms (e.g., La Porta and López-de Silanes, 1999; Dinc and Gupta, 2011; Howell, Jang, Kim, and Weisbach, 2022), creation of new power plants and adoption of innovative technologies are highly relevant in the energy sector. In addition, we observe no evidence of leakage of older fossil fuel power plants from DLCs to PE, institutional investors, and foreign publicly listed corporations, as domestic corporations are more likely to shut down their older fossil fuel power plants.

3.3 Decommissioning of Power Plants

Our analysis of sales and acquisitions suggests that there is no leakage of older fossil fuel power plants from domestic corporations, but it has two potential limitations. First, we focus only on power plants owned by DLCs at the beginning of our sample period since they accounted for 71% of electricity generation and reduced their ownership share in the next period. However, PE, institutional investors, and foreign publicly listed corporations jointly owned already 6% of the generation assets in 2005 and it may well be that they continue operating these assets for a longer period. Second, the multinomial logit analysis examines only the final outcomes and does not evaluate potential differences in the timing of power plant decommissioning across ownership categories. Due to these limitations, our previous analysis does not address an alternative version of the leakage hypothesis, which argues that DLCs decommission fossil fuel power plants sooner than PE, institutional investors, and foreign listed corporations because they are subject to stricter disclosure requirements and public scrutiny.

Power plant decommissioning is the third mechanism that could contribute to ownership changes. In this section, we analyze which owners are more likely to shut down energy assets as well as the economic conditions that facilitate the retirement of old technologies. Decommissioning power plants is risky as it exposes the last owners to risks related to pollution liability lawsuits, plant demolition, and reduced contracts with customers in anticipation of the shutdown date.

In terms of economic conditions, our focus is again on the role of energy market regulation. Figure 4 shows that the decisions to commission new greenfield plants and decommission old plants closely follow each other, as the figures display correlated trends over time. In line with the trend of plant creation, Panel C shows that owners shut down more power plants in deregulated markets with an independent balancing authority. On average, decommissioned power plants represent 1.21% of the total nameplate capacity in markets with an ISO balancing authority versus 0.76% of the total nameplate capacity in markets with a traditional balancing authority.

Panel D of Figure 4 illustrates that DLCs dominate retirement decisions, while PE, institutional investors, and foreign listed corporations own only a small fraction of the decommissioned power plant relative to their overall ownership share. For instance, DLCs own 65.6% of the decommissioned plants which is higher than their ownership share of 60.0% of all power plants, whereas foreign listed corporations own only 1.6% of the retired power plants as compared to 3.9% of all power plants. This figure suggests that ownership types differ in the probability to retire a power plant, but based on the figures, we cannot distinguish whether the new owners operate power plants longer or invest less in power plants affected by the shutdown trend (e.g., limited exposure to coal plants).[23]

In Table 6, we estimate the differences in decommissioning power plants across ownership types and market regulation settings. We estimate pooled OLS regressions where the unit of observation is at the plant-prime-mover-month level. The dependent variable captures completely decommissioned power plants (not a partial retirement of one generator) and equals one for the last 12 months of

[23] This figure also shows that electricity production is becoming more decentralized as often many small solar and wind power plants with diluted ownership replace one larger fossil fuel power plant. The greenfield power plants have a lower average nameplate capacity of 0.35GW, while the decommissioned plants have an average capacity of 0.71GW. Furthermore, the new technologies have a lower capacity factor than the replaced technologies. Thus, even though Figure 4 shows that the new greenfield capacity seems higher than the decommissioned capacity, the total capacity of U.S. power plants remains at best stable as the new technologies have a lower operating intensity.

plant operation. In the pooled OLS regressions, we weigh the power plants by nameplate capacity which assigns higher weight to larger power plants. We also control for plant capacity as larger power plants have greater strategic importance for network stability and security of electricity supply. The specifications include fully interacted fuel-type, state, and year-month fixed effects. We also control for plant age which in combination with fuel-type fixed effects captures the profitability and efficiency of a power plant. In these specifications with a saturated set of interacted fixed effects and plant age, the ownership coefficients can be interpreted as differences in the probability to decommission a power plant controlling for differences in profitability of different fuel sources and technologies.

The unconditional probability equals 1.06% which represents the proportion of power plants that are in their decommissioning stage in any given month. We do not find that DLCs are more likely to own a power plant that is going to be shut down. Based on Column (1), DLCs have no higher probability of owning a decommissioned plant as compared to the omitted ownership types, which are PE, institutional investors, and foreign corporations, when analyzing power plants using the same fuel, located in the same state, and at the same moment of time. Column (2) shows that private equity has a similar probability to own retired power plants, while institutional investors and foreign listed corporations have a 1.11 and 0.69 percentage points lower probability to own a decommissioned power plant. For institutional investors, we conclude that they invest in established operational assets and hold power plants in neither their decommissioning nor greenfield stage. In terms of economic significance, Figure 2 shows that institutional investors and foreign corporations have very limited exposure to legacy power plants using coal, which is the main fuel type subject to shutdowns, and this explains why the coefficient on DLCs is statistically insignificantly different.

We also observe that smaller power plants, as proxied by nameplate capacity, and older power plants have significantly higher decommissioning rates. These controls confirm that decommissioning decisions are affected by the strategic importance and profitability of technology over time.

The probability that DLCs shut down power plants is not equally distributed across all electricity markets. Based on the interaction term with ISO balancing authority in Column (3) of Table 6, DLCs are 0.94 percentage points less likely to shut down power plants in regulated electricity markets, but a largely offsetting coefficient on the interaction term with ISO Balancing suggests that most of this difference is gone in states with deregulated wholesale electricity markets. These results are significantly weaker in column (4) when we use *ISO Restructured* as the regulatory interaction variable. Column (5), however, includes an interaction term of DLCs and with *Retail Choice* variable, which is another more restrictive definition of deregulated markets. This interaction term is again strongly significant, which suggests that downstream retail market regulation may play a role in power plant decommissioning decisions. Column (6) examines whether the differences in the probability to shutdown power plants may just reflect the differences in the probability of decommissioning power plants between regulated electric utilities and independent power producers (IPPs). Traditional regulated electric utilities may be more restricted by the state public utility commissions when decisinding whether to shutdown or continue operating a power plant. In contrast to the greenfield results, we do not find evidence that the IPP status affects the probability of power plant decommissioning.

In Columns (3) through (6) of Table 6, we also examine whether the role of market deregulation in explaining the heterogeneity in ownership structure across decommissioned power plants is robust to two other economic factors. First, states where the population displays higher climate concerns may pressure relatively more the incumbent DLCs to retire power plants relatively faster after controlling for age and fuel technology. For instance, the higher climate concern among the population could incentivize politicians in these states to adopt stricter regulations and licensing of old power plants. Second, states implement various tax and production-based incentives to stimulate the transition to renewable energy and different ownership types may display different sensitivity to these incentives when deciding whether to retire an existing power plant. We find that the interaction term of DLCs and climate concern percentile ranking of the state is positive, suggesting that the differences in the probability to shut down existing power plants may be related to the stronger sensitivity of DLCs to climate concerns among the population. The differences in ownership of decommissioned plants are not captured by differences in the sensitivity of DLCs, PE, and foreign corporations to renewable energy policy incentives.

In Online Appendix Table A.7, we estimate a robustness test on the differences in decommissioning power plants across ownership types using a Cox proportional hazard model instead of pooled OLS model. We estimate the hazard rate of decommissioning a power plant, defined as the probability that a decommissioning will be completed in month t conditional on it not becoming complete prior to month t. These robustness specifications focus on the subsample of power plants with a nameplate capacity of at least 20MW and do not weigh the observations by nameplate capacity. One limitation of the hazard models is that we cannot include interacted fixed effects, but we still control for fuel and state fixed effects. The Cox proportional hazard model is robust to time-specific common factors, which is analogous to controlling for time fixed effects (Dinc and Gupta, 2011). The results suggest that DLCss are marginally more likely to shut down power plants than other ownership types, which provides some evidence supporting the leakage hypothesis, but PE is the second most likely ownership type to decommission power plants. The difference in the probability to retire electricity generating assets again seems to be concentrated in states with deregulated markets.

In Table 7, we examine differences by fuel type in the decommissioning decisions. The specifications focus on retired fossil fuel power plants as they account for almost all decommissioned power plants, leaving out of the analysis a small number of retired plants that use other technologies. In Columns (1) to (4), the sample covers power plants that use coal, waste coal, petroleum coke, and residual petroleum as fuel. In Columns (5) to (8), the sample includes natural gas power plants.[24] The baseline probability for decommissioned coal and petroleum plants is 0.65%, while the baseline probability for natural gas plants is 0.30% (which together add up to 0.95% out of the 1.06% shown in Table 6). The coefficient on the independent variables and interaction terms can be interpreted also as a decomposition of the results presented in Table 6.

Based on Columns (1) and (5) of Table 7 Panel A, DLCs seem to have a slightly higher probability to retire coal and petroleum power plants and a lower probability to retire natural gas power plants, but the differences are not significant. Column (2) of Table 7 shows that foreign listed corporations are less likely to retire coal and petroleum power plants after controlling for plant capacity, plant age, and fuel-state-time fixed effects. These results provide some evidence supporting the leakage hypothesis, but the differences in decommissioning rates are economically and statistically smaller than the differences in the creation of new power plants. In addition, we also document that PE is 0.36 percentage points more likely to decommission a natural gas power plant than DLCs.

The differences in the probability of decommissioning coal and petroleum power plants are concentrated in states with deregulated electricity markets, as the interaction terms with both ISO balancing authority and retail choice indicators explain the heterogeneity in shutdown rates across ownership types. For instance, Column (1) of Panel B shows that domestic listed corporations are 0.50 percentage points more likely to retire a coal or petroleum power plant located in a deregulated wholesale market than a power plant located in a traditional market. We do not find significant evidence of such heterogeneity among natural gas power plants. The baseline coefficient on DLCs in Columns (5) to (7) of Panel B indicates that DLCs have a 0.51 percentage points lower probability to retire a natural gas power plant in traditional markets than the other new ownership categories.

Overall, we observe that the higher level of power plant shutdowns in deregulated markets,

[24] If a power plant is designed to use both coal and natural gas as a fuel, we classify this plant in the sample of coal and petroleum power plants. Some natural gas power plants use also biogenic municipal solid waste, landfill gas, wood waste, or other gases as alternative fuels, so we can still include fuel-state-time fixed effects in the specifications.

presented in Figure 4 Panel C, reflects a higher decommissioning rate of coal and petroleum power plants by DLCs. These differences in the retirement of these fossil fuel plants might at first glance appear to provide supporting evidence of the leakage hypothesis. However, a more consistent interpretation is that competitive electricity markets with an independent balancing authority and retail choice stimulate a faster transition away from fossil fuels, since DLCs are retiring more fossil fuel plants in deregulated markets and, critically, new ownership types are not acquiring these plants. This interpretation is also in line with the results of Green and Vallee (2022) that banks reduce financing of coal power plants, which implies that DLCs cannot sell the power plants to new entrants and issue debt to finance these assets.

4 Power Plant Operating Performance

Based on the previous analysis, DLCs have lost ownership share primarily by creating fewer new greenfield power plants and retiring more power plants. We find only limited support for the leakage of older fossil fuel plants from DLCs to PE, institutional investors, and foreign publicly listed corporations. However, the previous analysis examines only ownership of power plants and does not study the fuel consumption and intensity of power plant operation. An alternative hypothesis is that the new ownership types operate their power plants with a higher capacity factor or lower heat rate. The increased operating intensity or lower fuel consumption efficiency could represent an alternative form of leakage.

In this section, we analyze power plant operating performance. In Columns (1) to (4) of Table 8, we focus on the power plant's capacity factor, which measures the operating intensity and equals the ratio of net electricity generation in MWh to nameplate capacity. We winsorize the capacity factor at 0.5% and 99.5%. In Columns (5) to (8), the dependent variable is the power plant's heat rate, which measures operating efficiency and is defined as the ratio of monthly fuel consumption in millions Btu to net electricity generation in MWh. The specifications in Table 8 include interacted fuel-state-year-month fixed effects and effectively limit the analysis to comparing the operating performance of power plants using the same fuel type, located in the same state, and in the same moment of time. This saturated set of fixed effects addresses to a large extent differences in the prices of resources (e.g., coal and natural gas prices) as well as weather differences (e.g., the number of sunshine hours in different months).

In the specifications, we also control for the greenfield and decommissioning stage. *Greenfield 1m* is an indicator for the first month when a plant starts operating, and *Greenfield 12m* is an indicator for the first 12 months when a plant starts operating. *Decommissioned 1m* is an indicator for the last month when a plant is still operating, and *Decommissioned 12m* is an indicator for the last 12 months when a plant is still operating. We find that creating new power plants and retiring old power plants is costly for the owners as power plants in these periods operate under significantly lower capacity factors as well as higher heat rates. Based on Column (1) of Table 8, power plants have a 0.14 lower capacity factor in the first 12 months after starting operation and a 0.13 lower capacity factor in the last 12 months of their operation. These coefficients are economically and statistically significant as the average capacity factor of all power plants is 0.40. Based on Column (5), power plants have a 1.77 higher heat rate in the first 12 months of operation and 0.52 in the last 12 months of their operation, which are economically significantly lower operating efficiencies relative to the average heat rate of 11.32.[25]

Regarding the lifecycle of power plant operating performance, the coefficients on *Greenfield 12m* and *Decommissioned 12m* should be also interpreted jointly with the coefficient on plant age.

[25]The operating performance seems to be even lower in the first and last month as the coefficients on *Greenfield 1m* and *Decommissioned 1m* indicator variables are negative and significant. However, these coefficients should not be added to the effect estimated for the 12-month indicator variables. A large part of the negative coefficient for the first and last month is probably mechanical as power plants do not always operate for the entire month and could be started or decommissioned in the middle of the month. We include separate indicators for the first and last month to isolate this mechanical effect so we can interpret the indicators for the first 12 and last 12 months as differences in operating performance during the greenfield and decommissioning stage.

The negative and significant coefficient on plant age suggests that newer assets are more efficient than older assets and operate with higher capacity factors and lower heat rates. Implementing new technologies leads to higher marginal efficiency of electricity generation. However, the indicators for the greenfield and decommissioning stage show that the creation and destruction processes in the electricity sector are costly for the owners as power plants in these stages stand idle for a longer period and generate less electricity as well as consume more fuel to generate electricity. For greenfield plants, we interpret these results as evidence that it takes time to gain market share, establish contracts with customers, and increase the capacity factor as well as to gain experience in how to operate the power plant efficiently with a lower heat rate.

Table 8 shows that power plant owner types differ in operating performance across owner types. Based on Column (2), PE owners have a 0.03 lower capacity factor on their power plants than DLCs. However, power plants owned by institutional investors seem to have the highest operating performance and their capacity factor is 0.10 higher than the capacity factor of plants owned by DLCs. The difference in operating intensity between DLCs and PE is concentrated in states with traditional wholesale electricity markets. In these markets, PE power plants depend on the local electric utility serving also as a balancing authority when deciding how much electricity to produce. Based on Column (3), a power plant owned by domestic corporations in areas that are not covered by an ISO balancing authority has a 0.05 higher capacity factor than plants owned by PE, institutional investors, and foreign corporations. The interaction term of DLCs and ISO balancing authority is significantly negative and outweighs the baseline coefficient on DLCs, which suggests that the differences in operating intensity across ownership categories are not significant in areas covered by an ISO balancing authority.

We also observe differences in power plant operating efficiency across ownership types. Based on Column (5), power plants owned by DLCs have a 0.48 higher heat rate than power plants owned by the new entrants. This coefficient implies that power plants owned by domestic listed corporations use around 4% (= 0.483 / 11.323) more fuel to produce one unit of electricity when we compare plants using the same fuel, located in the same state and in the same moment of time. Power plants owned by PE, institutional investors, and foreign listed corporations consume less fuel and operate more efficiently. The differences in operating efficiency between DLCs and new entrants are relatively larger in deregulated markets. Based on Column (8), DLCs have a 0.31 higher heat rate in states that offer a competitive retail choice to customers than in states without a retail choice. These interaction terms suggest that market competition attracts new entrants that potentially compete based on operating efficiency.

