Capital Allocation, Operational Efficiency, and Emissions: The Real Effects of ESG Divestment*

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ABSTRACT

We study the effect of ESG-induced divestment on access to financing, operating efficiency, and CO_2 emissions for long-lived, capital intensive assets: U.S. power plants. Using a shift-share measure of firms' exposure to banks' coal divestment policies, we find that divestment leads to a reduction in debt supply and subsequently lower capital expenditure. We then trace out the full chain of real consequences of this financial shock. Using hourly operating data for all major U.S. power plants, we show that capital rationing causes operational inefficiencies in generator utilization, resulting in inefficiently high CO_2 emissions. We show that policy choices play a major role in these unintended consequences. Exploiting the staggered introduction of emissions trading schemes, we show that, unlike ESG divestment, carbon pricing does not lead to inefficient asset utilization and excess CO_2 emissions.

Keywords: divestment, sustainability, climate finance, green impact.

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1 Introduction

> Failure to properly maintain infrastructure [...] results in a Run to Fail model, where the asset or infrastructure starved of capital operates until it fails or breaks.
>
> - *American Society of Civil Engineers (2023)*

Economists estimate $2.4 trillion of capital must be mobilized annually over the coming decade to finance the green energy transition. A prominent private-sector response has been ESG-driven investment policies, most notably divestment from carbon-intensive industries. The mechanism is financial: by raising the cost of capital for brown firms and lowering it for green firms, investors aim to reallocate resources toward sustainable activities (e.g., Heinkel, Kraus, and Zechner, 2001). This view has gained traction in both policy and practice, with estimates of ESG-driven assets under management reaching as much as $50 trillion by 2025.[1] However, this view largely reflects a comparative-static intuition, which contrasts a "brown" equilibrium with brown legacy technology against a "green" equilibrium with new technology. Under this logic, ESG investment accelerates what is broadly viewed as an ultimately unavoidable transition to a green new normal. In this paper, we argue that this view overlooks the transitional dynamics that arise when financially constrained firms operate long-lived, capital-intensive assets. Our results show that divestment increases emissions intensity by pushing generators away from their optimal utilization point.

For many of the most polluting sectors, such as power generation or heavy industry, capital is sunk, assets are long-lived, and marginal operating costs are relatively low. In such settings—or in industries where there is no "green" alternative to existing technologies, such as cement—restricting access to external finance is unlikely to trigger immediate exit of polluters. Instead, divestment restricts capital expenditures for maintenance and efficiency upgrades. The result is that firms continue to operate, but under suboptimal conditions. As a result, emissions intensity can rise, that is, emissions per unit of electricity output increase, rather than decrease. In effect, financial

[1] See Bloomberg. While there is a wide range in estimates for total ESG-driven assets, the overall growth in these types of investments has been widely acknowledged.

frictions induced by divestment can generate transitional inefficiencies that move the economy away from the transition path that maximizes overall welfare (Nordhaus, 2019). In such a scenario, even if divestment ultimately accelerates the green transition and reduces total emissions overall, the increased inefficiency from divestment means that the same transition speed could be implemented at lower emissions under different policies. As a result, the unintended consequence of ESG-driven divestment is an increase in emissions compared to the first-best (Hartzmark and Shue, 2022).

This paper documents, step by step, how financial frictions caused by ESG-driven divestment can lead to unintended increases in CO_2 emissions using the U.S. power sector as our laboratory. U.S. energy production is a capital-intensive, high-emission industry that has been a primary target of ESG divestment. We exploit quasi-exogenous variation in firms' exposure to banks' staggered adoption of coal exit policies as a shock to firms' access to capital, using a shift-share measure of divestment exposure based on preexisting lending relationships (Green and Vallee, 2025). We then trace out how this shock impacts capital expenditure and operational efficiency at the electricity plant level. Our results reveal three main findings. First, divestment reduces the supply of debt and lowers plant capital expenditures for coal power plants run by affected power producers. Second, these financial constraints have real consequences: using hourly data on fuel input and electricity output for the universe of major U.S. power plants, we show that constrained coal plants operate away from their efficiency frontier, raising relative CO_2 emissions per MWh of electricity produced. While relative efficiency declines, absolute emissions do not rise because the efficiency effect is masked by reduced generator run times, due to more frequent maintenance interruptions. As a result, contrary to the intuition often marketed by ESG investment products, total CO_2 emissions do not decline commensurately in capital-starved plants. In fact, due to operational inefficiencies, CO_2 emissions intensity increases, causing total emissions to exceed the operational optimum, where the same amount of electricity would have been generated with about 4% *fewer* emissions. Third, we highlight the importance of technology and policy context: reduced utilization increases emissions intensity for coal but not for gas plants, which operate under a technology that does not exhibit the same vulnerability to operating fluctuations. Policy-wise, we find that emissions trading schemes with carbon prices do not induce the same inefficient outcomes as divestment strategies, therefore offering a superior path to abatement. In other words, as predicted by theory (e.g., Pedersen, 2025b,a), carbon pricing is more efficient than blunt divestment. Together, these results demonstrate that ESG-driven divestment, while well-intentioned, can have unintended environmental consequences when applied to long-lived, capital-intensive assets. This is particularly worrisome as the largest polluters fit this description (Ilhan, Sautner, and Vilkov, 2021).

We select the U.S. power generation sector as a laboratory for our study of the unintended consequences of ESG-driven divestment. Coal-fired power plants represent an estimated 60% of total greenhouse gas (GHG) emissions from the electricity sector in the United States, and a staggering eleven gigatons of CO_2 emissions globally in 2023.[2] Importantly, while coal consumption has gradually declined in Europe and the United States in recent years, Appendix Figure A1 shows that global coal consumption continues to increase due to growing demand from developing countries. In fact, in 2024 alone, 43 gigawatts of additional coal-fired power plant capacity went online globally, with almost a terawatt worth of coal capacity added since the year 2000. The role of coal is likely to increase even further, given the increasing energy demand from data centers (IEA, 2025).[3]

Given that the average useful lifetime of a coal power plant is 50 years, even a complete and immediate stop in the construction of coal plants would mean that these assets will potentially continue to emit CO_2 for decades due to their relatively low marginal costs.[4] Managing the lifetime emissions of these assets and the dynamics of the energy transition become crucial questions in addressing climate change. The broader economic logic of our analysis extends beyond power plants

[2] In 2022, electricity and heat generation were responsible for nearly 44% of global CO_2 emissions from fuel combustion, with coal plants emitting around 73% of the associated emissions. For more details, see IEA Energy Data Explorer.

[3] The base case scenario of the IEA forecasts the energy demand from data centers to triple over the next five years, reaching 1,400 TWh by 2030. Coal is expected to cover roughly a third of this increase. See `https://www.iea.org/reports/energy-and-ai/energy-supply-for-ai`.

[4] For more details, see the following IEA Report, available at `https://www.iea.org/reports/the-role-of-ccus-in-low-carbon-power-systems/the-co2-emissions-challenge`.

to other industries worldwide, which generally suffer from the same type of dynamics (Hartzmark and Shue, 2022).

The starting point for our investigation is the large and growing literature documenting that ESG investment has the potential to change the cost of capital, with green firms enjoying a funding advantage in both access to and pricing of capital across various capital markets generally (Chava, 2014; Pastor, Stambaugh, and Taylor, 2021; Hsu, Li, and Tsou, 2023; Gormsen, Huber, and Oh, 2024; Pastor, Stambaugh, and Taylor, 2022), and debt financing in particular (Kacperczyk and Peydró, 2022; Green and Vallee, 2025; Altavilla, Boucinha, Pagano, and Polo, 2024; Correa, He, Herpfer, and Lel, 2025). Although the precise magnitude of these effects is still debated, directionally, the academic consensus aligns with the anecdotal assessment of practitioners that ESG investment has driven a wedge between the cost of capital of brown and green firms.[5] We therefore study the impact of one particularly common ESG-related investment strategy behind this trend - divestment - in the U.S. power sector.

In addition to being a primary source of CO_2 emissions, the U.S. power sector offers us a unique setting to study the operating effects of divestment. The Environmental Protection Agency (EPA) provides data that covers hourly utilization statistics for all major U.S. power plants, including energy input and electricity output, allowing us to trace the effects of divestment at the operational micro-level. Further, unlike in many other countries, the majority of energy production in the U.S. happens in the private sector, meaning that access to capital is a first-order issue for these firms. Another advantage is that we can access detailed financial accounting data for our sample firms.

Finally, we have access to a clean and granular measure of divestment exposure thanks to the detailed mapping of coal divestment policies in Green and Vallee (2025), henceforth 'GV index.'[6] The GV index collects a rich set of bank-level divestment policies. These policies focus heavily on the power generation sector, and coal-fired generation in particular, making the GV index a suitable instrument in our setting. Our main result exploits the introduction of banks' coal divestment

[5]See, for example, KPMG 2023.

[6]The authors generously shared the index with us.

policies combined with pre-existing lending relationships between borrowers and these banks, as a shift-share instrument. This effectively captures the extent to which coal-producing firms are being cut off from debt financing, allowing us to study the resulting financial and operational changes.

We begin our analysis by estimating the effect of ESG-driven divestment on generator efficiency and CO_2 emissions. Our primary measure of efficiency is the generator's heat rate, defined as the amount of fuel required to produce one unit of electricity. The heat rate is a widely used industry metric that captures operational efficiency (Demirer and Karaduman, 2024) and directly maps into CO_2 emissions, since any deviation from the optimal heat rate translates one-for-one into excess fuel consumption for a given level of output. For each generator-year, we estimate the utilization level at which it achieves its minimum heat rate (i.e., maximum efficiency). We then compute the average deviation between realized utilization and this efficiency-maximizing operating point.

We aggregate the hourly efficiency data to the weekly level, which both eases computational strain and reduces noise in the raw data. Leveraging a shift–share design based on the GV index, we interact banks' staggered adoption of coal divestment policies with borrowers' pre-existing lending relationships to construct firm-level exposure to newly enacted divestment policies.

To further sharpen our identification, we compare the effect of coal divestment policies on coal power generation with the effect of the same policies on unaffected gas turbines operated by the same borrower at the same point in time. Gas plants make an appealing control group for coal plants for two reasons.

First, since divestment is targeted towards coal power specifically, firms could selectively reduce capital expenditure in coal plants with the goal of lowering their coal exposure and eventually regain access to financing. Second, unlike coal plants, gas plants have a much less pronounced link between utilization and heat efficiency. Gas generators can generate electricity at relatively constant heat rates across their utilization spectrum, which implies that changes in their utilization level would result in smaller efficiency losses. Hence, even if there was a reduction in capital expenditure into gas plants, their different technology would not lead to the same efficiency reductions as in the case of coal plants. Finally, our empirical setup is similar to a triple difference in differences setup, effectively controlling for any time varying change in coal or gas power during our sample.

Consistent with these features insulating gas generators from a negative operational efficiency shock following divestment, we find no decrease in either efficiency or utilization for gas generators run by the same firm as coal generators. These tests not only establish the negative consequences of coal divestment, but also highlight the role of technology in shaping impact elasticity. We find that divestment pushes coal plants about 6 percentage points away from optimal utilization rates, and as a result lowers heat efficiency by roughly one percentage point. This effect is equivalent to a 4% relative reduction compared to the average generator efficiency. In other words, a socially optimal utilization could generate the same electricity output at a 4% lower level of emissions. We provide the first direct micro-founded evidence of the link between ESG divestment strategies and heightened emissions through impact elasticity, as hypothesized in Hartzmark and Shue (2022).

After establishing the negative impact elasticity of divestment on coal power plants and quantifying the loss of operating efficiency and the resulting increase in inefficient CO_2 emissions due to coal divestment, we identify the precise causal chain from divestment to emissions. We begin by showing that banks' coal divestment policies act as a shock to their pre-existing borrowers' supply of debt capital. A shift-share estimation based on preexisting banking relationships shows that, as banks divest more from coal, long-term debt volumes of borrowers decline. The shock is transmitted via lending relationships as in previous work on the financial crisis (Chodorow-Reich, 2013). Importantly, total credit declines, not just bank credit, consistent with an inability of affected borrowers to substitute bank credit with other types of credit.

Our next tests show that this drop in credit supply leads to a change in capital expenditure. We obtain detailed utility-level capital expenditure data from Federal Energy Regulatory Commission (FERC) filings. Specifically, FERC Form 1 mandates disclosure of capital expenditure for specific purposes, including capital outlays into boilers and generators as opposed to "general" plant investments. Borrowers affected by coal divestment reduce capital expenditures on boilers and generators in coal-fired power plants by roughly three percent relative to their capital investments in unaffected gas-fired plants. Lower availability of funding, hence, is associated with real capital expenditure changes, as opposed to, for example, simply lower dividends. The targeted reductions in technical equipment for coal generators are consistent with a targeted effect of divestment, and the absence of a reduction in general plant maintenance could speak to companies' plans to exchange coal power generators with other alternatives such as gas in the future.[7]

We then investigate the specific operating mechanism through which lower capital investment reduces operating performance. We focus on three measures of operational efficiency: the frequency of "start-stop-cycles" needed, for example, to perform maintenance on generators, the number of hours generators are running, and the volatility of their usage. Capital constraints can lead to deferred maintenance and delays in equipment replacement. As a result, it is plausible that generators need to be turned off more frequently and for longer periods to perform maintenance work, a pattern we indeed observe in the data. These types of shutdowns would show up both via lower total generator runtime and increased volatility of operations, since generators cannot be instantly switched on or off, but must be gradually ramped up and down. Turning to the data, we find that coal divestment results in more frequent start–stop cycles and, consequently, lower operational hours and higher utilization volatility for treated coal generators.

