# The Economics of Carbon Finance

by

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**Abstract**

My thesis introduces evidence of a possible link between a US-listed firm's likelihood of carbon credit usage and its financial performance, as well as the absence of a statistically significant relationship between that and its emissions level or intensities. The sources of my data are four offset verification registries and two S&P databases. I find that larger, less profitable, and more financially constrained firms are more likely to buy carbon credits. Up to 2020, US-listed firms' carbon credit retirement had been on the rise, though apparently not measuring up to the corresponding reported carbon emissions. Transportation and finance are the top two industries that report credit retirements in my sample, despite their divergent emissions profiles. Through case studies in aviation and banking, I present an on-the-ground look at firms' use (or lack thereof) of carbon credits within the context of their overall emissions reduction strategies and find that carbon credit usage may be associated with ESG-linked executive pay, yet further research is needed to reach a conclusion on this matter.

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Without my parents' love and care, I would not have made it here. My gratitude to them is greater than the most beautiful words can express. *Con có được ngày hôm nay là nhờ tình thương và công ơn nuôi dưỡng của ba mẹ. Lòng biết ơn của con với ba mẹ, không mỹ từ nào có thể tả xiết.*

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# 1. Introduction

Carbon finance has achieved ever-increasing importance since the 21st Conference of the Parties (COP21) by United Nations Framework Convention on Climate Change (UNFCCC) in 2015. Established to mitigate "dangerous human interference with the climate system" (UNFCCC, 1992), the UNFCCC conducts annual COP to address problems associated with global greenhouse gas (GHG) emissions. COP21 resulted in the legally binding Paris Agreement, in which all nations agree to keep "the increase in global temperature to well below 2°C above pre-industrial levels" and aim "to limit the temperature increase to 1.5°C above pre-industrial levels" (United Nations, 2015). Moreover, each nation is required to plan out its own nationally determined contributions (NDCs) and effectively needs to achieve net-zero[1] status by 2050 to meet the Paris Agreement's goals (United Nations, n.d.).

In November 2021, Article 6 of the Paris Agreement came into effect, which allows countries to use voluntary carbon credits (also known as carbon offsets[2]) to meet their NDCs, boosting the credibility of such credits alongside existing compliance market-based mechanisms, of which the most notable examples are carbon taxes and cap-and-trade systems[3]. Article 6 also creates a carbon credit accounting framework called "corresponding adjustment" to prevent double counting and further legitimizes private actors' transactions of carbon credits as serving "other international mitigation purposes", thus implicitly linking private actors' carbon credit usage with governments' progress towards their NDCs (Favasuli, 2021).

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[1] Net-zero: a state where GHG emissions are cut "to as close to zero as possible, with any remaining emissions re-absorbed from the atmosphere" (United Nations, n.d.); interchangeable with "carbon-neutral."

[2] In this paper, both "credits" and "offsets" refer to voluntary carbon credits.

[3] Also known as "emission trading" or "allowance trading."

Consequently, for anyone concerned about climate change, it is informative to examine the current state of private actors' commitment to offset their GHG emissions. To facilitate such commitments, a coalition of international organizations, including the UN, has set up the Science Based Targets initiative (SBTi) to create well-defined, customized pathways for companies to reach net-zero status by 2050. In addition, according to UNFCC's "Race to Zero" campaign's website[4], 7126 companies and 541 financial institutions have pledged to halve their emissions by 2030 and be carbon-neutral by 2050, just like national governments did at COP21. In fact, based on an aviation and banking-focused sample of six firms, I find that two of them have even set more ambitious net-zero targets than required by the Paris Agreement. For certain carbon-intensive companies, removing existing GHG from the atmosphere, or "negative emission", is effectively mandatory to be carbon-neutral (Blaufelder et al., 2021). One way to do so is to fund offset projects elsewhere.

Meanwhile, the advent of sustainable investing and the potential financial risks associated with high levels of carbon exposure have added another dimension to corporate reporting. In recent years, investors have incorporated climate-related information into their investment screening (Amel-Zadeh & Serafeim, 2018), taken seriously the financial effects of climate risks (Krueger et al., 2020) and revealed stronger demand for climate-related disclosures (Amel-Zadeh & Serafeim, 2018; Ilhan et al., 2023). On US markets, mutual funds with higher sustainability ratings receive greater fund flows (Hartzmark & Sussman, 2019). There is also evidence of a premium on carbon-intensive stocks, yet latest research has not reached a consensus on this point (Bolton &

[4] https://racetozero.unfccc.int/join-the-race/

Kacperczyk, 2021; Zhang, 2022). Nevertheless, listed firms have lower firm value (Jacobs, 2014) if they do not signal their intents to reduce GHG emissions.

Against this background, voluntary carbon markets have taken off in recent years. As of 2019, McKinsey[5] analysts calculated the quantities of carbon credits issued and retired to reach ever-increasing higher levels, clocking at 138 million $mtCO_2$[6] (almost doubling YoY) and 70 million $mtCO_2$ (33% increase YoY), respectively (Blaufelder et al., 2020). Deals mostly happen over the counter where buyers and sellers can trade carbon credits generated from offset projects verified by specialized non-governmental organizations (NGOs), yet some centralized exchanges have emerged, such as Xpansiv CBL in New York and AirCarbon Exchange in Singapore. To prevent duplicate offsetting, credits must be retired after being used. Retired credits offset the retiring entity's GHG emissions in the credits' vintage year and are entered into the verifying NGO's registry. The price of one carbon credit fluctuates according to the laws of supply-and-demand and can range from a few cents per $mtCO_2$ to $300/$mtCO_2$, depending on the type of offset projects it comes from (Favasuli & Sebastian, 2021). Payments for carbon credits are supposed to go to project developers to fund otherwise unprofitable offset projects.

Similar to carbon taxes or cap-and-trade systems, voluntary carbon markets serve to put a price on carbon emissions, thus partially internalizing firms' environmental externalities. However, with the exception of airlines, participation is not obligatory for public firms either at the time of writing or in the foreseeable future. This begs the questions of what type of firms use carbon

[5] McKinsey's reports are made in support of The Taskforce on Scaling Voluntary Carbon Markets, which is a private sector initiative created by the UN Special Envoy for Climate Action and Finance and sponsored by the Institute of International Finance.

[6] Metric tonnes of carbon-dioxide equivalent. GHG emissions and offsets are standardized across the board via conversion to the equivalent amount in CO2.

credits, what relevant patterns are emerging, and how those instruments fit with firms' overall emissions reduction efforts.

My goals are to address these questions in one of the first attempts to research public firms' involvement with carbon credits and to complement other studies in carbon finance. My paper is descriptive in nature and focused on US-listed firms and the period 2007-2021.

Using financial and emissions data from S&P Compustat and Trucost, respectively, as well as carbon credit retirement data from four NGOs that verify offset projects, I produce summary statistics and perform correlation studies on eleven firm-level characteristics and a dummy variable representing carbon credit retirement. After controlling for asset size, I find that a firm's likelihood of using carbon offsets positively correlates with asset size and financial leverage; and negatively correlates with cash holdings and operating performance. I then explore patterns within the transportation and finance industries. I examine those industries because they account for the top two spots in the quantities of carbon credits retired between 2007 and 2020 in my dataset, despite their diametrically opposite environmental profiles. I find that within the finance industry, reported carbon credit retirement generally matched up with scope 1 emissions, both being relatively stable. Meanwhile, transportation firms' ever-increasing emissions far outpaced reported carbon credit retirement.

I turn next to investigate transport and finance firms' use of carbon offsets (or lack thereof) in action by reviewing investor relations materials of three airlines (Delta Air Lines, JetBlue, and United Airlines) and three banks (Bank of America, Morgan Stanley, and Wells Fargo). I focus on airlines and banks since they dominate the quantity of credits retired in their respective industries. From those case studies, I find that statistical analyses on firm-level financial and environmental metrics alone do not paint a complete picture of how public firms are using carbon offsets to meet their net-zero targets, and that the prevalence of other types of market-based instruments, such as sustainable aviation fuel certificates and renewable energy certificates, might have a non-trivial effect on firm-level total carbon credits retired. Furthermore, some firms are choosing to reduce their reliance on offsets, or forego them entirely, in favor of investments into emerging sustainable technologies via corporate venture capital and industry alliances. I speculate that the choices about carbon credits and other types of market-based instruments may be related to how emissions reduction is tied to executive pay.

## 2. Related Literature

A pertinent issue to this paper is whether firms with better sustainability practices are more likely to be rewarded financially. Dowell et al. (2000) find that multinational enterprises with more stringent environmental standards have higher market valuation (Tobin's q), which is supported by Xu and Kim (2022), who find that greater toxic releases are predictive of lower operating performance (ROA) on top of lower market valuation (Tobin's q). Furthermore, Eccles et al. (2014) find that high sustainability firms are more long-term oriented, have long-term investor base (see also Starks et al. [2017]), and outperform low sustainability firms both on the market and in accounting metrics like ROE and ROA, exceeding analysts' forecasts. However, only sustainability investments that are material to the firm can enhance shareholder value and be predictive of superior financial returns (Khan et al., 2016).

While it is informative to establish the causal direction from sustainability practices to financial performances, it is also essential to investigate the opposite direction. Hong et al. (2012) suggest that financial constraints, more so than capital investment or research and development activities, are likely to determine the level of corporate goodness. Within the US context, there is evidence that financial constraints preclude meaningful sustainability practices. Both Xu and Kim (2022) and Bartram et al. (2022) find that under financial constraints, firms shift toxic releases in general and emissions in particular into less strictly regulated geographic areas instead of reducing overall pollution, thus undermining the effectiveness of compliance environmental policies.

Whether better pay incentivizes management to deliver a better ESG performance is another question of interest. Bonham and Riggs-Cragun (2022) find that promises of larger compensation in return for ESG improvements do not always result in desirable outcomes if that particular firm's shareholders do not intrinsically care about ESG issues. They also suggest that purely ESG-driven motives are not necessary, as long as compensations are tied to a balance between ESG and financial goals in line with shareholders' preferences. Cohen et al. (2022) find that firms that declare ESG commitments are more likely to link ESG metrics to executive pay, which appears to lead to improvements in one key environmental metric: carbon emission reduction (Cohen et al., 2022).

As awareness of climate-related risks increases and ideologies shift, there is evidence of investors having incorporated climate-related information in their investing decisions, although latest research has not reached a consensus on this matter. Hsu et al. (2023) find evidence of a pollution premium unattributable to the risks associated with policy uncertainty. Relatedly, Bolton and Kacperczyk (2021) suggest that investors demand greater returns from "brown" stocks, resulting in a carbon premium. There is a caveat to that premium, as the same study also finds that it is based more on total emissions than emission intensities, more common in salient high-emission industries, such as oil and gas, utilities, and transportation (Bolton & Kacperczyk, 2021). However, in a later study, Zhang (2022) replicates Bolton and Kacperczyk's (2021) analyses and argues that the alleged carbon premium exists because total emissions and emissions growth contains future information about sales and sales growth, which are the true reasons behind abnormal stock returns. Given the emerging research on climate risks, more time is needed to reach a definitive conclusion on this topic. Regardless, a survey of institutional investors by Krueger et al. (2020) shows that they generally believe that climate risks will affect their portfolios' performances and that equity valuations do not adequately account for them.

In fact, notwithstanding the weak consensus on the existence of climate-related premia, research suggests a significant appetite in the markets for voluntary ESG disclosures. Analysts and institutional investors alike express strong demand for climate disclosures (Amel-Zadeh & Serafeim, 2018; Ilhan et al., 2023), although retail investors seem to care less (Moss et al., 2020). The immediate relevance of disclosure content does not seem to matter. Jacobs (2014) shows that announcements of intents to reduce GHG emissions produce stronger positive reactions from the markets than those of realized achievements. Even managers' disclosures of their green investments, which do not directly affect firm performance, elicit favorable response from investors (Martin & Moser, 2016). Meanwhile, in a study that spans multiple international markets, Jiang et al. (2021) find that sufficient voluntary disclosures can mitigate the negative financial effects of large emissions.

