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Walking the talk? Firm emissions and disclosure during the third phase of the EU emissions trading system

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Abstract
I document trends in emissions and emission disclosure for a sample of 141 large firms that were active within the EU Emissions Trading System during its third phase (2013–2019). Using text from annual reports, I document a rising share of emissions-related information. However, my measure of emissions talk is generally not predictive of past or future changes in firm emissions. While scope 1 emissions decreased during the period, the decrease is entirely driven by the utility sector. I also find that, in general, firms that receive a larger share of their emission allowances for free tended to do worse in terms of reducing emissions. Finally, I find no evidence of emissions leakage during the sample period in spite of a shrinking emissions cap and a rise in the price of emission allowances.

Resume
Jeg beskriver udviklingen i udledninger og kommunikation om udledninger for 141 store virksomheder, der var en del af tredje fase i EU's kvotehandelssystem (2013-2019). Ved hjælp af tekst fra årsrapporter dokumenterer jeg, at virksomhederne i stigende grad kommunikerer om deres CO2e-udledninger. Til gengæld kan en virksomheds kommuniktion om udledning generelt ikke bruges til at forudsige hverken tidligere eller fremtidige ændringer i virksomhedens udledninger. Scope 1-udledninger faldt i den observerede periode, men faldet er udelukkende drevet af forsyningssektoren. Jeg finder desuden, at virksomheder, der modtager en større del af deres udledningskvoter gratis, generelt klarer sig dårligere med hensyn til at reducere udledninger. Endelig finder jeg ingen tegn på udledningslækage i perioden på trods af et faldende udledningsloft og en stigning i prisen på kvoter.

Key words
Climate, Financial stability

JEL classification
Q56; Q58

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The author alone is responsible for any remaining errors.

WALKING THE TALK?
FIRM EMISSIONS AND DISCLOSURE DURING THE THIRD PHASE OF THE EU EMISSIONS TRADING SYSTEM

WORKING PAPER

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ABSTRACT

I document trends in emissions and emission disclosure for a sample of 141 large firms that were active within the EU Emissions Trading System during its third phase (2013–2019). Using text from annual reports, I document a rising share of emissions-related information. However, my measure of emissions talk is generally not predictive of past or future changes in firm emissions. While scope 1 emissions decreased during the period, the decrease is entirely driven by the utility sector. I also find that, in general, firms that receive a larger share of their emission allowances for free tended to do worse in terms of reducing emissions. Finally, I find no evidence of emissions leakage during the sample period in spite of a shrinking emissions cap and a rise in the price of emission allowances.

1 Introduction

The manufacturing, utility, and fossil fuel sectors are responsible for about 60 percent of global emissions of greenhouse gases (GHG) (IEA, 2021). In order to mitigate climate change, these sectors have to reduce their emissions. While the EU has made progress towards climate neutrality (Lamb et al., 2021), efforts continue in order to reach the 2030 emission targets set by the the European Commission.[1] The EU's emission reductions so far have been partially attributed to the EU cap-and-trade system, the Emissions Trading System (ETS) (Bayer & Aklin, 2020).[2] Since its inception in 2005, the ETS has been a cornerstone of EU climate policy.

In this study, I document trends in emissions and environmental disclosure for a sample of 141 large firms that were active within the EU ETS during its third phase (2013 to 2019). Using plant-level emissions data from the ETS, voluntary emission disclosures, and firm annual reports, I uncover four stylized facts. First, firms that emit more also talk more about emissions in their annual reports. However, there is almost no within-firm correlation between emissions-related content in firm annual reports and actual emissions.

Second, while total emissions decreased during the sample period, the reduction was almost entirely driven by utility firms. Related to this result, I find a negative correlation between the share of free ETS emission allowances allocated to a firm and the change in emission levels, i.e. firms that had to buy allowances generally saw larger emission reductions over the period.

Third, I show that the share of firm emissions originating from within the EU is roughly constant over the period. This suggests that firms did not engage in any large-scale emissions offshoring[3] in spite of an increase in the price of

[1] The target is a 55 percent reduction in emissions relative to 1990 levels.

[2] EU emissions are estimated to have decreased by about 30 percent between 1990 and 2020 (European Environment Agency, 2021).

[3] Moving emissions to a different jurisdiction because of regulatory differences is often called carbon leakage.

emission allowances. This could mean that there is headroom to decrease the use of free emission allowances without causing firms to move emissions-intensive operations outside the EU.

Fourth, using plant level data from the ETS, I find that firms that manage to reduce emissions do so mainly via reducing emissions from existing plants as opposed to changing the composition of plants that they operate.

In 2019, the firms in my sample reported ETS emissions totalling over 400 million tons of CO_2e, or about 30 percent of total ETS emissions.[4] For a more complete picture of firm emissions, I also collect self-reported data on total scope 1[5] emissions, a measure which also covers non-EU emissions and other emissions for which the firm is not liable under the ETS. Scope 1 emissions (ETS emissions) for the firms in my sample decreased by 19 (17) percent from 2013 to 2019. However, the decrease is largely driven by the utility sector and its transition away from coal-fired power plants towards renewable energy sources.

As concern about emissions has risen among policymakers, investors, and the general public, firms are facing increased pressure to report and reduce their emissions (Amel-Zadeh & Serafeim, 2018; European Commission, 2021). Legislation requiring firms to disclose specific quantitative emission metrics is still not implemented in the EU. A majority of the firms in my sample still opt for some degree of voluntary emission disclosure. However, the share of firms choosing to disclose a scope 1 emission figure increased only marginally during the sample period, from 70 to 73 percent. I find that firms that choose to disclose are on average much larger both in terms of revenue and emission levels, which could reflect that small firms face less scrutiny or that emission disclosure is costly and that small firms lack the capacity to disclose.

The Task Force on Climate-related Disclosures[6] concludes that no jurisdiction has as of yet implemented formal reporting requirements aligned with TFCD guidelines on, for example, emission metrics and that few firms fully adhere to their reporting standard (TFCD, 2021). Some countries have adopted proposals for standards to be implemented in the future. In 2021, the European Commission issued a proposal for a Corporate Sustainability Reporting Directive (CSRD), an EU-wide sustainability disclosure standard that will cover a large number of European firms. The proposal is a part of the new EU Taxonomy: a common classification system for the environmental impact of economic activities.

Firms that choose to voluntary disclose emissions metrics often do so under the guidance of an NGO that can provide reporting frameworks and certification[7]. The majority of disclosure data in this study is provided by the non-profit organization CDP (via Bloomberg). A firm's motivation for voluntary disclosure can be part of a corporate social responsibility agenda, e.g. tracking progress towards an emissions target. Disclosure can also be part of a business strategy. The value of investment funds that explicitly include environmental, social, and governance (ESG) performance indicators in their investing process increased by almost 150 percent between 2016 and 2020 (GSIA, 2020). By disclosing environmental performance, a firm can gain access to capital from ESG-minded investors and lower their financing costs. Disclosure can also be a way to signal transparency and preparedness regarding climate risks, serving to gain investor trust and branding the firm as green.

Adopting an environmental disclosure framework does not guarantee an increase in the quality of environmental information available to investors (Bingler, Kraus, & Leippold, 2021). First, the firm may simply restructure existing information in order to adhere to reporting guidelines. Second, the firm may engage in cherry-picking when it comes to quantitative metrics, choosing to report environmental measures where the firm appears to be doing well. Third, the firm may focus their reporting on qualitative process-related information that is not of material importance to investors and may be less transparent regarding, for example, climate-related risks and emission metrics.

Using firm annual and sustainability reports, I derive a simple measure of firm attention to emissions by calculating the share of emissions-related words. I find that firms are increasingly prone to talking about emissions. However, I do not find any significant correlation between my emission word share measure and actual firm emissions except among utility firms. This result is consistent with Bingler et al. (2021) who find that firm emission reporting is characterized by "cheap talk" in the sense that it is focused on qualitative topics such as governance and risk management as opposed to hard metrics and targets. The significant negative correlation between emissions talk and (changes in) emission levels for utility firms reflects the fact that while every sector is talking more about emissions, only the utility sector showed large emission reductions during the sample period.

[4]The ETS has been estimated to cover around 50 percent of total GHG emissions within the EU.

[5]Scope 1 emissions cover direct emissions from firm installations and transports caused by, for example, fuel combustion and industrial processes. Scope 2 emissions cover indirect emissions from purchased power and heating. Scope 3 covers emissions stemming from the use of firm products by the end-user.

[6]TFCD is a global initiative by the Financial Stability Board that seeks to implement a uniform standard for climate-related disclosures on governance, strategy, risk management, and metrics.

[7]See, for example, CDP, the Global Reporting Initiative (GRI) and the Value Reporting Foundation.

During the third phase, the ETS moved to auctioning as the default method of allocating emission allowances as opposed to the free allocation of previous phases. This raised the financial incentives for emission reductions. However, free emission allowances were still in play for industries deemed to be facing competition from regions with less strict emissions regulation.[8] I find that there is a significant negative correlation between a firm's share of free allowances and their emission reductions. Utility companies, which receive the lowest share of their allowances for free, achieved the largest emission reductions of all industries. Conversely, the materials sector, which up until 2021 still received around 90 percent of their allowances for free, on average increased their emissions by about 12 percent between 2013 and 2019. This result suggests that the initial allocation has an impact on the distribution of emission reductions. While being awarded free allowances does not lower the opportunity cost of exercising them, firms are less prone to engage in trading allowances if they have a surplus (Abrell, Cludius, Lehmann, Schleich, & Betz, 2021). Furthermore, some firms do not view emission allowances as a valuable asset but rather as a regulatory burden (Martin, Muûls, & Wagner, 2014).

When setting internal emission targets, firms may prefer an emission intensity target, i.e. emissions per unit of output, to an absolute target. The former insures the company against the risk that growing output will force them to take increasingly costly abatement measures. Climate NGOs are generally not in favor of intensity targets that do not include a commitment to reducing emission levels (SBTi, 2020). However, regulators in several developing countries have supported intensity targets to avoid penalizing growing industries (Wang & Sueyoshi, 2018). While the ETS is ultimately concerned with absolute emission levels, emission intensity factors in heavily when it comes to the aforementioned free allocation of allowances. Firms are subject to product-specific benchmarking, where the free allocation is determined using, among other factors, the average emission intensity within the top ten percent of firms in each product group. Given this context, I analyse both the emission intensity as well as the absolute level of firms' emissions. I find that the average firm in my sample is only marginally more emissions efficient in 2019 than in 2013.

The free allocation mechanism has come under criticism for being too generous, resulting in free allowances being awarded to industries where the actual risk of non-EU competition and carbon leakage is low (de Bruyn, Nelissen, & Koopman, 2013; Martin, Muûls, de Preux, & Wagner, 2014).

In the next section, I present my data and sample selection approach. Section 3 presents my results and section 4 concludes.

2 Data

My data is constructed using three components: Plant-level emissions data from the ETS, firm-level emission- and financial disclosures, and raw text data from firm annual reports.

I collect data on emissions covered by the ETS from the EU Transaction Log (EUTL). Each year, firms operating under the ETS[9] are required to monitor their emissions and surrender the corresponding amount of EU Allowances (EUA). The ETS puts a cap on the number of allowances issued each year. A linear reduction in the cap secures a pre-determined decrease in long-term emissions.[10] EUAs can be traded freely, with the policy goal being cost-efficient emission reductions through free market allocation. Since 2005, the ETS has seen three major revisions.[11] To avoid the impact of regulatory changes, I restrict the sample period in this study to cover the third phase of the ETS, 2013 to 2019. I choose to exclude 2020 due to the extraordinary circumstances caused by the COVID-19 pandemic.

