Decarbonizing Institutional Investor Portfolios

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Abstract

Combining global data on institutional investors' equity holdings and firm-level carbon emissions, we study how climate-conscious institutions reduced the carbon emissions of their equity portfolios between 2005 and 2019. We hypothesize that institutions could either decarbonize via *tilting* their holdings towards lower emitting firms or via *engaging* their portfolio firms to curb emissions. Our analysis suggests that tilting is the predominant strategy used by climate-conscious institutions but also uncover some early evidence of longer-term engagement with the top emitting firms following the 2015 Paris Agreement. We also find limited evidence of other portfolio measures of energy transition in terms of green patents and firm revenues. Overall, our analysis raises some doubts about the effectiveness of investor-led initiatives in reducing corporate carbon emissions and taking necessary action on climate change.

JEL: G15, G23, G30, M14

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1. Introduction

Addressing the effects of climate change is one of the biggest challenges of our time. Particular attention has been focused on the role of publicly listed firms to curb their contribution to greenhouse gas (GHG) emissions that come from the burning of fossil fuels and other industrial production activities.[1] Institutional investors control a growing share of global equity market capitalization (Matos, 2020) and a recent survey by Krueger, Sautner, and Starks (2020) shows that these money managers believe that climate risks are financially material for their portfolios. The survey shows that, besides the physical, regulatory and technological risks possibly impacting their portfolio companies, many institutions are also motived by reputational concerns. This calls for the question: are institutional investors actively decarbonizing their portfolios to reduce the potentially negative climate change impact of their investments, and if so, how?

To better gauge the scale of decarbonization of institutional investors' equity portfolios, we aggregate GHG emission data for publicly listed companies around the world. Our analysis shows that between 2005 and 2019 the direct carbon emissions of publicly listed firms grew from 30% to 41% of total global CO2-equivalent emissions (Panel A Figure 1).[2] We then split out the GHG emissions by public firms into the fractions attributable to institutional investors, closely held shares, and other minority shareholders based on the ownership stake held by each group in their portfolio firms. The aggregate GHG emissions apportioned to institutional investor portfolios are essentially flat at 9% of total global emissions over the period (Panel A of Figure 1). This occurs despite the growth in total equity holdings of institutional investors from 43% to 53% of market capitalization (Panel B of Figure 1). A crude approximation would suggest that institutional investors portfolio GHG footprints should have grown proportionately from 9% to 15% {= 9%*[(53%/43%)*(41%/30%)]} of total global emissions over the period instead of staying flat. This indicates that institutional investors are

[1] We use the terms "GHG emissions" and "carbon emissions" interchangeably in the paper for simplicity of exposition. While CO2 is the largest contributor and most-commonly mentioned as the cause of the global rise in temperature, several gases, collectively known as GHG, are responsible for the "greenhouse effect." Climate scientists have concluded that continued growth in GHG emissions can lead to the earth's warming of 1.5°C, relative to pre-industrial levels, sometime between 2030 and 2050 (IPCC, 2018). According to Climate Action Tracker (2022), even if governments achieved their pledges agreed upon in the 2015 Paris Agreement, the world is likely to warm well above the 2°C limit by 2100 compared to pre-industrial levels.
[2] The total global CO2 equivalent yearly emission estimate for fossil fuel use, industrial processes and product is from EDGAR (the Emissions Database for Global Atmospheric Research) produced by European Commission, Joint Research Centre (2021).

decarbonizing their portfolios relative to other investor groups. Is this active decarbonization a result of increased climate risk awareness by institutional investors or rather the result of their engagement efforts with portfolio companies to curb company emissions and combat climate change?

In this paper, we conduct a comprehensive analysis of portfolio decarbonization strategies of "climate-conscious" institutional investors by studying their involvement with the first large-scale climate investor initiative: the CDP (formerly the Carbon Disclosure Project). In the absence of mandatory carbon emission disclosure, major investors created the CDP in 2000 to get companies worldwide to disclose their GHG emissions and their efforts to mitigate the effects of climate change. We begin our analysis by examining whether CDP members hold stocks that are responsible for less carbon emissions. We use global institutional equity holdings from FactSet Ownership to calculate absolute and normalized portfolio-level carbon metrics related to Scope 1 emissions (the direct GHG emissions stemming from operations that are owned or controlled by the portfolio firms) The analysis shows that while CDP signatories hold stocks with lower average and intensive carbon emissions in their portfolios compared to non-CDP institutional investors.

To get a better picture of whether institutional investors are actively decarbonizing their portfolios, we conduct tests on the year-on-year changes in GHG emissions. We find that CDP investors decarbonize portfolios across the majority of carbon metrics at a rate faster than other non-CDP institutional investors. Next, we test the different ways in which investors can approach portfolio decarbonization. Portfolio decarbonization can be achieved either by reducing their stakes in the top GHG emitters and rebalancing towards lower GHG emitters (portfolio *tilting*) or through targeted engagement by investors with portfolio companies to reduce their GHG emissions and green their business models (portfolio *engagement*). To test the tilting versus engagement hypotheses, we decompose the total change in portfolio carbon emissions into (1) a component that comes from investors changing their portfolio weights and (2) a component of the effect coming from portfolio firms changing emissions over time. Reductions in portfolio emissions due to changes in investor weights imply a tilting strategy, where investors reduce emissions by moving away from the highest emitters. In contrast, improvements in portfolio emissions that result from portfolio firms becoming less polluting over time suggest that investors may be engaging with firms to lower their emissions. Our results show that portfolio tilting explains most of the faster decarbonization by CDP investors. CDP investors decarbonize about 2 percentage points more than other institutional investors.[3] The CDP results on tilting are particularly significant for European-based CDP investors, perhaps reflecting that that lowering GHG emissions is a more salient issue in Europe as it introduced a "cap and trade" emissions trading system, the EU-ETS, that is increasingly pricing the external costs of GHG emissions.

The lack of large-scale evidence on engagement by CDP signatories may be due to these strategies needing to be more targeted and taking time to materialize. Consistent with this, when we isolate the top 100 Scope 1 emitting firms in each year and also expand to 3-year emission changes, we find some evidence of CDP investor engagement with respect to carbon emissions. In fact, recognizing that a disclosure push may not be sufficient to drive down emissions, a more recent investor initiative, Climate Action 100+ (CA100+), was launched in 2017 following the Paris Agreement Paris at the 2015 UN Climate Change Conference. CA100+ targets the world's largest corporate GHG emitters with the objective to get these to take necessary action on climate change. We find evidence that the investor signatories of CA100+ engage with portfolio companies to curb their emissions (in addition to tilting away from high-emission companies).

We also look beyond the current snapshot of portfolio GHG emissions to examine more forward-looking measures of how investee companies are developing green technologies (Cohen, Gurun, and Nguyen, 2021 and Hege, Pouget, and Zhang, 2022) and generating revenues associated with green products or services. Green patents and revenues have the potential to generate the technological breakthroughs and transformation of business models necessary to achieve net-zero emissions. We find that CDP (and CA100+) start to have a portfolio tilt to firms with higher green revenues, but not to green patents. One caveat to this analysis is the limited data which might still be a consequence of being in the early stages of a global transition to a green economy.

[3] For reference, UNEP (2019) estimates a required annualized fall of -7.6% in GHG emissions between 2020 and 2030 for the Paris Agreement goal of limiting global warming to +1.5°C compared to pre-industrial levels).

Our paper contributes to the growing climate finance literature (see Hong, Karolyi, and Scheinkmann, 2020, Giglio, Kelly, and Stroebel, 2021, Pastor, Stambaugh, and Taylor, 2021) and how investors incorporate firms' exposure to climate risks into security prices. For instance, Bolton and Kacperczyk (2021, 2022a) and Hsu, Li and Tsou (2022) focus on the cross-section of stock returns and find that firms that are more exposed to climate transition risk due to high GHG emissions earn higher risk-adjusted returns. In follow up studies, Bolton and Kacpercyck (2021b) examine the positive effects of disclosure of carbon emissions on stock returns and document that one cost of disclosing emissions is increased divestment by institutional investors, Bolton and Kacperczyk (2022) also study whether climate-related firm commitments via CDP and the science-based target initiative lead to a reduction in carbon emissions but the effect is small and tend to be in companies that already have lower carbon emissions (and not to those that need to reduce their emissions the most). By studying investor-led climate change initiatives, our paper is also related to the broader literature on ESG (see Pedersen, Fitzgibbons, and Pomorski, 2021; Goldstein et al 2021), responsible investing (see, for instance, Dyck et al 2019; Matos, 2020; Gibson et al. 2022) and divestment vs. engagement on ESG issues (Dimson et al. 2015, 2022, Edmans, Levit and Schneemeier, 2022).

Another stream of the literature focuses on how institutional investors as a group are approaching climate risk. For instance, Krueger, Sautner, and Starks (2020) show that institutional investors increasingly account for climate risk in their investment decision making. Ilhan et al. (2021) show that there is a positive association between institutional ownership and firm-level carbon disclosure. Flammer, Toffel, and Viswanathan (2021) examine the role of shareholder activism campaigns in eliciting greater voluntary disclosure of firms' exposure to climate risks. Azar et al. (2021) find that the "Big Three" have focused their climate engagement effort on large firms with high emissions and have been successful in influencing firms towards lower carbon emissions. Finally, in a contemporaneous study to ours, Cohen, Kadach and Ormazabal (2022) find that CDP signatories positively influence firms to disclose emissions and show evidence of engagement again by the "Big

Three". Our study is broader by studying how CDP investors decarbonize their portfolios by tilting and we examine engagement by the larger CA 100+ investor initiative beyond just the "Big Three". [4]

While some of the papers mentioned above examine investor engagement, other researchers have focused more extensively on the issue of portfolio divestment.[5] For instance in an early paper, Heinkel, Krauss, and Zechner (2001) examine the effects of exclusionary ethical investing on corporate behavior (see also or Hong and Kacpercyck, 2009). Using a theoretical framework, Davies and van Wesep (2018) document unintended consequences of divestment. For instance, Choi et al (2022) propose that divestment by financial institutions pushes public firms to adopt climate-friendly policies and decrease carbon footprints. In contrast to this finding, Berk and van Binsbergen (2022) evaluate the quantitative impact of ESG divestitures more generally and conclude that current ESG divesture strategies have had little impact. Atta-Darkua (2020) examines implications for firm equity value and ownership structure when a large and well-known institutional investor publicly excludes a firm from its portfolio due to unethical behavior. Finally, Bolton, Kacpercyck, and Samama (2022) propose a methodology of decarbonization such that investor portfolios are aligned with a science-based carbon budget consistent with maintaining the global temperature rise within what is set out in the Paris Agreement.

2. Data on Climate-Conscious Investors

2.1. Investor-Led Climate Change Initiatives

In this paper, we focus on "climate-conscious" investors that are engaged in CDP, the earliest and most prominent investor-led climate change initiative. CDP is a non-profit organization that was founded as the Carbon Disclosure Project in 2000 with funding from grants and investor membership fees to collect and distribute information on firm-level exposure to, and management of climate risks. To achieve this aim in 2002, the CDP started sending an annual questionnaire to request firms to report their greenhouse gas emissions as well as their climate risks, strategies, and actions. By 2021, CDP collected

[4] The results are robust to removing the Big Three (BlackRock, State Street, and Vanguard) from our sample.

[5] Divestment is sometimes used to refer to reducing just holdings in coal or oil & gas companies with the focus being on stopping future emissions if their fossil fuel reserves were burned (Bessembinder, 2016). Our paper takes a wider lens on portfolio decarbonization across all industries and focuses on tilting, engagement, and shifting assets to companies developing clean technology solutions.

environmental disclosure on over 13,000 companies on behalf of over 680 investor signatories.[6] In the later part of our analysis, we also examine membership in Climate Action 100+ (CA100+), a more recent initiative focused on investor engagement.[7] Launched in 2017, this initiative targets the global top 100 (subsequently expanded to the top 166) publicly listed companies that have the largest GHG emissions in order to accelerate their net-zero emissions transition and meet the objectives of the 2015 Paris Agreement. To identify this list of target companies, CA100+ used CDP data focusing on the top emitting firms whose aggregate GHG emissions accounted for over 80% of the total CDP global GHG emissions data. As of the 2022, CA100+ had over 700 signatory investors with a total of over US$ 68 trillion of assets under management.

We match the list of climate-conscious investors to FactSet Ownership, which provides global institutional equity holdings – see Ferreira and Matos (2008) for details on this data.[8] We use portfolio data at the end of each calendar year from 2005 to 2019. The final sample consists of institutional investors with at least US$ 100 million in equity holdings, owning at least five equity securities in their portfolio. As of the end of 2019, our sample of institutional investors included 623 CDP signatories and 268 CA100+ members.

Figure 2 shows the growth of the CDP and CA100+ initiatives both in terms of the number of signatory institutions (Panel A) and their total equity holdings (Panel B). At the end of the sample period, the equity assets under management (AUM) of CDP signatories comprised 55% of the US$ 37 trillion total institutional investor equity holdings while investors that were part of CA100+ still represented only 15% of total institutional ownership. Table 1 shows that about half of CDP signatories are based in Europe. Also of note is that the percentage of investment managers in CDP increased over time, whereas asset owners accounted for a larger proportion of the early cohort of signatories.[9] The investor

[6] For background see https://www.cdp.net/en/info/about-us/20th-anniversary. CDP also collects data on GHG emissions of cities, states, and regions and has broadened its mission statement to also include disclosure on water security and deforestation.
[7] For more details on CA100+ see https://www.climateaction100.org/.
[8] The match of CDP and CA100+ members to FactSet Ownership was done by exact and then a fuzzy name matching algorithm complemented with manual checks. We considered both parent or subsidiary entity names in FactSet and we used the closest match. For example, for Fidelity we found that FIL Investment Advisors (UK) Ltd. is a CDP signatory, but Fidelity Management & Research Co. LLC (US) is not.
[9] Note that for an asset owner to be covered by FactSet Ownership, the institution needs to have considerable direct equity holdings. Asset owners that outsource the management of their equity investments do not show up in our sample as a separate institution as their assets will be part of their respective investment managers' portfolio filings.

base of CA100+ is substantially smaller than the one of CDP, reflecting the fact that it is a more recent (and perhaps more focused) initiative.

In the Internet Appendix, we provide more details on the characteristics of institutional investors that are part of the two voluntary climate change related initiatives. Table IA.1 provides a list of the top 10 institutional investors (by Equity AUM as of 2019), showing that all of the top 10 European institutions were CDP signatories by the end of sample period while this was the case for only 5 of the top 10 domiciled elsewhere. Table IA.2 documents that the strongest factors associated with the decision to join CDP and CA100+ are equity AUM (*Portfolio Size*), being located outside of *North America*, and a more value-oriented portfolio (lower *Average Market-to-Book*).

2.2. Carbon Emissions, Green Revenue and Green Patents

We access global corporate carbon emissions data from Trucost in order to calculate the GHG emissions profile of institutional investor portfolios.[10] Trucost standardizes and validates the firm-level emission data, which spans from 2005 to 2019 and by the end of the period covers over 15,000 publicly listed firms representing over 95% of global market capitalization. We focus our analysis on firm Scope 1 emissions, which are the direct GHG emissions stemming from operations that are owned or controlled by firms. Emissions are measured in "carbon dioxide equivalents [CO2e]", a term used to describe all greenhouse gases in a common unit.[11] Examples of Scope 1 emissions include those from fossil fuels burned on site or emissions from vehicles. Trucost obtains emission data directly from companies' disclosure (in annual reports, regulatory filings, corporate social responsibility reports, etc.) and from third parties such as the CDP. When reported data is not available, Trucost uses its proprietary carbon estimation model (EEIO, Environmentally-Extended Input-Output Model) to impute emissions.

[10] Trucost is part of S&P Global (https://www.spglobal.com/esg/trucost) covers "core plus" listed equity securities that are part of the S&P Broad Market Index (BMI) (11,500 large-, mid-, small- and micro-cap companies) and some additional indices (S&P China A SmallCap 300 Index, S&P 500 Index, S&P Global 1200 Index, S&P/TOPIX 150 Index, S&P/TSX Composite Index, S&P/ASX 200 Index, S&P/ASX 300Index) as well as other large listed companies added per client request.

[11] Each GHG has its own global warming potential (GWP), which measures how much heat the specific GHG can trap within the atmosphere. CO2e puts all GHG emissions in relation to carbon dioxide, which has a GWP standardized to one.

Figure 1 shows that the total Scope 1 emissions of firms in Trucost grew from about 9 gigatons (billion tons) of CO2e in 2005 to close to 16 gigatons of CO2e in 2019.[12] This means that corporate emissions by publicly listed firms rose from 30% to 41% of total global CO2e emissions estimated by EDGAR[13] for fossil fuel use, industrial processes and product use which grew from 30 to 38 gigatons of CO2e in the time period. Panels A and B of Figure IA.1 show that there has been an increase in the rates of corporate GHG disclosures, either full or partial. The small dip in 2016 is due to the coverage expansion of the Trucost proprietary carbon estimation model that year.

We calculate four metrics of portfolio GHG emissions which are increasingly used by institutional investors in reporting the carbon profiles of their portfolios to their end investors or beneficiaries. The first measure is *Scope 1* which consists of the weighted average of the direct GHG emissions (in tons of CO2e) from operations by the firms held in an investor's portfolio. The weighted average carbon emissions of investor *I* at time *t* is defined as:

$$Scope\ 1_{it} = \sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}} \right) * Scope\ 1\ GHG\ Emissions_{jt}$$

where $\$\ Shares\ Held_{ijt}$ is the dollar amount of firm *j* stock which investor *i* holds at time *t*, $\$\ Portfolio\ Size_{it}$ is the dollar size the investor's equity portfolio, N_{jt} is the number of stocks in the investor's portfolio at time *t*, and $Scope\ 1\ GHG\ Emissions_{jt}$ are the Scope 1 emissions of firm *j*.