A different look at the literature gives the impression that investors and fund managers' commitment to ESG standards is inconsistent. On the one hand, a favorable sustainability status is often more attractive to investors. Baker et al. (2022) find that on average, investors are willing to pay 20 bps more per annum and effectively realize a 46 bps lower return for a fund with an ESG mandate. US mutual funds with higher sustainability ratings attract greater flows (Hartzmark & Sussman, 2019). Institutional investors also impose their ESG norms on firms in markets where those norms are more socially widespread, such as European countries (Dyck et al., 2019). On the other hand, there are limits to retail investors' appetite, as Döttling and Kim (2022) find that they will move away from ESG funds during economic hardships. Likewise, ESG fund managers, at least in the US, are still somewhat largely driven by financial returns and seem to only pay lip service to their mandate when voting on ESG proposals (Li et al., 2023). This is consistent with Raghunandan and Rajgopal (2022), who find that ESG funds often charge higher fees and invest in firms which have higher ESG ratings and disclose more but also pay higher fines for environmental and labor violations.

Since public firms' carbon credit usage has become mainstream rather recently, to the best of my knowledge, there has been no academic study on this topic. Therefore, research in carbon finance can make meaningful contributions to the wider literature in corporate ESG practices.

# 3. Data and Results

## 3.1. Data

### 3.1.1. Data Collection

First, I get carbon credit retirement data for all entities (private individuals, private firms, public firms, non-profits, etc.) from four non-profit carbon offset verification issuers: American Carbon Registry (ACR), The Climate Action Reserve (CAR), The Gold Standard (GS), and The Verified Carbon Standard (VCS). I then hand-collect identification information of all firms with US listings, including subsidiaries and foreign-based firms, and have the retirement date verified so that those firms were listed on a US exchange at the time the carbon credits were retired. Any credit retirement by US-listed firms that happened when they were private, listed elsewhere, before their acquisition and after their divestment by a US-listed firm (in the case of subsidiaries) are deemed invalid.

Data on carbon emissions and intensities (both total and scope 1), are obtained from S&P Trucost database. Firm-level financial metrics are retrieved from S&P Compustat, including but not limited to total assets, sales revenue, year-end stock prices, short-term and long-term debt.

In the end,  data from the three above sources are combined into one single dataset that contains 208,354 observations, many of which only have financial and emission data. Because 2007 was the earliest that any carbon credit retirements were recorded in my database, I begin my analyses from then on.

To categorize the firms by industry, I use Fama-French 30 industry classifications, which are based on Standard Industrial Classification (SIC) codes.

### 3.1.2. Financial Variables

In the spirit of Dowell et al. (2000), Eccles et al. (2014), and Hong et al. (2012), I examine the following firm-level financial variables: (I) total asset, (II) cash, (III) Tobin's q, (IV) return-on-asset (ROA), (V) capital expenditures (capex), (VI) research and development (R&D) expense, and (VII) debt-to-equity (D/E) ratio. Total asset and cash, Tobin's q, and ROA are proxies for firm size, market valuation, and operating performance, respectively. Low cash and high D/E ratio are stand-ins for financial constraints. Capex and R&D expense are self-explanatory.

### 3.1.3. Non-Financial Variables

<u>Total and scope 1 emissions:</u> Emissions are reported in metric tonnes $CO_2$. There are three categories of carbon emissions: direct emissions (scope 1); emissions from energy use (scope 2); and indirect emissions from down-stream and up-stream activities in the supply chain,

investments, customers' use of sold products, employees' commutes, etc. (scope 3). In this paper, I mostly study scope 1 and total emissions, as data on scope 2 and scope 3 are not readily available.

Carbon and scope 1 intensities: These variables are measured in $CO_2$/USD million. S&P Trucost arrives at firm-level carbon and scope 1 intensities in a given year by dividing their respective aggregate metrics by sales revenue (USD million).

Total carbon credits retired: This variable is also reported in metric tonnes $CO_2$. For this study's purpose, I use total carbon credits retired as a proxy for credit purchases. There are two reasons for this assumption. Firstly, data on credit purchases are not publicly accessible, whereas credit retirement data could be retrieved from NGOs' registries. Secondly, I am interested in the possible correlations between firms' total and scope 1 emissions and carbon credit usage, and only retired credits can offset GHG emissions.

### 3.1.4. Constraints

My study is subject to two major constraints. Firstly, because not all listed firms are willing to disclose the full extent of their involvement with carbon offsets, if a credit retiring firm does not reveal its identity to the data vendors, underreporting is bound to occur in my dataset. In addition, there are no strict formats in NGOs' retirement entries, making it difficult to track credits retirement back to a specific firm and exacerbating the underreporting issue. However, a closer examination shows that underreporting is possibly random, and my dataset is largely reliable with regards to whether a public firm retires credits in a given year. Secondly, data on carbon emissions from S&P Trucost appear to be less accurate from 2021 onwards due to their recency. Therefore, I limit my statistical analyses to only the years preceding 2021.

## 3.2. Results

### 3.2.1. Summary Statistics

To ease analysis of financial variables, I exclude all observations where total assets are missing. In addition, I winsorize all values at the 1st and 99th percentiles to mitigate the effects of outliers. Of the remaining 3649 entries, over 90% contain data on cash, Tobin's q, ROA, and D/E. However, only about 48.67% contain data on R&D expenses. In terms of non-financial variables, about 35.11% entries are missing emissions data. I assume that if no retirement data are available for a given fiscal year, the company did not use any carbon credits in that year[7]. Consequently, with regards to total credits retired, missing values are treated as zero.

Table 1 and 2 present summary statistics of all firms'[8] financial characteristics in units of USD millions and non-financial characteristics in metric tonnes $CO_2$, except for ratios. As seen in Table 1, there is a substantial right skewness in the distributions of total asset, cash, capex, and R&D expense. Meanwhile, ratios (Tobin's q, ROA, and D/E) appear less skewed. This suggests that a handful of extremely large firms have outsized influence over my sample. The median firm in my sample has a total asset size of $20.2 trillion, holds $1.8 trillion in cash, spends $394.3 million in capex and $354.8 million in R&D expense. The median Tobin's q, ROA, and D/E ratio are about 1.45, 4.1%, and 0.31, respectively. Interestingly, regarding the non-financial characteristics in Table 2, both ratio and non-ratio variables exhibit large skewness and interquartile ranges. The median level of total emissions is 695,499 $mtCO_2$ with an interquartile range of about 3.86 million $mtCO_2$. The median carbon intensity is about 60.9$mtCO_2$/USD million

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[7] See 3.1.4.

[8] Here, every entry is treated as a distinct "firm". All variables are reported by fiscal year. For instance, Wells Fargo in FY2014 is considered to be a distinct "firm" from Wells Fargo in FY2009.

with an interquartile range of about 214.2mt$CO_2$/USD million. The median, 25th percentile, and 75th percentile quantities of credits retired are all 0, which suggests that between 2007 and 2020, the overwhelming majority of firms in my dataset did not retire carbon credits. In fact, only about 16.69% of entries report non-zero values of carbon credits retired.

**Table 1. Summary statistics – financial variables (all firms)**

| | N | Mean | Median | SD | Max | Min | 25th pct | 75th pct |
|---|---|---|---|---|---|---|---|---|
| Total asset | 3649 | 155137.27 | 20200 | 407620.84 | 2435452.4 | 146.864 | 5520.746 | 88182 |
| Cash | 3649 | 19897.54 | 1796 | 59998.236 | 388805 | .935 | 456.553 | 8194 |
| Tobin's q | 3358 | 2.09 | 1.449 | 1.694 | 10.183 | .813 | 1.06 | 2.338 |
| ROA | 3349 | .06 | .041 | .086 | .379 | -.234 | .011 | .091 |
| Capex | 3635 | 2148.393 | 394.31 | 4544.262 | 26320 | 0 | 83.325 | 1696 |
| R&D | 1776 | 1521.845 | 354.822 | 2734.605 | 13600 | 0 | 28.693 | 1429.058 |
| D/E | 3636 | .879 | .308 | 1.63 | 9.867 | 0 | .125 | .828 |

**Table 2. Summary statistics – non-financial variables (all firms)**

| | N | Mean | Median | SD | Max | Min | 25th pct | 75th pct |
|---|---|---|---|---|---|---|---|---|
| Total credits retired | 3649 | 9616.8 | 0.0 | 49314.1 | 404915 | 0 | 0 | 0 |
| Total emissions | 2368 | 6744194.6 | 695499.3 | 17657502 | 1.080e+08 | 8367.4 | 165686.8 | 4023915.4 |
| Scope 1 emissions | 2368 | 4480658.2 | 83647.3 | 14804110 | 97331778 | 760 | 14675.2 | 732249.7 |
| Carbon intensity | 2368 | 328.5 | 60.9 | 827.1 | 5453.1 | 4.5 | 26.1 | 240.3 |
| Scope 1 intensity | 2368 | 227.1 | 10.1 | 764.8 | 5154.5 | .2 | 1.9 | 38.6 |

Table 3 and 4 isolate the financial and non-financial characteristics of only credit retiring firms. The median total asset, cash holdings, capex, and R&D expense are more or less double those of all firms. Standard deviations of the same variables are also larger for credit retiring firms. However, the minimum and maximum levels do not change. These results suggest that credit retiring firms are generally larger than a typical firm in my sample, yet there are greater variations and extremities within that subset's firm size. Meanwhile, credit retiring firms' financial ratios (Tobin's q, ROA, and D/E) exhibit less divergence from all firms' ratios. With regards to non-financial metrics, at 1.07 million $mtCO_2$, credit retiring firms' median level of carbon emissions is about 153.23% that of all firms, yet the standard deviations are roughly similar. The distribution of credit retirement data is heavily skewed right with a median of 6,576 $mtCO_2$ and an interquartile range from 750 $mtCO_2$ to 53,581 mtCO2.

**Table 3. Summary statistics – financial variables (credit retiring firms)**

| | N | Mean | Median | SD | Max | Min | 25th pct | 75th pct |
|---|---|---|---|---|---|---|---|---|
| Total asset | 609 | 236050.78 | 41443.950 | 505927.64 | 2435452.4 | 146.864 | 9487.433 | 179524.84 |
| Cash | 609 | 32739.094 | 3405.000 | 79653.712 | 388805 | .935 | 689 | 16492.084 |
| Tobin's q | 555 | 2.024 | 1.337 | 1.743 | 10.183 | .813 | 1.033 | 2.267 |
| ROA | 601 | .048 | 0.032 | .081 | .379 | -.234 | .009 | .079 |
| Capex | 609 | 2669.214 | 636.000 | 4921.931 | 26320 | 0 | 161.1 | 2604.235 |
| R&D | 262 | 2215.344 | 677.000 | 3330.84 | 13600 | 0 | 47.268 | 2793.192 |
| D/E | 609 | 1 | 0.402 | 1.753 | 9.867 | 0 | .166 | .933 |

**Table 4. Summary statistics – non-financial variables (credit retiring firms)**

| | N | Mean | Median | SD | Max | Min | 25th pct | 75th pct |
|---|---|---|---|---|---|---|---|---|
| Total credits retired | 609 | 57621.55 | 6576.00 | 108722.76 | 404915 | 1 | 750 | 53581 |
| Total emissions | 397 | 7502851.9 | 1065727.57 | 17998133 | 1.080e+08 | 8706.07 | 255622.09 | 6164832 |
| Scope 1 emissions | 397 | 5004836.6 | 113414.19 | 14462874 | 97331778 | 759.99 | 23093.06 | 1848856.1 |
| Carbon intensity | 397 | 359 | 73.38 | 818.68 | 5453.08 | 4.46 | 27 | 333.09 |
| Scope 1 intensity | 397 | 253.9 | 12.99 | 768.18 | 5154.54 | .17 | 2.25 | 192.75 |

### 3.2.2. General Patterns in Carbon Credit Retirement

I turn next to examine the aggregate emission and retirement patterns of credit retiring firms. For this section, I exclude any observations that report zero or missing values on credit retirement.