The ETS covers emissions from about 11,000 fixed installations (mainly power and manufacturing plants). Most installations serve to produce heat and power and generate emissions through fuel combustion. However, emissions stemming from other industrial processes such as the manufacturing of cement and fertilizers are also covered. To limit the administrative burden for small emitters, installations with emissions lower than 25 kt of CO_2e may be exempt from the ETS. To maintain a consistent sample selection, I require that all firms in the sample operate at least one installation with emissions greater than 25 kt of CO_2e annually during 2013-2019. Each installation is associated with an Operator Holding Account (OHA), which includes information on the name of the legal entity operating the installation. However, this can be a subsidiary of the ultimate owner (the parent company). In order to link ETS emissions to the ultimate owner of the installation, I rely on the work of Jaraite, Jong, Kažukauskas, Zaklan, and Zeitlberger (2013). The authors provide a dataset that allows us to link the OHA owner to the parent company. A drawback is that the dataset captures ownership of installations as it was during 2005-2007. I manually check each installation and update OHA ownership using data from Bloomberg. As I often cannot determine the date when an installation changes owner, the resulting

[8] Industries on the so-called Carbon Leakage List received up to 100 percent of allowances for free up to a product-specific emission benchmark level.

[9] For inclusion criteria, see European Commission (2010).

[10] The cap decreased by 21 percent between 2005 and 2020.

[11] Phase 1 (2005-2007), phase 2 (2008-2012), phase 3 (2013-2020), and phase 4 (2021-).

dataset only covers emissions from installations that the same owner operated throughout 2013 to 2019. Publicly traded firms face stricter reporting requirements and higher levels of scrutiny from investors. Therefore, I restrict my sample to firms that are listed on a stock exchange. Of the roughly 3,400 installations with annual emissions exceeding 25 kt CO_2e, I am able to match about 1,100 to a publicly traded parent company. Adding back 400 small installations operated by these firms (where emissions are lower than 25 kt annually) yields a data set of about 1,500 installations and 141 unique firms. These 1500 installations generate around 30 percent of all emissions under the purview of the ETS (figure 3). Figure 1 presents the industry composition of my sample. The industries consumer staples, consumer discretionary, industrials, and healthcare are minor in terms of number of firms as well as emissions. Therefore, I group them as "other" for the remainder of the paper.

The second component of my data is voluntary emission disclosures, specifically measures of scope 1 GHG emissions. This data, along with financial information and industrial classification, is gathered from Bloomberg. I focus on scope 1 emissions as they represent emissions over which the firm has the greatest amount of control and are the only type of emission for which the firm is liable under the ETS. In the remainder of the paper, I will refer to voluntarily disclosed scope 1 emissions as self-reported emissions and emissions that the firm reports within the ETS as ETS emissions. Many firms in my sample operate both within and outside of the EU. They also generate emissions within the EU that are not covered by the ETS (e.g. trucking and shipping). Therefore, the self-reported emission measure provides a more complete measure of firm emissions, assuming that it is accurate. For each firm that self-reports emissions, I also construct a measure of emission intensity by first deflating their revenue by industry-specific price indices. I then calculate emission intensity as scope 1 emissions per unit of deflated revenue. As ETS emissions only cover part of total firm emissions, it is not possible to calculate an intensity measure based on ETS emissions, as I cannot observe the output from individual installations.

The third and final component consists of firm annual and sustainability reports collected via Bloomberg and firm websites. I extract the raw text data from these documents and process them to remove formatting, tables, and figures. Using the text, I construct a simple measure of the emissions-related content in each report based on the ESG-dictionary constructed by Baier, Berninger, and Kiesel (2020). I count the occurrences of words related to emissions,[12] and their share of the total word count. While this measure is silent on the context of emissions talk, I believe it is a valid proxy for the general amount of attention the firm dedicates to emission disclosure. As figure 9 shows, the emission word share is significantly correlated with the level of ETS emissions. This is to be expected if high emission levels cause the firm to focus more of their communication with stakeholders on emissions.

Table 1 presents summary statistics. Out of 987 firm-year observations, I observe a self-reported scope 1 emission figure for 693 firm-years. The share of firms that opt to disclose emissions increases by only about 3 percentage points during the sample period. 70 percent of firms disclose a scope 1 emissions figure during all seven years between 2013 and 2019.

Table 1
Summary statistics

Variable	N	Mean	Median	SD	P25	P75	Histogram
Scope 1 emissions (Mt CO_2e)	700	18.75	4.34	32.81	1.52	19.20	
ETS emissions	987	5.22	0.85	12.03	0.20	4.54	
Scope 1 emissions, within EU	533	11.02	2.53	21.62	0.62	12.52	
Revenue (EURm)	979	23,832.68	8,015.72	43,918.84	2,559.53	22,275.22	
Scope 1 intensity (t CO_2e/EURm)	700	1,116.69	531.50	1,713.75	187.14	1,067.15	
ETS free allocation share	987	0.70	0.73	0.48	0.43	0.91	
Emission word share	858	1.19	1.15	0.79	0.59	1.62	
Self-reporting status, 2013	141	0.70	1.00	0.46	0.00	1.00	
Self-reporting status, 2019	141	0.73	1.00	0.45	0.00	1.00	
Self-reporter 7+ years	987	0.70	1.00	0.46	0.00	1.00	

3 Results

In this section, I start by describing general emissions trends during the sample period. Next, I examine the correlation between emissions talk and firm emissions. Finally, I examine some of the drivers behind emission performance, including the role of the free allowance allocation within the ETS, carbon leakage, and firm plant composition.

[12]The words are "emission","ghg","co2","greenhouse","atmosphere" and "emit".

The total self-reported (ETS-reported) emission volumes decreased by 19 (17) percent from 2013 to 2019.[13] By both measures, the reduction in emissions exceeded the 12 percent reduction in the emissions cap for the entire ETS during the sample period.[14] Figures 4 and 5 present self-reported and ETS emissions by sector. As the figures show, the utility sector has been the driving force behind the overall reduction in emissions. For other sectors, emission changes lie within the range of $\pm$ 10 percent.

Five utility firms, all of which operate coal-fired power plants[15], account for 75 percent of the in-sample reduction in ETS emissions and 25 percent of overall ETS emission reductions during the sample period. The leading cause of the drop in utility emissions is likely the transition from fossil fuels (notably coal) to renewable power sources (Ember Climate, 2019).

While the transition away from fossil fuels undoubtedly represents progress towards EU climate neutrality, emission reductions in the utility sector may have impeded emission reductions in other industries through what researchers have dubbed "the waterbed-effect" (Eichner & Pethig, 2019). This refers to the fact that targeted emission reductions, e.g. national coal phase-out plans, do not affect the overall emissions cap in the ETS and may simply serve to shift ETS emissions to other industries via lower market prices or stockpiling of allowances. In 2017, the European Commission introduced new rules aimed at reducing surplus allowances in order to support the market price of allowances (Perino, 2018). The spot price of an EUA remained stable from 2013 to about 2018 when it increased significantly (figure 11).

Across all self-reporting firms, mean emission intensity decreased by four percent during the sample period (figure 6). As with emission levels, utility companies stand out with a significant improvement. In figure 6, I have separated out the five automotive companies in my sample, as they stand out among other industries having reduced emission intensity by almost 20 percent on average.

Next, I examine the correlation between firm emission performance and their emissions-related reporting. My simple word share metric indicates a 30 percent increase in the share of emissions-related words in annual reports for the sample as a whole (figure 8). This is consistent with Bingler et al. (2021) who find a similar increase in environmental reporting between 2015 and 2019 using an advanced language model. Also in line with the findings of Bingler et al. (2021), I find that the energy and utility sectors have the highest share of emissions-related content. While a majority of the firms in my sample opt to disclose scope 1 emissions, they are free to choose if and how this number is presented in communications with stakeholders such as in annual reports. As figures 9 and 10 show, there is a significant correlation between the level of firm emissions and emissions talk, i.e. firms that emit more talk more about emissions. This is consistent with emissions talk in a risk management context, as firms that emit more face additional risks related to, for example, the cost of allowances and regulatory risk.

In the context of social responsibility and branding, there is reason to expect a dynamic correlation between emissions talk and emission performance. Firms that are successful in reducing emissions may want to stress this achievement in their annual report, whereas firms that are not successful may want to downplay emissions-related figures. However, this correlation is weakened if firms engage in greenwashing and "cheap talk" (Bingler et al., 2021), i.e. non-material emissions talk that lacks relevant quantitative measures and is decoupled from actual emission performance.

I find no significant correlation between the initial emission word share and subsequent firm-level changes in emissions and emission intensity (figures 12 and 13). For a more robust test of the correlation between emissions talk and emission performance, I estimate a linear regression model with firm and year fixed effects:

$$Y_{it} = \alpha_i + \beta E_{it} + \gamma_t + \varepsilon_{it} \tag{1}$$

where Y_{it} is a measure of the emissions of firm i in year t, E_{it} is the emission word share and α_i and γ_t are a full set of firm and year fixed effects, respectively. ε_{it} is an error term assumed to be i.i.d. between but not within firms. Using this specification, I account for time-invariant unobserved factors by restricting the variation in Y_{it} that is due to within-firm changes in E_{it}. β represents the expected change in firm emissions associated with a one word per thousand increase in emissions talk (about 80 percent of the sample mean). This model is conservative, as it requires a contemporaneous relationship between emissions talk and emissions. To loosen this restriction, I also estimate the model using lags and leads of E_{it}. However, increasing lag lengths comes at the cost of reducing the number of observations, leading to more uncertain estimates.

The estimation results are presented in figure 14 for different lags and leads of emission word share. A lagged effect suggests that emissions talk is predictive of future emissions, whereas a lead effect means that emissions talk predicts

[13] For the ETS as a whole, emissions decreased by 20 percent from 2013 to 2019.

[14] The annual cap was reduced linearly by 1.74 percent.

[15] These firms are RWE (Germany), EDF (France), Enel (Italy), PPC (Greece), and PGE (Poland). All aforementioned countries except Poland have announced national coal phase-out plans.

past changes in emissions. In general, I do not find evidence of any within-firm correlation between emissions talk and actual emissions even though most point estimates have the expected negative sign, i.e. more emissions talk is correlated with lower emissions. However, for utility firms I find some evidence of a significant correlation between emissions and contemporary as well as future emissions talk (panel (d) in figure 14). This is consistent with the aggregate trend for the sector as presented by figures 5 and 8: lower emissions and more emissions talk. The correlation between lower emissions and more future emissions talk could be interpreted as "bragging", i.e. utility firms that have managed to lower their emissions highlight this fact in subsequent annual reports. For the sample as a whole, my results are consistent with Bingler et al. (2021) who find that while the quantity of emissions-related content in annual reports has increased, the additional information is often non-material to investors and instead focuses on qualitative and process-related aspects.

The lack of correlation between emissions talk and emissions can partially be explained by the fact that emissions and emission intensity are almost flat during the sample period for several industries. This is sobering given the increased attention to climate change, a tightening ETS emissions cap, and higher market prices of allowances. Criticism has been raised against the ETS for freely allocating more allowances than necessary to protect firms from outside competition (de Bruyn et al., 2013; Martin, Muûls, de Preux, & Wagner, 2014). This practice could explain the lack of emission reductions in some industries. In my sample, the average share of allowances allocated for free dropped from 73 to 64 percent between 2013 and 2019.[16]

To further understand the role of free allowances, I examine the correlation between the share of EUAs that firms receive for free and their emissions growth during the sample period. According to the Coase (1960) theorem, the initial allocation of allowances should not matter for the distribution of emissions under a free market with no transaction costs. Being awarded allowances for free does not lower the opportunity cost of exercising them. In practice, firms that are under-allocated are forced to trade, while firms that are over-allocated have the option to trade and transaction costs may prohibit them from doing so. Studies on firms' trading behavior reveal that a large share of firms do not trade at all (Baudry, Faure, & Quemin, 2021), even if they have a substantial amount of excess allowances (Martin, Muûls, & Wagner, 2014).

While I cannot provide causal evidence for the impact of free allowances, I find that there is a small but significant correlation between the share of freely allocated allowances and changes in emissions during the period (figure 15), with firms that receive a lower share of their allowances for free managing larger emission reductions. However, this correlation could also reflect industry-specific availability of cost-effective emission abatement measures.