Table 9 examines separately the operating performance of wind and solar plants, natural gas plants, and coal and petroleum plants. Panel A shows that the difference in utilization rate between DLCs and new ownership structures is driven primarily by fossil fuel plants. Based on Column (1), DLCs operate their natural gas power plants with a 0.031 higher capacity factor, which is economically substantial as the average capacity factor of natural gas power plants is 0.276. Based on Column (2), the differences in the capacity factor of natural plants between DLCs and new ownership types are significant only in traditional markets. The interaction term of DLCs and ISO balancing authority is negative and outweighs the baseline coefficient on DLCs. The results for coal and petroleum present a similar trend in terms of differences between deregulated and traditional markets as natural gas power plants, but they are less significant because the new entrants own a very small proportion of the coal and petroleum power plants. For renewable power plants, the differences in operating performance are economically and statistically smaller.

Panel B of Table 9 shows that the difference in heat rate between DLCs and new ownership structures is also driven primarily by natural gas plants. DLCs operate their natural gas power plants with a 0.690 higher heat rate, which is economically substantial as the average heat rate of natural gas power plants is 11.816. There are no differences in the operating efficiency of coal and petroleum plants across ownership categories, which is in line with the observation that the new entrants do not hold a substantial share of these plants and the main action has been decommissioning of plants rather than improving operational performance.

Our results that new owners operate power plants more efficiently are in line with research that studies only power plants that experience changes in ownership and finds that acquisitions reduce the heat rate of acquired power plants. Similar to our findings that all new owners, PE, institutional investors, and foreign corporations, operate power plants more efficiently, Demirer and Karaduman (2023) document that high-productivity firms acquire plants and increase their efficiency by 4% five to eight months after acquisition. Bai and Wu (2023) focus on a smaller sample of private equity acquirers and also document that acquired plants operate with a lower heat rate, which translates into reduced fuel consumption and reduced output-scaled emissions.

Overall, we do not find evidence that new ownership types, which are subject to less strict disclosure requirements and public scrutiny operate fossil fuel power plants with a higher capacity factor. If anything, our results suggest that DLCs operating more intensely fossil fuel power plants in traditional markets where they face relatively more limited competition from new entrants. In addition, we observe that new entrants, such as PE and institutional investors, operate power plants more efficiently and consume less fossil fuel to produce one unit of electricity. This result suggests that the ownership changes are accompanied by operational improvements.

5 Electricity Pricing and Contractual Terms

In this section, we examine the implications of the emergence of PE, institutional investors, and foreign listed corporations as major electricity producers. The two main products that power plants sell are electricity and capacity. First, we study differences in contractual terms across ownership types. Second, we examine whether different ownership structures are associated with differences in electricity pricing. The new types of power plant owners enter electricity markets typically as independent power producers and have significant flexibility to adjust contractual sales terms in line with their objectives and incentives.

The contracting and pricing analysis is limited to the subsample of larger power plants matched with the FERC EQR data over the 2013–2020 period. We focus on power plants owned by DLCs, PE, institutional investors, and foreign publicly listed corporations, as the other ownership categories (e.g. industry and cooperatives) use a large part of their generated electricity for their own consumption and are not required to report all transactions to FERC.

In Table 10, we examine the contractual terms of electricity transactions. The dependent variables are the percentage of the transaction charges for electricity sales under different contractual terms. Columns (1) and (2) analyze contract duration and distinguish between short contracts with a duration of less than one year and long-term contracts. Columns (3) to (5) split the transactions into short, medium, and long based on increment terms used to determine the price. Columns (6) to (8) classify transactions into full-period, peak, and off-peak based on the peaking terms. The specifications include interacted fuel-state-year-month fixed effects which absorb variation in contracting terms across power plant technologies, location, and time. Online Appendix Table A.8 shows that our results are robust to defining all contractual-term dependent variables as a percentage of the quantity sold instead of the transaction charges.

PE seems to prefer selling electricity under contracts with shorter duration and during peak term periods. Column (1) shows that power plants owned by private equity sell 9.6 percentage points more electricity under short-term instead of long-term contracts. PE general partners also use more shorter increment pricing periods as they contract 13.1 percentage points more for electricity sales based on increment terms of less than one hour instead of long-term monthly or yearly increment terms.

Institutional investors differ significantly from PE and DLCs as they rely less on short increments to determine the price and establish contracts that cover the full period instead of targeting peak-period sales. Based on Column (6) of Table 10, institutional investors sell 23.8 percentage points more electricity under contracts that cover the full period instead of separate peak-period and off-peak-period contracts. This result is in line with the objective of institutional investors to obtain stable long-term cash flows from their direct investments in infrastructure assets (Andonov, Kräussl, and Rauh, 2021). The differences in contracting terms between institutional investors and PE are highly relevant as institutional investors supply the vast majority of commitments to PE funds. These differences indicate potential agency conflicts and misalignment of objectives between institutional investors and PE funds acting as intermediaries (Binsbergen, Brandt, and Koijen, 2008). For foreign listed corporations, we observe that they display some preferences against sales under longer increments and during off-peak hours. Their contractual terms have similarities with the contracts of PE as well as with the contracts of DLCs.

Online Appendix Table A.9 shows that the differences in contractual terms of electricity sales between new entrants and incumbent DLCs are entirely driven by fossil fuel power plants. When selling electricity from natural gas and coal power plants PE firms use contracts with a shorter duration and shorter pricing increments, and target peak-period sales. The contractual terms of fossil fuel power plants dominate the aggregate results because we weigh the observations by nameplate capacity and fossil fuel power plants are economically substantially more significant than renewable power plants. Panel C shows that wind and solar power plants owned by PE seem to be selling more electricity actually under long-term contracts and increments.

In Table 11, we analyze the capacity sales, which represent the second product sold by most power plants. We start the analysis by examining the probability that a power plant receives compensation for selling capacity and the sample covers all power plants reporting electricity sales in the FERC dataset. The dependent variable equals 0.836, which suggests that, on a nameplate-capacity-weighted basis, almost all large power plants receive compensation for maintaining available generation resources in the future. The probability to receive compensation for selling capacity differs within the universe of new ownership types. The difference in the probability to establish capacity sales contracts between DLCs and PE owners is not significant. Based on Column (2), power plants owned by institutional investors have actually an 8.2 percentage points higher probability to sell capacity which confirms our conclusion that institutional investors look for stable cash flows and capacity sales to ensure a long stream of payments in the future. Foreign corporations are the only new ownership category that is significantly less likely to participate in capacity markets.

Conditional on participating in capacity markets, the ownership types differ in the contract duration. We focus only on the contract duration as the capacity sales do not differ in the other dimensions and almost all of them are based on long-term increments and full-period coverage. Column (3) shows that DLCs sell more capacity under long-term contracts. Foreign corporations and PE owners are again more likely to establish short-term contracts for capacity sales. Based on Column (4), PE and foreign corporations sell 9.5 and 14.6 more capacity under contracts with a duration of less than one year. Institutional investors enter almost exclusively long-term contracts for capacity sales.

Overall, we document substantial heterogeneity in the contractual preferences of different ownership types. Private equity owners establish more short-term contracts that can respond more to short-term signals in the electricity market and have more flexibility to adjust their electricity production. Institutional investors seem to prefer long-term contracts that can deliver less volatile output and more predictable cash flows. Domestic and foreign publicly listed corporations seem to establish contracts between these two extremes.

In Table 12, we examine the pricing of electricity sales and the dependent variables are the mean and median of monthly electricity price per MWh, and we winsorize these pricing variables at 0.5% and 99.5%. The observations are weighted by the quantity of sold electricity and the specifications include either fuel-type and state-year-month fixed effects or fully interacted fuel-state-year-month fixed effects. We find that PE sells electricity for higher prices than domestic corporations. Based on Columns (1) and (3), private equity obtains a \$4.53 higher average price per MWh and \$4.50 higher median price per MWh of electricity sales. The interacted state-year-month fixed effects in this specification absorb variation in electricity prices across states and over time, but they do not absorb variation from power plants using different fuels and selling electricity in the same state and at the same moment in time.

In Columns (2) and (4), we introduce a more saturated set of fixed effects on a fuel-state-year-month level. In these specifications, the difference between PE and DLCs shrinks to \$1.92 average price per MWh and \$1.99 median price per MWh. This reduction in the coefficients suggests the higher prices obtained by PE may partly reflect the greater flexibility of PE owned plants to scale up or down their production using different fuels in certain state-months.

We interpret the pricing differences between PE and DLCs jointly with our results on contractual differences. We observe that power plants owned by PE have more flexible contractual terms, so they can adjust both output and pricing according to demand. PE owners seem to obtain higher electricity prices on the wholesale market through flexible output that responds to signals in the spot electricity market. For instance, PE could reduce electricity production in periods of low prices, which could result in higher average prices. PE could establish different sales contracts which result in higher average prices, such as short-term contracts that target peak-period sales. For institutional investors and foreign listed corporations, we do not observe significant differences in mean or median electricity prices. Even though these ownership types display some differences in the contractual terms, we do not see that these differences translate into different prices.

Reflecting on the challenges of adopting new technologies in the electricity sector, we find that greenfield power plants obtain significantly lower mean and median prices. This result can be interpreted in two ways. First, newer power plants are competitive and can potentially reduce the average prices on wholesale markets, by undercutting incumbents and increasing market competition. Second, new power plants seem to have lower operating performance (see Table 8) as well as lower average prices, which suggests that new owners adopting innovation need time to gain market share and establish contracts with customers as well as to gain experience with how to operate the power plant efficiently.

Overall, we document that the new ownership types offer different contractual terms and electricity pricing compared to domestic listed corporations. Private equity firms sell electricity for a higher price per MWh, and they sell electricity under contracts with shorter duration, shorter increment pricing, and peak term periods. Institutional investors establish fewer volatile contracts for the power plants that they own directly, thus reducing the volatility of the electricity sales by their power plants.

6 Conclusion

Regardless of the exact policy direction, stated national commitments to reduce greenhouse gas emissions and achieve greater energy independence will require substantial capital investments to change the mix of capital assets that produce electricity. Using data on U.S. power plants accounting for 99% of the electricity generation over 2005–2020 period, we find that incumbent domestic publicly listed corporations have reduced their ownership from 71% to 54%, while new entrants, such as private equity, institutional investors, and foreign corporations, have increased their ownership stakes from 6% to 24%.

Private equity and foreign publicly listed corporations have increased their ownership share largely through the creation of new solar, wind, and natural gas power plants in states with deregulated electricity markets, where the wholesale market is administered by an independent balancing authority and retail customers can choose electricity suppliers. We find limited support for the leakage hypothesis that incumbent domestic listed corporations, which are subject to higher disclosure requirements and public scrutiny, sell older fossil fuel power plants to the new ownership types. Domestic listed corporations have the highest probability of decommissioning a power plant conditional on plant age and capacity, but private equity is the second most likely ownership structure to shut down power plants. Institutional investors and foreign corporations maintain very low exposure to plants subject to decommissioning.

Domestic corporations operate electricity generating assets with higher intensity in traditional markets with limited competition, but they are less efficient. The new entrants, such as private equity and institutional invetsors, operate power plants more efficiently at lower heat rates

Private equity owners also show differences in contractual terms and electricity pricing compared to the incumbent domestic listed corporations. For instance, private equity sells electricity for \$1.92 higher average price per MWh. Private equity firms sell electricity under contracts with shorter duration, shorter increment pricing, and more peak-term periods, especially when selling electricity generated from fossil fuels. Overall, private equity owners appear to obtain higher electricity prices on the wholesale market through flexibility in output that responds to signals in the spot electricity market. Therefore, variation in market competition affects not only the financier of capital expenditures and ownership of assets but also pricing in the product market.

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Figure 1: Ownership and Electricity Generation

This figure presents the aggregate ownership by the eight categories of owners as a percentage of monthly electricity generation over the 2005–2020 period. Electricity generation is measured as the total electrical output net of power plant service. If a power plant is owned by multiple ownership types, we divide the ownership and generation equally across the ownership types (i.e., if a private equity and domestic corporation jointly own a power plant, we assume that each ownership type owns 50% of the power plant and accounts for 50% of the electricity output).