Outright divestment is not the only policy tool for reducing emissions. Fundamental economics, dating back to Arrow, suggests that carbon pricing is the optimal mechanism, as it induces the firms with the lowest marginal abatement costs to reduce emissions first (Acemoglu, Aghion, Bursztyn, and Hemous, 2012). We empirically test this important policy implication using the staggered introduction of major power plant emission trading schemes in California and the U.S. Northeast. We find that carbon trading is not associated with a reduction in funding for fossil-fuel power producers, and, as a result, does not lead to lower operating efficiency of generators. These results confirm economic theory that pricing carbon emissions leads the 'invisible hand' to steer investment to the firms that have the lowest marginal abatement cost, rather than the lowest ex ante emissions,

[7] See, for example, U.S. Department of Energy(2024).

and therefore reduce emissions more effectively.

Finally, we demonstrate that our results extend beyond ESG-driven divestment, potentially speaking more broadly to the negative impact elasticity of constraining capital expenditure for brown firms. As a complementary test, we study the staggered introduction of state-level minimum clean energy quotas, so-called Renewable Portfolio Standards (RPS), across the United States. We hypothesize that RPS laws both reduce the long-run profitability of coal generation and induce higher capital expenditures on renewable production. These two forces combined should generate indirect pressure on fossil-fuel firms' ability to invest in physical capital for their coal generators. Consistent with our main results, coal generators in RPS states subsequently operate further from their optimal utilization and efficiency levels. This result reinforces the conclusion that divestment pressures — whether financial or regulatory — can induce operational inefficiencies.

The paper closest to ours is Hartzmark and Shue (2022), which introduces the concept of impact elasticity, linking the cost of capital to firm emissions globally across all industries. The authors find a connection between increased cost of capital and higher emissions that is amplified for brown firms. This is consistent with the potential existence of unintended consequences of ESG investment. However, the authors do not aim to identify *changes* in cost of capital driven by ESG investing; instead, their analysis documents a broader correlation. The paper's broad applicability comes at the cost of not delving into the micro-founded mechanisms linking ESG divestment to emissions outcomes. We build on their insight, providing a tight step-by-step causal chain, which starts from ESG-driven divestment, moves to changes in financing policy, then to operating decisions, and ultimately operating performance. Thus, our paper provides the first complete causal chain of evidence for impact elasticity.

We contribute more broadly to the literature that seeks to understand how sustainable investing, and exclusion strategies in particular, can shape firm outcomes (e.g., Heinkel, Kraus, and Zechner (2001), Davies and Van Wesep (2018), Dangl, Halling, Yu, and Zechner (2025)). Most importantly for us, Edmans, Levit, and Schneemeier (2024) show theoretically that investment "tilting" where

ESG investors retain their holdings in a company based on the trajectory of emissions, not based on their level, can achieve more effective externality reductions than blanket divestment. Our empirical evidence from U.S. power plants is strongly consistent with these theoretical predictions.

An important starting point for our results comes from Green and Vallee (2025), who construct the most detailed mapping of bank-led coal divestment policies and find that exposure to divesting banks reduces capital supply to affected borrowers and accelerates the retirement of existing plants, while total CO_2 emissions remain stable. Importantly, this highly granular time-varying measure of banks' divestment policies provides a more accurate picture of banks' commitment to divestment than broad-based measures such as voluntary initiatives like the net zero banking alliance or broad ESG scores, which have been found to yield at best mixed changes in actual capital provision (Giannetti, Jasova, Loumioti, and Mendicino, 2025; Luneva and Sarkisyan, 2024; Sastry, Verner, and Marqués Ibáñez, 2024; Ye, 2022). Our results use the link between divestment and access to finance as an initial shock that allows us to study, in detail, the resulting operating inefficiencies. We highlight the importance of considering not just the comparative statics of a faster phase-out of existing assets but crucially the path to it and the potential excessive CO_2 emissions during the phase-out.

Several papers study the link between ESG goals and access to credit. Beyond Green and Vallee (2025), Kacperczyk and Peydró (2022) find that banks ration credit to brown firms, and Berg, Ma, and Streitz (2023) find that firms under divestment pressure outsource polluting activities from developed countries with high ESG pressure to other regions. Our results add to this discussion by showing that even the remaining operations in developed countries suffer from excessive emissions due to capital rationing.

Our paper also relates to the literature estimating the "greenium", the premium investors may be willing to pay (or lower yield they are willing to accept) to hold a green instead of a comparable conventional asset. The ultimate goal of ESG-linked divestment is to restrict the supply of capital to brown firms and increase it for green firms, ultimately driving this greenium up. Estimates of green premia across municipal bond, corporate bond, and equity markets range from approximately zero to 100 basis points. (e.g., Baker, Bergstresser, Serafeim, and Wurgler 2018; Zerbib 2019; Colombage and Nanayakkara 2020; Larcker and Watts 2020; Eskildsen, Ibert, Jensen, and Pedersen 2024).

Flammer (2021) finds that investors react positively to the issuance of corporate green bonds, and D'Amico, Klausmann, and Pancost (2025) show that investors have non-pecuniary green preferences in the sovereign green bond market. A more recent strand of the literature focuses on the pricing of so-called sustainability-linked bonds and loans (e.g., Kölbel and Lambillon 2022; Feldhütter, Halskov, and Krebbers 2024, Berrada, Engelhardt, Gibson, and Krueger 2022), finding that they seem to accelerate the green transition despite offering only relatively small financial incentives. We add to this discussion by studying the impacts of greeniums on the transition pathway to a low-carbon economy. Our paper finds that divestment strategies can increase emissions intensity in the short run, potentially raising the present value of total emissions.[8]

2 Data and Institutional Setting

Our sample includes energy firms based in the U.S. between 1998 and 2021. We obtain hourly data on the utilization rate, fuel input, and electricity output of all power plants with installed nameplate capacity beyond 25 MW from the EPA's Clean Air Markets Division (CAMD), covering approximately 96% of U.S. fossil fuel generation.[9] These data provide a comprehensive picture of the "lower 48" (excluding Hawaii and Alaska) U.S. states' electricity market, since all generators connected to the grid must report to a balancing authority and are therefore included in our

[8]Our paper also speaks to the growing literature in economics and finance that studies power plants, including their operational efficiency. Both mergers (Demirer and Karaduman, 2024) and general changes in equity ownership Andonov and Rauh (2024); Bai and Wu (2024); Fang (2024) impact the operational efficiency of power plants. Emissions do not only change due to core operations, but can also change indirectly through investments in solar capacity on top of existing plants (Kumar, 2023). We add to this by showing how changes in capital availability impact operational efficiency.

[9]See https://campd.epa.gov/ for more details about how the data is collected.

sample.[10]

Fossil fuel generators produce electricity by converting the heat energy released from burning fuels such as coal, natural gas, or oil. In this process, the input is measured by the fuel's heat content—for example, coal has a smaller heat content per unit of mass than natural gas—while the output is the amount of electricity generated per unit burned. This relationship gives rise to a natural efficiency metric, the heat rate, which reflects how efficiently a generator transforms fuel into electricity. The heat efficiency is the inverse of the heat rate and is computed as the ratio of energy output to input. The higher the heat efficiency, the more electricity a generator can produce per unit of input.

Our institutional setting has three key advantages. First, our output measure is a commodity and therefore it is not subject to differences in quality across firms. Second, the efficiency of electricity production is a quantity-based metric, i.e., one that is derived from quantities, not prices. Finally, given the granularity of the data, we can precisely estimate the maximum efficiency of a generator. Similar to Demirer and Karaduman (2024), we estimate fits between the observed heat efficiency and utilization ratio for each generator-year individually. Repeating these estimations annually enables our framework to account for investments in additional technologies or updates to boilers and generators, as well as their degradation over time as the capital stock becomes older. We then compute, for each generator-year, the data implied maximum attainable heat efficiency. Figure 1 shows the raw data and estimated efficiency curve for the universe of coal-fired generators in our sample.

— Figure 1 —

In the next step, we compare the actual operating points to this benchmark to measure the devi-

[10]Balancing Authorities are functional entities certified by the North American Electric Reliability Corporation (NERC), with oversight from the Federal Energy Regulatory Commission (FERC), responsible for maintaining real-time balance between electricity generation, load, and net interchange within its designated control area, while enforcing grid frequency stability and coordinating interchanges with neighboring authorities.

ation from optimal efficiency. This procedure provides a consistent way to quantify efficiency losses at the generator level while accounting for technological upgrades over time and varying operating conditions across units. Our two main dependent variables are *Distance from Optimal Utilization* and *Distance from Optimal Efficiency*, capturing the intuition that generators can operate inefficiently either by consuming more fuel or by operating at a suboptimal capacity.[11] In addition to the mean absolute deviation from the optimum, we also calculate the standard deviation, which captures the variability of efficiency performance relative to the benchmark.

We then enrich the sample with data on electricity plant characteristics obtained from the U.S. Emissions & Generation Resource Integrated Database (eGRID) as well as information about capital expenditures for utility companies from the Federal Energy Regulatory Commission (FERC), Form 1. These include the type of generator (usually coal or gas), its energy capacity, location, and investments in upkeep and maintenance. We also add firm-level accounting information from FactSet.

Next, we obtain data on banks' coal divestment policies from Green and Vallee (2025), who construct it using information from the NGO Urgewald, which compiled a list covering 85% of global coal production. The authors then merge this dataset with Dealscan, IJGlobal, and SDC Platinum to identify the loans that banks issue to firms. The main treatment variable is based on data from the NGO Reclaim Finance, which documents banks' coal exit policies. Using this information, Green and Vallee (2025) construct several measures of a firm's exposure to coal divestment, defined by the share of its borrowing from banks that have adopted coal exit policies.[12] For example, a firm that relies heavily on banks with stringent exit policies is more exposed to divestment than a firm that primarily borrows from banks without such restrictions. These exposure shares are

[11] The efficiency of coal power plants varies based on the technology of the generator, but also based on the way in which the power plant is operated. For example, start-stop cycles are very inefficient and waste significant amounts of resources. See, e.g., U.S. Environmental Protection Agency (2014), for more technical details about channels driving variation in generator efficiency.

[12] While the measure technically captures a range of topics covered by bank policies, a particularly strong emphasis lies on coal fuel and power generation. The most widely adopted measures are banning "coal projects" broadly, and coal power production specifically.

predetermined as of the year 2014, which is just before the first bank divestment policy started, and fixed over time, while bank debt varies annually, allowing us to exploit the historical bank-borrower relationship in our analysis.

Following Green and Vallee (2025), our key variable of interest is long-term lending, which captures the aggregate impact of divestment while accounting for potential substitution through bond financing. We further control for standard accounting variables such as total assets, cash holdings, profitability, and retained earnings. Among these, total assets play a particularly important role: as a proxy for firm size, they help control for the possibility that banks disproportionately target larger firms in their divestment policies.

Figure 1 shows that coal generators follow a hump-shaped efficiency curve, with an optimal point at which heat efficiency — and thus output per unit of input — is maximized. Both under- and over-utilization reduce efficiency, leading to higher carbon emissions per unit of energy produced. Banks that divest from coal generators can exacerbate this problem by constraining access to capital, which may force operators to run plants less consistently or at non-optimal load levels. As a result, divestment can unintentionally shift operations away from the efficiency peak, increasing emissions relative to a scenario with steady optimal utilization. Firms may also invest less in emission abatement technologies, which consequently leads to higher carbon emissions per unit of energy.

Our data cover a wide range of generators and utilization levels. Panel A of Figure 2 shows that many generators run more than 6,000 hours a year, or 70% of the time, consistent with high utilization. Yet, many generators run more intermittently, from 25% of the time to 70%. This range of operating hours reflects the varying degrees of utilization and operating modes in our sample.

— Figure 2 —

Panel B of Figure 2 shows the distribution of generator capacity in our sample. All generators exceed 25MW, the minimum threshold for inclusion in the CAMD data, with the majority of generators showing a nameplate capacity below 400 MW. Here, we also observe a large degree of heterogeneity with 10% of generators exceeding 800MW of capacity.

— Table 1 —

The summary statistics at the generator-by-week level are presented in Panel A of Table 1. The sample reveals several initial insights. First, 54% of the generators in our sample are coal plants. In contrast, other generators, such as gas plants, exhibit far less of a hump-shaped efficiency curve, a fact that we exploit in several placebo tests in our analysis. Second, about 48% of all generators are subject to coal divestment policies of varying stringency imposed by banks. Third, the median number of operating hours is 168, which means that most generators operate continuously throughout the week. At the same time, others are used far less frequently and therefore remain idle for extended periods, as can be seen from the large standard deviation of 55 hours. On average, a generator would operate for 127 hours, or 76% of the time.

Panel B of Table 1 reports summary statistics for standard firm-level financial data obtained from FactSet. The average utility firm in our sample has 57 USD Billion of assets and 14 USD Billion of long-term debt on its balance sheet. Yearly capital expenditures amount to 6% of assets. We winsorize all continuous variables at the 1% level to account for outliers.

3 The Real Effects of Divestment

This section explores the extent to which banks' decisions to divest from coal impact the operational efficiency of coal power plants.