The rationale behind free allowances lies in the implicit threat of offshoring emissions and jobs to countries where emissions are less costly. To investigate the prevalence of carbon leakage, I make use of the fact that some firms opt to disclose a geographic breakdown of their scope 1 emissions.[17] For this subset of firms, I examine the relative share of their emissions originating within the EU versus the rest of the world over time (figure 16). While the share of within-EU emissions decreased by about five percentage points for the sample as a whole, this effect can be attributed to lower emissions from the utility sector. As most of my utility firms operate solely within the EU, lower utility emissions will mechanically decrease the share of within-EU emissions. When I exclude utility firms (figure 17), the share of within-EU emissions is roughly constant at around 40 percent. For these firms, there was no aggregate leakage of emissions-intensive operations. This suggests that the free allowance policy was successful in mitigating leakage. However, we do not know the counterfactual outcome under a less generous scheme.

Using the aforementioned geographic breakdown of scope 1 emissions, I am also able to shed some light on the drivers behind emission reductions. For firms that disclose a regional breakdown, I compare their self-reported emissions originating within the EU to same-plant ETS emissions. As figure 18 shows, same-plant ETS emissions make up around 70 percent of scope 1 EU emissions. The residual covers emissions stemming from activities not covered by the ETS, e.g. transportation, as well as emissions from plants that the firms did not operate throughout the period due to, for example, acquisitions or divestment. A different way of visualizing this data is to examine which emission component contributed to annual within-EU emissions growth. As figure 19 shows, the fall in emissions during 2018 and 2019 can be largely attributed to lower same-plant ETS emissions. This suggests that firms, in particular in the utility sector, were either operating plants at lower capacity and/or at higher emissions efficiency.[18]

[16] The drop is due to a phase-out of free allowances to industries not on the Carbon Leakage List.

[17] 57 firms, around 40 percent of my sample, disclose a regional breakdown every year during the sample period.

[18] For example, coal-fired power plants can be converted to run on gas or biomass for a higher CO_2 efficiency.

4 Conclusion

I document trends and correlations related to emissions and emission disclosure for a sample of large publicly traded firms active within the EU ETS. In line with previous work on the efficacy of the ETS, I find that corporate emissions decreased significantly during its third phase. However, the emission reduction is largely driven by the utility sector, highlighting the need for future reductions to be broad-based. The average firm in 2019 is negligibly more efficient in terms of emissions than in 2013, in spite of the rising cost of emission allowances.

My main finding is that firm annual reports contain an increasing share of emissions-related information and that there is a significant correlation between my measure of emissions talk and the level of firm emissions. However, there is little to no within-firm correlation between emissions talk and actual emissions. This means that a firm disclosing more emissions-related information in their annual report is, in general, not indicative of past or future emission reductions. In 2021, the European Commission adopted a proposal for a new Corporate Sustainability Reporting Directive (CSRD). Their motivation includes the need for more reliable climate-related reporting:

> *The current legal framework does not ensure that the information needs [...] are met. This is because some companies from which users want sustainability information do not report such information, while many that do report sustainability information do not report all the information that is relevant for users. When information is reported, it is often neither sufficiently reliable, nor sufficiently comparable, between companies. The information is often difficult for users to find and is rarely available in a machine-readable digital format.* (European Commission, 2021, p. 2)

What specific disclosures will become mandatory should the proposal become a directive remains to be decided at the time of writing. This study lends support to the argument that the new directive should, at the very least, require firms to consistently report basic measures of GHG emissions.

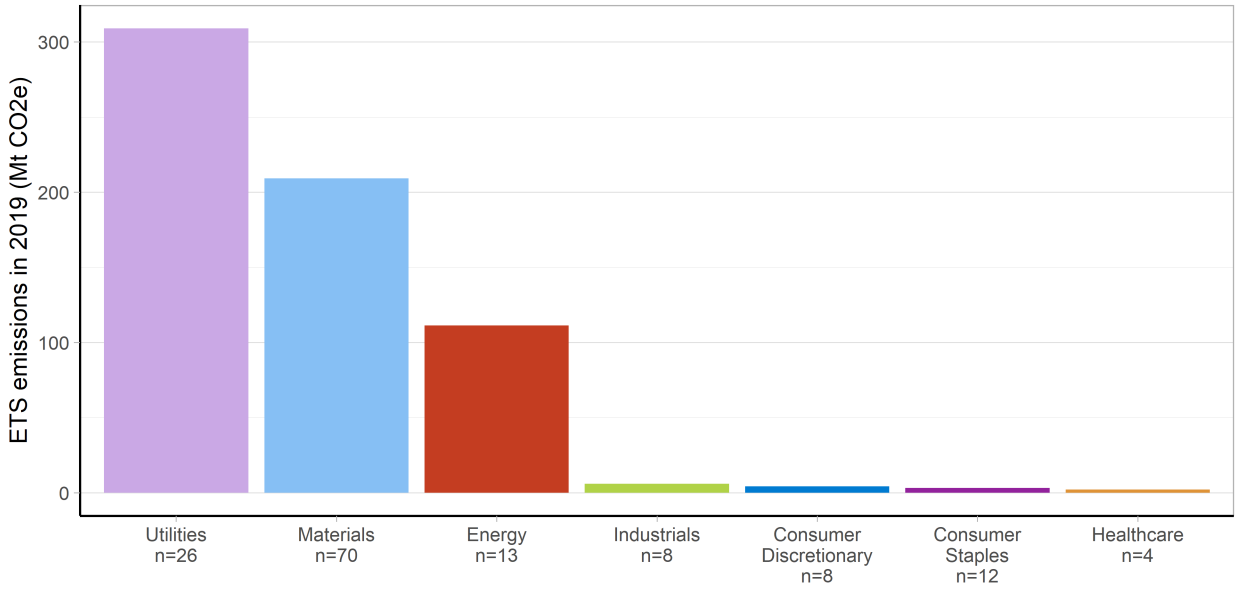


Figure 1
Sample firms by industry group.

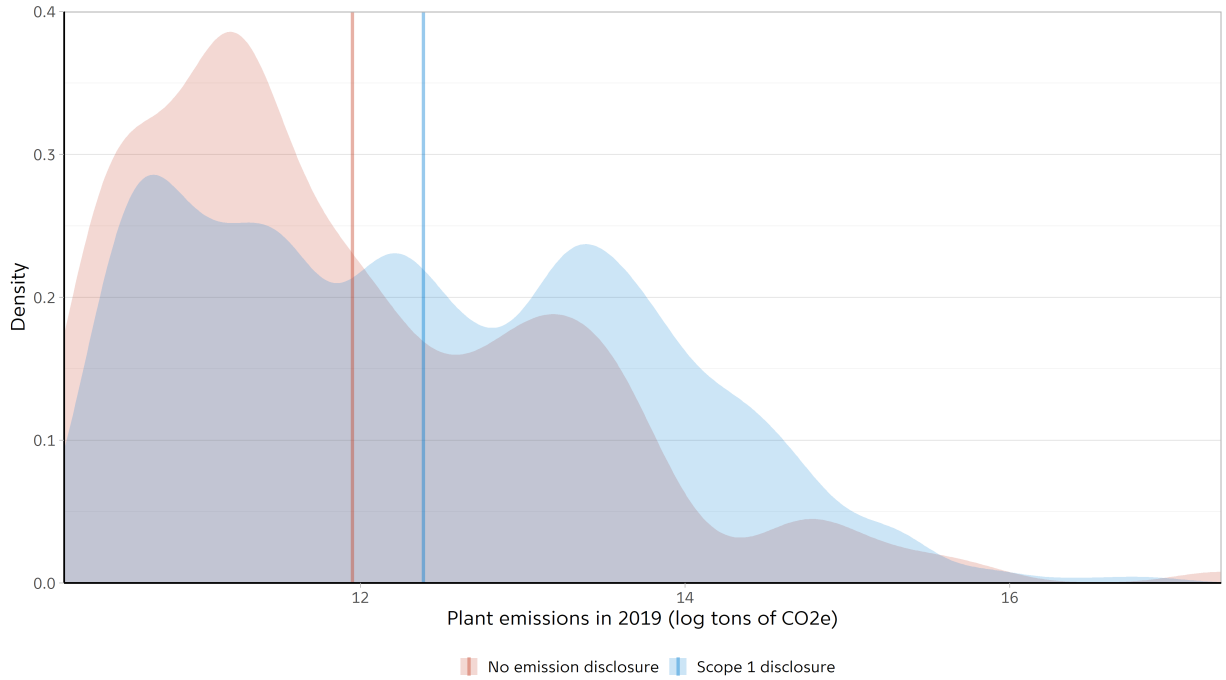


Figure 2
Installation-level emissions by self-reporting status in 2019.

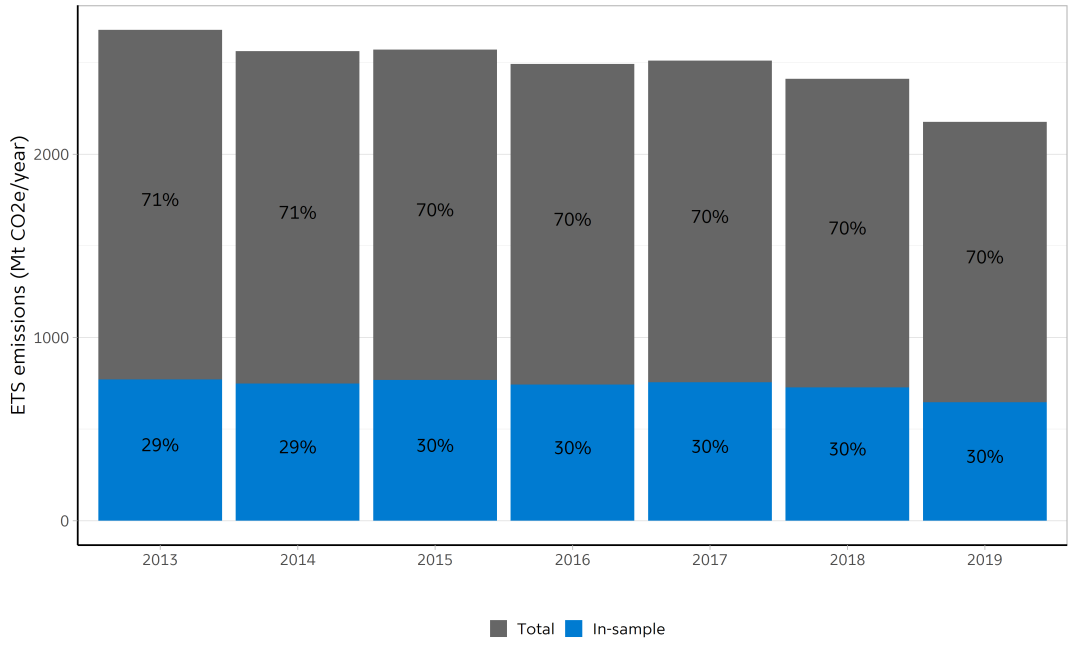


Figure 3
In-sample ETS emissions as a share of all emissions from stationary installations reported to the ETS.

