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Correlation or Causation? Challenges in Assessing the Effect of Carbon Credit Use on Corporate Climate Action

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List of Abbreviations

ESG	Environmental, Social and Governance
EU ETS	European Union Emission Trading System
GHG	Greenhouse gas
IPCC	Intergovernmental Panel on Climate Change
SBTi	Science Based Targets initiative
VCM	Voluntary Carbon Market

Glossary

Carbon credits	Units issued by carbon crediting programmes representing one tonne of emission reductions or removals of GHG generated by a mitigation activity, typically measured in tCO_2e.
Carbon credit use	Carbon credit use is an umbrella term that refers to purchasing or retiring carbon credits.
Emission offsetting	Retiring carbon credits to offset corporate emissions.
Internal emission reductions	Emission reductions within the corporate value chain.
Scope 1 emissions	Direct GHG emissions resulting from sources that are owned or controlled by the company.
Scope 2 emissions	Indirect emissions resulting from the generation of purchased or acquired energy consumed by the company.
Scope 3 emissions	Indirect GHG emissions from sources not owned or controlled by the company such as upstream and downstream emissions.
Substitute	Substitutes are pairs of goods or services that are used in place of each other. Two goods or services are substitutes if 'an increase in the price of one leads to an increase in the demand of the other' (Mankiw 2015, p. 70).
Complement	Complements are pairs of goods or services that are used together. Two goods or services are complements if 'an increase in the price of one leads to a decrease in the demand for the other' (Mankiw 2015, p. 70).
Endogeneity	Endogeneity refers to a situation in which an 'explanatory variable in a multiple regression model […] is correlated with the error term, either because of an omitted variable, measurement error, or simultaneity' (Wooldridge 2012, p. 848).

Summary

In this study, we assess the challenges and prospects of investigating whether and how the use of carbon credits affects corporate internal emission reductions. To this end, we review the existing literature related to the use of carbon credits and corporate emission reductions, conduct qualitative interviews, and investigate the possibility of developing a study design for assessing whether the use of carbon credits has a causal effect on internal emission reductions.

Our analysis shows that, in theory, the use of carbon credits could enhance or reduce internal emission reductions, or have no effect at all, depending on the companies' climate strategies. Empirically, several studies find a positive correlation between the use of carbon credits and internal emission reductions. This positive correlation cannot be confirmed by a recent peer-reviewed study, which finds no significant relationship between the use of carbon credits and internal emission reductions. However, for a few companies, the study finds qualitative evidence suggesting that carbon credits can compete with internal decarbonisation efforts.

The question of whether carbon credits substitute or complement internal emission reductions remains unanswered as none of the existing studies provides causal evidence. Hence from the existing literature, no clear conclusion can be drawn as to whether the use of carbon credits has a causal effect on internal emission reductions or not, and if so, whether that effect would be positive or negative.

The interviews suggest that carbon credits are used for various purposes and that companies have changed their approaches towards using carbon credits over time: in response to increased media focus on integrity issues in the voluntary carbon market along with greenwashing accusations, many companies have become more reluctant to use carbon credits to make offsetting claims.

Finally, we find that when exploring the relationship between the use of carbon credits and internal emission reductions, several factors need to be considered, including potential endogeneity, data limitations and structural changes in companies' approaches towards using carbon credits. Therefore, it would be inherently challenging to develop a robust and representative study design that would be suitable to empirically test whether the use of carbon credits has a causal effect on internal emission reductions.

1 Introduction

Voluntary corporate climate action has increasingly gained importance over the last two decades due to the growing demand for “green” or “sustainable” consumption and business practices. One form of voluntary corporate climate action is the use of carbon credits, i.e. units issued by carbon crediting programmes representing one tonne of emission reductions or removals of greenhouse gases (GHGs). The voluntary carbon market (VCM) emerged in the early 2000s and offers companies a way of financing mitigation activities that reduce emissions or enhance removals outside the companies’ value chain.

Companies have predominantly used carbon credits from the VCM to offset corporate emissions, enabling them to make green claims and/or achieve their climate targets. However, after peaking in 2021, the VCM declined after research and the media increasingly reported concerns regarding the quality of carbon credits and their ineffectiveness at delivering the intended mitigation outcomes (West et al. 2023; Haya et al. 2023; CCQI 2024; SBTi 2024; Gill-Wiehl et al. 2024).

In addition, concerns have been raised that carbon credits may risk substituting rather than complementing corporate efforts to enhance internal emission reductions, i.e. emission reductions within the corporate value chain, due to the relatively large difference in costs between carbon credits and internal emission reduction measures (Day et al. 2020; Donofrio and Procton 2023). This is often referred to as ’mitigation deterrence’ as it may extend the lifetime of “dirty businesses” by providing a “licence to pollute” (Trouwloon et al. 2023). If this is the case, corporate carbon offsetting may risk hampering the green transition, especially if the carbon credits have a low environmental integrity.

Several studies have investigated the correlation between companies’ carbon credit use and the rate of internal emission reductions, yet with mixed findings. The majority of these studies find a positive correlation between carbon credit use and internal emission reductions (Sylvera 2023; Donofrio and Procton 2023; MSCI Carbon Markets 2023a; Watanabe et al. 2024). However, this positive correlation cannot be confirmed by the only peer-reviewed study published on this matter (Stolz and Probst 2025). All studies assessed the correlation between carbon credit use and internal emission reductions rather than the causal effect of carbon credit use on internal emission reductions.

This study aims to assess the challenges and prospects of investigating whether and how the use of carbon credits causally affects internal emission reductions. To this end, we first review the existing literature on the role of carbon credits in corporate climate action and the correlation between carbon credit use and internal emission reductions with a view to drawing preliminary conclusions and identifying research gaps. This is supplemented by interviews with companies to gain insights into which factors may affect internal emission reductions and the use of carbon credits. Based on these findings, the study discusses challenges in developing a study design to empirically assess the causal effect between corporate carbon credit use and internal emission reductions.

While the total climate impact of corporate carbon credit use also hinges on the environmental integrity of the carbon credits used, the incorporation of quality aspects lies outside the scope of this study. Limiting the scope to the effect of carbon credit use on internal emission reductions allows us to focus on the question of whether carbon credit use and internal emission reductions are substitutes, complements or independent from each other.

2 Structure of the study

The study is structured as follows:

In a first step, we identify relevant literature that provides insights on possible factors determining the use of carbon credits (see section 3.1) as well as the theoretical and empirical link between carbon credit use and internal emission reductions (see section 3.1.4 and 3.3, respectively). We critically assess existing studies with regard to potential biases and limitations in their design, methodology, and data. We synthesise our findings regarding the role of carbon credits from the literature in section 3.4 and identify remaining research gaps.

In a second step, we collect insights on whether and how the use of carbon credits affects internal emission reductions efforts that companies make. For this purpose, we conduct interviews with selected companies to collect additional information about the role of carbon credits in companies' decarbonisation strategies and potential implications on internal emission reduction measures. The interviews also serve to identify potential confounding factors that must be considered when aiming to empirically test whether there is a causal effect between corporate carbon credit use and internal emission reductions. This includes factors related to corporate decision-making on internal emission reductions and the use of carbon credits.

In a third step, we discuss the challenges involved in developing a study design – including data requirements and econometric methods – that is suited to a causal assessment of the effect of carbon credit use on internal emission reductions by comparing companies using carbon credits to a counterfactual scenario in which no carbon credits would have been used.

3 Literature review

There is very limited research on the role that carbon credits play in companies' decarbonisation strategies. In order to investigate the potential causal effects of carbon credit use on internal emission reductions, it is essential to identify potential drivers of both carbon credit use and internal emission reductions, and the mechanisms through which carbon credit use may affect internal emission reductions.

This section therefore presents a review of the existing literature on potential determinants of carbon credit use, potential mechanisms through which carbon credits may affect internal emission reductions, as well as statistical correlations between carbon credit use and internal emission reductions. Based on this review, we determine the potential implications that can(not) be derived from the existing literature and identify research gaps.

When using the umbrella term **carbon credit use**, this may refer to carbon credit **purchases** and/or **retirements,** for offsetting or other purposes. We use this umbrella term because purchases and retirements are often not clearly distinguished in the literature or underlying data.[1] Some of the empirical literature clearly distinguishes between carbon credit purchases and retirements, and whether carbon credits are retired for offsetting purposes or for other purposes.

Accordingly, we refer to companies that use carbon credits as 'users' and to companies that do not use carbon credits as 'non-users' (or more specifically as 'buyers' and 'non-buyers').

3.1 Potential factors determining the use of carbon credits

In this section, we summarise studies that empirically investigate the motivations for using carbon credits as well as company characteristics that are correlated with the use of carbon credits. This provides an overview of the potential drivers of carbon credit use.

3.1.1 Lou et al. (2023) – Corporate motivations and co-benefit valuation in private climate finance investments through voluntary carbon markets

Lou et al. (2023) assess key reported **motivations for companies to voluntarily purchase carbon credits**. They conduct a data analysis covering 186 companies from different geographical locations and (sub-)sectors. These companies reported to the Climate Change Questionnaire from the CDP (formerly the Carbon Disclosure Project)[2] in the 2017 reporting year and disclosed carbon offset investments in their Corporate Social Responsibility reports for the same year.

They find that the vast majority of companies (155) reported that they purchased carbon credits to offset internal emissions to **meet voluntary climate targets** in a cost-effective manner. Approximately 60 companies purchased carbon credits to improve their market competitiveness through **climate-positive branding**. A similar number of companies used carbon credits to uphold **company values** such as supporting Sustainable Development Goals, responsibility for the "greater good", strengthening public relations and commitment to philanthropy (Lou et al. 2023). The analysis suggests that companies that purchase carbon credits for the latter two reasons are willing to pay a

[1] Carbon credits must be purchased before they can be retired. Not all purchased carbon credits have to be retired and they can be retired at a later point in time.

[2] The CDP data is derived from self-reported data that companies voluntarily report in an annual questionnaire. Among other things, the questionnaire covers environmental metrics such as emissions and carbon credit use.

premium for co-benefits as opposed to companies merely interested in cost-effective emission reductions to meet voluntary climate targets.

3.1.2 Engler et al. (2023) – On the relationship between corporate CO_2 offsetting and pro-environmental activities in small- and medium-sized firms in Germany

Engler et al. (2023) conduct an online survey among 991 decision-makers in small- and medium-sized companies in Germany in 2021 to identify **company characteristics correlating with emission offsetting**.

