Out of sight, out of mind: Divestments and the Global Reallocation of Pollutive Assets*

Tobias Berg — Goethe University
Lin Ma — IWH Halle
Daniel Streitz — IWH Halle

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Abstract

Large emitters reduced their carbon emissions by around 11-15% after the 2015 Paris Agreement ("the Agreement") relative to public firms that are less in the limelight. We show that this effect is predominantly driven by divestments. Large emitters are 9 p.p. more likely to divest pollutive assets in the post-Agreement period, an increase of over 75%. This divestment effect comes from asset sales and not from closures of pollutive facilities. There is no evidence for increased engagements in other emission reduction activities. Our results indicate significant *global* asset reallocation effects after the Agreement, shifting emissions out of the limelight.

JEL classification: G30, G34, G38, Q50, Q54

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"Public firms [...] are selling their most polluting assets in order to please ESG investors and meet their carbon-reduction targets. But those oil wells and coal mines are not being shut down. Instead they are being bought by private companies and and funds [...] and stay out of the limelight." (The Economist, 2022)[1]

1 Introduction

Over the last decade, large emitters have been under increased pressure from investors, stakeholders, and the public to reduce their carbon footprint. Those firms in the limelight have responded by pledges to reduce emissions, with many of the largest emitters announcing concrete emission reduction targets.[2] However, there are increasing concerns that firms might divest dirty assets instead of making their overall operations greener.[3] In this paper, we examine carbon policies of publicly listed firms worldwide. Specifically, we analyze whether divestment activity is a common phenomenon that can explain a significant part of emission reductions by large emitters.

We make use of a comprehensive global data set on publicly listed firms' carbon emissions for the 2011-2021 period (the Carbon Disclosure Project data set, CDP henceforth). For each firm, we can break down year-on-year changes in combined Scope 1 and 2 emissions into four distinct categories: [1] boundary of the firm (divestment or acquisition), [2] changes in output, [3] changes in methodology, and [4] a residual (that is, a change in carbon intensity on a like-for-like basis). To the best of our knowledge, our paper is the first to analyze the *global* nature of asset reallocation after the Paris agreement, as well as the first paper to assess the *relative* importance of divestments vis-à-vis other emission reduction strategies.

We split our data set into two samples and two periods. *Large emitters* are firms targeted by Climate Action 100+, an investor-led scheme signed by more than 500 asset managers worldwide that aims at putting pressure on the largest firms across the globe to reduce

[1] The Economist, February 2022, "The truth about dirty assets."

[2] Engle et al. (2020) show that news coverage of climate change related issues has increased significantly. Net Zero Tracker, a non-profit organization, reports that 77% of revenues from the largest 100 listed firms are covered by net-zero targets, while the equivalent figure for the largest 100 private firms stands at 14%, see (Lang, 2022).

[3] See BSR "Exit Strategies for Dirty Assets" or The Economist, February 2022, "Who buys the dirty energy assets public companies no longer want?" as well as the quote above.

emissions; and *other emitters*, which comprises all other publicly listed firms. Large emitters are plausibly subject to increased pressure from investors, stakeholders, and the public to reduce their carbon footprint. We compare the behavior of large emitters to other emitters worldwide, both in the period before the Paris agreement (2011-2015) and in the period thereafter (2016-2021).

Panel A: Carbon emissions **Panel B: Divestments**

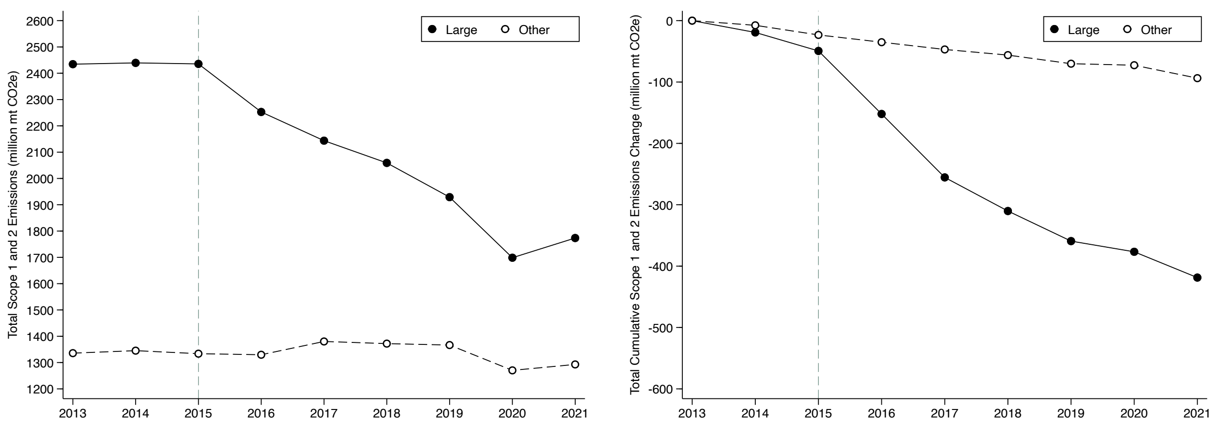

Figure 1: **Emissions around the 2015 Paris Agreement**
Panel A of this figure shows the total combined gross Scope 1 and 2 emissions for a balanced sample of 613 firms around the 2015 Paris Agreement (million mt CO2e), split by large emitters (N=73) and other emitters (N=540). Panel B shows that combined *cumulative* gross Scope 1 and 2 emissions (million mt CO2e) that firms divested since 2013 (base year) for the same sample of firms. See main text for details and definitions.

We document three key results: First, in the aggregate, large emitters reduce their combined Scope 1 and 2 emissions by 19% after the Paris agreement relative to the period before the Paris agreement; while other publicly listed firms do not reduce carbon emissions at all (see Panel A of Figure 1). Within-firm estimates confirm this trend, with large emitters reducing their emissions relative to other emitters by 11-15% after the Paris Agreement, on average.

Second, changes to the boundary, driven by divestments, are the single-largest contributor to emissions reductions of large emitters vis-a-vis other emitters after the Paris Agreement (see Panel B of Figure 1). Large emitters are 9 p.p. more likely to divest pollutive assets in the post-Agreement period, an increase of over 75%. We do not find any significant difference between large emitters and other emitters after the Paris Agreement for any of the other categories (output, methodology, change in carbon emissions on a like-for-like basis).

The divestment activity by large emitters after the 2015 Paris agreement could be due to large emitters being quicker in realizing the consequences of the 2015 Paris agreement, that is, realizing quickly that their business model faces greater risks than previously assumed. Alternatively, large emitters face greater investor pressure and decide to divest polluting assets to stay out of the limelight. CDP explicitly asks firms to report about their perceived climate risks, categorized into physical risks, regulatory/transition risks, and other risks (which includes investor-related risks). We analyze firms' responses and find that both large and other emitters increase their assessment of regulatory/transition risks after the 2015 Paris agreement; however, without any significant differences between large and other emitters. In constrast, we do find strong evidence that larger emitters face more investor-related risk relative to other emitters after the 2015 Paris agreement.

Third, we hand-collect information on divestments that includes seller information, buyer information, as well as exact information about the assets being sold. We find that most buyers tend to be private, financial, or public firms that do not disclose emissions to CDP. Divestment activity leads to a reallocation of ownership from European firms to firms in the rest of the world. Furthermore, divestments are associated with positive announcement returns in the post-Paris-agreement period, suggesting that divestments are beneficial to the shareholders of the divesting firms. Taken together, our evidence is consistent with the narrative that dirty assets tend to be acquired by firms that are less in the limelight.

These key results are robust to a wide array of econometric specifications and data checks. The results hold when controlling for firm fixed effects, industry x times fixed effects, and region x times fixed effects. Our results hold in a balanced as well as an unbalanced sample. They also hold when excluding closures (firms sometimes, but rarely, report closures under the divestment category). Thus, the result cannot be explained by large emitters clustering in certain industries or regions, by different unobservable (time-invariant) firm characteristics, by differences in exit and entry rates, or by large emitters closing down polluting plants. Furthermore, differences in divestment rates between large and small emitters only emerge after the 2015 Paris agreement, suggesting we do not pick up a mechanical relation between large and small emitters that would hold in any period.

The CDP data relies on self-reported information. A difference in divestment activities between large and small emitters could, in theory, arise if large firms overreport divestment activity or small firms underreport divestment activity after the Paris agreement. Note that incentives, if at all, should lead large firms to underreport divestments. To ensure our results are not driven by post-Paris differences in reporting, we manually verify divestment activities for large emitters as well as for other emitters using a hand-collected data set from annual reports and company filings. We do not find any evidence that differences in reporting rates drive our results.

While we use firms that fall under the ClimateAction 100+ initiative as an objective metric to identify firms with a large carbon footprint that are increasingly in the limelight, our paper does not aim to identify a causal effect of this specific initiative. Our results also hold when defining *large emitters* as either the top 150 emitters worldwide or the top decile of firms by carbon emissions in our sample. More generally, our aim is to document that large emitters in the limelight respond by cutting carbon emissions via divestments. Further, we are not able to track carbon emissions after dirty assets have been divested. Tracking carbon emissions post-divestment is only feasible when dirty assets are sold to firms that are subject to reporting requirements themselves. The nature of the reallocation we document—a global reallocation of dirty assets to firms that do not report emissions—is precisely what makes tracking post-divestment emissions impossible, but at the same time makes documenting these patterns most relevant. The global reallocation we document is large in scale, with 369 million mt CO2e of carbon emissions being reallocated via divestments in the post-Paris-agreement period, approximately the size of France's total annual carbon emissions.

Related literature. We relate to the literature on unintended side effects of climate policies. There is a sizeable literature on carbon leakage across countries and states, i.e., whether a more stringent climate policy in one country/state leads to an increase in emissions in other countries/states with laxer policies. Most of this literature applies country- and sectoral-level data on carbon emissions, combined with import and export data to assess the importance of carbon leakage after shocks to carbon policies in some countries (see, e.g., Aichele and Felbermayr, 2015; Böhringer et al., 2017, among others). A few firm-level studies document carbon leakage across countries/states, either by documenting reallocation of carbon emissions within firms or along the supply chain. For example, Bartram et al. (2022) provide evidence that the California cap-and-trade program led firms to shift emissions and output from California to other (less regulated) states; Ben-David et al. (2021) document that firms headquartered in countries with strict environmental policies perform their polluting activities abroad in countries with relatively weaker policies. Li and Zhou (2017) document that U.S. plants release less toxic emissions when their parent firm imports more from low-wage countries; Dai et al. (2022) document that firms reduce their Scope 1 carbon emissions at the cost of increasing Scope 3, suggesting that firms may "outsource" emissions to (foreign) suppliers; while Bisetti et al. (2023) document that ESG preferences in capital markets can trickle down from large publicly listed firms to suppliers in far-flung economies.[4] Bellon (2020) examines the effect of private equity (PE) ownership on environmental outcomes in the oil and gas industry. The author shows that portfolio firms increase pollution in locations where environmental liability risk is low, indicating a strategic redistribution of operations depending on local regulation.

We complement the literature by providing direct evidence for a significant global asset reallocation around the 2015 Paris Agreement across firms. Large public firms under the pressure to reduce carbon emissions from investors, stakeholders, and the public reduce their carbon footprint by divesting dirty assets. We show that divestment activity is a not only a common phenomenon, but also document that divestment activity can explain a large part of emission reductions by large emitters. We find that most buyers tend to be private, financial, or public firms that do not disclose emissions to the Carbon Disclosure Project. Furthermore, divestment activity leads to a reallocation of ownership from European firms

[4] Unrelated to pressure from investors, Pankratz and Schiller (2023) document that climate-related shocks to suppliers affects customers upstream.

to firms in the rest of the world.

We also relate to the larger literature that examines the effects of public pressure on the environmental profile of firms.[5] Pressure can come from different sources, including, for example, institutional investors and banks (e.g., Ilhan et al., 2022; Ivanov et al., 2022; Kacperczyk and Peydró, 2021; Krueger et al., 2020; Sautner et al., 2022), corporate governance and activists (e.g., Shive and Forster, 2020; Akey and Appel, 2019) disclosure requirements (e.g., Jouvenot and Krueger, 2019; Tomar, 2023; Bonetti et al., 2023), environmental regulation (e.g., Colmer et al., 2020; Dechezleprêtre et al., 2018; He et al., 2020; Hsu et al., 2022), or self-commitments (e.g., Bolton and Kacperczyk, 2022; Comello et al., 2021; Dahlmann et al., 2019; Freiberg et al., 2021; Ioannou et al., 2016). Evidence generally supports the conclusion that public pressure can induce larger, public firms to reduce emissions (see, e.g., Azar et al., 2021; Choi et al., 2021; Downar et al., 2021; Jouvenot and Krueger, 2019).[6] Duchin et al. (2022) provide a cautionary assessment of public pressure; documenting that firms divest pollutive plants following environmental risk incidents to other firms along the supply chain.[7] We add to this literature by documenting the global nature of asset reallocation after the Paris agreement. To the best of our knowledge, we are the first paper to assess the relative importance of divestments vis-à-vis other emission reduction strategies. In particular, we show that divestment activity is a common phenomenon that can explain a large part of emission reductions by large emitters worldwide.

[5] Furthermore, a large literature analyzes asset pricing impliations of investors' preferences for green assets (e.g., Heinkel et al., 2001; Pástor et al., 2021; Pedersen et al., 2021; Zerbib, 2022; Bolton and Kacperczyk, 2021; Goldstein et al., 2022) as well as the conditions for impact investing to work (e.g., Berk and van Binsbergen, 2022; Broccardo et al., 2022; Oehmke and Opp, 2022; Edmans et al., 2023).

[6] Furthermore, De Haas and Popov (2019) document that carbon emissions per capita are lower in economies that are relatively more equity-funded, driven – among others – by stock markets reallocating investment towards less polluting sectors.

[7] Similar to Duchin et al. (2022), Zhou (2022) find that publicly listed energy firms divest pollutive assets (at the time of writing, only an abstract of this paper is available). Gözlügöl and Ringe (2023) provides case studies on the divestment of carbon-intensive assets from publicly listed firms to private firms.