The second portfolio measure, *Scope 1 Footprint*, quantifies how much of a firm's emissions can be apportioned to that institutional investor based on its ownership share in the investee firms. To illustrate it with an example: if an investor's position in a company is equal to 1% of the company's market capitalization, then the investor "owns" 1% of the company's direct Scope 1 GHG emissions. Calculating the "owned" GHG emissions from each position in the portfolio and summing those

[12] Trucost coverage of public listed companies is higher than other leading data providers. For example, the total GHG emissions of MSCI ACWI Investable Market Index (which covers over 9,200 listed companies) were estimated at 11.3 gigatons of CO2e in 2019 (see MSCI "The MSCI Net-Zero Tracker", October 2021).
[13] EDGAR is an independent report of global GHG emissions that contributes to the Paris Agreement process. The data considers carbon dioxide emissions from all anthropogenic activities such as the burning of fossil fuels and cement manufacture, but not emissions from land use and forestry (which are hard to account for in terms of carbon emissions and removals, due to the complexity of terrestrial ecosystems and the difficulty of disentangling anthropogenic and natural fluxes).

emissions yields the total GHG emissions of an investor's portfolio. It is an estimate of an investor's total contribution to climate change based on its ownership stake in the emitting firms. The *Scope 1 Footprint* for an investor *i* at time *t* is defined as:

$$Scope\ 1\ Footprint_{it} = \sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}} \right) * Scope\ 1\ GHG\ Emissions_{jt}$$

where *$ Shares Held*$_{ijt}$ is the dollar amount of firm *j* stock which investor *i* holds at time *t*, *$ Market Cap*$_{jt}$ is the dollar size of firm *j*, N_{jt} the number of stocks in the investor's portfolio at time *t*, and *Scope 1 GHG Emissions*$_{jt}$ are the Scope 1 emissions of firm *j*. Using this measure, Figure 1 shows that institutional investors "owned" collectively a total of 2.8 gigatons of CO2e in 2005 (9% of the global total in EDGAR, 31% of public firms in Trucost) and 3.4 gigatons of CO2e in 2019 (still 9% of the global total, 21% of public firms). By comparison, if we take the emissions apportioned to the ownership stakes held by other non-institutional blockholders (and minority investors) in public firms it grew faster from 2.0 to 4.8 (and 4.1 to 7.4) gigatons of CO2e from 2005 to 2019.

The next portfolio carbon metric is *Scope 1/ Portfolio Size* which divides the *Scope 1 Footprint* measure of each investor by *Portfolio Size* (i.e., it normalizes the carbon emissions for every $1 million of market value of an investor's equity portfolio). This allows us to make comparisons across investors of different portfolio sizes. Therefore, the *Scope 1/Portfolio Size* for an investor *i* at time *t* is defined as:

$$\text{Scope 1}/Portfolio\ Size_{it} = \frac{\sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}} \right) * Scope\ 1\ GHG\ Emissions_{jt}}{Portfolio\ Size_{it}}$$

The final portfolio measure *Scope 1/Revenue* is computed as the weighted average carbon intensity of the portfolio, based on firms' Scope 1 emissions divided by their revenues. This is achieved by first calculating the carbon intensity (Scope 1 / $ mln Sales) for each portfolio company and then computing the weighted average using the investor portfolio market value weights. It captures carbon efficiency for the level of output of firms held by an investor. Sales are used in this portfolio context as the most comparable measure of the scale of firm operations when comparing across industries (instead of industry-specific measures of output such as per tons of steel, miles flown, MWh of power generated, etc.). The *Scope 1 / Revenue* for an investor *i* at time *t* is:

$$Scope\ 1/\ Revenue_{it} = \sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}} \right) * \frac{Scope\ 1\ GHG\ Emissions_{jt}}{Revenue_{jt}}$$

where *\$ Shares Held*$_{ijt}$ is the dollar amount of firm *j* stock which investor *i* holds at time *t*, *\$ Portfolio Size*$_{it}$ is the dollar size the investor's equity portfolio, N_{jt} the number of stocks in the investor's portfolio, Scope 1 GHG Emissions$_{jt}$ are the Scope 1 emissions of firm *j*, and *Revenue*$_{jt}$ is firm *j*'s revenue.

To provide some examples, Figure IA.2 in the Internet Appendix displays GHG emissions metrics for four prominent institutional investors: the "Big Three" institutions (Blackrock, State Street, Vanguard) and the world's largest sovereign wealth fund (Norges GPFG).[14] Panels A and D shows that all four institutions have been gradually reducing their portfolio weighted Scope 1 average and intensity emissions. However, since the aggregate size of their equity portfolios has been rising (Panel C), so has their total portfolio emissions footprint (Panel B). In Panel E, we examine the relation between portfolio size and emissions footprint by plotting the proportion of equity assets that are allocated to each investor among the four, as well as their proportion of the investors' carbon footprint. This analysis shows that State Street stands out as having decarbonized faster than its peers.

We also examine two other portfolio measures of an investors' exposure to climate change that are less risk-focused than carbon emissions but rather more forward-looking and intended to capture opportunities from developing solutions to address climate change. The first metric we employ is an investor portfolio's exposure to firms developing technologies related to the environment and climate change adaptation. We collect firm patent data from the Global Corporate Patent Dataset (GCPD) developed by Bena, Ferreira, Matos and Pires (2017).[15] Then we identify which patents are green using the OECD environmental-related mapping developed by Hascic and Migotto (2015) and used in other recent finance papers such as Cohen, Gurun and Nguyen (2021) and Hege, Pouget, and Zhang (2022).[16]

[14] For ease of interpretation, in this figure we aggregate all of the sub-entities (e.g. Blackrock Fund Advisors US, Blackrock Investment Management UK) to the parent companies (ex: Blackrock) to treat each Big Three as a single aggregate portfolio.
[15] The GCPD data is available at https://patents.darden.virginia.edu.
[16] Source: http://stats.oecd.org/wbos/fileview2.aspx?IDFile=0befc58e-d72f-4ff9-b27e-84e446240e34

Once we classify the set of green patents by each publicly listed firm, we create the variable *Green Patent %* at the portfolio level as the ratio of green patents to total patents by the firms held by an institutional investor. Missing firm data is filled in with zeros. We use granted patents, and since there is a lag in approving filed patents, this measure is available only from 2005 to 2012.

The second measure is the fraction of firm-level revenues which come from green business activities. Examples include revenues from clean technologies such as, for instance, electrified cars or solar panels. We access data from FTSE Russell on revenue exposure to green business activities for over 16,000 stocks starting from 2017 and classified using the EU Taxonomy on sustainable activities.[17] We use this firm-level data to calculate a weighted average measure of the *Green Revenue %* of an investor's portfolio. Firms that are not covered in the FTSE Russell dataset are assumed to have zero green revenues.

Another forward-looking measure of firm behavior are their emissions reduction targets (Bolton and Kacperczyk, 2022 and Freiberg, Grewal and Serafeim, 2021). These are commitments by firms to reduce their future emissions to a specified absolute or relative (e.g. revenue-adjusted) level. We obtain this data from firm disclosures to the CDP (available 2010-2018). In addition to the firm's internal targets, from 2016, CDP disclosures also identify which firms have plans aligned with the emission reduction objectives of the Paris Agreement and verified by the Science-based Targets Initiative (SBTi)[18]. We use this data to create two portfolio-level emissions target measures: *Emissions target %,* which captures the percentage of firms in the investor portfolio that have an emissions reduction target, and *Science-based Emissions target %,* which captures the percentage of firms in the investor portfolio that have a verified Science Based Targets initiative emission reduction target plan. However, science-based emissions targets are still recent and small-scale (see Panel D of Figure IA.1).

2.3. *Sample Statistics*

[17] For more information, see FTSE Russell "Sizing the green economy: Green Revenues and the EU taxonomy" https://content.ftserussell.com/sites/default/files/sizing_the_green_economy_green_revenues_and_the_eu_taxonomy_final_4.pdf and European Commission "EU taxonomy for sustainable activities - What the EU is doing to create an EU-wide classification system for sustainable activities" https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en

[18] Information on the Science based Targets Initiative is available at: https://sciencebasedtargets.org. The SBTi is a partnership between CDP, the United Nations Global Compact, World Resources Institute and the World Wide Fund for Nature.

We control for investor characteristics and portfolio investment styles in our multivariate regressions. Our set of investor controls comprises an investor's equity AUM (*Portfolio Size*), region of domicile (*Europe*, *North America*, or *Rest of the World*), and investor type (*Asset Owner* or *Investment Manager*). Our set of portfolio controls includes the number of companies and industries (*# Companies*, *# Industries*), type of stocks (*Average Market Cap* and *Average Market-to-Book*) and geographic exposure (*Own Region %*, *Developed Markets %*). Appendix A provides detailed definitions and the data sources for each of these variables. Table 2 provides summary statistics for our sample consisting of 56,981 investor-year observations between 2005 and 2019 used in subsequent regression analysis.

3. Climate-Conscious Investors and Carbon Emissions

3.1. Do the Portfolios of Climate-Conscious Investors Have Lower Carbon Emissions?

We begin our analysis by examining whether climate-conscious investors hold stocks with lower GHG emissions. Figure 3 shows a downward trend in the portfolio carbon metrics of institutional investors, regardless of whether or not investors are CDP (or CA100+) signatories. It shows also that decarbonization is a common feature for large cap companies in the MSCI ACWI index (a benchmark that is commonly tracked by major institutional investors around the world).

Panel A of Table 3 examines our four portfolio-level Scope 1 emission metrics and the main variable of interest is *CDP* (a dummy that identifies climate-conscious investors as those that signed up for the CDP initiative). In the regressions, the baseline group are institutional investors that did not join the initiative. For each metric, we run three specifications and winsorize all continuous variables at the 1% and 99% cutoff levels each year. Our first model includes only basic investor characteristics and year fixed effects (columns 1, 4, 7, 10) and these regressions would suggest that CDP signatories have significantly higher Scope 1 carbon emissions than their institutional peers. However, these results change once we include additional portfolio controls to capture differences in investment styles, such as, for instance, an orientation towards large-caps, value, or emerging market stocks that have higher carbon emissions (columns 2, 5, 8, 11). Our main specification additionally includes investor fixed effects (columns 3, 6, 9, 12) which absorb all time-invariant effects at the investor-level, so the analyses can be interpreted as capturing how investors change their portfolio carbon metrics once they join the

CDP initiative. We find that CDP investors reduce their average and intensive portfolio emissions more than other institutional investors (columns 3 and 6). Examining the economic significance of the effects, once they join the initiative, CDP investors have around -7.1% lower average portfolio emissions, and -4.2% lower emissions intensity than otherwise similar investors. However, we find that the effects are not statistically significant for metrics that take into account an institution's equity ownership share in the portfolio companies (columns 9 and 12).

While our analysis focuses on Scope 1 emission, climate-conscious investors may be interested in other carbon indicators on their portfolio companies. First, in Panel B of Table 3 we repeat the analysis for *Scope 2+3* emissions. Scope 2 emissions comprise companies' indirect GHG emissions from the purchased energy. Scope 3 emissions are indirect greenhouse gas emissions from upstream supply chain and purchased materials and also downstream emissions inherent in the use of its products and services and constitute a large part of GHG emissions for many industries (Dai, Duan, Liang and Ng, 2021).[19] The results suggest that CDP signatories are less concerned about indirect carbon emissions of their portfolios. Second, since CDP is a disclosure-based initiative, Panel C of Table 3 shows, as expected, that portfolios of investors that join the CDP tend to have higher *Full Carbon Disclosure %* than those of other investors. Finally, another focus of the CDP initiative is to get firm commitments to set targets in terms of reductions in carbon emissions. However, the regression results with investor fixed effects do not show significant improvement in *Emissions Target %* or *Science-based Emissions Target %* .

3.2. How Are Climate-Conscious Investors Decarbonizing their Portfolios?

We now look at how climate-conscious institutional investors decarbonize their portfolios by examining key factors associated with annual changes across the carbon emission metrics. We compute the annual changes by subtracting the log measures of portfolio emissions in period $t + 1$ from those in period t (and it is easy to interpret log differences as percentage change in carbon metrics). We also forward the changes by one period since emissions data are typically reported with a significant time lag. Panel A of Table 4 shows that CDP investors decarbonize portfolios across two of the four Scope 1 emission

[19] These definitions follow the Greenhouse Gas Protocol (https://ghgprotocol.org/). However, an important caveat is that *Scope 2 + 3* emissions are often not consistently calculated or disclosed by companies as these occur from sources not controlled by the company, and the boundaries to measure Scope 3 emissions are not well-defined.

measures (carbon intensities and total footprint). In Panel B, we investigate if these efforts extend beyond Scope 1 but, after we account for portfolio characteristics, the decarbonization of portfolio Scope 2 + 3 emissions is weaker.

The main focus of our paper is testing the different ways in which investors can approach portfolio decarbonization. To better illustrate different ways of decarbonizing, in Panel A of Figure 4, we plot the total footprint of institutional holdings in the top 100 Scope 1 emitting firms in the public equity markets each year. Splitting the top 100 emitters into quintiles, we can see that over time institutional investors have reduced their exposure to emissions from the top 20 emitting firms (which we label *brown* firms). The first method, which we refer to as *tilting*, is visualized in Panel B of Figure 4 and consists of investors reducing ownership of brown high-emission firms and substituting towards green lower-emitting firms. In Panel C of Figure 4 we illustrate *engagement*, the alternative approach in which the investor is more proactively influencing its portfolio firms to reduce their GHG emissions, rather than just shying away from owning them. Both tilting and engagement could help an investor decarbonize. However, with the tilting approach, portfolio firms are not encouraged to improve emissions over time and therefore investors may be shielding their portfolios but not addressing climate change from a societal perspective. This is a simplified representation which does not account for second-order effects such as a potential higher cost of capital for firms adversely impacted by tilting. Engagement has the benefit of improving both an investor's exposure to climate change and also potentially addresses the negative externality by reducing firm-level carbon emissions. In contrast, tilting may be simply pushing the problem on to other investor groups, or to state it differently, it makes the negative externality "someone else's problem".

To test for tilting vs. engagement, we decompose the total change in portfolio carbon emissions into (1) the component that comes from investors changing their portfolio weights in different firms as well as (2) the component of the effect of portfolio firm emissions changing over time. To separate these, we allow only one of the two components to change over time. In the tilting regressions, we calculate the emissions metrics in period $t + 1$ using updated portfolio weights but keep firm emissions the same as they were at time t. We then subtract this measure from the portfolio emissions at time t.

These change variables, which we label "Δ *weights-only*" capture the extent to which investors are moving their equity portfolio allocations away from high emissions firms and towards firms with lower emissions. In contrast, in the engagement regressions, we only permit firm emissions to change in $t + 1$, but keep firm portfolio weights the same as they were in period t. We subtract this measure from the portfolio emissions in period t. The resulting variables, "Δ *emissions-only*" capture the change in emissions footprint which is due to improving emissions in firms owned at time t. Such improvements should be, at least to some extent, a result of investors engaging with their portfolio firms to reduce their emissions. We describe these measures in more detail in Appendix B of the paper.

Table 5 shows the tests for tilting (Panel A) and engagement (Panel B) analysis for the Scope 1 emission measures. The results of Panel A indicate that portfolio tilting explains most of the decarbonization of CDP investors. In Panel B we do not find statistical evidence of corporate engagement strategies. We can also comment on the economic magnitude of these effects. Since the emissions change variables are differences of logs, for small changes, we can interpret the CDP coefficients as the percentage change in the emissions variables compared to other institutional investors. Across three of the measures, CDP investors decarbonize -2 percentage points more than non-CDP institutional investors via tilting. Using the sample averages we estimate a decarbonization rate of around -7% per year for CDP investors (which compares to -5% for non-CDP investors as shown in Panel B of Table 2). To put these magnitudes into context, UNEP (2019) warned that emissions need to fall by an annualized -7.6% between 2020 and 2030 for the Paris agreement goal of limiting global warming to +1.5°C to be met. Thus while this portfolio decarbonization is economically meaningful, tilting implies that this is achieved primarily by selling shares to other investor groups, rather than pushing companies to improve emissions, somewhat making the GHG emissions to be "someone else's problem". Part of the emissions are being "traded" from CDP to non-CDP institutions but Figure 1 suggest that an even larger fraction become "owned" by non-institutional blockholders and minority shareholders that may be even less motivated to tackle corporate carbon emissions.

The salience of climate change is likely to vary across the world. A survey by Amel-Zadeh and Serafeim (2018) suggests that ethical motives to invest responsibly may play greater role among

European investors and Dyck et al. (2019) also suggest that institutional investor decisions are influenced by their more environmental-friendly social norms. Perhaps even more significantly, Europe started in 2005 the world's first emissions trading system (or EU-ETS) which remains the biggest one.[20] The "cap and trade" scheme makes the financial costs of GHG emissions more visible to European-based investors. We test if there is a differential effect by adding an interaction dummy *CDP * Europe,* where the Europe dummy identifies if a CDP investor is headquartered in Europe. Table 6 shows that European CDP investors tilt significantly more than other CDP and non-CDP investors across all emissions specifications (Panel B) but this is not the case for engagement (Panel C). Using Panel B, we estimate that decarbonization via tilting is faster for European CDP investors who are decarbonizing at a rate between -3 to -4 percentage points higher than other institutional investors. In robustness checks tabulated in the Internet Appendix, we test if tilting is stronger in sectors where emissions are more material for firms. In Table IA.3, we run regressions using the emissions of European investors that stem from firms in three sectors that have the largest total GHG emissions (materials, utilities, and energy). The results suggest that European CDP investors reduce their footprints in material sectors more than other European investors and this is achieved via tilting. However, we do not document higher tilting across the other measures.