They find that voluntary emission offsetting is positively and significantly correlated with the formulation of specific goals for the company's climate protection activities. In addition, they find that emission offsetting is significantly positively correlated with participation in the European Union Emission Trading System (EU ETS), environmental product and service innovations[3] and the share of environment-related staff. Having an average employee age of up to 34 years, as well as having more than 49 employees, is also positively and significantly correlated with offsetting emissions.

In contrast, firm age is significantly negatively correlated with emission offsetting in most specifications. The study does not provide insights on causality or the potential direction thereof. However, the correlation may imply that these correlating factors could potentially have an effect on carbon credit use, or carbon credit use could potentially have an effect on correlating factors.

3.1.3 Kim et al. (2024) – Carbon Offsets: Decarbonization or Transition-Washing?

A study by Kim et al. (2024) investigates publicly listed companies around the world and identifies **company characteristics that correlate with emission offsetting**.

They find that using carbon credits to offset emissions is particularly common among large companies, companies with high institutional ownership[4], companies with net-zero commitments and companies domiciled in the United States.

In addition, they conduct a **quasi-experiment to assess causal effects** and find that the effect of increased incentives to boost Environmental, Social and Governance (ESG) ratings on the relative[5] number of carbon credits used for offsetting differs by company characteristics. While the effect is positive for low-emission companies or companies requiring low emission reductions to boost their ESG ratings relative to their peers, the effect is insignificant for high-emission companies or companies requiring high emission reductions to boost their ESG ratings relative to their peers. Rather, high-emission companies or companies requiring high emission reductions to boost their ESG ratings directly reduce their Scope 1 emissions.

Kim et al. (2024) suggest that this finding can be explained by two hypotheses: The 'outsourcing hypothesis' and the 'certification hypothesis'.

According to the outsourcing hypothesis, offsetting emissions is more attractive for companies with low emissions, whereas internal emission reduction measures are more attractive for companies with high emissions. This is because offsetting incurs minimal fixed costs and high variable costs, whereas investments in abatement technologies incur high fixed costs but small variable costs. This

[3] Environmental product and service innovations is a dummy variable that turns to 1 if at least one environmental product or service innovation has been implemented between 2018 and 2020.
[4] Institutional ownership is defined as the fraction of shares held by institutional investors.
[5] The number of carbon credits used for offsetting is measured relative to Scope 1 emissions.

implies that offsetting is more attractive if the amount of emissions to be offset is low, whereas internal emission reduction measures are more attractive if unabated emissions are high.

According to the certification hypothesis, offsetting emissions is more attractive for companies that only require low amounts of emission reductions to boost their ESG ratings relative to their peers, i.e. when the emission gap for an improvement in the rating is small. Hence, companies with high institutional ownership and a small gap to boost their ESG ratings tend to retire more carbon credits. Typically, companies fulfilling these criteria are in the services and financial sector (Kim et al. 2024).

3.1.4 Carbon Direct 2024 – The State of Corporate Climate Commitment

A survey of 700 professionals working in the finance, sustainability, and compliance industry across the United States and Europe, conducted by Wakefield Research on behalf of Carbon Direct, investigates **motivations for climate action**, which may or may not include the use of carbon credits.

They find that the most frequently stated motivations are competitive necessity, required emission disclosures and voluntary emission disclosures (Carbon Direct 2024). Of this sample, 38% of companies purchased carbon credits. The share of companies purchasing carbon credits was slightly higher among medium-sized companies (39%) than large companies (33%).

3.1.5 South Pole (2024) – Destination Zero

South Pole surveyed 1,400 sustainability executives of ‘climate-conscious companies’[6] from 12 countries and 14 different sectors to identify **drivers of climate commitments**, including the use of carbon credits.

They find that the main stated driver for companies to purchase carbon credits is customer/ stakeholder demand for products with reduced climate impacts. This was followed by better or more detailed oversight of and data on supply chain risks and vulnerabilities and building resilience to external shocks (Kähkönen et al. 2024).

3.2 Mechanisms through which carbon credits could affect internal emission reductions

In this section, we provide an overview of common arguments for whether and why the use of carbon credits may substitute or complement internal emission reductions. These arguments point to different mechanisms through which carbon credits may affect internal emission reductions. Each mechanism is based on specific assumptions about the companies’ climate strategies, particularly their approach towards determining climate targets or climate budgets and how the use of carbon credits affects these climate targets or budgets. Understanding the different assumptions serves to inform a study design that controls for relevant factors that may influence the potential effect of carbon credits on internal emission reductions. The arguments and related mechanisms are derived from the related literature.

[6] South Pole defines ‘climate-conscious companies’ as companies that have more than 1,000 employees and a ‘dedicated Head of Sustainability or similar role, at a director level, who has decision-making authority over their company’s sustainability strategy and teams’ (Kähkönen et al. 2024, p. 2).

In total, we identify four possible mechanisms through which carbon credits may either substitute or complement internal emission reductions, as summarised in Table 1. Essentially, the four mechanisms assume different effects on internal emission reductions because they rely on different assumptions about the following three dimensions:

1. Whether corporate climate action is driven by a climate budget or a climate target;
2. Whether the commitment to set a climate target depends on whether the company uses carbon credits; and
3. Whether the ambition of the climate target, or the size of the climate budget, depends on whether carbon credits are used.

We explore each of these mechanisms in more detail in sections 3.2.1 to 3.2.4.

Table 1 Overview of mechanisms and their implication regarding the effect of carbon credits on internal emission reductions

Mechanism	Budget-driven or climate target-driven	Commitment to set climate target depends on whether carbon credits are used	Ambition of the climate target /size of the budget depends on whether carbon credits are used	Effect on internal emission reductions	References
1: Achieving a given target in a cost-effective manner	Target-driven	No	No	Negative	Stolz and Probst (2025)
2: Fixed budget for climate action	Budget-driven	Not applicable	No	Negative	Stolz and Probst (2025)
3: Opportunity costs of not reducing internal emissions	Target-driven	Yes	No	Positive (or no effect)	MSCI Carbon Markets (2023a); Watanabe et al. (2024)
4: Enhanced ambition in climate targets	Target-driven	No	Yes	Unclear	MSCI Carbon Markets (2023b)

Source: Authors' own compilation.

3.2.1 Mechanism 1: Achieving a climate target in a cost-effective manner

Under this mechanism, a company uses carbon credits to achieve a given climate target if doing so is more cost-effective than pursuing internal emission reductions. This mechanism is referred to as the **'target effect'** by Stolz and Probst (2025) and has also been discussed by Day et al. (2020) and

Trouwloon et al. (2023). It implies reduced incentives to pursue internal emission reduction measures and is based on the following assumptions about the companies' climate strategies:

1. The company would commit to setting a climate target irrespective of whether carbon credits can be used to achieve the target;
2. The ambition of the climate target is fixed;
3. The climate target can be achieved through internal emission reductions and/or emission offsetting;
4. The company aims to achieve its target in a cost-effective manner.

In this setting, the company would choose the most cost-effective approach to achieve the target and weigh the costs for internal emission reduction measures against the price of carbon credits. This means that investments in internal emission reduction measures compete with the use of carbon credits. If achieving emission reductions through carbon credits is more cost-effective than reducing internal emissions, carbon credits would **substitute** internal emission reductions.

3.2.2 Mechanism 2: Fixed budget for climate action

Under this mechanism, a company has a fixed budget for climate action which can be dedicated to purchasing carbon credits or funding internal emission reductions. This mechanism is referred to as the **'investment effect'** by Stolz and Probst (2025). It implies that the use of carbon credits crowds out internal emission reduction measures and is based on the following assumptions about the companies' climate strategies:

1. The budget of the company for climate action is fixed irrespective of whether carbon credits are used;
2. Climate action can involve internal emission reductions and/or the use of carbon credits;
3. The company has incentives to purchase carbon credits, either because the use of carbon credits provides a higher climate impact than internal emission reductions or because the use of carbon credits is attractive for other reasons (e.g. for making green claims).

In this setting, any amount of money spent on carbon credits from the fixed budget for climate action would no longer be available for internal emission reduction measures. If the company decides to purchase carbon credits from the fixed budget, then spending on internal emission reduction measures would decline, which would reduce the rate of internal emission reductions. Hence, carbon credits would **substitute** internal emission reductions.

3.2.3 Mechanism 3: Opportunity costs of not reducing internal emissions

Under this mechanism, a company purchases carbon credits to achieve a climate target but would not have set a climate target without access to carbon credits. As the purchase of carbon credits is associated with a cost, this implicitly creates incentives for internal emission reductions. This mechanism has been discussed by Watanabe et al. (2024). It implies that carbon credit use incentivises internal emission reductions and is based on the following implicit assumptions about the companies' climate strategies:

1. The company would commit to setting a climate target **only if** it can use carbon credits towards achieving the target. Otherwise the company would not set a climate target and hence pursue no or fewer internal emission reductions;

2. The ambition of the climate target is fixed.

3. The climate target can be achieved through internal emission reductions and/or emission offsetting;

4. The company aims to achieve its target in a cost-effective manner.

In this setting, the carbon credit use incentivises internal emission reductions as long as the marginal abatement costs for internal emission reductions are smaller than the price of carbon. In this case, carbon credit use is likely complementary to internal emission reductions since internal emission reductions would not have been incentivised without the use of carbon credits.

It is important to note that assumption 1 is central, as the mechanism would otherwise be identical to mechanism 1. If the company had committed to a climate target of a given ambition regardless of whether carbon credits can be used towards achieving this target, then emissions would have been incentivised regardless of whether carbon credits are used.

Under the above assumptions, the rate of internal emission reductions may be enhanced through the use of carbon credits if the price of carbon credits exceeds the abatement costs of at least some mitigation measures. In practice, however, the cost of internal emission reduction measures is typically larger than the current carbon credit prices. This suggests that the effect of using carbon credits on internal emission reductions may not be large. In addition, carbon credits are often used to compensate only a small fraction of Scope 1 and 2 emissions (on average 13%) and a minor fraction of total Scope 1, 2 and 3 emissions (on average 0.5%) (Watanabe et al. 2024). In cases in which emissions are not covered by the climate target, this mechanism would not come into effect.