We start by visually showing that divestment leads to inefficient generator utilization. To this end, Panel A of Figure 3 shows a scatter plot with 10 bins highlighting the positive relationship between operational inefficiency (proxied by the distance from the optimal heat efficiency of a generator, measured as the weekly absolute mean deviations in utilization rate from the optimal point) and the parent company's exposure to banks' divestment for the coal power plants in our sample. The larger the exposure of a utility company to divestment, the farther away from the optimal point the operational efficiency is. Panel B studies the same relationship for generators that use other fossil fuels—but not coal. As expected, we find no relationship between operational inefficiency and exposure to banks' coal divestment strategies since other technologies, in particular gas, do not exhibit a hump shaped efficiency curve. Figure 4 confirms that the same patterns hold when looking at thermal efficiency (measured as mean deviations in heat efficiency from the optimal point). Here again, we find that divestment exposure reduces thermal efficiency only for coal power plants (shown in Panel A), but not for other types of generators (shown in Panel B).

— Figures 3 and 4 —

For a more formal analysis, we estimate the following panel regression specification on the generator-by-week level for the sample period from 1999 to 2022:

$$Inefficiency_{i,t} = \beta Divestment_{i,t} \times Coal_{i,t} + \Gamma \mathbf{X_{i,t}} + \gamma_i + \alpha_i \times \delta_t + \kappa_i \times \delta_t + \epsilon_{i,t} \quad (1)$$

The dependent variable, $Inefficiency_{i,t}$, captures the deviation from the optimal level of utilization or efficiency. The optimal point is obtained from the vertex of a second-order polynomial fitted to hourly efficiency–utilization observations for each generator-year. The yearly estimates take into account potential changes in installed technology or other changes in the operating environment. The deviation from the optimum is computed hourly for utilization rates and thermal efficiency, separately. We then average each measure over one week to obtain the two dependent variables. Our key variable of interest, $Divestment_{i,t}$, is the shift share instrument introduced by Green and Vallee (2025) to capture a borrower's exposure to bank-level coal divestment policies. This instrument captures the time-varying intensity of each bank's policies relating to coal, tracking specific policies down to the individual project level. It then interacts this time-varying policy measure with the 2009–2014 bank–firm relative financing share, defined as the fraction of total borrowing a firm obtains from each bank during the five years preceding the introduction of the first coal-divestment policies.[13] $Coal_{i,t}$ is an indicator variable equal to 1 for coal-fired generators and 0 otherwise. The main coefficient of interest, β, captures the decrease in efficiency of coal generators after banks divest from fossil fuels, relative to the efficiency of non-coal generators operated by the same utility firm. The control group—comprised mainly of gas-fired generators—offers a useful comparison because gas generators are technologically different from coal-powered generators and can scale utilization up and down with far smaller losses in efficiency.

$\mathbf{X_i, t}$ is a vector of time-varying controls at the utility firm level, which includes size, ROA, capital expenditures, cash, and retained earnings. $\gamma_i \times \delta_t$ and α_i capture firm-by-year and generator fixed effects, respectively, that absorb any time varying firm level characteristics as well as generator traits. $\kappa_i \times \delta_t$ are state-by-week fixed effects which control for state-specific, time-varying factors (e.g., differences in legislation across states and within-state changes in legislation) as well as time-varying factors (such as macroeconomic cycles). $\epsilon_{i,t}$ represents error terms, clustered at the firm-level to account for arbitrary time series correlation in error term on the unit of treatment, the firm. In robustness tests, we cluster standard errors at the generator-level, and our results remain unchanged.

Table 2 shows the results of estimating specification 1.

— Table 2 —

Column 1 of Table 2 estimates a roughly 6 percentage points (pp) decrease in generator efficiency as a result of a one standard deviation increase in divestment exposure.

Column 2 turns to the intensive margin of divestment. The coefficient implies that a one standard deviation increase in divestment exposure at the utility firm level leads to a statistically

[13] While the majority of our sample lies in the time period after the introduction of policies some of our sample spans the period before the introduction of these policies, during which the shift share instrument always takes value 0 by construction. Our results remain unchanged when we restrict our sample to only the post-2014 period.

significant decrease in operational efficiency of roughly 2.2pp (=0.133×0.169) for coal generators, relative to gas plants operated by the same firm. This is an economically large effect, representing a change of about a third of a standard deviation in efficiency. For comparison, the difference in the heat rate between the average coal plant and the 10% most efficient plants is roughly 5pp. Columns 3 and 4 show similar results when looking at the loss in thermal efficiency. For example, a one standard deviation increase in divestment intensity relates to a statistically significant decrease in thermal efficiency of about 1pp (=0.133×0.010).

The reason why divestment can affect the efficiency of coal power plants is that these plants are sensitive to changes in utilization. Specifically, as shown in Figure 1, coal generators exhibit a hump-shaped heat-rate curve, with a clear optimum at which output per unit of fuel input is maximized.[14] Reduced access to financing due to bank divestment leads operators to deviate from this optimum due to lack of funding, either by under-utilizing or over-utilizing capacity, resulting in higher emissions per unit of electricity. For instance, under-utilization may occur when firms lack credit to purchase sufficient fuel inputs or postpone essential maintenance, forcing them to operate plants at an inefficient load. Over-utilization, by contrast, can arise when operators push older generators harder to maximize short-term cash flow or to recover fixed costs in the face of higher financing expenses.

These results show that coal divestment policies of banks can indeed cause an unintended increase in emissions per unit of output. As generators operate at inefficient levels, their plants could, in effect, produce the same amount of energy at lower fuel input, and hence lower emissions.

In additional robustness checks, we further corroborate our findings by using the natural logarithms of the annual mean deviations from the optimal efficiency level. Internet Appendix Table A.4 shows that the results are consistent with our previous findings.

In addition, we examine parallel trends in our difference-in-differences regressions in Figure 5. We find no evidence of pre-trends, with coefficients for three and two years prior to treatment being economically small and statistically insignificant. We find that inefficiencies in generator

[14] For a summary of research on this topic, see Congressional Research Service Report 2013.

operations increase following divestment, where the effect is initially relatively small but then steadily increasing starting two years after divestment. This pattern is indeed consistent with inefficiency being largely driven by a lack of capital expenditure on plant maintenance, leading to gradually increasing inefficiencies over time.

— Figure 5 —

4 Divestment, Access to Capital, and Investment

This section investigates the exact channel that links the decision of banks to divest from coal and the excessive emissions caused by the inefficient operation of coal-powered power plants. Previous work shows that divestment-affected coal firms take on less debt, both from banks and the broader market (Green and Vallee, 2025). Maintaining an efficiently operating plant requires substantial resources and investment, such as filter replacements or generator upkeep. A likely candidate linking divestment and inefficiency is hence a financing or investment channel.

We build directly on this literature and examine whether coal firms targeted by divesting banks indeed experience reduced access to capital. Our focus is on long-term debt, which aligns most closely with the setting in Green and Vallee (2025). We collapse our sample at the parent company level and study the relationship between the parent's long-term debt and its exposure to divestment.[15] Specifically, we estimate regression 2 below.

$$Log\ Long\text{-}Term\ Debt_{i,t} = \beta Divestment_{i,t} + \Gamma \mathbf{X_{i,t}} + \alpha_i + \kappa_i \times \delta_t + \epsilon_{i,t} \tag{2}$$

$Log\ Long\text{-}Term\ Debt_{i,t}$ is the natural logarithm of the amount of long-term debt firm i has in year t obtained from FactSet. $Divestment_{i,t}$ is the exposure of firm i in year t to coal divestment policies by banks. $\mathbf{X_{i,t}}$ is a vector of time-varying firm-level controls including total assets, return on assets,

[15] We do this because balance sheet information is not available at the generator level.

cash, and retained earnings. α_i is a firm fixed effect. Following Green and Vallee (2025), $\kappa_i \times \delta_t$ are size quintiles-by-year fixed effects, which absorb time-varying changes in the extent to which firms of different sizes have access to credit. For example, this addresses the possibility that small firms find it harder to raise credit, especially when credit markets are tighter (e.g., Chodorow-Reich (2013)). $\epsilon_{i,t}$ is the error term, clustered at the firm level. Table 3 presents the results.

— Table 3 —

Column 1 shows that there is a negative, statistically significant relationship between *Divestment intensity* and firms' long-term debt. The coefficient implies that a one standard deviation increase in exposure to banks' coal exit policies relates to a decrease in long-term debt of about 35% (=0.133×-2.611). Column 2 adds size quintiles by year fixed effects, which significantly reduces the size of the effect. In this specification, the same increase in divestment exposure relates to a decrease in long-term debt of 18%. Finally, the last column shows that the results are robust to adding additional time-varying firm-level controls.

These baseline results replicate, in our sample, the relationship that prior studies have documented in other contexts between banks' divestment policies and firms' access to financing (Green, 2018; Kacperczyk and Peydró, 2022). In our work, this foundational result then motivates a causal chain of consequences connecting divestment to inefficiently high emissions. We initiate this chain with the question whether the divestment-induced lack of access to capital lowers capital expenditure.

To examine this question, we add capital expenditure information from FERC Form 1. This form offers detailed balance sheet information at the utility firm level. Most relevant for us, it covers capital expenditures split by type, including maintenance of steam power generation, electrical power transmission, and general plant maintenance. Steam power maintenance encompasses expenses related to the upkeep of power-generating facilities, including the maintenance of the boiler, turbine structure, and associated personnel costs. Transmission expenses cover, for example, the maintenance of overhead and underground power lines, as well as regional transmission facilities. General plant maintenance covers expenses related to office equipment and the building.

To build intuition, we begin our investigation with a binned scatterplot (10 bins) that documents the relationship between utility firm-level capital expenditures and exposure to banks' coal divestment strategies. Figure 6 documents a clear association of divestment exposure with lower capital expenditure.

— Figure 6 —

To test this formally, we run the generator-week–level regressions in Equation 3 presented below.

$$Capex^{\theta}_{i,t} = \beta Divestment_{i,t} \times Coal_{i,t} + Divestment_{i,t} + Coal_{i,t} \Gamma \mathbf{X_{i,t}} + \alpha_i + \gamma_i + \kappa_i \times \delta_t + \epsilon_{i,t} \quad (3)$$

$Capex^{\theta}_{i,t}$ are annual capital expenditures of type θ incurred by firm i during year t, where θ is one of the following types: *Steam*, *Transmission*, or *General plant*. The main coefficient of interest, β, captures the differential capital expenditures by firms that operate coal-powered generators and are affected by banks' divestment policies. The specification also includes time-varying firm-level controls ($\mathbf{X_{i,t}}$) as well as firm, generator, and state-by-week fixed effects ($\alpha_i,\ \gamma_i,\ \kappa_i \times \delta_t$, respectively). The error term, $\epsilon_{i,t}$, is clustered at the firm level. Table 4 shows the results.

— Table 4 —

We find evidence of a statistically and economically significant negative relationship between divestment exposure and reductions in capital expenditures by utility firms operating coal power plants. We find particularly strong effects for the extensive margin of divestment exposure on yearly steam and transmission capital expenditures (columns 1 and 2) with divestment leading to a 3 percent and 1 percent drop in capex for coal powered generators and transmission systems relative to gas plants, respectively. The extensive set of fixed effects implies that we control for all time-invariant firm characteristics (e.g., some firms operating in areas where more maintenance is required) as well as overall time trends (such as changes in technology that alter capital requirements). We find broadly consistent results when studying the intensive margin of divestment exposure (columns 4 to 6). The strongest reductions in these specifications seem to be in terms of investments in energy transmission.

The result suggests that financial constraints induced by divestment translate into lower spending on abatement-related projects, which could unintentionally undermine environmental objectives through reduced operational efficiency on the ground.

5 The Operational Channel

In this section, we turn to generator-level evidence to assess whether divestment-induced capital constraints and lower investment manifest in less efficient day-to-day operations.

The following Tables estimate variations of equation 1, but use different measures of operational efficiency as the dependent variable.

We begin our analysis with the frequency of start-stop cycles on the weekly level. Operators maximize efficiency and output when running generators nearly nonstop, as seen in Figure 2. One reason for the optimality of running generators continuously is that stopping the generator and restarting it (referred to as a "start-stop cycle" in practice) is a particularly costly and inefficient procedure. Among other challenges, the generators and boilers have substantial "own mass" and a large amount of energy during a start-stop cycle is consumed by bringing the machine itself to operating temperature after it cooled down. Another reason for the inefficiency of start-stop cycles is that the heat efficiency curve is decreasing in utilization, meaning an extreme move away from optimal utilization down to 0 is particularly wasteful. Finally, generators need to be taken off the grid during this process meaning they actually run without generating electricity. If a lack of access to capital leads to aging equipment, we would expect an increase in these wasteful start-stop cycles to accommodate increasingly frequent emergency repairs and maintenance.

The results in Table 5 are consistent with this hypothesis. We find that coal power plants exposed to divestment exhibit a large increase in the frequency of start-stop cycles.

— Table 5 —

In addition to the wasted energy of the process of ramping up and down production, long periods of idleness can lower efficiency due to deteriorating equipment. Figure 7 displays a simple scatterplot showing a negative relationship between divestment and plant operating hours.

— Figure 7 —

In Table 6 we estimate the effect of divestment exposure on operating hours.

— Table 6 —

Column 1 of Table 6 presents striking results: firms targeted by divestment significantly reduce the number of operating hours of their generators. This result is not only highly statistically significant but also economically meaningful: The runtime of the average generator decreases by as much as 19 hours during a week, which corresponds to 11% of the maximum runtime. Considering the intensive margin of divestment in column 2, we find that a one standard deviation increase in *Divestment Intensity* leads to approximately 6.6 fewer hours of operation. Columns 3 and 4 yield consistent evidence when the analysis is conducted using the natural logarithm of runtime.