To conclude our analysis, we discuss whether portfolio tilting might have real effects by imposing higher cost of capital on firms that are being divested by CDP investors. To provide an upper bound of the impact of tilting, we calculate an estimate based on the formula of Berk and van Binsbergen (2022, page 2). If we assume all CDP investors were to divest all firms in three material sectors (materials, energy, and utilities), the change in the cost of capital for those firms would be 15 basis points.[21] We believe that this is economically quite modest to incentivize large-scale corporate decarbonization.

[20] For details see https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets_en.
[21] We adapt the Berk and van Binsbergen (2022, page 2) cost of capital charge formula as follows: $Market\ Risk\ Premium \times \left(\frac{\$\ Held\ by\ CDP\ Investors}{\$\ Rest\ of\ Total\ Market\ Cap}\right) \times \%\ Material\ Sectors\ \times (1 - correlation^2)$. We then assume a 6% market risk premium, and using data from 2019 where CDP investors make up 29% of equity market capitalization (=53%*55% of institutional investor holdings, see Panel B of Figure 1 and Panel A of Table 1), the weight of firms in the material sectors is 20% of the MSCI ACWI index in December 2019, and their returns correlation with the rest of the market we estimated 83% from 2006-2019 data.

3.3. *Evidence of Engagement: Does it Take Time and Need to be Targeted?*

While our tests have examined large-scale portfolio decarbonization via tilting, engagement by climate-conscious investors may need to be more targeted and also such efforts might take time to materialize. As we discussed when describing Figure 4, aggregate carbon emissions are particularly concentrated in the top 100 emitting firms (and this is also why the CA100+ initiative started with 100 focus companies that were deemed most important). In 2005, over two thirds (68%) of the overall institutional investor carbon footprint can be attributed to those top 100 emitting firms, falling to just under half of total emissions in 2019 (46%). By comparison, Figure IA.3 in the Internet Appendix shows that other investors decarbonized less and the proportion of their carbon footprint coming from top 100 emitting firms fell from 63% to 54% over the same time period. Consequently, we test how CDP investors are decarbonizing faster their emissions stemming from these top 100 emitting firms. The results in Table 7 show that CDP investors consistently reduce their footprints stemming from the top 100 Scope 1 emitters (Panel A). We find evidence this is achieved by a combination of tilting (Panel B) and to a smaller extent also via engagement (Panel C).

Another issue is the time horizon over which different approaches to portfolio decarbonization might produce effects. While portfolio tilting can be implemented within a year via rebalancing, engaging with firms to reduce emissions can be a more involved process taking place over multiple years to deliver tangible results. To test this hypothesis, we run regressions with three-year portfolio changes. Table 8 shows that CDP investors improve the absolute and portfolio size-adjusted carbon footprint of their portfolio firms more than the average institutional investor (Panel C). Even though the multi-period analysis shows more evidence of engagement, we still find results for tilting across average and intensive portfolio emissions (Panel B). Both effects contribute to the significant overall decarbonization across all portfolio emissions measures (Panel A).

The pressure for investors to engage on climate change issues rose following the Paris Agreement of December 2015 with the finance sector (and institutional investors in particular) being asked to contribute to the global effort. Specifically, we examine how investors that signed up to the CA100+ initiative with the specific mandate to engage with the 100 top emitting firms in the public equity markets (later increasing the number to 166). There is a high overlap in the memberships of CDP and CA 100+, with over 75% of CA100+ signatories also being signatories of CDP. Therefore, we create three new dummies, one for investors who are only members of CDP (but not CA100+), one for investors who are only signatories of CA100+ (but not of CDP), and finally, one for investors who have committed to both initiatives. Because CA100+ did not have investor members prior to 2017, an investor can only fall in the second two categories from 2017 onwards.

Table 9 shows that both only CA100+ investors and members of both coalitions incrementally reduce portfolio emissions across all measures, except emissions intensity (Panel A). In fact, those who only participate in CA100+ increase their portfolio intensity emissions over time more than other investors. The tilting results mirror those for total changes. This finding is consistent with investors committed to only CA100+ tilting away high absolute emitters and, perhaps inadvertently, towards high intensity emitters (Panel B). We also document some evidence for engagement for this group of investors (only CA100+), as their absolute and relative portfolio footprint measures are decreasing more than for other institutional investors in the engagement test (Panel C). The estimated engagement effects, however, are lower in magnitude than those for tilting. The engagement results also show a relative increase in the average emissions of the signatories to only CA100+, suggesting that the footprint reduction in their portfolios could come at a cost. High overall emissions could potentially capture portfolio exposure to future emissions regulations. We conclude that following the Paris Agreement, there is evidence consistent with some climate-conscious investors also increasingly engaging with portfolio firms. However, the impact on their portfolios from such potential actions is smaller in magnitude than that achieved by tilting.

In the Internet Appendix we conduct additional robustness checks. First, in Table IA.4 we concentrate on European CDP investors and the changes in portfolio allocations and GHG footprints of firms in the material sectors (energy, materials and utilities). We split portfolio emissions into those that come from the top 100 emitting firms in the material sectors each year (Panel A), those coming from the remaining firms in the material sectors (Panel B), and those from firms in non-material sectors (Panel C). We find that European CDP investors reduce their portfolio weights and footprint in the top 100 emitters in the material sectors. In contrast, we do not find incremental reductions for allocations and emissions from the other two groups. Second, in Table IA.5 we examine whether climate-conscious investors are reducing their exposure to Scope 1 emissions as a proportion to total Scope 1 + 2 + 3 emissions and find evidence that CDP investor portfolios tilt towards firms with lower direct to indirect emissions ratios. This could be consistent with CDP investors having a preference towards firms that may be curbing their emissions by "outsourcing" it to others in their supply chain (Dai et al., 2021). Finally, in Table IA.6 we examine changes across investors full portfolio emissions (Scope 1 + 2 + 3) and find evidence for tilting across our internal emissions measures (average and intensive emissions), and for engagement in our external portfolio emissions (absolute and relative footprint).

Overall, we document that climate-conscious investors decarbonize their portfolios more than other institutional investors. This is primarily achieved by tilting portfolio weights towards lower emitting firms. However, we also find evidence of engagement in some circumstances, with the top 100 emitting firms, over a longer time period, and for investors committed to the CA100+ initiative following the Paris Agreement.

4. Climate-Conscious Investors and Green Business Activities

In this section, we study the role of institutional investors in increasing green business activities, both in terms of the successful development of green technologies and ultimately selling more green products or services. Although green business activities do not have necessarily an immediate effect on reducing carbon emissions, these have the potential to do so over the long-term and help with the transition to a carbon-neutral economy. Without technological breakthroughs and transformation of business models of corporations, it may become increasingly hard with each passing year to achieve the required reductions to reach net-zero emissions in their portfolios in alignment with the Paris Agreement.

In Panel A of Table 10, we examine the relation between climate-conscious investors and green patents, capturing the invention of green technologies (e.g., more efficient carbon abatement technologies). We have data on green patents only between 2005 and 2012 in the GCPD data, which is due to the fact that patent data becomes available only with a significant lag (see Section 2.2.). This is before the 2015 Paris Agreement and the launch of the CA100+ initiative and, therefore, we cannot split out CA100+ climate-conscious investors in the analysis. As the results in columns 1 to 3 indicate, we observe that CDP signatories do not have stronger exposure to firms producing green patents than non-CDP investors. We also find no attempts that CDP signatories increase their exposure to green patents (columns 4 to 6). We do find, however, some evidence of tilting away from firms with high green patent ratios (columns 7 to 9). This is consistent with work by Cohen, Gurun, and Nguyen (2020) who also use examine green patents and argue that firms in the energy sector, who tend to be shunned by ESG investors, actually produce more green patents.

Next, in Panel B of Table 10 we explore whether climate-conscious investors consider measures of green revenue in their portfolios based on the proportion of firm revenue coming from green business activities in their investee firms (e.g., selling electric cars and solar panels or providing data-driven monitoring solutions for carbon emission reductions). The revenue data is from 2017 onwards (see Section 2.2.) so we are able to split climate-conscious investors into our three categories of only CDP, only CA100+ or both. In columns 1 to 3, we observe that all three groups of climate-conscious investors have a significantly higher exposure to firms generating higher green revenues However, this effect is economically moderate given that the average firm in the portfolios of climate-conscious investors have 0.3-0.8 percentage points more green revenues (which translates to 10-25 percent higher green revenues relative to the sample median). Columns 7 to 9 show some evidence that climate-conscious investors attempt to increase their exposure to green revenue via tilting (and no evidence of engagement in columns 10 to 12). We also run the analysis for three-year changes instead in Panel B of Table 11 and find results consistent with those of the one-year changes. One caveat in this analysis is again the short sample period over which we can observe the green revenue data which allows us to run just one cross section.

We conclude that climate-conscious investors might start to have a slightly higher exposure to green revenue, but not to green patents. One caveat is that might be a consequence of being in the early stages of transition to green economy so it may just be too early to conclude.

5. Conclusions

In this paper we study how institutional investors are actively decarbonizing their equity portfolios to reduce their exposure to the potential risks of climate change. We combine global data on portfolio equity holdings and firm-level GHG emissions and analyze climate-conscious institutional investors that are members of the most prominent investor-led climate change initiatives: the first one being CDP (that seeks corporate disclosure on climate risk related matters) and the subsequent Climate Action 100+ (that calls for investor action).

We conclude that CDP signatory investors decarbonize their portfolios mostly via tilting (rebalancing their holdings towards low-emitting firms) rather than via engagement (working with the high-emitter firms to curb their emissions). We do, however, find some evidence consistent with engagement among holdings of top emitting firms, over longer time periods, and following the Paris Agreement through the CA100+ initiative. We fail to find evidence that climate-conscious investors seek companies that are developing green technologies or generating a significant fraction of their revenues from green products or services. Overall, our paper raises the concern that addressing the steep challenge posed by climate change and energy transition requires more than portfolio tilts. Institutional investors that decarbonize their portfolios via tilting but may just be pushing away the problem to other investor groups that might be even less motivated to tackle corporate carbon emissions.

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Appendix A: Variable Definitions and Data Sources

Variable	Definition and Source
CDP	dummy =1 if an institutional investor is a signatory of the CDP (formerly known as the Carbon Disclosure Project) initiative, using yearly data from CDP investor signatory lists and matching it to FactSet Ownership
Climate Action 100+	dummy =1 if an institutional investor is a signatory or participant of the Climate Action 100+ initiative, using a membership list provided by the initiative and matching it to FactSet Ownership
Scope 1, 2, or 3	Weighted average portfolio Scope 1, 2, or 3 Carbon emissions (e.g., tons of carbon dioxide equivalent [CO2e] emissions) of firms in investor portfolio). We use firm-level yearly emission data from Trucost and end-of-year investor portfolio holdings from FactSet Ownership. Scope 1 emissions are Greenhouse Gas (GHG) emissions from operations that are owned or controlled by the company. Scope 2 emissions are the indirect GHG emissions from consumption of purchased electricity, heat or steam by the company. Scope 3 are other indirect GHG emissions from upstream supply chain and purchased materials as well as emissions inherent in the use of its products and services. Trucost definitions follow the Greenhouse Gas Protocol. The weighted average carbon emissions of investor *i* at time *t* is defined as: $$Scope\ 1_{it} = \sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}} \right) * Scope\ 1\ GHG\ Emissions_{jt}$$ where $\$\ Shares\ Held_{ijt}$ is the dollar amount of firm *j* stock which investor *i* holds at time *t*, $\$\ Portfolio\ Size_{it}$ is the dollar size the investor's equity portfolio, N_{jt} is the number of stocks in the investor's portfolio at time *t*, and $Scope\ 1\ GHG\ Emissions_{jt}$ are the Scope 1 emissions of firm *j*.
Scope 1, 2, or 3 Footprint	Total portfolio Scope 1, 2, or 3 Carbon emissions attributable to investor (sum of io * CO2e tons Scope 1, 2 or 3 emissions), using firm-level emission data from Trucost and investor portfolio holdings from FactSet Ownership. io is shares owned by an investor in a firm / total outstanding shares of the firm, using data from FactSet Ownership. The *Scope 1 Footprint* for an investor *i* at time *t* is defined as: $$Scope\ 1\ Footprint_{it} = \sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}} \right) * Scope\ 1\ GHG\ Emissions_{jt}$$ where $\$\ Shares\ Held_{ijt}$ is the dollar amount of firm *j* stock which investor *i* holds at time *t*, $\$\ Market\ Cap_{jt}$ is the dollar size of firm *j*, N_{jt} the number of stocks in the investor's portfolio at time *t*, and $Scope\ 1\ GHG\ Emissions_{jt}$ are the Scope 1 emissions of firm *j*.
Scope 1, 2, or 3 /Revenue	Value-weighted portfolio Scope 1 ,2 or 3 Carbon Intensity (CO2e tons / revenue in $ million) of firms in investor portfolio, using firm-level emission data from Trucost and investor portfolio holdings from FactSet Ownership. The *Scope 1 / Revenue* for an investor *i* at time *t* is: $$Scope\ 1/\ Revenue_{it} = \sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}} \right) * \frac{Scope\ 1\ GHG\ Emissions_{jt}}{Revenue_{jt}}$$

	where *\$ Shares Held*$_{ijt}$ is the dollar amount of firm *j* stock which investor *i* holds at time *t*, *\$ Portfolio Size*$_{it}$ is the dollar size the investor's equity portfolio, N_{jt} the number of stocks in the investor's portfolio, Scope 1 GHG Emissions$_{jt}$ are the Scope 1 emissions of firm *j*, and *Revenue*$_{jt}$ is firm *j*'s revenue.
Scope 1, 2, or 3/Portfolio Size	Total portfolio Scope 1, 2 or 3 Carbon Footprint per million \$ invested ((sum of io * CO2e tons Scope 1, 2, or 3 emissions)/Portfolio Size in \$ million), using firm-level emission data from Trucost and investor equity portfolio holdings from FactSet Ownership. The *Scope 1/Portfolio Size* for an investor *i* at time *t* is defined as: $$\text{Scope } 1/Portfolio\ Size_{it} = \frac{\sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}} \right) * Scope\ 1\ GHG\ Emissions_{jt}}{Portfolio\ Size_{it}}$$
Carbon Disclosure %	Value-weighted percentage of disclosed emissions by the investor portfolio firms, using firm-level emission disclosure data from Trucost and investor portfolio holdings from FactSet Ownership.
Full Carbon Disclosure %	Value-weighted percentage of firms in the investor portfolio which disclose 100% of their emissions, using firm-level emission disclosure data from Trucost and investor portfolio holdings from FactSet Ownership.
Trucost Data Coverage in Portfolios %	Value-weighted percentage of investors portfolio equity assets covered by the Trucost emissions data, using firm-level emission disclosure data from Trucost and investor portfolio holdings from FactSet Ownership.
Emissions Target %	Value-weighted percentage of firms in the investor portfolio that have an emissions reduction target (available 2010-2018), using firm-level data from CDP and investor portfolio holdings from FactSet Ownership.
Science-based Emissions Target %	Value-weighted percentage of firms in the investor portfolio that have a verified Science Based Targets initiative emission reduction target plan (available 2016-2018), using firm-level data from CDP and investor portfolio holdings from FactSet Ownership.
Green Patent %	Value-weighted portfolio ratio of green patents to total patents, for an investor's portfolio of firms (calculated for 2005-2012). Firm-level patent data is from the Global Corporate Patent Dataset (https://patents.darden.virginia.edu/). Green Patents are classified using the OECD Environmental-related technology mapping of developed by Hascic and Migotto (2015) and updated in 2020.
Green Revenue %	Value-weighted portfolio ratio of green revenues for an investor's portfolio of firms (available for 2016-2019, missing values filled in as zeros). Data on the percentage of green revenues are defined using the EU Taxonomy for Sustainable Activities classification in firm level data from FTSE Russell. Investor portfolio holdings from FactSet Ownership.
Portfolio Size	Portfolio equity assets under management in \$ million, from FactSet Ownership. In regressions we take the log of this variable.
Europe	dummy = 1 if the institutional investor is domiciled in Europe, from FactSet Ownership.
North America	dummy = 1 if the institutional investor is domiciled in North America, from FactSet Ownership.
Rest of World	dummy = 1 if the institutional investor is domiciled in a region outside of Europe and North America, from FactSet. Ownership
Asset Owner	dummy = 1, if the institutional investor is classified as a Corporate, Foundation/Endowment Manager, Insurance Company, Pension Fund Manager, or Sovereign Wealth Manager in FactSet Ownership.

# Companies	Number of equity securities in the investor portfolio, using FactSet Ownership data. In regressions we take the log of this variable.
# Industries	Number of SIC2 industries represented in the investor portfolio, using FactSet Fundamentals and Ownership data.
Average Market Cap	Value-weighted average market capitalization of portfolio firms in $ million, using FactSet Fundamentals and Ownership data. In regressions we take the log of this variable.
Average Market-to-Book	Value-weighted average market-to-book of portfolio firm, using FactSet Fundamentals and Ownership data. In regressions we take the log of this variable.
Own Region %	Percentage of investor equity portfolio which is invested in companies listed in the same region where the investor is domiciled in (Europe, North America, Rest of World), using data from FactSet Fundamentals and Ownership.
Developed Markets %	Percentage of investor equity portfolio which is invested in firms listed in MSCI developed markets, using data from FactSet Fundamentals and Ownership.