Figure 1a presents a time series graph of all reported carbon credits retired in my dataset. After comparing with McKinsey analysts' estimates of carbon credits retired in all markets as shown in Figure 1b (Blaufelder et al., 2020, 2021), I find that unless US-listed firms' carbon credit retirement diverges significantly from market-wide patterns, assuming little overestimation by McKinsey's analysts, underreporting is most likely to be found in the period 2013-2019. Specifically, my graph shows a downward trend for the years 2013 and 2018, yet McKinsey analysts' estimates show a stable and upward trend throughout the period, as seen in Figure 1b. It is therefore logical to infer underreporting in credit retirement from 2014 and 2019, which came right after 2013 and 2018, respectively, and is either equal to or above the previous year's level in Figure 1b. Understatement of 2019 credit retirement is corroborated by the fact that the rate of change between 2019 and 2020 appears to be larger in Figure 1a than Figure 1b. Figure 1b shows that 2015 and 2016 credit retirement is higher than 2012 level, which contradicts Figure 1a. Thus, 2015 and 2016 credit retirement are likely to be underreported. This leaves 2017 as the only year that visual comparisons and logic cannot prove underreporting with certainty. Although McKinsey analysts retrieve data from one additional NGO registry (Plan Vivo), it is not among the major offset verifiers[9], so the influence of its verified credits over market-wide patterns is likely to be small. Within the scope of my research, I cannot determine the extent of underreporting. Regardless of the issue, both my data and Blaufelder et al. (2020, 2021) suggest minimal yearly credit retirement prior to 2013 and a clear general upward trend from 2016 onwards.

[9] S&P Global Platts, a member of the Taskforce on Scaling Voluntary Carbon Markets, only deals in credits certified by GS, CAR, VCS, ACR, and Architecture for REDD+ Transactions (Favasuli & Sebastian, 2021).

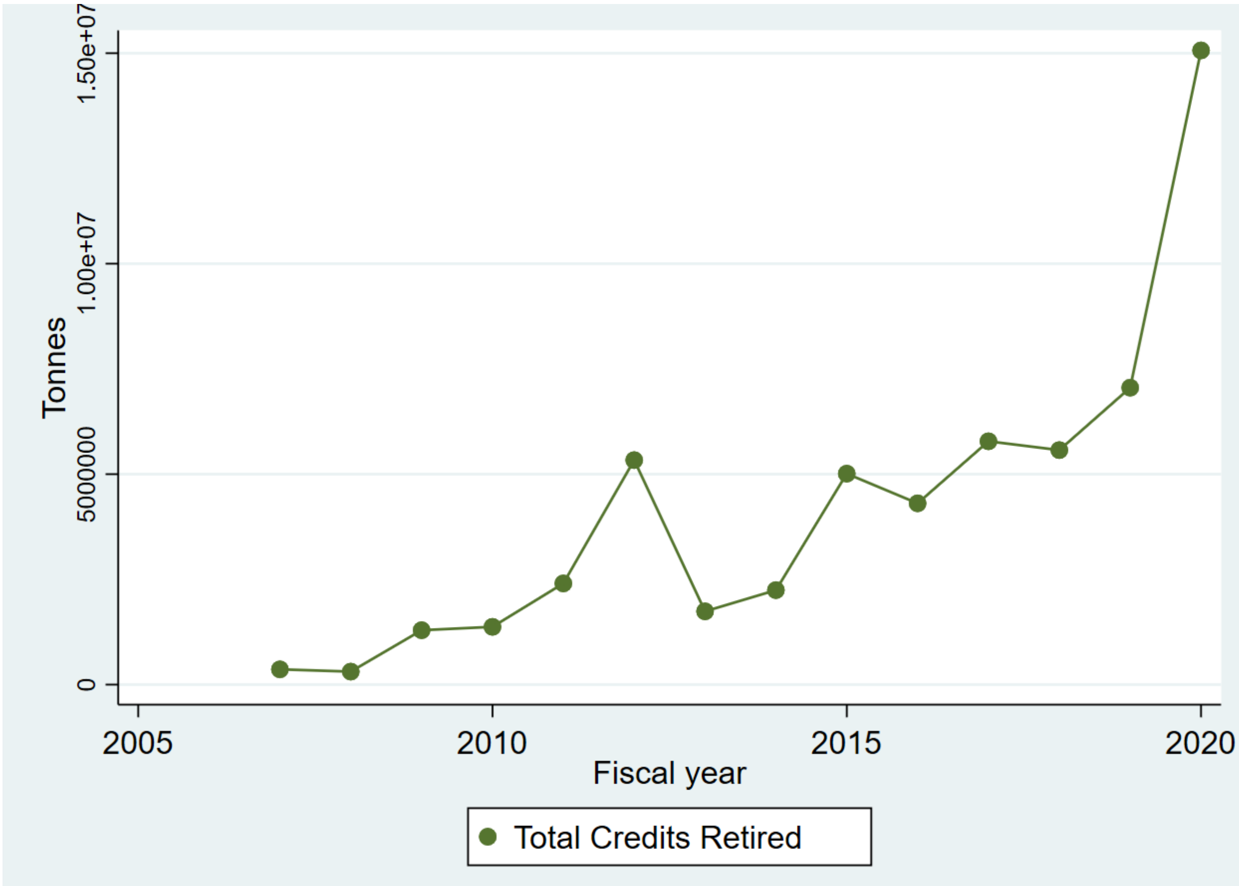


**Figure 1a**. Aggregate carbon credits retired, 2007-2020

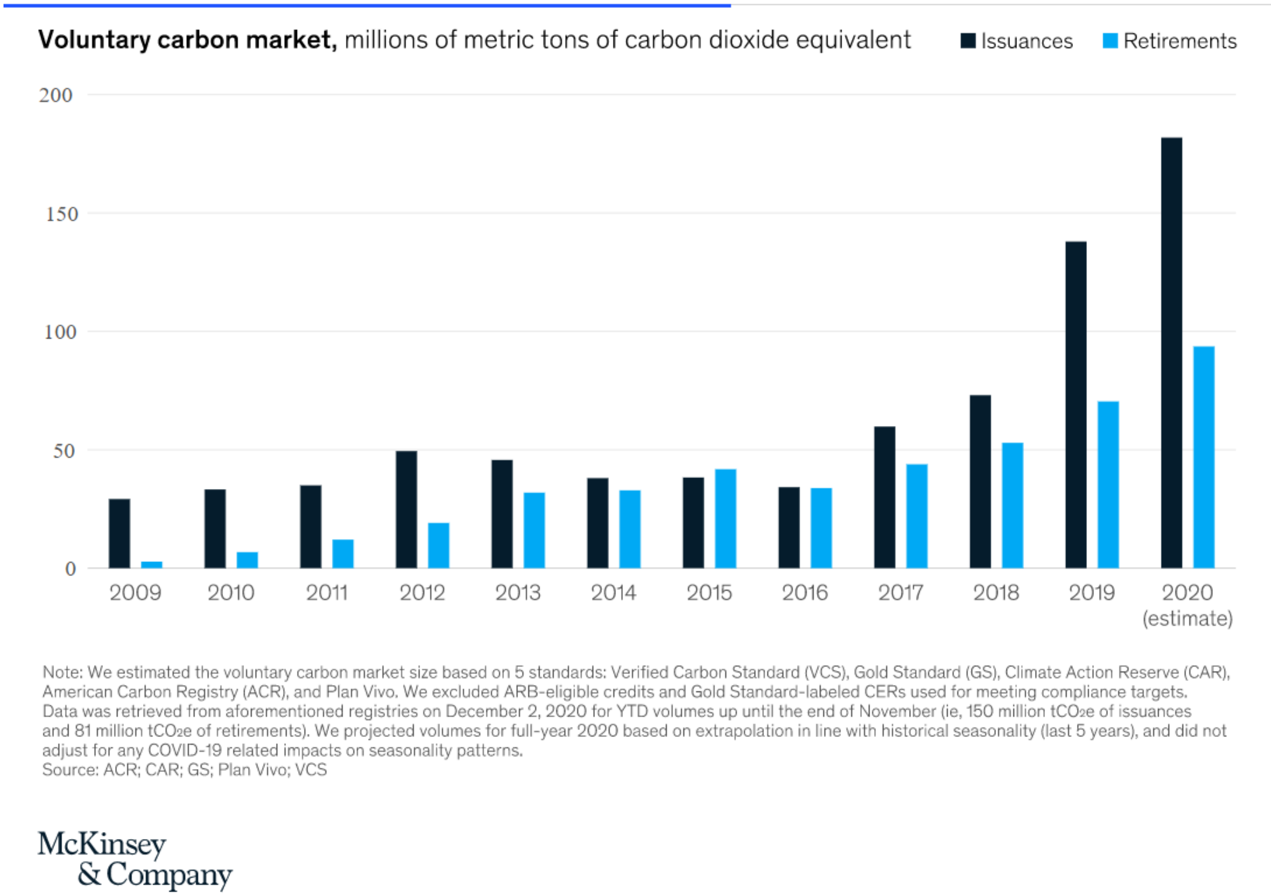


**Figure 1b**. Aggregate carbon credits issued and retired, 2009-2020 (Blaufelder et al., 2020)

However, when measured against total and scope 1 emissions, the reported quantity of credits retired has been minimal since 2010, as seen in Figure 2. Visually speaking, the line for total credits retired is flat throughout the period in question, which demonstrates a significant difference in the scales of credit retirement and emissions being reported. If underreporting is not severe in my dataset, it means that among credit retiring firms, the amount of GHG being offset via carbon credits has been nowhere near the amount being emitted. Random omissions aside, it could also mean that firms are more willing or find it easier to provide public-friendly, standardized data on emissions than carbon credit retirement. Interestingly, following COP21 in November

2015, total reported carbon emissions by known credit retiring firms fell 40% YoY, then shot up 214% YoY in 2017 and do not appear to head back towards pre-2015 level.

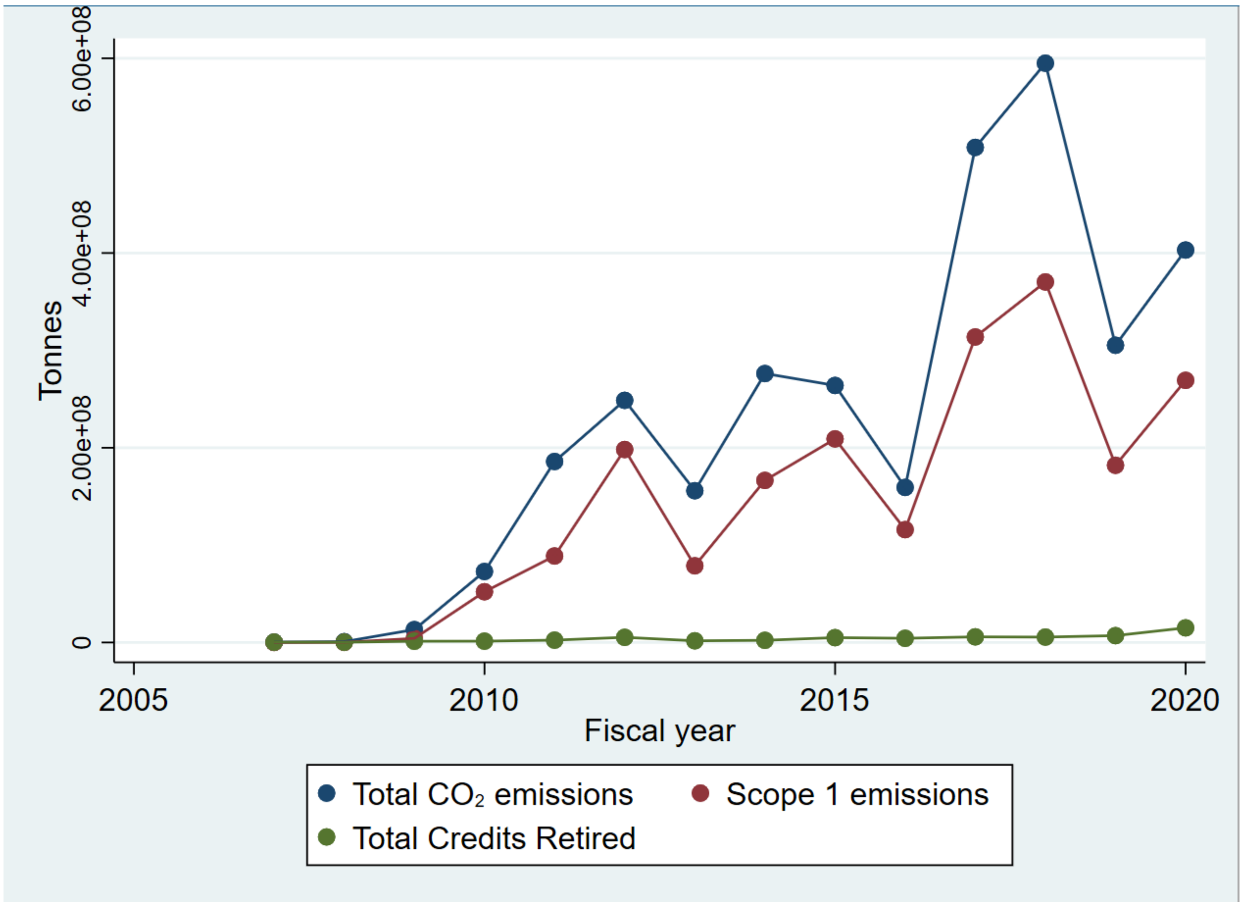


**Figure 2**. Aggregate carbon credits retired and emissions (total and scope 1), 2007-2020

Table 5 explores the correlations between firm-level variables and carbon credit retirement. Since my data is more reliable about whether a public firm retires credits than the actual number of credits retired, I create a dummy variable for total credits retired. Beside total asset itself, Tobin's q, and D/E ratio, I divide financial variables by total asset to make comparisons fair across all firms. I use current total asset as the denominator, except for capex, for which I use previous year's total asset. Despite the relatively low availability of R&D expense data, I include that variable in my correlation studies due to its possible statistical relationship with total credits retired.