The reduction in operating hours can be interpreted as evidence of financial constraints induced by divestment. With less external financing available, firms may struggle to cover the costs associated with regular maintenance, filter replacements, or other abatement-related activities required to keep generators operating at their optimal efficiency. Instead of investing in upkeep, firms appear to scale back utilization, which in turn may push the operation of the remaining hours further away from the efficiency frontier. In this way, divestment indirectly contributes to inefficient generator usage, not because firms intend to pollute less, but because they lack the financial flexibility to sustain optimal operation. In addition, this result reconciles our finding of increased inefficiency with the finding in Green and Vallee (2025) that total generator emissions do not increase following divestment: Generators run inefficiently for shorter periods of time, causing excess CO_2 emissions relative to a social planner's optimum, resulting in electricity output falling at constant emissions. In other words, emission *intensity* increases.

Taken together, this generator-level evidence reinforces our earlier firm-level findings: while divestment successfully reduces capital availability, it may have the side effect of lowering maintenance and abatement investments, worsening the environmental performance of coal generators as a result. The findings highlight the importance of distinguishing between financial strategies, such as divestment, that indirectly restrict capital access and policy tools, such as carbon markets, that directly incentivize firms to improve efficiency and reduce emissions.

Are start-stop cycles and hours run actually explaining the rise in inefficiency? Table 7 shows that both operational categories are statistically and economically significantly associated with lower utilization and efficiency in coal generators even after controlling for generator fixed effects.

— Table 7 —

This result extends the causal chain from divestment to less capital, less capital expenditure, to increased operating issues and lower efficiency.

Finally, we calculate the standard deviation of the distance from optimal generator usage. Coal generators face constraints such as load changes and maintenance, so this standard deviation provides a measure of how consistently the plant operates near its most efficient point. Since fluctuating temperature ranges in boilers require additional fuel, generators with larger fluctuations consume more fuel and emit more CO_2 than generators with the same average, but more steady utilization.[16] As a result, a low standard deviation indicates that the plant operates efficiently, while a higher standard deviation may signal operational inefficiencies or lower investment in maintenance. Table 8 shows that, following divestment pressure, coal generators become more volatile in their efficiency - that is, they do not only operate further from the optimal point of utilization, but also fluctuate in their utilization more heavily, consistent with operational changes such as more frequent start-stop cycles for maintenance or uneven performance due to changes in aging equipment. As in the previous analysis, this effect is observed only for coal generators, not for gas plants.

Table 8 here

6 Alternative Policies to Divestment

This section studies two alternative types of policies often used to reduce the CO_2 footprint of utilities: emission trading schemes and legislation setting minimum quotas of renewable energy in the production mix.

6.1 Carbon Pricing

One potential question is whether *any* type of environmental policy might generate unintended consequences. If so, divestment may still be the first-best solution to foster the growth of sustainable energy supply. We explicitly test this possibility using an alternative policy frequently used

[16] See Congressional Research Service Report 2013

to decrease emissions, carbon trading schemes, and, in particular, the staggered introduction of carbon markets in the United States. Although there is no nationwide carbon market yet, several states have implemented local initiatives and created regional cap-and-trade systems, some of which are specifically designed for power plants. Specifically, the state of California introduced a broad-based cap-and-trade system in 2013, and the Regional Greenhouse Gas Initiative (RGGI) in the Northeast has targeted only power plants since 2009. RGGI has operated continuously in Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont, with Virginia and Pennsylvania being part of the group intermittently. It affects all generators with a minimum capacity of 25MW—exactly the cutoff for inclusion in the CAMD data underlying our analysis.

This staggered introduction of cap-and-trade carbon markets allows us to study whether, following the introduction of these carbon markets, we observe similar efficiency losses as those associated with bank divestment from coal. We estimate a specification similar to 1, with the outcomes being firm-level debt and capital expenditure, as well as generator-level efficiency. The main explanatory variable in the tests is "Carbon market", an indicator variable equal to 1 in all years after a state in which a power plant operates becomes exposed to the cap-and-trade market.

In Table 9, we find that participation in carbon markets does not restrict firms' access to capital (columns 1 and 2), nor does it affect firms' capital expenditures (columns 3 and 4), with coefficient estimates being statistically insignificant throughout.

— Table 9 —

In Table 10, we move to the generator level, estimating regressions of our measures of efficiency on an indicator variable equal to one after the introduction of a carbon market in a given generator's state.

Table 10 here

Strikingly, we find no evidence that the introduction of carbon markets leads to operational or thermal efficiency losses. These results align with the intended function of carbon markets: if the cost of abatement is lower than the price of purchasing a pollution permit, the firm will invest money (raising capital expenditure) and abate, lowering emissions; if abatement is more expensive than buying a permit, the firm will purchase the permit instead. This market-based mechanism ensures that abatement occurs where it is cheapest, achieving a socially optimal allocation. In addition, the absence of capital rationing means that generators do not suffer from lower upkeep and maintenance. Our findings are consistent with this mechanism and the interpretation that carbon markets could be a superior form of reducing emissions compared to ESG-driven divestment.

6.2 External Validity: Evidence from Renewable Portfolio Standards

In our final section, we investigate whether our finding that ESG driven divestment constrains capital expenditure and can lead to lower operational efficiency extends to other settings that limit the investment capacity of polluters. We investigate this question in the context of Renewable Portfolio Standards (RPS) and Clean Energy Standards (CES). These are state-level policies in the United States that require utilities to generate a minimum share of electricity from renewable or low-carbon sources such as wind, solar, hydro, or nuclear. As of the early 2020s, more than 30 U.S. states have enacted some form of RPS or CES, with substantial heterogeneity in timing, stringency, and eligible technologies.

By setting legally binding targets that typically increase over time, these policies enforce increased capital expenditure on renewable energy projects, which might lower available capital for brown legacy assets. Consequently, the introduction of RPS laws can serve as a plausibly exogenous shock for coal plant capital expenditure. As a result, we hypothesize that RPS laws might lead to lower generator level utilization and efficiency, analogous to the divestment shocks studied in our main analysis.

To test this conjecture, we estimate dynamic difference-in-differences regressions that explain generator level measures of utilization for the subset of coal powered generators. For each state and year, we determine the time to treatment—that is, the time relative to the first introduction of RPS as in Cornaggia and Iliev (2023)—and estimate dynamic coefficients of time to treatment on coal generator utilization and efficiency.

— Figures 8 and 9 —

Figures 8 and 9 present the dynamic treatment effects of RPS implementation on generator utilization and efficiency. Econometrically, these tests implement the Borusyak, Jaravel, and Spiess (2024) estimator, which recovers unbiased dynamic treatment effects under staggered treatment adoption and treatment effect heterogeneity. This approach is particularly well suited to policy environments like RPS/CES, where adoption occurs at different times across states but the underlying policy design is comparable.

The results in Figure 8 indicate that, following the enactment of RPS standards, coal-fired generators operate increasingly further away from their estimated optimal utilization rate. Similar to other work on these policies (Cornaggia and Iliev, 2023), we see a gradual ramping up of the effect already one to two years prior to the rules taking effect, but after they have been passed. This anticipation effect is consistent with firms shifting capital expenditure towards renewables prior to the mandates being binding, as one would expect given the long time horizon of these capital intensive projects.

Figure 9 shows that, just as in the case of divestment, pushing legacy coal generators away from their optimal point of utilization leads to inefficiencies that lower heat rates and increase emissions relative to the social optimum. Just as for utilization, the effects take off after the quotas are passed and before they take effect, and ramp up for three years following the initial introduction.

This pattern suggests that clean-energy mandates accelerate the decline in operational efficiency and shift production away from cost-optimal levels, consistent with the reallocation of capital and reduced investment in coal assets. These results provide evidence for the importance of capital constraints and inefficiency beyond our main setting of ESG driven divestment.

7 Conclusion

This study shows that ESG-motivated divestment, while intended to accelerate the green transition, can lead to unintended consequences, in particular in sectors with long-lived and capital-intensive assets. Utilizing the U.S. coal power sector as a laboratory, we document bank-policy driven divestment reduces access to debt financing to borrowers through a relationship banking channel, resulting in lower capital expenditure at exposed firms. We then trace out the real effects of this shock using hourly operational data on the near-universe of large U.S. generators, finding that divestment pushes power plant operators to run plants in inefficient conditions. This raises emissions intensity rather than reducing it, causing an unnecessarily high level of CO_2 emissions compared to the amount of power produced. Hence, ESG induced financial frictions can push the economy further from the social optimum in the short to medium run, even if it might succeed in somewhat accelerating a shift towards a new green equilibrium in the long run.

More broadly, our findings caution against treating ESG divestment as a one-size-fits-all tool for decarbonization. While effective in shifting capital flows toward green industries, constraining brown industries risks increasing emissions if transitional dynamics are ignored. This finding is the first documented case of the concept of impact elasticity in the context of specific ESG policies, with our rich micro level evidence supporting the operating channel hypothesized in Hartzmark and Shue (2022). Our findings highlight the sensitivity of policy outcomes to technological differences, as operating inefficiencies lead to more avoidable emissions in some sectors than in others. Our results have important policy implications, since carbon pricing mechanisms appear to offer the ability to reduce emissions, while not being subject to the same unintended consequences of ESG-driven divestment. In the absence of the political conditions to establish carbon markets, one possible implication of our results could be that rather than divest, creditors might be more impactful if they were to lend money that is not fungible, and earmarked exclusively for improving efficiency in legacy brown assets. We leave a detailed analysis of the value of green loans and bonds and their optimal application in the economy to future work.

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Figure 1. Example Curve of Utilization and Efficiency
This figure shows the realized annual fuel efficiency levels plotted against generator utilization for the average of all SUB fuel type generators. The fitted curve is the estimated heat efficiency function.

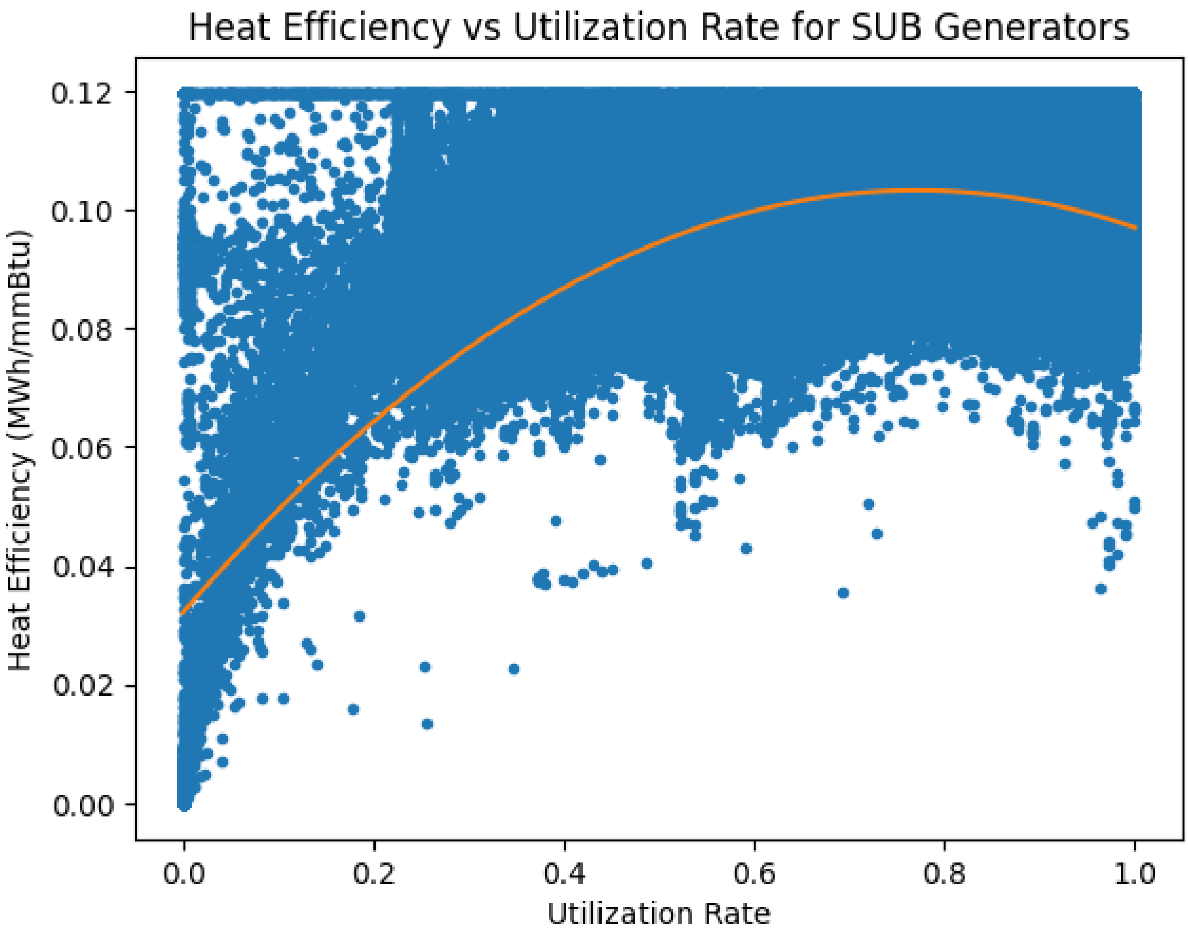
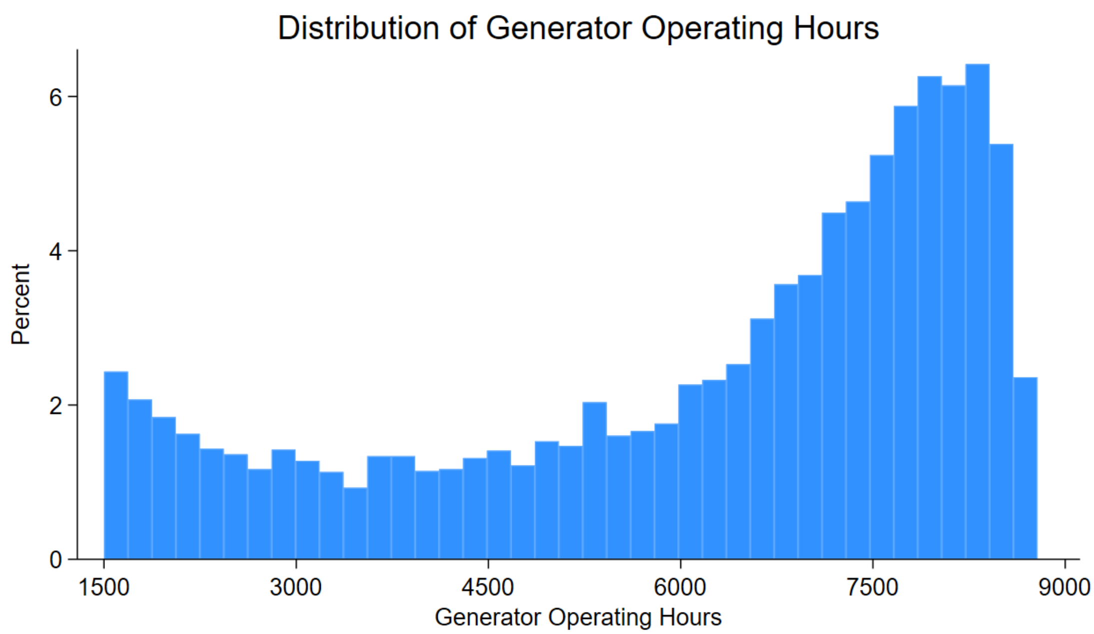


Figure 2. Overview Operating Hours and Efficiency
This figure shows the histogram of annual hours run per generator (Panel A) and the distribution of generator nameplate capacity (Panel B) in our sample.