Appendix B: Measuring Portfolio Carbon Emission Changes, Tilting and Engagement

In this section we describe the change measures we use in the analysis in section 3.2 and Table 5 where we test portfolio decarbonization strategies.

1. Total Changes

The Scope 1 Δtotal change variables for investor *i* at time *t* are defined as:

$$\Delta Total\,\log Scope\ 1_{it}$$

$$= \log\left(\sum_{j=1}^{N_{jt+1}}\left(\frac{\$\ Shares\ Held_{ijt+1}}{\$\ Portfolio\ Size_{it+1}}\right) * Scope\ 1\ GHG\ Emissions_{jt+1}\right)$$

$$-\ \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}}\right) * Scope\ 1\ GHG\ Emissions_{jt}\right)$$

, where \$ Shares Held$_{ijt}$ is the dollar amount of firm j stock which investor i holds, \$ Portfolio Size$_{it}$ is the dollar size the investor's equity portfolio, N_{jt} the number of stocks in the investor's portfolio, and Scope 1 GHG Emissions$_{jt}$ are the Scope 1 emissions of firm j.

$$\Delta Total\,\log Scope\ 1/\ Revenue_{it}$$

$$= \log\left(\sum_{j=1}^{N_{jt+1}}\left(\frac{\$\ Shares\ Held_{ijt+1}}{\$\ Portfolio\ Size_{it+1}}\right) * \frac{Scope\ 1\ GHG\ Emissions_{jt+1}}{Revenue_{jt+1}}\right)$$

$$-\ \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}}\right) * \frac{Scope\ 1\ GHG\ Emissions_{jt}}{Revenue_{jt}}\right)$$

, where Revenue$_{jt}$ is the revenue of firm j at time t.

$$\Delta Total\,\log Scope\ 1\ Footprint_{it}$$

$$= \log\left(\sum_{j=1}^{N_{jt+1}}\left(\frac{\$\ Shares\ Held_{ijt+1}}{\$\ Market\ Cap_{jt+1}}\right) * Scope\ 1\ GHG\ Emissions_{jt+1}\right)$$

$$-\ \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}}\right) * Scope\ 1\ GHG\ Emissions_{jt}\right)$$

, where \$ Market Cap_{jt} is the dollar size of firm j at time t.

$$\Delta Total \log Scope\ 1/Portfolio\ Size_{it}$$

$$= \log\left(\frac{\sum_{j=1}^{N_{jt+1}}\left(\frac{\$\ Shares\ Held_{ijt+1}}{\$\ Market\ Cap_{jt+1}}\right) * Scope\ 1\ GHG\ Emissions_{jt+1}}{Portfolio\ Size_{it+1}}\right)$$

$$- \log\left(\frac{\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}}\right) * Scope\ 1\ GHG\ Emissions_{jt}}{Portfolio\ Size_{it}}\right)$$

2. Tilting Changes

The Scope 1 Δweights-only change variables for investor *i* at time *t* are defined as:

$$\Delta weights - only \log Scope\ 1_{it}$$

$$= \log\left(\sum_{j=1}^{N_{jt+1}}\left(\frac{\$\ Shares\ Held_{ijt+1}}{\$\ Portfolio\ Size_{it+1}}\right) * Scope\ 1\ GHG\ Emissions_{jt}\right)$$

$$- \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}}\right) * Scope\ 1\ GHG\ Emissions_{jt}\right)$$

$$\Delta weights - only\ \log Scope\ 1/\ Revenue_{it}$$

$$= \log\left(\sum_{j=1}^{N_{jt+1}}\left(\frac{\$\ Shares\ Held_{ijt+1}}{\$\ Portfolio\ Size_{it+1}}\right) * \frac{Scope\ 1\ GHG\ Emissions_{jt}}{Revenue_{jt}}\right)$$

$$- \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}}\right) * \frac{Scope\ 1\ GHG\ Emissions_{jt}}{Revenue_{jt}}\right)$$

$$\Delta weights - only \log Scope\ 1\ Footprint_{it}$$

$$= \log\left(\sum_{j=1}^{N_{jt+1}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt+1}}\right) * Scope\ 1\ GHG\ Emissions_{jt}\right)$$

$$-\ \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}}\right) * Scope\ 1\ GHG\ Emissions_{jt}\right)$$

$$\Delta weights - only \log Scope\ 1/Portfolio\ Size_{it}$$

$$= \log\left(\frac{\sum_{j=1}^{N_{jt+1}}\left(\frac{\$\ Shares\ Held_{ijt+1}}{\$\ Market\ Cap_{jt+1}}\right) * Scope\ 1\ GHG\ Emissions_{jt}}{Portfolio\ Size_{it+1}}\right)$$

$$-\ \log\left(\frac{\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}}\right) * Scope\ 1\ GHG\ Emissions_{jt}}{Portfolio\ Size_{it}}\right)$$

3. Engagement Changes

The Scope 1 Δemissions-only change variables for investor *i* at time *t* are defined as:

$$\Delta emissions - only \log Scope\ 1_{it}$$

$$= \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}}\right) * Scope\ 1\ GHG\ Emissions_{jt+1}\right)$$

$$-\ \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}}\right) * Scope\ 1\ GHG\ Emissions_{jt}\right)$$

$$\Delta emissions - only\ \log Scope\ 1/\ Revenue_{it}$$

$$= \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}}\right) * \frac{Scope\ 1\ GHG\ Emissions_{jt+1}}{Revenue_{jt+1}}\right)$$

$$- \log\left(\sum_{j=1}^{N_{jt}}\left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Portfolio\ Size_{it}}\right) * \frac{Scope\ 1\ GHG\ Emissions_{jt}}{Revenue_{jt}}\right)$$

$\Delta emissions - only\ \log Scope\ 1\ Footprint_{it}$

$$= \log\left(\sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}}\right) * Scope\ 1\ GHG\ Emissions_{jt+1}\right)$$

$$- \log\left(\sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}}\right) * Scope\ 1\ GHG\ Emissions_{jt}\right)$$

$\Delta emissions - only\ \log Scope\ 1/Portfolio\ Size_{it}$

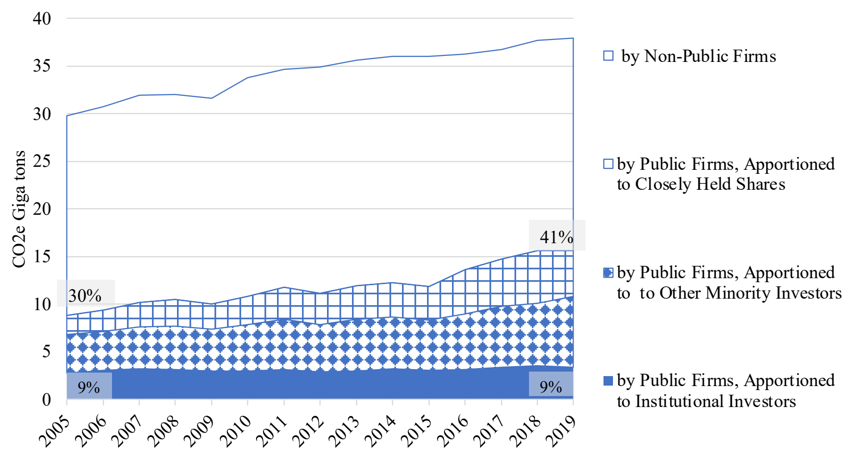
$$= \log\left(\frac{\sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}}\right) * Scope\ 1\ GHG\ Emissions_{jt+1}}{Portfolio\ Size_{it}}\right)$$

$$- \log\left(\frac{\sum_{j=1}^{N_{jt}} \left(\frac{\$\ Shares\ Held_{ijt}}{\$\ Market\ Cap_{jt}}\right) * Scope\ 1\ GHG\ Emissions_{jt}}{Portfolio\ Size_{it}}\right)$$

Figure 1: Institutional Share of Global Carbon Emissions and Market Capitalization

This figure shows the share of total carbon (GHG) emissions apportioned to the equity holdings of institutional investors and also the fraction of outstanding shares held in publicly listed firms for the 2005-2019 sample period. In Panel A we plot the total GHG (CO2-equivalent) emissions by public firms compared to the total global emissions from fossil fuel use, industrial processes and product use estimated by the EDGAR v6.0 data from European Commission, Joint Research Centre (2021). We then split out the GHG emissions by public firms into the fractions attributable to closely held shares, other minority investor shareholders, and institutional investors based on the ownership stake of each group. In Panel B we show the total equity market capitalization of all public firms and the total equity holdings of institutional investors.

Panel A: Total Carbon (GHG) Emissions



Panel B: Total Equity Market Values

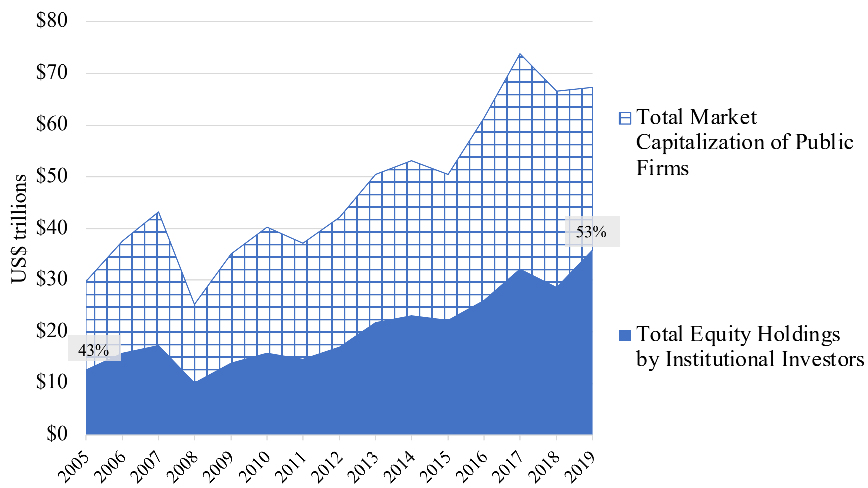
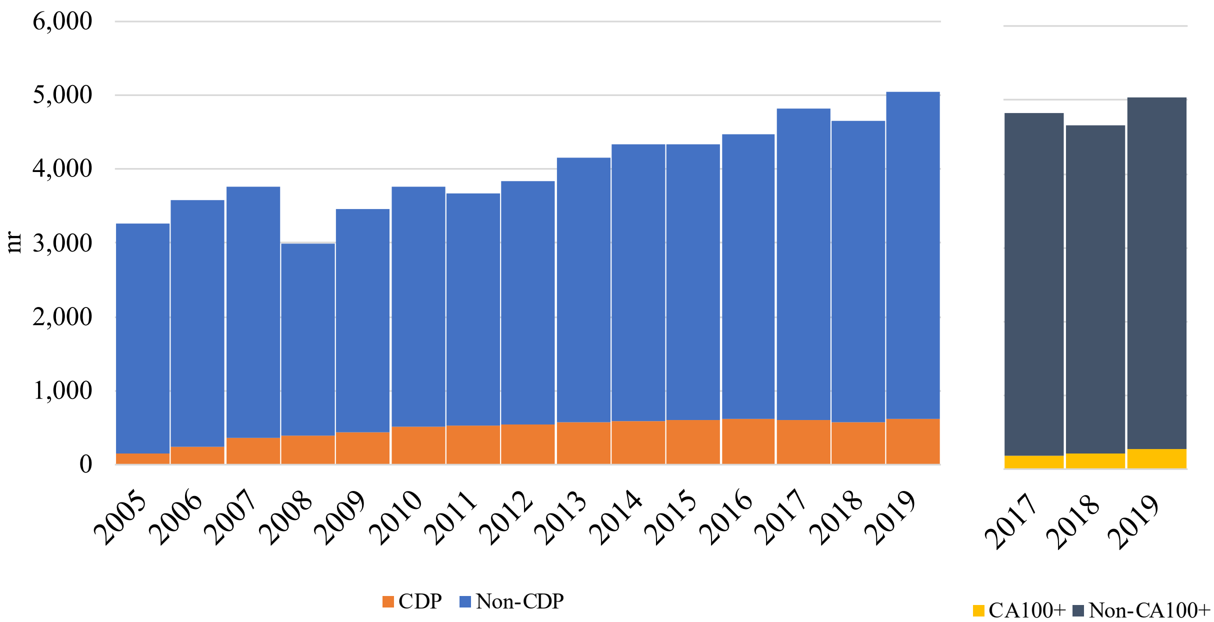


Figure 2: Climate-Conscious Institutional Investors

This figure displays the number and total equity holdings of climate-conscious institutional investors for the 2005-2019 sample period. We define as climate-conscious those investors that are signatories of the CDP or Climate Action 100+(CA100+) initiatives. Panel A shows the number of these institutional investors per year and Panel B provides the end-of-year size of their total equity portfolio holdings.

Panel A: Number of Institutional Investors



Panel B: Total Institutional Equity Holdings

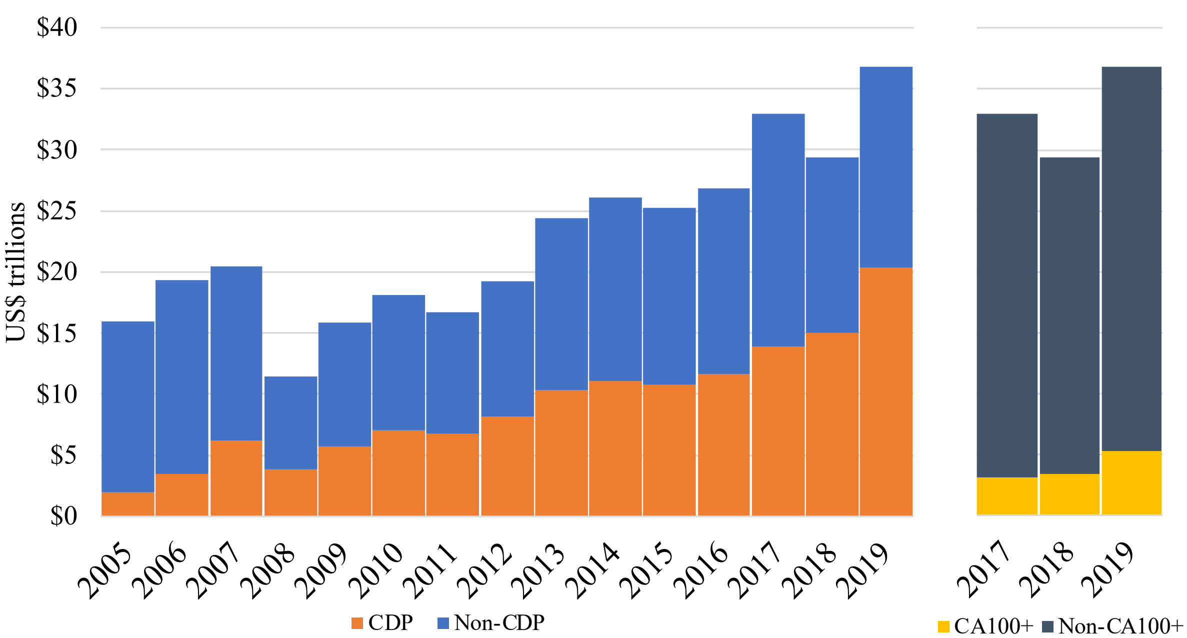
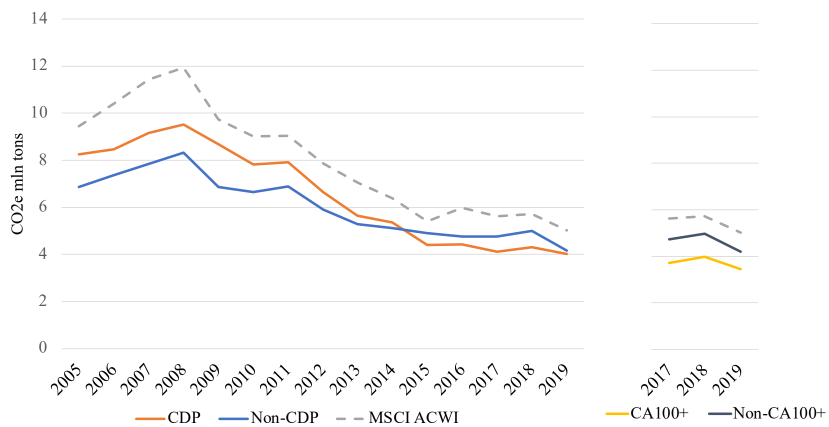


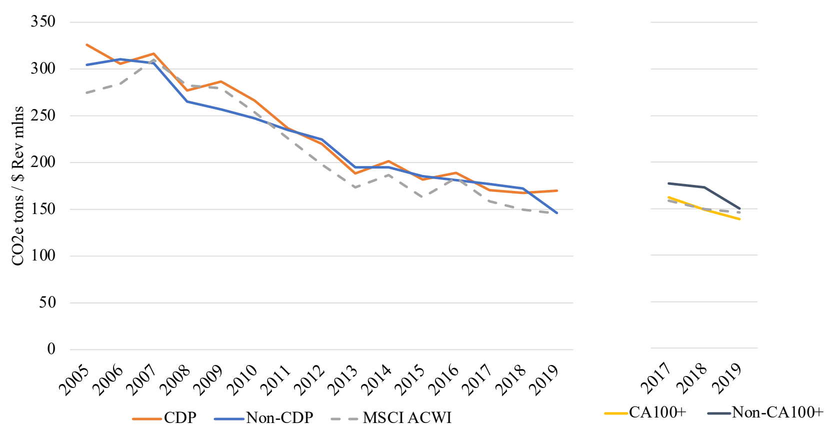
Figure 3: Portfolio Decarbonization by Climate-Conscious Institutional Investors

This figure shows the portfolio carbon (GHG) emission metrics of climate-conscious investors over time using alternative emission measures. We define as climate-conscious those investors that are signatories of the CDP or Climate Action 100+(CA100+) initiatives. We also add portfolio GHG metrics for Non-CDP and Non-CA100+ investors, as well as for a representative investor holding the MSCI ACWI index. Panel A displays mean Scope 1 carbon emissions over time, Panel B presents mean Scope 1/ Revenue, and Panel C shows mean Scope 1 / Portfolio Size. In Panel C we assume that the MSCI ACWI investor holds all the free-floating shares of MSCI ACWI firms.