3.2.4 Mechanism 4: Enhanced ambition of climate targets

Under this mechanism, a company sets a more ambitious climate target if it uses carbon credits to achieve this target. This mechanism has been discussed by MSCI Carbon Markets (2023b). It is based on the following implicit assumptions about the companies' climate strategies:

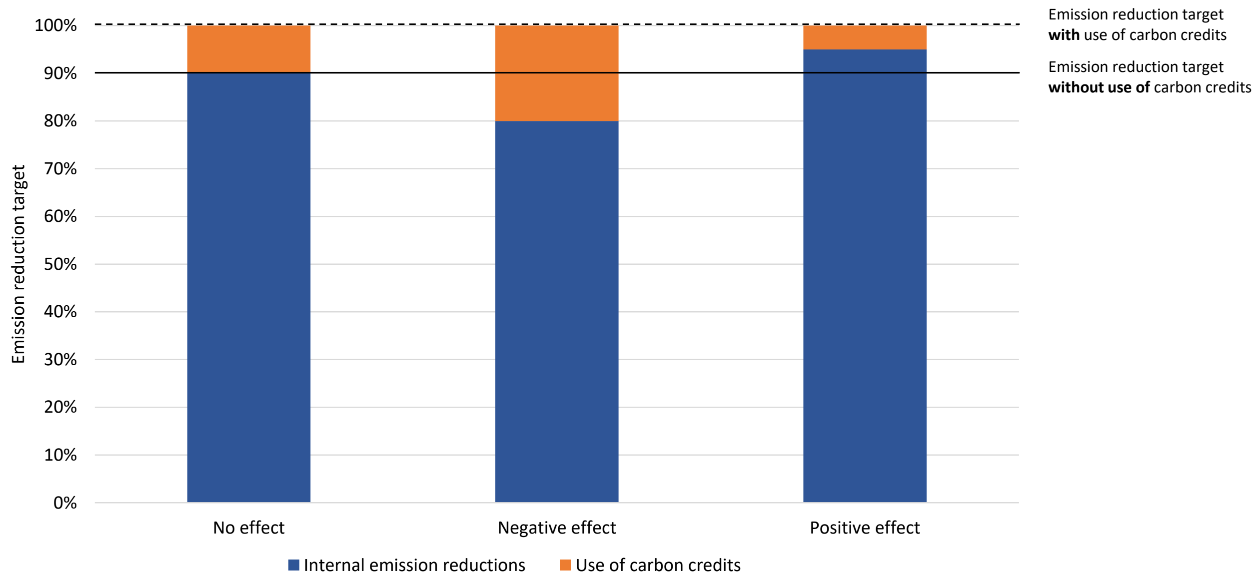
1. The company would commit to setting a climate target regardless of whether carbon credits can be used to achieve the target;

2. The company would enhance the ambition of the climate target if carbon credits can be used towards achieving the climate target (e.g. reducing net emissions by 100% instead of 90% by 2040).

3. The company aims to achieve its target in a cost-effective manner.

In this setting, the climate target is made more ambitious through the use of carbon credits. However, it is **unclear** whether and how this would affect the **proportion of emission reductions that would be achieved through internal emission reductions or the use of carbon credits**. If the additional ambition were exactly matched by the use of carbon credits, then the use of carbon credits would not affect internal emission reductions (see the left bar in Figure 1). However, depending on the relative cost of reducing emissions internally or purchasing carbon credits, the extent to which carbon credits are used towards achieving the overall climate target may be smaller or larger than the additional ambition due to the enhanced climate target (see the centre and right bar in Figure 1, respectively). Therefore, the effect on internal emission reductions is unclear.

Figure 1 Possible effects of enhanced climate target ambition on internal emission reductions



Source: Authors' own compilation.

3.3 Empirical studies on the correlation between carbon credit use and internal emission reductions

To date, no study has quantitatively assessed the causal effect of carbon credits on internal emission reductions. However, there are several studies which assess the empirical correlation between the use of carbon credits and internal emission reductions. When observing the correlation between carbon credit use and internal emission reductions, it must be interpreted cautiously as correlation studies typically face multiple caveats that impede causal inference. These caveats are summarised in section 3.4.

We identified five studies that investigate the correlation between carbon credit use and internal emission reductions in a statistical manner. The findings of these studies, along with their methodological limitations, are summarised below. Based on these studies, we determine the conclusions that may be derived on the effect between carbon credit use and internal emission reductions, see section 3.4.

3.3.1 Sylvera 2023 – Carbon Credits: Permission to Pollute, or Pivotal for Progress?

A study conducted by the carbon credit rating agency Sylvera analyses data from 102 large companies across multiple industries and geographic locations from 2013 to 2021, of which 50% purchased carbon credits (Sylvera 2023). Using self-reported data on Scope 1 and Scope 2 emissions derived from the CDP database, they find that companies that purchased carbon credits over this period achieved larger average annual emission reductions compared to their peers that did not purchase carbon credits.

On average, they find that companies that purchased carbon credits cut their emissions by **6.2%** per year, whereas companies that did not purchase carbon credits cut their emissions by only **3.4%** per year. The highest emission reductions are observed in the financial services industry, while the lowest emission reductions are observed among manufacturing and technology companies. Yet, when the authors exclude the airlines sector – in which emission reductions in 2020 and 2021 are predominantly driven by the COVID-19 pandemic – from the analysis, the difference in emission reductions between carbon credit buyers and non-buyers shrinks.

While this observation may suggest a **positive correlation between carbon credit purchases and internal emission reductions**, the study design does not allow causal inference. Firstly, the sample size is relatively small and has not explicitly been randomly chosen, which may imply a risk of selection bias, i.e. that companies which purchased carbon credits may not be comparable to companies which did not purchase carbon credits with regards to their ability or incentives to abate internal emissions. This means that the difference in internal emission reductions may be driven by confounding factors.

Secondly, where data on location-based Scope 2 emissions are missing, Sylvera (2023) uses market-based Scope 2 emissions data, arguing that this does not affect the results because they are comparing changes in emissions over time rather than absolute emission levels. However, market-based Scope 2 emissions decline with the purchase of Renewable Energy Certificates.[7] It seems plausible that companies experienced with market-based instruments, such as Renewable Energy Certificates, are also more likely to purchase carbon credits and vice versa. If the sample of companies only reporting market-based Scope 2 emissions is skewed towards carbon credit buyers, the reported emission reductions could be driven by the purchase of Renewable Energy Certificates rather than by internal emission reductions. This issue has also been raised by Dufrasne and Faecks (2023).

Thirdly, the data only covers Scope 1 and Scope 2 emissions. While Scope 1 and Scope 2 emissions make up the majority of GHG emissions in a few selected sectors (e.g. utilities), Scope 3 emissions account for the highest share in most sectors (Furdak et al. 2024), including some of the largest buyers of carbon credits. Although the influence of companies on Scope 3 emissions is limited compared to Scope 1 and 2 emissions, Scope 3 emissions can be partially controlled through, for example, modifications within procurement, business travel, the emission intensity of using the products (e.g. electric vehicles versus combustion engines). Therefore, only observing changes in Scope 1 and Scope 2 emissions may not adequately proxy total emission reductions and the role of carbon credits in respect to Scope 3 emission reductions.

Finally, the study does not address the question of statistical significance. While the observed internal emission reductions are almost twice as high among companies that purchased carbon credits, the results could be driven by individual outliers.

[7] Renewable Energy Certificates reflect one megawatt hour of renewable electricity generated by a power plant and supplied to a shared electricity grid. Companies can claim this renewable electricity in their market-based Scope 2 emissions regardless of their actual electricity source (for further details, see Benchimol et al. (2022)).

3.3.2 Ecosystem Marketplace 2023 – All in on Climate: The Role of Carbon Credits in Corporate Climate Strategies

A study conducted by Ecosystem Marketplace analyses self-reported data to the CDP database in the 2022 reporting year by more than 7,000 companies (Donofrio and Procton 2023). Of this total, 815 companies voluntarily purchased carbon credits, whereas 6,538 did not.

The analysis suggests that setting an emission target is relatively more common among carbon credit buyers than among non-buyers. With regards to decarbonisation of Scope 1 and Scope 2 emissions – defined as companies that reported 'lower gross emissions in 2021 than in 2020 and identified renewable energy consumption or other emissions reduction activities as a contributing cause' – the study finds a **higher decarbonisation share among carbon credit buyers than non-buyers**.

These statistical observations suggest that companies purchasing carbon credits outperform companies that do not purchase carbon credits on multiple emission performance indicators. Yet, the study shares several methodological limitations with the study by Sylvera (2023). This includes the omission of potential confounding factors as well as the focus on Scope 1 and Scope 2 emissions only. Although the sample of companies in this study is larger than that in the Sylvera (2023) study, Scope 1, Scope 2[8] and Scope 3 emissions were higher among companies that voluntarily purchased carbon credits than those that did not. This makes the two samples less comparable and susceptible to confounding factors.

In addition, Donofrio and Procton (2023) do not provide in-depth analyses into whether the differences are statistically significant or driven by extreme outliers, or how sensitive the results are to changes in the methodology or sub-samples.

3.3.3 MSCI 2023 and 2024 – Corporate Emission Performance and the Use of Carbon Credits

A study conducted by MSCI Carbon Markets (formerly Trove Research) finds similar results (MSCI Carbon Markets 2023a) using internal Scope 1 and Scope 2 emissions data combined with data on carbon credit use (combination of purchases and retirements based on carbon crediting registries, CDP data and company reports). Their analysis covers 4,156 companies over the years 2017 – 2022.

Excluding outliers as well as oil and gas companies, their results indicate that annual **emission reductions are significantly higher among 'material' users of carbon credits** – defined as companies that used at least 100 credits corresponding to at least 5% of their Scope 1 and Scope 2 emissions – **than among non-users**. The observed median annual emission reductions are similar in extent to those in the Sylvera (2023) study, amounting to **6%** and **3%**, respectively. The results remain robust across all time periods[9] and most regional sub-samples, when including Scope 3 emissions, when considering mean reductions as opposed to median reductions, and when using alternative thresholds for carbon credit users versus non-users.

In addition, they find that 'heavier' users of carbon credits achieve higher emission reductions than 'lighter' users of carbon credits. This suggests a robust correlation between the use of carbon credits

[8] Referring to location-based emissions.
[9] For the 2017-2019 period, the observed emission reductions remain higher among users than non-users; however, the difference is not statistically significant at the 95% level of confidence.

and internal emission reductions. According to MSCI, this could be explained via the self-imposed internal price on GHG emissions (see mechanism 3 in section 3.1.4).

Dufrasne and Faecks (2023) suggest that the correlation may partially be driven by the fact that companies that have experience with market-based approaches may face lower costs to decarbonise (e.g. services/financial services as opposed to industry). However, the correlation between carbon credit use and internal emission reductions can also be observed within the services, financial services, and materials sectors, although these are very broadly defined. For manufacturing, retail, infrastructure, food/beverage & agriculture, biotech/heath care & pharma, and hospitality, the study does not find a significant difference in internal emission reduction rates between users of carbon credits and non-users. In the transportation and apparel sectors, the trend even reverses, although the difference is not statistically significant.