2 Data and descriptive statistics

Emission data. We obtain firm-level emission data from the Carbon Disclosure Project (CDP) Climate Change dataset. CDP is the most comprehensive source of information on carbon emissions of public firms across the globe and provides estimates of firms' CO2 emissions on an annual basis. Emissions are categorized into three "scopes" following the Greenhouse Gas (GHG) Protocol Corporate Standard: Scope 1 emissions are direct GHG emissions from controlled or owned sources. Scope 2 emissions are indirect GHG emissions from the purchase of electricity, steam, heat, or cooling. Scope 3 emissions are indirect emissions not produced by the company itself, and not contained in Scope 2 emissions. This category comprises indirect emissions that occur in the firm's value chain (upstream or downstream). We focus on Scope 1 and 2 emissions, i.e., emissions that are directly under the reporting firms' control.

We obtain further information on various aspects of firms' GHG emissions from the CDP database. This information, available from 2011 onwards, includes the reasons firms give for why their combined gross global Scope 1 and 2 emissions increased or decreased relative to the previous year. Firms are required to break-down year-on-year emission changes (in percent of previous year emissions) into 11 reasons, which we group into 4 categories:[8]

1) *boundary of the firm* (divestment, acquisition, merger),

2) *changes in output* (change in output),

3) *changes in methodology* (change in methodology, change in boundary[9]), and

4) a *residual*; that is, a change in carbon intensity on a like-for-like basis (all other reasons, that is, change in renewable energy consumption, other emission reduction activities, change in physical operating conditions, other, unidentified, and any other residual).

[8] Note that most but not all reasons are available for all survey waves. The reasons "change in renewable energy consumption" and "change in physical operating conditions" were only added in the most recent survey waves.

[9] The CDP reporting guidance describes *change in boundary* as "Changes in the boundary used for your inventory calculation, i.e., changing from financial control to operational control." Thus, this reason most adequately fits into the *changes in methodology* category

Firms indicate in which direction the respective reason affected emissions (increase or decrease) and by how much. Note that the direction is category-specific, i.e., firms can report that certain reasons increased emissions while other reasons decreased emissions in the same year. That is, individual reasons might increase (decrease) emissions even though the net emission change in the year is negative (positive).

[Figure 2 here]

Figure 2 exemplarily shows the response by the Spanish natural gas and electrical energy utilities company Naturgy Energy Group SA to the 2022 CDP survey question C7.9a about *"the reasons for any change in [the firm's] gross global emissions (Scope 1 and 2 combined) [...]."* Naturgy's response provides information on how the firm's total emission change from 2020 to 2021 can be broken down into different categories.[10] Changes in energy consumption, other emission reduction activities, and divestments decreased the firm's emissions by 16.46% (2.99+7.39+6.08), while output changes and other miscellaneous factors increased emissions by 3.49% (3.37+0.12), yielding a net emission change of 3.49-16.46=−12.97%. This exactly corresponds to Naturgy's total reported Scope 1 and 2 emissions change from 2020 to 2021.[11] Firms are further asked to provide a text description how emissions are allocated to the different categories.

Sample selection. The raw sample comprises 19,857 firm-years for public non-financial firms (non-missing ISIN) over the 2011 (the first year with available CDP information on emission reduction categories) to 2021 period that can be linked to S&P's Compustat Global

[10] The data from Figure 3 is available via Link to Naturgy Energy 2022 CDP Survey by scrolling down to C7.9a (access is free of charge, but users need to registered with CDP). Data for other firms is also freely accessible via Link CDP Seach. Note that each CDP survey wave contains information about the firms' activities in the previous year. That is, the 2022 survey wave asks about information on emission activity for the year 2021.

[11] In this example the firm's total emission change can be perfectly decomposed into different categories. This, however, is not always the case, i.e., reporting is noisy and the sum across all categories might not exactly correspond to the firm's reported change in total Scope 1 and 2 emissions over the respective period. Figure A-1 in the Appendix shows the histogram for the "pure emission growth residual," i.e., the difference between the total Scope 1 and 2 emission growth rate for firm i from year $t-1$ to t (in percentage points) and the total emission growth rate implied by the 11 emission change categories described in Figure 2. As noted above, we include this "pure residual" in the *residual* category 4) such that the sum across categories 1) to 4) always corresponds exactly to the firm's observed Scope 1 and 2 growth rate. While reporting is clearly noisy, the residuum is centered around zero and small for most of the sample.

database or S&P's Compustat North America database. We apply the following additional filters: i) we require that firms are in the database for at least 3 years and that firms report information for at least one year in both the pre- and post-Paris Agreement period (−6,317 firm-years; −20% of total baseline sample Scope 1 and 2 emissions), ii) we remove firms with large outliers, i.e., firms that have reporting years in which the absolute combined Scope 1 and 2 emission growth rate exceeds 500% (−617 firm-years; −6.6% of total baseline sample Scope 1 and 2 emissions),[12] and iii) firms with very small average emission levels (combined Scope 1 and 2 emissions <1000 mt CO2e) in the pre-Paris Agreement period (−570 firm-years; −0.04% of total baseline sample Scope 1 and 2 emissions). The final sample comprises 12,353 firm-years and 1,354 public firms that are incorporated in 45 different countries. We define the panel based on "reporting years," i.e., the year in which the respective reporting period ends.[13] We supplement the dataset with balance sheet information on firms from S&P's Compustat Global and Compustat North America as well as with stock price information from Refinitiv Datastream.

Large emitters. We classify all Climate Action 100+ focus companies as "large emitters." Climate Action 100+ is an investor-led scheme signed by more than 500 asset managers worldwide that aims at putting pressure on 166 of the largest firms across the globe to reduce emissions. We use this list of firms as it avoids having to rely on ad-hoc emission level cut-off rules and because it comprises the most visible large emitters that have been increasingly under public pressure, particularly since the 2015 Paris Agreement. However, we obtain similar result if we simply define the top 150 emitters or the top 10% emitters according to CDP data as large emitters (the overlap between the definitions is naturally very high).[14] We can identify 111 of the 166 Climate Action 100+ focus companies in our final sample. While these large emitters make up for only about 8% of all firms in our final sample, they, on average, account for about 60% of total emissions.

[12] Extremely large emissions growth rates are generally the result of reporting errors. We remove firms with spotty reporting as growth rates cannot be reliably adjusted with the available information.

[13] For most firms in the reporting years coincide with calendar years, i.e., firms generally report information for the January to December period.

[14] Table A-1 in the Appendix reports our baseline results using alternative treatment definitions.

Divested assets. We hand-collect detailed information on divested assets of large emitters from company filings, press releases, and other available resources. This includes information on buyers and assets (type, location). We discuss this data in detail in Section 3.3.

Regulatory and ESG risks. In later sections, we further supplement the dataset with information on regulatory stringency and firms' exposure to ESG risks. We use data from the World Economic Forum (WEF) that contains information about the strictness of environmental regulation at the country (in which the respective firm is headquartered) level (Ben-David et al., 2021). The WEF assigns countries a score between 1 and 7, where higher values indicate more stringent environmental regulation (SER). We use the 2017 vintage of the ranking, i.e., the first available ranking after the 2015 Paris Agreement.

We obtain information on firms' exposure to ESG and business conduct risks from RepRisk. RepRisk uses a combination of machine-learning and human analysis to create a firm-level index, the RepRisk Index (RRI), that dynamically captures and quantifies a company's reputational exposure to ESG and business conduct risks. The RRI ranges from zero (lowest) to 100 (highest). A higher value indicates a higher risk exposure.

Descriptive statistics. Table 1 reports descriptive statistics on our final sample. The firms in our sample are large with median total assets of 9 billion USD. The Scope 1 (Scope 2) emission distribution is highly skewed with a median of 146 (185) thousand mt CO2e and a mean of 3.5 (0.7) million mt CO2e. Emissions grow by 1.82 p.p. per year on average.[15] The total sample is split relatively evenly across geographic regions: Europe (37%), North America (28%), Rest of the World (35%).

We report net annual emission changes (in percent of previous year total emissions) for the four aggregate categories $j = \{\text{Firm boundary, Output, Method, Residual}\}$. On average, emissions increase by 0.46 p.p. per year because of changes in firm boundary, by

[15] Note that the number of observations for the scope 1+2 growth rate is somewhat lower than for the emission level because calculating growth rates requires infomation on previous year emissions (that is, growth rates are not defined for the first year that a firm is observed in the database). Similarly, the *residual* category in Panel C of Table 2 requires information on the total emission growth rate, as the category includes any unexplained emission changes relative to the observed growth rate, see footnote 11. Excluding all firm-years with missing emission growth rates from the analyses yields very similar results.

1.36 p.p. per year because of output changes, and by 0.63 p.p. per year because of changes in the methodology. The net residual; that is, a change in carbon intensity on a like-for-like basis, decreases emissions by -1.36 p.p. per year, on average. Overall, emissions decrease because of a decrease in emissions on a like-for-like basis, but increase because of increases in output. Changes to the boundary of the firm increase emissions on average; however, we will document a dramatic difference between large and small firms in our empirical analysis below.

We further report information on indicator variables equal to one if firm i indicates that their combined global Scope 1 and 2 emissions changed in year t because of one of the four categories j, separately for emission increases and decreases. In 12% of firm-years companies indicate that emissions were reduced because of divestments, while in 14% of firm-years emissions increase because of M&A. Output changes decrease emissions in 17% of cases and increase emissions in 32% of cases (in the remaining 51% of cases firms do not report significant output changes that affected their carbon emissions). Changes in the method decrease reported emissions in 11% of cases, and increase emissions in 15% of cases.

[Table 1 and Table 2 here]

Table 2 reports descriptive statistics for the 111 "large emitters" (treatment firms). Unsurprisingly, treatment firms are large, both in terms of total asset (mean: 92 billion USD) and emissions (mean Scope 1 emissions: 23.5 million mt CO2e). Panel B reports details on the geographical distribution. The majority of treatment firms are located in North America (N=41) or Europe (N=46). Individual countries with the most treatment firms are the US (N=35), Germany (N=10), France (N=9), the UK (N=9), and Japan (N=8). Panel B reports details on the distribution across industries. Most treatment firms are in oil and gas, transportation, or chemicals sectors.

3 Results

3.1 Baseline effect on firm emissions

3.1.1 The Paris Agreement

We start by analyzing the behavior of large emitters around the 2015 Paris Agreement ("the Agreement"). The Agreement, signed by 194 parties in December 2015, formulated the goal to keep the rise in mean global temperature to well below 2°C above pre-industrial levels. The Agreement increased both the awareness of risks tied to GHG emissions and the prospect of tighter regulatory frameworks to limit emissions.

This event has been used in a variety of recent studies (e.g., Bolton and Kacperczyk, 2021; Ginglinger and Moreau, 2019; Ilhan et al., 2021; Mueller and Sfrappini, 2022; Ramadorai and Zeni, 2021; Reghezza et al., 2022; Seltzer et al., 2022) and constitutes a shock to firms' environmental policies. Even though the meeting was planned for a long time, the outcome was uncertain even weeks before the conference (see, e.g., the references provided in Seltzer et al., 2022). Further, the scope, both in terms of the ambition of the goals that were set and the number of participants that agreed to the terms, was surprising to many observers.

The event implied that in particular high GHG emitting firms would face an increase in climate regulatory risk. For instance, Ramadorai and Zeni (2021) provide evidence that firms upwardly revised their beliefs about future climate regulation intensity. Engle et al. (2020) find a significant increase in their climate change news index, indicating a significant shift in public awareness. Seltzer et al. (2022) provide evidence that investor concerns about climate and other regulatory risks increased after the Agreement, affecting firm's bond spreads.

3.1.2 Empirical strategy

We examine the effect of increased pressure on large emitters after the Paris Agreement using a difference-in-differences (DiD) framework. We run the following standard DiD specification:

$$\ln(\mathrm{Y})_{i,t} = \beta \text{Large Emitter}_i \times \text{Post}_t + \alpha_i^{ind} \times \text{Post}_t + \alpha_i^{region} \times \text{Post}_t + \alpha_t + \alpha_i + \epsilon_{i,t}, \quad (1)$$

where Y is a measure of firm GHG emissions in mt CO2e (Scope 1 or combined Scope 1 and 2) in reporting year t. *Large Emitter* is an indicator variable equal to one if firm i is a large emitter, as defined in Section 2, and zero otherwise. *Post* is an indicator variable equal to one for reporting years after 2015, and zero otherwise. α_i and α_t are firm and reporting year fixed effects, respectively. α_i^{ind} are 2-digit SIC code fixed effects. α_i^{region} are geographic region (North America, Europe, Rest of the World) fixed effects.[16]

3.1.3 Emissions around the Paris Agreement

We start by performing a parametric test of the parallel trend assumption, i.e., we estimate a dynamic version of equation (1) by including separate year dummies instead of the *Post* 2015 indicator. Figure 3 illustrates that there are no significantly different pre-trends in combined Scope 1 and 2 emissions of Large Emitters ("treatment firms") versus other public firms with positive emission levels ("control firms") before the Paris Agreement in 2015. All coefficients are statistically insignificant at conventional levels in the period prior to 2015. Following the Agreement, emissions start to decrease visibly for treatment relative to control firms, and the effect is statistically significant. In other words, even if there was a decrease in emissions already before the Paris Agreement, this trend was not different for treatment compared to control firms. The economic magnitude of the treatment effect is large: Scope 1 and 2 emissions decrease by up 14% for treatment versus control firms until 2021 relative to the 2015 emission levels.

[16] We use region instead of country fixed effects to ensure that we have a reasonable number of treatment firms within each cluster, see Table 2.