Panel A: Scope 1



Panel B: Scope 1/ Revenue



Panel C: Scope 1/ Portfolio Size

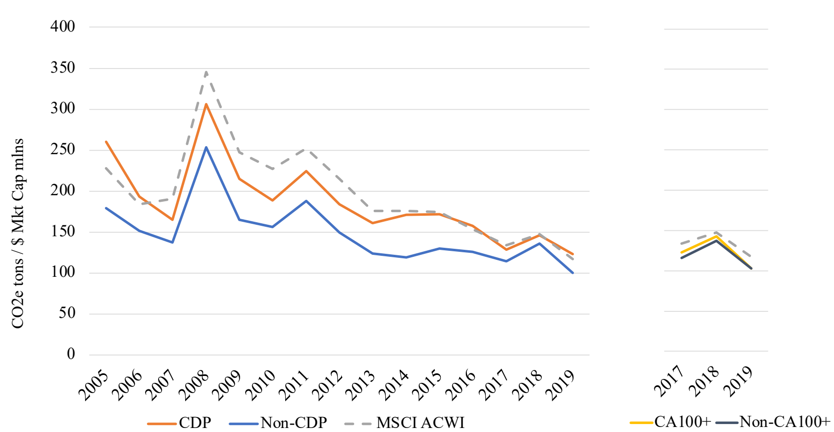
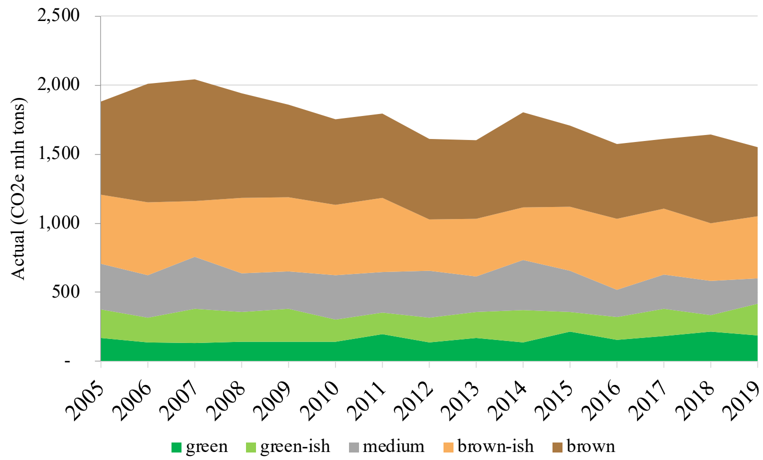


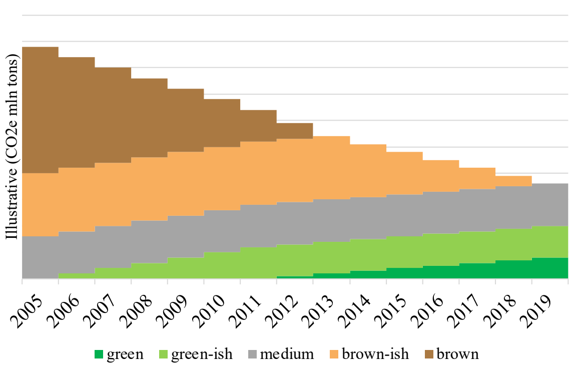
Figure 4: Portfolio Decarbonization Strategies

This figure shows the actual portfolio decarbonization of institutional investors as well as two illustrations of the "titling" versus "engagement" approaches that investors may employ. In Panel A we show the total Scope 1 emissions footprint of the institutional investors' portfolio, using their aggregate holdings in the emitting firms in Trucost each year (by Scope 1 emissions). The graph decomposes the aggregate Scope 1 emissions into those stemming from firms in different emission quintiles ("brown" = sum of apportioned emissions by institutional holdings of the top 20 polluter firms; "brown-ish" = sum of apportioned emissions from holdings of firms ranked 21-40 in emission levels; etc.). Panel B provides an illustrative example of a portfolio "tilting" strategy where investors reduce only their portfolio weights, with firms not improving their Scope 1 emissions. Panel C exemplifies a portfolio "engagement" strategy where firm emissions are improved, but investor portfolio weights remain unchanged.

Panel A: Institutional Investor Total Scope 1 Footprint (in the Top 100 Emitting Firms)



Panel B: Example of a Tilting Strategy



Panel C: Example of an Engagement Strategy

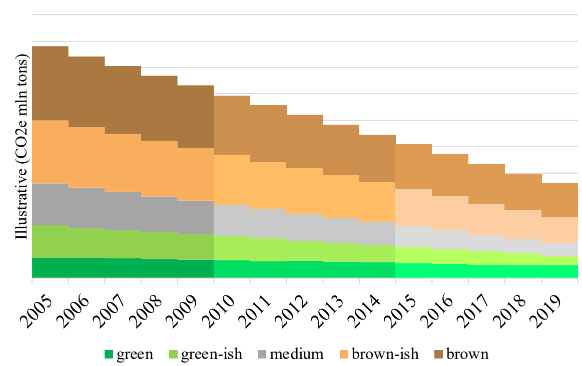


Table 1: Descriptive Statistics for Climate-Conscious Institutional Investors

This table describes the portfolio characteristics of climate-conscious investors (institutions that are CDP and Climate Action 100+ signatories) versus other institutional investors across different sample years from 2005 to 2019. *Number of Investors* and *Equity Holdings (AuM)* display the total number of institutional investors and their total equity assets under management in each category and year. The number of investors is then decomposed by region, type and portfolio size. It then displays the mean portfolio carbon metrics, disclosure and green metrics for climate-conscious versus other institutional investors. Definitions of the variables are provided in Appendix A.

Panel A: Investor and Portfolio Characteristics and Scope 1 Carbon Emissions Measures

	CDP			Non-CDP			CA100+	Non-CA100+	ALL
	2005	2012	2019	2005	2012	2019	2019	2019	Pooled Avg.
Number of Investors	149	550	623	3,109	3,281	4,420	268	4,775	
Equity Holdings (AuM) in US$ Trillion	2.0	8.2	20.4	14.0	11.0	16.4	5.3	31.5	22.6
% Equiity AuM Coverage	13%	43%	55%	87%	57%	45%	14%	86%	
by Region:									
Europe	51%	45%	48%	22%	18%	16%	54%	18%	22%
North America	30%	33%	32%	71%	71%	74%	26%	71%	67%
Rest of World	19%	22%	21%	7%	11%	10%	20%	11%	11%
by Type:									
Asset Owner	12%	7%	5%	5%	3%	2%	10%	2%	4%
Investment Manager	88%	93%	95%	95%	97%	98%	90%	98%	96%
By Equity Portfolio Size:									
<1bn	38.9%	40.5%	32.3%	64.4%	67.5%	69.6%	24.6%	67.2%	63.9%
1-10bn	29.5%	34.2%	36.0%	28.3%	26.8%	24.7%	38.1%	25.4%	27.5%
10-100bn	30.2%	22.7%	26.5%	6.8%	5.4%	5.2%	32.8%	6.4%	7.9%
>100bn	1.3%	2.5%	5.3%	0.5%	0.3%	0.5%	4.5%	0.9%	0.7%
Carbon Metrics:									
Scope 1 (CO2 mln tons)	8.3	6.7	4.0	6.9	5.9	4.2	3.4	4.2	6.1
Scope 1 Footprint (CO2 giga tons)	0.4	1.3	1.8	2.4	1.6	1.5	0.5	2.9	3.1
Scope 1 / Revenue	326	220	170	305	225	146	139	150	228
Scope 1 / Portfolio Size	260	184	123	179	150	100	103	103	153
% Total Scope 1 Footprint	14%	45%	55%	86%	55%	45%	14%	86%	
Scope 2 + 3 (CO2 mln tons)	11.8	10.0	6.8	10.3	9.4	7.1	6.4	7.1	8.7
Scope 2 + 3 Footprint (CO2 giga tons)	0.4	1.4	2.2	2.4	1.8	1.7	0.6	3.2	3.3
Scope 2 + 3/Revenue	252	203	182	253	196	166	179	168	206
Scope 2 + 3/Portfolio Size	201	194	125	156	157	109	121	110	150
% Total Scope 2 + 3 Footprint	14%	44%	57%	86%	56%	43%	16%	84%	
Disclosure:									
Trucost Data Coverage in Portfolios %	81%	88%	96%	70%	77%	93%	96%	93%	82%
Carbon Disclosure %	41%	74%	77%	33%	67%	68%	76%	69%	60%
Full Carbon Disclosure %	2%	39%	47%	2%	37%	42%	45%	43%	31%
Green Business Activities									
Green Patent %	6.2%	9.4%		6.8%	8.7%				7.7%
Green Revenue %			4.5%			3.6%	4.9%	3.7%	3.5%
Allocations (weights)									
Top 100 in Material Sectors %	9%	6%	4%	8%	5%	3%	3%	3%	6%
Non-Top 100 in Material Sectors %	12%	16%	11%	13%	15%	9%	10%	9%	14%

Table 2: Summary Statistics

This table provides summary statistics for the variables used in our analysis. Definitions of the variables are provided in Appendix A and Appendix Tables B.1. After displaying the summary statistics for the total sample, we show the average measures for climate-conscious (CDP, CA100+) and non-climate-conscious institutional investors (non-CDP, non-CA100+). The sample comprises investor-year observations where there is emission data for portfolio holdings, the investor has at least 100$ mln in equity assets under management, it has at least five equity holdings. We also remove outliers where average portfolio Scope 1 emissions are larger than 100 million CO2e tons. The sample period ranges from 2005 to 2019 except for the following variables: (i) the *Climate Action 100+* dummy variable is only available from 2017 onwards (when the initiative begins); (ii) Green Patent % data from GCPD is populated only up till 2012; (iii) *Green Revenue %* data from FTSE Russell commences in 2016; (iv) *Emissions Target %* data from CDP starts in 2010 and is populated until 2018; (v) *Science-based Emissions Target %* data from CDP is available for 2016-2018. In the regressins we forward all dependent variables so we also lose the last year of the sample for the control variables. We adjust the sample for the table statistics to reflect this. Panel A shows the statistics for the main variables in our analysis, and Panel B tabulates the data for the emissions change variables. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Main Variables

Variable	Mean	SD	Min	p10	p50	p90	Max	N	CDP	Non-CDP	CA100+	Non-CA100+
CDP	0.12	0.32	0	0	0	1	1	56,981	1	0	0.81	0.11
Climate Action 100+	0.01	0.08	0	0	0	0	1	56,981	0.05	0	1	0
Scope 1 (CO2e mln)	5.89	5.60	0	0.29	4.62	12.83	41.45	56,981	6.00	5.88	3.67	5.91
Scope 1/ Revenue (CO2e / $ Rev mln)	208.87	237.35	1.02	29.09	149.89	416.08	2,296.33	56,981	213.61	208.24	143.84	209.31
Scope 1 Footprint (CO2e mln)	0.53	1.42	0	0.00	0.05	1.25	10.28	56,981	1.47	0.40	1.49	0.52
Scope 1/ Portfolio Size (CO2e / $ Mkt Cap mln)	145.09	177.64	0	13.09	96.12	311.29	1,755.13	56,981	176.18	140.95	123.25	145.23
Scope 2+3 (CO2e mln)	8.48	6.57	0	1.23	7.37	16.88	42.70	56,981	8.56	8.47	7.17	8.49
Scope 2+3/ Revenue (CO2e / $ Rev mln)	201.95	67.47	36.64	126.05	197.13	277.23	598.91	56,981	203.09	201.80	184.93	202.06
Scope 2+3 Footprint (CO2e mln)	0.56	1.47	0	0.01	0.07	1.27	9.99	56,981	1.60	0.42	1.85	0.55
Scope 2+3/ Portfolio Size (CO2e / $ Mkt Cap mln)	148.15	98.03	2	46.23	130.97	261.90	927.27	56,981	173.11	144.84	142.82	148.19
Carbon Disclosure %	61	25	0	22	67	89	100	56,981	71	59	76	61
Full Carbon Disclosure %	32	21	0	2	35	58	100	56,981	39	31	46	32
Emissions Target %	43	24	0	6	48	71	100	36,180	50	42	51	43
Science-based Emissions Target %	7	6	0	0	6	15	38	13,360	8	6	11	7
Green Patent %	8	6	0	3	7	12	57	26,387	8	7	.	8
Green Revenue %	3	2	0	1	3	6	19	17,872	4	3	5	3
Portfolio Size ($bln)	3.66	9.58	0.10	0.14	0.53	8.20	70.97	56,981	10.25	2.79	14.33	3.59
Europe	0.22	0.41	0	0	0	1	1	56,981	0.47	0.19	0.57	0.22
North America	0.67	0.47	0	0	1	1	1	56,981	0.32	0.72	0.24	0.67
Rest of World	0.11	0.31	0	0	0	1	1	56,981	0.21	0.10	0.19	0.11
Asset Owner	0.04	0.20	0	0	0	0	1	56,981	0.07	0.04	0.12	0.04
# Companies	364	618	5	26	128	966	3,336	56,981	901	293	988	360
# Industries	36	18	1	12	35	62	71	56,981	49	34	51	36
Average Market Cap ($ bln)	66	55	0.12	8	55	138	437	56,981	65	66	90	66
Average Market-to-Book	5	4	1	2	4	9	51	56,963	4	5	6	5
Own Region %	83	24	0	45	93	100	100	56,981	72	84	64	83
Developed Markets %	90	24	0	67	99	100	100	56,981	83	91	85	90

Panel B: Emission and Green Metrics Changes Variables

Variable	Mean	SD	Min	p10	p50	p90	Max	N	CDP	Non-CDP	CA100+	Non-CA100+
Δ Total log Scope 1	-0.05	0.73	-4.13	-0.63	-0.04	0.54	3.85	50,997	-0.08	-0.05	-0.21	-0.05
Δ Total log Scope 1/Revenue	-0.06	0.62	-3.42	-0.59	-0.05	0.50	3.05	50,997	-0.07	-0.05	-0.07	-0.06
Δ Total log Scope 1 Footprint	-0.06	0.91	-5.30	-0.83	-0.02	0.70	4.67	50,997	-0.08	-0.05	-0.18	-0.06
Δ Total log Scope 1/Portfolio Size	-0.04	0.77	-4.02	-0.70	-0.07	0.69	4.13	50,997	-0.07	-0.04	-0.32	-0.04
Δ weights-only log Scope 1	-0.05	0.71	-3.97	-0.61	-0.04	0.50	3.73	50,971	-0.08	-0.05	-0.16	-0.05
Δ weights-only log Scope 1/Revenue	-0.03	0.60	-3.22	-0.54	-0.02	0.48	3.10	50,971	-0.05	-0.03	-0.04	-0.03
Δ weights-only log Scope 1 Footprint	-0.10	0.89	-5.40	-0.86	-0.03	0.61	4.49	50,971	-0.10	-0.10	-0.15	-0.10
Δ weights-only log Scope 1/Portfolio Size	-0.08	0.75	-3.76	-0.73	-0.09	0.61	3.80	50,971	-0.09	-0.08	-0.29	-0.08
Δ emissions-only log Scope 1	0.00	0.18	-1.72	-0.12	0.00	0.14	1.56	52,442	0.00	0.00	-0.02	0.00
Δ emissions-only log Scope 1/Revenue	-0.03	0.19	-1.16	-0.18	-0.03	0.15	1.65	52,442	-0.02	-0.03	-0.01	-0.03
Δ emissions-only log Scope 1 Footprint	0.03	0.24	-1.24	-0.12	0.00	0.19	3.52	52,442	0.01	0.03	-0.04	0.03
Δ emissions-only log Scope 1/Portfolio Size	0.03	0.24	-1.24	-0.12	0.00	0.19	3.52	52,442	0.01	0.03	-0.04	0.03
Δ Total Green Patent %	0.20	4.69	-48.89	-2.60	0.20	2.97	30.91	22,230	0.10	0.21		0.20
Δ Total Green Revenue %	0.18	1.55	-7.18	-1.15	0.16	1.48	8.79	12,944	0.23	0.17	0.37	0.18