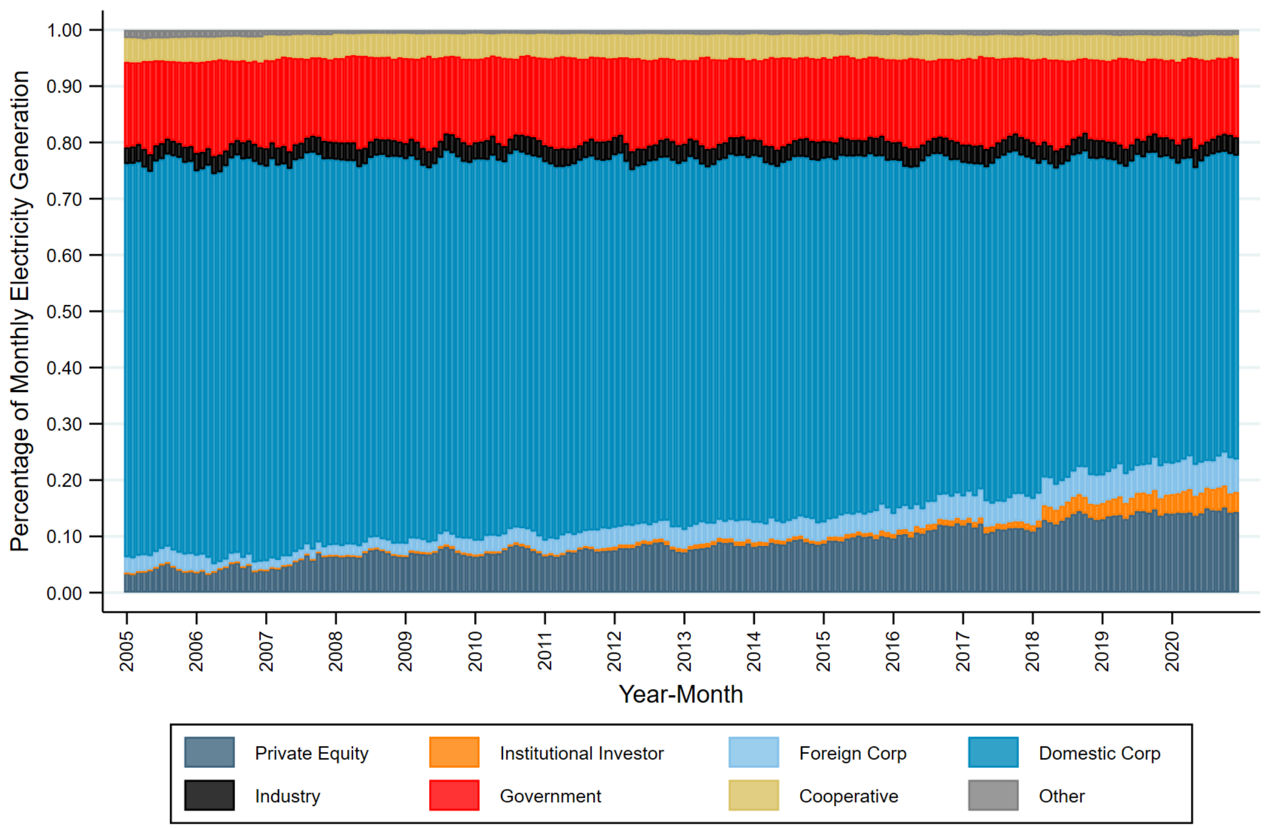


Figure 2: Ownership and Electricity Generation by Fuel Type

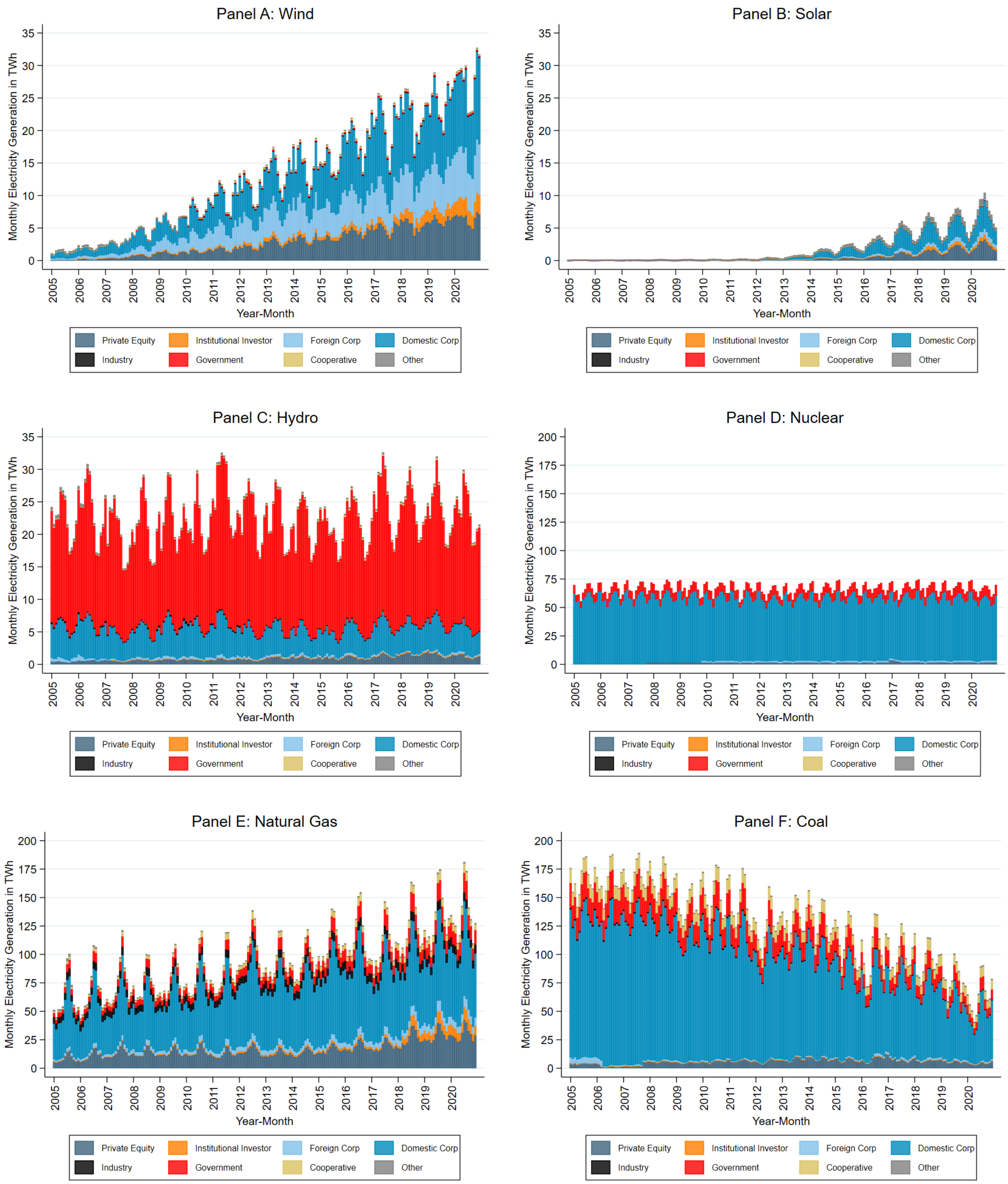


Figure 3: Ownership and Electricity Generation by State

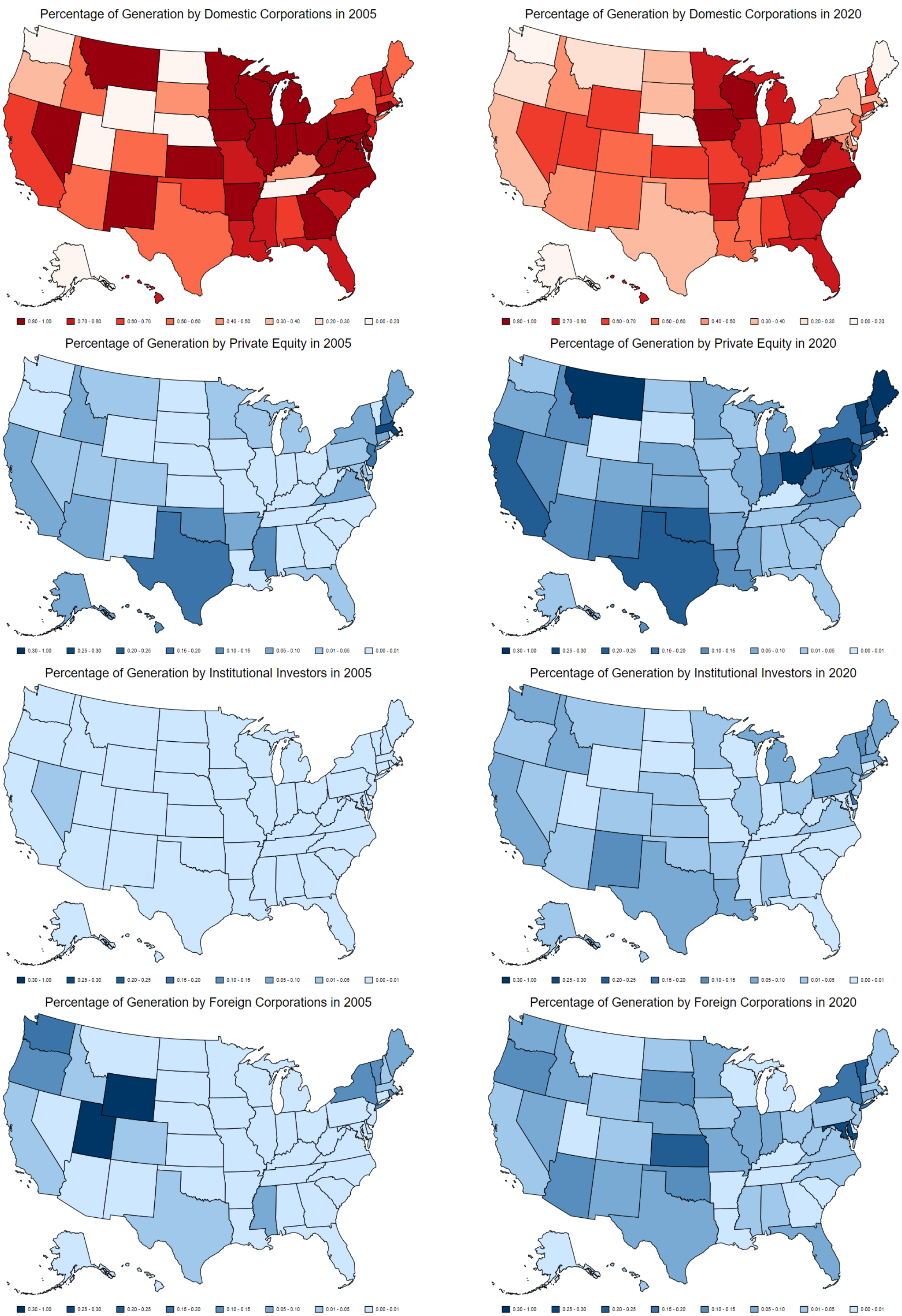


Figure 4: Greenfield and Decommissioned Power Plants

We classify power plants as greenfield assets in the first 12 months of plant operation. Panel A presents the percentage of greenfield power plants weighted by nameplate capacity and Panel B shows the ownership of greenfield plants. We classify power plants as decommissioned assets in the last 12 months of plant operation. Panel C shows the percentage of decommissioned power plants weighted by nameplate capacity, and Panel D presents the ownership of decommissioned power plants. *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority and electric power transmission system operator.

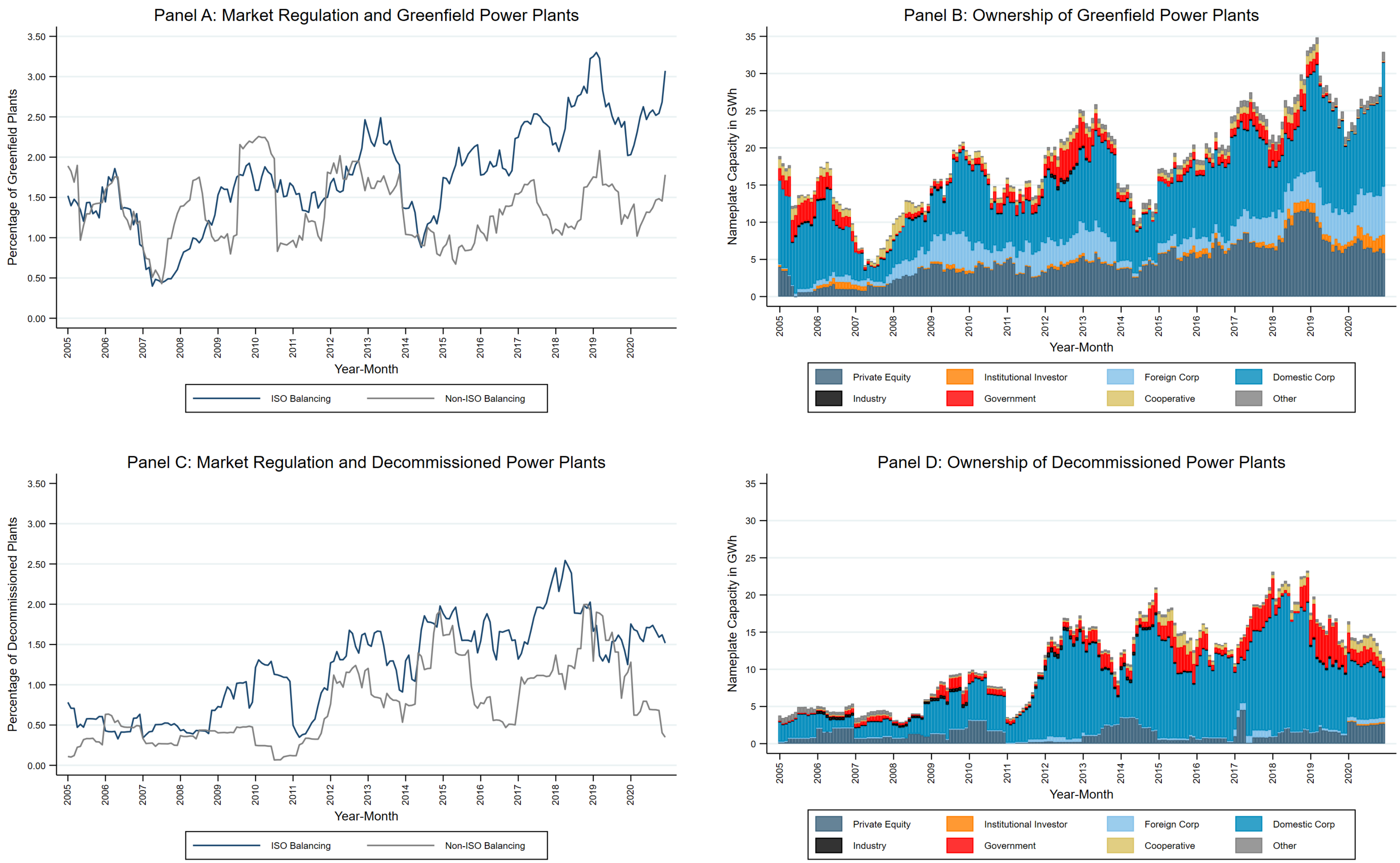


Figure 5: Ownership of Greenfield Power Plants

This figure presents coefficient estimates and confidence intervals of multiple specifications. In all models, observations are at the plant-prime-mover-month level and weighted by power plant nameplate capacity. The dependent variable captures greenfield power plants and equals one for the first 12 months of plant operation. Panel A presents the coefficients for private equity and foreign corporations from multiple subsample specifications. The omitted category in all specifications is domestic corporations, and we also control for the ownership by institutional investors, industry firms, government, cooperatives, and others. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover. The baseline coefficients correspond to the estimations in Table 3 Column (2). We estimate separately the role of ownership categories for power plants located in areas administered by an ISO balancing authority or traditional balancing authority. Next, we estimate separately the role of ownership categories for power plants located in areas where residential or business customers have some level of choice of who provides their electricity as compared to plants located in areas where residential or business customers have no choice of retail electricity supplier. Panel B presents the coefficient estimates of two specifications that replicate Columns (3) and (5) of Table 3, but instead of including an interaction term of domestic publicly listed corporations with the aggregate *Renewable Incentives* index we include five separate interaction terms with the indicators if a state has corporate tax, property tax, sales tax, production, or feed-in tariffs incentives for renewable energy.

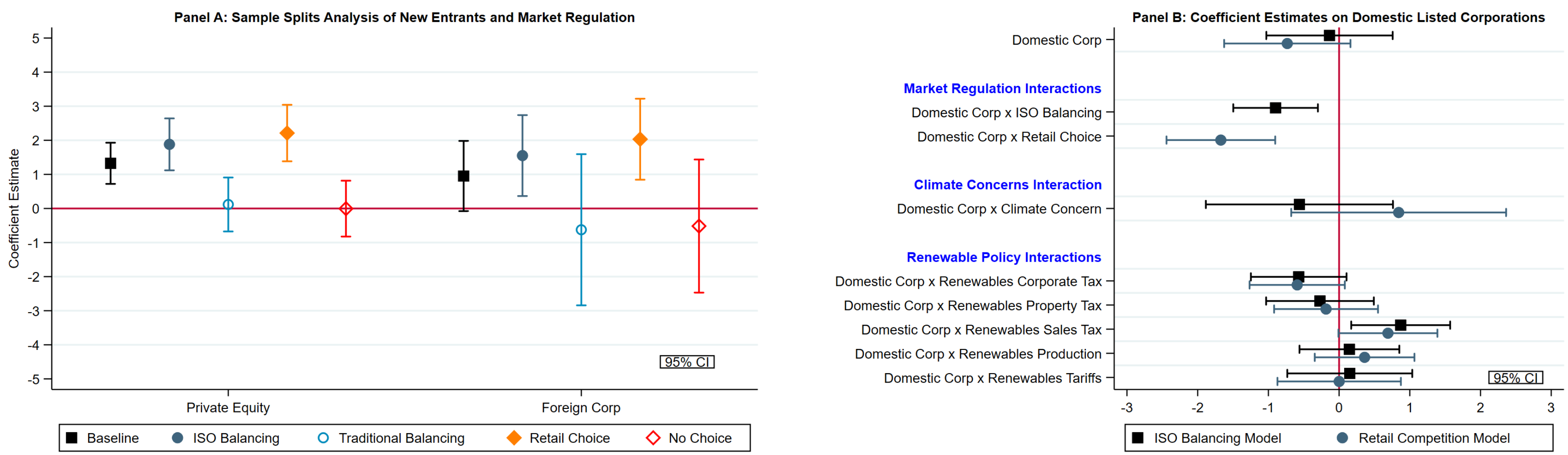


Table 1: EIA Power Plants

The table presents summary statistics on a plant-prime-mover-month level for all power plants together as well as separately for the main fuel types: natural gas, coal, nuclear, hydro, wind, and solar plants. All statistics are the weighted averages by power plant nameplate capacity. Panel A reports statistics for the power plant characteristics. *Capacity* is the average nameplate capacity in GWh. *Capacity Factor* is the mean ratio of monthly net generation to capacity. *Heat Rate* is the mean ratio of fuel consumption in millions Btu to electricity generation in MWh. *Age* presents the average plant age in years. *Independent Power Producer* is an indicator for an entity that owns and operates power plants, but is not regulated as a traditional vertically integrated electric utility. *Greenfield 12m* is an indicator for the first 12 months when a plant starts operating. *Decommissioned 12m* is an indicator for the last 12 months when a plant is still operating. Panel B reports the average ownership by the eight categories in percent. If a power plant is owned by multiple ownership types, we divide the ownership and generation equally across the ownership types. Panel C presents statistics on electricity markets. *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority and electric power transmission system operator. *ISO Restructured Utilities* is an indicator for power plants that participate in a wholesale market administered by an ISO balancing authority and are located in areas with restructured electric utilities. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *Climate Concern* is the percentile ranking of the state where the plant is located based on the percentage of the state population who think that global warming is happening surveyed by the Yale Climate Opinion Maps. *Renewables Incentives* is an aggregate index of three indicators if a state has corporate tax, property tax, and sales tax incentives for renewable energy as well as two indicators if a state has production or feed-in tariffs incentives for renewable energy.