**Table 5. Pairwise correlations (all firms)**

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Credits retired dummy | 1.000 | | | | | | | | | | | |
| (2) Total asset | 0.089*** | 1.000 | | | | | | | | | | |
| (3) Cash | -0.042** | -0.017 | 1.000 | | | | | | | | | |
| (4) Tobin's q | -0.017 | -0.200*** | 0.467*** | 1.000 | | | | | | | | |
| (5) ROA | -0.035** | -0.161*** | 0.057*** | 0.463*** | 1.000 | | | | | | | |
| (6) Capex | -0.015 | -0.225*** | -0.095*** | 0.075*** | 0.118*** | 1.000 | | | | | | |
| (7) R&D expense | -0.029 | -0.191*** | 0.651*** | 0.499*** | -0.169*** | -0.064** | 1.000 | | | | | |
| (8) D/E | 0.033** | 0.551*** | -0.051*** | -0.290*** | -0.276*** | -0.104*** | -0.160*** | 1.000 | | | | |
| (9) Total emissions | 0.019 | 0.025 | -0.224*** | -0.184*** | -0.049** | 0.257*** | -0.175*** | -0.004 | 1.000 | | | |
| (10) Scope 1 emissions | 0.016 | 0.009 | -0.204*** | -0.173*** | -0.063*** | 0.239*** | -0.136*** | 0.011 | 0.969*** | 1.000 | | |
| (11) Carbon intensity | 0.017 | -0.069*** | -0.232*** | -0.190*** | -0.108*** | 0.206*** | -0.297*** | 0.048** | 0.677*** | 0.739*** | 1.000 | |
| (12) Scope 1 intensity | 0.016 | -0.053** | -0.197*** | -0.181*** | -0.107*** | 0.200*** | -0.181*** | 0.063*** | 0.660*** | 0.742*** | 0.983*** | 1.000 |

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

Consistent with Bartram et al. (2022) and Xu and Kim (2022), I find a statistically significant negative correlation between cash and total emissions. Meanwhile, D/E ratio does not highly correlate with either total or scope 1 emissions but exhibits mildly positive correlation with carbon and scope 1 intensities. Like Eccles et al. (2014) and Xu and Kim (2022) suggest, firms with better environmental performance (lower emissions and emission intensities) tend to have higher market valuation (Tobin's q) and operating performance (ROA). Interestingly, the dummy variable shows negative correlation with cash (r = -0.042) and ROA (r = -0.035). In addition, it has a positive correlation with asset size (r = 0.089) and D/E ratio (r = 0.033). Tobin's q, R&D expense, and capex do not have a statistical relationship with the dummy variable. Relatedly, Hong et al. (2012) comment on the relatively lesser effect of R&D and capex on the level of corporate goodness. However, whether that points toward a link between corporate goodness and reported carbon credits retired is a matter for further research. Another channel for explaining that lack of correlation, one that does not necessarily contradict Hong et al. (2012), might lie in the fact that multiple industries are present in my sample with very different levels of capital investment or R&D, and a similar variety may be found in credit retiring firms. Meanwhile, there is no statistically significant relationship between the dummy variable and any non-financial variables. These results suggest that larger, less cash-rich firms with lower operating performance and a higher degree of leverage are more likely to have carbon credits retired, notwithstanding their varying level of capital investment, R&D activities, and environmental performance.

Thus, I examine the industry breakdown of carbon credit retirement reported in my data, aggregated across the period 2007-2020. Figure 3 shows that the top two industries reporting credit retirement in my dataset are transportation and finance. As far as environmental characteristics are concerned, these two industries cannot be any more different. Collectively, all credit retiring firms in the transport industry emitted 716.7 million mt$CO_2$ and had a carbon intensity[10] of 428.6 mtCO2/USD million, whereas finance firms only emitted 30.2 million mt$CO_2$ and had a carbon intensity of 6.31 mtCO2/USD million. Therefore, to understand the diverse factors behind public firms' carbon credit usage, I take a closer look at each of those industries' relevant patterns.

[10] Calculated as aggregate sales over aggregate carbon emissions from all firms within the industry across 2007-2020.

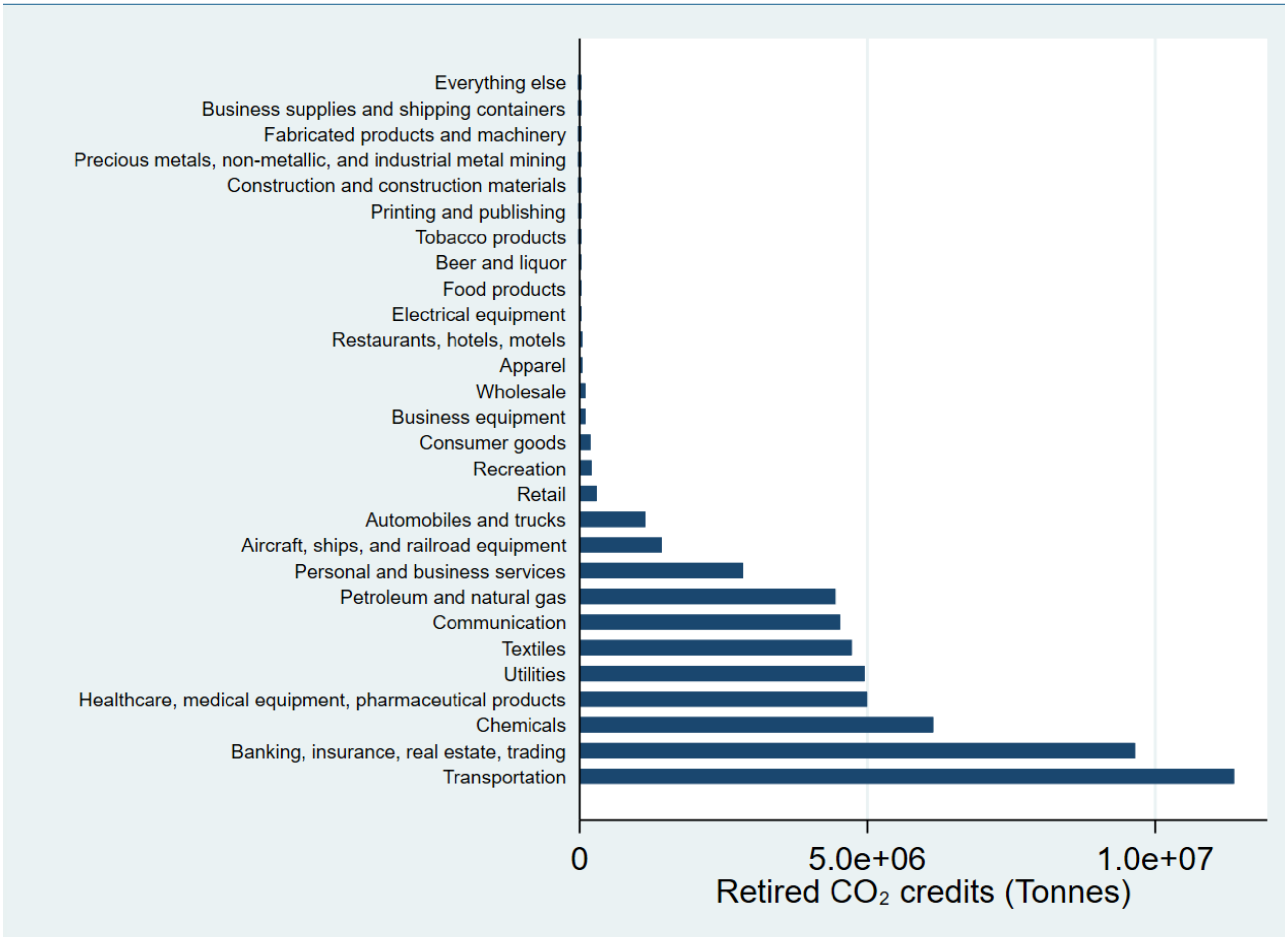


**Figure 3.** Aggregate credits retired between 2007 and 2020, by industry

### 3.2.3. Transportation and Finance: A Tale of Two Industries

Figure 4a shows that, like patterns in the universe of all credit retiring firms in my dataset, reported carbon credits by transport firms did not measure up to total or scope 1 emissions. Apart from the dip in 2013, both types of emissions continued to increase rapidly up to 2015, when COP21 took place in Paris. From 2016 onwards, emissions level seems to have tapered off, then headed back up until 2020, when the first COVID-19 cases were reported in the United States. Meanwhile, as shown in Figure 4b, there seems to be an abrupt growth in the reported quantity of credits retired in 2017. Moreover, the impact of the COVID-19 pandemic is much more noticeable on carbon credit retirement than on carbon emissions.