Table 3: Portfolio Carbon Emission Levels

This table presents regressions of institutional investors' portfolio carbon metrics, disclosure and targets, and whether the investor is climate-conscious. The main variable of interest is whether an institution is a member of the CDP initiative. Control variables include investor characteristics (size, geography and type) and, portfolio characteristics (*# Companies*, *# Industries*, *Average Market Cap*, *Average Market-to-Book*, *Own Region %*, *Developed Markets %* and *Fossil Fuel %*). In Panel A we show the results for the Scope 1 emissions variables. In Panel B we display the same regressions as in Panel A but for the Scope 2+3 emissions variables. In Panel C we run regressions of portfolio disclosure and emissions targets. Definitions of the variables are provided in Appendix A. All specifications include year fixed effects, while specifications in (3), (6), (9), and (12) also have investor fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Scope 1 Emissions

	log Scope 1(t+1)			log Scope 1/Revenue (t+1)			log Scope 1 Footprint (t+1)			log Scope 1/Portfolio Size (t+1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CDP	0.320***	-0.064**	-0.071**	0.160***	0.004	-0.042*	0.230***	-0.009	-0.060	0.238***	0.012	-0.028
	[0.041]	[0.027]	[0.025]	[0.031]	[0.023]	[0.023]	[0.040]	[0.029]	[0.041]	[0.041]	[0.031]	[0.035]
Portfolio Size	0.064***	-0.154***	-0.032*	0.060***	-0.087***	-0.029	1.092***	0.905***	0.725***	0.091***	-0.086***	-0.060***
	[0.012]	[0.009]	[0.018]	[0.007]	[0.008]	[0.017]	[0.011]	[0.011]	[0.025]	[0.011]	[0.011]	[0.015]
Europe	0.294***	0.376***		-0.453***	-0.021		-0.191**	0.168**		-0.188***	0.189***	
	[0.066]	[0.042]		[0.041]	[0.041]		[0.068]	[0.060]		[0.058]	[0.053]	
North America	0.022	0.212***		-0.577***	0.088		-0.808***	-0.144**		-0.791***	-0.108*	
	[0.057]	[0.051]		[0.054]	[0.057]		[0.064]	[0.063]		[0.047]	[0.058]	
Asset Owner	0.385***	0.143**		0.095*	0.118**		0.067	0.019		0.101	0.059	
	[0.065]	[0.056]		[0.052]	[0.047]		[0.066]	[0.053]		[0.060]	[0.050]	
# Companies		-0.011	0.148***		0.030	0.132***		-0.219***	0.104**		-0.215***	0.075*
		[0.058]	[0.033]		[0.052]	[0.029]		[0.062]	[0.041]		[0.059]	[0.038]
# Industries		0.032***	0.002		0.023***	0.001		0.048***	0.008**		0.046***	0.009**
		[0.005]	[0.002]		[0.004]	[0.002]		[0.005]	[0.003]		[0.005]	[0.003]
Average Market Cap		0.823***	0.342***		0.084***	-0.047**		0.298***	0.011		0.282***	0.042
		[0.021]	[0.023]		[0.016]	[0.020]		[0.039]	[0.026]		[0.038]	[0.027]
Average Market-to-Book		-0.410***	-0.082***		-0.260***	-0.047**		-0.543***	-0.159***		-0.577***	-0.188***
		[0.044]	[0.017]		[0.032]	[0.018]		[0.048]	[0.032]		[0.052]	[0.044]
Own Region %		0.005***	0.002***		0.002***	0.002**		0.003***	0.000		0.004***	0.001
		[0.001]	[0.001]		[0.000]	[0.001]		[0.001]	[0.001]		[0.001]	[0.001]
Developed Markets %		-0.011***	-0.005***		-0.012***	-0.006***		-0.012***	-0.005***		-0.012***	-0.006***
		[0.001]	[0.001]		[0.001]	[0.001]		[0.001]	[0.001]		[0.001]	[0.001]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Investor FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Observations	56981	56963	56053	56981	56963	56053	56981	56963	56053	56981	56963	56053
Adjusted R^2	0.053	0.514	0.809	0.088	0.252	0.696	0.596	0.683	0.843	0.112	0.337	0.725

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B: Scope 2+3 Emissions

	log Scope 2+3 (t+1)			log Scope 2+3/Revenue(t+1)			log Scope 2+3 Footprint(t+1)			log Scope 2+3/Portfolio Size (t+1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CDP	0.224***	-0.061***	-0.020	0.015*	-0.016*	0.005	0.083***	-0.030	-0.051*	0.089***	-0.009	-0.014
	[0.029]	[0.014]	[0.017]	[0.009]	[0.008]	[0.007]	[0.022]	[0.018]	[0.025]	[0.023]	[0.019]	[0.017]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Investor FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Observations	56981	56963	56053	56981	56963	56053	56981	56963	56053	56981	56963	56053
Adjusted R^2	0.053	0.688	0.850	0.137	0.196	0.689	0.752	0.789	0.879	0.145	0.329	0.714

Panel C: Emission Disclosure and Targets

	Carbon Disclosure %(t+1)			Full Carbon Disclosure %(t+1)			Emissions Target %(t+1)			Science-based Emissions Target %(t+1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CDP	7.282***	2.995***	-0.137	5.015***	3.019***	1.051**	7.296***	2.449***	-0.559	1.065*	0.406	-0.066
	[0.794]	[0.598]	[0.542]	[0.615]	[0.471]	[0.413]	[0.819]	[0.663]	[0.485]	[0.311]	[0.251]	[0.588]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Investor FE	No	No	Yes	No	No	Yes	No	No	Yes	No	No	Yes
Observations	56981	56963	56053	56981	56963	56053	36372	36356	35504	13373	13362	12528
Adjusted R^2	0.237	0.574	0.819	0.435	0.591	0.792	0.099	0.607	0.883	0.153	0.378	0.727

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4: Portfolio Carbon Emission Changes

This table presents regressions of yearly changes in portfolio carbon metrics of institutional investors. The main variable of interest is a dummy indicating if the institution is a member of the CDP initiative. Regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients not shown). In Panel A, the dependent variables are the yearly changes in log Scope 1 emission metrics. In Panel B we display the same regressions as in Panel A but for the yearly changes in Scope 2+3 emissions. We calculate the changes from period t + 1 to t. Definitions of the variables are provided in Appendix A. All specifications include year fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Scope 1 Emissions Yearly Changes (Δ Total)

	Δ Total log Scope 1 (t+1)		Δ Total log Scope 1/Revenue (t+1)		Δ Total log Scope 1 Footprint (t+1)		Δ Total log Scope 1/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.018*	-0.012	-0.014*	-0.013*	-0.027*	-0.030**	-0.025	-0.017
	[0.010]	[0.010]	[0.007]	[0.006]	[0.014]	[0.011]	[0.016]	[0.011]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50997	50983	50997	50983	50997	50983	50997	50983
Adjusted R^2	0.012	0.012	0.013	0.013	0.009	0.010	0.075	0.077

Panel B: Scope 2+3 Emission Yearly Changes (Δ Total)

	Δ Total log Scope 2+3 (t+1)		Δ Total log Scope 2+3/Revenue (t+1)		Δ Total log Scope 2+3 Footprint (t+1)		Δ Total log Scope 2+3/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.007	-0.002	-0.002	-0.003	-0.014	-0.018*	-0.012	-0.005
	[0.008]	[0.006]	[0.003]	[0.002]	[0.012]	[0.009]	[0.013]	[0.009]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50997	50983	50997	50983	50997	50983	50997	50983
Adjusted R^2	0.035	0.037	0.103	0.103	0.030	0.033	0.216	0.223

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Portfolio Decarbonization Strategies

This table presents regressions of yearly Scope 1 emission changes illustrating two portfolio rebalancing approaches. The first one is "tilting" (Panel A), where we calculate the portfolio Scope 1 emission variables by changing only the portfolio weights of the investor in t+1, keeping the firm Scope 1 emissions unchanged from period t. The second is "engagement" (Panel B), where we calculate the portfolio Scope 1 emission variables by changing only the firm Scope 1 emissions of portfolio firms in period t+1, leaving the investor portfolio weights the same as in period t. The main variable of interest is a dummy indicating if the institution is a member of the CDP initiative. Regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients not shown). We calculate the changes from period t + 1 to t. Definitions of the variables are provided in Appendix A. All specifications include year fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Tilting Hypothesis (Δ weights-only, assuming portfolio firm emissions at t+1 remain the same as at t)

	Δ weights-only log Scope 1 (t+1)		Δ weights-only log Scope 1/Revenue (t+1)		Δ weights-only log Scope 1 Footprint (t+1)		Δ weights-only log Scope 1/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.022***	-0.021***	-0.017**	-0.019**	-0.005	-0.023**	-0.003	-0.009
	[0.003]	[0.006]	[0.007]	[0.007]	[0.008]	[0.010]	[0.010]	[0.010]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50971	50957	50971	50957	50971	50957	50971	50957
Adjusted R^2	0.010	0.010	0.010	0.010	0.004	0.006	0.072	0.073

Panel B: Engagement Hypothesis (Δ emissions-only, assuming portfolio weights at t+1 remain the same as at t)

	Δ emissions-only log Scope 1 (t+1)		Δ emissions-only log Scope 1 /Revenue (t+1)		Δ emissions-only log Scope 1 Footprint (t+1)		Δ emissions-only log Scope 1 /Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	0.001	0.007	0.003	0.005	-0.021*	-0.008	-0.021*	-0.008
	[0.007]	[0.006]	[0.004]	[0.004]	[0.010]	[0.005]	[0.010]	[0.005]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	52442	52426	52442	52426	52442	52426	52442	52426
Adjusted R^2	0.068	0.075	0.103	0.105	0.077	0.107	0.077	0.107

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Portfolio Decarbonization Strategies: European CDP Investors

This table presents regressions for total yearly changes in portfolio carbon metrics of institutional investors. The main variable of interest is " CDP * Europe" dummy indicating if the institution is a member of the CDP initiative and domiciled in a European country. The specifications follow those of Tables 4 (Panel A) and 5 (Panels B and C) and regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients not shown). Definitions of the variables are provided in Appendix A. All specifications include year fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Scope 1 Emissions Yearly Changes (Δ Total)

	Δ Total log Scope 1 (t+1)		Δ Total log Scope 1/Revenue (t+1)		Δ Total log Scope 1 Footprint (t+1)		Δ Total log Scope 1/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.007	-0.000	-0.007	-0.007	-0.022	-0.024*	-0.023	-0.012
	[0.017]	[0.016]	[0.010]	[0.010]	[0.016]	[0.012]	[0.021]	[0.014]
CDP * Europe	-0.024	-0.027	-0.015	-0.015	-0.011	-0.012	-0.006	-0.010
	[0.021]	[0.021]	[0.013]	[0.014]	[0.016]	[0.014]	[0.019]	[0.018]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50997	50983	50997	50983	50997	50983	50997	50983
Adjusted R^2	0.012	0.012	0.013	0.013	0.009	0.010	0.075	0.077

Panel B: Tilting Hypothesis (Δ weights-only, assuming portfolio firm emissions at t+1 remain the same as at t)

	Δ weights-only log Scope 1 (t+1)		Δ weights-only log Scope 1/Revenue (t+1)		Δ weights-only log Scope 1 Footprint (t+1)		Δ weights-only log Scope 1/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.007	-0.007	-0.003	-0.006	0.017	-0.004	0.017	0.009
	[0.008]	[0.010]	[0.008]	[0.008]	[0.010]	[0.011]	[0.011]	[0.012]
CDP * Europe	-0.033**	-0.032**	-0.032***	-0.031**	-0.052***	-0.044**	-0.047**	-0.042**
	[0.014]	[0.014]	[0.010]	[0.011]	[0.017]	[0.017]	[0.016]	[0.018]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50971	50957	50971	50957	50971	50957	50971	50957
Adjusted R^2	0.010	0.010	0.010	0.010	0.004	0.006	0.073	0.073

Panel C: Engagement Hypothesis (Δ emissions-only, assuming portfolio weights at t+1 remain the same as at t)

	Δ emissions-only log Scope 1 (t+1)		Δ emissions-only log Scope 1 /Revenue (t+1)		Δ emissions-only log Scope 1 Footprint (t+1)		Δ emissions-only log Scope 1 /Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.003	0.004	-0.004	-0.001	-0.034**	-0.018*	-0.034**	-0.018*
	[0.009]	[0.008]	[0.004]	[0.003]	[0.015]	[0.009]	[0.015]	[0.009]
CDP * Europe	0.010	0.006	0.016	0.014	0.030**	0.022*	0.030**	0.022*
	[0.009]	[0.009]	[0.010]	[0.010]	[0.014]	[0.011]	[0.014]	[0.011]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	52442	52426	52442	52426	52442	52426	52442	52426
Adjusted R^2	0.069	0.075	0.103	0.105	0.077	0.107	0.077	0.107

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Portfolio Decarbonization Strategies: Top 100 emitting firms

This table presents regressions for total yearly changes in portfolio carbon metrics of institutional investors, in particular the emissions measures related to their holdings of the top 100 Scope 1 emitting firms in each year. The main variable of interest is a dummy indicating if the institution is a member of the CDP initiative. The specifications follow those of Tables 4 (Panel A) and 5 (Panels B and C) and regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients not shown). Definitions of the variables are provided in Appendix A. All specifications include year fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Top 100 firms Scope 1 Emissions Yearly Changes (Δ Total)

	Δ Total log Scope 1 Top 100 (t+1)		Δ Total log Scope 1/Revenue Top 100 (t+1)		Δ Total log Scope 1 Footprint Top 100 (t+1)		Δ Total log Scope 1/Portfolio Size Top 100 (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.009*	-0.005	-0.008*	-0.009	-0.042**	-0.038**	-0.012	-0.010
	[0.005]	[0.005]	[0.004]	[0.007]	[0.014]	[0.016]	[0.011]	[0.011]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39580	39580	39580	39580	39580	39580	39580	39580
Adjusted R^2	0.027	0.029	0.042	0.043	0.006	0.007	0.103	0.105

Panel B: Tilting Hypothesis, Yearly Changes (Δ weights-only, assuming portfolio firm emissions at t+1 remain the same as at t)

	Δ weights-only log Scope 1 Top 100(t+1)		Δ weights-only log Scope 1/Revenue Top 100(t+1)		Δ weights-only log Scope 1 Footprint Top 100(t+1)		Δ weights-only log Scope 1/Portfolio Size Top 100(t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.008**	-0.006*	-0.004	-0.006	-0.019**	-0.023**	0.015	0.009
	[0.003]	[0.003]	[0.005]	[0.006]	[0.007]	[0.010]	[0.012]	[0.012]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39697	39697	39697	39697	39697	39697	39505	39505
Adjusted R^2	0.009	0.009	0.009	0.009	0.004	0.005	0.090	0.091

Panel C: Engagement Hypothesis, Yearly Changes, (Δ emissions-only, assuming portfolio weights at t+1 remain the same as at t)

	Δ emissions-only log Scope 1 Top 100 (t+1)		Δ emissions-only log Scope 1 /Revenue Top 100 (t+1)		Δ emissions-only log Scope 1 Footprint Top 100 (t+1)		Δ emissions-only log Scope 1 /Portfolio Size Top 100 (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.007*	-0.005*	0.003	0.004	-0.009**	-0.006**	-0.009**	-0.006**
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.002]	[0.003]	[0.002]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	42141	42141	42141	42141	42141	42141	42141	42141
Adjusted R^2	0.106	0.113	0.309	0.313	0.122	0.130	0.122	0.130

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 8: Portfolio Decarbonization Strategies: 3-Year Changes

This table presents regressions for three-year changes in portfolio carbon metrics of institutional investors. The variable of interest is a dummy indicating if the investor is a member of the CDP initiative. The specifications follow those of Tables 4 (Panel A) and 5 (Panels B and C) and regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients not shown). Definitions of the variables are provided in Appendix A. All specifications include year fixed effects, while specifications in (3), (6), (9), and (12) also have investor fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded.We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Scope 1 Emissions 3-Year Changes (Δ3-year Total)

	Δ3 Total log Scope 1 (t+1)		Δ3 Total log Scope 1/Revenue (t+1)		Δ3 Total log Scope 1 Footprint (t+1)		Δ3 Total log Scope 1/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.054***	-0.033**	-0.044***	-0.038***	-0.081**	-0.075**	-0.095***	-0.061**
	[0.013]	[0.014]	[0.010]	[0.010]	[0.033]	[0.032]	[0.030]	[0.026]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39776	39771	39776	39771	39776	39771	39776	39771
Adjusted R^2	0.017	0.019	0.016	0.017	0.008	0.014	0.051	0.067

Panel B: Tilting Hypothesis, 3-Year Changes (Δ3 weights-only, assuming portfolio firm emissions at t+3 remain the same as at t)

	Δ3 weights-only log Scope 1 (t+1)		Δ3 weights-only log Scope 1/Revenue (t+1)		Δ3 weights-only log Scope 1 Footprint (t+1)		Δ3 weights-only log Scope 1/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.051***	-0.045***	-0.031**	-0.040**	0.011	-0.041	-0.004	-0.029
	[0.012]	[0.014]	[0.012]	[0.013]	[0.029]	[0.028]	[0.019]	[0.020]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	39657	39652	39657	39652	39657	39652	39657	39652
Adjusted R^2	0.017	0.020	0.015	0.017	0.002	0.009	0.048	0.051

Panel C: Engagement Hypothesis, 3-Year Changes, (Δ3 emissions-only, assuming portfolio weights at t+3 remain the same as at t)

	Δ3 emissions-only log Scope 1 (t+1)		Δ3 emissions-only log Scope 1 /Revenue (t+1)		Δ3 emissions-only log Scope 1 Footprint (t+1)		Δ3 emissions-only log Scope 1 /Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	0.005	0.014**	0.004	0.010	-0.065***	-0.028**	-0.065***	-0.028**
	[0.008]	[0.005]	[0.008]	[0.006]	[0.018]	[0.010]	[0.018]	[0.010]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	43372	43365	43372	43365	43372	43365	43372	43365
Adjusted R^2	0.029	0.047	0.111	0.116	0.053	0.132	0.053	0.132

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Portfolio Decarbonization Strategies: Climate Action 100+

This table presents regressions for yearly changes in portfolio carbon metrics of institutional investors. The variables of interest are dummies indicating if the investor is a only member of the CDP initiative, only a member of the Climate Action 100+ initiative, or a member of both initiatives. The specifications follow those of Tables 4 (Panel A) and 5 (Panels B and C) and regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients not shown). Definitions of the variables are provided in Appendix A. All specifications include year fixed effects, while specifications in (3), (6), (9), and (12) also have investor fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded.We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Scope 1 Emissions 1-Year Changes (Δ Total)