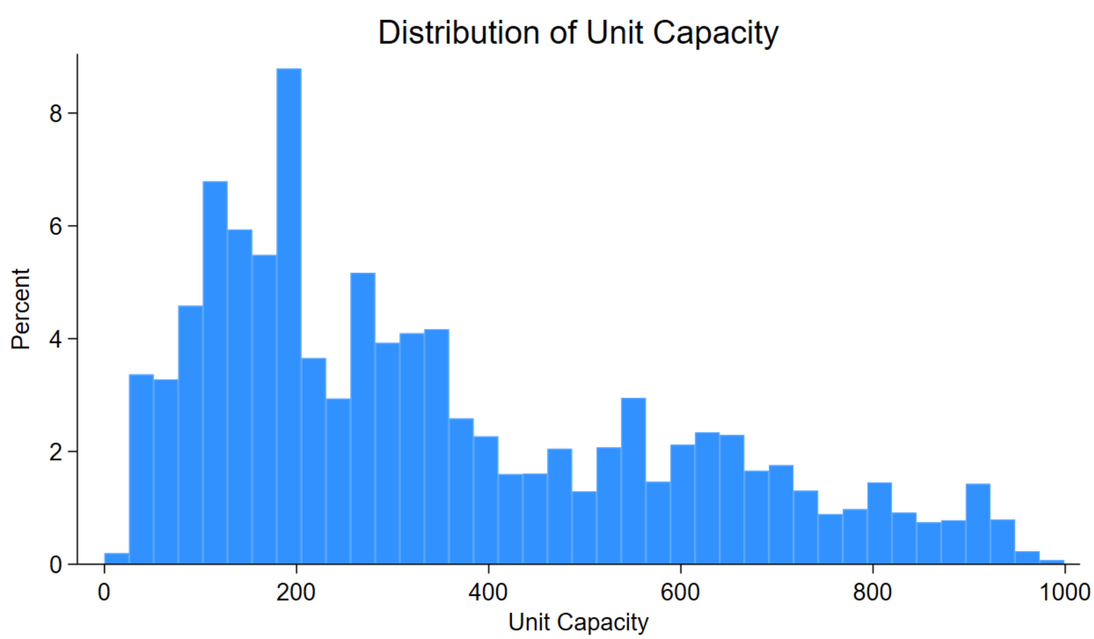
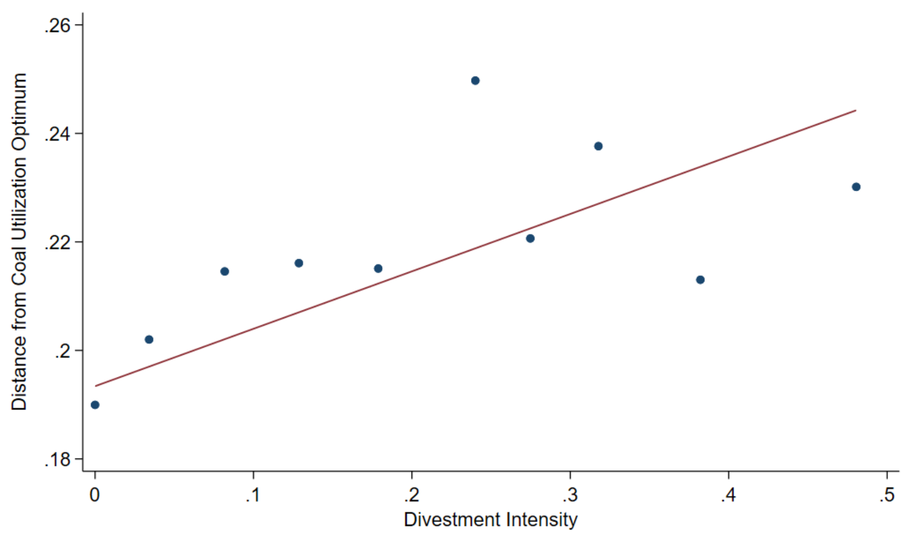


Figure 3. Divestment and Generator-Level Utilization Inefficiency
This figure presents a binned scatter plot (10 bins) showing the relationship between bank divestment policy strength and the weekly average absolute distance from the generator's utilization optimum, based on annually estimated utilization—efficiency curves. Panel (a) keeps only coal powered generators, while Panel (b) looks only at non-coal powered generators. The sample is at the generator-by-week level.

(a) Coal powered generators



(b) Non-coal powered generators

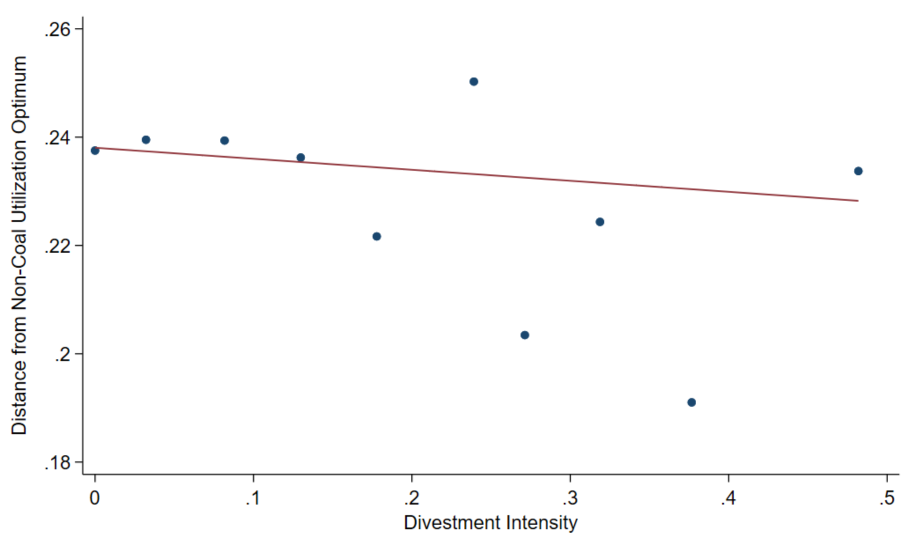
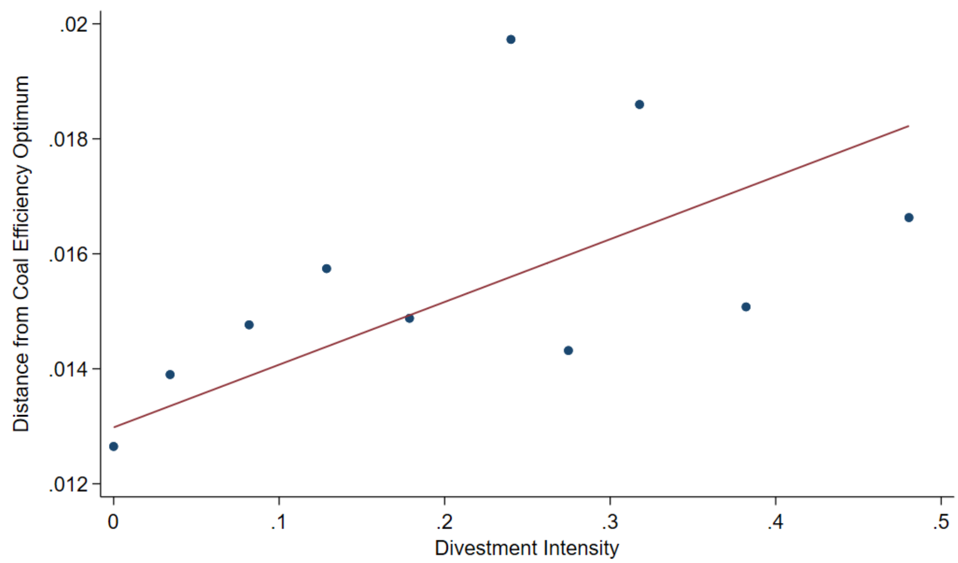


Figure 4. Divestment and Generator-Level Heat Inefficiency
This figure presents a binned scatter plot (10 bins) showing the relationship between bank divestment policy strength and the weekly average absolute distance from the generator's heat efficiency optimum, based on annually estimated utilization—efficiency curves. Panel (a) keeps only coal powered generators, while Panel (b) looks only at non-coal powered generators. The sample is at the generator-by-week level.

(a) Coal powered generators



(b) Non-coal powered generators

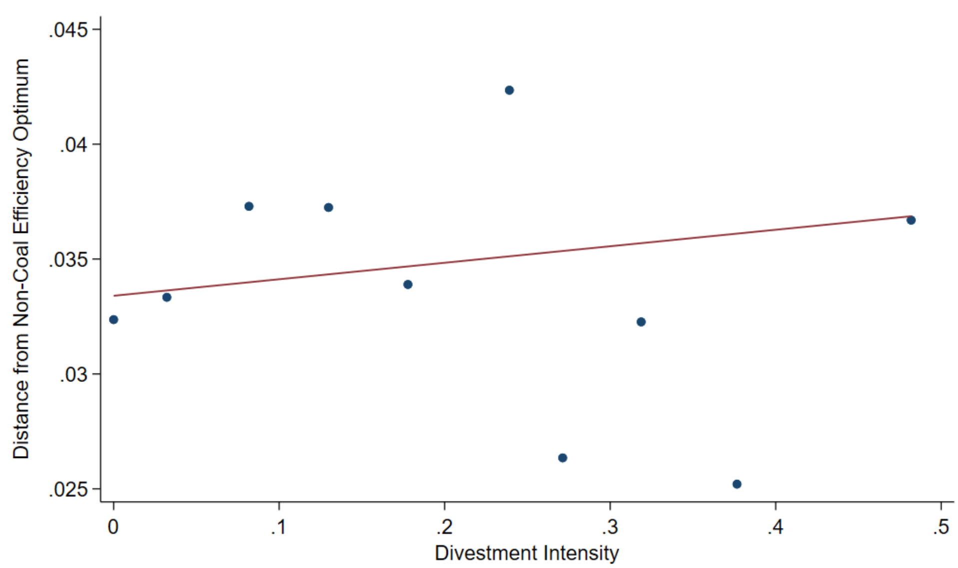


Figure 5. Dynamic Effects of Coal Divestment on Generator Inefficiency
This figure plots the estimated coefficients from a dynamic regression of the distance from optimal generator utilization on banks' coal divestment exposure. The horizontal axis represents event time relative to the first year of being exposed to a bank exit policy, and the vertical axis shows the corresponding coefficient estimates. All regressions include firm, generator and state times year-week fixed effects as well as standard control variables. Confidence intervals are based on standard errors clustered at the generator level.