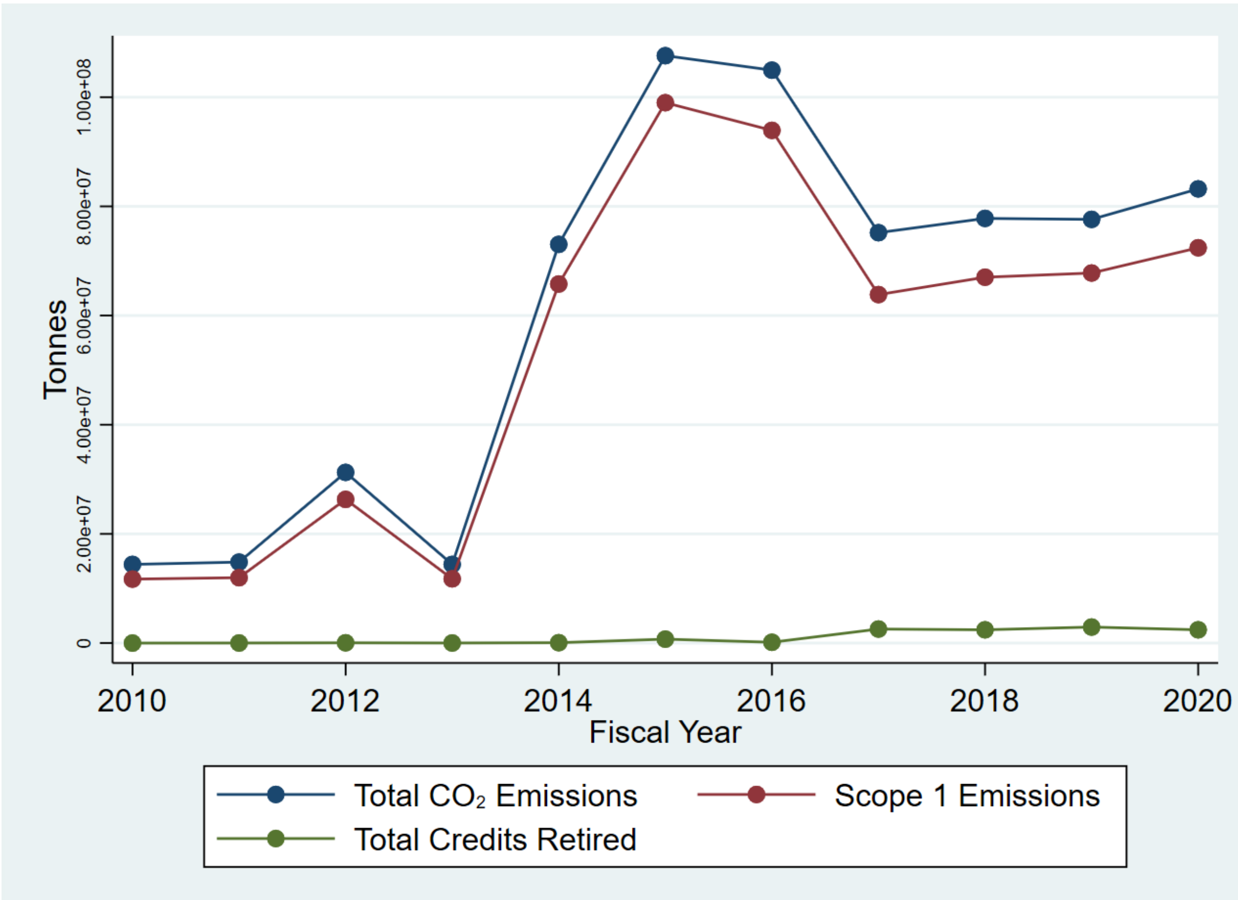


**Figure 4a.** Transport industry's carbon retirements & emissions (total & scope 1), 2010-2020

Interestingly, Figure 4b also demonstrates airlines' dominance in the transportation industry's reported carbon credit usage. The line for the whole industry's carbon credit retirement almost overlaps with that for airlines', except for 2020, when the pandemic placed serious constraints on air travel. A possible explanation for this pattern is that airlines are more willing to disclose their purchase of carbon credits due to an industry-specific initiative, which is discussed in more detail in Section 4. The slope between 2019 and 2020 is steeper for the airline-only line than the industry line, suggesting that the pandemic made a stronger impact on airlines' carbon offsets usage than the rest of the industry's.

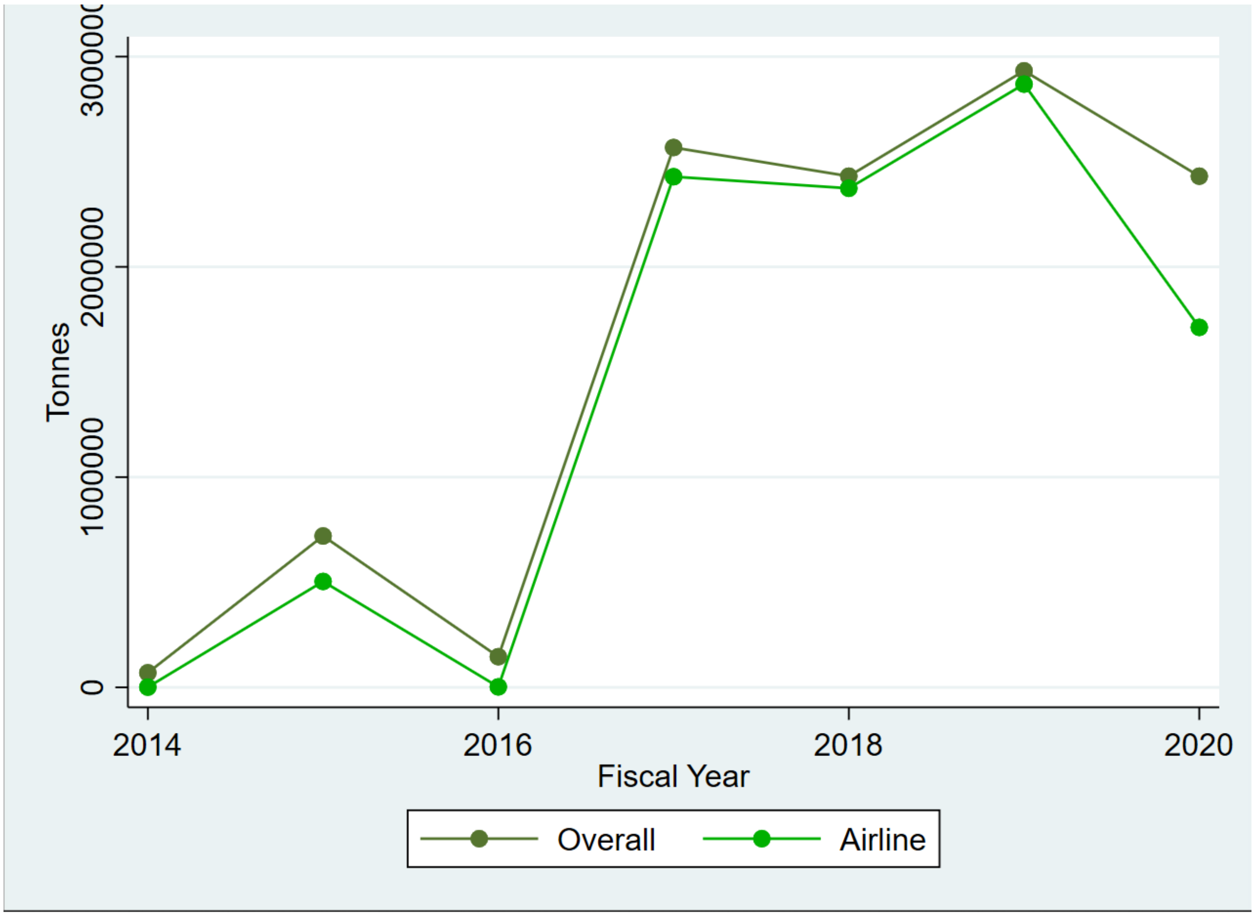


**Figure 4b.** Transport industry's carbon retirements, overall and airline-only, 2014-2020

In contrast with the transportation industry's patterns, during the period 2009-2020, within the finance industry, reported carbon credit retirement consistently matched or exceeded the corresponding scope 1 emissions, as seen in Figure 5a. In fact, it even went above total emissions in 2012. Apart from a spike in the same year, reported carbon credit retirement was relatively stable throughout the period. Likewise, scope 1 emissions were stable throughout the years. Interestingly, they did not move in tandem with total emissions, which is different from the patterns in the transportation industry. One possible explanation lies in the fact that for finance firms, emissions from portfolio companies (financed emissions; scope 3) are over 700 times larger than operational emissions (scope 1 and 2) (Power et al., 2020). As those firms diversify their portfolios, they extend their exposure to industries with different, sometimes contrasting, environmental profiles from their own. Calculating financed emissions proves to be challenging and sometimes impossible (Morgan Stanley, 2022a), thus involving a certain amount of educated guesswork. It is perhaps these factors that cause a noticeable divergence in the patterns of finance firms' total and scope 1 emissions. Note that the Carbon Disclosure Project (CDP), which runs a global reporting system, estimates that only 25% disclosing financial institutions reported their financed emissions in 2020 (Power et al., 2020).

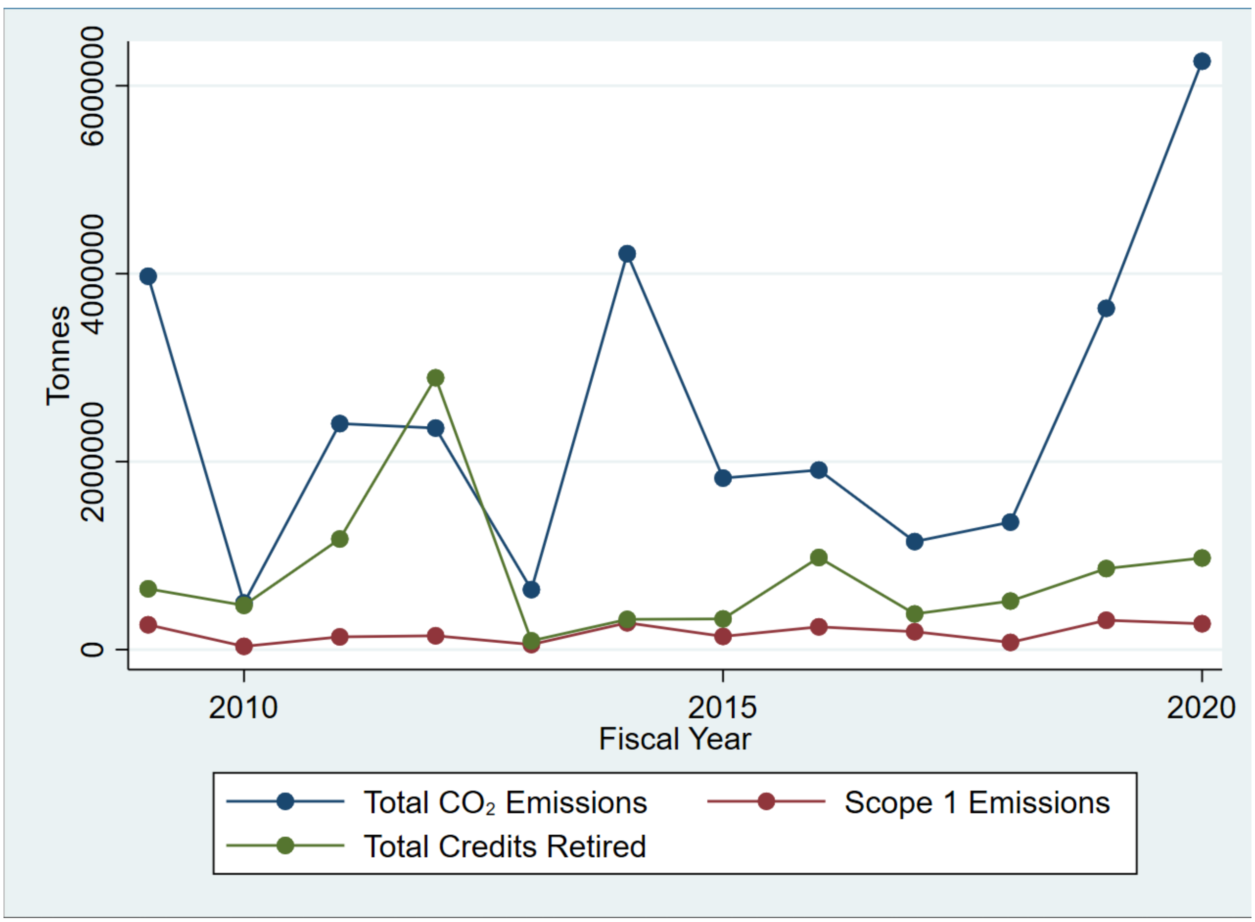


**Figure 5a.** Finance industry's carbon retirements & emissions (total & scope 1), 2009-2020

However, like transportation, the finance industry also sees one sector dominating the reported quantity of credits retired. As seen in Figure 5b, the overlapping of bank-only line with the overall line is even stronger than the case with airlines and the transportation industry. This suggests that among finance firms, banks are the most likely to fully reveal their identities to my data vendors. However, it does not necessarily translate into a willingness to disclose details of carbon offset usage to investors.