This analysis was extended in a **second report by MSCI**, which focuses not only on internal emission reductions but also on the setting of climate targets (Watanabe et al. 2024). The analysis covers 2,665 companies that reported their Scope 1 and Scope 2 emissions over the same period, i.e. 2017–2022.

Their findings suggest that among material users of carbon credits – defined as companies that used more than 1,000 carbon credits over the sample period – the median annual emission reduction was **3.6%**. Statistically, this is significantly higher than among non-users, whose median annual reduction amounted to only **1.5%**. The results are robust to parameter changes such as the sample period or the threshold for defining material users. The difference also persists within all regional sub-samples, i.e. the Americas, Europe, the Middle East and Africa, and Asia–Pacific, although the difference is highest within the Asia–Pacific region and lowest within the Americas. Similarly to the preceding MSCI study, statistical significance can only be observed within some sectors, including consumer discretionary, communication services, financials, materials, industrials, and health care. The difference is insignificant for utilities, consumer staples, information technologies, real estate, and energy.

In addition, Watanabe et al. (2024) analyse the reductions in carbon intensity, i.e. emissions per USD of revenues. The results confirm the trend that material users of carbon credits achieve significantly higher annual emission reductions in their carbon intensity than non-users, albeit to a lower extent (5.6% per annum versus 4.4% per annum). As for absolute emission reductions, this finding is robust to changes in the sample period and threshold for material usage and persists across regions. Yet, the difference is only statistically significant in the consumer discretionary, health care, industrials and information technology sectors.

When considering only Scope 3 emissions, the trend that material users reduce emissions at a higher rate than non-users can **only be observed for one of 15 emission categories**, i.e. business travel. Considering that Scope 3 emissions make up the majority of emissions in several sectors, this raises the question of whether the positive correlation between carbon credit use and emission reductions can be observed for total emissions (Scope 1, 2 and 3).

Furthermore, Watanabe et al. (2024) find that a larger share of material users have set or committed to set climate targets compared to non-users. Among those that have set or committed to set climate targets, the share of companies that appear to have more “credible” targets based on four indicators[10] is larger among material carbon credit users than non-users. Finally, the proportion of

[10] The indicators are: at least one short-term target for the relevant scope, at least one externally validated target, a track record of achieving past targets, a current trajectory to meet at least some ongoing targets.

the revenue derived from low-carbon solutions seems to be higher among material carbon credit users than non-users except for the industrials and consumer staples sectors.

However, as in the study by Sylvera (2023) and in Donofrio and Procton (2023), the positive correlation between carbon credit purchases and emission reductions may be driven by confounding factors.

3.3.4 Stolz and Probst 2025 – The negligible role of carbon offsetting in corporate climate strategies

One limitation of most studies discussed above is that they define carbon credit users in a binary way. The group of users may be very heterogenous, with some using carbon credits only to a minor extent and others using an amount of carbon credits equal to their gross emissions (e.g. to make offsetting claims). Some companies may implement extensive emission reduction measures and only use a small amount of carbon credits to offset unabated emissions. Others may primarily use carbon credits to address gross emissions. While MSCI Carbon Markets (2023a) address this to some extent by differentiating between ‘heavy’ and ‘light’ users of carbon credits, Stolz and Probst (2025) provide insights from a more in-depth analysis, taking into account diversity within the group of carbon credit users.

The peer-reviewed study conducted by Stolz and Probst (2025) **contradicts the notion that carbon credit users achieve higher internal emission reductions**. A novelty of this study is that it analyses the correlation between the *number* of retired carbon credits and internal emission reductions using a linear regression model as opposed to relying on a binary variable determining users versus non-users (or ‘heavy’ and ‘light’ users versus non-users). Similarly to the other studies, their analysis is primarily based on the CDP database, covering 89 companies in the hard-to-decarbonise sectors (oil and gas, automobile manufacturing, airline) that cumulatively retired 24% of carbon credits in the VCM in 2022.

Stolz and Probst (2025) run a linear regression between the number of carbon credits retired in 2022 and the ratio of Scope 1 emissions in 2022 compared to 2017, controlling for the revenue, sector and continent of headquarters.

They find **no significant correlation** between the number of carbon credit retirements and reductions in Scope 1 emissions. The robustness checks indicate that the correlation remains insignificant when slightly altering the explanatory and outcome variable. These alterations include using all the carbon credits retired between the 2018 and 2023 CDP survey waves as an explanatory variable, or using a binary variable for carbon credit use rather than the number of carbon credits retired, as well as using both Scope 1 and Scope 2 emissions as an outcome variable (Stolz and Probst 2025).

However, they find qualitative evidence for mitigation deterrence among a few large-scale carbon credit users whereby carbon credits compete(d) directly with alternative mitigation measures due to either the target effect (Shell, Eni and Inpex), described in section 3.2.1 or the investment effect (Delta Air Lines and easyJet), described in section 3.2.2 (Stolz and Probst 2025). In addition, they find no significant linear effect of carbon credit retirements on climate target ambition, defined as the cumulative gap between a company’s targeted emission trajectory for the period 2020 to 2050 (Scope 1, 2 and 3) and the average trajectory of all 1.5 degree Celsius emission scenarios from the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC).

Nevertheless, the absence of quantitative evidence does not necessarily imply the absence of any effect. The study only covers a small number of companies and cross-sectional data. Therefore, the model cannot control for unobserved year- and company-fixed effects (e.g. demand shocks or values of a company) that may influence the observed results. This means that we cannot rule out that carbon credits may have a causal effect on internal emission reductions only because there is no observed correlation.

However, the absence of correlation along with the descriptive evidence indicates that, **for most companies, carbon credits likely have a negligible effect on internal emission reductions** due to the small amount invested in carbon credits relative to total capital expenditures and non-persistent offsetting strategies (Stolz and Probst 2025).

Nevertheless, for a **few companies**, carbon credits have been found to compete with internal emission reduction measures and hence to **substitute internal emission reductions** (Stolz and Probst 2025).

Furthermore, the study considers only Scope 1 and Scope 2 emissions rather than total emissions. This means that even if there is no effect on Scope 1 and Scope 2 emissions, there may be an effect on total emissions (i.e. including Scope 3 emissions).

3.4 Takeaways and research gaps

The existing literature suggests inconclusive evidence with a view to the correlation between carbon credit use and internal emission reductions. While most studies suggest that **carbon credit users achieve higher reductions** in Scope 1 and Scope 2 emissions than non-users, this **correlation is not confirmed by Stolz and Probst (2025)** – the only peer-reviewed study – when controlling for the revenue, sector and continent of the headquarters.

Furthermore, the observed correlations (or absence thereof) must **not be interpretated causally**. In contrast to causality, a statistical correlation does not imply that one variable has an effect on the other, nor does it suggest the direction of such an effect. Many other factors may contribute to the observed correlation. These include:

- **Confounding factors:** All the reviewed studies may be prone to biases from confounding factors impeding causal inference. Both carbon credit use and internal emission reductions may be affected by factors such as profitability, revenue, experience with environmental markets, regulatory requirements or consumer/stakeholder pressure, as highlighted by Dufrasne and Faecks (2023). This might drive the observed correlation. In addition, under certain climate targets or commitments to make climate-related claims may affect both internal emission reductions and carbon credit use.

- **Data quality:** Another caveat in the correlation studies is that the underlying CDP data on carbon credit use and emissions are self-reported and have not necessarily been verified by external auditors. This bears the risk of erroneous entries, sample bias and misinterpretation of the underlying question, resulting in irregularities and influencing the robustness of the findings (Data Desk; SOMO 2025). In addition, emission accounting and reporting approaches are inconsistent across companies, particularly for Scope 3 emissions, making it difficult to meaningfully compare these across companies (Klaaßen and Stoll 2021). Other factors influencing the quality of the data are unaddressed changes in company structure, e.g. due to mergers or acquisitions, or differences in emission accounting methodologies (Data Desk; SOMO 2025). Furthermore, Donofrio and Procton (2023) state that among 204 known carbon credit buyers, only 64% disclosed carbon credit purchases in the CDP, which further supports the concerns with data quality.

- **Sample bias:** Another limitation is the sample of companies included in the studies. As pointed out in a recent study conducted by Data Desk and SOMO, the CDP data may not be representative due to voluntary participation rates. This suggests that there may be a sample bias towards more “climate-aware” companies or companies that are highly scrutinised and hence incentivised to disclose climate-related information. Disclosure rates vary across industry and region and tend to be higher among carbon credit users than non-users (Data Desk; SOMO 2025).

When assessing whether the use of carbon credits causally affects internal emission reductions, we need to differentiate between state and effect. **The question is not whether companies that use carbon credits reduce emissions faster but whether the use of carbon credits complements or substitutes internal emission reductions**. This is because users and non-users may be structurally different and face different incentives to reduce emissions or are embedded in different regulatory landscapes.

Whether carbon credits reduce, enhance or do not affect the rate of internal emission reductions largely depends on the drivers of the observed correlation. To determine the causal effect of carbon credit use on internal emission reductions, it would therefore be important to assess differences in companies that are comparable in terms of their likelihood to reduce internal emissions in the absence of carbon credits. This would mitigate biases due to confounding factors (e.g. climate targets, regulation).

The question of causality remains unanswered to date as none of the existing studies provides causal evidence. Shedding light on this question requires the consideration of potentially confounding factors as well as controlling for potential biases due to sample selection and bi-directional effects. A summary of potential confounding factors, i.e. those that might affect both carbon credit use and internal emission reductions, is provided in Table 2 based on the factors found to be correlated with carbon credit use in section 3.1.

Table 2 Potentially confounding factors correlating with carbon credit use and internal emission reductions

Factor correlating with carbon credit use	Direction of correlation	Evidence	Potential confounding effect on emission reductions
Commitment to (voluntary) climate targets / net-zero	+	Lou et al. 2023; Engler et al. 2023; Watanabe et al. 2024; Kim et al. 2024	Climate targets may drive carbon credit use and incentivise companies to reduce their emissions.
Competitive advantages/ consumer or stakeholder demand for green products or services	+	Carbon Direct 2024; Kähkönen et al. 2024	Demand for green products/services can be met through either carbon credits or emission reductions.
Institutional ownership (the fraction of shares held by institutional investors)	+	Kim et al. 2024	Institutional investors themselves might face consumer demand to invest in companies that offset emissions through carbon credits or achieve high internal emission reductions.
Voluntary emission disclosure	+	Carbon Direct 2024; Watanabe et al. 2024; Donofrio and Procton 2023	Transparency on company emissions may increase public pressure to reduce internal emissions over time or offset emissions through carbon credits; However, if disclosure is voluntary, the high achievements in emission reductions may incentivise disclosure of emissions, implying a potential two-way direction.
Mandatory emission disclosure (e.g. EU ETS)	+	Engler et al. 2023	Transparency on company emissions may increase public pressure to reduce internal emissions over time or offset emissions through carbon credits.
Share of staff working on environmental-related matters	+	Engler et al. 2023	A high share of environment-related staff might drive internal emission reductions and increase pressure to offset unabated emissions through carbon credits.
Environmental product/service innovations	+	Engler et al. 2023	Innovations themselves might directly drive emission reductions while being correlated with carbon credit use.