[Figure 3 and Table 3 here]

Table 3 confirms this result using a standard DiD design, i.e., the model described in equation (1). Column 1 documents that Scope 1 emissions decrease, on average, by 17% for treatment relative to control firms post 2015, and the effect is highly statistically significant. Column 2 includes 2-digit SIC code dummies interacted with the *Post* 2015 indicator to account for differences in emission reduction activities across industries. The economic magnitude of the treatment effect is only marginally reduced (-16%). Column 3 additionally includes geographic region dummies interacted with the *Post* 2015 indicator with similar results. Columns 4 to 6 examine effects on combined Scope 1 and 2 emissions. Also combined Scope 1 and 2 emissions decrease by about 11-15%. Overall, the baseline effects on firm emissions shows that *Large Emitters* significantly decreased their Scope 1 and 2 emissions after the Paris Agreement relative to other emitters.

3.2 Reasons for changes in firm emissions

3.2.1 Baseline results

CDP asks firms to indicate why their combined Scope 1 and 2 emissions changed relative to the previous year. As discussed in Section 2, we classify reasons into four broad categories: i) firm boundary, ii) output, iii) method, iv) residual. We start by defining indicator variables that are equal to one if firm i indicates that the respective category is responsible for an emission change in year t, and zero otherwise. We further distinguish between emission increases and decreases (for the firm boundary category this is equivalent to distinguishing between divestments and M&A). Given that the residual category is non-zero for most firm years (albeit often small), we define indicator variables equal to one if the residual is above/below $1\%/-1\%$ or $5\%/-5\%$. We estimate linear probability models similar to the setup described in equation (1), and report the results in Table 4.

[Table 4 here]

Panel A, columns 1 to 5 report results for the likelihood that firm i indicates that the respective activity reduced emissions in year t. We find a highly statistically and economically significant effect for divestments. Treatment firms are 9 p.p. more likely to report that divestment activities decreased emissions relative to control group firms and relative to the period before the Paris Agreement. This effect is large: relative to the unconditional mean of 12% the effect implies an increase of over 75% in the likelihood that *Large Emitters* attribute emission reductions to divestment activities in the period after the Paris Agreement.

There is limited evidence for increased engagements in other emission reduction activities, i.e., the coefficients in Panel A, columns 2 to 4 are small and statistically insignificant. If anything, we are *less* likely to observe a decrease in emissions on a like-for-like basis in the post-Paris period for treatment firms (see columns 4 and 5).

Similarly, we find no differential effects for activities that increase emissions for treatment relative to control firms (see Panel B, columns 1 to 5). The only exception is that treatment firms appear to be somewhat less likely to report that "methodological changes" increased emissions in the period after the Paris Agreement (Panel B, column 3). Overall, the results indicate that the main reason for emission decreases of *Large Emitters* relative to other firms in the post treatment period is divestments.

Next, we examine the dynamic effect on firm divestment activities around the 2015 Paris Agreement to account for potential violations of the parallel trends assumption. That is, we estimate a dynamic version of the linear probability model reported in Table 4, Panel A, column 1, by including separate year dummies instead of the *Post* 2015 indicator. Figure 4 illustrates that there are no significantly different pre-trends. All coefficients are statistically insignificant at conventional levels in the period prior to 2015. Post 2015 the likelihood that a firm indicates that emissions are reduced because of divestment activities increases significantly.

[Figure 4 here]

3.2.2 Asset sales versus closures

One potential concern might be that firms classify closures of plants or other facilities as divestments. If this were the case this would affect the interpretation of the results presented in this paper. If assets are divested, i.e., sold, the facility continues to operate, i.e., emit CO2, under a different owner. In contrast, if facilities are closed down, emissions are reduced overall. We address this issue in two ways: i) we use text descriptions on emission changes by category contained in the CDP data (see Figure 2) to distinguish between asset sales and closures. ii) We hand-collect information on all divestments by large emitters and manually verify that assets are sold (and who bought them). We discuss ii) in detail in Section 3.3.

To test for asset sales versus closures within the CDP data [approach i)], we flag all entries that contain (versions of) the keywords "closed," "closure," or "shut down" in the comment field of the divestment category. We separately flag all entries that contain (versions of) the keywords "sale," "sold," or "spin-off." Note that this approach is conservative as firms in most cases generially speak of "divestments" without using keywords that explicitly refer to asset sales (see, e.g., the Naturgy example in Figure 2).

[Table A-3 here]

Column 1 of Table A-3 repeats the baseline divestment effect for convenience. Column 2 uses an adjusted version of the "divestments indicator," i.e., we set the variable to zero for firm-years where the comment field contains any keywords that might be associated with closures of plants or other facilities. The coefficient is virtually identical to the baseline effect reported in column 1, highlighting that treatment firms are indeed more likely to sell but not close down assets after the Paris Agreement.

Column 3 uses an indicator that is equal to one if firm i states that their combined global Scope 1 and 2 emissions changed in year t because of divestments *and* the comment field indicates that the firm *closed down* plants or other facilities. The coefficient is close to zero and statistically insignificant, indicating that treatment firms are not more likely to close down facilities after the Paris Agreement.

Column 4 uses an indicator that is equal to one if firm i states that their combined global Scope 1 and 2 emissions changed in year t because of divestments *and* the comment field indicates that the firm *sold* plants or other facilities. We continue to find a positive and significant effect. The coefficient is smaller (3 p.p.) compared to the baseline, however, relative to the mean of the *Sale* variable (0.03) the economic magnitude is still +100%. Note again that the fact that we only identify assets sales in 3% of all firm-years, i.e., one-quarter of all firm-years with positive divestment activities (0.03/0.12), does not imply that the majority of divestment entries reflect plant closures. Instead it is simply a reflection of the fact that firms' descriptions of their divestment activities are mostly generic, i.e., firms indicate that they "divested" asset without giving further details. The fact that we continue to find an effect despite this limitation is a strong indication that our results are driven by divestment activities and not plant closures. As noted above, this is confirmed in Section 3.3 where we present evidence based on hand-collected data for divestment activities of large emitters.

3.2.3 Intensive margin

The results reported in Tables 4 and A-3 focus on the "extensive margin," i.e., the likelihood that a firm cites a particular category as the reason for changes in emissions in a given year. This might mask important information. For instance, even if there is no change in the *likelihood* that firms report output reductions, they might report *stronger* reduction activities after the Paris Agreement.

We address this concern by examining intensive margin effects. Specifically, we estimate models similar to Table 4 but instead of indicator variables use the annual net percentage changes by category (see Section 2). We omit firm-years in which the firm did not report any change in emissions as result of the respective category, that is, any estimated effect comes from changes in the importance of the category for a firm over time, conditional on reporting an activity. Results are shown in Table 5.

[Table 5 here]

We do not find effects at the intensive margin, including on firm boundaries (M&A minus divestment activities). The firm boundary effect is negative (-2 p.p.)—suggesting that, if at all, there is a tendency for large firms to divest more on the intensive margin—but not statistically significant. This is unsurprising as divestments are relatively rare events (firms report divestment activities in 12% of all firm-years) that can have large effects on firms' total emissions. That is, most of the divestment effect is plausibly at the extensive margin, as documented in Table 4.

3.2.4 Decomposing total emission reductions

The prior subsections have documented that large firms predominantly reduce emissions via divestments in the post-Agreement period. We now want to analyze the *relative* importance of divestments in the post-Agreement period. By how much did large firms reduce carbon emissions since 2015, and which percentage of this is driven by divestments?

To answer this questions, we decompose total firm emission changes in million mt CO2e by category. We start by focussing on the balanced sample of firms used in the motivating Figure 1 to rule out that results are affected by changes in the sample composition over time. Figure 5 shows the total year-over-year changes in emission by category for large emitters and other public firms. We report M&A and divestments ("firm boundary") separately to highlight the role of divestments in emission reductions of large emitters.

[Figure 5 and Table A-4 here]

The figure again document that large emitters significantly increase divestment activities after the Paris Agreement. The effect is both immediate and largest in the two years after the Agreement. This is consistent with divestments being among the fastest methods that can be employed to reduce emissions. The divestment effect is sizable: over the total 2016 to 2021 period large emitters divest on average 61 million mt CO2e *per year* ($>$ 100 million mt in both 2016 and 2017). The cumulative emission reduction as result of divestments over this period is 369 million mt CO2e, approximately the size of France's total annual carbon emissions.

Large emitters report somewhat larger emission reductions on a like-for-like basis ("residual") in the post-Paris period (about 45 million mt per year, on average, in the post-Paris period relative to 23 million mt per year in the pre-Paris period). Finally, the impact of the Covid-19 pandemic is clearly visible. Large emitters significantly reduced output in 2020 when stringent lock-down measures were in place all over the world. Production rebounded in 2021 leading to a significant increase in overall emissions.

For other emitters, no increase in divestment activity is observed after 2015. The Covid-19 effect in 2020 and 2021 as well as somewhat larger emission reduction activities ("residual") is also observed for control group firms, albeit with a smaller magnitude.

Table A-4 shows the *cumulative* emission reductions for large and other emitters over the pre- and post-Paris period (as well as the pre-post difference and DiD). As shown in Figure 1, large emitters reduced their total emission by about 616 million mt CO2e more relative to the pre-Paris period and relative to other public firms. Thereof, 55% (−339 million mt) can be explained by a change in the firm boundary (−266 million mt divestment and −73 million mt M&A). That is, changes in firm boundaries, and divestments in particular, are the single largest contributer to the relative emission reduction by large emitters versus other emitters over the post-Paris period. The remainder is explained by relative output reductions (15%), reductions resulting from changes in the methodology how emissions are calculated (6%), and other emission reduction activities ("residual;" 24%).

Finally, we provide evidence for the overall (i.e., unbalanced) sample in a regression framework, controlling for the typical set of fixed effects also used in prior regressions. Specifically, we estimate models that combine the intensive and extensive margin, and weight regressions using firms' (lagged) Scope 1 and 2 emissions. The latter ensures that results are informative about aggregate emission changes similar to Table A-4. Results are reported in Table 6.

[Table 6 here]

The results document again that changes to firm boundary (divestments and M&A) are the largest contributer to emission reductions by large emitters in the post-Paris period. The coefficient of -1.8 p.p. per year implies a relative emission reduction of approximately 56.6 million mt CO2 per year, evaluated against the average total emission level of large emitters over the pre-Paris period in the unbalanced sample ($3{,}142 \times 0.018 = 56.6$ million mt).[17] Over the 2015-2021 horizon, this adds up to 339 million mt CO2 that is reallocated via changes to the firm boundary.

Overall, the results document that divestment activities are the single largest contributor to emissions reductions of large emitters vis-a-vis other emitters after the Paris Agreement. Once we control for fixed effects, changes to the firm boundary explain essentially the entire large-versus-other emitter difference after the Paris agreement. This result questions whether the observed large emission reductions following increased public pressure on large emitters de facto result in overall lower emission levels in the economy.

3.2.5 Why do large firms divest?

So far, we have documented *that* divestment activities are the single largest contributor to emissions reductions of large emitters vis-a-vis other emitters after the Paris Agreement. We now turn to the question *why* large emitters behave differently to small emitters. Two explanations come to mind: first, large emitters might either face more physical or regulatory risks, or be quicker in realizing the consequences of the Paris Agreement. First, large emitters, after the 2015 Paris Agreement, realize that their business model and assets face greater risks than previously assumed (transition risk such as stranded assets, tougher expected regulation, or declining consumer demand for brown products). Therefore, these large emitters decide to divest polluting assets to transition their business to a more carbon neutral model. Second, large emitters face pressure from investors and other stakeholders

[17] When we separate firm boundary into divestment and M&A, the effect is large (coefficient of -1.24 p.p.) and highly significant at the 1 perent level for divestment, and insignificant for M&A, suggesting the boundary effect is largely driven by divestments.

and therefore divest polluting assets to stay out of the limelight.

The CDP questionnaire explicitly asks firms about their perceived climate risks, categorized into physical risks, regulatory risks, and other risks and provide a short description of the key risks they are facing. Firms both report whether they have ”identified any inherent climate change risks that have the potential to generate a substantive change in your business operations, revenue or expenditure” (yes/no) as well as the expected magnitude of the impact (low, medium-low, medium, medium-high, high). We aggregate the answers into a score which is equal to 0 if firms answer ”no” to a particular category and ranges from 1 (low) to 5 (high). The categories are (a) physical risk, (b) regulatory risks, (c) investor-related risk, and (d) other risks. Both (c) and (d) are formally part of the ”other risks” category in the CDP category, and we identify investor-related risks by the keyword ”investor” in the textual description of the risk. If large emitters are quicker in realizing the risks to their business models after the Paris Agreement than small emitters, we would therefore expect them to report regulatory or other risks earlier than smaller firms.

We collapse data into a pre- and post-period and report results of a difference-in-difference regression in Table **??**. There is no evidence for larger emitters facing higher physical, regulatory or other risks in the post-Paris period. There is, however, clear evidence that larger emitters face higher investor-related risks. The coefficient in column (3) is both larger than all other coefficients, it is much larger relative to the unconditional mean (reported at the bottom of the table), and it is the only coefficient that is statitically significant (even though the regulatory coefficient is just insignificant). Panel B and Panel C of Table **??** provide two alternative measures instead of the score: We either simply classify observations with a medium-high risk or higher as ”1”, and all others as zero (Panel B), or we simply classify all observations with a ”yes” to the respective questions as ”1”, irrespective of the perceived magnitude of the risk. Results in Panel B and C confirm the prior results. Figure **??** in the Appendix provide a dynamic version of Table **??**, showing no pre-trends and an increase in investor-related risks post Paris-Agreement.

One might be concerned that larger emitters – for strategic reasons – do not report a perceived inrease in risks post Paris-Agreement. Note, however, that we do observe a significant increase in our risk score for regulatory risks post Paris-Agreement (this cannot be seen in the table because we absort Post-2015 fixed effects). This makes intuitive sense: both small and large emitters recognize that regulatory risks have increased post 2015. If large firms strategically underreport risks in order to be able to sell polluting assets, they would have need to quite elaborately deceipt investors that rely on CDP data to assess firm risk.