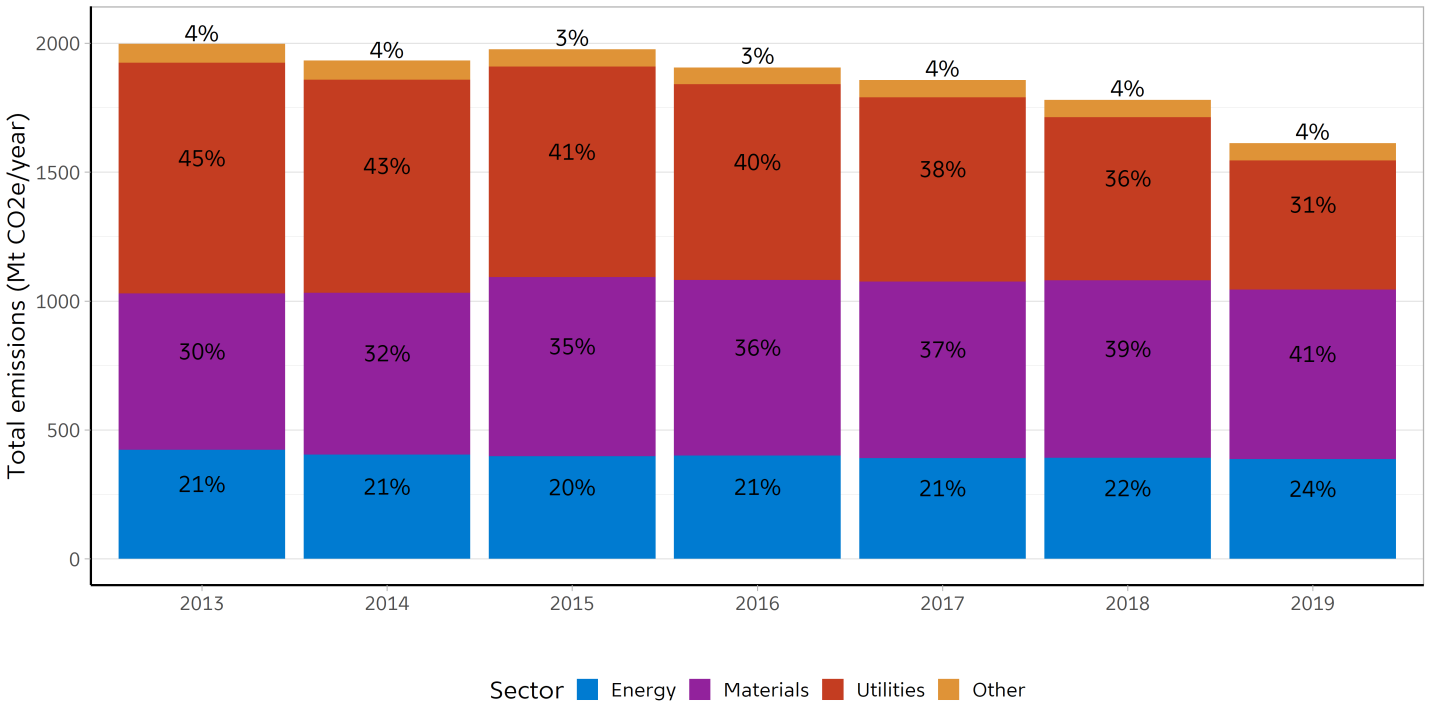


Figure 4
Self-reported emission volumes by industry.

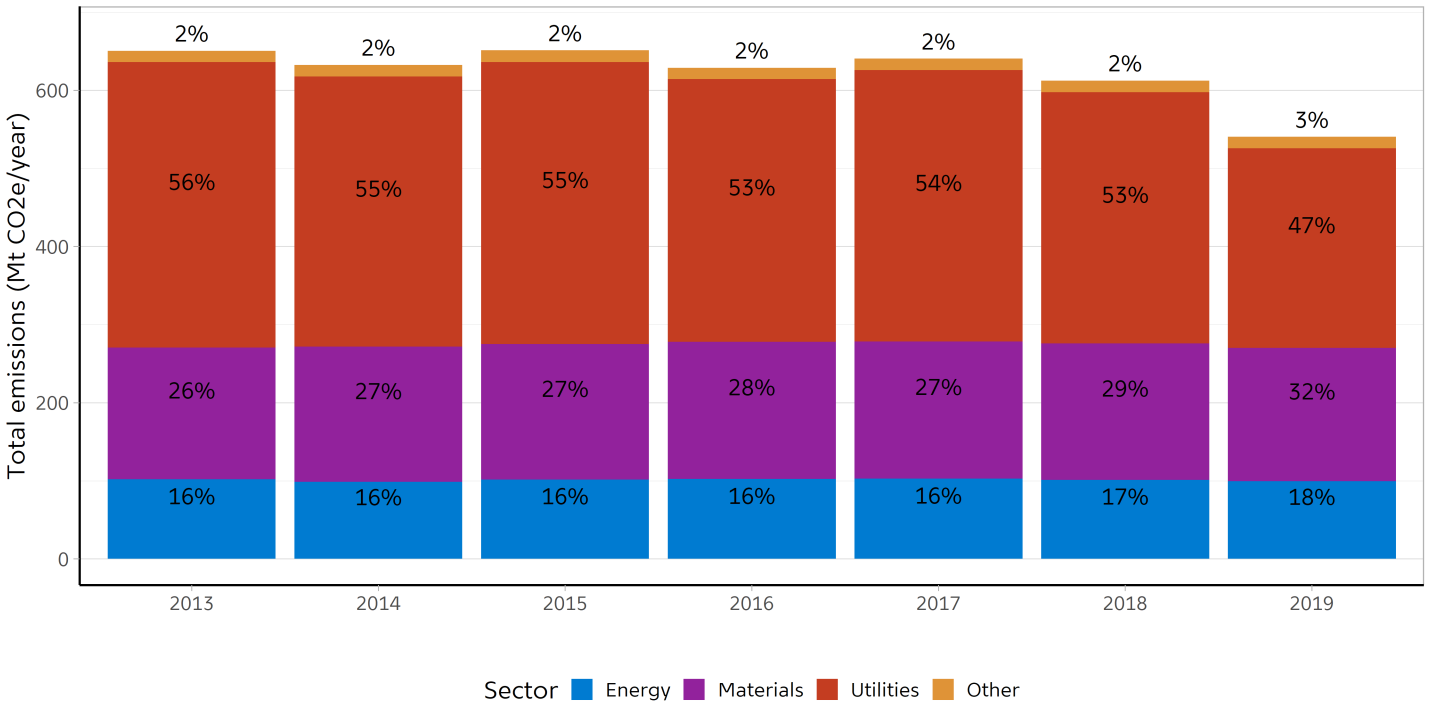


Figure 5
EU ETS emission volumes by industry for self-reporting firms.

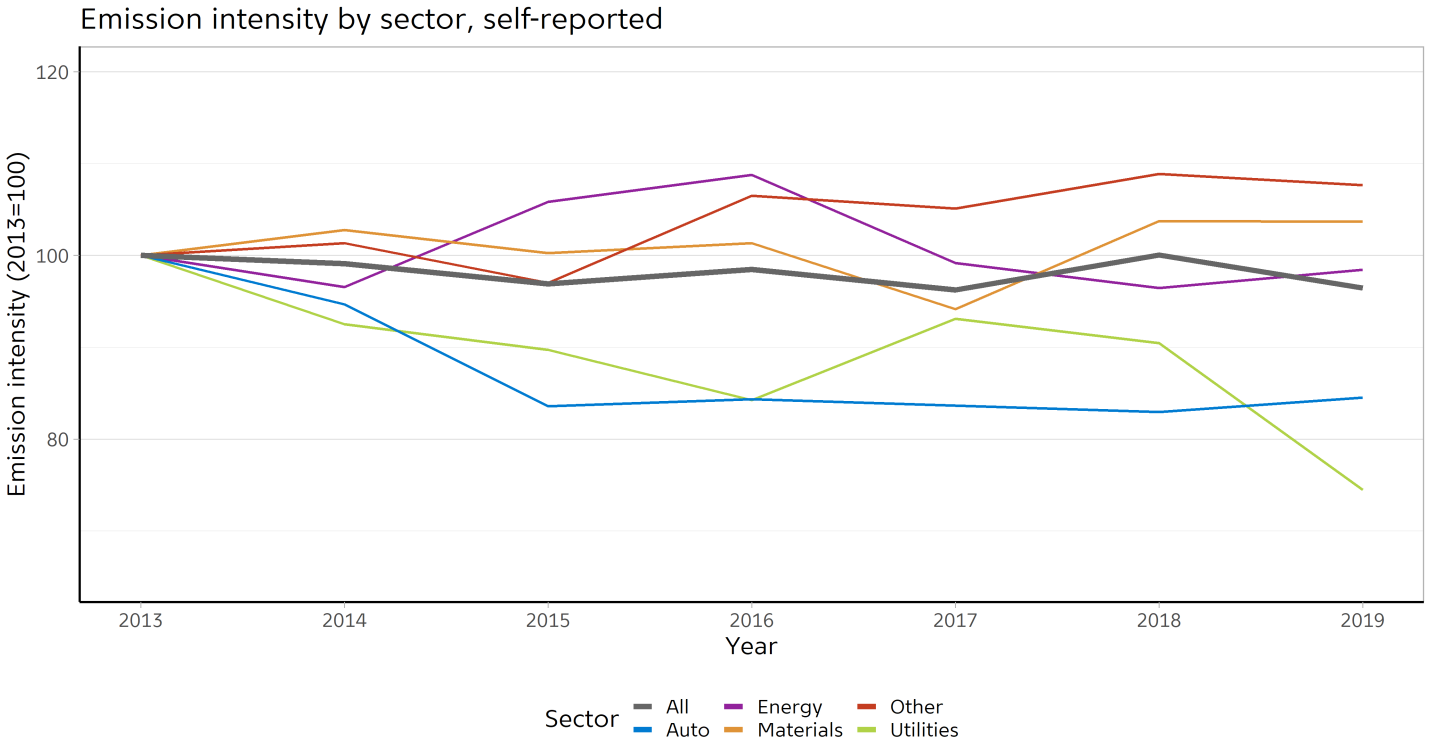


Figure 6
Self-reported emissions per unit of revenue by sector, unweighted means across firms (2013=100).

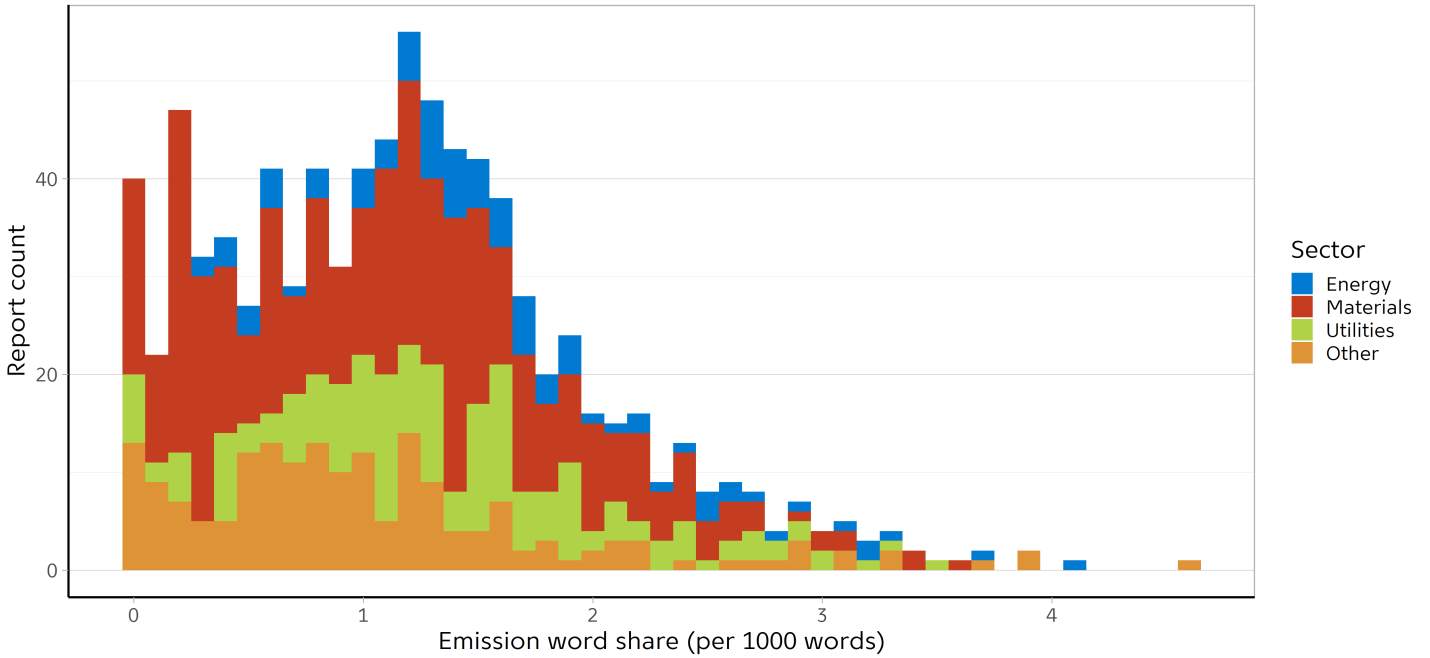


Figure 7
Distribution of the shares of emission related words in annual reports ("emission","ghg","co2","greenhouse","atmosphere","emit").