	All	**NatGas**	**Coal**	**Nuclear**	**Hydro**	**Wind**	**Solar**
Panel A: Power Plant Characteristics							
# Unique Plants	11,590	3,024	751	66	1,498	1,294	3,941
# Unique Plants-Prime-Mover	13,282	4,152	869	66	1,498	1,294	3,941
Observations	1,510,761	573,095	115,510	12,215	270,578	135,746	188,070
Capacity (GWh)	0.980	0.707	1.426	2.037	1.090	0.176	0.100
Capacity Factor	0.429	0.308	0.533	0.855	0.399	0.328	0.241
Heat Rate		11.635	10.686	10.457			
Age (Years)	30.909	26.006	41.945	33.091	58.884	6.161	2.912
Independent Power Producer	0.429	0.495	0.277	0.445	0.079	0.845	0.900
# Unique Greenfield	6,111	767	38	0	54	1,035	3,631
Greenfield 12m	0.016	0.015	0.003	0.000	0.000	0.116	0.244
# Unique Decommissioned	2,015	976	315	10	101	98	44
Decommissioned 12m	0.011	0.011	0.017	0.005	0.000	0.002	0.000
Panel B: Power Plant Ownership							
Domestic Listed Corp	0.600	0.595	0.718	0.843	0.210	0.421	0.473
Private Equity	0.109	0.143	0.051	0.019	0.035	0.222	0.250
Institutional Investor	0.011	0.014	0.002	0.000	0.003	0.049	0.046
Foreign Listed Corp	0.039	0.036	0.013	0.014	0.013	0.269	0.063
Industry	0.024	0.039	0.017	0.000	0.006	0.001	0.006
Government	0.159	0.114	0.131	0.124	0.716	0.015	0.007
Cooperative	0.047	0.051	0.064	0.000	0.007	0.010	0.006
Other	0.010	0.008	0.003	0.000	0.010	0.014	0.149
Panel C: Wholesale and Retail Electricity Markets							
ISO Balancing Authority	0.607	0.639	0.607	0.630	0.267	0.788	0.611
ISO Restructured Utilities	0.368	0.393	0.335	0.486	0.122	0.369	0.158
Retail Choice	0.448	0.465	0.339	0.515	0.399	0.488	0.597
Climate Concern	0.530	0.546	0.410	0.558	0.650	0.529	0.737
Renewables Incentives	2.179	2.221	2.066	2.065	2.198	2.705	2.598

Table 2: FERC Electricity Pricing and Contracting

We report summary statistics on a plant-prime-mover-month level and they are weighted by power plant nameplate capacity. The sample includes power plants owned by domestic corporations, private equity, institutional investors, and foreign corporations. Panel A presents summary statistics on electricity prices and reports the average of the mean and median monthly price per MWh. This panel also reports the average percentage of transaction charges for electricity sales by different contractual terms. We split the electricity sales based on three contractual terms. First, we analyze contract duration and distinguish between short contracts with a duration of less than one year and long-term contract duration. Second, we split the transactions into short, medium, and long based on the increment terms. Short transactions use 5-minute, 15-minute, or hourly increments (up to 6 hours). Medium transactions have daily or weekly increments (from 6 hours to 168 hours). Long transactions use monthly or yearly increments (longer than 168 hours). Third, we classify transactions into full-period, peak, and off-peak based on the peaking terms. Panel B presents the average percentage of transaction charges for capacity sales by different contractual terms. We split the capacity sales also based on three contractual terms. We analyze contract duration and distinguish between short contracts with a duration of less than one year and long-term contract duration. For increment terms and peak period terms there is very limited variation in capacity contracts.

	All	**NatGas**	**Coal**	**Nuclear**	**Hydro**	**Wind**	**Solar**
Panel A: Electricity Sales							
#Unique Plants	5,554	1,473	381	56	673	868	1,726
Observations	306,160	98,984	24,041	4,538	52,102	52,582	54,322
Mean Price MWh	33.572	33.241	29.909	29.582	29.718	40.210	70.584
Median Price MWh	31.079	30.244	28.098	27.281	27.955	39.270	66.728
Contract Duration - Short	0.580	0.641	0.594	0.481	0.675	0.370	0.262
Contract Duration - Long	0.418	0.355	0.405	0.519	0.324	0.623	0.737
Increment Terms - Short	0.504	0.557	0.564	0.384	0.387	0.334	0.196
Increment Terms - Medium	0.044	0.057	0.032	0.043	0.084	0.014	0.031
Increment Terms - Long	0.426	0.373	0.389	0.531	0.398	0.606	0.725
Peaking Terms - Full Period	0.385	0.335	0.348	0.478	0.360	0.560	0.585
Peaking Terms - Peak	0.353	0.396	0.376	0.284	0.296	0.206	0.207
Peaking Terms - Off-Peak	0.192	0.203	0.216	0.179	0.181	0.141	0.080
Panel B: Capacity Sales							
#Unique Plants	4,435	1,428	361	53	632	432	1,203
Observations	203,455	90,648	20,734	3,988	43,449	14,309	18,453
Contract Duration - Short	0.152	0.160	0.121	0.147	0.282	0.160	0.106
Contract Duration - Long	0.847	0.839	0.877	0.853	0.718	0.840	0.894
Increment Terms - Short	0.009	0.011	0.007	0.003	0.017	0.008	0.010
Increment Terms - Medium	0.034	0.035	0.055	0.015	0.049	0.056	0.012
Increment Terms - Long	0.946	0.946	0.932	0.961	0.879	0.929	0.960
Peaking Terms - Full Period	0.926	0.925	0.940	0.940	0.817	0.882	0.818
Peaking Terms - Peak	0.015	0.015	0.012	0.003	0.036	0.049	0.052
Peaking Terms - Off-Peak	0.010	0.009	0.009	0.005	0.031	0.008	0.045

Table 3: Ownership of Greenfield Power Plants

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. The dependent variable captures greenfield power plants and equals one for the first 12 months of plant operation. We measure the ownership by domestic publicly listed corporations (*DLC*), private equity, institutional investors, and foreign publicly listed corporations. We also control for the ownership by industry firms, government, cooperatives, and others. *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority. *ISO Restructured* is an indicator for power plants that participate in a wholesale market administered by an ISO balancing authority and are located in areas with restructured electric utilities. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *Independent Power Producer* is an indicator for an entity that owns and operates power plants, but is not regulated as a traditional vertically integrated electric utility. *Climate Concern* is the percentile ranking of the state where the plant is located based on the percentage of the state population who think that global warming is happening. *Renewables Incentives* is an aggregate index of three indicators if a state has corporate tax, property tax and sales tax incentives for renewable energy as well as two indicators if a state has production or feed-in tariffs incentives for renewable energy. *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. $^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

	All Greenfield Power Plants (Unconditional Prob. = 1.63%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Domestic Listed Corp (DLC)	-1.089***		-0.228	-0.732	-0.912**	-0.229
	[0.267]		[0.455]	[0.457]	[0.460]	[0.548]
Private Equity		1.325***				
		[0.308]				
Institutional Investor		-0.919				
		[0.927]				
Foreign Corp		0.952*				
		[0.525]				
DLC × ISO Balancing			-1.094***			
			[0.290]			
DLC × ISO Restructured				-1.527***		
				[0.375]		
DLC × Retail Choice					-1.835***	
					[0.390]	
Independent Power Producer (IPP)						0.266
						[0.402]
DLC × IPP						-1.977***
						[0.464]
DLC × Climate Concern			-0.023	0.105	1.496*	0.657
			[0.658]	[0.674]	[0.770]	[0.658]
DLC × Renewables Incentives			-0.031	0.122	-0.016	-0.017
			[0.164]	[0.164]	[0.163]	[0.163]
ln Plant Capacity	0.131**	0.132**	0.151**	0.135**	0.134**	0.151**
	[0.064]	[0.064]	[0.064]	[0.064]	[0.063]	[0.063]
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761
Adjusted R-squared	0.166	0.166	0.166	0.167	0.167	0.167

Table 4: Ownership of Greenfield Power Plants by Fuel Type

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. In Columns (1) to (4), the dependent variable equals one for the first 12 months of operation for solar and wind greenfield power plants. In Columns (5) to (8), the dependent variable equals one for the first 12 months of operation for natural gas greenfield power plants. We measure the ownership by domestic publicly listed corporations (DLC), private equity, institutional investors, and foreign publicly listed corporations. We also control for the ownership by industry firms, government, cooperatives, and others. Panel A presents the results of baseline specifications, while Panel B presents the results of specifications with interaction terms of domestic listed corporations and market regulation. *ISO Balancing* is an indicator for power plants that participate in a wholesale market administered by an ISO balancing authority. *ISO Restructured* is an indicator for power plants that participate in a wholesale market administered by an ISO balancing authority and are located in areas with restructured electric utilities. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *Independent Power Producer* is an indicator for an entity that owns and operates power plants, but is not regulated as a traditional vertically integrated electric utility. We also control for interaction terms with *Climate Concern* percentile ranking variable and *Renewables Incentives* aggregate index. *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. *$p < .10$; **$p < .05$; ***$p < .01$.

	Solar & Wind Power Plants Unconditional Prob. = 0.75%				**Natural Gas Power Plants** Unconditional Prob. = 0.82%			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Specifications with Baseline Coefficients on Ownership Categories								
Domestic Listed Corp (DLC)	-0.606***				-0.408*			
	[0.134]				[0.225]			
Private Equity		0.697***				0.537**		
		[0.134]				[0.268]		
Institutional Investor		-1.420**				0.470		
		[0.660]				[0.689]		
Foreign Listed Corp		0.951**				-0.035		
		[0.396]				[0.341]		
Plant Capacity	Yes	Yes			Yes	Yes		
Other Owners	Yes	Yes			Yes	Yes		
Fuel-State-Year-Month FE	Yes	Yes			Yes	Yes		
Observations	1,510,761	1,510,761			1,510,761	1,510,761		
Adjusted R-squared	0.194	0.195			0.130	0.130		
Panel B: Specifications with Interaction Terms of Domestic Listed Corporation and Market Regulation								
Domestic Listed Corp (DLC)	-0.352*	-0.416*	-0.446**	-0.228	0.327	-0.096	-0.249	0.198
	[0.200]	[0.216]	[0.216]	[0.229]	[0.376]	[0.356]	[0.361]	[0.461]
DLC × ISO Balancing	-0.127				-0.939***			
	[0.133]				[0.252]			
DLC × ISO Restructured		-0.050				-1.532***		
		[0.165]				[0.334]		
DLC × Retail Choice			-0.458**				-1.404***	
			[0.185]				[0.338]	
Independent Power Producer (IPP)				0.097				0.133
				[0.153]				[0.363]
DLC × IPP				-0.629***				-1.376***
				[0.202]				[0.410]
Plant Capacity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Interaction with Climate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Interaction with Incentives	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761
Adjusted R-squared	0.194	0.194	0.194	0.195	0.130	0.131	0.131	0.131

Table 5: Transitions of Power Plants Owned by Domestic Corporations

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. We present the results of a multinomial logit regression and report the marginal effects at the means of the independent variables. The sample covers power plants that were owned by domestic corporations at the beginning of our sample, in January 2008. We analyze four potential outcomes based on the latest observation in our dataset (December 2020 for plants that are not retired). These are the four potential outcomes: *Still Own & Operating* covers plants that are still owned and operated by domestic corporations; *Owned & Retired* covers plants that remained in domestic corporations' ownership, but were retired during the sample period; *Sold & Operating* captures plants that were sold to other ownership types and are still operating; *Sold & Retired* captures plants that were sold to other ownership types and were retired by these other owners during the sample period. *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *Climate Concern* is the percentile ranking of the state where the plant is located based on the percentage of the state population who think that global warming is happening. *Renewables Incentives* is an aggregate index of three indicators if a state has corporate tax, property tax and sales tax incentives for renewable energy as well as two indicators if a state has production or feed-in tariffs incentives for renewable energy. *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. *ln Plant Age* is the natural logarithm of plant age in years. The specifications include fuel-type fixed effects. We report the coefficients on the fixed effects for coal, petroleum, and natural gas fuels. *Coal & Petroleum* is a joint indicator for power plants that use coal, waste coal, petroleum coke, or residual petroleum fuel. In this table, we include Coal & Petroleum as a joint indicator variable for power plants that use coal, waste coal, petroleum coke, or residual petroleum fuel to simplify the interpretation and cover the impact across a broader set of fuels. In all other tables, we include separate fuel fixed effects for these four fuel types. We cluster standard errors by power plant, and report standard errors in brackets. $^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

	Still Own & Operating		**Owned & Retired**		**Sold & Operating**		**Sold & Retired**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
# Unique Plants	1,122	1,122	474	474	524	524	82	82
Unconditional Prob.	0.639	0.639	0.164	0.164	0.178	0.178	0.019	0.019
ISO Balancing	-0.286***		0.082**		0.176***		0.028***	
	[0.042]		[0.032]		[0.035]		[0.010]	
Retail Choice		-0.235***		0.053*		0.165***		0.017**
		[0.043]		[0.030]		[0.037]		[0.008]
Climate Concern	-0.020	-0.056	0.023	0.048	-0.010	-0.012	0.007	0.020
	[0.068]	[0.070]	[0.052]	[0.053]	[0.051]	[0.057]	[0.020]	[0.021]
Renewables Incentives	-0.005	0.005	0.015	0.014	-0.018	-0.025*	0.007**	0.007**
	[0.017]	[0.018]	[0.013]	[0.013]	[0.014]	[0.014]	[0.003]	[0.003]
ln Plant Capacity	0.122***	0.112***	-0.080***	-0.077***	-0.034***	-0.028***	-0.008***	-0.006**
	[0.015]	[0.015]	[0.010]	[0.010]	[0.011]	[0.011]	[0.002]	[0.003]
ln Plant Age	-0.045*	-0.042*	0.137***	0.138***	-0.099***	-0.101***	0.007	0.006
	[0.023]	[0.024]	[0.021]	[0.021]	[0.014]	[0.014]	[0.005]	[0.005]
Coal & Petroleum	-0.347***	-0.340***	0.326***	0.325***	-0.020	-0.022	0.041	0.037
	[0.042]	[0.043]	[0.041]	[0.041]	[0.041]	[0.040]	[0.027]	[0.026]
Natural Gas	-0.327***	-0.323***	0.283***	0.284***	-0.006	-0.007	0.049**	0.046**
	[0.052]	[0.053]	[0.050]	[0.049]	[0.036]	[0.036]	[0.021]	[0.020]
Fuel FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,202	2,202	2,202	2,202	2,202	2,202	2,202	2,202

Table 6: Ownership of Decommissioned Power Plants

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. The dependent variable captures decommissioned power plants and equals one for the last 12 months of plant operation. We measure the ownership by domestic publicly listed corporations, private equity, institutional investors, and foreign publicly listed corporations. We also control for the ownership by industry firms, government, cooperatives, and others. *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority. *ISO Restructured* is an indicator for power plants that participate in a wholesale market administered by an ISO balancing authority and are located in areas with restructured electric utilities. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *Independent Power Producer* is an indicator for an entity that owns and operates power plants, but is not regulated as a traditional vertically integrated electric utility. *Climate Concern* is the percentile ranking of the state where the plant is located based on the percentage of the state population who think that global warming is happening. *Renewables Incentives* is an aggregate index of three indicators if a state has corporate tax, property tax, and sales tax incentives for renewable energy as well as two indicators if a state has production or feed-in tariffs incentives for renewable energy. *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. *ln Plant Age* is the natural logarithm of plant age in years. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. *$p < .10$; **$p < .05$; ***$p < .01$.