3.2.6 Heterogeneity

While we use the Paris Agreement as a specific event that increased pressure on firms to reduce emissions, our result that firms mainly react by increasing divestment activity is relevant to any study that aims at understanding the effects of firm behavior on emissions. That is, the main focus of this paper is not on details of the Paris Agreement. We use the Agreement as a laboratory to make the more general point that if polluting assets are reallocated across firms without simultaneous efficiency increases, emissions are not reduced. That being said, in this section we examine potential heterogeneous effects and present suggestive evidence how the Paris Agreement affected firms to better understand the mechanisms in this particular setting.

Regulatory costs and reputational risk. The implementation of the Paris Agreement varied significantly between the U.S., Europe, and the rest of the world. In particular the election of Donald Trump in Q4:2016 and the withdrawal of the U.S. from the Paris Agreement in 2017 under the Trump administration meant that risks related to more stringent climate regulation were significantly lower for large emitters located in the U.S. (see, among others, Ilhan et al., 2021; Ramelli et al., 2021) compared to Europe, where climate awareness is high and regulatory pressure on large firms increased significantly. It is therefore plausible that effects vary across geographic regions.

[Table 8 here]

Table 8, Panel A, column 1, shows the effect on total firm emissions but splits the treatment effect by geographic region. Table 8, Panel B, column 1, shows the divestment effect by geographic region. The results highlight that indeed mainly European firms reduced their Scope 1 and 2 emissions after the Paris Agreement by about 19 p.p. The effect for North American and Rest of the World firms is only around -4 ro -7 p.p. and not statistically significant. Also the divestment effect is stronger in Europe compared to North America, however, the difference is economically small. This, however, masks important heterogeneity across regions over time. As shown in Figure A-2 in the Appendix, there is a strong and immediate increase in divestment activity in particular for European firms over the 2016 to 2018 period of around +15 p.p. (compared to a pre-Paris effect of virtually zero). This effect is only muted over the Covid-19 period. For both North America and the Rest of the World an increase in divestment activtiy is also visible, however, the effects are significantly noisier and no clear reaction to the Paris Agreement is visible (in fact, only the Europe divestment coefficient remains large and significant if the 2020-21 Covid-19 period is removed from the sample).

Next, we examine if the effects vary by the stringency of environmental regulations in the firms' home countries. We follow Ben-David et al. (2021) and use data from the World Economic Forum (WEF) that contains information about the strictness of environmental regulation and enforcement at the country level. In particular, the WEF assigns countries a score between 1 and 7, where higher values indicate more stringent environmental regulation (SER). We use the 2017 vintage of the ranking, i.e., the first available ranking after the 2015 Paris Agreement.

Table 8, Panel A and B, column 2 examine the effects on firms' Scope 1 and 2 emissions and divestments splitting the treatment sample into firms located in countries with a high SER score (ranked among the "top 20" worldwide) and firms located in countries with a lower SER score (ranked > 20). A lower rank (i.e., higher score) indicates more stringent environmental regulation at the country level. We find that in particular large emitters that are located in countries with more stringent environmental regulation reduce emissions and increase divestment activity after the Paris Agreement.

Finally, we obtain information on firms' exposure to ESG and business conduct risks from RepRisk. RepRisk uses a combination of machine-learning and human analysis to create a firm-level index, the RepRisk Index (RRI), that dynamically captures and quantifies a company's reputational exposure to ESG and business conduct risks. The RRI ranges from zero (lowest) to 100 (highest). A higher value indicates a higher risk exposure. RepRisk classifies firms with an index value below 25 as having "low exposure."

Table 8, Panel A and B, column 3 splits the treatment sample into firms with an RRI above versus below 25 (using the average RRI over the pre Paris period). We only see an emission reduction and an increase in divestment activity for large emitters that have a high RRI score, i.e., a higher exposure to ESG and business conduct risks.

Note that both the SER score and the RRI is strongly correlated with geographic region and firms in European countries have both relatively high SER scores (low SER ranks) and high RRI scores. We therefore run separate models instead of jointly including region, SER score, and RRI and focus on the overall evidence across models instead of discriminating between individual proxies. Overall, the evidence suggests that increased regulatory risks and reputational concerns seem to be an important factor in understanding the relative emissions reductions and increased divestment activity by large emitters after the 2015 Paris Agreement.

Financial constraints. Another, not mutually exclusive, channel is that in particular firms that face tighter financial constraints are more likely to react to increased climate risks. For instance, Bartram et al. (2022) provide evidence that financially constrained firms reallocate their emissions away from California to other states after the implementation of the cap-and-trade program. However, financial constraints are unlikely to be a main explanation for our findings as our treatment firms are large publicly listed firms.

Table 8, Panel A and B, columns 4 and 5 split the treatment sample into firms with above and below median total assets and leverage, respectively. Total assets and leverage are defined as averages over the pre Paris Agreement period. The results show that, if anything, it is the largest firms with the lowest leverage ratios that decrease their emissions. This evidence is inconsistent with the idea that binding financial constraints are a main explanation for why large emitters reduced their Scope 1 and 2 emissions after the Paris Agreement.[18]

3.3 Divested assets

Finally, we examine divested assets in more detail. As information on individual transactions is not available in the CDP database, we carefully hand-collect data on firm-years with large divestment activities from firms' annual reports and other publicly available sources (e.g., press-releases and news articles). We restrict the sample to treatment firms (large emitters) and firm-years in which divestment activities reduced firms' total emissions by at least 1%. This leaves us with 187 observations. We can find detailed divestment information for 139/187 (74%) of the firm-years.[19] We verify that divestments are indeed asset sales and not closures of plants and facilities (cf. Section 3.2). We find mentionings of plant closures in 8 firm-years, however, even then the firm engaged in a combination of assets sales and closures. We find no firm-year in which the divestment activity can plausibly be mainly attributed to closures of facilities.[20]

We carefully collect information on all divestments the seller reports in the respective year, including information on who bought the asset. Sellers can engage in multiple transactions per year that involve different buyers. As information on emissions is not available at the deal-level (and can also not be systematically recovered from public sources), we approximate emissions at the deal/buyer level as follows: First, we split the total reported emission

[18] There is some evidence that the divestment effect is stronger for firms with high versus low leverage, however, the difference is economically small and not statistically significant.

[19] The remaining observations are mainly firm-years during which a firm engages in multiple transactions that are individually small (and hence transaction details are hard to come by/not disclosed).

[20] We also manually checked 20 random firm-years for control group firms that do not indicate any divestment activities in their CDP reporting. We verify that we indeed cannot find indications in their annual filings or other publicly available sources that the firms engaged in divestments that significantly reduced their emissions in the respective years.

reduction due to divestments by seller i in year t equally across all deals of the seller that we can identify in the respective year. Second, in case a deal involves multiple buyers, we equally split emissions across all firms. The number of deals (# Deals) is defined in the same manner (e.g., for a deal with two buyers, each buyer is assigned a deal share of 0.5).

[Table 9 here]

Table 9 provides information on seller and buyer location. We report information separately for asset sales (Panel A) and spin-offs (Panel B).[21] Looking at the combined volume of asset sales and spin-offs, the total emission reduction due to divestments is 358 million mt CO2e in the post Paris period (267.1 from asset sales, 90.8 from spin-offs) and 138 million mt CO2e in the pre Paris period (112.1 from asset sales, 25.5 from spin-offs), i.e., divestment activity almost tripled in terms of volume. While spin-offs only account for 4% (6/141) of deals in the post Paris period, they account for 25% of the total divestment volume. This is unsurprising as spin-off transactions are typically large (the sample, e.g., includes the "E.ON-Uniper," "BHP Billiton-South32," and "Exelon-Constellation" deals). The aggregate increase in divestment activity is, however, not exclusively driven by a few large spin-off transactions. Also excluding spin-offs, the divestment volume increased by a factor of ∼2.5 in the post-Paris period (+155 million mt CO2e).

Panel A provides information on sellers and buyers of divested assets by geograpic region (excluding spin-offs). We find that predominantly firms located in Europe increased their divestment activities from 81.2 to 176.3 million mt CO2e (+95.1 million mt CO2e or +117%). The divestment activities of North American firms also increased significantly, however, at a much lower level (+44.1 million mt CO2e). There is only limited divestment activity for firms located in other countries.

While European sellers account for a large share of the total divested emissions, European firms only account for a small share of buyers. Europe is a "net seller" of assets both in

[21] Spin-offs are large but rare transactions. Further, in spin-offs shares are offered to the shareholders of the parent firm. That is, there is no clearly defined "buyer" and the spun-off part of the business continues to operate as a stand-alone entitiy.

the pre-Paris period and in the post-Paris Period (pre: −46.5, post: −132.3 million mt CO2e). Most buyers are North American firms or firms located in other countries around the world (mainly Asia and Oceania). Both regions have *tripled* the purchase volume relative to the pre-Paris period, while the total volume purchased by European firms has (roughly) remained stable. Overall, the results indicate that European firms are net sellers of divested assets, while firms in the "Rest of the World" and North America are net buyers.

[Table 10 here]

Table 10 provides information on whether or not the buyer disclose information to CDP. Buyers that do not report emissions to CDP account for about 70% (180/267) of the volume in the post Paris period. We carefully check that we correctly aggregate buyers to the parent level, i.e., we make sure that also the parent firms, if applicable, do not disclose information on carbon emissions. Firms with limited emissions disclosure not only account for the majority of buyers, this group also exhibited the largest growth relative to the pre Paris period. Overall, this evidence is consistent with the narrative that dirty assets tend to be acquired by firms that are less in the limelight.

Finally, in Appendix Table A-2 we report information on the type and location of the assets that are divested. The asset type distribution mirrors the industry distribution for the sample of large emitters repoted in Table 2. Most of the divested assets are in the oil and gas and energy sector. In terms of asset location an interesting picture emerges. While most of the assets sold by North American and "Rest of the World" firms are located in the regions in which the sellers are headquartered, European firms, the most active sellers, mainly divest assets that are not located in Europe. This might suggest that firms that are under more pressure to reduce emissions start by divesting assets in non-core markets first.

Annoucement returns. The evidence suggests that firms strategically divest assets after the Paris Agreement. This strategy can be value enhancing for the sellers, i.e., divesting assets might be an effective response to limit exposure to regulatory and reputational risks. We therefore examine stock returns for 203 divestments (of the 255 events contained in

Table 10) for which we can identify the exact annoucement date and stock price information is available in Refinitiv Datastream. Results are depicted in Figure 6.

[Figure 6 and Table 11 here]

The figure shows cumulative abnormal returns around divestment annoucements over the [-2,+3] trading day window, separately for divestments that are announced during the pre-Paris period (2010-2015) and the post-Paris period (2016-2021). Abnormal returns are defined as return for firm i on event day t minus the market return on the same day.[22]

The results indicate significantly positive stock market reactions over the [0,+1] annoucement window of around 0.6 p.p. for divestment annoucements after the Paris Agreement. In contrast, the effect is close to zero for annoucements made during the pre-Paris period. This suggests that investors react positively to news about divestments of large emitters, in particular after the Paris Agreement was signed.

Next, we examine if the stock market responses are more favourable to divestmens for firms that faced increased pressure. Table 11 column 1 regresses the cumulative abnormal returns over the [-1,1] window around the annoucement on a *Post 2015* indicator. Consistent with Figure 6, the results document that stock market reactions are more positive (+0.7 p.p.) to annoucements after 2015. In column 2 and 3 we split the sample into divestment annoucement by European firms and firms located in other regions. Evidence suggests that stock market reactions are stronger for European firms after the Paris Agreement relative to firms located in other regions (the difference between the coefficients is statistically significant at the 10% level).[23]

[22] We use the S&P500 Index for North American firms, the EURO STOXX 50 Index for European firms, and the MSCI Asia Pacific Index for firms in the "Rest of the World" (most firms are located in the Asia-Pacific region, cf. Table 2).

[23] We focus on a split by region for brevity but obtain similar results if we split by the SER rank, the firms' RRI score (cf. Section 3.2.6), or divestment size (announcement returns are more positive if the SER rank is lower, the RRI score is higher, and if the size of the divestment is larger).

4 Conclusion

This paper analyzes if and how firms reduce carbon emissions in response to increased public pressure. We document that large emitters reduced their combined Scope 1 and 2 emissions by around 11-15% in the years after the 2015 Paris Agreement relative to other public firms. The effect is predominantly driven by a sizable increase in divestment activities. Large emitters are 9 p.p. more likely to report that they reduced emissions through divestments in the period after the Paris Agreement. This constitutes an increase of over 75% relative to the sample mean. There is no evidence for increased engagements in other emission reduction activities.

The reallocation we document is global in nature, and economically large, with 369 million mt CO2e of carbon emissions being reallocated via divestments in the post-Paris-agreement period, approximately the size of France's total annual carbon emissions. Divestments are also accompanied by positive announcement returns, suggesting that reallocation is beneficial to the divesting firms' shareholders. Divestment leads to a reallocation of ownership from firms in Europe to firms in the rest of the world; divestments are more frequent for firms located in countries with a more stringent environmental regulation, as well as for firms with a higher reputational risk. Overall, our results indicate that public pressure can lead to significant asset reallocation effects on a global scale, shifting emissions out of the limelight.

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Reason	Direction of change	Emissions value (percentage)	Please explain calculation
Change in renewable energy consumption	Decreased	2.99	*1)
Other emission reduction activities	Decreased	7.39	*2)
Divestment	Decreased	6.08	*3)
Acquisitions			
Mergers			
Change in output	Increased	3.37	*4)
Change in methodology			
Change in boundary			
Change in physical operating conditions			
Unidentified			
Other	Increased	0.12	*5)

***1)** "In Electricity Generation, a) the increase in renewable capacity of 73MW in wind capacity in Spain in 2021 resulted in 45,755 tCO2e avoided [...] b) the increase in renewable capacity of 206MW in wind capacity and 101MW in solar PV capacity in Chile in 2021 resulted in 177,501 tCO2e avoided [...] c) the increase in renewable capacity of 181MW in wind capacity in Australia in 2021 resulted in 238,968 tCO2e avoided [...] In total, the emissions reduction activities described above avoided the emission of 462,224 tCO2e. The emissions (scope 1 and 2) in 2020 were 15,455,482 tCO2e. Therefore, the percentage of emission decrease can be calculated as 462,224 tCO2e / 15,455,482 tCO2e = 2.99%. [...]"