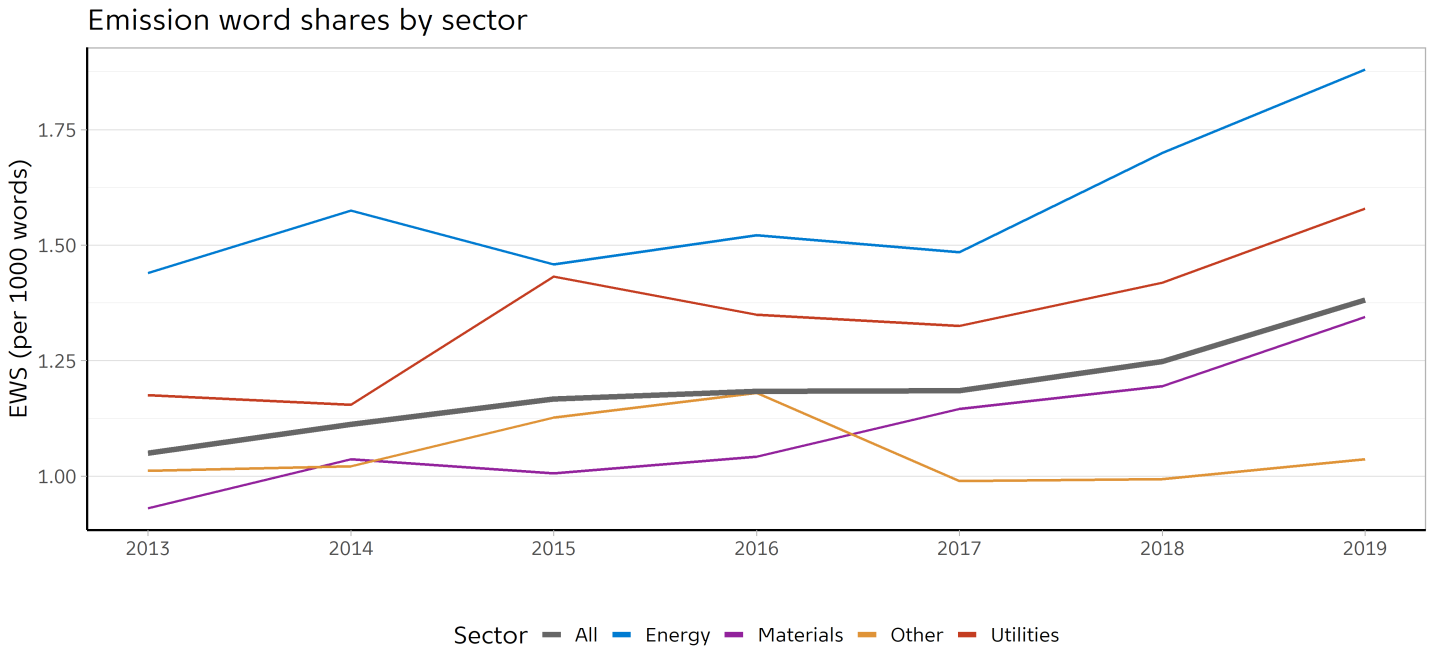


Figure 8
The share of emissions-related words in annual reports over time by sector.

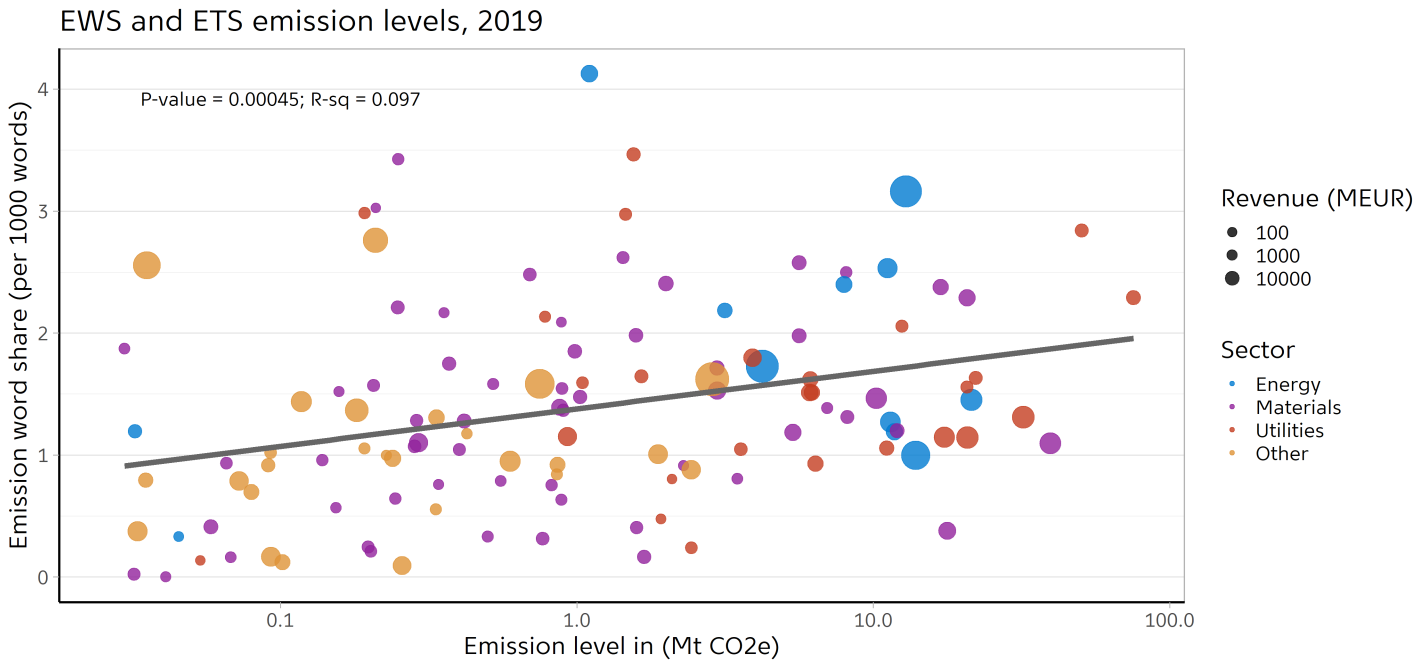


Figure 9
ETS emissions and firm emission word share in 2019. Note the logarithmic x-axis.

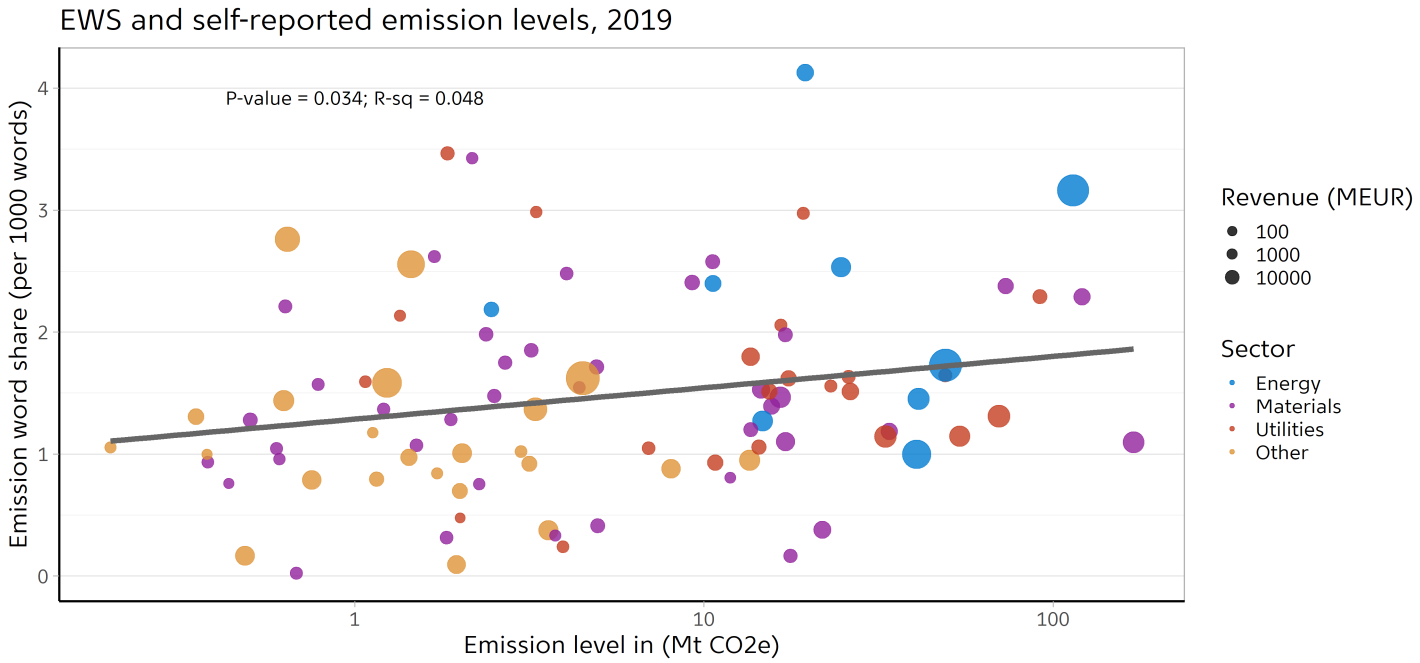


Figure 10
Self-reported scope 1 emissions and firm emission word share in 2019. Note the logarithmic x-axis.

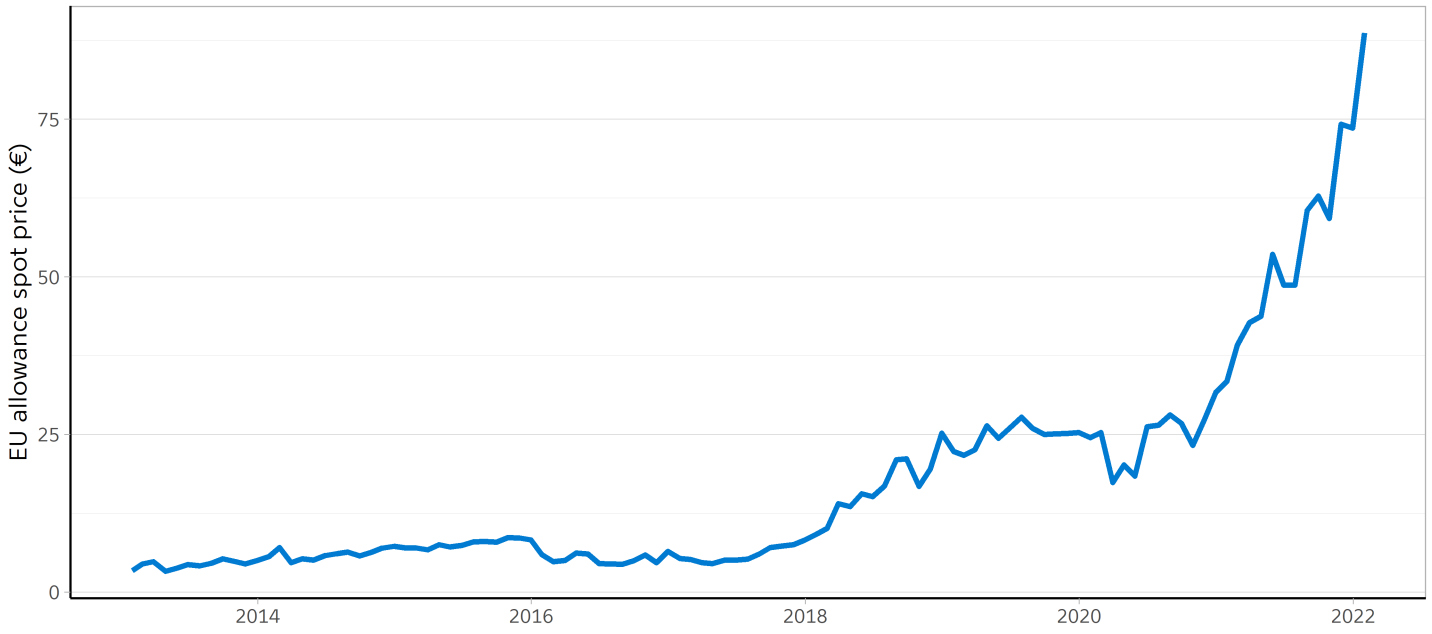


Figure 11
Historical spot price of an EUA.