	All Decommissioned Power Plants (Unconditional Prob. = 1.06%)					
	(1)	(2)	(3)	(4)	(5)	(6)
Domestic Listed Corp (DLC)	0.060		-0.936**	-0.582	-0.534	-0.097
	[0.215]		[0.412]	[0.386]	[0.392]	[0.567]
Private Equity		0.236				
		[0.271]				
Institutional Investor		-1.109***				
		[0.258]				
Foreign Corp		-0.686***				
		[0.248]				
DLC × ISO Balancing			0.686***			
			[0.250]			
DLC × ISO Restructured				0.042		
				[0.362]		
DLC × Retail Choice					0.738**	
					[0.375]	
Independent Power Producer (IPP)						0.693
						[0.457]
DLC × IPP						-0.018
						[0.506]
DLC × Climate Concern			1.465**	1.638**	0.921	1.296**
			[0.620]	[0.645]	[0.760]	[0.628]
DLC × Renewables Incentives			-0.143	-0.139	-0.146	-0.141
			[0.145]	[0.148]	[0.144]	[0.145]
ln Plant Capacity	-0.642***	-0.642***	-0.661***	-0.650***	-0.650***	-0.654***
	[0.077]	[0.077]	[0.077]	[0.077]	[0.077]	[0.076]
ln Plant Age	1.054***	1.066***	1.037***	1.047***	1.044***	1.058***
	[0.124]	[0.124]	[0.123]	[0.124]	[0.123]	[0.124]
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761
Adjusted R-squared	0.241	0.241	0.241	0.241	0.241	0.241

Table 7: Ownership of Decommissioned Power Plants by Fuel Type

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. In Columns (1) to (4), the dependent variable equals one for the last 12 months of operation for decommissioned power plants that use coal, waste coal, petroleum coke, and residual petroleum as fuel. In Columns (5) to (8), the dependent variable equals one for the last 12 months of operation for decommissioned natural gas power plants. We measure the ownership by domestic publicly listed corporations, private equity, institutional investors, and foreign publicly listed corporations. We also control for the ownership by industry firms, government, cooperatives, and others. Panel A presents the results of baseline specifications, while Panel B presents the results of specifications with interaction terms of domestic listed corporations and market regulation. *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority. *ISO Restructured* is an indicator for power plants that participate in a wholesale market administered by an ISO balancing authority and are located in areas with restructured electric utilities. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *Independent Power Producer* is an indicator for an entity that owns and operates power plants, but is not regulated as a traditional vertically integrated electric utility. We also control for interaction terms with *Climate Concern* percentile ranking variable and *Renewables Incentives* aggregate index. *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. *ln Plant Age* is the natural logarithm of plant age in years. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. $^*p < .10$; $^{**}p < .05$; $^{***}p < .01$.

	Coal and Petroleum Power Plants Unconditional Prob. = 0.65%				**Natural Gas Power Plants** Unconditional Prob. = 0.30%			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Specifications with Baseline Coefficients on Ownership Categories								
Domestic Listed Corp (DLC)	0.213				-0.197			
	[0.132]				[0.126]			
Private Equity		-0.189				0.364**		
		[0.161]				[0.172]		
Institutional Investor		0.070				-0.757***		
		[0.077]				[0.185]		
Foreign Corp		-0.379**				-0.017		
		[0.189]				[0.093]		
Plant Capacity and Age	Yes	Yes			Yes	Yes		
Other Owners	Yes	Yes			Yes	Yes		
Fuel-State-Year-Month FE	Yes	Yes			Yes	Yes		
Observations	1,510,761	1,510,761			1,510,761	1,510,761		
Adjusted R-squared	0.358	0.359			0.029	0.029		
Panel B: Specifications with Interaction Terms with Market Regulation								
Domestic Listed Corp (DLC)	-0.219	0.022	0.074	0.213	-0.511**	-0.441**	-0.449**	-0.184
	[0.286]	[0.263]	[0.269]	[0.504]	[0.204]	[0.191]	[0.192]	[0.184]
DLC × ISO Balancing	0.497***				0.105			
	[0.190]				[0.105]			
DLC × ISO Restructured		0.368				-0.289*		
		[0.254]				[0.168]		
DLC × Retail Choice			0.579**				0.089	
			[0.290]				[0.155]	
Independent Power Producer (IPP)				0.282				0.359***
				[0.434]				[0.111]
DLC × IPP				0.104				-0.045
				[0.466]				[0.150]
Plant Capacity and Age	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Interaction with Climate	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Interaction with Incentives	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761	1,510,761
Adjusted R-squared	0.359	0.359	0.359	0.359	0.029	0.029	0.029	0.030

Table 8: Operating Performance

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. In Columns (1) to (4), the dependent variable is the monthly capacity factor, which is the ratio of net electricity generation in MWh to nameplate capacity. We winsorize the capacity factor at 0.5% and 99.5%. In Columns (5) to (8), the dependent variable is the monthly heat rate, which is the ratio of fuel consumption in millions Btu to electricity generation in MWh. We observe the heat rate for fossil fuel and nuclear power plants. We measure the ownership by domestic publicly listed corporations, private equity, institutional investors, and foreign publicly listed corporations. We also control for the ownership by industry firms, government, cooperatives, and others. *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. *ln Plant Age* is the natural logarithm of plant age in years. *Greenfield 1m* is an indicator for the first month when a plant starts operating. *Greenfield 12m* is an indicator for the first 12 months when a plant starts operating. *Decommissioned 1m* is an indicator for the last month when a plant is still operating. *Decommissioned 12m* is an indicator for the last 12 months when a plant is still operating. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. *$p < .10$; **$p < .05$; ***$p < .01$.

	Capacity Factor Mean Dependent Variable = 0.403				**Heat Rate** Mean Dependent Variable = 11.323			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Domestic Listed Corp (DLC)	0.017		0.050***	0.038***	0.483***		0.262	0.246
	[0.010]		[0.015]	[0.013]	[0.154]		[0.180]	[0.182]
Private Equity		-0.028**				-0.361**		
		[0.012]				[0.173]		
Institutional Investor		0.096***				-1.609***		
		[0.035]				[0.499]		
Foreign Listed Corp		-0.014				-0.564**		
		[0.015]				[0.285]		
DLC × ISO Balancing			-0.048***				0.307*	
			[0.014]				[0.183]	
DLC × Retail Choice				-0.038***				0.427*
				[0.015]				[0.231]
ln Plant Capacity	0.018***	0.018***	0.019***	0.018***	-0.363***	-0.363***	-0.369***	-0.371***
	[0.004]	[0.003]	[0.004]	[0.003]	[0.067]	[0.067]	[0.068]	[0.067]
ln Plant Age	-0.109***	-0.110***	-0.108***	-0.109***	1.335***	1.342***	1.331***	1.333***
	[0.006]	[0.006]	[0.006]	[0.006]	[0.112]	[0.111]	[0.112]	[0.112]
Greenfield 1m	-0.168***	-0.168***	-0.168***	-0.169***	1.861***	1.857***	1.861***	1.866***
	[0.009]	[0.009]	[0.009]	[0.009]	[0.584]	[0.581]	[0.584]	[0.585]
Greenfield 12m	-0.142***	-0.142***	-0.142***	-0.143***	1.772***	1.781***	1.776***	1.787***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.230]	[0.229]	[0.230]	[0.230]
Decommissioned 1m	-0.073***	-0.073***	-0.073***	-0.073***	0.445	0.441	0.444	0.441
	[0.014]	[0.014]	[0.014]	[0.014]	[0.420]	[0.420]	[0.421]	[0.421]
Decommissioned 12m	-0.125***	-0.124***	-0.124***	-0.124***	0.521***	0.516***	0.510***	0.500***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.165]	[0.165]	[0.166]	[0.166]
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,510,761	1,510,761	1,510,761	1,510,761	680,092	680,092	680,092	680,092
Adjusted R-squared	0.667	0.668	0.668	0.668	0.341	0.341	0.341	0.341

Table 9: Operating Performance by Fuel Type

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. In Panel A, the dependent variable is the monthly capacity factor, which is the ratio of electricity generation in MWh to nameplate capacity. We winsorize the capacity factor at 0.5% and 99.5%. In Panel B, the dependent variable is the monthly heat rate, which is the ratio of fuel consumption in millions Btu to electricity generation in MWh. We do not observe the heat rate for wind, solar, and hydro power plants. Columns (1) to (3) examine the subsample of natural gas plants, Columns (4) to (6) examine the subsample of coal, waste coal, petroleum coke and residual petroleum plants, and Columns (7) to (9) examine the subsample of solar and wind power plants. We focus on the ownership by domestic publicly listed corporations and also control for the ownership by industry firms, government, cooperatives, and others (the omitted ownership categories are private equity, institutional investors, and foreign publicly listed corporations). *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. *ln Plant Age* is the natural logarithm of plant age in years. *Greenfield 1m* is an indicator for the first month when a plant starts operating. *Greenfield 12m* is an indicator for the first 12 months when a plant starts operating. *Decommissioned 1m* is an indicator for the last month when a plant is still operating. *Decommissioned 12m* is an indicator for the last 12 months when a plant is still operating. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. $^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

	Natural Gas			**Coal & Petroleum**			**Solar & Wind**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Capacity Factor	Mean Dep. Var. = 0.276			Mean Dep. Var. = 0.481			Mean Dep. Var. = 0.314		
Domestic Listed Corp (DLC)	0.031**	0.079***	0.063***	-0.016	0.006	0.018	0.006	-0.001	0.010*
	[0.014]	[0.022]	[0.019]	[0.037]	[0.043]	[0.038]	[0.004]	[0.005]	[0.005]
DLC × ISO Balancing		-0.071***			-0.024			0.009	
		[0.022]			[0.027]			[0.006]	
DLC × Retail Choice			-0.060***			-0.057			-0.008
			[0.021]			[0.037]			[0.008]
Plant Age and Capacity Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	482,799	482,799	482,799	153,511	153,511	153,511	323,816	323,816	323,816
Adjusted R-squared	0.361	0.364	0.364	0.539	0.540	0.541	0.672	0.672	0.672
Panel B: Heat Rate	Mean Dep. Var. = 11.816			Mean Dep. Var. = 10.913					
Domestic Listed Corp (DLC)	0.690***	0.345	0.425*	-0.230	-0.352	-0.495*			
	[0.179]	[0.229]	[0.228]	[0.266]	[0.308]	[0.271]			
DLC × ISO Balancing		0.500*			0.138				
		[0.280]			[0.180]				
DLC × Retail Choice			0.473			0.466*			
			[0.312]			[0.242]			
Plant Age and Capacity Controls	Yes	Yes	Yes	Yes	Yes	Yes			
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes			
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes			
Observations	341,625	341,625	341,625	135,548	135,548	135,548			
Adjusted R-squared	0.269	0.269	0.269	0.383	0.383	0.384			

Table 10: Contractual Terms of Electricity Sales

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. The dependent variables are the percentages of electricity transaction charges under three different contractual terms. First, we distinguish between short contracts with a duration of less than one year and long-term contracts. Second, we split transactions into short, medium, and long based on the increment pricing terms. Short transactions use 5-minute, 15-minute, or hourly increments (up to 6 hours). Medium transactions have daily or weekly increments (from 6 hours to 168 hours). Long transactions use monthly or yearly increments (longer than 168 hours). Third, we classify transactions into full-period, peak, and off-peak based on the peaking terms. The sample includes power plants owned by domestic publicly listed corporations, private equity, institutional investors, and foreign publicly listed corporations. We focus on the ownership by private equity, institutional investors, and foreign corporations (the omitted ownership category is domestic corporations). *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. *ln Plant Age* is the natural logarithm of plant age in years. *Greenfield 12m* is an indicator for the first 12 months when a plant starts operating. *Decommissioned 12m* is an indicator for the last 12 months when a plant is still operating. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. $^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

	Contract Duration		**Increment Terms**			**Peaking Period Terms**		
	Short	Long	Short	Medium	Long	Full	Peak	Off-Peak
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean Dependent Variable	0.580	0.417	0.504	0.044	0.425	0.384	0.353	0.192
Private Equity	0.096***	-0.099***	0.131***	-0.011	-0.131***	-0.020	0.070***	-0.022**
	[0.029]	[0.030]	[0.024]	[0.008]	[0.026]	[0.025]	[0.019]	[0.010]
Institutional Investor	-0.165**	0.176***	-0.271***	0.044	0.234***	0.238***	-0.141***	-0.038
	[0.065]	[0.066]	[0.061]	[0.033]	[0.078]	[0.075]	[0.045]	[0.028]
Foreign Corp	0.023	-0.019	0.068*	0.005	-0.119***	0.037	-0.032	-0.043***
	[0.039]	[0.039]	[0.037]	[0.010]	[0.039]	[0.036]	[0.022]	[0.014]
ln Plant Capacity	0.015	-0.018*	0.001	-0.002	0.008	-0.008	0.009	0.003
	[0.010]	[0.011]	[0.009]	[0.003]	[0.010]	[0.010]	[0.007]	[0.003]
ln Plant Age	-0.011	0.006	0.004	-0.005	0.003	-0.020	0.030***	-0.001
	[0.016]	[0.016]	[0.014]	[0.005]	[0.013]	[0.013]	[0.010]	[0.004]
Greenfield 12m	0.011	-0.027	0.056**	-0.001	-0.060**	-0.066***	0.072***	0.028***
	[0.027]	[0.027]	[0.023]	[0.007]	[0.024]	[0.024]	[0.017]	[0.008]
Decommissioned 12m	0.048	-0.046	0.023	0.003	-0.004	-0.020	0.019	0.007
	[0.035]	[0.035]	[0.033]	[0.004]	[0.031]	[0.035]	[0.026]	[0.015]
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	305,962	305,962	305,962	305,962	305,962	305,962	305,962	305,962
Adjusted R-squared	0.582	0.581	0.640	0.605	0.618	0.608	0.618	0.596

Table 11: Contractual Terms of Capacity Sales

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. The sample includes power plants owned by domestic publicly listed corporations, private equity, institutional investors, and foreign publicly listed corporations. In Columns (1) and (2), the dependent variable is an indicator equal to one if a power plant receives compensation for capacity sales. The sample in these specifications includes all power plants reporting in the FERC dataset. In Columns (3) to (6), the dependent variables measure the average percentage of transaction charges for capacity sales by contract length. These specifications limit attention to the subsample of power plants with capacity sales. *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. *ln Plant Age* is the natural logarithm of plant age in years. *Greenfield 12m* is an indicator for the first 12 months when a plant starts operating. *Decommissioned 12m* is an indicator for the last 12 months when a plant is still operating. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. $^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

	Probability		**Short Contracts**		**Long Contracts**	
	(1)	(2)	(3)	(4)	(5)	(6)
Mean Dependent Variable	0.836	0.836	0.153	0.153	0.846	0.846
Domestic Listed Corp (DLC)	0.028		-0.068**		0.067**	
	[0.018]		[0.033]		[0.033]	
Private Equity		-0.009		0.095**		-0.094**
		[0.022]		[0.038]		[0.038]
Institutional Investor		0.082**		-0.255***		0.255***
		[0.041]		[0.066]		[0.066]
Foreign Corp		-0.094***		0.146***		-0.146***
		[0.031]		[0.051]		[0.051]
ln Plant Capacity	0.015**	0.015**	-0.010	-0.007	0.010	0.007
	[0.007]	[0.007]	[0.009]	[0.009]	[0.009]	[0.009]
ln Plant Age	0.007	0.008	0.024**	0.026**	-0.024**	-0.026**
	[0.007]	[0.007]	[0.011]	[0.011]	[0.011]	[0.011]
Greenfield 12m	-0.016	-0.013	-0.012	-0.009	0.012	0.009
	[0.018]	[0.018]	[0.027]	[0.027]	[0.027]	[0.027]
Decommissioned 12m	-0.002	-0.002	-0.007	-0.006	0.008	0.007
	[0.024]	[0.024]	[0.036]	[0.035]	[0.036]	[0.035]
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	316,081	316,081	203,492	203,492	203,492	203,492
Adjusted R-squared	0.593	0.596	0.533	0.542	0.533	0.542

Table 12: Pricing of Electricity Sales

In this table, observations are at the plant-prime-mover-month level and are weighted by the quantity of sold electricity. The dependent variables are the mean and median of monthly electricity prices per MWh. We winsorize the dependent variables at 0.5% and 99.5%. The sample includes power plants owned by domestic publicly listed corporations, private equity, institutional investors, and foreign publicly listed corporations. We focus on the ownership by private equity, institutional investors, and foreign corporations (the omitted ownership category is domestic corporations). *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. *ln Plant Age* is the natural logarithm of plant age in years. *Greenfield 12m* is an indicator for the first 12 months when a plant starts operating. *Decommissioned 12m* is an indicator for the last 12 months when a plant is still operating. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. *$p < .10$; **$p < .05$; ***$p < .01$.