	Δ Total log Scope 1 (t+1)		Δ Total log Scope 1/Revenue (t+1)		Δ Total log Scope 1 Footprint (t+1)		Δ Total log Scope 1/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
only CDP	-0.018*	-0.012	-0.014*	-0.014*	-0.027*	-0.030**	-0.026	-0.017
	[0.010]	[0.011]	[0.007]	[0.006]	[0.014]	[0.011]	[0.017]	[0.011]
only Climate Action 100+	-0.207***	-0.201***	0.028***	0.030***	-0.174***	-0.163***	-0.128***	-0.118***
	[0.011]	[0.011]	[0.006]	[0.007]	[0.011]	[0.018]	[0.011]	[0.014]
CDP * Climate Action 100+	-0.027**	-0.022*	0.004	0.004	-0.042***	-0.045**	-0.028*	-0.024
	[0.012]	[0.012]	[0.007]	[0.009]	[0.013]	[0.019]	[0.014]	[0.018]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50997	50983	50997	50983	50997	50983	50997	50983
Adjusted R^2	0.012	0.012	0.013	0.013	0.009	0.010	0.075	0.077

Panel B: Tilting Hypothesis, 1-Year Changes (Δ weights-only, assuming portfolio firm emissions at t+1 remain the same as at t)

	Δ weights-only log Scope 1 (t+1)		Δ weights-only log Scope 1/Revenue (t+1)		Δ weights-only log Scope 1 Footprint (t+1)		Δ weights-only log Scope 1/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
only CDP	-0.022***	-0.021***	-0.017**	-0.019**	-0.005	-0.022**	-0.002	-0.009
	[0.004]	[0.007]	[0.007]	[0.007]	[0.008]	[0.010]	[0.010]	[0.010]
only Climate Action 100+	-0.138***	-0.137***	0.062***	0.063***	-0.179***	-0.183***	-0.134***	-0.140***
	[0.009]	[0.009]	[0.007]	[0.008]	[0.012]	[0.014]	[0.011]	[0.011]
CDP * Climate Action 100+	-0.032***	-0.036***	-0.010	-0.013	-0.050***	-0.067***	-0.034**	-0.045***
	[0.010]	[0.009]	[0.009]	[0.011]	[0.012]	[0.016]	[0.012]	[0.011]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50971	50957	50971	50957	50971	50957	50971	50957
Adjusted R^2	0.010	0.010	0.010	0.010	0.004	0.006	0.072	0.073

Panel C: Engagement Hypothesis, 1-Year Changes, (Δ emissions-only, assuming portfolio weights at t+1 remain the same as at t)

	Δ emissions-only log Scope 1 (t+1)		Δ emissions-only log Scope 1 /Revenue (t+1)		Δ emissions-only log Scope 1 Footprint (t+1)		Δ emissions-only log Scope 1 /Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
only CDP	0.001	0.007	0.003	0.005	-0.022*	-0.008	-0.022*	-0.008
	[0.007]	[0.006]	[0.004]	[0.004]	[0.010]	[0.005]	[0.010]	[0.005]
only Climate Action 100+	0.028***	0.032***	0.006	0.005	-0.025***	-0.014*	-0.025***	-0.014*
	[0.005]	[0.005]	[0.005]	[0.005]	[0.005]	[0.008]	[0.005]	[0.008]
CDP * Climate Action 100+	0.007	0.014*	0.007	0.009	-0.003	0.006	-0.003	0.006
	[0.006]	[0.007]	[0.007]	[0.007]	[0.009]	[0.012]	[0.009]	[0.012]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	52442	52426	52442	52426	52442	52426	52442	52426
Adjusted R^2	0.068	0.075	0.103	0.105	0.077	0.107	0.077	0.107

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 10: Green Business Activities: Green Patents and Green Revenues

This table presents regressions of the levels and yearly changes of portfolio green patent and revenue metrics for institutional investors. Regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients shown). We also add two additional controls in specifications (3), (6) and (9). These are log *Scope 1/Revenue*, and *Carbon Disclosure %*. The dependent variable *Green Patent %* is available for 2005-2012, while *Green Revenue %* is available for 2016-2019. Further, we regress yearly changes in the measures as well as decomposing those into "tilting" and "engagement" changes as in Table 5. We show the results for Green Patents in Panel A and for Green Revenues in Panel B. The main variables of interest in Panel A are dummies indicating if the institution is a member of only the CDP initiative, only the Climate Action 100+ initiative, or both. The variable of interest in Panel B is a dummy showing if the investor is a member of the CDP initiative, as the Green Patent data ends before the Climate Action 100+ initiative was formed. Definitions of the variables are provided in Appendix A. All specifications include year fixed effects. For Green Revenues standard errors are clustered at the investor level, while for Green Patents they are clustered at the investor and year level. The Dependent variables are all forwarded by one period. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Green Patents (2005-2012)

	Green Patent % (t+1)			Δ Total Green Patent % (t+1)			Δ weights-only Green Patent % (t+1)			Δ patent-only Green Patent % (t+1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CDP	0.316	0.248	0.156	-0.146	-0.158	-0.189	-0.102**	-0.067	-0.086*	0.019	-0.041	-0.036
	[0.238]	[0.243]	[0.226]	[0.081]	[0.108]	[0.115]	[0.036]	[0.048]	[0.044]	[0.046]	[0.067]	[0.081]
log Scope 1/Revenue			0.746***			0.009			-0.032			0.065
			[0.121]			[0.070]			[0.034]			[0.042]
Carbon Disclosure %			0.070***			-0.003			0.000			-0.004
			[0.009]			[0.006]			[0.003]			[0.004]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26505	26505	23465	22230	22230	19286	25701	25701	22746	22894	22894	19875
Adjusted R^2	0.056	0.067	0.111	0.006	0.007	0.007	0.008	0.009	0.009	0.024	0.026	0.028

Panel B: Green Revenues (2016-2019)

	Green Revenue % (t+1)			Δ Total Green Revenue % (t+1)			Δ weights-only Green Revenue % (t+1)			Δ revenue-only Green Revenue % (t+1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
only CDP	0.452***	0.308***	0.305***	0.072**	0.070**	0.068*	0.065*	0.076**	0.079**	0.024**	0.013	0.008
	[0.098]	[0.098]	[0.097]	[0.035]	[0.035]	[0.035]	[0.034]	[0.034]	[0.034]	[0.012]	[0.012]	[0.012]
only Climate Action 100+	0.728**	0.541*	0.511	0.357	0.364	0.365	0.312	0.323	0.327	-0.116	-0.115	-0.120
	[0.326]	[0.316]	[0.323]	[0.322]	[0.323]	[0.322]	[0.305]	[0.304]	[0.304]	[0.121]	[0.121]	[0.120]
CDP * Climate Action 100+	0.774***	0.599***	0.665***	0.259**	0.264**	0.263**	0.292***	0.307***	0.309***	0.014	0.010	0.005
	[0.210]	[0.212]	[0.209]	[0.111]	[0.112]	[0.112]	[0.101]	[0.102]	[0.102]	[0.047]	[0.047]	[0.048]
log Scope 1/Revenue			0.377***			-0.006			-0.011			-0.003
			[0.040]			[0.018]			[0.017]			[0.005]
Carbon Disclosure %			-0.001			0.001			-0.000			0.001***
			[0.002]			[0.001]			[0.001]			[0.000]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17889	17876	17827	12944	12935	12888	12944	12935	12888	13373	13362	13314
Adjusted R^2	0.034	0.064	0.083	0.001	0.002	0.002	0.002	0.002	0.002	0.019	0.041	0.042

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 11: Green Business Activities: Green Patents and Green Revenues, 3-Year Changes

This table presents regressions of the levels and 3-year changes of portfolio green patent and revenue metrics for institutional investors. Regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients shown). We also add two additional controls in specifications (3), (6) and (9). These are log *Scope 1/Revenue*, and *Carbon Disclosure %*. The dependent variable *Green Patent %* is available for 2005-2012, while *Green Revenue %* is available for 2016-2019. For Green Patents. the total and patent-only (engagement) 3-year changes are available for 2005-2009, while the weights-only 3-year changes are available for 2005-2012. The 3-year changes for Green Revenues are available for 2016. Further, we regress yearly changes in the measures as well as decomposing those into "tilting" and "engagement" changes as in Table 5. We show the results for Green Patents in Panel A and for Green Revenues in Panel B. The main variables of interest in Panel A are dummies indicating if the institution is a member of only the CDP initiative, only the Climate Action 100+ initiative, or both. The variable of interest in Panel B is a dummy showing if the investor is a member of the CDP initiative, as the Green Patent data ends before the Climate Action 100+ initiative was formed. Definitions of the variables are provided in Appendix A. All specifications include year fixed effects. For Green Revenues standard errors are clustered at the investor level, while for Green Patents they are clustered at the investor and year level. The Dependent variables are all forwarded by one period. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Green Patents (2005-2012), 3-year changes for 2005-2009, except weights-only which are 2005-2012

	Green Patent % (t+1)			Δ3 Total Green Patent % (t+1)			Δ3 weights-only Green Patent % (t+1)			Δ3 patent-only Green Patent % (t+1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CDP	0.316	0.248	0.156	0.189	0.154	0.034	0.110	0.127	-0.006	0.056	-0.113	-0.112
	[0.217]	[0.218]	[0.216]	[0.179]	[0.176]	[0.195]	[0.126]	[0.129]	[0.138]	[0.102]	[0.102]	[0.112]
log Scope 1/Revenue			0.746***			-0.153*			-0.222***			0.060
			[0.085]			[0.084]			[0.061]			[0.040]
Carbon Disclosure %			0.070***			0.018***			0.013***			-0.007**
			[0.007]			[0.005]			[0.003]			[0.003]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	26505	26505	23465	14498	14498	11748	24197	24197	21418	15967	15967	12974
Adjusted R^2	0.056	0.067	0.111	0.009	0.015	0.019	0.001	0.002	0.005	0.037	0.063	0.072

Panel B: Green Revenues (2016-2019), All 3-year changes for 2016 only

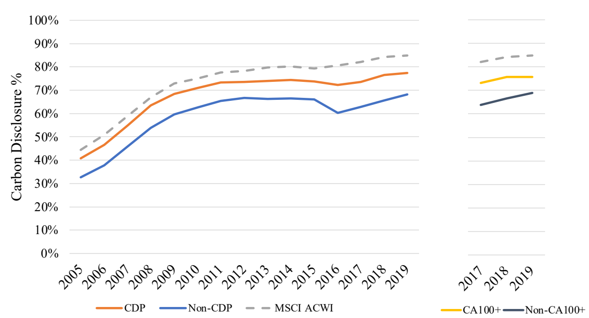
	Green Revenue % (t+1)			Δ3 Total Green Revenue % (t+1)			Δ3 weights-only Green Revenue % (t+1)			Δ3 revenue-only Green Revenue % (t+1)		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
CDP	0.483***	0.337***	0.344***	0.175*	0.171*	0.161	0.161*	0.194**	0.193**	-0.012	-0.030	-0.037
	[0.099]	[0.099]	[0.098]	[0.100]	[0.101]	[0.101]	[0.095]	[0.096]	[0.097]	[0.031]	[0.030]	[0.031]
log Scope 1/Revenue			0.376***			-0.027			0.021			-0.008
			[0.040]			[0.048]			[0.047]			[0.014]
Carbon Disclosure %			-0.001			0.003			0.002			0.002*
			[0.002]			[0.003]			[0.002]			[0.001]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Year FE	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No
Observations	17889	17876	17827	3887	3886	3846	3887	3886	3846	4292	4290	4247
Adjusted R^2	0.034	0.063	0.083	-0.000	0.004	0.005	-0.000	-0.000	-0.000	0.006	0.070	0.075

Internet Appendix

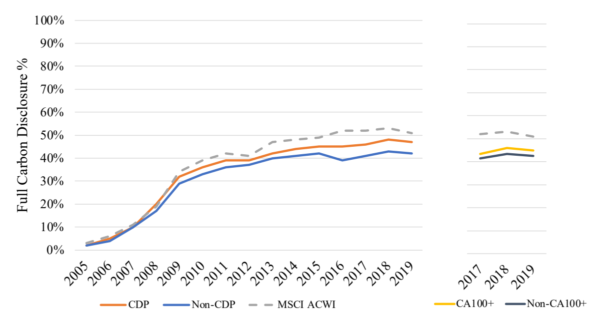
Figure IA.1: Portfolio Carbon Emission Disclosures and Targets

This figure shows the fraction of firms in investor portfolios which have disclosed carbon emissions or emission reduction targets. We define as climate-conscious those investors that are signatories of the CDP or Climate Action 100+ initiatives. We also add other mean disclosure and target variables for Non-CDP and Non-Climate Action 100+ investors, as well as for a representative MSCI ACWI investor. Panel A displays the weighted average percentage of disclosed carbon emissions by firms in investor portfolios. Panel B displays the mean percentage of firms in the investor portfolios which disclose 100% of their carbon emissions. Panel C displays the mean percentage of firms in the investor portfolios that have an emissions reduction target. Panel D shows the mean percentage of firms in investor portfolios that have a verified Science-based Target initiative (SBTi) emissions reduction target program. Definitions of the variables are provided in Appendix A.

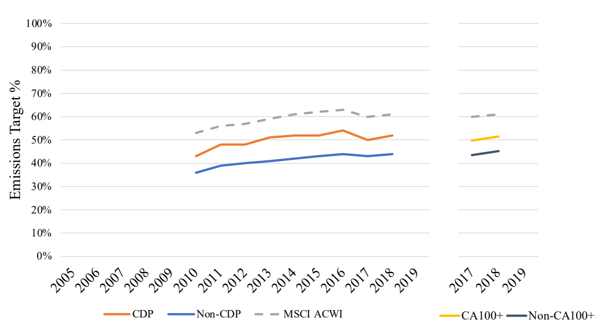
Panel A: Carbon Disclosure %



Panel B: Full Carbon Disclosure %



Panel C: Emissions Target %



Panel D: Science-based Emissions Target %

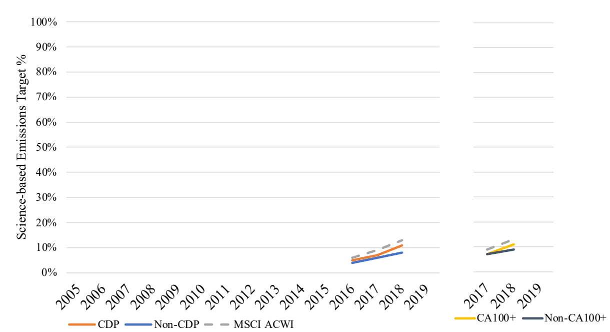
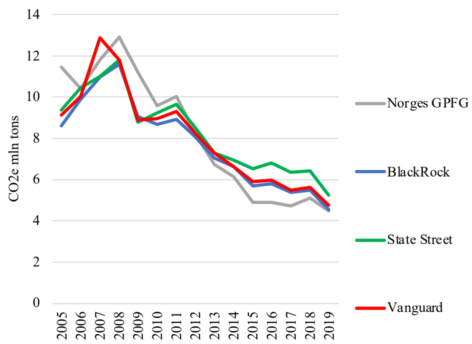


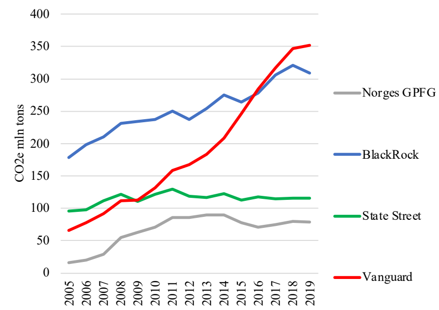
Figure IA.2: Emissions and Equity Holdings for Norges GPFG and the Big 3

This figure displays portfolio carbon emissions and equity holdings data for prominent institutional investors, as described in Section 2.2. The first one is Norges GPFG (the Government Pension Fund Global), commonly known as the Norwegian sovereign Wealth Fund. The next three are the “Big 3”: Blackrock, State Street and Vanguard. Definitions of the variables are provided in Appendix A.

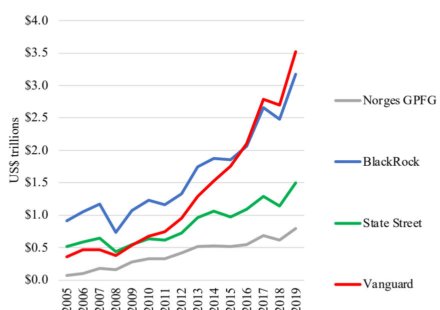
Panel A: Scope 1



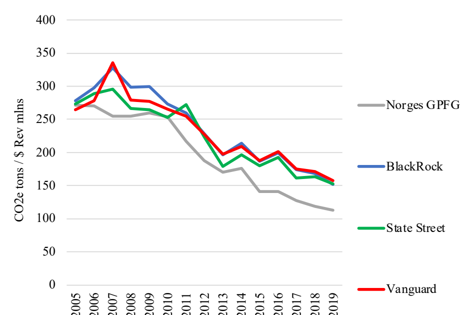
Panel B: Scope 1 Footprint



Panel C: Total Equity Holdings



Panel D: Scope 1/Revenue



Panel E: Total % Equity Holdings vs % Scope 1 Footprint

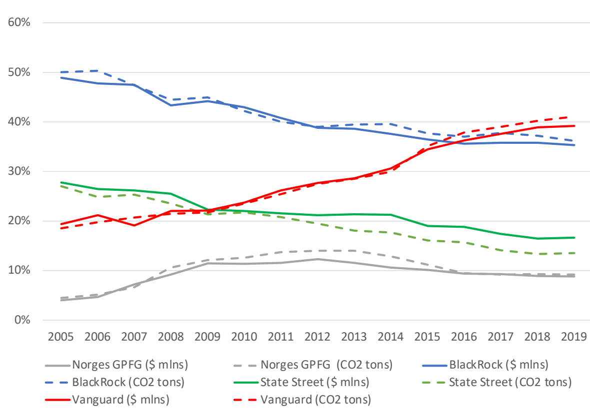


Figure IA.3: Institutional Share of Global Carbon Emissions and Market Capitalization: Top 100 Emitting Firms

This figure shows the share of total carbon (GHG) emissions apportioned to the equity holdings of institutional investors, other public investors, and to non-public firms for the 2005-2019 sample period. In Panel A we plot the total GHG (CO2-equivalent) emissions by public firms compared to the total global emissions from fossil fuel use, industrial processes and product use estimated by the EDGAR v6.0 data from European Commission, Joint Research Centre (2021). We then split out the GHG emissions by public firms into the fractions attributable to institutional and non-institutional investors based on the ownership stake of each group. Finally, we split the two groups further into the GHG emissions coming from the top 100 emitters in each year (brown and brown-checkered) and the remaining non-top 100 emitting firms (green and green-checkered).