Incentives to boost ESG ratings	+	Kim et al. 2024	ESG ratings may be boosted through emission offsetting and measures to reduce internal emissions.
Average employee age	-	Engler et al. 2023	Younger people may be more climate-conscious and therefore more likely to seek employers that are implementing emission reduction measures or addressing their unabated emissions through emission offsetting.

Source: Authors' own compilation.

4 Insights gathered from interviews with companies

To reach a better understanding of corporate decision-making regarding companies' decarbonisation strategies and the role of carbon credits in such strategies, we collected case-based evidence by interviewing a small sample of companies. The aim of the interviews was to gain insights into the factors that may affect the decarbonisation strategies and the use of carbon credits. This information is important for developing a methodological approach to test a causal effect of corporate carbon credit purchases on internal emission reductions. It may help to identify potential confounding factors that should be considered to derive robust results.

4.1 Selection of companies

In order to interview a relevant sample of companies, we applied the following criteria in the process of selection:

1. Commitment to climate targets or climate strategies: Companies without climate-related targets or climate strategies may have little interest in or knowledge about carbon credits and are less likely to be confronted with the trade-off between purchasing carbon credits and reducing internal emissions. Therefore, we aimed to interview companies for which at least one of the mechanisms discussed in section 3.1.4 could be relevant.

2. Diversity in climate targets: The role of carbon credits may differ depending on the specific climate target; therefore, it may be insightful to interview companies with different climate targets. For example, some companies set targets that may be met by using carbon credits, whereas other companies set targets that cannot be met by using carbon credits.

3. Diversity in carbon credit use: To better understand the role of carbon credits, it is helpful to hear the perspectives of both carbon credit users and non-users (or ex-users). This likely generates a better understanding of the perceived benefits and risks of using credits. Furthermore, companies that do not currently use carbon credits may plan to do so in the future and might share considerations that are of interest.

4. Regional diversity: Interviewing companies based in different geographical locations may deliver insights on potential regional factors such as the regulatory environment or differences in the preference of the companies' target groups or clients for corporate climate action.

5. Sectoral diversity: Interviewing companies from different sectors may deliver insights on potential regulatory factors and emission reduction levers and their corresponding marginal abatement costs in contrast to using carbon credits. In addition, the influence on suppliers' emissions (Scope 3) may be lower in sectors that tend to procure from highly concentrated markets.

6. Diversity in company size: We did not apply any restrictions on the company size, as it may be a confounding factor. On the one hand, larger companies are more likely to address climate action more strategically with a dedicated sustainability department and face higher pressure from consumers or civil society stakeholders. In addition, large companies may have more influence on Scope 3 emissions by exerting pressure on their suppliers. On the other hand, smaller companies may have to purchase carbon credits to address their Scope 3 emissions precisely because of their reduced influence on suppliers' emissions. Hence, both small and large companies may be of interest in this study.

In addition, we considered companies that act as intermediaries in the VCM and are therefore able to share second-hand insights on the role of carbon credits in companies' decarbonisation strategies based on their exchange with companies using carbon credits.

Based on the above selection criteria, we contacted 25 companies, four of which act as intermediaries, i.e. companies that are directly involved in the VCM and are hence in close contact with carbon credit buyers.

4.2 Questionnaire

Based on the identified research gaps, we developed a questionnaire for company interviews centred around three topics related to their climate strategy: the setting of climate targets, the use of carbon credits, and making climate-related claims. The focus of the interviews was to gather insights into considerations and potential trade-offs that companies face when making decisions on emission reduction measures.

We developed a questionnaire template for all companies and slightly tailored the questions towards companies based on information collected prior to the interviews through desk research, e.g. regarding companies' climate targets, green claims and use of carbon credits. Given the conversational nature of the interviews, we modified questions slightly to react to the answers provided during the interview. This includes adding clarifying questions, changing the order of questions, or omitting questions that were not relevant based on the information already provided. We used a slightly modified questionnaire when interviewing intermediaries in the VCM (see Appendix).

Climate Targets

1. Do you have climate targets or are you considering setting climate targets?

   If so:

   - What are your climate targets?
   - What are/were your considerations when setting climate targets?
   - How do you plan to achieve your targets?

Beyond value chain mitigation

2. Did you ever purchase carbon credits?

   If so:

   - When did you use carbon credits for the first time and what were the considerations when using them?
   - What are the main factors that influenced your decision to buy carbon credits?
   - Please describe the purposes for which carbon credits are/were used.
   - What are the main benefits and constraints of using carbon credits for your company?
   - What type of internal budget is used to purchase the carbon credits?

- What other mitigation actions do/did you take to reduce emissions? (may be implicitly answered already)

Carbon credits and climate targets: Do you plan to achieve your targets (partially) through carbon offsetting?

If so:

- Do/did you define a relative or absolute limit for which carbon credits may be used?
- Do you plan to use carbon credits only in the target year(s) or already before that?
- When do/did you make the decision to purchase carbon credits?
- When do/did you determine the amount of carbon credits to be bought?
- What other mitigation actions do/did you take to meet your climate targets? (may be implicitly answered already)

If not:

- Have you ever considered purchasing carbon credits?
- What are your reasons for not purchasing carbon credits?
- What mitigation actions do/did you take to reduce emissions? (may be implicitly answered already)

Claims

3. Do you make any claims in relation to carbon credits?

3.1. What were your considerations in choosing a certain claim?

3.2. When do you decide to make an offsetting claim?

3.3. Have you considered making non-offsetting claims?

4.3 Interview findings

In total, six companies (based in the European Union, the United Kingdom and the United States) agreed to participate in the interviews. Three were large companies that use voluntary carbon credits, and the other three were intermediaries in the VCM which reported second-hand experience from companies with which they work.

Some caution should be exercised when drawing implications based on these interviews. Firstly, having interviewed a small, non-representative sample of companies, our findings cannot be generalised and do not account for structural differences across companies. Secondly, even though the participation and responses of the companies are treated confidentially, companies may have protected internal information that they deemed to be sensitive. Thirdly, insights from interviewed intermediaries may potentially be biased, depending on their role in the VCM. Fourthly, there may be some form of response bias as interviewees may react not only to the question but also to other aspects of the interview settings (Bogner and Landrock 2016). This may lead to biases due to socially desirable responding, reactions to the behaviour or characteristics of the interviewers, or a different interpretation or evaluation of questions depending on the order of the questions (Bogner and Landrock 2016).

Below, we summarise our central findings from the interviews. Given the small sample of interviewees, we refrain from indicating the frequency of provided responses since it would not be representative.

4.3.1 Target-setting

Interviewees report several reasons for companies to set voluntary climate targets:

1. Driving efficiency in their operations in anticipation of regulation;
2. Enhancing the reputation of the brand (e.g. being a climate leader);
3. Meeting demand for ‘sustainability’ up and down the value chain;
4. Attracting talent;
5. Being aligned with the climate science.

We observe that companies strongly differ in their approach towards setting climate targets. While the decision on the exact climate target is often made top-down (e.g. by the CEO) to keep up with or go beyond competitors’ climate ambition, the climate target may also sometimes be set more strategically as a combination of top-down and bottom-up considerations on the business unit level.

4.3.2 Reasons for (not) purchasing carbon credits

In the interviews, we observed that companies typically use carbon credits for one or more of the following purposes:

1. Making offsetting claims (e.g. climate neutrality) or other forms of public communication;
2. Meeting emission reduction targets;
3. Offering “green” products or services to consumers or customers up the value chain;
4. Taking corporate responsibility for unabated emissions in the form of a climate contribution;
5. Gaining experience with the VCM and “smoothing out the journey” towards future liabilities[11];
6. Securing a sufficient supply of carbon credits that can be used to claim net-zero once long-term science-based emission reduction targets have been met.

The interviewees reported the following reasons for not using carbon credits:

1. Lack of clarity about how carbon credits can be used;
2. Fear of greenwashing accusations and related reputational risks;
3. Risk of wasting money on low quality carbon credits;

[11] Companies that aim to make net zero claims, e.g. according to SBTi, may already anticipate using carbon credits in the future and therefore already engage in the VCM to gain expertise and experience with the purchase and retirement of carbon credits.

4. Recently in the United States: reduced political desire for climate action.

4.3.3 Interplay between carbon credits, climate targets and climate budgets

Some companies allow carbon credits to be used towards their emission reduction targets through offsetting, while others set emission reduction targets only for internal emission reductions (i.e. carbon credits may not be used towards those targets). Some companies have one single and fixed budget for total climate action (including internal emission reductions and carbon credits), while others keep the budgets for internal emission reductions and carbon credits separate. None of the interviewed companies' climate strategies relied solely or predominantly on offsetting through carbon credits, even if there was no clearly defined limitation on the extent to which carbon credits may be used. However, depending on how targets are set, and budgets are determined, carbon credits may still compete with internal emission reduction measures to some extent:

- If carbon credits may be used to achieve emission reduction targets, carbon credits may compete with internal emission reduction measures, especially if there is one common and fixed budget for climate action within and beyond the value chain. In that case, the means of achieving the target is flexible. According to the interview responses, the extent to which the target is met through internal emission reductions versus carbon credits (sometimes purchased well in advance of the target year) is then determined by strategic and financial considerations. These considerations may include the costs and long-term impact of emission reduction measures on unabated emissions that would have to be offset, but also practical aspects, e.g. sourcing green energy when a contract needs to be renewed.

- If carbon credits may not be used towards emission reduction targets, the risk of carbon credits competing with internal emission reductions is likely lower, especially if the climate target is ambitious and science-based (e.g. SBTi approved). This is because the emission reduction target necessitates that internal emission reductions are implemented. Carbon credits may only be used to go beyond internal efforts required to meet the target (e.g. to offer "green" products to customers or to make offsetting claims) or to claim net-zero in the target year once long-term targets have been achieved. In this case, according to the interview responses, purchasing carbon credits can be attractive for companies for two reasons: to gain experience with the VCM and build internal capacity to "smooth out the journey" towards achieving long-term targets and/or to invest in ensuring sufficient supply of carbon credits to offset residual emissions in the target year and beyond (e.g. to make net-zero claims when meeting long-term SBTi targets, see (SBTI 2025).