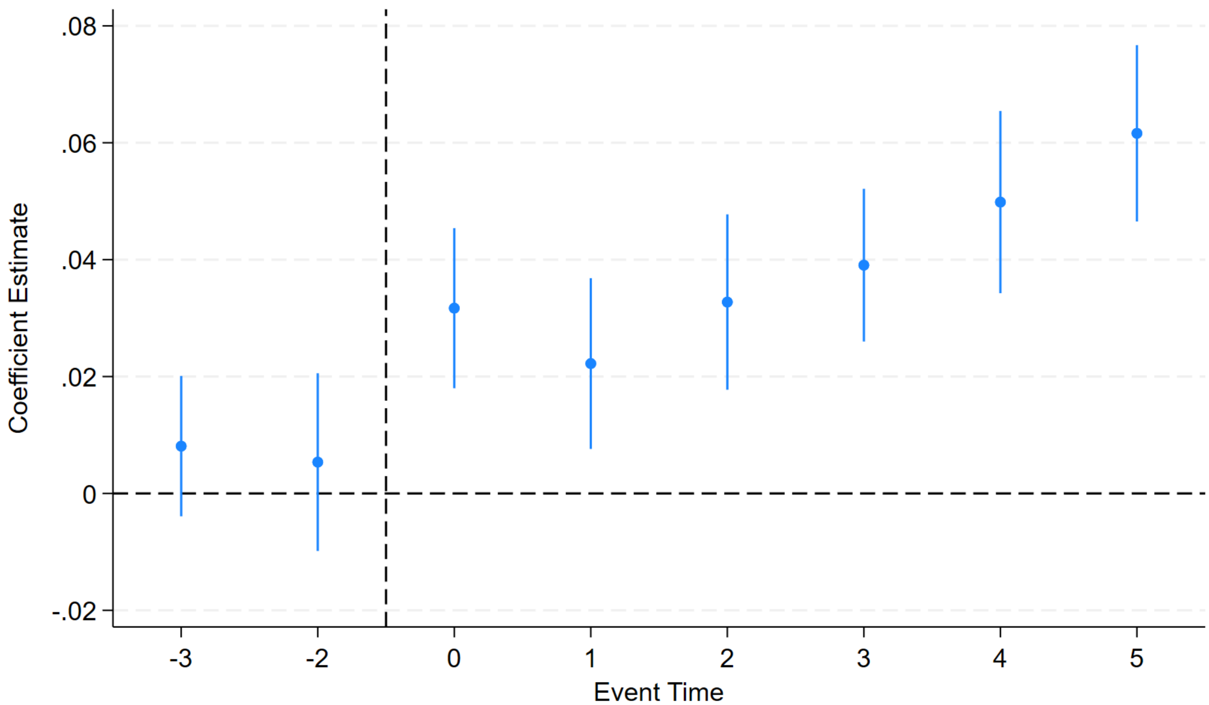
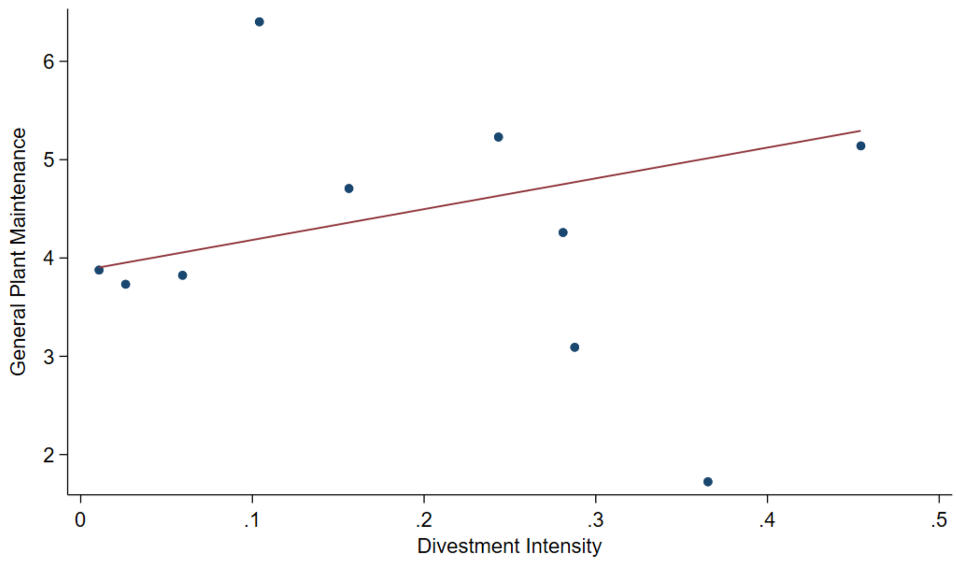


Figure 6. Impact of Divestment on Plant Maintenance Expenditures

This figure presents a binned scatter plot (10 bins) showing the relationship between bank divestment policy strength and the weekly plant capital expenditures. Panel (a) shows the relationship with general plant maintenance expenditures and Panel (b) considers expenditures particularly related to the plant's transmission. The sample is at the generator-by-week level and includes the standard firm accounting controls used in the regressions.

(a) General plant maintenance expenditures



(b) Plant transmission expenditures

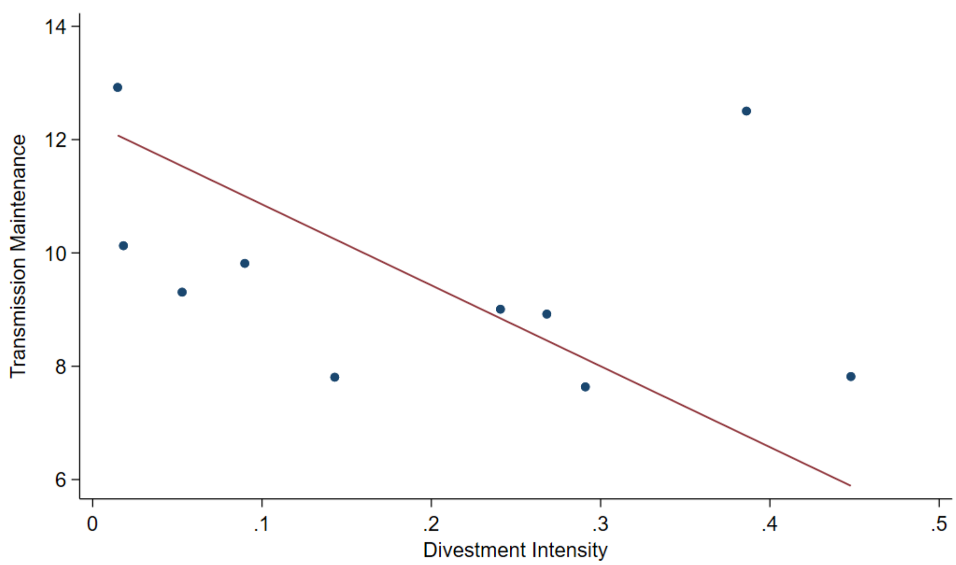


Figure 7. Impact of Divestment on Generator Operating Hours
This figure shows the univariate relationship between bank coal divestment policy strength and the number of operating hours of generators.

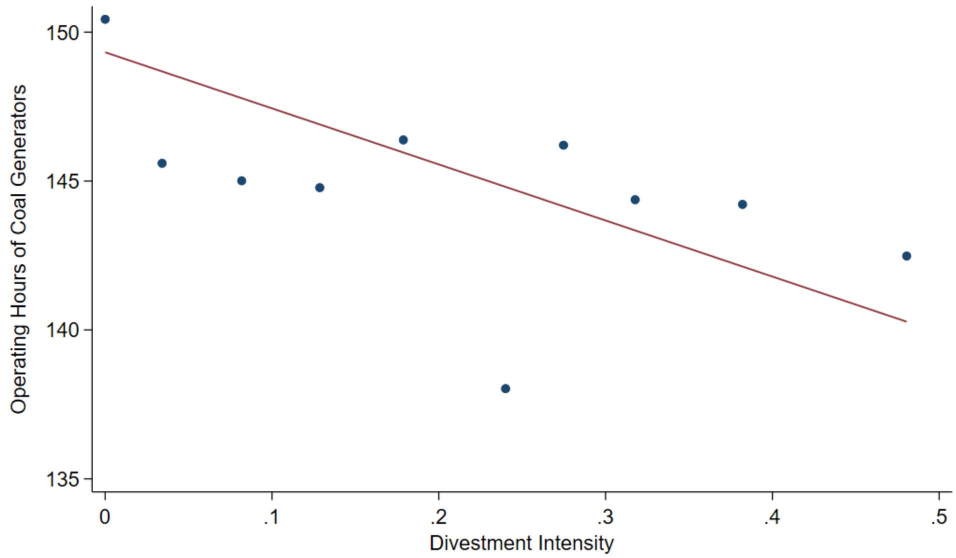


Figure 8. Dynamic Effects of Renewable Portfolio Standards on Generator Utilization This figure plots the estimated coefficients from a dynamic regression of the distance from optimal generator utilization on an indicator for whether a generator is located in a state with a Renewable Portfolio Standard (RPS) in a given year. The horizontal axis represents event time relative to the first year of RPS adoption, and the vertical axis shows the corresponding coefficient estimates. All regressions include generator and year fixed effects as well as standard control variables. Confidence intervals are based on standard errors clustered at the generator level.

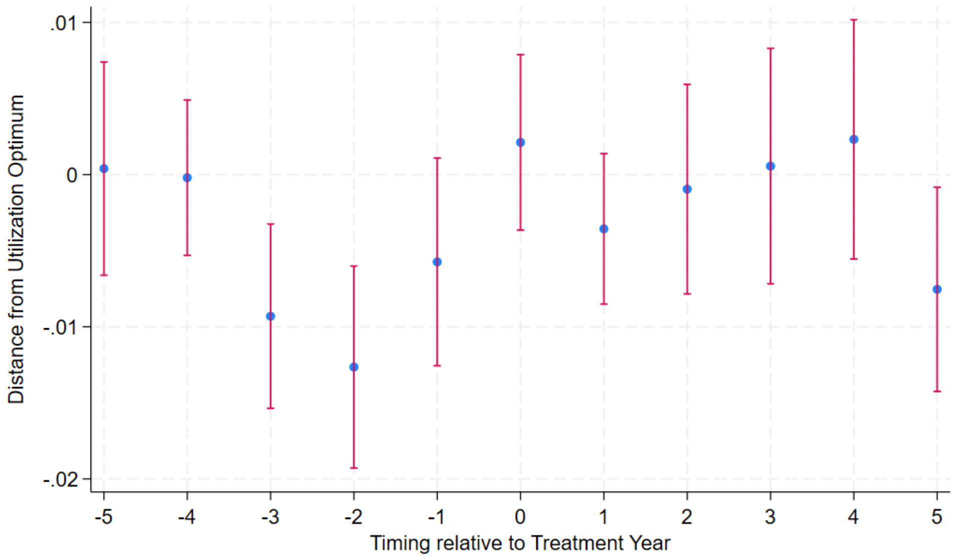


Figure 9. Dynamic Effects of Renewable Portfolio Standards on Generator Efficiency This figure plots the estimated coefficients from a dynamic regression of the distance from optimal generator efficiency on an indicator for whether a generator is located in a state with a Renewable Portfolio Standard (RPS) in a given year. The horizontal axis represents event time relative to the first year of RPS adoption, and the vertical axis shows the corresponding coefficient estimates. All regressions include generator and year fixed effects as well as standard control variables. Confidence intervals are based on standard errors clustered at the generator level.

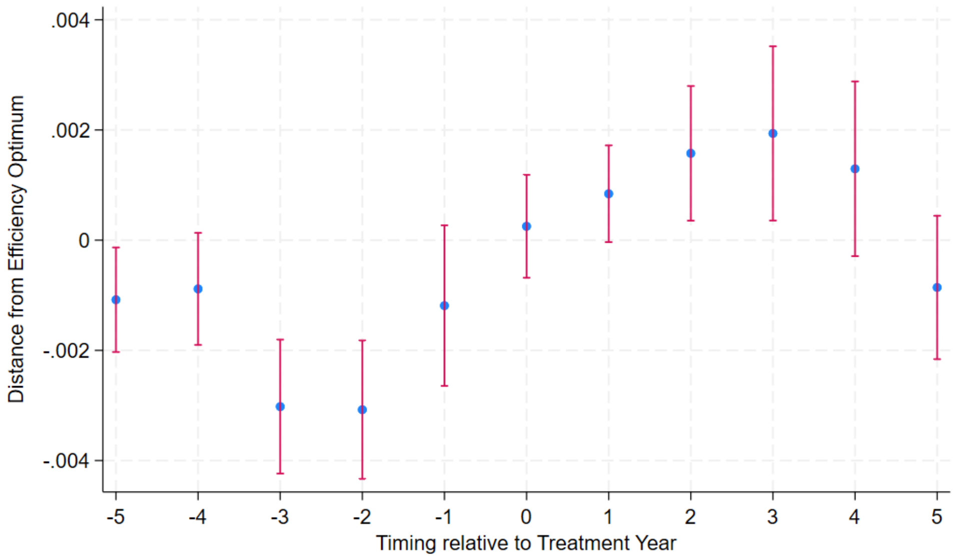


Table 1. Summary Statistics

This table shows summary statistics. The sample covers the years from 2009 to 2022 for variables in Panel A, and the years from 1999 to 2022 in Panel B. Variables are defined as in Appendix Table A.1. The statistics are on the generator-week level for EIA data, and firm-year level for Factset accounting variables.