***2)** "Regarding Scope 1, a) in Electricity Generation the shut-down of all coal power plants ins Spain implies a reduction of 1,067,936 tCO2e; b) in Electricity Generation as a result of the Energy Efficiency Operational Plan (E.E.O.P), resulting in a reduction in specific fuel consumptions, [...] which implies the reduction of 73,788 tCO2e; Regarding Scope 2, c) in Electricity Distribution, the decrease in electricity losses in transport and distribution in Spain implies a reduction of 5 tCO2e. [...] the percentage of emission decrease can be calculated as 1,141,729 tCO2e / 15,455,482 tCO2e = 7.39%."

***3)** "The divestment in electricity networks in Chile implies a reduction of 939,057 tCO2e (scopes 1 and 2). [...] the percentage of emission decrease can be calculated as 939,057 tCO2e / 15,455,482 tCO2e = 6.08%."

***4)** "a) The increase in LNG activities implies an increase of 359,712 tCO2e; b) the increase in natural gas distribution activities imply an increase of 119,597 tCO2e; c) the increase in electricity distribution activities implies an increase of 41,943 tCO2e; [...] the percentage of emission decrease can be calculated as 521,252 tCO2e / 15,455,482 tCO2e = 3.37%."

***5)** "Increase in emissions due to different small factors. The sum of all of them accounts for an increase in emissions of 18,583 tCO2e (0.12% of total emissions in 2020)."

Figure 2: **CDP Information on changes in gross global Scope 1 and 2 emissions**
This figure shows the response by Naturgy Energy Group SA to question C7.9a (*"Identify the reasons for any change in your gross global emissions (Scope 1 and 2 combined), and for each of them specify how your emissions compare to the previous year."*) for the 2022 CDP survey wave (which asks about information on emission activity for the year 2021). According to the 2022 survey response, Naturgy's total Scope 1 and 2 emissions for the year 2021 were 13,452,307 tCO2e. In the previous year, Naturgy reported 15,455,482 tCO2e, i.e., Scope 1 and 2 emissions declined by 12.97% from 2020 to 2021. Naturgy's response to question C7.9a indicates how this change can be broken down into different categories. Changes in energy consumption, other emission reduction activities, and divestments decreased emissions by 16.46% (2.99+7.39+6.08), while output changes and other miscellaneous factors increased emissions by 3.49% (3.37+0.12), yielding a net emission change of 3.49-16.46=−12.97%.

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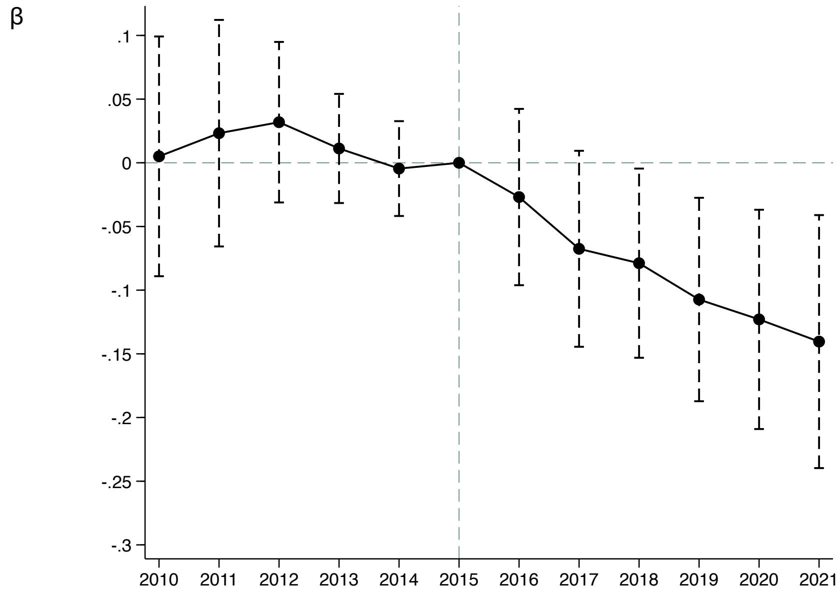

Figure 3: **Dynamic effect on firm emissions**
This figure examines the combined Scope 1 and 2 emissions of large emitters around the 2015 Paris Agreement. Specifically, the figure plots estimated coefficients from the following regression specification:

$$\ln(\text{Scope 1+2}_{i,t}) = \sum_{k=2010}^{2021} \beta_k \left(\text{Large Emitter } (0/1)_i \times \text{Year k } (0/1)_t\right) + \alpha_i^{ind} \times \text{Post}_t$$

$$+ \alpha_i^{region} \times \text{Post}_t + \delta_i + \chi_t + \epsilon_{i,t},$$

where *Large Emitter*$_i$ equals one if firm i is a larger CO2 emitter (defined in more detail in the main text), and zero otherwise. *Year* k_t equals one in (reporting) year k, and zero otherwise (2015 is the omitted category). *Scope 1+2*$_{it}$ is the gross global combined Scope 1 and 2 emission (in metric tones CO2e) of firm i in reporting year t. δ_i and χ_t denote firm and reporting year fixed effects, respectively. α_i^{ind} are 2-digit SIC code fixed effects. α_i^{region} are geographic region (North America, Europe, Rest of the World) fixed effects. The dashed lines represent 90% confidence intervals, adjusted for firm-level clustering.

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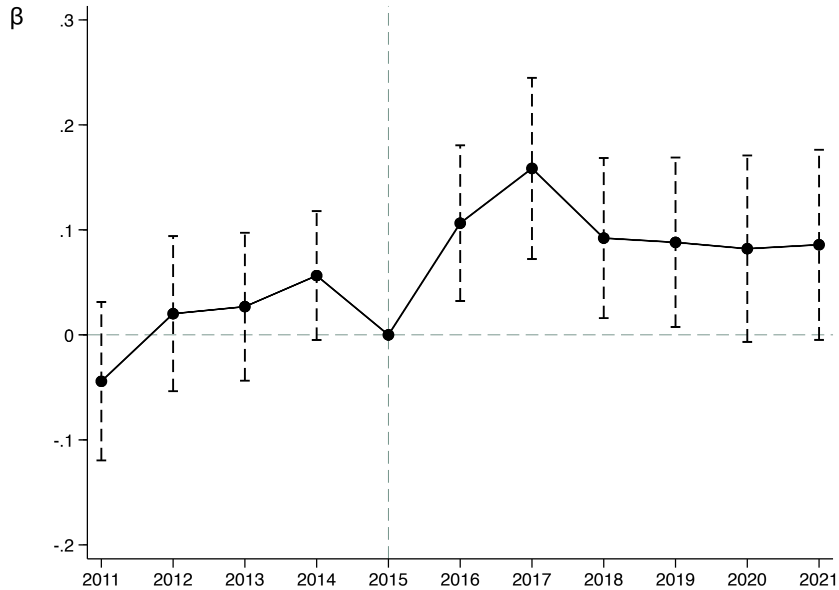

Figure 4: **Dynamic effect on firm divestment activities**
This figure plots estimated coefficients from the regression:

$$\text{Divestments } (0/1)_{i,t} = \sum_{k=2010}^{2021} \beta_k \left(\text{Large Emitter } (0/1)_i \times \text{Year k } (0/1)_t\right) + \alpha_i^{ind} \times \text{Post}_t$$

$$+ \alpha_i^{region} \times \text{Post}_t + \delta_i + \chi_t + \epsilon_{i,t},$$

where the dependent variable is an indicator variable that is equal to one if firm i indicates that their combined global Scope 1 and 2 emissions changed in year t because of divestments, and zero otherwise. All other variables are defined in Figure 3. The dashed lines represent 90% confidence intervals, adjusted for firm-level clustering.

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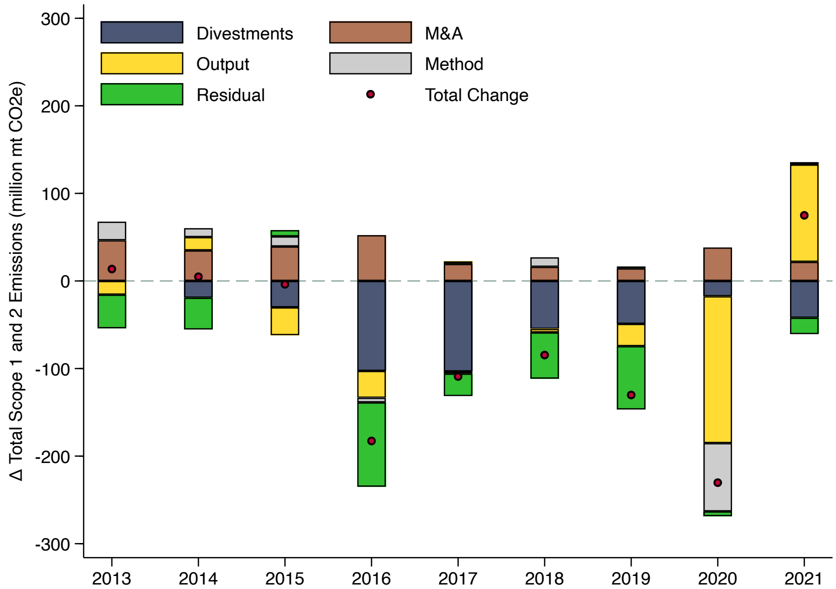
Large Emitters:



Other Emitters:

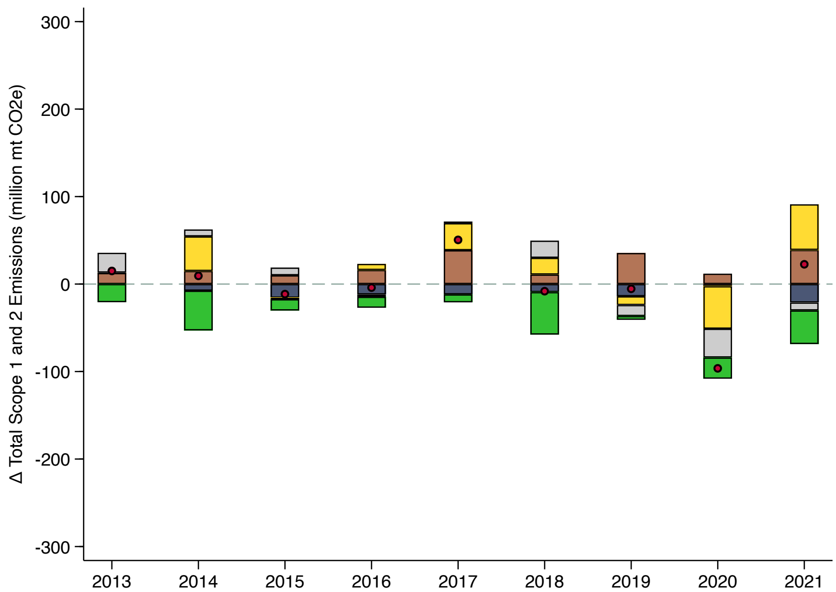


Figure 5: **Annual changes in firm emissions by category**
This figure shows the annual change in total combined gross Scope 1 and 2 emissions (million mt CO2e) by category for a balanced sample of large emitters (N = 73) and other emitters (N = 540).

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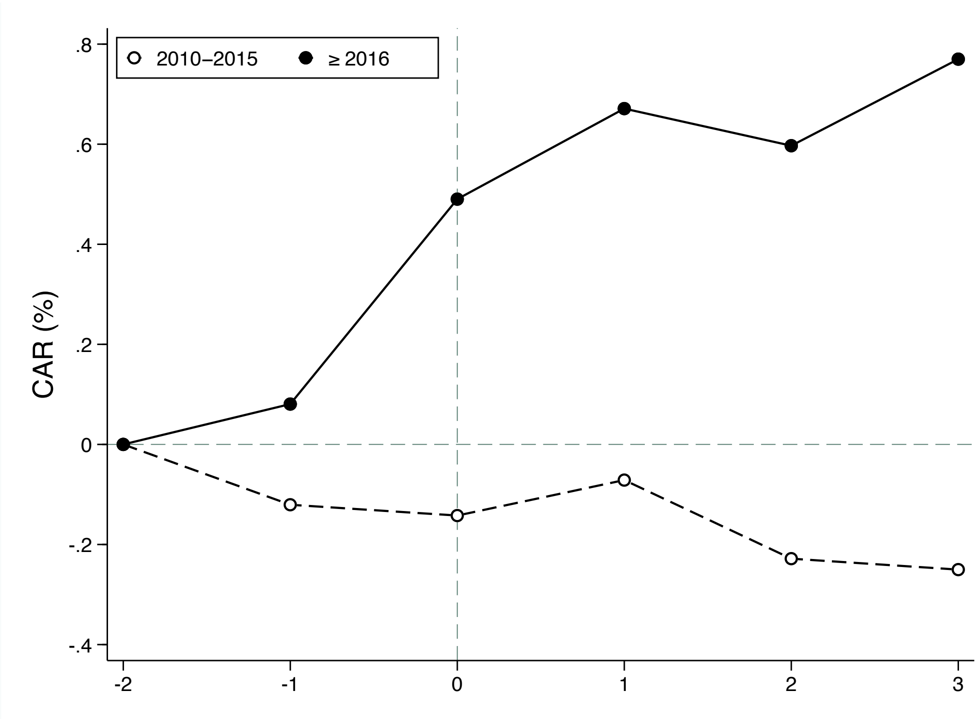

Figure 6: **CARs around divestment announcements**
This figure plots selling firms' cumulative abnormal returns from (trading) day -2 before to (trading) day +3 after a divestment announcement. The daily abnormal returns are calculated as the difference between the return of selling firm i on event day t and the return of the MSCI World Index on the same day. All cumulative abnormal returns are calculated relative to day -2, i.e., the abnormal return on day -2 is zero by construction. The solid (dashed) line indicates if the divestment announcement is after (before) the Paris Agreement.

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Table 1: **Descriptive statistics**

This table reports descriptive statistics at the firm- (reporting) year level. The sample period is 2011 to 2021.