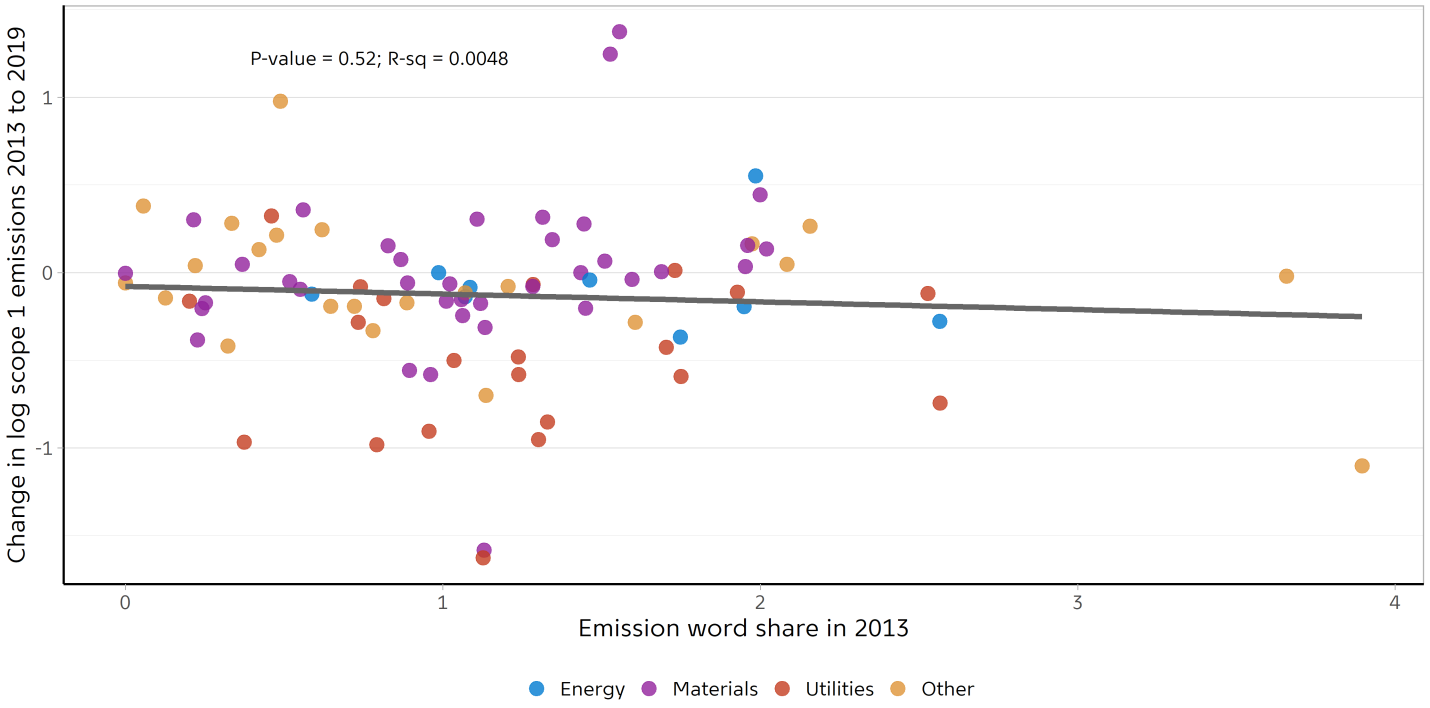


Figure 12
Firm emission word share in 2013 (x-axis) and subsequent change in self-reported emissions.

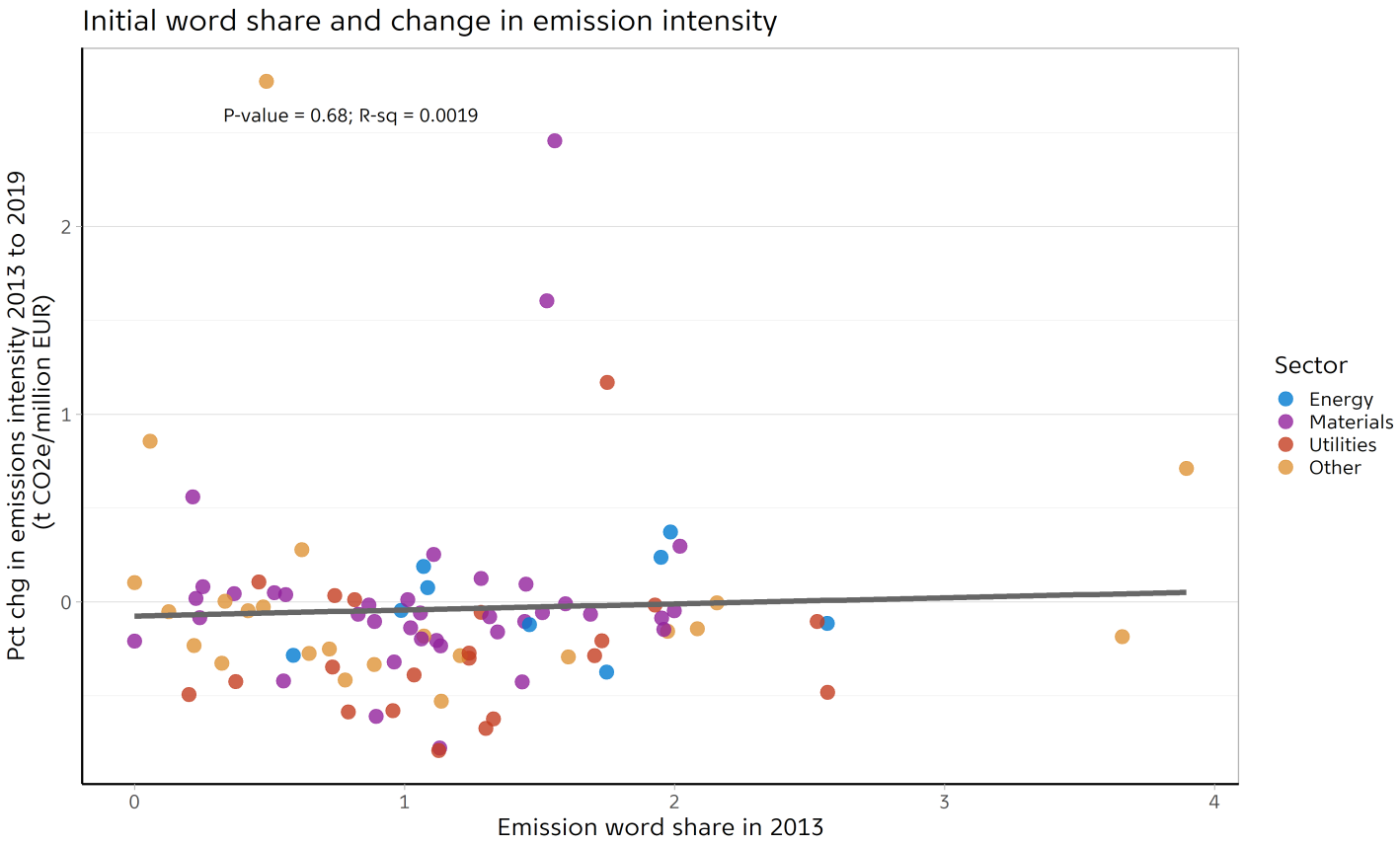
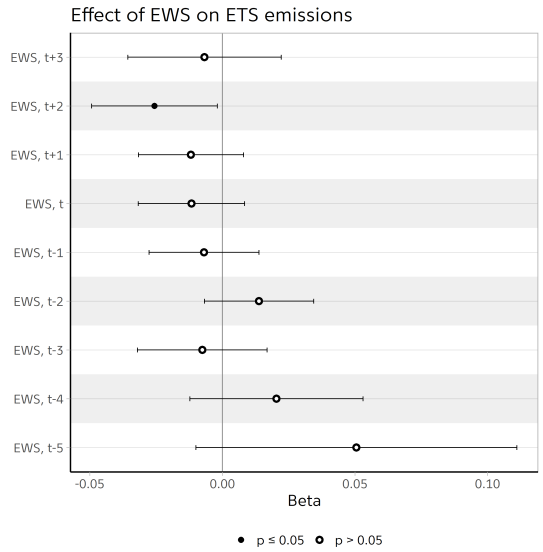
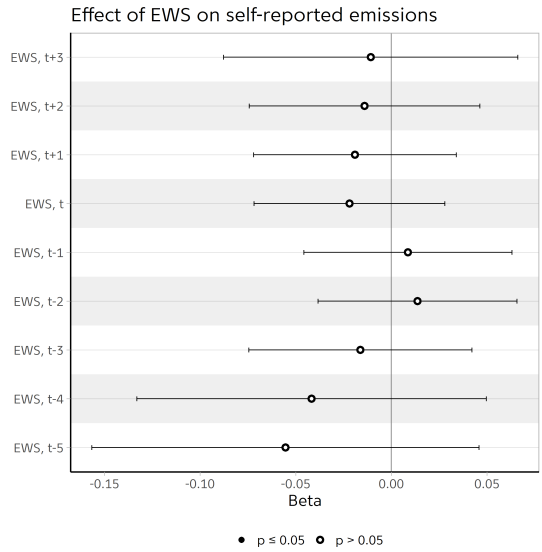


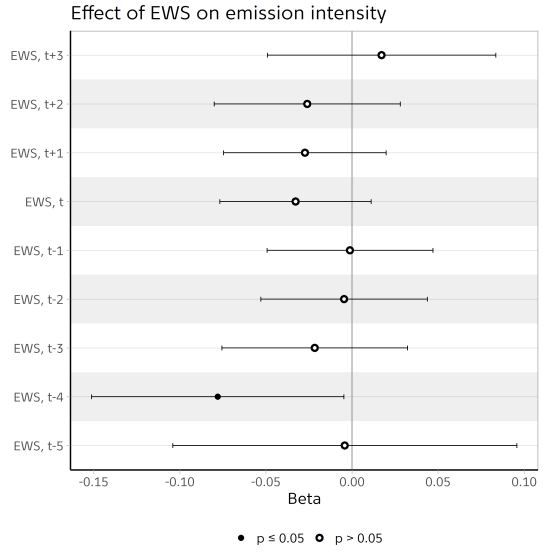
Figure 13
Firm emission word share in 2013 (x-axis) and subsequent change in self-reported emission intensity.



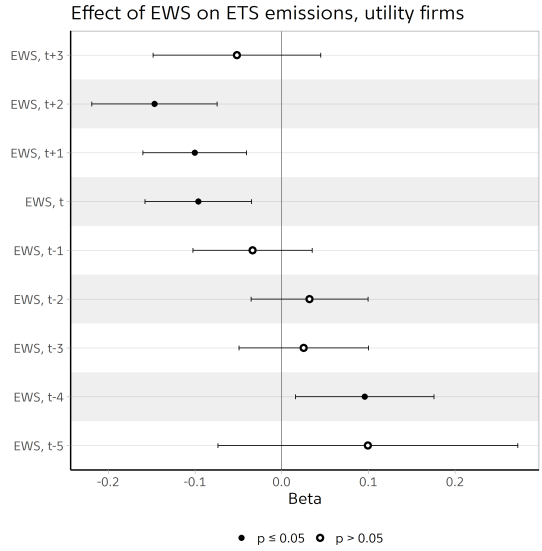
(a) ETS emissions



(b) Self-reported scope 1 emissions



(c) Self-reported emissions intensity



(d) ETS emissions, utility firms only

Figure 14
Estimation of equation 1. Standard errors clustered at the firm level.