4.3.4 Timing of carbon credit purchases

The timing of carbon credit purchases differs from company to company. A central observation is that carbon credits purchased in a given year may not necessarily be retired in the same year.

When companies have decided to use carbon credits, they may forecast the number of carbon credits they may need to offset unabated emissions in future years, e.g. when used to make offsetting claims, and plan for that. However, the exact number of carbon credits needed can only be determined retrospectively for the previous year. Therefore, in many cases, companies retire carbon credits to offset emissions from the previous year.

In contrast, some companies are purchasing carbon credits well before they anticipate using them. There can be multiple reasons for this. One is to prepare for anticipated use in the future by gaining experience with purchasing and retiring carbon credits before needing to do so to make offsetting claims in long-term target years (e.g. SBTi 'net-zero'). Another reason is to purchase carbon credits at lower prices to use them for offsetting in the future (if prices are anticipated to increase). Finally, some companies have offtake agreements with specific projects and therefore purchase carbon credits before they may be needed for retirement.

4.3.5 Trends over time

Multiple interviewees made the same observation that the reasons for whether to purchase carbon credits and the ways in which they are used have shifted over time. Up to 2022, the key benefit of using carbon credits was the ability to make offsetting claims, especially climate neutrality claims, as a form of marketing/PR strategy to keep up with or to get ahead of the competition or to meet investors' demand for climate action. Since 2023, fundamental integrity issues in the voluntary carbon market have increasingly been discussed in the press along with greenwashing accusations, sometimes followed by lawsuits. Since then, the reasons for using carbon credits have changed and their use is handled with more caution. The value of making offsetting claims has decreased due to increased reputational risks and the risk of distracting from internal emission reductions efforts along with a perceived lower political priority for climate action, especially in the United States, but also in Europe. Therefore, companies have become more reluctant to purchase carbon credits or to make offsetting claims.

Furthermore, although some companies continue to purchase carbon credits, they tend to see little marketing value in communicating this as a "headline" contribution claim due to a fear of criticism or legal repercussions. While some companies consider making contribution claims, only a few companies actually make such "headline" claims.

In the recent years, it has become more common to set science-based targets, particularly for large companies. This is because science-based targets, especially when approved by the SBTi, are perceived as best practice and supported by a broad group of stakeholders, which can enhance the company's reputation. In addition, some investors explicitly ask for SBTi approved targets to be able to offer a green portfolio.

These changes in trends over time present a key challenge when attempting to quantitatively assess the effect of carbon credit use on internal emission reductions. Since the incentives and strategies are so dynamic, the effect of carbon credits on internal emission reductions may strongly depend on the use purpose and decision-making approach of the company.

5 Developing a study design

In this section, we investigate the possibility of developing a study design to quantitatively test whether there is a causal effect of carbon credit use on internal emission reductions. This involves formulating a precise research question, determining the outcome and explanatory variables to be considered, identifying data requirements and potential data gaps, and discussing methodological challenges as well as possibilities and limitations in overcoming them.

5.1 Research question

Designing an empirical study requires the research question to be clearly defined. As discussed in section 3.4, the central question is whether and how corporate use of carbon credits affects internal emission reductions, i.e. **whether carbon credits substitute or complement internal emission reductions**. To answer this question, it is not sufficient to test whether companies that use carbon credits achieve higher or lower emission reductions than those that do not use carbon credits. This is because companies that use carbon credits could systematically differ from those that do not, meaning that factors other than carbon credit use could explain differences in the rate of internal emission reductions. Instead, it is necessary to test whether there is a causal link between **carbon credit use and the rate of internal emission reductions**.

In addition, the literature and interview findings suggest that the effect of carbon credit use on internal emission reductions likely depends on the way in which companies use carbon credits. According to the interviews, the question of whether carbon credits can be used to achieve climate targets seems to be particularly relevant. If companies can use carbon credits towards achieving their emission reduction targets, carbon credit use may be more likely to crowd out internal emission reductions than if companies set emission reductions targets that may not be achieved by offsetting emissions. This is especially the case if mechanism 1 comes into effect (see section 3.2).

Hence, the following two hypothesis could be tested empirically:

Hypothesis 1: Carbon credit use affects internal emission reductions.

Hypothesis 2: The effect of carbon credit use on internal emission reductions is more adverse if companies can use carbon credits towards achieving their climate targets.

5.1.1 Outcome variable: Internal emission reductions

A second important consideration in the design of the study is how the outcome variable – the internal emission reductions – is defined and quantified. Here, an important challenge is that there are multiple ways to measure internal emission reductions. We identify three possible approaches:

1. **Achieved emission reductions:** The most direct way is to measure the achieved emission reductions. This can be measured as the ratio of **absolute emissions** relative to absolute emissions in previous years (as carried out in most studies discussed in section 3.3) or the ratio of the **emission intensity** (i.e. emissions relative to production or revenue) relative to the emission intensity in previous years (see, for example, Watanabe et al. (2024)). The latter would account for changes in production volumes and changes in the company structure, e.g. in the case of mergers or acquisitions.
2. **Financial investments:** Alternatively, the financial **investment** in internal emission reductions relative to the company's total capital investments could be used as an indirect proxy for the internal emission reductions that will be achieved in the future. This would reflect the priority of

internal emission reductions in the overall company budget. However, this would not directly capture the effectiveness of these measures in achieving emission reductions.

3. **Commitments:** Another approach could be to use the company's commitments, e.g. the ambition and scope of climate targets, as an indirect proxy for the internal emission reductions that will be achieved in the future. The challenge with this approach is that climate targets are defined very diversely across companies and allow for different near-term and long-term ambitions and limited coverage (e.g. only Scope 1 or 2). In addition, Jiang et al. (2025) find limited public accountability for target outcomes and show that a large share of companies failed to meet their 2020 climate targets or revoked them altogether.

Therefore, we suggest focusing on the achieved emission reductions, i.e. the ratio of absolute emissions or the emission intensity relative to the previous year.

When considering the achieved emission reductions, another important issue is the scope of the emissions considered. Since companies use different accounting approaches to determine Scope 3 emissions (Klaaßen and Stoll 2021) and have more control over Scope 1 and Scope 2 emissions than Scope 3 emissions, we recommend focusing on **Scope 1 and Scope 2 emissions.** However, the companies can still act on Scope 3 emissions, e.g. through adjustments in procurement or business travels. We therefore suggest using emission reductions in Scope 1, 2 and 3 in a sensitivity check in an empirical framework.

5.1.2 Explanatory variable: carbon credit use

A third important issue for the design of the study is how the explanatory variable – carbon credit use – is defined and quantified.

A first important consideration is whether carbon credit use should be measured as a binary variable or a discrete variable. A binary variable refers to **users versus non-users** (Sylvera 2023; Donofrio and Procton 2023; MSCI Carbon Markets 2023a; Watanabe et al. 2024; Stolz and Probst 2025)**,** while a discrete variable refers to the **number of carbon credits** used (Stolz and Probst 2025). While the number of carbon credits may have a linear negative effect on internal emission reductions according to the 'target effect' and 'investment effect' underlying mechanism 1 and 2 in sections 3.2.1 and 3.2.2 (Stolz and Probst 2025), the use of carbon credits – irrespective of the amount – may positively affect internal emission reductions under the assumptions of mechanism 3 in section 3.2.3. Due to these considerations along with potential biases discussed in section 3.4, we recommend investigating both linear and non-linear effects through discrete and binary approaches.

If the number of carbon credits is considered in the study, a second important question is whether the use of carbon credits should be measured in terms of carbon credit **purchases** or carbon credit **retirements**.

A challenge in using **purchased carbon credits** is that the process of making a purchase is not clearly defined and may involve several steps. In some cases, companies may purchase 'secondary carbon credits' (i.e. the carbon credits have already been issued). In this case, the purchase commonly corresponds to the delivery of the carbon credit to the company. In other cases, however, companies may sign offtake agreements with the mitigation activity developer when the carbon credits have not yet been issued (often referred to as 'primary carbon credits'). Depending on the conditions stipulated in the individual contracts, carbon credits may be purchased before delivery, upon delivery or in tranches, making it difficult to connect the timing of the carbon credit purchases with emission reduction measures and strategies in a given year. A key challenge is that from the data reported by companies, what exactly a purchase refers to may not always be clear. Depending on how each reporting company understands the term ‘purchase’, different stages in the purchasing process may be reported.

Another disadvantage of using purchased carbon credits as the explanatory variable is that purchased carbon credits may potentially be re-sold or retired at a different point in time than the time of their purchase. On the other hand, carbon credit purchases may indicate the intention to offset emissions at the point of purchase and may therefore better reflect the companies’ decarbonisation strategy, affecting internal emission reductions and investment in internal emission reductions at that time.

In contrast, **carbon credit retirements** may better reflect the actual volume of carbon credit use, albeit with some delay. According to insights gathered in the interviews, carbon credits are typically used to offset emissions in the previous year. Accordingly, both carbon credit purchases and carbon credit retirements have their benefits and limitations in serving as an explanatory variable.

5.2 Endogeneity: correlation versus causality

As discussed in section 3.4, the correlation between carbon credit use and internal emission reductions may be influenced by many factors, thereby impeding causal inference. Empirically assessing the causal effect of carbon credit use on internal emission reductions requires specifying a model that mitigates potential biases from endogeneity. Endogeneity refers to a situation when there is at least one ‘explanatory variable in a multiple regression model […] is correlated with the error term’ (Wooldridge 2012, p. 848). When estimating the effect of carbon credits on internal emission reductions, endogeneity may arise if carbon credit use is correlated with the error term. This would mean that that there are unobserved effects (captured by the error term) that lead to biases in the observed correlation, which impede causal interpretation.

There are three factors that commonly cause endogeneity biases:

- confounding factors that are correlated with both the outcome and the explanatory variable (often referred to as **omitted variable bias**);
- measurement errors; and
- simultaneity (often referred to as **reverse causality**).

A common approach to reduce the influence of confounding factors is using panel data, i.e. a data sample covering the same entities (in our case companies) over time. Panel data estimators enable controlling for time-fixed effects (e.g. shocks affecting all companies in the sample such as the COVID-19 pandemic) as well as time-constant unobserved company-fixed effects that are correlated with carbon credit use (e.g. the values of the company) (Wooldridge 2010).

In the context of carbon credit use and internal emission reductions, the critical assumption for these estimators to be unbiased is that carbon credit use is strictly exogenous after controlling for time-constant unobserved effects. This means that the error term must not be correlated with current, past or future carbon credit use. Accordingly, there must be no sources of endogeneity in place, other than the controlled time-constant unobserved effects.