	Mean	Median	Std. Dev	Obs.
A. Firm characteristics				
Large Emitter (0/1)	0.09	0.00	0.29	12,353
Total Assets ('000 million USD)	24.44	9.02	43.01	12,353
Total Revenue ('000 million USD)	15.85	6.48	25.96	12,353
Europe (0/1)	0.37	0.00	0.48	12,353
North America (0/1)	0.28	0.00	0.45	12,353
Rest of the World (0/1)	0.35	0.00	0.48	12,353
B. Emission data				
Scope 1 ('000 metric tonnes CO2e)	3,497.82	146.03	10,641.61	12,340
Scope 2 ('000 metric tonnes CO2e)	693.76	185.43	1,428.05	11,868
Scope 1+2 Growth Rate (%)	1.82	-1.01	25.29	10,785
C. Emission breakdown				
Firm Boundary				
Firm boundary net (%)	0.46	0.00	5.24	12,331
Divestment (0/1)	0.12	0.00	0.32	12,353
M&A (0/1)	0.14	0.00	0.35	12,353
Output				
Ouput net (%)	1.36	0.00	7.25	12,331
Decreased output (0/1)	0.17	0.00	0.37	12,353
Increased output (0/1)	0.32	0.00	0.47	12,353
Method				
Method net (%)	0.63	0.00	5.67	12,331
Decreased method (0/1)	0.11	0.00	0.32	12,353
Increased method (0/1)	0.15	0.00	0.36	12,353
Residual				
Residual net (%)	-1.36	-1.76	21.45	10,785
Residual $< -1\%$ (0/1)	0.55	1.00	0.50	10,785
Residual $< -5\%$ (0/1)	0.32	0.00	0.47	10,785
Residual $> 1\%$ (0/1)	0.27	0.00	0.44	10,785
Residual $> 5\%$ (0/1)	0.16	0.00	0.37	10,785

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Table 2: **Descriptive statistics – Large emitters**

This table reports descriptive statistics for the sample of 111 large CO2 emitters (see main text for details).

Panel A. Firm characteristics (averages over 2011 to 2015 period)

	Mean	Median	Std. Dev	Obs.
Total Assets ('000 million USD)	92.33	66.45	74.47	111
Total Revenue ('000 million USD)	59.62	46.35	47.80	111
Scope 1 ('000 metric tonnes CO2e)	23,460.00	12,429.31	25,201.66	111
Scope 2 ('000 metric tonnes CO2e)	2,719.39	1,594.59	2,789.60	108

Panel B. Geographical distribution	#
North America (N=41)	
USA	35
Canada	6
Europe (N=46)	
Austria	1
Denmark	1
Finland	1
France	9
Germany	10
Ireland	1
Italy	3
Luxembourg	1
Netherlands	3
Norway	1
Spain	3
Switzerland	3
United Kingdom	9
Other Countries (N=24)	
Australia	5
Brazil	3
Colombia	1
Japan	8
Mexico	1
Russia	1
South Africa	1
South Korea	2
Taiwan	1
Thailand	1

Panel C. Industries (2-digit SIC)	#
Electric and Gas Services (49)	26
Petroleum Refining (29)	15
Transportation Equipment (37)	15
Chemicals (28)	9
Oil and Gas Extraction (13)	6
Metal Mining (10)	5
Food and Kindred Products (20)	5
Stone, Clay, Glass, and Concrete (32)	5
Primary Metal (33)	5
Transportation by Air (45)	4
Public Sector (Other) (99)	4
Other	13

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Table 3: **Baseline effects on firm Scope 1 and 2 emissions**

This table examines the emission activity of large emitters around the 2015 Paris Agreement. The unit of observation is the firm-reporting year-level *it*. The sample period is 2011 to 2021. *Large Emitter* equals one if firm i is a large CO2 emitter (defined in more detail in the main text), and zero otherwise. *Post 2015* is an indicator variable that is equal to one for firm reporting years after 2015, and zero otherwise. *Scope* is the gross global emission (in metric tonnes CO2e) of firm i in reporting year t. Columns 1 to 3 report results for Scope 1 emissions; columns 4 to 6 report results for combined Scope 1 and 2 emissions. The regressions include firm, (reporting) year, *Post 2015* × industry (2-digit SIC code), and *Post 2015* × region fixed effects, when indicated. p-values based on robust standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Variable:	ln(Scope 1)	ln(Scope 1)	ln(Scope 1)	ln(Scope 1+2)	ln(Scope 1+2)	ln(Scope 1+2)
	(1)	(2)	(3)	(4)	(5)	(6)
Large Emitter$_i$ × Post 2015$_t$	-0.171***	-0.158***	-0.141**	-0.145***	-0.134***	-0.110**
	(0.003)	(0.010)	(0.021)	(0.004)	(0.009)	(0.032)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Post 2015	No	Yes	Yes	No	Yes	Yes
Region x Post 2015	No	No	Yes	No	No	Yes
Observations	12,331	12,330	12,330	11,852	11,851	11,851
Adj R^2	0.96	0.96	0.96	0.96	0.96	0.96

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Table 4: **Reasons for changes in firm emissions**

This table explores through what means emission activities of large emitters change around the 2015 Paris Agreement. The unit of observation is the firm-reporting year-level *it*. The sample period is 2011 to 2021. *Large Emitter* equals one if firm i is a large CO2 emitter (defined in more detail in the main text), and zero otherwise. *Post 2015* is an indicator variable that is equal to one for firm reporting years after 2015, and zero otherwise. The dependent variables are indicator variables equal to one if firm i indicates that their combined global Scope 1 and 2 emissions changed in year t because of: i) divestments, ii) output changes, iii) how emissions are calculated ($Method$), iv) merger activity, or v) other reasons including efficiency improvements and emission reduction activities (*Residual*). Panel A (B) examines activities that reduced (increased) emissions. The regressions include firm, (reporting) year, *Post 2015* × industry (2-digit SIC code), and *Post 2015* × region fixed effects, when indicated. p-values based on robust standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Panel A.	Activities that **decrease** emissions				
Variable:	Divestments	Output	Method	Residual $< -1\%$	Residual $< -5\%$
	(0/1)	(0/1)	(0/1)	(0/1)	(0/1)
	(1)	(2)	(3)	(4)	(5)
Large Emitter$_i$ × Post 2015$_t$	0.091***	0.036	-0.027	-0.028	-0.070**
	(0.005)	(0.210)	(0.258)	(0.432)	(0.037)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes	Yes
Observations	12,352	12,352	12,352	10,755	10,755
Adj R^2	0.25	0.16	0.14	0.07	0.08
Mean of dependent variable:	0.12	0.17	0.11	0.55	0.32

Panel B.	Activities that **increase** emissions				
Variable:	M&A	Output	Method	Residual $> 1\%$	Residual $> 5\%$
	(0/1)	(0/1)	(0/1)	(0/1)	(0/1)
	(1)	(2)	(3)	(4)	(5)
Large Emitter$_i$ × Post 2015$_t$	0.027	-0.037	-0.052*	-0.011	-0.010
	(0.282)	(0.291)	(0.056)	(0.724)	(0.656)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes	Yes
Observations	12,352	12,352	12,352	10,755	10,755
Adj R^2	0.19	0.21	0.13	0.04	0.05
Mean of dependent variable:	0.14	0.32	0.15	0.27	0.16

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Table 5: **Reasons for changes in firm emissions − Intensive margin**

This table explores through what means emission activities of large emitters change around the 2015 Paris Agreement. The unit of observation is the firm-reporting year-level *it*. The sample period is 2011 to 2021. *Large Emitter* equals one if firm i is a large CO2 emitter (defined in more detail in the main text), and zero otherwise. *Post 2015* is an indicator variable that is equal to one for firm reporting years after 2015, and zero otherwise. The dependent variable is the Scope 1 and 2 emission change in year t (in percent of total $t-1$ emissions) that results from category k, where $k = \{\text{Firm Boundary, Output, Method, Residual}\}$. Positive (negative) values indicate that emissions increased (decreased) as result of the respective category. Note that *net* changes by category are calculated, e.g., *Firm Boundary* is the difference between divestment and M&A activity and can take on both positive or negative values. This table focuses on the intensive margin, i.e., firm-years in which there was no emission change as result of the respective category are excluded. The regressions include firm, (reporting) year, *Post 2015* × industry (2-digit SIC code), and *Post 2015* × region fixed effects, when indicated. p-values based on robust standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Variable:	Firm Boundary	Output	Method	Residual
	Net %	Net %	Net %	Net %
	(1)	(2)	(3)	(4)
$\text{Large}_i \times \text{Post } 2015_t$	-2.325	1.270	-1.888	-0.149
	(0.391)	(0.184)	(0.510)	(0.891)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes
Observations	2,374	5,757	2,763	10,717
Adj R^2	0.14	0.16	0.09	-0.00
Mean of dep. var.:	2.90	3.51	3.70	-1.30

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Table 6: **Reasons for changes in firm emissions – Ex- and intensive margin**

This table explores through what means emission activities of large emitters change around the 2015 Paris Agreement. The unit of observation is the firm-reporting year-level *it*. The sample period is 2011 to 2021. *Large Emitter* equals one if firm i is a large CO2 emitter (defined in more detail in the main text), and zero otherwise. *Post 2015* is an indicator variable that is equal to one for firm reporting years after 2015, and zero otherwise. The dependent variable is the Scope 1 and 2 emission change in year t (in percent of total $t-1$ emissions) that results from category k, where $k = \{\text{Firm Boundary, Output, Method, Residual}\}$. Positive (negative) values indicate that emissions increased (decreased) as result of the respective category. Note that *net* changes by category are calculated, e.g., *Firm Boundary* is the difference between divestment and M&A activity and can take on both positive or negative values. Regressions are weighted by the firms' (lagged) Scope 1 and 2 emissions. The regressions include firm, (reporting) year, *Post 2015* $\times$ industry (2-digit SIC code), and *Post 2015* $\times$ region fixed effects, when indicated. p-values based on robust standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Variable:	Firm Boundary	Output	Method	Residual
	Net %	Net %	Net %	Net %
	(1)	(2)	(3)	(4)
$\text{Large}_i \times \text{Post 2015}_t$	-1.817**	0.302	-0.019	-0.373
	(0.035)	(0.685)	(0.967)	(0.842)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes
Observations	10,954	10,954	10,954	10,755
Adj R^2	0.08	0.16	0.00	0.08
Mean of dep. var.:	0.47	1.46	0.62	-1.30

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Table 7: **Risk factors**

This table explores risk factors that large emitters report around the 2015 Paris Agreement. The unit of observation is the firm-period-level *it*, i.e., the sample period is split into a pre-Paris period (2011 to 2015) and a post-Paris period (2016 to 2021). *Large Emitter* equals one if firm *i* is a large CO2 emitter (defined in more detail in the main text), and zero otherwise. *Post 2015* is an indicator variable that is equal to one for the post-Paris period, and zero otherwise. The dependent variables measure whether firms are exposed to i) physical risks, ii) regulatory risks, iii) investor related risks, or iv) other risks (categories are defined in more detail in the main text). Panel A uses *ln(Risk Score)* as dependent variable, where risk scores range from 1 (no risk) to 6 (high risk). Scores are defined as maximum scores by period and category. Panel B uses indicator variables that are equal to one if the firm reports risk exposure with a score of *medium-high* or *high* in the respective category and period, and zero otherwise. Panel C uses indicator variables that are equal to one if the firm reports *any* risk exposure in the respective category and period, and zero otherwise. The regressions include firm, *Post 2015* $\times$ industry (2-digit SIC code), and *Post 2015* $\times$ region fixed effects, when indicated. *p*-values based on robust standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Panel A.	ln(Risk score [1-6])			
Variable:	Physical	Regulatory	Investor	Other
	(1)	(2)	(3)	(4)
Large Emitter$_i$ $\times$ Post 2015$_t$	-0.035	0.060	0.155**	-0.081
	(0.472)	(0.104)	(0.039)	(0.127)
Firm FE	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes
Observations	2,666	2,666	2,666	2,666
Adj R^2	0.50	0.56	0.55	0.43
Mean of dep. var.:	1.32	1.37	0.30	1.20
Panel B.	High magnitude risk (0/1)			
Variable:	Physical	Regulatory	Investor	Other
	(1)	(2)	(3)	(4)
Large Emitter$_i$ $\times$ Post 2015$_t$	-0.050	-0.001	0.071*	-0.049
	(0.283)	(0.984)	(0.097)	(0.358)
Firm FE	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes
Observations	2,666	2,666	2,666	2,666
Adj R^2	0.49	0.54	0.48	0.42
Mean of dep. var.:	0.51	0.53	0.09	0.43
Panel C.	Any risk (0/1)			
Variable:	Physical	Regulatory	Investor	Other
	(1)	(2)	(3)	(4)
Large Emitter$_i$ $\times$ Post 2015$_t$	-0.013	0.028	0.117**	-0.068
	(0.622)	(0.154)	(0.020)	(0.101)
Firm FE	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes
Observations	2,666	2,666	2,666	2,666
Adj R^2	0.41	0.42	0.55	0.34
Mean of dep. var.:	0.90	0.93	0.22	0.77

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Table 8: **Effects on firm emissions and divestment activity – Heterogeneity**