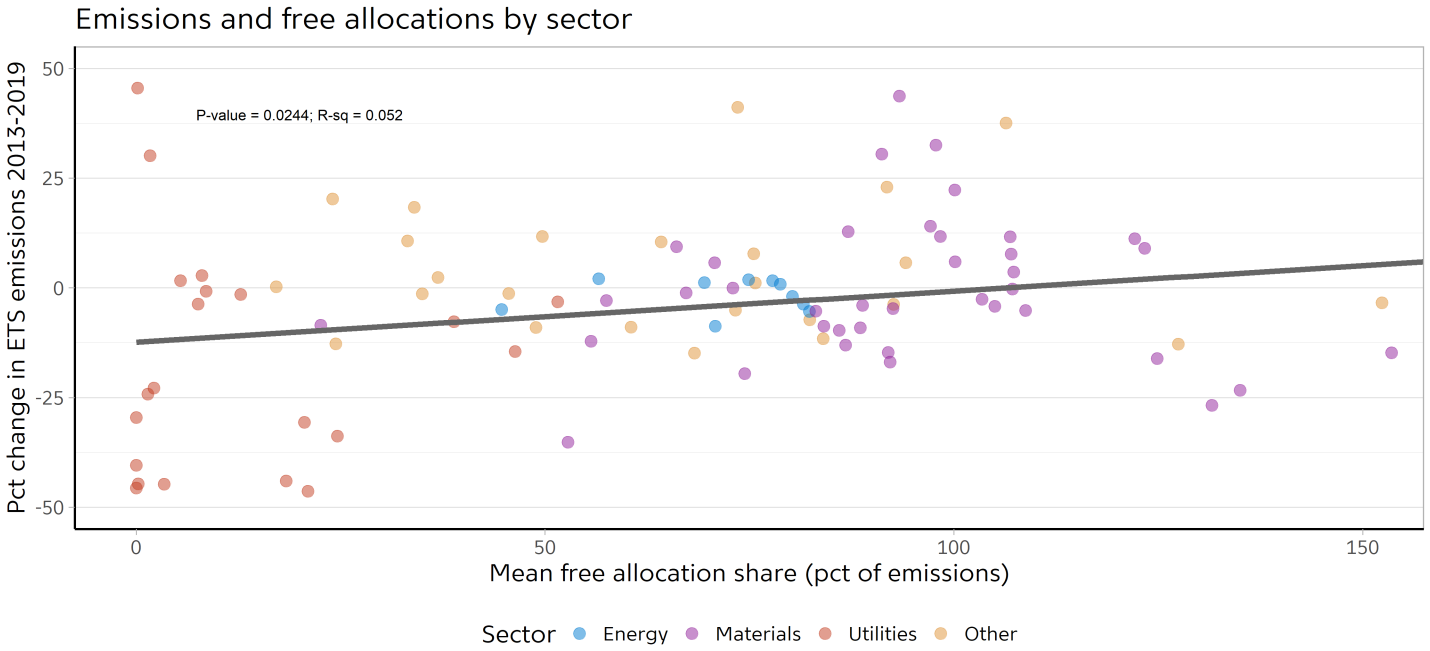


Figure 15
Firm-level free allocation (as share of ETS emissions) and changes in ETS emissions during the sample period.

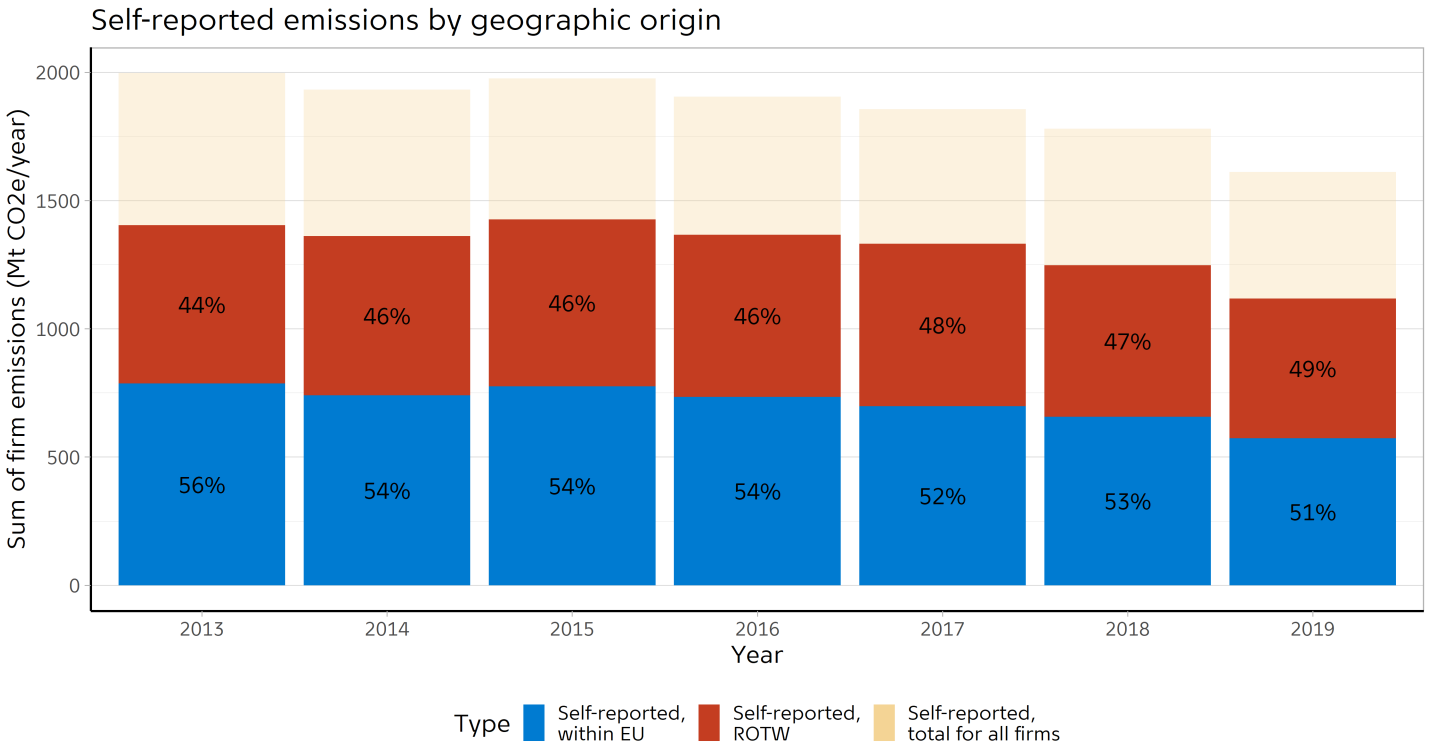


Figure 16
Self-reported emissions by region, within EU versus rest of the world. Yellow bars indicate the total volume of emissions, including firms that do not provide a geographic breakdown.

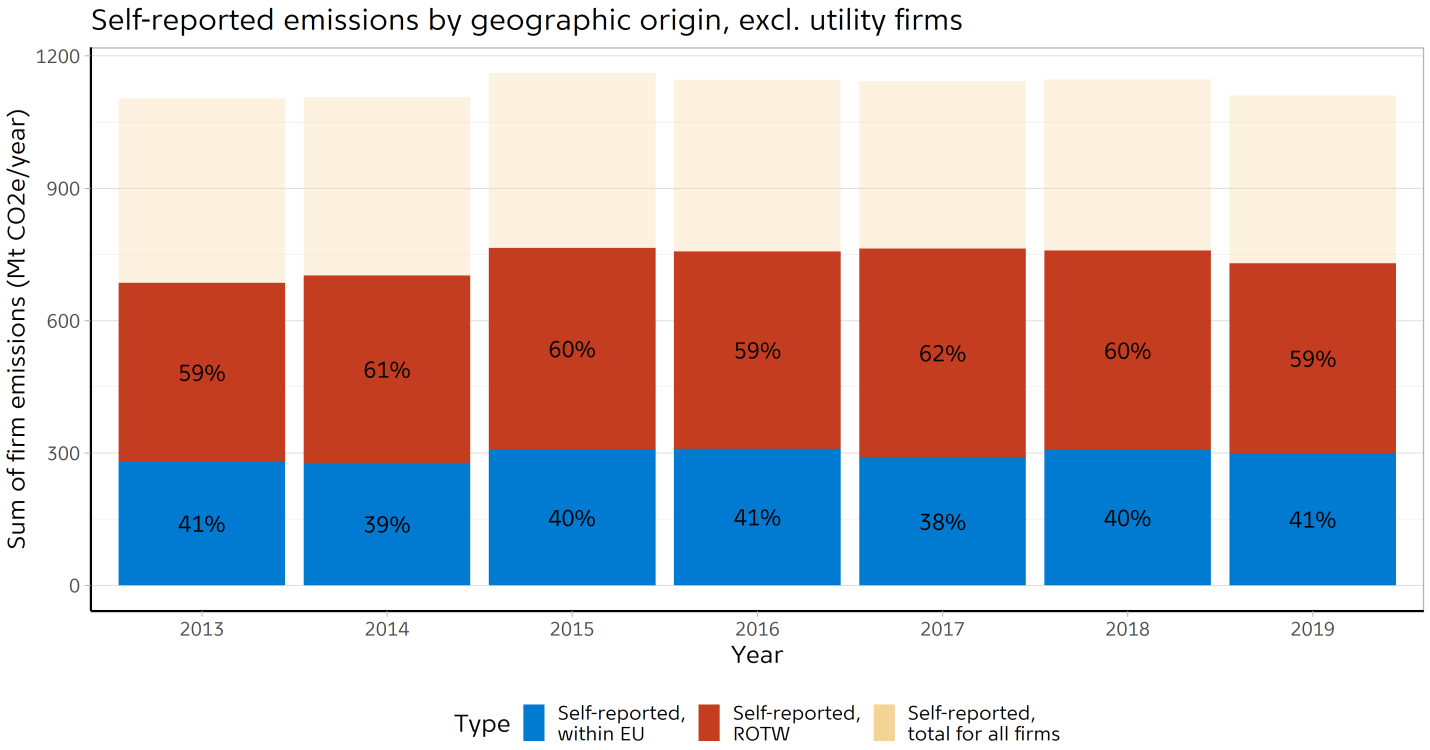


Figure 17
Self-reported emissions by region excluding utility companies, within EU versus rest of the world. Yellow bars indicate the total volume of emissions, including firms that do not provide a geographic breakdown.

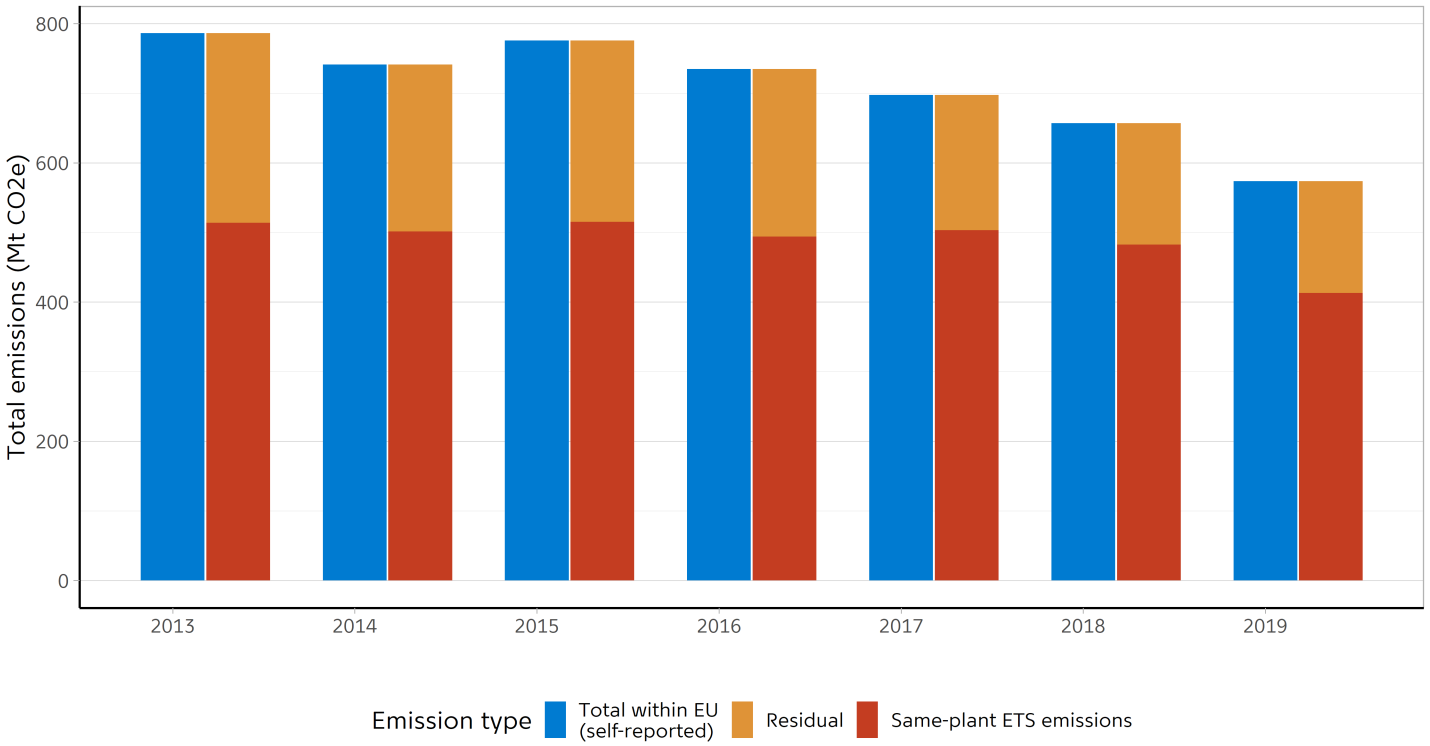


Figure 18
Self-reported EU emissions and same-plant ETS emissions for firms (N=57) that disclose a geographic emissions breakdown.