Nevertheless, all three causes of endogeneity may remain – even when controlling for time-constant unobserved effects. Time-varying confounding factors such as climate targets, stakeholder /consumer demand, or pressure from investors or procures, among others, may affect both internal emission reductions and carbon credit use. Measurement errors may exist in the underlying data (see discussion in section 5.3). Simultaneity may exist if, for example, the achieved emission reductions affect the number of carbon credits used.

The challenge of controlling for such endogeneity can be demonstrated based on the example of climate targets. According to goal setting theory, setting challenging and specific goals positively affects task performance (Locke and Latham 2002). This would suggest that climate targets may positively affect emission reductions. In addition, climate targets – if they may be achieved with carbon credits – may also affect the number of used carbon credits.

The empirical literature on the effect of climate targets on emission reductions provides mixed results (Dahlmann et al. 2019; Klaaßen et al. 2024). A study conducted by Bolay (2024) suggests that target ambition is negatively correlated with target performance; however having an SBTi approved target is positively correlated with target progress. With regards to emission reductions, a recent study conducted by Sun et al. (2025) suggests that adopting SBTi targets enhances carbon performance among companies that are best-in-class. However, this positive effect cannot be found for companies that are worst-in-class. This suggests that climate targets can affect emission reductions, at least for some types of companies.

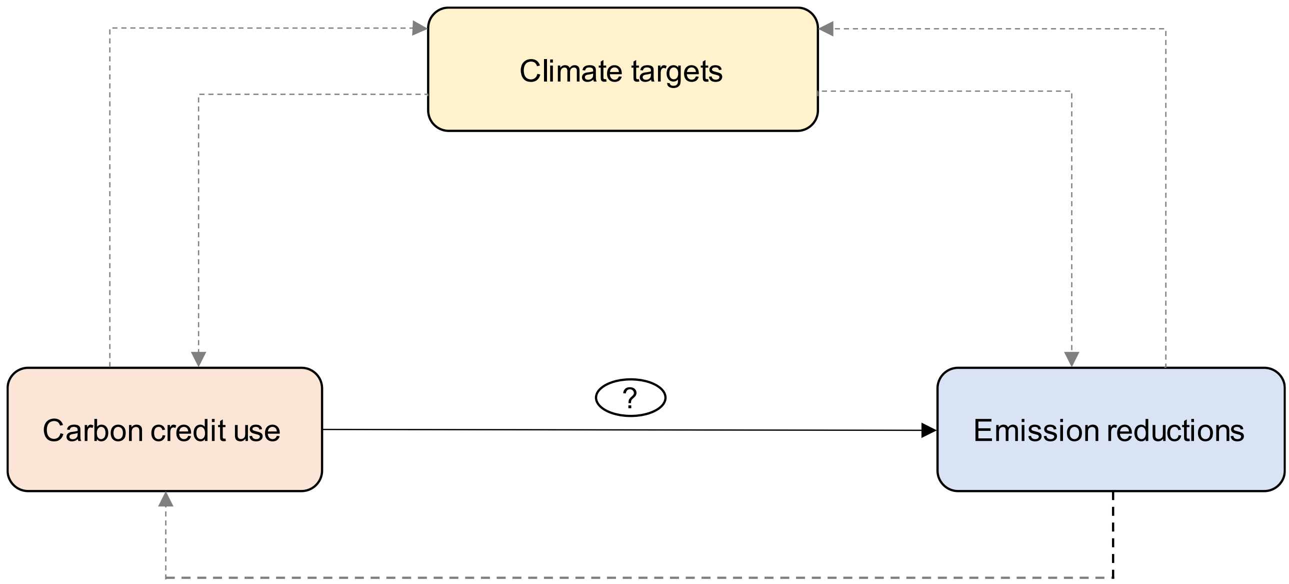
While the role of climate targets in determining carbon credit use and emission reductions is not clear, the interview findings suggest that it is reasonable to assume that climate targets that can be achieved through emission offsetting may positively affect carbon credit use, especially when approaching the target year. This means that not controlling for climate targets could potentially lead to an **omitted variable bias**.

Sun et al. (2025) further observe that companies with high carbon performance are more likely to set SBTi targets, meaning that controlling for climate targets may on the other hand raise a **simultaneity issue**. In addition, access to carbon credits that can be used towards climate targets may incentivise the setting of climate targets or enhancing the ambition thereof, see section 3.2.3. In this case, climate targets would be a mediator of the causal effect, i.e. the mechanisms through which carbon credit use may affect internal emission reductions, and should therefore not be controlled for.

Furthermore, simultaneity may occur if emission reductions affect the number of carbon credits used, which may skew the results. Companies that are already on a fast decarbonisation track and achieving high internal emission reductions may require a lower number of carbon credits to achieve their climate targets and hence purchase fewer carbon credits. Hence, another potential challenge in the study design is to control for reverse causality between internal emission reductions and carbon credit use.

Figure 2 illustrates the potential complexity due to endogeneity.

Figure 2 Potential confounding effects



Source: Authors' own compilation.

In practice, it is difficult to rule out endogeneity altogether. However, certain model applications along with sensitivity checks can reduce potential biases from reverse causality, measurement errors or time-varying confounding factors. In the following sections, we discuss the suitability of available data and study designs that may be used to estimate the causal effect of carbon credit use on internal emission reductions as well as their limitations.

5.3 Data availability and limitations

To empirically assess the effect of carbon credit use on internal emission reductions, we need detailed information on emission data (outcome variable), the use of carbon credits (explanatory variable) and confounding factors such as general company characteristics (e.g. sector, the region of the headquarters, company size, etc.) and factors related to climate strategies such as climate targets.

Ideally, this data should be available for a large sample of companies over a long time-series.

5.3.1 CDP data

The most suitable provider of such data is the CDP, a UK-based organisation that has collected data from companies on climate impacts since 2002. In-depth information on carbon credit use and science-based climate targets have been reported in a consistent format since 2018. However, CDP frequently changed the survey questions over time, making it difficult to find a long time-horizon over which data can be compared. Along with the data limitations discussed in section 3.4, data must be cleaned to account for erroneous entries, structural changes in company characteristics (e.g. due to mergers and acquisitions) and changes in companies' accounting methodologies, which may result in a reduced sample size.

Table 3, Table 4 and Table 5 provide an overview of the core data requirements and their availability through CDP over the 2018–2024 reporting period.

Table 3 CDP data on emissions

	Available	Note
Absolute Scope 1 emissions	YES	
Absolute Scope 2 emissions	YES	
Absolute Scope 3 emissions	YES	Available only for some companies.
Emission intensity Scope 1 Emission intensity Scope 2	YES	CDP reports the combined Scope 1 and Scope 2 emissions per unit currency total revenue, but not separately. However, inflation and variability in exchange rates may challenge the comparability of the emission intensity over time and across countries.
Emission intensity Scope 3	PARTIALLY	Requires additional information on company revenue.
Investment in internal emission reductions relative to total capital expenditures	NO	Information available on investment in emission reduction initiatives but no information available on company-wide capital expenditures.

Source: CDP Climate Change Information Requests; CDP Climate Change 2022 Questionnaire; CDP Climate Change 2023 Questionnaire, derived on 22.08.2025.

Table 4 CDP data on carbon credit use

	Available	Note
Number of carbon credits purchased for voluntary emission offsetting	PARTIALLY	In the 2018–2022 reporting years, CDP reports the number of carbon credits purchased and whether the carbon credits have been cancelled (but not how many). From the 2023 reporting year and onwards, CDP reports the number of carbon credits cancelled and whether they have been purchased or issued, but not when they have been purchased. Since carbon credits do not have to be cancelled in the same year they are purchased, the data may not be fully comparable. In addition, the data from 2023 onwards only specifies the number of carbon credits cancelled within the reporting year. It does not specify whether the cancellation is made to offset emissions in the same year or any earlier accounting year.
Number of carbon credits retired for voluntary emission offsetting	PARTIALLY	

Source: CDP Climate Change Information Requests; CDP Climate Change 2022 Questionnaire; CDP Climate Change 2023 Questionnaire, derived on 22.08.2025.

Table 5 CDP data on emission reduction targets

	Available
Whether there is an emission reduction target	YES
Year in which target was set	YES
Base year	YES
Target year	YES
Scope coverage	YES
Targeted percentage reductions	YES
Whether carbon credits can be used towards the climate target	NO
Whether the target is SBTi aligned	YES

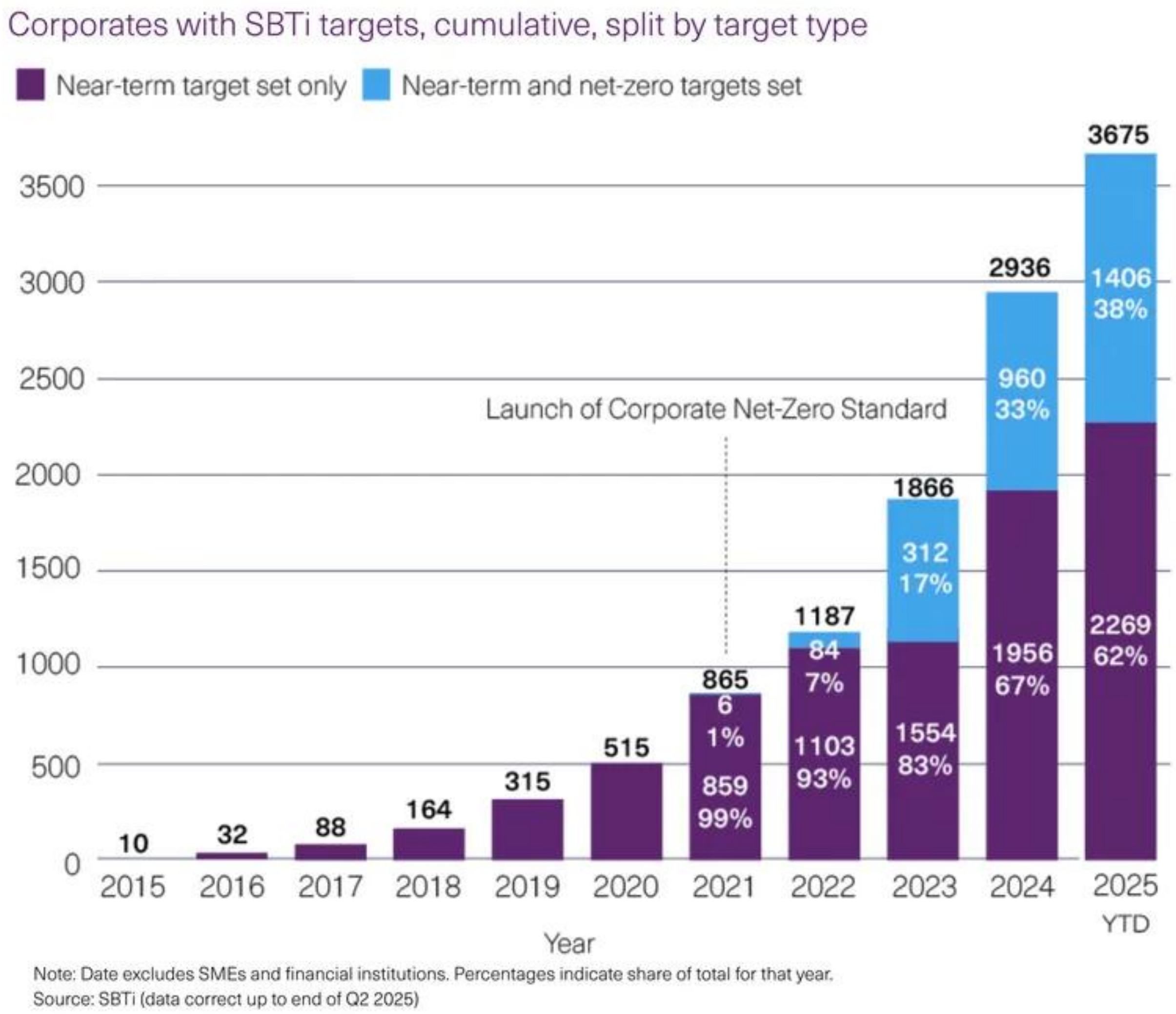
Source: CDP Climate Change Information Requests; CDP Climate Change 2022 Questionnaire; CDP Climate Change 2023 Questionnaire, derived on 22.08.2025.