Panel A: Total Carbon (GHG) Emissions

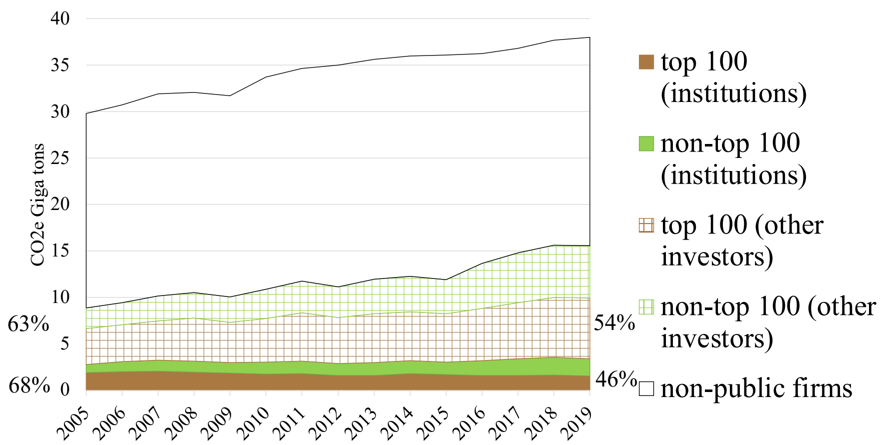


Table IA.1: Top Institutional Investors

This table displays the top ten institutional investors in our data in 2019 by Portfolio Size (Equity AuM) domiciled both in Europe and outside of Europe. Definitions of the variables are provided in Appendix A.

Region	Investor Name	Equity AuM in 2019 (in US $ blns)	Country of Domicile	Year joined CDP	Year joined CA100+	*Scope 1 (Average CO2e million tons)*	*Scope 1/ Revenue (Average CO2e tons/ $ Rev millions)*	*Scope 1 Footprint (Total CO2e million tons)*	*Scope 1/ Portfolio Size (Total CO2e tons/ $ Mkt Cap millions)*
Europe	Norges Bank Investment Management	$ 794	Norway	2009		4.48	113	79	99
	BlackRock Investment Management (UK) Ltd.	$ 341	UK	2007		4.87	131	28	82
	BlackRock Advisors (UK) Ltd.	$ 274	UK	2007		5.30	156	34	124
	Baillie Gifford & Co.	$ 195	UK	2003		1.51	46	6	29
	APG Asset Management NV	$ 166	Netherlands	2004	2017	3.92	148	18	105
	DWS Investment GmbH	$ 155	Germany	2005	2017	4.84	175	13	81
	Legal & General Investment Management Ltd.	$ 144	UK	2003	2017	5.43	185	13	92
	JPMorgan Asset Management (UK) Ltd.	$ 109	UK	2008		4.69	136	11	100
	Schroder Investment Management Ltd.	$ 103	UK	2006	2017	4.87	126	13	125
	FIL Investment Advisors (UK) Ltd.	$ 94	UK	2019	2019	4.36	90	8	90
Non-Europe	The Vanguard Group, Inc.	$ 3,363	USA	2018		4.72	158	337	100
	BlackRock Fund Advisors	$ 2,084	USA	2007		4.52	160	208	100
	SSgA Funds Management, Inc.	$ 1,403	USA	2004		5.20	153	104	74
	Fidelity Management & Research Co. LLC	$ 916	USA			3.40	96	56	61
	T. Rowe Price Associates, Inc. (Investment Management)	$ 785	USA	2011		2.60	121	38	49
	Capital Research & Management Co. (World Investors)	$ 702	USA			4.63	113	55	78
	Geode Capital Management LLC	$ 530	USA			4.79	140	43	81
	Wellington Management Co. LLP	$ 509	USA	2019		3.66	106	27	53
	Capital Research & Management Co. (Global Investors)	$ 505	USA			5.25	131	35	70
	Dimensional Fund Advisors LP	$ 417	USA			4.28	174	82	197

Table IA.2: Factors Associated with Joining the CDP and Climate Action 100+ Initiatives

This table presents regressions of the factors associated with membership of CDP and Climate Action 100+, two prominent climate-conscious investor initiatives. We show results for Logit regressions. The dependent variables dummies take the value of one if an investor is a member of CDP in a given year and zero otherwise. Definitions of the variables are provided in Appendix A. All specifications include fixed effects and the standard errors are clustered at the investor level. We forward the dependent variables by one year. We winsorise all continuous variables at the 1 and 99% cutoff levels.

	CDP (t+1)		Climate Action 100+ (t+1)	
	(1)	(2)	(3)	(4)
Portfolio Size	0.495***	0.279***	0.525***	0.373***
	[0.023]	[0.027]	[0.037]	[0.047]
Europe	0.145	-0.037	0.494***	0.273
	[0.116]	[0.148]	[0.183]	[0.238]
North America	-1.676***	-1.621***	-1.622***	-1.563***
	[0.118]	[0.165]	[0.203]	[0.287]
Asset Owner	0.140	0.184	1.021***	1.157***
	[0.172]	[0.172]	[0.232]	[0.235]
# Companies		0.575***		0.020
		[0.103]		[0.179]
# Industries		-0.015*		0.023
		[0.008]		[0.014]
Average Market Cap		0.263***		0.138*
		[0.045]		[0.080]
Average Market-to-Book		-0.434***		-0.523***
		[0.074]		[0.136]
Own Region %		-0.001		-0.002
		[0.002]		[0.003]
Developed Markets %		-0.001		0.004
		[0.002]		[0.003]
Year FE	Yes	Yes	Yes	Yes
Observations	62212	62194	13605	13594
Pseudo R^2	0.206	0.235	0.221	0.237

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table IA.3: Portfolio Decarbonization Strategies: In Three Material Sectors (Materials, Utilities, Energy), for European Investors

This table presents regressions for yearly changes in portfolio carbon metrics of institutional investors, in the part of their portfolios which is allocated to one of the three material sectors (materials, utilities, and energy).The sectors are classified using the GICs sectors in the Trucost emissions data. We limit the sample to only include European institutional investors. The main variable of interest is a dummy indicating if the institution is a member of the CDP initiative. The specifications follow those of Tables 4 (Panel A) and 5 (Panels B and C) and regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients not shown). Definitions of the variables are provided in Appendix A. In specifications (10) to (12) we normalise Footprint by dividing it by the part of the portfolios which is allocated to the three material sectors. All specifications include year fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded.We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Scope 1 Emission Yearly Changes (Δ Total)

	Δ Total log Scope 1 3MS (t+1)		Δ Total log Scope 1/Revenue 3MS (t+1)		Δ Total log Scope 1 Footprint 3MS (t+1)		Δ Total log Scope 1/Portfolio Size 3MS (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.013	-0.012	-0.011	-0.008	-0.032**	-0.029**	-0.010	-0.009
	[0.011]	[0.014]	[0.009]	[0.008]	[0.015]	[0.012]	[0.011]	[0.009]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10816	10816	10816	10816	10816	10816	10816	10816
Adjusted R^2	0.009	0.012	0.033	0.034	0.007	0.011	0.179	0.180

Panel B: Tilting Hypothesis, Yearly Changes (Δ weights-only, assuming portfolio firm emissions at t+1 remain the same as at t)

	Δ weights-only log Scope 1 3MS (t+1)		Δ weights-only log Scope 1/Revenue 3MS (t+1)		Δ weights-only log Scope 1 Footprint 3MS (t+1)		Δ weights-only log Scope 1/Portfolio Size 3MS (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.014	-0.014	-0.007	-0.008	-0.030*	-0.029**	-0.011	-0.011
	[0.012]	[0.014]	[0.007]	[0.007]	[0.014]	[0.012]	[0.011]	[0.011]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10829	10829	10829	10829	10829	10829	10811	10811
Adjusted R^2	0.010	0.012	0.019	0.018	0.005	0.007	0.184	0.184

Panel C: Engagement Hypothesis, Yearly Changes, (Δ emissions-only, assuming portfolio weights at t+1 remain the same as at t)

	Δ emissions-only log Scope 1 3MS (t+1)		Δ emissions-only log Scope 1 /Revenue 3MS (t+1)		Δ emissions-only log Scope 1 Footprint 3MS (t+1)		Δ emissions-only log Scope 1/Portfolio Size 3MS (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.000	0.000	-0.001	0.000	-0.002	-0.001	-0.002	-0.001
	[0.003]	[0.003]	[0.003]	[0.003]	[0.004]	[0.003]	[0.004]	[0.003]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11165	11165	11165	11165	11165	11165	11165	11165
Adjusted R^2	0.050	0.055	0.203	0.207	0.057	0.074	0.057	0.074

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table IA.4: Portfolio Carbon Emission Changes: allocations (weights) and Scope 1 footprint in firms in material and non-material sectors, for European investors

This table presents regressions of the yearly changes in institutional investor portfolio allocations (weights, 0-100) and portfolio footprint in the polluting firms in three material sectors, non-top 100 polluting firms in the three material sectors, and in firms outside of the three material sectors. We rank firms based on their Scope 1 emissions each year. We define the three material sectors as materials, utilities, and energy. The sectors are classified using the GICs sectors in the Trucost emissions data.The variable of interest is a dummy showing if an investor is a member of the CDP initiative. The regressions include Investor and Portfolio Characteristics as in Table 3. Definitions of the variables are provided in Appendix A. Regressions (1) to (3) are in yearly changes. All specifications include year fixed effects. Standard errors are clustered at the year and investor level. Panel A shows the regressions for the Top 100 firms in the three material sectors, Panel B for non-top 100 firms in the three material sectors, andPanel C for the measures based on portfolio non-material sector firms. Dependent variables are forwarded.We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Top 100 in Three Material Sectors

	Δ % Top 100 in Material Sectors (t+1)		Δ log Scope 1 Footprint Top 100 in Material Sectors (t+1)	
	(1)	(2)	(3)	(4)
CDP	-0.184***	-0.142***	-0.043***	-0.039***
	[0.041]	[0.043]	[0.006]	[0.007]
Investor Controls	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	11394	11394	9495	9495
Adjusted R^2	0.054	0.059	0.011	0.016

Panel B: Non-Top 100 in Three Material Sectors

	Δ % Non-Top 100 in Material Sectors (t+1)		Δ log Scope 1 Footprint Non-Top 100 in Material Sectors (t+1)	
	(1)	(2)	(3)	(4)
CDP	0.078	0.036	-0.004	-0.000
	[0.108]	[0.093]	[0.015]	[0.020]
Investor Controls	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	11394	11394	10729	10729
Adjusted R^2	0.037	0.040	0.013	0.015

Panel C: Non-Three Material Sectors

	Δ % Non-Material Sectors (t+1)		Δ log Scope 1 Footprint Non-Material Sectors (t+1)	
	(1)	(2)	(3)	(4)
CDP	0.125	0.123*	-0.025	-0.021
	[0.078]	[0.066]	[0.014]	[0.016]
Investor Controls	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	11394	11394	11342	11342
Adjusted R^2	0.045	0.046	0.021	0.023

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table IA.5: Portfolio Decarbonization Strategies: Ratio of Scope 1 / (1+ 2 + 3)

This table presents regressions for total yearly changes in portfolio carbon metrics of institutional investors, in particular the ratio of Scope 1 to Scope 1 + 2 + 3 emissions. The main variable of interest is a dummy indicating if the institution is a member of the CDP initiative. The specifications follow those of Tables 4 (Panel A) and 5 (Panels B and C) and regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients not shown). Definitions of the variables are provided in Appendix A. All specifications include year fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Scope 1 / (1 +2+3) Emissions Emission Yearly Changes (Δ Total)

	Δ Total log Scope 1 % All (t+1)		Δ Total log Scope 1/Revenue % All (t+1)		Δ Total log Scope 1 Footprint % All (t+1)		Δ Total log Scope 1/Portfolio Size % All (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.003**	-0.002	-0.003**	-0.002**	-0.003**	-0.003**	-0.003**	-0.003**
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50997	50983	50997	50983	50997	50983	50997	50983
Adjusted R^2	0.016	0.017	0.009	0.010	0.010	0.011	0.010	0.011

Panel B: Tilting Hypothesis, Yearly Changes (Δ weights-only, assuming portfolio firm emissions at t+1 remain the same as at t)

	Δ weights-only log Scope 1 % All (t+1)		Δ weights-only log Scope 1/Revenue % All (t+1)		Δ weights-only log Scope 1 Footprint % All (t+1)		Δ weights-only log Scope 1/Portfolio Size % All (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.003**	-0.003**	-0.004**	-0.004**	-0.004***	-0.004***	-0.004***	-0.004***
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50971	50957	50971	50957	50971	50957	50971	50957
Adjusted R^2	0.008	0.008	0.010	0.010	0.002	0.002	0.002	0.002

Panel C: Engagement Hypothesis, Yearly Changes, (Δ emissions-only, assuming portfolio weights at t+1 remain the same as at t)

	Δ emissions-only log Scope 1 % All (t+1)		Δ emissions-only log Scope 1/Revenue % All (t+1)		Δ emissions-only log Scope 1 Footprint % All (t+1)		Δ emissions-only log Scope 1/Portfolio Size % All (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	0.001	0.001	0.001	0.001	0.000	0.001	0.000	0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	52442	52426	52442	52426	52442	52426	52442	52426
Adjusted R^2	0.213	0.214	0.079	0.082	0.099	0.101	0.099	0.101

Standard errors in brackets
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table IA.6: Portfolio Decarbonization Strategies: Sum of Scope 1 + 2 + 3

This table presents regressions for total yearly changes in portfolio carbon metrics of institutional investors, in particular the sum of Scope 1 + 2 + 3 emissions. The main variable of interest is a dummy indicating if the institution is a member of the CDP initiative. The specifications follow those of Tables 4 (Panel A) and 5 (Panels B and C) and regressions include Investor and Portfolio Characteristics as in Table 3 (coefficients not shown). Definitions of the variables are provided in Appendix A. All specifications include year fixed effects. Standard errors are clustered at the year and investor level. Dependent variables are forwarded. We winsorise all continuous variables at the 1 and 99% cutoff levels.

Panel A: Scope 1+2+3 Emission Yearly Changes (Δ Total)

	Δ Total log Scope 1+2+3 (t+1)		Δ Total log Scope 1+2+3 /Revenue (t+1)		Δ Total log Scope 1+2+3 Footprint (t+1)		Δ Total log Scope 1+2+3 /Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.010	-0.005	-0.006	-0.007*	-0.019	-0.022**	-0.016	-0.009
	[0.009]	[0.008]	[0.005]	[0.003]	[0.012]	[0.009]	[0.014]	[0.010]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50997	50983	50997	50983	50997	50983	50997	50983
Adjusted R^2	0.026	0.026	0.034	0.034	0.019	0.020	0.162	0.167

Panel B: Tilting Hypothesis, Yearly Changes (Δ weights-only, assuming portfolio firm emissions at t+1 remain the same as at t)

	Δ weights-only log Scope 1+2+3 (t+1)		Δ weights-only log Scope 1+2+3/Revenue (t+1)		Δ weights-only log Scope 1+2+3 Footprint (t+1)		Δ weights-only log Scope 1+2+3/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.012**	-0.011**	-0.008**	-0.010**	0.003	-0.014*	0.006	0.001
	[0.004]	[0.005]	[0.003]	[0.003]	[0.006]	[0.008]	[0.008]	[0.009]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	50971	50957	50971	50957	50971	50957	50971	50957
Adjusted R^2	0.012	0.014	0.013	0.014	0.004	0.007	0.161	0.162

Panel C: Engagement Hypothesis, Yearly Changes, (Δ emissions-only, assuming portfolio weights at t+1 remain the same as at t)

	Δ emissions-only log Scope 1+2+3 (t+1)		Δ emissions-only log Scope 1+2+3/Revenue (t+1)		Δ emissions-only log Scope 1+2+3 Footprint (t+1)		Δ emissions-only log Scope 1+2+3/Portfolio Size (t+1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CDP	-0.001	0.004	0.002	0.003*	-0.021**	-0.010*	-0.021**	-0.010*
	[0.008]	[0.005]	[0.002]	[0.002]	[0.009]	[0.005]	[0.009]	[0.005]
Investor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio Controls	No	Yes	No	Yes	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	52442	52426	52442	52426	52442	52426	52442	52426
Adjusted R^2	0.145	0.156	0.232	0.234	0.175	0.216	0.175	0.216

Standard errors in brackets

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$