Variables	N	Mean	SD	Min	Median	Max
Panel A: Generator-Year-Week Variables						
Distance from Optimal Efficiency	288,124	0.021	0.025	0.001	0.011	0.125
Distance from Optimal Utilization	288,124	0.211	0.124	0.042	0.185	0.753
Log Distance from Optimal Efficiency	288,124	-4.426	1.056	-6.759	-4.494	-2.081
Log Distance from Optimal Utilization	288,124	-1.699	0.532	-3.171	-1.689	-0.284
Coal Generator	288,124	0.565	0.496	0.000	1.000	1.000
Divestment	288,124	0.468	0.499	0.000	0.000	1.000
Divestment Intensity	288,124	0.076	0.132	0.000	0.000	0.549
Total Operating Hours	288,124	131.310	51.487	1.000	168.000	168.000
Log Total Operating Hours	288,124	4.713	0.762	0.693	5.130	5.130
Start-Stop Cycles	288,124	0.646	1.660	0.000	0.000	30.000
Panel B: Firm-Year Accounting Variables						
Total Assets (USD Billion)	432	57.229	120.650	0.495	23.719	958.784
Long-Term Debt (USD Billion)	432	14.193	18.931	0.000	7.877	113.438
Log Long-Term Debt	432	8.769	1.631	0.000	8.972	11.639
Return on Assets (ROA)	432	0.083	0.030	0.011	0.077	0.222
Capital Expenditures	432	0.060	0.028	0.000	0.060	0.225
Log Capital Expenditures	432	6.981	1.616	0.000	7.192	9.686
Cash / Assets	432	0.043	0.055	0.000	0.020	0.354
Retained Earnings	432	0.137	0.197	-0.567	0.100	1.045
Tobin's Q	432	1.280	0.310	0.874	1.211	3.136
Property, Plant & Equipment (PPE)	432	0.564	0.189	0.014	0.609	0.854

Table 2. Bank Divestment Policy Exposure and Operational Inefficiency
This table shows results from linear regressions of the absolute deviation from the optimal generator utilization levels and efficiency on exposure to banks' coal divestment strategies and an indicator variable equal to 1 if the generator is coal powered. Panel A uses the distance from optimal utilization as the dependent variable. In Panel B, we replace it with the distance from optimal efficiency. The sample covers the years from 2009 to 2022. Variables are defined as in Appendix Table A.1. t-statistics, based on robust standard errors clustered at the firm level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

(a) Distance from Optimal Utilization

Dep. Variable	Distance from Optimal Utilization			
Regression	(1)	(2)	(3)	(4)
Divestment × Coal	0.0601***	0.0556***		
	(0.00651)	(0.00628)		
Divestment Intensity × Coal			0.1617***	0.1592***
			(0.01953)	(0.01915)
Divestment	-0.0164			
	(0.01421)			
Divestment Intensity			-0.1593*	
			(0.08995)	
Coal	-0.0417*	-0.0396*	-0.0142	-0.0165
	(0.02372)	(0.02392)	(0.02228)	(0.02258)
Ln Total Assets	-0.0247**		-0.0248**	
	(0.01044)		(0.01030)	
ROA	-0.1902		-0.0942	
	(0.13483)		(0.13144)	
Capex	0.0467		0.1039	
	(0.16897)		(0.17256)	
Cash	-0.0617		-0.0650	
	(0.05611)		(0.05781)	
Retained Earnings	0.0163		-0.0021	
	(0.01816)		(0.02241)	
Tobin's Q	0.0094		-0.0029	
	(0.01552)		(0.01660)	
PPE	-0.0506		-0.0635	
	(0.04180)		(0.04487)	
Firm FE	Yes	No	Yes	No
Firm x Year FE	No	Yes	No	Yes
Generator FE	Yes	Yes	Yes	Yes
State x Year-Week FE	Yes	Yes	Yes	Yes
Observations	286,304	286,304	286,304	286,304
Adjusted R^2	0.330	0.346	0.328	0.345

(b) Distance from Optimal Efficiency

Dep. Variable	Distance from Optimal Efficiency			
Regression	(1)	(2)	(3)	(4)
Divestment × Coal	0.0062***	0.0051***		
	(0.00128)	(0.00134)		
Divestment Intensity × Coal			0.0105**	0.0081*
			(0.00409)	(0.00421)
Divestment	-0.0050**			
	(0.00252)			
Divestment Intensity			-0.0247*	
			(0.01389)	
Coal	-0.0050	-0.0042	-0.0011	-0.0008
	(0.00808)	(0.00831)	(0.00761)	(0.00780)
Firm FE	Yes	No	Yes	No
Firm x Year FE	No	Yes	No	Yes
Generator FE	Yes	Yes	Yes	Yes
State x Year-Week FE	Yes	Yes	Yes	Yes
Observations	286,304	286,304	286,304	286,304
Adjusted R^2	0.558	0.568	0.557	0.567

Table 3. Bank Divestment Policy Exposure and Long-Term Debt
This table shows results from linear regressions of the natural logarithm of firm long-term debt on exposure to banks' coal divestment strategies and firm-level control variables. The sample covers the years from 1999 to 2022. Variables are defined as in Appendix Table A.1. Divestment intensity is normalized to mean zero and standard deviation of one. t-statistics, based on robust standard errors clustered at the firm level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	Log Long-Term Debt			
Regression	(1)	(2)	(3)	(4)
Divestment Intensity	-0.443***	-0.225***	-0.168*	-0.299**
	(0.140)	(0.0577)	(0.0814)	(0.112)
Ln Total Assets			1.306***	
			(0.219)	
ROA			-1.606	-7.623**
			(3.496)	(3.429)
Capex			0.00732	-1.283
			(2.201)	(2.110)
Cash			1.114	0.245
			(0.821)	(0.995)
Retained Earnings			-3.395**	-3.457*
			(1.581)	(1.734)
Tobin's Q			-0.558	-0.663
			(0.376)	(0.396)
PPE			0.918	0.495
			(0.540)	(0.619)
Borrower FE	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No
Size x Year FE	No	Yes	No	Yes
Observations	432	423	432	423
Adjusted R^2	0.842	0.867	0.939	0.926

Table 4. Bank Divestment Policy Exposure and Plant Capital Expenditures
This table reports regressions examining the relationship between bank coal divestment policies and maintenance expenditures at fossil fuel generators. The dependent variables are measures of the natural logarithm of maintenance activity: total transmission maintenance, general plant maintenance, and steam power generation maintenance. The key independent variable is the interaction between divestment policy dummy or intensity and an indicator for coal-fueled generators. All specifications control for firm-level characteristics. Standard errors are clustered at the generator level. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	Steam	Transmission	General Plant	Steam	Transmission	General Plant
Regression	(1)	(2)	(3)	(4)	(5)	(6)
Divestment × Coal	-0.0292***	-0.0113*	0.00707			
	(0.0112)	(0.00686)	(0.0132)			
Divestment Intensity × Coal				0.00521	-0.0661***	-0.00153
				(0.0321)	(0.0210)	(0.0709)
Divestment	0.473***	-0.0423	-2.633***			
	(0.113)	(0.101)	(0.677)			
Divestment Intensity				-1.688***	-0.982***	-4.365***
				(0.614)	(0.252)	(0.923)
Coal	-0.00986	-0.0145	-0.134**	-0.0415	-0.0223	-0.203**
	(0.0274)	(0.0169)	(0.0560)	(0.0293)	(0.0161)	(0.0874)
Borrower FE	Yes	Yes	Yes	Yes	Yes	Yes
Generator FE	Yes	Yes	Yes	Yes	Yes	Yes
State x Year-Week FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	219,580	219,580	219,580	219,580	219,580	219,580
Adjusted R^2	0.995	0.992	0.964	0.995	0.992	0.957

Table 5. Bank Divestment Exposure and Number of Start-Stop Cycles
This table shows results from linear regressions of total generator start-stop cycles (columns (1) and (2) and their natural logarithm (columns (3) and (4)) on exposure to banks' coal divestment strategies interacted with an indicator variable equal to 1 if the generator is coal powered. The sample covers the years from 2009 to 2022. Variables are defined as in Appendix Table A.1. t-statistics, based on robust standard errors clustered at the generator level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	Start-Stop Cycles		Log Start-Stop Cycles	
Regression	(1)	(2)	(3)	(4)
Divestment × Coal	0.334***		0.152***	
	(0.0744)		(0.0255)	
Divestment Intensity × Coal		1.119***		0.487***
		(0.281)		(0.0873)
Coal	-0.763***	-0.654***	-0.284***	-0.230***
	(0.139)	(0.125)	(0.0427)	(0.0390)
Firm x Year FE	Yes	Yes	Yes	Yes
Generator FE	Yes	Yes	Yes	Yes
Year-Week FE	Yes	Yes	Yes	Yes
Observations	286,304	286,304	286,304	286,304
Adjusted R^2	0.394	0.394	0.354	0.354

Table 6. Bank Divestment Policy Exposure and Generator Operating Hours

This table shows results from linear regressions of total generator operating hours (columns (1) and (2) and their natural logarithm (columns (3) and (4)) on exposure to banks' coal divestment strategies interacted with an indicator variable equal to 1 if the generator is coal powered. The sample covers the years from 2009 to 2022. Variables are defined as in Appendix Table A.1. t-statistics, based on robust standard errors clustered at the generator level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	Total Hours		Log Hours	
Divestment × Coal	-15.79***		-0.190***	
	(2.411)		(0.0314)	
Divestment Intensity × Coal		-40.37***		-0.550***
		(6.813)		(0.0929)
Coal	22.63***	15.18***	0.265***	0.187***
	(4.191)	(3.874)	(0.0601)	(0.0575)
Firm x Year FE	Yes	Yes	Yes	Yes
Generator FE	Yes	Yes	Yes	Yes
State x Year-Week FE	Yes	Yes	Yes	Yes
Observations	286,304	286,304	286,304	286,304
Adjusted R^2	0.464	0.463	0.370	0.370

Table 7. Operating Hours, Start-Stop Cycles and Generator Inefficiency
This table shows results from linear regressions of generator inefficiency (columns (1) and (2) and their natural logarithm (columns (3) and (4)) on total operating hours and the number of start-stop cycles. The sample covers the years from 2009 to 2022. Variables are defined as in Appendix Table A.1. t-statistics, based on robust standard errors clustered at the generator level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	Utilization	Efficiency	Log Utilization	Log Efficiency
Regression	(1)	(2)	(3)	(4)
Total Operating Hours	-0.148***	-0.0253***		
	(0.00258)	(0.000417)		
Start-Stop Cycles	0.737***	0.129***		
	(0.0600)	(0.00888)		
Log Total Operating Hours			-0.309***	-0.542***
			(0.00610)	(0.00964)
Log Start-Stop Cycles			0.209***	0.485***
			(0.00729)	(0.0151)
Firm x Year FE	Yes	Yes	Yes	Yes
Generator FE	Yes	Yes	Yes	Yes
Year-Week FE	Yes	Yes	Yes	Yes
Observations	286,304	286,304	286,304	286,304
Adjusted R^2	0.560	0.723	0.606	0.730

Table 8. Bank Divestment Exposure and the Variability of Operational Inefficiency
This table shows results from linear regressions of the standard deviation from the optimal generator utilization (columns 1 and 2) and efficiency (columns 3 and 4) on exposure to banks' coal divestment strategies interacted with an indicator variable equal to 1 if the generator is coal powered. The sample covers the years from 1999 to 2022. Variables are defined as in Appendix Table A.1. t-statistics, based on robust standard errors clustered at the firm level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	SD Utilization		SD Efficiency	
Regression	(1)	(2)	(3)	(4)
Divestment × Coal	0.0211***		0.0030***	
	(0.0033)		(0.0006)	
Divestment Intensity × Coal		0.0471***		0.0038*
		(0.0089)		(0.0020)
Coal	-0.0221***	-0.0109*	-0.0069***	-0.0048***
	(0.0067)	(0.0064)	(0.000997)	(0.0009)
Firm x Year FE	Yes	Yes	Yes	Yes
Generator FE	Yes	Yes	Yes	Yes
State x Year-Week FE	Yes	Yes	Yes	Yes
Observations	285,249	285,249	285,249	285,249
Adjusted R^2	0.207	0.206	0.405	0.404

Table 9. Alternative Mechanism: Carbon Trading

This table shows results from linear regressions of the natural logarithm of long-term debt (columns (1) and (2)) and the natural logarithm of capital expenditures (columns (3) and (4)) on an indicator variable equal to 1 for firms subject to a cap-and-trade carbon trading system. We also include firm-level financial control variables. The sample covers the years from 1999 to 2022. Variables are defined as in Appendix Table A.1. t-statistics, based on robust standard errors clustered at the firm level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	Log Long-Term Debt		Log Capex	
Regression	(1)	(2)	(3)	(4)
Carbon Trading	0.0003	0.1793	-0.0169	0.0395
	(0.1175)	(0.1831)	(0.1740)	(0.2106)
Ln Total Assets	1.3601***		1.2789***	
	(0.2146)		(0.3352)	
ROA	-1.7959	-8.4336*	9.1048	-2.9713
	(3.7179)	(4.0025)	(7.4281)	(2.3974)
Cash	1.1002	0.5470	3.3532	1.9032
	(0.7737)	(0.8846)	(2.8424)	(1.3232)
Retained Earnings	-3.3233*	-3.0696	1.8777	2.6843
	(1.6362)	(1.8822)	(1.4097)	(1.9943)
Tobin's Q	-0.6144	-0.8695**	-0.8431	-1.0293*
	(0.3925)	(0.4090)	(0.8693)	(0.5715)
PPE	1.0108	0.6949	3.3994**	3.3266**
	(0.6877)	(0.7515)	(1.3058)	(1.3470)
Borrower FE	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No
Size x Year FE	No	Yes	No	Yes
Observations	432	423	432	423
Adjusted R^2	0.937	0.921	0.792	0.791

Table 10. Impact of Carbon Market on Generator Efficiency

This table shows results from linear regressions of the absolute distance from optimal utilization (columns (1) and (2)) and optimal efficiency (columns (3) and (4)) on an indicator variable equal to 1 for firms subject to a cap-and-trade carbon trading system interacted with dummy equal to 1 of the generator is coal-powered. The sample covers the years from 1999 to 2022. Variables are defined as in Appendix Table A.1. t-statistics, based on robust standard errors clustered at the firm level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	Utilization		Efficiency	
Regression	(1)	(2)	(3)	(4)
Carbon Trading × Coal	0.0224	0.0267	-0.00097	-0.00007
	(0.0225)	(0.0225)	(0.00707)	(0.0069)
Coal	-0.00023	-0.0045	-0.0116***	-0.0124***
	(0.0057)	(0.0058)	(0.0014)	(0.00141)
Firm x Year FE	Yes	No	Yes	No
Firm FE	No	Yes	No	Yes
Year-Week FE	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes
Observations	286,304	286,304	286,304	286,304
Adjusted R^2	0.127	0.105	0.248	0.226

Internet Appendix - For Online Publication Only

Figure A1. Global coal consumption - projections

This figure shows the current and projected global coal consumption based on IEA forecasts.