This table examines the emission and divestment activity of large emitters around the 2015 Paris Agreement. The unit of observation is the firm-reporting year-level *it*. The sample period is 2011 to 2021. *Large Emitter* equals one if firm *i* is a large CO2 emitter (defined in more detail in the main text), and zero otherwise. *Post 2015* is an indicator variable that is equal to one for firm reporting years after 2015, and zero otherwise. *S. 1+2* is the global Scope 1 and 2 emissions (in mt CO2e) of firm *i* in reporting year *t*. *Div.* is an indicator equal to one if firm *i* indicates that their emissions changed in year *t* because of divestments. *EU* (*NA*) is an indicator variable that is equal to one for firms headquartered in Europe [EU27, Switzerland, UK, Norway] (North America [US and Canada]). *RW* indicates firms headquartered in other countries. *SER Rank* is the countries' (firm headquarter) rank according to the WEF Stringency of Environmental Regulation (SER) score. A lower rank (higher score) indicates more stringent regulation. *Low* indicates an *SER Rank* $\leq$ 20 and *High* an *SER Rank* $>$ 20. *RRI* is the firm's average RepRisk Index over the pre-Paris period. A higher value indicates a higher reputational exposure to ESG risks. *Low* indicates an RRI $<$ 25 and *High* an RRI $\geq$ 25. Low (high) *Size* and *Leverage* indicate large emitters with below (above) median total assets and leverage, respectively (defined as averages over the pre-Paris period). All other variables are defined in Table 3. The regressions include firm, (reporting) year, *Post 2015* $\times$ industry (2-digit SIC code), and *Post 2015* $\times$ region fixed effects, when indicated. *p*-values based on robust standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Panel A.	Region	SER Rank	RRI	Size	Leverage
Variable:	ln(S. 1+2)	ln(S. 1+2)	ln(S. 1+2)	ln(S. 1+2)	ln(S. 1+2)
	(1)	(2)	(3)	(4)	(5)
$\text{Large}_i \times \text{Post}_t \times EU_i$	-0.188**				
	(0.020)				
$\text{Large}_i \times \text{Post}_t \times NA_i$	-0.042				
	(0.488)				
$\text{Large}_i \times \text{Post}_t \times RW_i$	-0.067				
	(0.545)				
$\text{Large}_i \times \text{Post}_t \times High_i$		-0.049	-0.131**	-0.194***	-0.074
		(0.484)	(0.045)	(0.006)	(0.163)
$\text{Large}_i \times \text{Post}_t \times Low_i$		-0.136**	0.012	-0.039	-0.145*
		(0.028)	(0.890)	(0.536)	(0.063)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes	Yes
Observations	11,851	11,833	9,875	11,804	11,804
Adj R^2	0.96	0.96	0.96	0.96	0.96
Panel B.	Region	SER Rank	RRI	Size	Leverage
Variable:	Div. (0/1)	Div. (0/1)	Div. (0/1)	Div. (0/1)	Div. (0/1)
	(1)	(2)	(3)	(4)	(5)
$\text{Large}_i \times \text{Post}_t \times EU_i$	0.100*				
	(0.062)				
$\text{Large}_i \times \text{Post}_t \times NA_i$	0.069				
	(0.101)				
$\text{Large}_i \times \text{Post}_t \times RW_i$	0.108*				
	(0.100)				
$\text{Large}_i \times \text{Post}_t \times High_i$		0.071	0.117***	0.104**	0.105***
		(0.249)	(0.005)	(0.019)	(0.004)
$\text{Large}_i \times \text{Post}_t \times Low_i$		0.097***	0.040	0.079*	0.076
		(0.006)	(0.445)	(0.066)	(0.124)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes	Yes
Observations	12,352	12,333	10,252	12,298	12,298
Adj R^2	0.25	0.25	0.24	0.25	0.25

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Table 9: **Divestment activity by large emitters – Seller and buyer region**

This table reports descriptive statistics on the divestment activities of large emitters. We collect information on divestment activities for all firm-years in which a large emitter reports that divestments reduced their total combined Scope 1 and 2 emissions by at least 1% (139 firm-years). We report separate statistics for the period before the Paris Agreement (2010-2015) and the period after the Paris Agreement (2016-2021). Panel A reports information on all sales of assets and subsidiaries. "Volume sold" is the total Scope 1 and 2 emission reduction in million mt CO2e that results from divestments by large emitters that are headquartered in region j = {Europe (EU), North America (NA), Rest of the World (RoW), Unknown (Unk.)}. "Volume bought" is the flipside of "volume sold" and identifies in which regions the divested emissions end up (based on the headquarter location of the buyer(s)). That is, for each period and across all regions, total volume sold == total volume bought. When identifying buyers, we take into account that sellers can engage in multiple divestments per year that involve different buyers (potentially located in different regions). As CDP information on emission reductions due to divestments is only available at the (selling-) firm-year level, we approximate emissions at the deal × buyer level as follows: First, we split the total reported emission reduction due to divestments by seller i in year t equally across all deals of the seller that we can identify in the respective year. Second, in case a deal involves multiple buyers, we equally split emissions across all firms. The number of deals (# Deals) is defined in the same manner (e.g., for a deal with two buyers, each buyer is assigned a deal share of 0.5). Panel B reports information on spin-off transactions. For spin-offs we do not differentiate between buyer and seller region, as the spun-off entity remains a stand-alone company (whose shares are offered to the current shareholders of the seller).

PANEL A. ASSET SALES

Pre Paris Agreement:

	Volume (mil mt CO2e)					# Deals				
	Total	EU	NA	RoW	Unk.	**Total**	EU	NA	RoW	Unk.
Sell	**112.1**	81.2	30.0	0.9	–	**101**	74.0	25.0	2.0	–
Buy	**112.1**	34.7	37.0	39.2	1.1	**101**	21.0	43.5	35.5	1.0
Net (B–S)	–	-46.5	7.0	38.3	1.1	–	-53.0	18.5	33.5	1.0

Post Paris Agreement:

	Volume (mil mt CO2e)					# Deals				
	Total	EU	NA	RoW	Unk.	**Total**	EU	NA	RoW	Unk.
Sell	**267.1**	176.3	74.1	16.7	–	**141**	92.0	42.0	7.0	–
Buy	**267.1**	44.1	115.8	104.7	2.6	**141**	28.5	47.8	57.7	7.0
Net (B–S)	–	-132.3	41.6	88.0	2.6	–	-63.5	5.8	50.7	7.0

Post–Pre Paris Agreement:

	Volume (mil mt CO2e)					# Deals				
	Total	EU	NA	RoW	Unk.	**Total**	EU	NA	RoW	Unk.
Net (Po–Pr)	**155**	-85.7	34.6	49.6	1.5	**40**	-10.5	-12.7	17.2	6.0

PANEL B. SPIN-OFFS

	Volume (mil mt CO2e)					# Deals				
	Total	EU	NA	RoW	Unk.	**Total**	EU	NA	RoW	Unk.
Pre Paris	**25.5**	4.7	20.8	–	–	**7**	2.0	5.0	–	–
Post Paris	**90.8**	82.2	8.2	0.4	–	**6**	3.0	2.0	1.0	–
Post–Pre	**65.3**	77.5	-12.7	0.4	–	**-1**	1.0	-3.0	1.0	–

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Table 10: **Divestment activity by large emitters – Buyer in CDP?**

This table reports descriptive statistics on the divestment activities of large emitters. Specifically, the table reports information on whether or not the buyer of the divested assets (excluding spin-offs) reports information on emission activity to CDP. See Table 9 for details on sample selection and variable definitions.

Pre Paris Agreement:	
	Volume (mil mt CO2e)
Buyer reports to CDP: No	70.7
Buyer reports to CDP: Yes	41.3
Net (Yes−No)	-29.4
Post Paris Agreement:	
	Volume (mil mt CO2e)
Buyer reports to CDP: No	179.6
Buyer reports to CDP: Yes	87.5
Net (Yes−No)	-92.1
Post−Pre Paris Agreement:	
	Volume (mil mt CO2e)
Net (Post−Pre)	-62.7

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Table 11: **Divestment announcement returns**

This table studies the impact of divestment activity on selling firms' stock returns around divestment announcements. The sample comprises divestments by large emitters (defined in more detail in the main text), only. See Table 9 for details on the sample construction. The table reports univariate regression results from an event study using daily stock returns. The dependent variable is the cumulative abnormal return (CAR) over the [-1,1] window around the divestment announcement date (in %). The details of computing the abnormal stock returns are provided in Section 3.1. *Post 2015* is an indicator variable that is equal to one for announcements after 2015, and zero otherwise. Columns 2 to 3 report sample splits. *Europe* indicates if the seller is headquartered in Europe or not. *p*-values based on robust standard errors are in parentheses. ***, **, * denote significance at the 1, 5 and 10% level, respectively.

Variable:	CAR[-1,1]	CAR[-1,1]	CAR[-1,1]
		Europe (0/1)	
Sample:		== 1	== 0
	(1)	(2)	(3)
Post 2015_t	0.742*	1.227**	-0.375
	(0.081)	(0.013)	(0.653)
Constant	-0.071	-0.358	0.615
	(0.807)	(0.257)	(0.333)
Observations	203	141	62
Δ *Coeffs. (p-value)*		-1.602* (0.092)	

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Appendix to
Out of sight, out of mind: Divestments and the Global Reallocation of Pollutive Assets

Tobias Berg, Lin Ma, and Daniel Streitz

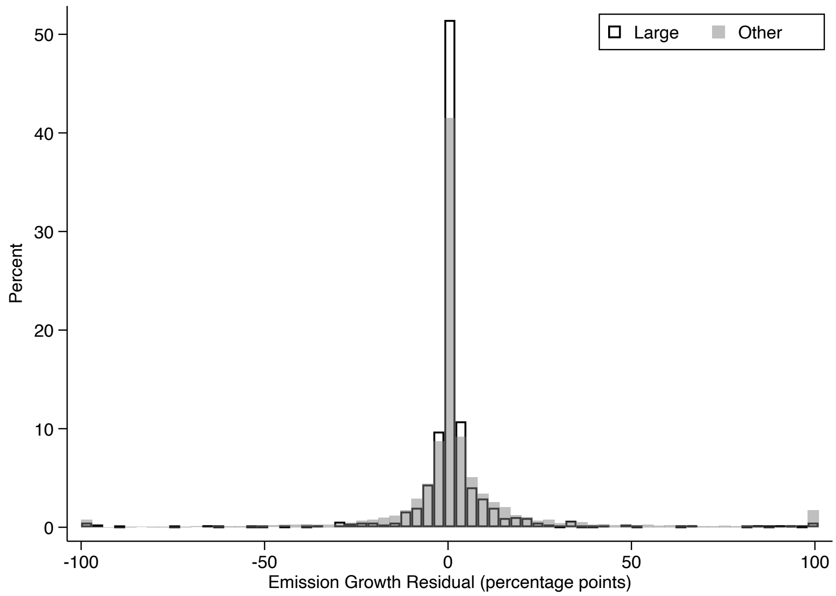

Figure A-1: **CDP Information on changes in Scope 1 and 2 emissions − Residual** This figure shows the histogram for the variable *Emission* $Growth^{Residual}_{i,t}$, which is the difference between the total Scope 1 and 2 emission growth rate for firm i from year $t-1$ to t (in percentage points) and the total emissions growth rate implied by the emission reduction category breakdown (see Figure 2 in the main paper for details). The sample is split into large emitters and other emitters.

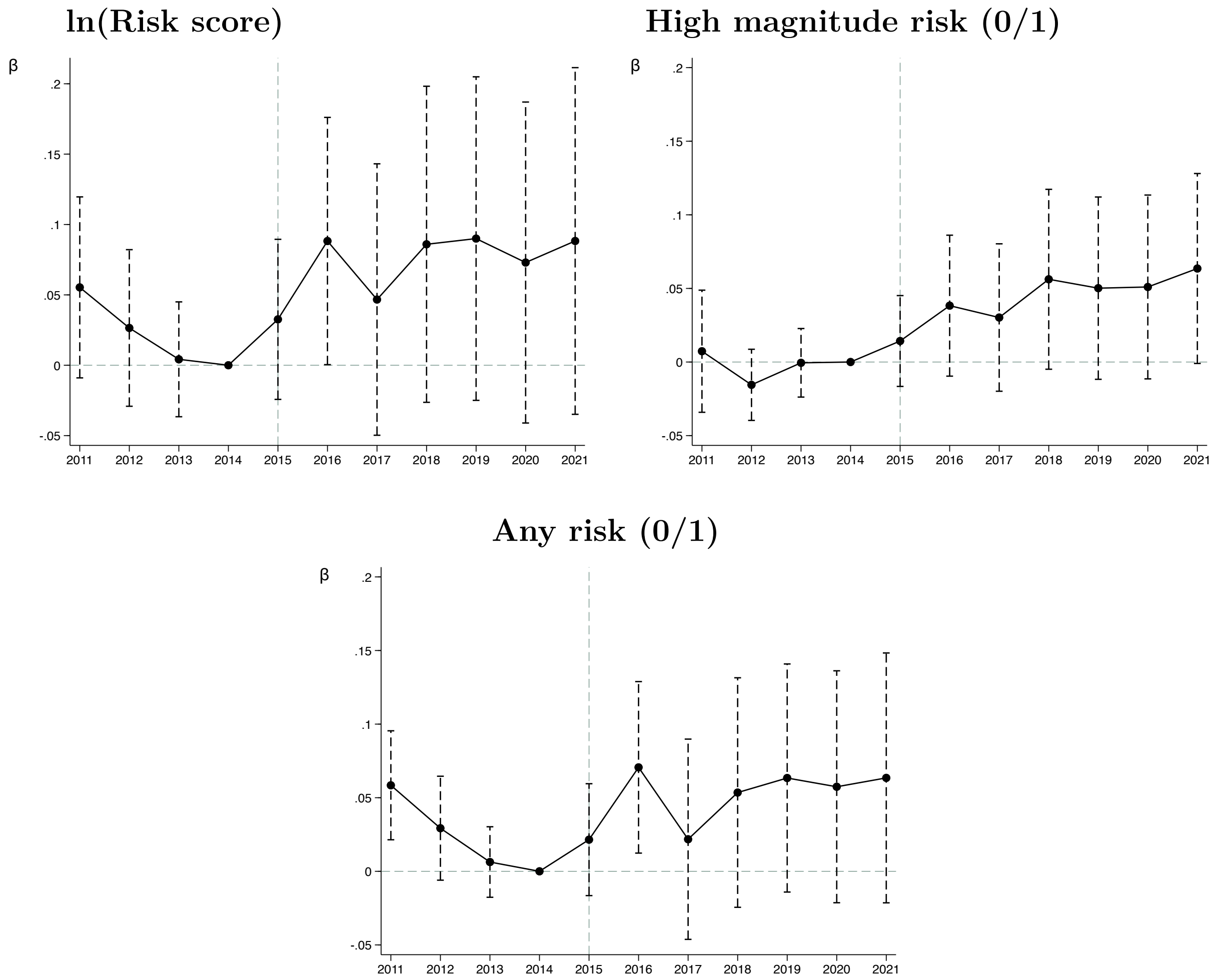

Figure A-2: **Dynamic effect: investor-related risks**
This figure plots estimated coefficients from the regression:

$$y_{i,t} = \sum_{k=2010}^{2021} \beta_k \left(\text{Large Em } (0/1)_i \times \text{Year k } (0/1)_t\right) + \alpha_i^{ind} \times \text{Post}_t + \alpha_i^{region} \times \text{Post}_t + \delta_i + \chi_t + \epsilon_{i,t},$$

where the dependent variable is either the (investor-related) *ln(Risk score)*, an indicator variable for high magnitude investor-related risks (*High magnitude risk*), or an indicator variable for any investor-related risks (*Any risk*). Variables are defined in more detail in Table 7 and in the main text. The dashed lines represent 90% confidence intervals, adjusted for firm-level clustering.