	Mean Price		**Median Price**	
	(1)	(2)	(3)	(4)
Mean Dependent Variable	33.373	33.373	30.198	30.198
Private Equity	4.525***	1.920*	4.450***	1.994*
	[0.973]	[1.097]	[0.940]	[1.057]
Institutional Investor	0.952	1.186	0.203	0.174
	[2.524]	[2.275]	[2.177]	[1.878]
Foreign Corp	1.056	-1.597	1.152	-1.091
	[1.544]	[1.650]	[1.428]	[1.667]
ln Plant Capacity	-0.448	-0.101	-0.384	0.100
	[0.489]	[0.583]	[0.466]	[0.583]
ln Plant Age	1.233**	1.029*	1.176**	0.812
	[0.486]	[0.577]	[0.483]	[0.567]
Greenfield 12m	-5.029***	-5.545***	-4.988***	-5.715***
	[1.139]	[1.226]	[1.084]	[1.159]
Decommissioned 12m	-1.380	-1.386	-2.088	-2.729
	[1.407]	[1.675]	[1.799]	[2.383]
State-Year-Month FE	Yes		Yes	
Fuel FE	Yes		Yes	
Fuel-State-Year-Month FE		Yes		Yes
Observations	236,674	236,674	236,674	236,674
Adjusted R-squared	0.587	0.718	0.521	0.676

Online Appendix

The Shifting Finance of Electricity Generation

A.1 Power Plants and Electricity Generation

The percentage of electricity generated by power plants owned by domestic publicly listed corporations (DLCs) declines from 71% in 2005 to 54% in 2020. Private equity (PE), institutional investors, and foreign corporations replace domestic corporations as their share jointly increases from 6% in 2005 to 24% in 2020. The generation share of governments, cooperatives, and industry firms remains constant. The ownership changes while the total output remains constant. Online Appendix Figure A.1 Panel A shows that U.S. produced around 4.1 trillion kWh of electricity in 2005 and the total output has remained constant over our sample period. Panel B plots the total imports and exports of electricity, which also remain stable over our analysis and are economically marginal as they account for less than 1.5% of the U.S. electricity market.

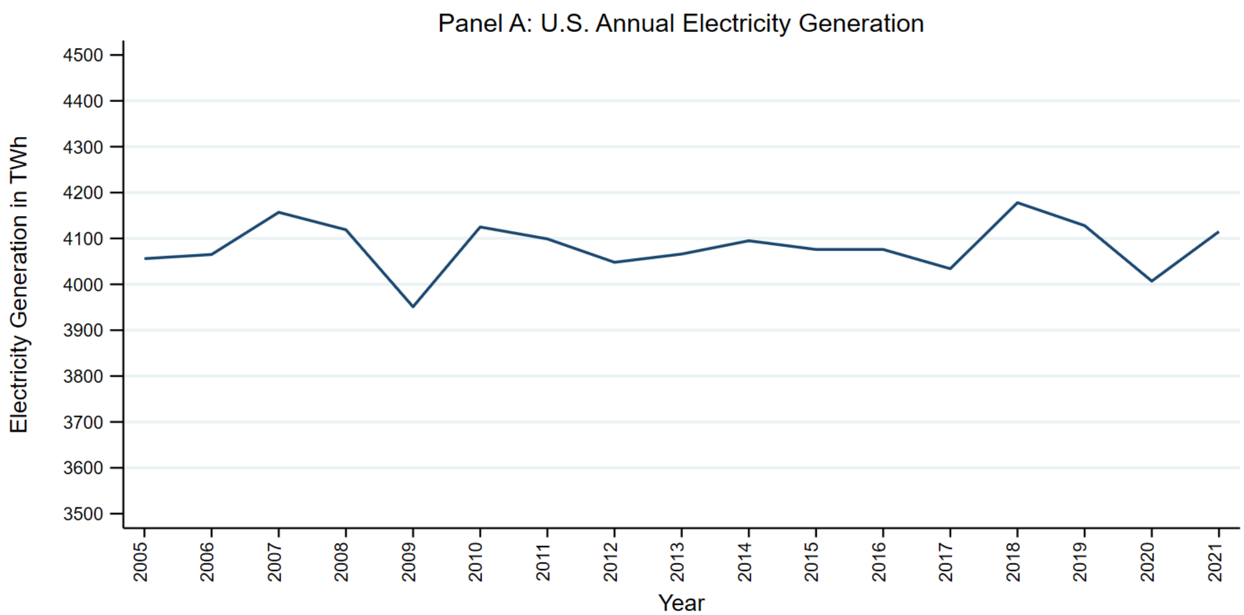
In our analysis, all values are weighted by power plant nameplate capacity. We present weighted statistics and regression estimates, as the sample of power plants contains many small power plants that contribute very little to overall net generation. Online Appendix Table A.1 reports summary statistics without weighting the power plants and focuses only on the subsample of power plants with a capacity of at least 20MW.

Online Appendix Table A.2 shows how many power plants in each state operate under a deregulated wholesale and retail market. This table shows that the *ISO Balancing* measure is broader as it covers also states that did not restructure their utilities but agreed to operate in a competitive wholesale market. On the other hand, the vast majority of power plants located in an area that offers a *Retail Choice* participate in an *ISO Restructured* wholesale market.

We use the Database of State Incentives for Renewables & Efficiency from the N.C. Clean Energy Technology Center to collect information on the policy incentives introduced by different states to stimulate the transition to renewable energy sources. We split the policy initiatives into three types of tax incentives: Renewables Corporate Tax, Renewables Property Tax, and Renewables Sales Tax; and two types of production incentives: Renewables Production and Renewables Tariffs. Renewables Corporate Tax Incentives capture programs that provide a corporate tax credit, corporate tax deduction, and corporate depreciation. Renewables Property Taxes capture programs offering property tax exemption or reduction. Renewables Sales Taxes incentives offer an exemption or reduction from sales and use tax for equipment, generation, etc. Renewables Production incentives offer monetary compensation per KWh that can differ by fuel type and plant capacity. Renewables Tariffs incentives capture primarily feed-in tariffs, which offer long-term contracts with an above-market price to renewable energy producers. In our analysis, we include a *Renewables Incentives* index, which aggregates the three tax indicators and the two production indicators. Online Appendix Table A.3 presents the average value of the five indicators and aggregate renewables incentives index by state over the 2005–2020 period. The index varies from 0.00 in Arkansas to 3.91 incentive types in Vermont.

Figure A.1: Total U.S. Electricity Generation

Panel A presents the total U.S. electricity generation over the 2005–2021 period. The data is based on the Energy Information Administration (EIA) Monthly Energy Review Table 7.2a and includes generation from power plants with at least 1 MW electric generation capacity. Panel B shows the total U.S. electricity imports and electricity exports to Canada and Mexico over 2011–2021 period. The data is based on the Energy Information Administration (EIA) Table 2.14. (Sources: 2016–2021, U.S. Energy Information Administration, Form EIA-111, Quarterly Electricity Imports and Exports Report; 2006–2015 data, National Energy Board of Canada; FERC 714, Annual Electric Balancing Authority Area and Planning Report; California Energy Commission; and EIA estimates.)



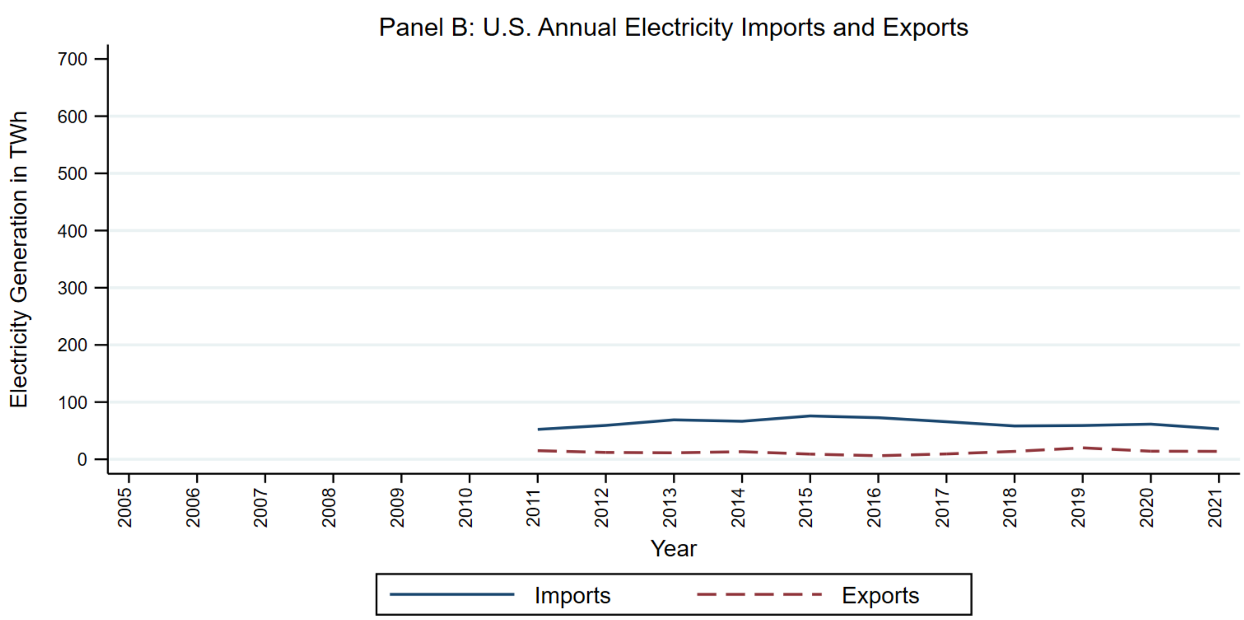


Table A.1: EIA Power Plants (Not Weighted Observations)

Robustness statistics of Table 1: We do not weight observations by power plant nameplate capacity, but we limit attention to the subsample of power plants with a nameplate capacity of at least 20MW.

The table presents summary statistics on a plant-prime-mover-month level for all power plants together as well as separately for the main fuel types: natural gas, coal, nuclear, hydro, wind, and solar plants. The sample includes only power plants with a nameplate capacity of at least 20MW. Panel A reports statistics for the power plant characteristics: *Capacity*, *Capacity Factor*, *Heat Rate*, *Age*, *Independent Power Producer*, *Greenfield 12m*, and *Decommissioned 12m*. Panel B reports the average ownership by the eight categories in percent. If a power plant is owned by multiple ownership types, we divide the ownership and generation equally across the ownership types. Panel C presents statistics on electricity markets. *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority and electric power transmission system operator. *ISO Restructured Utilities* is an indicator for power plants that participate in a wholesale market administered by an ISO balancing authority and are located in areas with restructured electric utilities. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *Climate Concern* is the percentile ranking of the state where the plant is located based on the percentage of the state population who think that global warming is happening surveyed by the Yale Climate Opinion Maps. *Renewables Incentives* is an aggregate index of three indicators if a state has corporate tax, property tax, and sales tax incentives for renewable energy as well as two indicators if a state has production or feed-in tariffs incentives for renewable energy.

	All	**NatGas**	**Coal**	**Nuclear**	**Hydro**	**Wind**	**Solar**
Panel A: Power Plant Characteristics							
# Unique Plants	4,458	1,961	651	66	457	881	502
# Unique Plants-Prime-Mover	5,409	2,800	730	66	457	881	502
Observations	753,948	420,746	102,666	12,215	86,146	88,185	21,062
Capacity (GWh)	0.285	0.283	0.635	1.689	0.163	0.114	0.063
Capacity Factor	0.318	0.286	0.478	0.857	0.373	0.321	0.257
Heat Rate		11.738	10.768	10.459			
Age (Years)	28.528	25.654	42.952	33.668	61.290	7.059	2.701
Independent Power Producer	0.525	0.531	0.416	0.478	0.138	0.869	0.871
# Unique Greenfield	1,889	518	36	0	5	779	501
Greenfield 12m	0.028	0.014	0.004	0.000	0.001	0.099	0.252
# Unique Decommissioned	819	539	250	10	5	28	1
Decommissioned 12m	0.013	0.015	0.029	0.009	0.001	0.004	0.001
Panel B: Power Plant Ownership							
Domestic Corporation	0.425	0.407	0.519	0.864	0.347	0.414	0.530
Private Equity	0.143	0.146	0.072	0.013	0.074	0.242	0.273
Institutional Investor	0.016	0.016	0.003	0.000	0.005	0.040	0.055
Foreign Corporation	0.069	0.042	0.015	0.016	0.029	0.260	0.097
Industry	0.064	0.095	0.120	0.000	0.012	0.001	0.011
Government	0.198	0.191	0.169	0.106	0.512	0.017	0.002
Cooperative	0.051	0.063	0.071	0.000	0.020	0.009	0.004
Other	0.034	0.040	0.032	0.000	0.001	0.018	0.027
Panel C: State Electricity Markets							
ISO Balancing Authority	0.637	0.668	0.641	0.700	0.399	0.774	0.555
ISO Restructured Utilities	0.333	0.368	0.331	0.494	0.144	0.330	0.097
Retail Choice	0.490	0.497	0.350	0.515	0.429	0.486	0.579
Climate Concern	0.572	0.575	0.442	0.560	0.573	0.534	0.738
Renewables Incentives	2.217	2.211	2.066	2.107	2.033	2.575	2.515

Table A.2: Regulatory Policy by State

We present the number of plant-prime-mover-month observations by state based on the electricity market regulatory status. *ISO Balancing* is an indicator for power plants that participate in a wholesale market that is administered by an Independent System Operator (ISO) as a balancing authority and electric power transmission system operator. *ISO Restructured Utilities* is an indicator for power plants that participate in a wholesale market administered by an ISO balancing authority and are located in areas with restructured electric utilities. *Retail Choice* is an indicator for power plants located in an area where residential or business customers can choose an electricity provider. *Traditional* markets do not offer retail choice and vertically integrated local electric utilities own power plants generating electricity as well as the transmission system and delivery network.