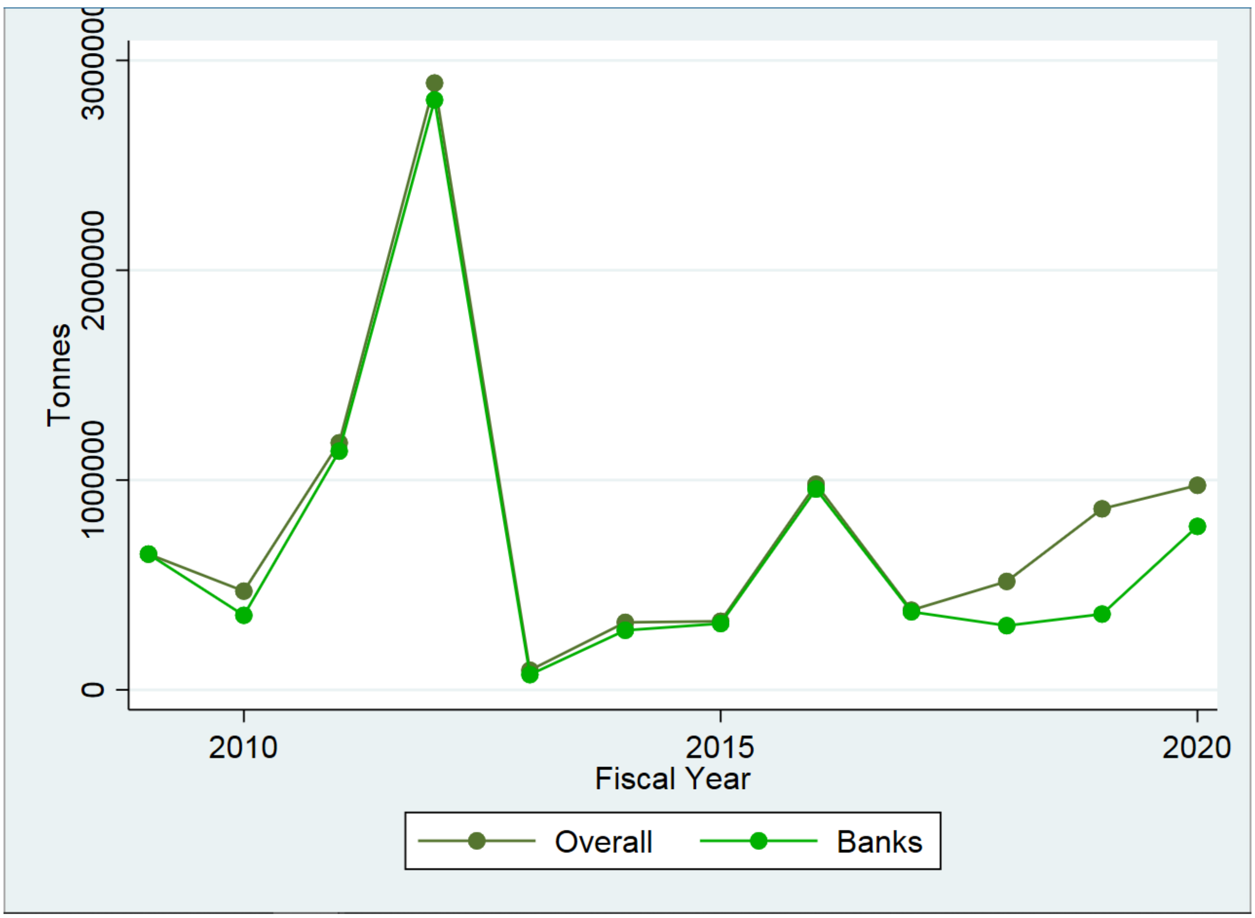


**Figure 5b.** Finance industry's carbon retirements, overall and bank-only, 2009-2020

# 4. Case Studies

To get a glimpse of carbon credits' role in public firms' emissions reduction strategy, I study three airlines (Delta Air Lines, JetBlue, and United Airlines) representing the transportation industry; and three banks (Bank of America, Morgan Stanley, and Wells Fargo), representing the finance industry. I choose them due to their relative openness about carbon credit usage and the interesting differences in how they disclose related information.

All claims, facts, and figures about the firms in this section are sourced from the following investor relations materials, unless stated otherwise: (I) self-disclosed ESG materials ("ESG reports"); (II) responses to the CDP's requests ("CDP responses"); and (III) form 10-Ks. The exact label of (I) varies from firm to firm, and they can come in the form of multiple filings. I find that the most informative source is often ESG reports, followed by CDP responses. The CDP asks comprehensive questions about firms' carbon-related performances and strategies, including those about the governance of carbon-related issues. Firms respond on a voluntary basis and do not have to address all questions. Meanwhile, form 10-Ks are essential in the case of airlines, since those firms are required to participate in an industry-specific global initiative which introduces new compliance costs.

## 4.1. Airlines

***Background information***

In 2016, the International Civil Aviation Organization (ICAO) launched the Carbon Offsetting and Reduction Scheme (CORSIA), which will end in 2035, in an unprecedented move by a single sector to mandate participation in a market-based system for GHG emission mitigation purposes (IATA, 2019). Airlines in 193 ICAO member states are required to keep their emissions to 100% of the 2019 level in the period 2021-2023 and 85% of the 2019 level in the period 2024-2035. If in-sector methods, such as adopting sustainable technologies or ICAO-approved sustainable aviation fuels (SAF), fail to help certain airlines meet that target, those airlines must still comply with CORSIA by buying ICAO-approved carbon credits. The voluntary phase of CORSIA lasts from 2021 to 2026, during which only flights between volunteering member states must be subject to CORSIA. The US is among those volunteers. However, from 2027, the scheme will apply to flights between all member states with certain exemptions for the least developed as well as small island countries. Thus, CORSIA is a major driver behind airlines' consumption of and openness about carbon credits.

Meanwhile, in 2022, Congress passed the Inflation Reduction Act, which includes a 5-year tax credit scheme to scale up SAF production in the US. Eligible SAF blenders can claim tax credits ranging from $1.25 to $1.75 per gallon of SAF that meets certain standards. The idea was first proposed in a 2021 House of Representative bill aptly titled Sustainable Skies Act, which supports tax credits starting at $1.50 per gallon of SAF that results in 50% or less of the GHG emitted by an equivalent amount of regular jet fuels[11]. In addition to CORSIA, these frameworks has lent credibility to SAF and its associated market-based instrument.

Below are profiles of the three airlines I study, in alphabetical order:

<u>Delta Air Lines</u> ("Delta", NYSE: DAL) is based in Atlanta and offers Transatlantic, Transpacific, and Latin America routes with a fleet size of around 1200 aircrafts, approximately 30% of which are operated by regional partners on its behalf (Delta Air Lines, 2022b). It is the largest airline in the US by market capitalization and a global industry leader in brand value.

[11] See Schneider (2021).

JetBlue (NASDAQ: JBLU) is based in New York and serves the US, the Caribbean, and Latin America markets as well as the city of London with a fleet size of just above 280 aircrafts (JetBlue, 2022b). It is the youngest and smallest airline of all three, incorporated in 1998. While being a low-cost carrier, its target segment is middle-of-the-road passengers who are not very price-sensitive or frequent business flyers.

United Airlines ("United", NASDAQ: UAL) is based in Chicago and serves the US, Asia, Europe, Africa, the Pacific, the Middle East, and Latin America markets with a fleet size of over 1300 active aircrafts, nearly 40% of which are operated by regional partners on its behalf (United Airlines, 2022a). Domestically, United relies on its ability to maintain a competitive cost structure while still offering a wide range of flight schedules to both premium and price-conscious customers.

### *Carbon credit usage*

Aviation is commonly considered to be a "hard-to-abate" sector, since applicable decarbonization technologies are either still in early development or too costly to implement on a meaningful scale. Carbon credits, therefore, provide a quick and inexpensive solution. Delta, JetBlue, and United have all made use of these instruments in recent years, each with their own justification. However, both Delta and United have signaled a shift towards other emissions reduction methods, with the latter making a strong statement about reducing 100% of its emissions by 2050 without carbon credits (United Airlines, 2022b).

Out of the three airlines, Delta is the most transparent about carbon credit usage in its ESG reports. It acknowledges the difficulty of CORSIA compliance without such instruments and discusses the type of projects the firm will support going forward. In fact, it makes a point to mention offset projects' names and methods. Unlike JetBlue, which presents carbon credit usage as just another aspect of its business model, Delta presents them as a tool to address current climate challenges, most notably deforestation, and even discloses its membership in the Taskforce for Scaling Voluntary Carbon Markets. It now seems to follow the "negative emissions" route by planning to buy more removal and fewer avoidance and reduction credits, which made up 94% of its 2021 offset portfolio (Delta Air Lines, 2022a). Its rationale is that "direct air capture and carbon sequestration technologies will be necessary" (Delta Air Lines, 2022a). Like United, the major carrier expects to shift its focus onto other emissions reduction methods. However, that shift might happen well in the future, as I find scant evidence of Delta making significant investments in either direct air capture or carbon sequestration innovations or showing clear support for them. Accounting-wise, the airline includes carbon credit purchases in fuel costs and related taxes on its statements of operations (Delta Air Lines, 2022b).

Unlike its bigger peers, JetBlue does not appear to see the need to justify its carbon credit usage. In line with its carbon neutrality initiative, announced in 2020, it has purchased "high-quality carbon offsets" to reduce 100% of emissions from all domestic and transatlantic flights (JetBlue, 2022a). Similar to Delta, JetBlue expenses those credits to jet fuels' costs and related taxes (JetBlue, 2022b). In 2021, it launched a corporate partner membership program, which offers complimentary carbon offsets on all domestic flights. If it is reasonable to assume other costs to remain unchanged, this implies that the low-cost carrier has been passing offset costs to other customers to preserve its profit margin. Interestingly, JetBlue is one of the two firms in my case studies which set a more ambitious target than the Paris Agreement's requirements (the other firm being Bank of America). It aims to achieve net-zero status in 2040, ten years before the global deadline.

United purchased a certain number of offsets in 2019 and 2020 as part of a discrete promotional program prior to its renouncement of those instruments in December 2020 (United Airlines, 2022b). It reiterates its focus on in-sector emissions reduction methods, as opposed to out-of-sector ones like carbon credits in all disclosure materials in very strong and clear language. To understand United's resolute stance on carbon credits, I find it essential to survey other emissions reduction methods and to see how the other two airlines fit carbon credit usage into their overall emission reduction strategy.

### ***Other common emissions reduction methods***

Apart from carbon offsets, the most common alternative methods to reduce emissions are fuel optimization, fleet renewal, and technological investments, among others. These methods are not mutually exclusive and may all improve airlines' finances in one way or another.

Fuel optimization is the most straightforward option to translate emissions reduction efforts into greater profit as it helps airlines reduce a significant portion of their costs. In fact, jet fuels accounted for roughly over 20% of all three airlines' 2021 operating expenses (Delta Air Lines, 2022b; JetBlue, 2022b; United Airlines, 2022a). As a result, it appears to be a mutual favorite method among the three airlines. Both Delta and United claim that conserving fuels is crucial to the achievement of carbon-neutral status in their CDP responses (Delta Air Lines, n.d.; United Airlines, n.d.). JetBlue identifies it as one of the six key levers to achieve decarbonization and touts its new, fuel-efficient fleet as one of its competitive advantages (JetBlue, 2022b).

Fleet renewal is also highly relevant to airlines' finances. Newer aircrafts often come with greater fuel efficiency, which complements the fuel optimization strategy in the long run. Delta estimates that in meeting its pending SBTi target in 2050, between 21% and 24% of its projected emissions mitigation will be attributable to fleet renewal (Delta Air Lines, 2022a). JetBlue has an ambitious plan to replace all E190 aircrafts, which makes up about 14% of all aircrafts under its ownership, with more efficient models by 2025 (JetBlue, 2022a). Meanwhile, as part of its ESG reports' section on *fuel efficiency*, United declares its pending purchase of nearly 300 narrow-body aircrafts, which it expects to both increase fuel optimization and lower carbon emissions (United Airlines, 2022b). Therefore, it is helpful to consider fleet renewal to be an extension of fuel optimization. However, it differs from pure fuel optimization methods in that it requires major capex, which exacerbates financial constraints in loss-making airlines.