5.3.2 Structural limitations

As discussed in section 5.3.2, CDP provides most, but not all, of the core data required to conduct an empirical analysis. In order to address the endogeneity issues discussed in section 5.2, a large enough sample of companies and years must have continuously reported to the CDP. In addition, to mitigate biases from the potential effect of climate targets, this sample should ideally consist of companies that had set climate targets prior to the start of the first year in the sample and kept these fixed over time to avoid simultaneity biases. Moreover, the information on whether these climate targets may be achieved through carbon credits would be essential to test hypothesis 2. Along with measurement errors that are expected to be prevalent in the data, this may make it very challenging to test the hypotheses empirically.

Furthermore, the VCM and the target-setting behaviour of companies have changed significantly in recent years, as indicated by the interviewees (see section 4.3). While only 88 companies had set SBTi targets globally in 2017, this figure had increased by more than 4,000 percent by 2025 (see Figure 3). In addition, revisions to the SBTi Corporate Net Zero Standard have been made in the meantime, which may make early adopters and late adopters less comparable. These dynamics make it very challenging to sufficiently control for all the factors that may affect the correlation between carbon credit use and internal emission reductions.

Figure 3 **Trends in SBTi target-setting**



Source: SBTi, link

5.4 Conclusions on the feasibility of an empirical study assessing causality

To empirically assess the causal effect of carbon credit use on internal emission reductions, it would be necessary to control for all potential biases resulting from endogeneity and cover a large sample of companies over a long period. As discussed in section 5.3, the most comprehensive data source, the CDP, provides the required data only to a limited extent due to:

- measurement errors associated with self-reported information, structural changes (e.g. mergers and acquisitions) and alterations to the wordings of the questions over time;
- missing information on whether climate targets may be achieved through the offsetting of emissions;
- unclear distinction between carbon credit purchases and carbon credit retirements;
- potential selection bias due to voluntary participation in the questionnaire; and

- limited number of companies continuously reporting to the CDP.

In addition, the companies' approach to using carbon credits and setting climate targets has changed in recent years, making it difficult to control for potential confounding effects, e.g. related to the setting of climate targets, even if the data were accurately collected. This means that an empirical model may not be robust enough to provide clear insights on the causal effect of carbon credits on internal emission reductions.

To some extent, endogeneity may be addressed by only focusing on a sub-sample of companies. For example, to control for the effect of climate targets, one could attempt to test hypothesis 1 by assessing companies that do not use carbon credits to achieve their climate targets. This would be the case, for example, for the 88 companies that set near-team SBTi targets in 2017, as it is not possible to use carbon credits to fulfil SBTi targets. As shown in Figure 3, the number of companies setting near-term SBTi targets has rapidly increased since 2017, implying a trade-off between sample size and length of the study period covered in the sample selection. If a sufficiently large sample of these companies also reported continuously to CDP, did not revoke or adjust their targets over the study period, and covered both carbon credit users and non-users, endogeneity related to the setting of climate targets would be mitigated. In this way, we could estimate whether carbon credits affect internal emission reductions if they cannot be used towards climate targets.

However, limiting the analysis to companies that had set SBTi targets prior to the beginning of the study period would imply that findings could not be generalised. Rather, they may only be representative for ambitious companies that had set SBTi targets early on. Furthermore, by definition, mechanisms 1, 3 and 4 established in section 3.1.4 could not be tested as the sample excludes companies that use carbon credits towards achieving climate targets. In addition, endogeneity related to other potential confounding factors that play a role in companies' climate strategies, measurement errors and potential reverse causality from internal emission reductions to carbon credit use may persist.

An estimation approach that may account for reverse causality from emission reductions to the number of carbon credits used is the Arellano-Bond estimator (Arellano and Bond 1991). The Arellano-Bond estimator addresses endogeneity by 'instrumenting' endogenous variables with their own lagged values. 'Instrumenting' means determining variation in the endogenous explanatory variable though an instrumental variable (in this case, past values of the explanatory variable) that does not affect the outcome variable except through its effect on the explanatory variable. This enables isolating exogenous variation in the explanatory variable to estimate its effect on the outcome variable.

In the context of carbon credit use and internal emission reductions, this approach would use past values of carbon credit use to isolate exogenous variation in carbon credit use in the current year to estimate the effect on internal emission reductions. The core assumptions underlying this approach are that (i) the endogenous variable is **inert**, i.e. changes slowly over time and hence is strongly affected by its past values, and (ii) the endogenous variable is **sequentially exogenous** i.e. the error term may be correlated with future values of the explanatory variable, but not with current and past values. In practice, this means that past and current emission reduction rates are allowed to affect current and future values of carbon credit use, but carbon credit use must not correlate with future error terms, e.g. due to anticipation effects.

This assumption is not plausible when considering carbon credit purchases, however. This is because carbon credits are often purchased prior to their use in anticipation of achievable emission reductions in the future. For carbon credit retirements, the assumption of sequential exogeneity may be reasonable since carbon credits are typically retired to offset unabated emissions in the current or previous year. Hence, emission reductions in the current year may affect carbon credit retirements in the current year and future years, whereas it is unlikely that carbon credit retirements in the current year are correlated with future error terms.

If the data suggests that the required assumptions about inertia and sequential exogeneity are met, it may be possible to control for a substantial part of endogeneity. However, the changing nature of corporate climate action makes it difficult to rule out any confounding factors with certainty. Therefore, it is inherently challenging to quantitatively investigate the question of whether and how the use of carbon credits affects internal emission reductions with certainty.

6 Conclusion

This study examined the question of whether and how corporate carbon credit use affects companies’ internal emission reductions. To this end, we reviewed the literature on the correlation between corporate carbon credit use and internal emission reductions from both theoretical and empirical perspectives, conducted qualitative interviews with relevant companies, and discussed the possibility of a study design to investigate whether there is a causal effect of carbon credit use on internal emission reductions.

Our analysis shows that, in theory, different kinds of scenarios would be conceivable depending on the underlying assumptions: carbon credit use could substitute or complement internal emission reductions or have no effect on internal emission reductions at all.

However, the empirical literature provides only limited insights into this question. It mainly investigates whether companies that use carbon credits reduce internal emissions faster than those that do not use carbon credits, rather than investigating whether and how carbon credit use causally affects internal emission reductions. In addition, these studies face several methodological limitations.

While most studies find a positive correlation between carbon credit use and internal emission reductions, this correlation cannot be confirmed by the only peer-reviewed study available, conducted by Stolz and Probst (2025). None of the studies aims to investigate whether there is a causal effect of carbon credit use on internal emission reductions and therefore does not answer the question of whether carbon credit use substitutes, complements or does not affect internal emission reductions at all. However, Stolz and Probst (2025) provide descriptive evidence that for a few companies, carbon credits do compete with internal emission reductions while for most companies, carbon credits likely have no effect at all.

The interviews conducted with relevant companies provided some indications as to what affects the purchase of carbon credits. The reasons stated for purchasing carbon credits were: making offsetting claims, meeting emission reduction targets, offering “green” products and services, making climate contributions, gaining experience with the voluntary carbon market and securing sufficient supply to be able to claim net zero when their long-term targets have been met. Furthermore, the interviews indicated that if carbon credits can be used towards achieving emission reduction targets, carbon credits are more likely to compete with internal emission reduction measures.

Due to data limitations, structural changes in companies’ approach towards carbon credit use and target-setting as well as endogeneity in the use of carbon credits, it is inherently challenging to develop a study design that could overcome these issues with certainty and causally test the effect of carbon credit use on internal emission reductions.

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Annex I. Interview questions for intermediaries in the VCM

Climate Targets

1. What are the considerations companies make when setting climate targets?
   - In particular, what are the considerations when setting scope 1, 2, 3 targets and target years?
   - How do companies plan to achieve their targets?

Beyond value chain mitigation

2. For companies that do/did purchase carbon credits:
   - What are the main factors that influence the decision to buy carbon credits?
   - What role does the way the carbon credits are used play in this decision?
   - What are the main benefits and constraints of using carbon credits for companies?
   - What other mitigation actions typically compete with carbon credits?
   - What type of internal budget is used to purchase the carbon credits?

   For companies that use **carbon credits to achieve their targets**:
     - Is it common to define a relative or absolute limit for how many carbon credits may be used?
     - Is it common to plan using carbon credits only in the target year or before that?

   For companies that use **carbon credits to achieve their targets or make claims**:
     - When do companies typically make the decision whether to purchase carbon credits in the context of achieving climate targets or making climate-related claims?
     - When do companies typically decide on how many carbon credits to buy?
3. For companies that do/did not purchase carbon credits
   - What are the typical reasons for not purchasing carbon credits?

Claims

4. What are considerations when choosing to make a certain claim?
5. How do you perceive that different claims are being accepted or not accepted by companies?