State	ISO Balancing	ISO Restructured	Retail Choice	Traditional	Total Plants
Alabama	0	0	0	18,746	18,746
Alaska	0	0	0	28,251	28,251
Arizona	261	0	0	22,266	22,527
Arkansas	9,286	0	0	3,144	12,430
California	174,432	0	210,889	0	210,889
Colorado	162	0	0	30,655	30,817
Connecticut	18,038	18,038	18,038	0	18,038
Delaware	5,024	5,024	5,024	0	5,024
DC	503	503	503	0	503
Florida	0	0	0	42,660	42,660
Georgia	0	0	0	29,487	29,487
Hawaii	0	0	0	12,192	12,192
Idaho	0	0	0	22,249	22,249
Illinois	41,261	41,261	41,261	882	42,143
Indiana	24,455	0	0	361	24,816
Iowa	37,401	0	0	5,261	42,662
Kansas	23,054	0	0	3,095	26,149
Kentucky	3,283	0	0	6,861	10,144
Louisiana	17,689	0	0	2,654	20,343
Maine	18,527	18,527	20,240	0	20,240
Maryland	15,671	15,671	15,671	0	15,671
Massachusetts	47,402	47,402	47,402	0	47,402
Michigan	46,572	46,572	47,504	0	47,504
Minnesota	59,894	0	0	3,125	63,019
Mississippi	4,786	0	0	7,611	12,397
Missouri	17,718	0	0	8,535	26,253
Montana	1,100	0	8,953	0	8,953
Nebraska	14,559	0	0	4,946	19,505
Nevada	983	0	15,771	0	15,771
New Hampshire	12,736	12,736	12,736	0	12,736
New Jersey	38,957	38,957	38,957	0	38,957
New Mexico	3,502	0	0	11,330	14,832
New York	82,378	82,378	82,378	0	82,378
North Carolina	7,173	0	0	56,414	63,587
North Dakota	7,866	0	0	581	8,447
Ohio	30,401	30,401	30,958	0	30,958
Oklahoma	17,399	0	0	3,193	20,592
Oregon	0	0	27,892	0	27,892
Pennsylvania	42,801	42,801	43,047	0	43,047
Rhode Island	5,677	5,677	5,677	0	5,677
South Carolina	0	0	0	22,093	22,093
South Dakota	3,231	0	0	3,267	6,498
Tennessee	368	0	0	12,804	13,172
Texas	84,534	84,534	68,863	3,887	88,421
Utah	0	0	0	15,493	15,493
Vermont	14,195	0	0	0	14,195
Virginia	27,510	27,510	24,008	819	28,596
Washington	0	0	0	26,294	26,294
West Virginia	6,159	0	0	954	7,113
Wisconsin	36,371	0	0	2,248	38,619
Wyoming	0	0	0	11,207	11,207

Table A.3: Renewable Policy Index by State

We use the Database of State Incentives for Renewables & Efficiency from the N.C. Clean Energy Technology Center to collect information on the renewable policy incentives by state-year-month. We split the policy initiatives into three types of tax incentives: Corporate Tax, Property Tax, and Sales Tax; and two types of production incentives: Production and Tariffs. For each type of incentive, we create an indicator variable equal to one if a state has at least one incentive in that category in a given month. The table presents the average values of these indicators over the 2008–2020 period by state. In our analysis, we include a *Renewables Incentives* index, which aggregates the three tax indicators and the two production indicators.

State	Corporate Tax	Property Tax	Sales Tax	Production	Tariffs	Renewables Incentives
Alaska	0.00	0.00	0.00	1.00	0.00	1.00
Alabama	0.00	0.00	0.00	0.62	0.52	1.14
Arkansas	0.00	0.00	0.00	0.00	0.00	0.00
Arizona	0.94	1.00	1.00	0.00	0.00	2.94
California	0.06	0.00	0.19	1.00	0.90	2.15
Colorado	0.37	0.84	0.91	0.93	0.00	3.04
Connecticut	0.00	0.00	0.84	0.49	0.00	1.34
DC	0.00	0.53	0.00	0.49	0.00	1.03
Delaware	0.00	0.00	0.00	0.97	0.00	0.97
Florida	0.62	0.78	1.00	0.30	0.00	2.70
Georgia	0.40	0.00	0.00	0.58	0.00	0.98
Hawaii	1.00	0.70	0.00	0.49	0.71	2.91
Iowa	1.00	1.00	1.00	0.00	0.56	3.56
Idaho	0.00	0.81	0.98	0.00	0.00	1.80
Illinois	0.00	0.88	0.72	0.65	0.00	2.24
Indiana	0.00	0.68	0.00	0.67	0.36	1.71
Kansas	0.31	1.00	0.00	0.00	0.00	1.31
Kentucky	0.81	0.00	0.81	0.62	0.00	2.24
Louisiana	0.62	0.00	0.00	0.00	0.00	0.62
Massachusetts	1.00	1.00	0.00	1.00	0.00	3.00
Maryland	0.87	1.00	0.78	0.49	0.00	3.15
Maine	0.00	0.05	0.00	0.58	0.00	0.63
Michigan	0.00	1.00	0.00	0.71	0.37	2.08
Minnesota	0.00	1.00	1.00	0.93	0.48	3.41
Missouri	0.00	0.59	0.00	0.00	0.00	0.59
Mississippi	0.00	0.00	0.00	0.62	0.38	0.99
Montana	0.69	1.00	0.00	0.00	0.00	1.69
North Carolina	0.68	0.78	0.00	0.98	0.00	2.44
North Dakota	0.62	1.00	0.34	0.00	0.00	1.96
Nebraska	0.88	0.67	0.83	0.00	0.00	2.38
New Hampshire	0.00	1.00	0.00	0.00	0.00	1.00
New Jersey	0.00	0.77	1.00	1.00	0.00	2.77
New Mexico	1.00	0.69	0.84	0.67	0.00	3.20
Nevada	0.00	1.00	0.75	0.93	0.00	2.68
New York	0.37	1.00	0.96	0.07	0.21	2.61
Ohio	0.31	1.00	1.00	0.71	0.00	3.03
Oklahoma	1.00	0.38	0.00	0.00	0.00	1.38
Oregon	0.97	0.66	0.00	0.99	0.00	2.63
Pennsylvania	0.00	0.88	0.00	0.49	0.00	1.37
Rhode Island	0.63	1.00	1.00	0.60	0.00	3.23
South Carolina	0.94	0.00	0.00	0.81	0.00	1.75
South Dakota	0.00	0.84	0.67	0.00	0.00	1.51
Tennessee	0.00	1.00	0.66	0.58	0.00	2.24
Texas	1.00	1.00	0.00	0.66	0.52	3.18
Utah	1.00	0.00	1.00	0.00	0.00	2.00
Virginia	0.00	1.00	0.00	0.62	0.00	1.62
Vermont	0.20	1.00	1.00	0.71	1.00	3.91
Washington	0.00	0.00	0.72	0.96	0.90	2.58
Wisconsin	0.00	0.00	1.00	0.89	0.00	1.89
West Virginia	1.00	1.00	0.00	0.00	0.00	2.00
Wyoming	0.00	0.00	1.00	0.00	0.00	1.00

A.2 FERC Data on Electricity Transactions

Panel A of Table 2 reports the average percentage of transaction charges for electricity sales by different contractual terms, while Online Appendix Table A.4 presents the average percentage of the quantity of electricity sold by different contractual terms. Around 58% of the electricity charges in our sample are for sales under contracts with short durations and 50% of the transactions use short increments to determine the price. Transactions covering the full period account for 39% of the quantity sold and charges. Peak period sales are more expensive as they account for 31% of the quantity and 35% of the charges, while off-peak sales are smaller and cheaper. Power plants using fossil fuels, such as coal and natural gas, are more flexible to adjust operation hours so they rely relatively more on short-term contracts, short increment pricing, and peak-term production for electricity sales. Solar and wind power plants depend on weather conditions and have limited flexibility in operating hours, so they use relatively more long-term contracts, long increment pricing, and full-period contractual terms for electricity sales.

Table A.4: FERC Electricity Pricing and Contracting

Robustness statistics of Table 2 Panel B: We present the average percentage of electricity quantity sold by different contractual terms instead of the average percentage of transaction charges for electricity sales by different contractual terms.

We report summary statistics on a plant-prime-mover-month level and they are weighted by power plant nameplate capacity. The sample includes power plants owned by domestic corporations, private equity, institutional investors, and foreign corporations. This table reports the average percentage of electricity quantity sold by different contractual terms. We split the electricity sales based on three contractual terms. First, we analyze contract duration and distinguish between short contracts with a duration of less than one year and long-term contract duration. Second, we split the transactions into short, medium, and long based on the increment terms. Short transactions use 5-minute, 15-minute, or hourly increments (up to 6 hours). Medium transactions have daily or weekly increments (from 6 hours to 168 hours). Long transactions use monthly or yearly increments (longer than 168 hours). Third, we classify transactions into full-period, peak, and off-peak based on the peaking terms.

	All	**NatGas**	**Coal**	**Nuclear**	**Hydro**	**Wind**	**Solar**
Contractual Terms of Electricity Sales Based on Quantity Sold							
Contract Duration - Short	0.563	0.611	0.585	0.491	0.664	0.380	0.244
Contract Duration - Long	0.434	0.385	0.413	0.509	0.335	0.614	0.756
Increment Terms - Short	0.501	0.545	0.557	0.408	0.380	0.346	0.196
Increment Terms - Medium	0.041	0.052	0.032	0.045	0.085	0.012	0.028
Increment Terms - Long	0.432	0.389	0.395	0.504	0.404	0.595	0.728
Peaking Terms - Full Period	0.391	0.350	0.352	0.467	0.356	0.550	0.593
Peaking Terms - Peak	0.313	0.350	0.330	0.256	0.267	0.180	0.186
Peaking Terms - Off-Peak	0.222	0.231	0.252	0.215	0.210	0.174	0.092

A.3 The Determinants of Ownership Changes

Panel B of 4 shows that private equity, institutional investors, and foreign listed corporations are more likely to own a greenfield power plant as compared to their overall ownership share. For instance, private equity owns on average 24.6% of the greenfield power plants versus 10.9% of all power plants. Appendix Figure A.2 shows that most of the newly created power plants use wind and solar technology, but there is also a significant share of new natural gas power plants which were supported by the shale gas boom (see Gilje, Loutskina, and Strahan (2016) for discussion on the rapid growth of shale gas production). This figure suggests that ownership structures could differ in their relative importance in the creation of both renewable and natural gas power plants.

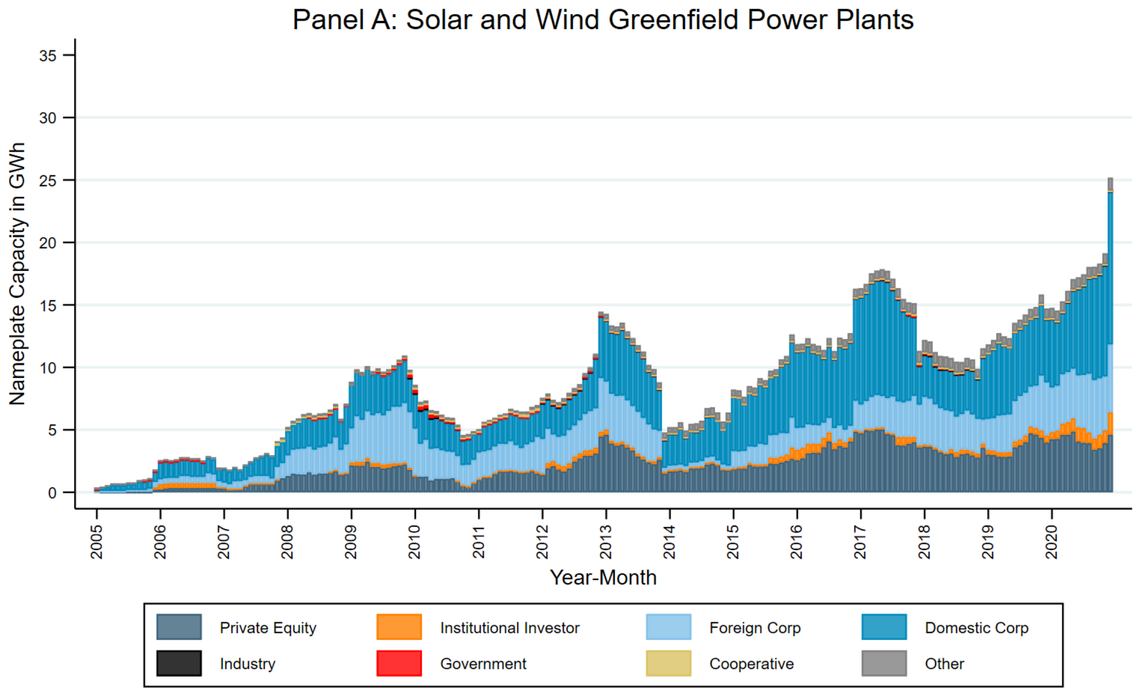
Online Appendix Table A.5 shows that our results are robust to using logit specifications instead of pooled OLS, and without weighting the observations by nameplate capacity. However, we rely more on the OLS specification as the weighted coefficients are economically more relevant, and they include a more saturated set of fixed effects.

In Online Appendix Table A.6, we estimate a robustness test by limiting attention to the subsample of power plants with a nameplate capacity above 20MW as we cannot weigh the observations by power plant capacity instead of weighting power plants by nameplate capacity. In this test, we want to test that the results are not driven by a few large newly created power plants (we also do not include all power plants to avoid that the results are driven by micro solar plants). The unconditional baseline probability in this unweighted subsample equals 2.75% as compared to 1.63% in the weighted broad sample, which shows that the newly create power plants tend to be on average smaller than the existing power plants. The results confirm that DLCs are less likely to create new power plants than private equity and foreign corporations. The difference in the probability to create new electricity generating assets is concentrated in states with deregulated wholesale and retail electricity markets.

In Online Appendix Table A.7, we estimate a robustness test on the differences in decommissioning power plants across ownership types using a Cox proportional hazard model instead of pooled OLS model. We estimate the hazard rate of decommissioning a power plant, defined as the probability that a decommissioning will be completed in month t conditional on it not becoming complete prior to month t. These robustness specifications focus on the subsample of power plants with a nameplate capacity of at least 20MW and do not weigh the observations by nameplate capacity. One limitation of the hazard models is that we cannot include interacted fixed effects, but we still control for fuel and state fixed effects. The Cox proportional hazard model is robust to time-specific common factors, which is analogous to controlling for time fixed effects (Dinc and Gupta, 2011). The results suggest that DLCss are marginally more likely to shut down power plants than other ownership types, which provides some evidence supporting the leakage hypothesis, but PE is the second most likely ownership type to decommission power plants. The difference in the probability to retire electricity generating assets again seems to be concentrated in states with deregulated markets.

Figure A.2: Ownership of Greenfield Power Plants by Fuel Type

Panel A presents the ownership of new solar and wind greenfield generation capacity by month. Panel B presents the ownership of new natural gas greenfield generation capacity by month. We classify power plants as a greenfield asset in the first 12 months of plant operation.



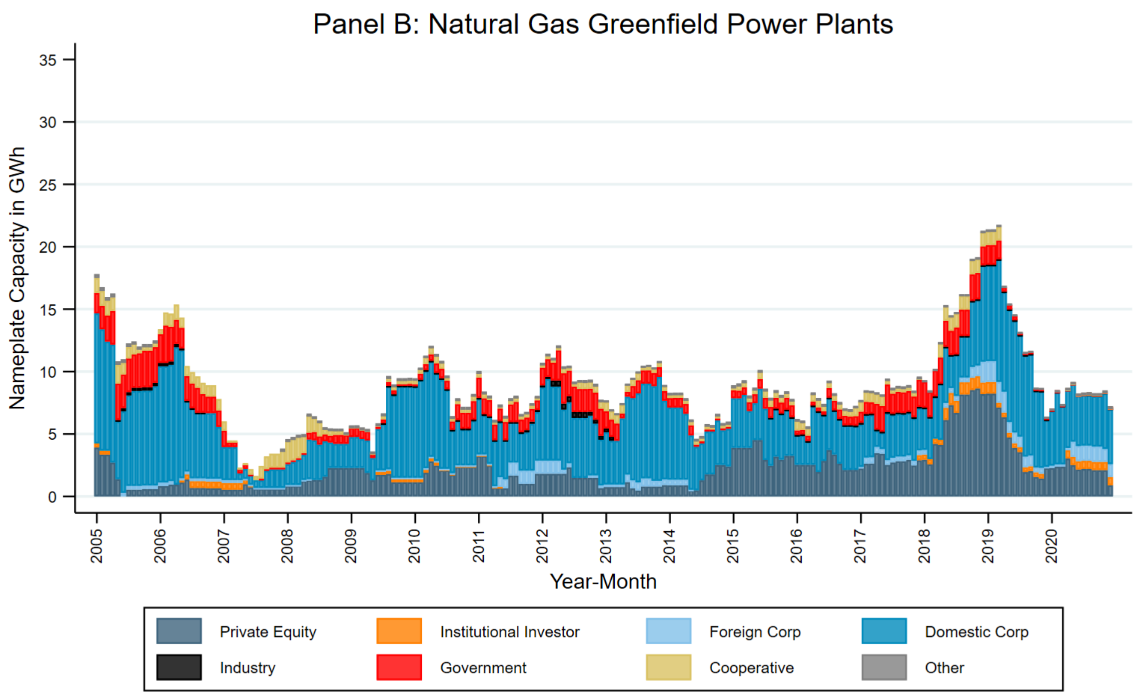


Table A.5: Ownership of Greenfield Power Plants (Logit Specifications)

Robustness check of Table 3: We use logit specifications and do not weight observations by power plant nameplate capacity, but we limit attention to the subsample of power plants with a nameplate capacity of at least 20MW.