Unlike fuel optimization and fleet renewal, technological investments seem to be the area where the three airlines differ on a strategic level. While all three have championed promising decarbonization innovations, such as direct air capture technologies, United stands out in its vocal support for SAF-related technologies. In light of CORSIA requirements and projected booming demands for carbon credits in the next decade (Blaufelder et al., 2021), getting a good deal on SAF would likely help airlines control CORSIA compliance costs in the medium and long term. As it stands now, SAF production has neither caught up with airlines' current demand nor JetBlue and Delta's commitment to source 10% of their fuels from sustainable sources and United's 5% commitment by 2030 (Delta Air Lines, 2022a; JetBlue, 2022a; United Airlines, 2022a). While Delta and JetBlue are mostly focused on offtake deals with SAF producers or partnerships with corporate customers to fund SAF production together, United has poured $30 million into Fulcrum BioEnergy in return for an equity stake and a long-term supply agreement (United Airlines, 2022a). By investing early on, United appears to be vying for an advantage over other competitors on a major source of operational expense. United has especially been active at SAF promotion in other ways as well. In  February 2023, through its corporate VC arm, the firm launched the Sustainable Flight Fund, which ask customers to contribute a token amount of money to pay for future SAF purchase agreements and production when booking their flights. Unlike traditional offset programs, it does not claim to offer carbon footprint reductions in return. On the lobbying front, United has worked closely with US lawmakers to put forward the Sustainable Skies Act (United Airlines, 2022a) and is a founding member of the Sustainable Aviation Buyers Alliance, alongside JetBlue and two other aircraft operators.

### ***SAF certificates: potential competition to carbon credits?***

Nevertheless, due to high costs and low availability, actual usage of SAF remain a medium to long term solution for airlines. As of 2021, only two commercial SAF plants have been in operation across the world, meeting 0.01% of the global demand for jet fuels (WEF et al., 2021). Interestingly, the COVID-19 pandemic has provided airlines with an unexpected opportunity to get their clients to fund SAF purchase and development. According to JetBlue, corporates are seeking ways to offset their employees' business travel emissions (scope 3) as pre-pandemic conditions resume (JetBlue, 2022a). The pandemic enabled many firms to achieve substantial emissions reduction in 2020 and 2021 and investors may expect firms to lower carbon footprints even further or at least stay close to that baseline. As carbon-neutral target deadlines are looming, corporate customers have shown interests in paying extra for SAF to reduce their emissions (WEF et al., 2021).

Since SAF is drop-in ready and often mixed with conventional fuels in current aircrafts in practice without any known technical and safety concerns, buying SAF certificates will give corporate customers the rights to claim SAF usage without necessarily being on SAF-powered flights and to offset their business travel emissions (scope 3). At the same time, airlines get to claim scope 1 reduction through "certified" usage of SAF. A Word Economic Forum's Clean Skies Tomorrow initiative report finds anecdotal evidence of corporates' willingness to bear an extra 5-

10% costs in airline tickets in return for emission reduction (WEF et al., 2021). Six US airlines have joined that initiative to support a market for this new instrument, including all three firms being discussed here. In fact, JetBlue has already been offering SAF certificates for selected corporate partners (JetBlue, 2022a).

As SAF certificates were still in their pilot stage in 2021, it is uncertain whether it will complement or compete against carbon offsets as the market-based environmental instrument of choice. On the one hand, SAF certificates appear to be more standardized than carbon offsets[12], which makes it easier to justify their usage to external stakeholders. On the other hand, given their niche relevance to aircraft operators and air travelers, their appeal is likely to be limited even in the long term. However, SAF certificates seem to have generated interest from a few major corporations already, including Shell and Boston Consulting Group[13], making them the market-based environmental instrument to watch in the upcoming years.

***Executive-level incentives for management of climate-related issues***

Unlike its two larger peers, JetBlue is explicit about setting ESG-linked compensation for its executives. It claims to have developed an ESG index using emission reductions and SAF volume as the metrics on which leadership payouts are based (JetBlue, n.d.). The firm also claims that similar metrics map out to its long-term incentive plan and and are connected to its short-term and medium-term ESG goals (JetBlue, n.d.). Interestingly, JetBlue stands out as the only one which does not attempt to trace financial success to better environmental practices in its CDP response.

Meanwhile, both Delta and United tie executive pay to financial success alone, which they claim to come from better environmental practices. However, if I am to take the wording of their

[12,13] See WEF et al. (2021)

answers to CDP's questions about management incentives at face value, the crucial difference lies in the fact that Delta identified better use of fuels, both through saving them and improving their efficiency, as the single emission-related cost-cutting measure (Delta Air Lines, n.d.), which is already a prevailing idea among airlines, whereas United lists reducing GHG emissions and fuel saving separately (United Airlines, n.d.). The intuitive explanation is that United goes the extra mile to insert emissions reduction into its answer about management incentives to make itself more appealing to emission-conscious customers and investors. At the same time, it might be a reach to say that Delta's compensation structure does not reward emissions reduction achievements. If anything, the two airline's CDP responses only showcase different publicized strategic goals for their executives and just one part of their compensation structures, all of which are likely to be written with climate-conscious policymakers and investors in mind. Nevertheless, United's CEO is held responsible as the key decision-maker on the firm's multiple investments in decarbonization technologies (United Airlines, n.d.). Therefore, even if United does not reward emissions reduction achievements per se, the success of such investments almost certainly factors in the CEO's compensation.

## 4.2. Banks

***Background information***

In 2021, 43 banks, including Bank of America and Morgan Stanley, signed the commitment to join the UN's Net-Zero Banking Alliance (NZBA), whose goal is to channel the finance sector's resources into decarbonizing the real economy. NZBA membership has expanded to 126 banks by early 2023. The alliance emphasizes portfolio/financed emissions reduction as a major way finance firms can contribute to a net-zero future. Signatories pledge to set the first interim target in 2030, then a new one every five years, and one long-term target for 2050. At the time of writing, only emissions from on-balance sheet investment and lending activities are required to be included in banks' total emissions, while emissions from off-balance sheet activities are pending consideration. Signatories are also encouraged to set GHG reduction targets for their portfolios with priorities given to the most carbon-intensive sectors. Examples of those sectors are agriculture, coal, oil and gas, transportation, among others. With regards to carbon credits, NZBA recommends due diligence over clients' claims and encourages limiting their usage to only removal credits in case of "limited technologically or financially viable alternatives to eliminate emissions" (UNEP-FI, 2021).

Below are profiles of the three banks I study, in alphabetical order:

Bank of America (NYSE: BAC) is in Tier 3 of global systematically important banks. It is in the top 5 largest US banks by market capitalization. Its four reportable operating segments, in descending order by 2021 net income, are Consumer Banking, Global Banking, Global Markets, and Global Wealth & Investment Management (Bank of America, 2022b).

Morgan Stanley (NYSE: MS) is in the top 5 largest US banks by market capitalization. Its three reportable operating segments, in descending order by 2021 net income, are Institutional Securities, Wealth Management and Investment Management (Morgan Stanley, 2022b).

Wells Fargo (NYSE: WFC) is in the top 5 largest US banks by market capitalization. Its four reportable operating segments, in descending order by 2021 net income, are Consumer Banking and Lending, Commercial Banking, Corporate and Investment Banking, Wealth & Investment Management, and Corporate (Wells Fargo, 2022b).

### ***Carbon credit usage***

Since portfolio emissions account for the overwhelming majority of finance firms' emissions (Power et al., 2020), much of banks' emissions reduction strategy involves client advisory and portfolio adjustments. It is in their interests for borrowers and portfolio firms to use carbon credits, as long as those credits meet NZBA's guidelines. However, since those guidelines are only recommendations, banks have plenty of discretions about what advice to offer to their clients on these instruments. Thus, banks' involvement with carbon credits is typically more nuanced than firms in other industries. Within the scope of my research, I focus more on credits purchased by the banks themselves than on the related advisory services they offer.

In terms of transparency, Bank of America truly stands out in the type of information it discloses. It reports the specific types of emissions being offset with carbon credits and details about offset projects they are buying from, including name and country of origin. As part of its goal to maintain operational carbon neutrality, the bank has matched credit retirement with 100% of scope 1 and market-based scope 2 emissions since at least 2019 (Bank of America, 2022a). Since 2020, it has also matched 100% business travel emissions with carbon credit retirement (Bank of America, 2022a). Therefore, in Bank of America's case, the strongest predictor of carbon credit purchases is its operational GHG emissions. Its aggressiveness in this regard might stem from an ambitious commitment to reach net-zero status before 2050 (Bank of America, 2022c), which is beyond the Paris Agreement's requirements. It is the only bank to mention "environmental justice benefits" (Bank of America, 2022c) as a priority in choosing what credits to buy.

Meanwhile, Wells Fargo's approach to carbon credits is similar to Bank of America's on offset reporting. Interestingly, both banks started achieving operational carbon neutrality as early as 2019 by heavily relying on carbon credits. In Wells Fargo's case, carbon credits purchased even exceeded total scope 1 and market-based scope 2 emissions in the period 2019-2021. However, I cannot find specific details about the nature of those credits or any justifications from Wells Fargo about its reliance on such instruments in its ESG reports.

Morgan Stanley stands out as the only bank in my case studies to *not* report a specific number of carbon credits or the emission scopes being offset with such instruments. Although Morgan Stanley shares an operational carbon neutrality target with its other peers, to be reached by 2022, it only mentions carbon credits in passing among the list of current emission methods. Its efforts appear to be more channeled into renewable energy instead.

***Renewable energy and renewable energy certificates: the preferred alternatives?***

Both Wells Fargo and Morgan Stanley seem to be more invested in renewable energy as a GHG emission reduction method than carbon credits, despite their different disclosure approaches. Meanwhile, Bank of America does not prominently display details of its renewable energy usage in its ESG materials. Interestingly, although Bank of America fully discloses that 100% of its market-based scope 2 emissions have already been offset by carbon credits, it does not discuss the way it reduces location-based scope 2 emissions with equal transparency.

In most cases, location-based scope 2 emissions generated by electricity usage are significantly larger than that calculated under market-based method. Using Wells Fargo as an example, I calculate that difference to be as large as 567,841 $mtCO_2$ in 2021, which matches up exactly with the discrepancy between location-based and market total scope 2 emissions (Wells Fargo, 2022a). This is because the location-based method factors in average emissions from the local grid, regardless of firms' renewable energy contracts. In addition, since electricity can come from a mix of both conventional and renewable sources, it would be hard for firms to make claims of renewable energy usage. The solution to both issues comes in two forms. Banks can secure power purchase agreements with renewable energy producers which will supply them with renewable energy certificates (RECs) on top of actual renewable energy. These agreements offer bundled RECs. Alternatively, they can buy unbundled RECs to claim renewable energy usage without changing their current electricity consumption patterns. Unbundled RECs increase firms' electricity costs, whereas that is not necessarily the case with bundled RECs because there might be discounts coming with signing a power purchase agreement.

Wells Fargo makes extensive use of unbundled RECs to meet its target of 100% renewable energy usage and does not hide that fact. In 2021, unbundled RECs accounted for about 96.2% of Wells Fargo's reported renewable energy usage. Meanwhile, consistent with its approach to carbon credits disclosures, Morgan Stanley does not discuss its use of RECs in detail. However, it mentions signing a power purchase agreement with Akuro Energy to get electricity from an Illinois-based wind farm and the associated bundled RECs. The bank claims that the agreement would result in a 30% reduction of its carbon footprint once in full effect (Morgan Stanley, 2022a). If this happens to be the case, it leaves 70% of Morgan Stanley's operational emissions (scope 1, 2 and business travel) to be managed with other emissions reduction methods, such as self-supplied renewable energy, carbon credits, and unbundled RECs. Therefore, for both Morgan Stanley and Wells Fargo, market-based instruments will continue to play a key role in meeting their emissions reduction targets.

### ***Executive-level incentives for management of climate-related issues***

Among the three banks, Bank of America is the only one that directly mentions environmental metrics as among the criteria for executive performance evaluation. These metrics are said to be focused on progress toward its $1.5 trillion Sustainable Finance commitment and Net Zero Goal (Bank of America, 2022c), without little further detail. Note that Bank of America is the also most proactive in disclosing carbon credit usage. These two surface-level observations suggest that Bank of America takes the most aggressive stance in presenting itself as an ESG-minded firm, compared to Morgan Stanley and Wells Fargo.