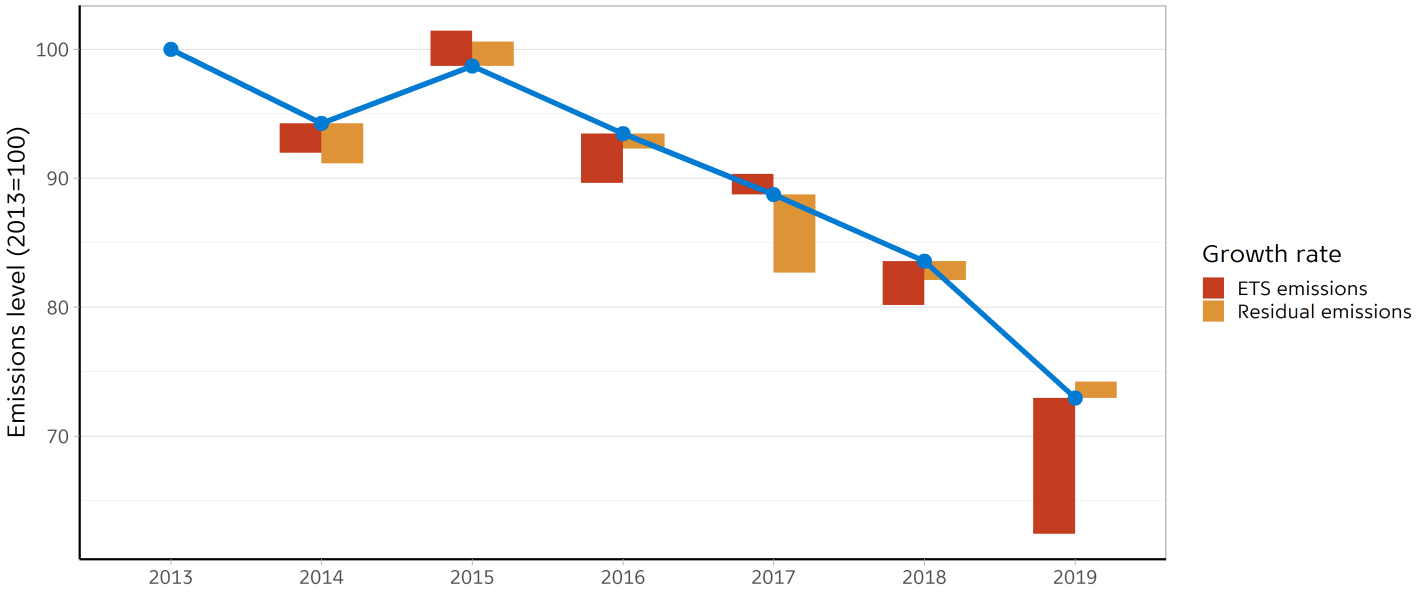


Figure 19
Scope 1 within-EU emissions (blue line) with annual growth decomposed into same-plant ETS emissions and the residual component for all firms that disclose EU emissions (N=57).

References

Abrell, J., Cludius, J., Lehmann, S., Schleich, J., & Betz, R. (2021, aug). Corporate emissions-trading behaviour during the first decade of the EU ETS. *Environmental and Resource Economics*, 1–37. Retrieved from https://digitalcollection.zhaw.ch/handle/11475/23286

Amel-Zadeh, A., & Serafeim, G. (2018). Why and how investors use ESG information: Evidence from a global survey. *Financial Analysts Journal*, *74*(3), 87-103.

Baier, P., Berninger, M., & Kiesel, F. (2020). Environmental, social and governance reporting in annual reports: A textual analysis. *Financial Markets, Institutions & Instruments*, *29*(3), 93-118. Retrieved from https://onlinelibrary.wiley.com/doi/abs/10.1111/fmii.12132

Baudry, M., Faure, A., & Quemin, S. (2021). Emissions trading with transaction costs. *Journal of Environmental Economics and Management*, *108*, 102468. Retrieved from https://www.sciencedirect.com/science/article/pii/S0095069621000516

Bayer, P., & Aklin, M. (2020). The European Union Emissions Trading System reduced CO_2 emissions despite low prices. *Proceedings of the National Academy of Sciences*, *117*(16), 8804–8812. Retrieved from https://www.pnas.org/content/117/16/8804

Bingler, J. A., Kraus, M., & Leippold, M. (2021). Cheap talk and cherry-picking: What ClimateBert has to say on corporate climate risk disclosures. *SSRN working paper*.

Coase, R. H. (1960). The problem of social cost. *The Journal of Law & Economics*, *3*, 1–44. Retrieved 2022-06-07, from http://www.jstor.org/stable/724810

de Bruyn, S., Nelissen, D., & Koopman, M. (2013). *Carbon leakage and the future of the EU ETS market.* (Available at https://cedelft.eu/publications/carbon-leakage-and-the-future-of-the-eu-ets-market/, accessed August 8 2022.)

Eichner, T., & Pethig, R. (2019). EU-type carbon regulation and the waterbed effect of green energy promotion. *Energy Economics*, *80*(C), 656-679. Retrieved from https://ideas.repec.org/a/eee/eneeco/v80y2019icp656-679.html

Ember Climate. (2019). *EU Power Sector 2019.* (Available at https://ember-climate.org/insights/research/eu-power-sector-2019, accessed May 26, 2022)

European Commission. (2010). *Guidance on Interpretation of Annex I of the EU ETS Directive.*

European Commission. (2021). *Proposal for a Directive of the European parliament and of the Council amending directive 2013/34/eu, directive 2004/109/ec, directive 2006/43/ec and regulation (eu) no 537/2014.* (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52021PC0189)

European Environment Agency. (2021). *Total greenhouse gas emissions trends and projections in europe.* (Available at https://www.eea.europa.eu/data-and-maps/indicators/greenhouse-gas-emission-trends-8, accessed August 10 2022.)

GSIA. (2020). *Investment review 2020.* (Available at http://www.gsi-alliance.org/, accessed March 4 2022.)

IEA. (2021). *Greenhouse gas emissions from energy: Overview.* (Available at https://www.iea.org/reports/greenhouse-gas-emissions-from-energy-overview/emissions-by-sector, accessed March 4 2022)

Jaraite, J., Jong, T., Kažukauskas, A., Zaklan, A., & Zeitlberger, A. C. (2013). Matching EU ETS accounts to historical parent companies. a technical note. *SSRN working paper*.

Lamb, W. F., Wiedmann, T., Pongratz, J., Andrew, R., Crippa, M., Olivier, J. G. J., ... Minx, J. (2021, jun). A review of trends and drivers of greenhouse gas emissions by sector from 1990 to 2018. *Environmental Research Letters*, *16*(7), 073005.

Martin, R., Muûls, M., de Preux, L. B., & Wagner, U. J. (2014, August). Industry compensation under relocation risk: A firm-level analysis of the eu emissions trading scheme. *American Economic Review*, *104*(8), 2482-2508. Retrieved from https://www.aeaweb.org/articles?id=10.1257/aer.104.8.2482

Martin, R., Muûls, M., & Wagner, U. J. (2014). Trading behavior in the eu emissions trading scheme. *SSRN working paper*.

Perino, G. (2018). New EU ETS phase 4 rules temporarily puncture waterbed. *Nature Climate Change*, *8*(4), 262-264. Retrieved from https://EconPapers.repec.org/RePEc:nat:natcli:v:8:y:2018:i:4:d:10.1038_s41558-018-0120-2

SBTi. (2020). *Science-based target setting manual. version 4.1.* (Science Based Targets initiative (Available at https://sciencebasedtargets.org/, accessed May 6 2022))

TFCD. (2021). *2021 Status Report.* (Available at https://www.fsb-tcfd.org/publications/, accessed May 11 2022.)

Wang, D. D., & Sueyoshi, T. (2018). Climate change mitigation targets set by global firms: Overview and implications for renewable energy. *Renewable and Sustainable Energy Reviews*, *94*, 386-398. Retrieved from https://www.sciencedirect.com/science/article/pii/S1364032118304593

CLI
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Climate change

Climate change is impacting society already today and will have further consequences in the future. A successful green transition will require unprecedented efforts, both in Denmark and abroad.

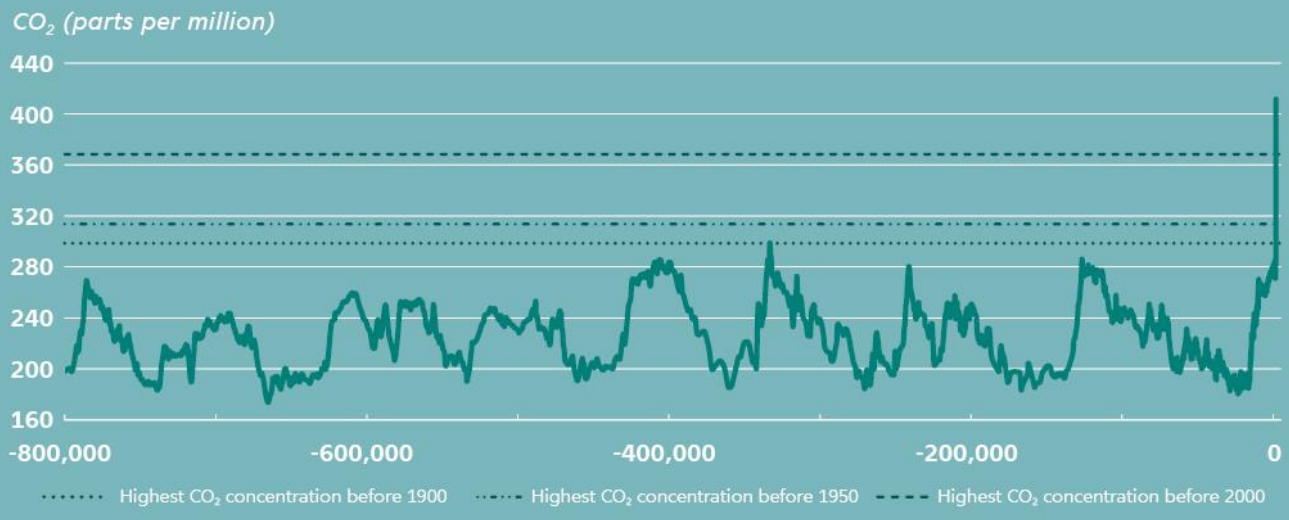
As a case in point, climate change and the transition to a greener economy will impact corporate earnings and economic activity. This may compromise price and financial stability in Denmark, which it is Danmarks Nationalbank's objective to ensure. It is therefore essential that Danmarks Nationalbank increases its knowledge of how, and by how much, the climate challenges will impact various parts of the economy.

Against this backdrop, Danmarks Nationalbank will focus on climate challenges in a series of publications.

CO_2 concentration in the atmosphere

800,000 BCE to 2019 ACE

The chart shows the number of carbon dioxide molecules per million molecules of dry air.



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Source: National Oceanic and Atmospheric Administration (until 1957) and National Aeronautics and Space Administration (from 1958).

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