In this table, observations are at the plant-prime-mover-month level and the sample includes only power plants with a nameplate capacity of at least 20MW. The dependent variable captures greenfield power plants and equals one for the first 12 months of plant operation. We measure the ownership by domestic publicly listed corporations (*DLC*), private equity, institutional investors, and foreign publicly listed corporations. We also control for the ownership by industry firms, government, cooperatives, and others. *ISO Balancing*, *ISO Restructured*, and *Retail Choice* are indicators for power plants located in an area with a deregulated electricity market. *Independent Power Producer* is an indicator for an entity that owns and operates power plants but is not regulated as a traditional vertically integrated electric utility. The specifications include fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. *$p < .10$; **$p < .05$; ***$p < .01$.

Greenfield Power Plants with Capacity ≥ 20MW (Unconditional Prob. = 2.75%)						
	(1)	(2)	(3)	(4)	(5)	(6)
Domestic Listed Corp (DLC)	-0.887***		-0.351	-0.797**	-1.013***	-0.497
	[0.138]		[0.387]	[0.360]	[0.360]	[0.593]
Private Equity		1.098***				
		[0.163]				
Institutional Investor		-1.045**				
		[0.522]				
Foreign Corp		0.822***				
		[0.178]				
DLC × ISO Balancing			-0.870***			
			[0.233]			
DLC × ISO Restructured				-1.451***		
				[0.277]		
DLC × Retail Choice					-1.456***	
					[0.286]	
Independent Power Producer (IPP)						-0.059
						[0.477]
DLC × IPP						-1.060**
						[0.504]
DLC × Climate Concern			-0.343	-0.218	1.109*	0.003
			[0.485]	[0.480]	[0.566]	[0.491]
DLC × Renewables Incentives			0.115	0.197*	0.088	0.134
			[0.111]	[0.113]	[0.110]	[0.111]
ln Plant Capacity	0.779***	0.786***	0.784***	0.788***	0.786***	0.781***
	[0.076]	[0.076]	[0.076]	[0.077]	[0.076]	[0.076]
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes	Yes
Fuel FE	Yes	Yes	Yes	Yes	Yes	Yes
Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	741,555	741,555	741,555	741,555	741,555	741,555

Table A.6: Ownership of Greenfield Power Plants (Not Weighted Observations)

Robustness check of Table 3: We do not weight observations by power plant nameplate capacity, but we limit attention to the subsample of power plants with a nameplate capacity of at least 20MW.

In this table, observations are at the plant-prime-mover-month level and the sample includes only power plants with a nameplate capacity of at least 20MW. The dependent variable captures greenfield power plants and equals one for the first 12 months of plant operation. We measure the ownership by domestic publicly listed corporations (*DLC*), private equity, institutional investors, and foreign publicly listed corporations. We also control for the ownership by industry firms, government, cooperatives, and others. *ISO Balancing*, *ISO Restructured*, and *Retail Choice* are indicators for power plants located in an area with a deregulated electricity market. *Independent Power Producer* is an indicator for an entity that owns and operates power plants, but is not regulated as a traditional vertically integrated electric utility. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. $^{*}p < .10$; $^{**}p < .05$; $^{***}p < .01$.

Greenfield Power Plants with Capacity ≥ 20MW (Unconditional Prob. = 2.75%)						
	(1)	(2)	(3)	(4)	(5)	(6)
Domestic Listed Corp (DLC)	-1.484***		-0.882	-1.471***	-1.643***	-0.929
	[0.280]		[0.555]	[0.539]	[0.537]	[0.601]
Private Equity		1.791***				
		[0.321]				
Institutional Investor		-1.019				
		[1.047]				
Foreign Corp		1.392***				
		[0.515]				
DLC × ISO Balancing			-1.176***			
			[0.335]			
DLC × ISO Restructured				-1.245***		
				[0.381]		
DLC × Retail Choice					-1.540***	
					[0.435]	
Independent Power Producer (IPP)						0.182
						[0.347]
DLC × IPP						-1.870***
						[0.467]
DLC × Climate Concern			-0.311	-0.353	1.096	0.203
			[0.697]	[0.692]	[0.830]	[0.723]
DLC × Renewables Incentives			0.172	0.276	0.146	0.197
			[0.172]	[0.172]	[0.172]	[0.172]
ln Plant Capacity	0.718***	0.720***	0.738***	0.732***	0.722***	0.736***
	[0.075]	[0.075]	[0.076]	[0.075]	[0.075]	[0.075]
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	753,948	753,948	753,948	753,948	753,948	753,948
Adjusted R-squared	0.101	0.101	0.101	0.101	0.101	0.102

Table A.7: Ownership of Decommissioned Power Plant (Hazard Model)

Robustness check of Table 6: We estimate Cox proportional hazard model instead of pooled OLS.

In this table, observations are at the plant-prime-mover-month level. We present the results of a survival analysis using the Cox proportional hazard model. The event of interest is a complete decommissioning of a power plant (not partial retirement of one generator). We limit attention to the subsample of power plants with a nameplate capacity of at least 20MW. *#Plants* reports the number of unique plant-prime-mover units included in the survival analysis, while *#Decommissioned* reports the number of unique plant-prime-mover units that are retired by the end of the survival analysis. We measure the ownership by domestic publicly listed corporations (DLC), private equity, institutional investors, and foreign publicly listed corporations. We also control for the ownership by industry firms, government, cooperatives, and others. *ISO Balancing*, *ISO Restructured*, and *Retail Choice* are indicators for power plants located in an area with a deregulated electricity market. *Independent Power Producer* is an indicator for an entity that owns and operates power plants, but is not regulated as a traditional vertically integrated electric utility. The specifications include fuel-type and state fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. *$p < .10$; **$p < .05$; ***$p < .01$.

Power Plants with Capacity ≥ 20MW (5,409 Plants; 784 Decommissioned)						
	(1)	(2)	(3)	(4)	(5)	(6)
Domestic Listed Corp (DLC)	0.316***		0.053	0.212	0.194	0.175
	[0.121]		[0.286]	[0.261]	[0.260]	[0.305]
Private Equity		-0.075				
		[0.129]				
Institutional Investor		-6.376***				
		[2.130]				
Foreign Corp		-0.517**				
		[0.221]				
DLC × ISO Balancing			0.184			
			[0.157]			
DLC × ISO Restructured				-0.162		
				[0.160]		
DLC × Retail Choice					-0.002	
					[0.174]	
Independent Power Producer (IPP)						0.008
						[0.191]
DLC × IPP						0.259
						[0.230]
DLC × Climate Concern			-0.017	0.051	0.001	-0.208
			[0.315]	[0.320]	[0.356]	[0.341]
DLC × Renewables Incentives			0.056	0.059	0.050	0.054
			[0.064]	[0.065]	[0.064]	[0.064]
ln Plant Capacity	-0.469***	-0.464***	-0.471***	-0.468***	-0.469***	-0.467***
	[0.037]	[0.037]	[0.038]	[0.038]	[0.038]	[0.038]
ln Plant Age	1.052***	1.051***	1.057***	1.052***	1.053***	1.069***
	[0.084]	[0.083]	[0.085]	[0.084]	[0.084]	[0.086]
Other Owners	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-Type FE	Yes	Yes	Yes	Yes	Yes	Yes
Plant State FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	752,565	752,565	752,565	752,565	752,565	752,565

A.4 Electricity Pricing and Contractual Terms

In Table 10, we examine the contractual terms of electricity transactions. The dependent variables are the percentage of the transaction charges for electricity sales under different contractual terms. Online Appendix Table A.8 shows that our results are robust to defining all contractual-term dependent variables as a percentage of the quantity sold instead of the transaction charges.

Online Appendix Table A.9 shows that the differences in contractual terms of electricity sales between new entrants and incumbent domestic corporations are entirely driven by fossil fuel power plants. When selling electricity from natural gas and coal power plants PE firms use contracts with a shorter duration and shorter pricing increments, and target peak-period sales. The contractual terms of fossil fuel power plants dominate the aggregate results because we weigh the observations by nameplate capacity and fossil fuel power plants are economically substantially more significant than renewable power plants. Panel C shows that wind and solar power plants owned by PE seem to be selling more electricity actually under long-term contracts and increments.

Table A.8: Contractual Terms of Electricity Sales

Robustness check of Table 10: The dependent variables capture the percentage of electricity quantity sold instead of the percentage of transaction charges under various contractual terms.

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. The dependent variables are the percentages of electricity quantity sold under three different contractual terms. First, we distinguish between short contracts with duration of less than one year and long-term contracts. Second, we split transactions into short, medium, and long based on the increment pricing terms. Short transactions use 5-minute, 15-minute or hourly increments (up to 6 hours). Medium transactions have daily or weekly increments (from 6 hours to 168 hours). Long transaction use monthly or yearly increments (longer than 168 hours). Third, we classify transactions into full-period, peak, and off-peak based on the peaking terms. The sample includes power plants owned by domestic publicly listed corporations, private equity, institutional investors, and foreign publicly listed corporations. We focus on the ownership by private equity, institutional investors, and foreign corporations (the omitted ownership category is domestic corporations). *ln Plant Capacity* is the natural logarithm of plant's monthly capacity. *ln Plant Age* is the natural logarithm of plant age in years. *Greenfield 12m* is an indicator for the first 12 months when a plant starts operating. *Decommissioned 12m* is an indicator for the last 12 months when a plant is still operating. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. *$p < .10$; **$p < .05$; ***$p < .01$.

	Contract Duration		**Increment Terms**			**Peaking Period Terms**		
	Short	Long	Short	Medium	Long	Full	Peak	Off-Peak
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean Dependent Variable	0.563	0.434	0.501	0.041	0.432	0.391	0.313	0.222
Private Equity	0.106***	-0.109***	0.134***	-0.010	-0.132***	-0.026	0.078***	-0.024**
	[0.027]	[0.028]	[0.023]	[0.009]	[0.025]	[0.025]	[0.018]	[0.011]
Institutional Investor	-0.175***	0.185***	-0.276***	0.025	0.259***	0.238***	-0.143***	-0.061**
	[0.063]	[0.063]	[0.058]	[0.033]	[0.073]	[0.074]	[0.037]	[0.030]
Foreign Corp	0.039	-0.034	0.076**	0.002	-0.122***	0.021	-0.019	-0.045***
	[0.040]	[0.040]	[0.036]	[0.011]	[0.039]	[0.037]	[0.021]	[0.017]
ln Plant Capacity	0.009	-0.012	-0.001	-0.003	0.011	-0.003	0.006	0.001
	[0.011]	[0.011]	[0.009]	[0.003]	[0.010]	[0.010]	[0.006]	[0.004]
ln Plant Age	-0.004	-0.000	0.003	-0.003	0.002	-0.023*	0.030***	0.001
	[0.014]	[0.014]	[0.013]	[0.004]	[0.013]	[0.013]	[0.009]	[0.005]
Greenfield 12m	0.013	-0.028	0.052**	-0.000	-0.055**	-0.064***	0.063***	0.037***
	[0.025]	[0.025]	[0.023]	[0.006]	[0.023]	[0.024]	[0.015]	[0.009]
Decommissioned 12m	0.030	-0.029	0.009	0.000	0.012	-0.002	0.008	-0.000
	[0.034]	[0.034]	[0.032]	[0.004]	[0.029]	[0.034]	[0.022]	[0.018]
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	306,080	306,080	306,080	306,080	306,080	306,080	306,080	306,080
Adjusted R-squared	0.608	0.607	0.652	0.624	0.635	0.621	0.625	0.611

Table A.9: Contractual Terms of Electricity Sales by Fuel Type

Robustness check of Table 10: The dependent variables capture contractual terms of electricity sales by fuel type.

In this table, observations are at the plant-prime-mover-month level and are weighted by power plant nameplate capacity. The dependent variables are the percentages of electricity transaction charges under three different contractual terms. The contractual terms focus on the contract duration, increment pricing, and peaking period. Panel A examines the subsample of natural gas plants, Panel B examines the subsample of coal, waste coal, petroleum coke, and residual petroleum plants, and Panel C examines the subsample of solar and wind power plants. The sample includes power plants owned by domestic corporations, private equity, institutional investors, and foreign corporations. We focus on the ownership by private equity, institutional investors, and foreign corporations (the omitted ownership category is domestic corporations). We include the same control variables for plant size, age, greenfield stage, and decommissioning stage. The specifications include interacted fuel-type, state, and year-month fixed effects. We cluster standard errors by plant-prime-mover, and report standard errors in brackets. *$p < .10$; **$p < .05$; ***$p < .01$.

	Contract Duration		**Increment Terms**			**Peaking Period Terms**		
	Short	Long	Short	Medium	Long	Full	Peak	Off-Peak
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Natural Gas Power Plants								
Private Equity	0.113***	-0.113***	0.153***	-0.015	-0.145***	-0.029	0.104***	-0.039***
	[0.039]	[0.040]	[0.031]	[0.011]	[0.034]	[0.035]	[0.026]	[0.013]
Institutional Investor	-0.281***	0.299***	-0.393***	-0.007	0.416***	0.395***	-0.232***	-0.093***
	[0.083]	[0.084]	[0.071]	[0.040]	[0.080]	[0.078]	[0.050]	[0.030]
Foreign Corp	0.021	-0.017	0.071	0.019	-0.095*	0.047	-0.020	-0.058***
	[0.057]	[0.058]	[0.051]	[0.019]	[0.057]	[0.049]	[0.035]	[0.019]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	82,641	82,641	82,641	82,641	82,641	82,641	82,641	82,641
Adjusted R-squared	0.399	0.397	0.546	0.413	0.491	0.514	0.499	0.471
Panel B: Coal and Petroleum Power Plants								
Private Equity	0.322***	-0.322***	0.304***	0.005	-0.291***	0.017	-0.002	0.008
	[0.101]	[0.101]	[0.101]	[0.009]	[0.111]	[0.044]	[0.044]	[0.019]
Institutional Investor	-2.220***	2.218***	-1.772***	-0.109**	2.114***	2.163***	-0.806***	-0.589***
	[0.287]	[0.286]	[0.284]	[0.053]	[0.280]	[0.186]	[0.116]	[0.068]
Foreign Corp	0.490***	-0.490***	0.420**	0.053	-0.465***	-0.013	-0.043	0.049*
	[0.164]	[0.164]	[0.174]	[0.046]	[0.166]	[0.027]	[0.034]	[0.029]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,372	29,372	29,372	29,372	29,372	29,372	29,372	29,372
Adjusted R-squared	0.600	0.602	0.659	0.880	0.685	0.659	0.628	0.600
Panel C: Solar and Wind Power Plants								
Private Equity	-0.124***	0.102**	-0.084**	-0.008	0.027	-0.017	-0.005	0.009
	[0.046]	[0.047]	[0.040]	[0.006]	[0.045]	[0.051]	[0.026]	[0.017]
Institutional Investor	-0.023	0.020	-0.125**	0.106**	-0.028	-0.069	0.035	0.059*
	[0.082]	[0.082]	[0.060]	[0.043]	[0.082]	[0.093]	[0.047]	[0.035]
Foreign Corp	-0.097**	0.098**	-0.096**	-0.013**	-0.014	0.085	-0.094***	-0.062***
	[0.049]	[0.049]	[0.041]	[0.005]	[0.048]	[0.052]	[0.024]	[0.016]
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fuel-State-Year-Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	106,782	106,782	106,782	106,782	106,782	106,782	106,782	106,782
Adjusted R-squared	0.243	0.233	0.287	0.236	0.225	0.190	0.275	0.296