Morgan Stanley has a executive position dedicated to ESG matters called Chief Sustainability Officer, who oversees both for sustainable investing and operational emissions reduction. I find it reasonable to assume that this position's pay is dependent on certain sustainability targets being met. However, I cannot determine the weighting given to emissions reduction specifically or whether the metrics are quantitative in nature. Given Morgan Stanley's focus on corporate advisory and investment services, there might be greater emphasis on reducing financed emissions than operational emissions, with the latter being more pertinent to this paper's topic. Each type of emissions is under the management of a separate division within the bank, both reporting to the Chief Sustainability Officer.

On paper, Wells Fargo's approach appears to be different from Bank of America's and Morgan Stanley's. The language of its 2022 CDP response gives the impression that the bank's management is expected to monitor climate-related issues as just another part of risk asssesment, as opposed to a conscious shift towards the adoption of ESG values. It is unclear whether Wells Fargo is fundamentally different from its two peers in this regard. However, the noncommittal wording of its CDP response reveals a lesser emphasis on ESG branding relative to the other banks.

## 4.3. Discussion

In both aviation and banking, recent legal frameworks and industry initiatives are the catalysts of carbon credit usage. Except for United Airlines, all firms here have embraced carbon credits as a key part of their net-zero tool kit. The most crucial difference between these two industries is the nature of their business operations, and the ways firms in either of these industries present carbon credits in their investor relations materials reflects that fact. Consistent with the greater materiality of carbon offsets to airlines' bottom lines, information about those instruments can be found in their Form 10-Ks, while banks only discuss that in their ESG reports, if at all. Delta and Bank of America, both being industry leaders, adopt more ESG-oriented language to disclose their carbon credit usage. JetBlue does not even attempt to justify carbon credits, while United goes the extra mile to distance itself from them in favor of SAF and SAF certificates. Neither Morgan Stanley nor Wells Fargo discuss carbon credits in detail, perhaps due to their focus on renewable energy.

The presence of SAF certificates and RECs complicates the long-term demand for carbon credits. SAF represent a more sustainable solution for airlines, both financially and environmentally, and the associated certificates might help scale up SAF production to the point of commercial viability before 2050. Similar reasonings may be applied to renewable energy and RECs. As a result, even financially constrained firms might be more interested in these alternative market-based instruments than carbon credits.

Interestingly, despite being known as a "hard-to-abate" sector, airlines do not tend to reward emissions reduction achievements at the executive level. This seems to be inconsistent with Cohen et al. (2022), who find that firms environmentally controversial industries are more likely to link ESG performance to executive pay. In addition, from my observations, firms that draw attention to the role of environmental metrics in their executive pay mix and set more ambitious net-zero targets (i.e., Bank of America and JetBlue) might be more aggressive in their carbon credit usage. Aggressiveness can be measured by the quantity of carbon credits retired relative to emissions rather than absolute quantity of carbon credits retired. However, I do not assert a causal relationship between ESG weighting in executive compensation structure and carbon credit aggressiveness. It is likely that both variables are two sides of the same coin. As Cohen et al. (2022) suggest, firms with environmental pledges and higher ESG ratings are more likely to have ESG criteria in executive compensation contracts. Carbon credit aggressiveness is perhaps one way for firms to adhere to their environmental pledges and/or achieve better ESG ratings. However, given my very small case studies sample with obvious selection bias and the constraints on my data, a more systematic study into the quantity of carbon credits purchased and executive pay mix would result in clearer and more robust findings.

# 5. Conclusion

My paper presents an overview of public firms' involvement with carbon credits through quantitative analysis and case studies. I find evidence of positive correlations between financial constraints in the form of lower cash holdings and higher leverage ratio and a public firm's likelihood of carbon credit usage. These firms also tend to have larger asset bases and generate lower returns on them. Interestingly, environmental metrics like emissions or emission intensities do not appear to correlate with carbon credit usage. This is corroborated by the fact that the top two credit retiring industries in my data are transportation and finance, whose environmental characteristics are very different. Due to unexpected constraints being placed on the data collection process, I do not attempt to reach any conclusions about the quantity of carbon credits retired. A larger-scale study with more robust data and empirical tools is needed both to verify my findings in this paper and to establish causal relationships. From my case studies, I speculate that executive pay mix and carbon credit usage aggressiveness are related. However, the exact nature of that relationship also needs to be subject to further research.

Given the ambiguous[14] nature of carbon credits, I do not assert any claims about their effectiveness as an emissions reduction tactic. However, as Florida is facing more challenges[15] from climate change, a better understanding of carbon credits and its role in public firms' emissions reduction strategies may be helpful to anyone concerned. My work can inform Floridian policymakers, businesses, and investors about market-based environmental instruments, which will potentially have a key role in meeting the state's climate challenges.

[14] See Calel et al. (2021) and Lovell et al. (2009).
[15] See Butler et al. (2016) and McAlpine & Porter (2018).

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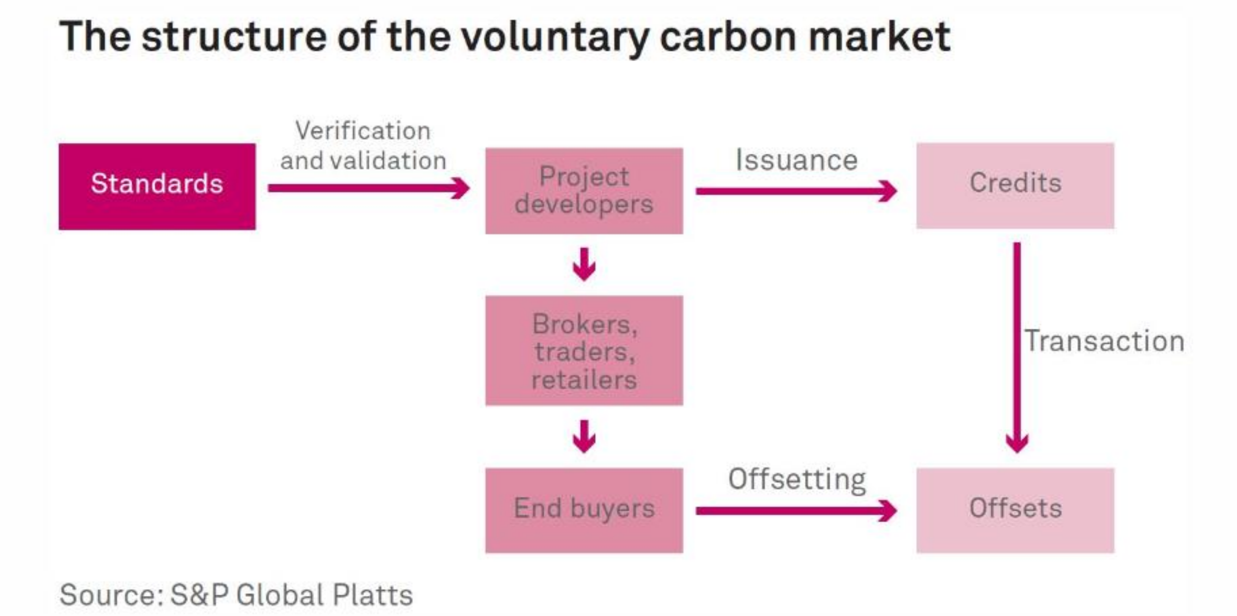
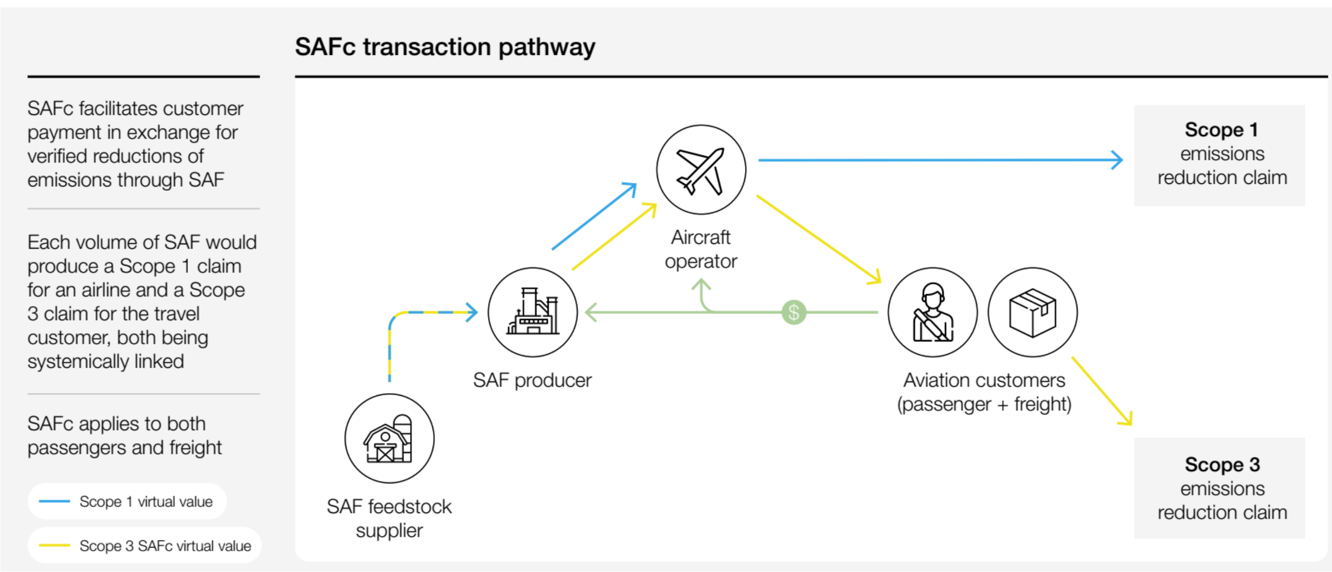
# Appendix: The Paths of Market-based Environmental Instruments

## Carbon credits (offsets)

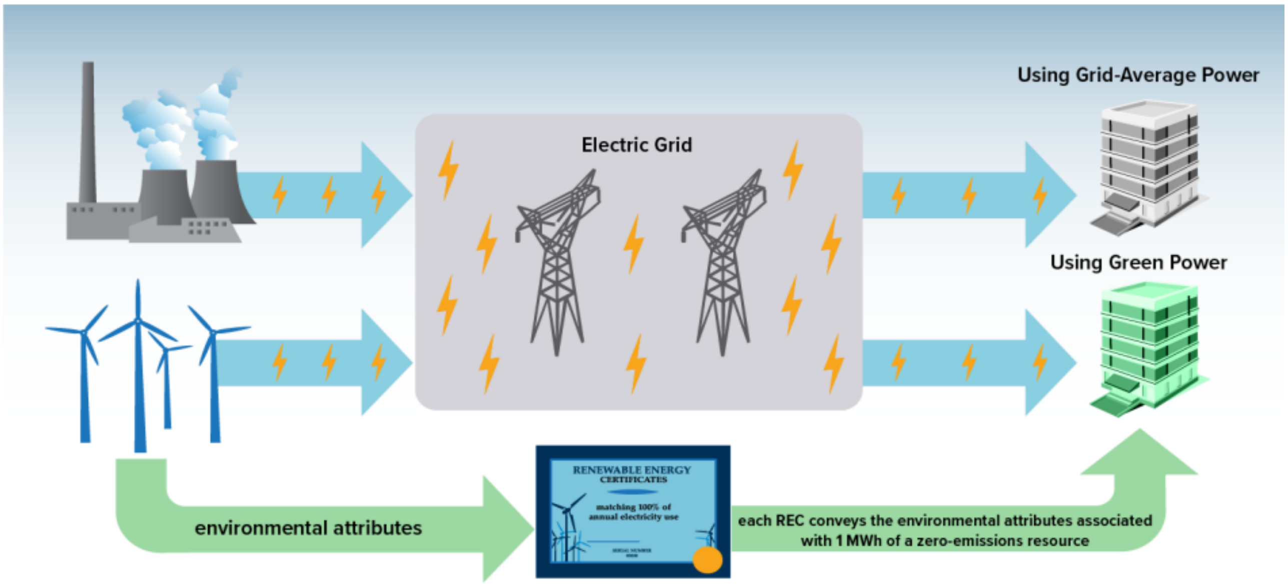



## Sustainable aviation fuel certificates (SAFcs)




Source: World Economic Forum

**Bundled renewable energy credits (RECs)**




Source: United States Environmental Protection Agency