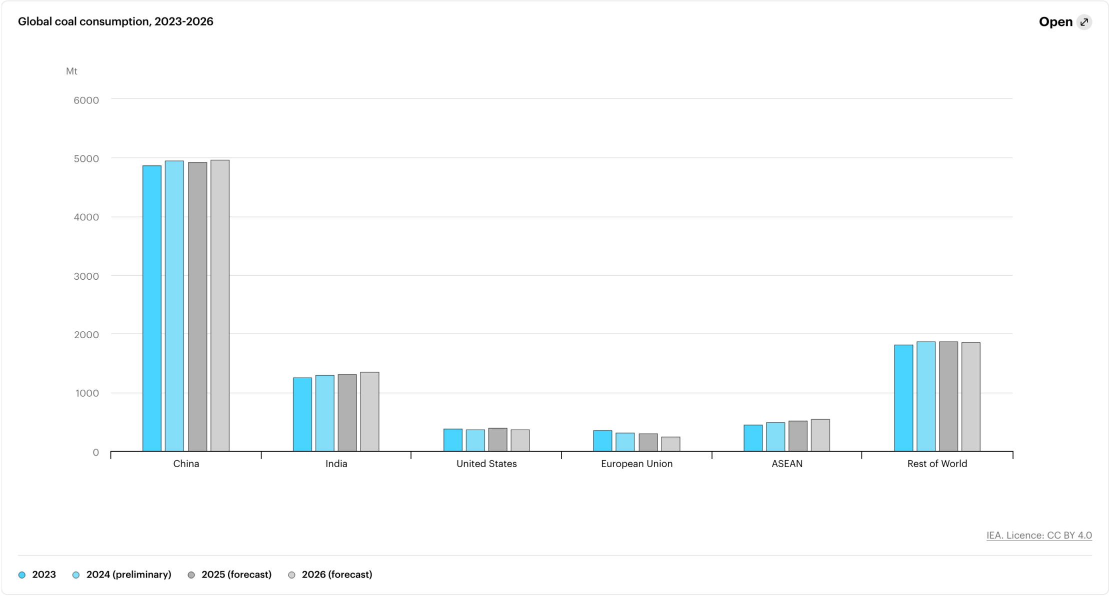


Table A.1: Variable Definitions and Data Sources

In this table we define the key variables used in the analyses and provide for each of them the respective data source.

Variable	**Definition**
Distance from Optimal Utilization	Absolute deviation of a generator's observed utilization rate from its estimated optimal utilization rate based on the fitted efficiency curve. We compute absolute hourly deviations from annually estimated efficiency curves and take the weekly mean of these deviations. Higher values indicate operation further from the optimal load factor.
Log Distance from Optimal Utilization	Natural logarithm of the variable *Distance from Optimal Utilization*.
Distance from Optimal Efficiency	Absolute deviation of a generator's observed heat rate (efficiency) from its estimated optimal efficiency based on the fitted efficiency curve. We compute absolute hourly deviations from annually estimated efficiency curves and take the weekly mean of these deviations. Higher values indicate operation further from the optimal efficiency frontier.
Log Distance from Optimal Efficiency	Natural logarithm of the variable *Distance from Optimal Efficiency*.
Total Assets	Total assets in millions of US dollars (FactSet item *FF_ASSETS*).
ROA	Operating income (FactSet item *FF_OPER_INC*) plus interest expenses (FactSet item *FF_INT_EXP_DEBT*) divided by total assets (FactSet item *FF_ASSETS*).
Cash	Cash and short-term investments (FactSet item *FF_CASH_ST*) divided by total assets (FactSet item *FF_ASSETS*).
Capex	Capital expenditures (FactSet item *FF_CAPEX_FIX*).
Retained Earnings	Retained earnings (FactSet item *FF_COM_EQ_RETAIN_EARN*) divided by total assets (FactSet item *FF_ASSETS*).
Tobin's Q	Total assets (FactSet item *FF_ASSETS*) plus market value of equity (Factstet item *FF_MKT_VAL*) minus book value of equity (Factstet item *FF_COM_EQ*) divided by total assets.
PPE	Property, plant & equipment (FactSet item *FF_PPE*) divided by total assets (FactSet item *FF_ASSETS*).
Long-Term Debt	Long-term debt (FactSet item *FF_DEBT_LT*).
Coal	Indicator variable equal to 1 if it is a coal generator and 0 otherwise (eGrid).
Total Hours	Number of hours a generator was used each year (eGrid).
Divestment	Indicator variable equal to 1 if a borrower has been targeted by a bank divestment policy as defined in Green and Vallee (2025).

Table A.1 (continued): Variable Definitions

Variable	**Definition**
Divestment Intensity	Divestment strength of banks from coal generators from Green and Vallee (2025).
Carbon Trading	Indicator variable equal to 1 if a firm is subject to a carbon market and 0 otherwise.
Start-Stop Cycles	Count of operational cycles in which the generator was either started or shut down.
RPS	Dummy variable equal to 1 if a state requires utilities to source a minimum share of electricity from eligible renewable technologies under a Renewable Portfolio Standard in a given year.
CES	Dummy variable equal to 1 if a state mandates a minimum clean-energy share for utilities in a given year.

Table A.2. Borrowers in the Sample
This table lists all fossil fuel firms included in the analysis. The first column reports the *FactSet Entity ID*, the second column the company name, and the third column indicates whether the firm was ever subject to a bank coal-divestment policy during the sample period.

FactSet ID	**Company Name**	**Divestment**
000BN8-E	Air Products and Chemicals, Inc.	1
000CS1-E	Berkshire Hathaway Inc. Class A	0
000DW6-E	CMS Energy Corporation	1
000HMG-E	Dominion Energy Inc	1
000NDZ-E	Evergy, Inc.	1
000TLW-E	PPL Corporation	1
000ZPG-E	Ameren Corporation	1
000ZW7-E	DTE Energy Company	1
0013FQ-E	AES Corporation	1
0013YQ-E	NRG Energy, Inc.	1
001H0J-E	FirstEnergy Corp.	1
002VYY-E	TXNM Energy, Inc.	1
0031L0-E	Enel SpA	1
003DJY-E	CenterPoint Energy, Inc.	1
05MLTZ-E	Black Hills Corporation	1
06F9DV-E	Duke Energy Corporation	1
0FM1RN-E	WEC Energy Group Inc	1

Table A.3. Bank Divestment Policy Exposure and Leverage
This table shows results from linear regressions of the natural logarithm of firm leverage on exposure to banks' coal divestment strategies and firm-level control variables. The sample covers the years from 1999 to 2022. Variables are defined as in Appendix Table A.1. t-statistics, based on robust standard errors clustered at the firm level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	Leverage			
Regression	(1)	(2)	(3)	(4)
Divestment Intensity	-0.252*	-0.0994**	-0.172**	-0.166**
	(0.138)	(0.0408)	(0.0673)	(0.0754)
Ln Total Assets			0.317*	
			(0.181)	
ROA			0.0775	-3.172***
			(2.755)	(1.044)
Capex			2.027	2.138*
			(1.238)	(1.127)
Cash			0.637	-0.277
			(0.881)	(0.749)
Retained Earnings			-2.536**	-2.476**
			(0.981)	(1.042)
Tobin's Q			-0.496	-0.322
			(0.341)	(0.283)
PPE			0.660	0.581
			(0.416)	(0.448)
Borrower FE	Yes	Yes	Yes	Yes
Year FE	Yes	No	Yes	No
Size x Year FE	No	Yes	No	Yes
Observations	432	423	432	423
Adjusted R^2	0.531	0.576	0.707	0.731

Table A.4. Bank Divestment Policy Exposure and Log Operational Inefficiency
This table shows results from linear regressions of the absolute deviation from the optimal generator efficiency on exposure to banks' coal divestment strategies and an indicator variable equal to 1 if the generator is coal powered. The sample covers the years from 2009 to 2022. Variables are defined as in Appendix Table A.1. t-statistics, based on robust standard errors clustered at the borrower level, are reported in parentheses. ***, **, and * indicate that the parameter estimate is significantly different from zero at the 1%, 5%, and 10% level, respectively.

Dep. Variable	Log Utilization		Log Efficiency	
Regression	(1)	(2)	(3)	(4)
Divestment × Coal	0.316***		0.642***	
	(0.0245)		(0.0297)	
Divestment Intensity × Coal		0.815***		1.339***
		(0.0997)		(0.227)
Coal	-0.210*	-0.0622	-0.633**	-0.274
	(0.100)	(0.0918)	(0.251)	(0.251)
Firm x Year FE	Yes	Yes	Yes	Yes
Generator FE	Yes	Yes	Yes	Yes
State x Year-Week FE	Yes	Yes	Yes	Yes
Observations	286,304	286,304	286,304	286,304
Adjusted R^2	0.446	0.443	0.585	0.581

A.1 Anecdotal evidence and external validity

This section provides anecdotal evidence that practitioners and policymakers explicitly recognize the channel we study, both inside the United States and globally: when power generators lose access to affordable capital, they cut maintenance and efficiency upgrades, which in turn raises forced outage rates and degrades operational efficiency. We hand collect qualitative evidence from international infrastructure reviews, World Bank reports, court affidavits, utility press releases, and industry reliability assessments.

Two themes emerge. First, when tariffs or capital markets starve power utilities of cash, maintenance, and reinvestment in existing plants, are the first items to be cut. Second, as investment is deferred, aging coal and oil units are run harder with less redundancy, and the remaining budget is used to address acute failures rather than preventive work. The excerpts below closely mirror the mechanism we quantify in the main text: divestment and other capital rationing push long lived power assets away from their technical optimum, raising emissions per unit of output.

1. **Industry-wide evidence on deferred maintenance and forced outages.** At the system level, the North American Electric Reliability Corporation (NERC) reports that the weighted equivalent forced outage rate (WEFOR, a capacity weighted measure of the probability that a unit is unexpectedly unavailable) for coal units in North America rose from an average of about 10 percent between 2014 and 2022 to roughly 12 percent in 2023.[17] NERC staff attribute this increase in part to **reduced maintenance on older coal units** as they are phased out and to more aggressive cycling to accommodate variable renewable generation. These statistics are consistent with our generator level evidence that capital constraints and declining investment in coal assets translate into lower run times and higher forced outage rates for treated units.

2. **Revenue shortfalls, maintenance cuts, and outages.** In a review of the electricity supply industry (ESI) in South Africa, the National Treasury and Department of Public

[17] NERC 2024 State of Reliability report.

Enterprises emphasizes that weak finances eventually become reliability problems:

> "In extreme cases the ESI cannot even maintain existing equipment; reliability and availability drop, and power outages become the norm."[18]

An affidavit in the Eskom load-shedding litigation describes the same dynamic at the firm level: high debt service costs have left Eskom heavily reliant on government guarantees and unable to finance the maintenance and capital expansion needed to stabilize the system.[19]

A World Bank report generalizes this mechanism beyond a single firm:

> "One of the casualties of insufficient revenue is maintenance expenditure. Utility managers often have to choose between paying salaries, buying fuel, or purchasing spares."[20]

These sources explicitly link chronic revenue and financing gaps to deferred maintenance and ultimately power outages.

3. **Divestment, hostile capital markets, and under-maintained coal fleets.** A report by the Center for the Advanced Study of India discusses the rapid withdrawal of financial capital from coal in Asia and explicitly warns that blunt divestment policies can worsen, rather than ease, the transition in coal intensive systems:

   > "The problem is that the blunt instrument of divestment may actually exacerbate transition problems in coal-heavy countries."[21]

   The study notes that coal plants have high recurrent operations and maintenance (O&M) costs, and that, facing an increasingly hostile investment environment, generators with persistent short-term liquidity problems tend to cut corners on O&M and environmental compliance

[18] "South African Network Infrastructure Review: Electricity"

[19] De Ruyter (2023)

[20] Foster and Briceño-Garmendia (eds., 2010), "Africa's Infrastructure: A Time for Transformation", World Bank, Chapter 2.

[21] Chandra (2019), "Coal Divestment is a Blunt Instrument", India in Transition, Center for the Advanced Study of India, University of Pennsylvania.

rather than invest in efficiency-improving equipment. This narrative is consistent with our finding that divestment induced capital rationing reduces abatement investment and worsens operating efficiency at remaining coal plants.

4. **Financial constraints and deferred maintenance in a U.S. jurisdiction.** The same mechanism appears in a recent explanation of repeated blackouts by the Virgin Islands Water and Power Authority, a U.S. territorial utility. In a 2024 press release issued after a series of outages, the utility writes:

   > "The existing electrical infrastructure across the Territory has faced challenges as a result of aging components and deferred maintenance due to financial constraints."[22]

   The same document explicitly links these constraints to frequent equipment failures and service interruptions and notes that scarce funds are being triaged between emergency repairs and longer term grid upgrades. This echoes the idea that when access to capital is limited, utilities focus spending on keeping units barely running, not on efficiency improving upgrades.

Taken together, these anecdotes from diverse settings point to a common mechanism: when utilities and generators face credit market exclusion, non-cost reflective tariffs, or explicit divestment from lenders, they cut maintenance and efficiency investments on legacy fossil assets, tolerate higher forced outage rates, and operate plants farther from their technical efficiency frontier. This qualitative evidence closely matches the quantitative patterns we document for divestment exposed coal plants in the U.S. power sector.

[22] Virgin Islands Water and Power Authority (2024)