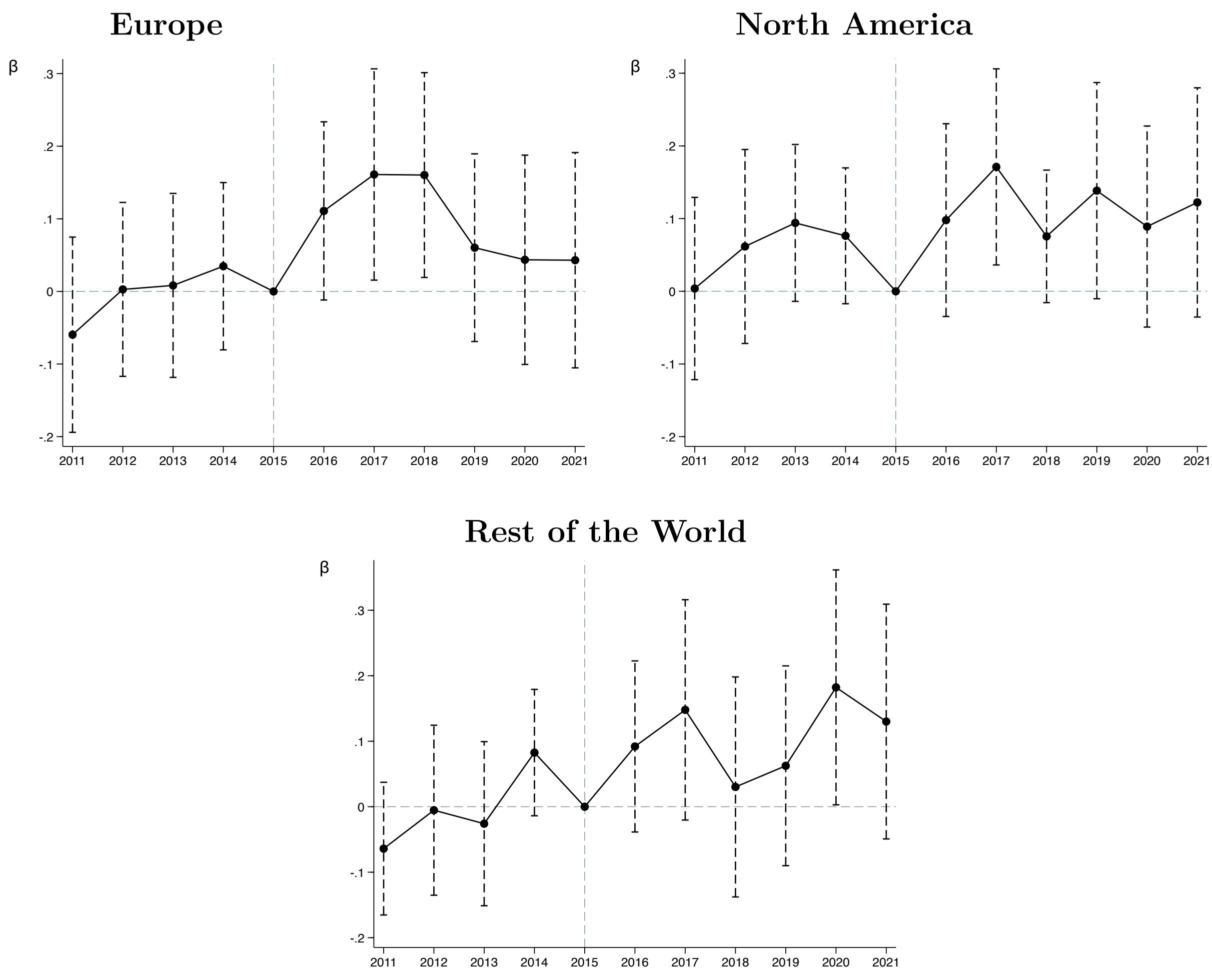

Figure A-3: **Dynamic effect on firm divestment activities − By region**
This figure plots estimated coefficients from the regression:

$$\text{Divestments } (0/1)_{i,t} = \sum_{k=2010}^{2021} \beta_k \left(\text{Large Emitter } (0/1)_i \times \text{Year k } (0/1)_t\right) + \alpha_i^{ind} \times \text{Post}_t$$

$$+ \alpha_i^{region} \times \text{Post}_t + \delta_i + \chi_t + \epsilon_{i,t},$$

where the dependent variable is an indicator variable that is equal to one if firm i indicates that their combined global Scope 1 and 2 emissions changed in year t because of divestments, and zero otherwise. All other variables are defined in Figure 3 in the main paper. The dashed lines represent 90% confidence intervals, adjusted for firm-level clustering. We estimate separate regressions for different geographic regions.

Table A-1: **Robustness: Alternative treatment definitions**

This table examines the emission activity of large emitters around the 2015 Paris Agreement. The unit of observation is the firm-reporting year-level *it*. The sample period is 2011 to 2021. *Top 150* equals one if firm i is among the 150 largest CO2 emitters (average Scope 1 emission level over the pre-Paris period), and zero otherwise. *Top 10%* equals one if firm i is among the top 10% largest CO2 emitters (average Scope 1 emission level over the pre-Paris period), and zero otherwise. *Scope 1+2* is the global Scope 1 and 2 emissions (in mt CO2e) of firm i in reporting year t. *Divestments* is an indicator equal to one if firm i indicates that their emissions changed in year t because of divestments. The regressions include firm, (reporting) year, *Post 2015* $\times$ industry (2-digit SIC code), and *Post 2015* $\times$ region fixed effects, when indicated. p-values based on robust standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Variable:	ln(Scope 1+2)	Divestments (0/1)	ln(Scope 1+2)	Divestments (0/1)
	(1)	(2)	(3)	(4)
Top 150_i $\times$ Post 2015_t	-0.131**	0.075**		
	(0.026)	(0.017)		
Top $10\%_i$ $\times$ Post 2015_t			-0.130**	0.076**
			(0.028)	(0.017)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes
Observations	11,851	12,352	11,851	12,352
Adj R^2	0.96	0.25	0.96	0.25

Table A-2: **Divestment activity by large emitters – Asset type and location**

This table reports descriptive statistics on the divestment activities of large emitters. Specifically, the table reports information on asset type and location of the asset (excluding spin-offs). See Table 9 for details on sample selection and variable definitions. Panel A reports information on the type (industry) of the divested asset. Panel B reports information on the asset location (geographical region). We report information separately by the region of the seller of the asset.

PANEL A. ASSET TYPE

Pre Paris Agreement			***Post Paris Agreement***		
	Volume (mil mt CO2e)	#Deals		Volume (mil mt CO2e)	#Deals
Power plant/distr.	41.5	23	Power plant/distr.	103.3	33
Oil and gas	39.8	46	Oil and gas	70.2	43
Steel plant	10.0	1	Steel plant	37.1	3
Other	5.5	21	Cement plant	36.8	14
Glass production	4.9	2	Other	7.9	29
Aluminium plant	4.8	4	Coal mine	6.6	12
Coal mine	3.4	3	Unknown	5.2	7
Unknown	2.0	1			
Total	112.1	101	Total	267.1	141

PANEL B. ASSET LOCATION

Pre Paris Agreement			***Post Paris Agreement***		
	Volume (mil mt CO2e)	#Deals		Volume (mil mt CO2e)	#Deals
Seller: Europe			*Seller: Europe*		
Europe	31.1	21	Rest of the World	72.4	47
Rest of the World	30.9	26	Europe	63.5	24
North America	17.2	26	North America	37.5	17
Unknown	2.0	1	Unknown	2.9	4
Total	81.2	74	Total	176.3	92
Seller: North America			*Seller: North America*		
North America	23.0	21	North America	49.5	24
Rest of the World	4.9	3	Rest of the World	19.4	12
Europe	2.2	1	Europe	2.8	3
			Unknown	2.4	3
Total	30.0	25	Total	74.1	42
Seller: Rest of the World			*Seller: Rest of the World*		
Rest of the World	0.9	2	Rest of the World	14.7	5
			North America	1.2	1
			Europe	0.8	1
Total	0.9	2	Total	16.7	7

Table A-3: **Divestment activity − Robustness**

This table explores through what means emission activities of large emitters change around the 2015 Paris Agreement. The unit of observation is the firm-reporting year-level *it*. The sample period is 2011 to 2021. *Large Emitter* equals one if firm i is a large CO2 emitter (defined in more detail in the main text), and zero otherwise. *Post 2015* is an indicator variable that is equal to one for firm reporting years after 2015, and zero otherwise. *Divestments* is an indicator equal to one if firm i indicates that their combined global Scope 1 and 2 emissions changed in year t because of divestments. *Sale* is an indicator equal to one if firm i indicates that their combined global Scope 1 and 2 emissions changed in year t because of divestments and the text description of the firm's divestment activities includes (versions of) the keywords: "sale," "sold," "sell," "spin-off," and related keywords that indicate asset sales. *Closure* is an indicator equal to one if firm i indicates that their combined global Scope 1 and 2 emissions changed in year t because of divestments and the text description of the firm's divestment activities includes (versions of) the keywords: "closed," "closure," "shut down," "ceased," or "stopped." *Divestments ex closures* is defined analogous to *Divestments* but the variable is set to zero if the text description of why firm i's combined global Scope 1 and 2 emissions changed contains any keywords associated with closures (as defined above). The regressions include firm, (reporting) year, *Post 2015* $\times$ industry (2-digit SIC code), and *Post 2015* $\times$ region fixed effects, when indicated. p-values based on robust standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

Variable:	Divestments	Divestments ex closures	Closure	Sale
	(0/1)	(0/1)	(0/1)	(0/1)
	(1)	(2)	(3)	(4)
Large Emitter$_i$ $\times$ Post 2015$_t$	0.091***	0.093***	-0.010	0.030*
	(0.005)	(0.002)	(0.557)	(0.094)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes	Yes
Observations	12,352	12,352	12,352	12,352
Adj R^2	0.25	0.22	0.15	0.10
Mean of dependent variable:	0.12	0.09	0.02	0.03

Table A-4: **Cumulative change in firm emissions – Balanced sample**

This table shows the cumulative change in total combined gross Scope 1 and 2 emissions (million mt CO2e) by category for a balanced sample of large emitters (N = 73) and other emitters (N = 540) over the pre-Paris period (2013-2015) and the post-Paris period (2016-2021).

	Other Emitters			**Large emitters**			
	Pre Paris	*Post Paris*	*Pre-Post*	*Pre Paris*	*Post Paris*	*Pre-Post*	*DiD*
Divestments	-34.6	-70.5	-35.9	-67.3	-369.3	-302.0	-266.2
M&A	37.5	151.9	114.4	120.7	162.2	41.5	-72.9
Firm Boundary	2.9	81.5	78.5	53.5	-207.1	-260.6	-339.1
Output Net	38.3	50.5	12.2	-32.3	-113.9	-81.6	-93.8
Method Net	39.4	-35.8	-75.1	42.9	-69.8	-112.8	-37.7
Residual Net	-79.0	-137.1	-58.1	-67.4	-271.2	-203.7	-145.6
Total	1.6	-40.9	-42.5	-3.3	-662.0	-658.7	-616.2

Table A-5: **Investor-related opportunities**

This table explores opportunities that large emitters report around the 2015 Paris Agreement. The unit of observation is the firm-period-level *it*, i.e., the sample period is split into a pre-Paris period (2011 to 2015) and a post-Paris period (2016 to 2021). *Large Emitter* equals one if firm i is a large CO2 emitter (defined in more detail in the main text), and zero otherwise. *Post 2015* is an indicator variable that is equal to one for the post-Paris period, and zero otherwise. The dependent variables measure whether firms indicate that climate factors bring investor-related opportunities (defined in more detail in the main text). Column 1 uses *ln(Oppo Score)* as dependent variable, where opportunity scores range from 1 (no opportunities) to 6 (high opportunities). Scores are defined as maximum scores by period and category. Column 2 uses an indicator variable that is equal to one if the firm reports investor-related opportunities with a score of *medium-high* or *high* in period t, and zero otherwise. Column 3 uses an indicator variable that is equal to one if the firm reports *any* investor-related opportunities in period t, and zero otherwise. The regressions include firm, *Post 2015* $\times$ industry (2-digit SIC code), and *Post 2015* $\times$ region fixed effects, when indicated. p-values based on robust standard errors, clustered at the firm level, are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

	Investor related opportunities		
Variable:	ln(Oppo score)	High mag. Oppo (0/1)	Any Oppo (0/1)
	(1)	(2)	(3)
Large Emitter$_i$ $\times$ Post 2015$_t$	0.086	0.006	0.027
	(0.712)	(0.904)	(0.590)
Firm FE	Yes	Yes	Yes
Industry x Post 2015	Yes	Yes	Yes
Region x Post 2015	Yes	Yes	Yes
Observations	2,666	2,666	2,666
Adj R^2	0.52	0.49	0.54
Mean of dep. var.:	0.84	0.15	0.20