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German Index Engineering

A guide to carbon emission impact on equities

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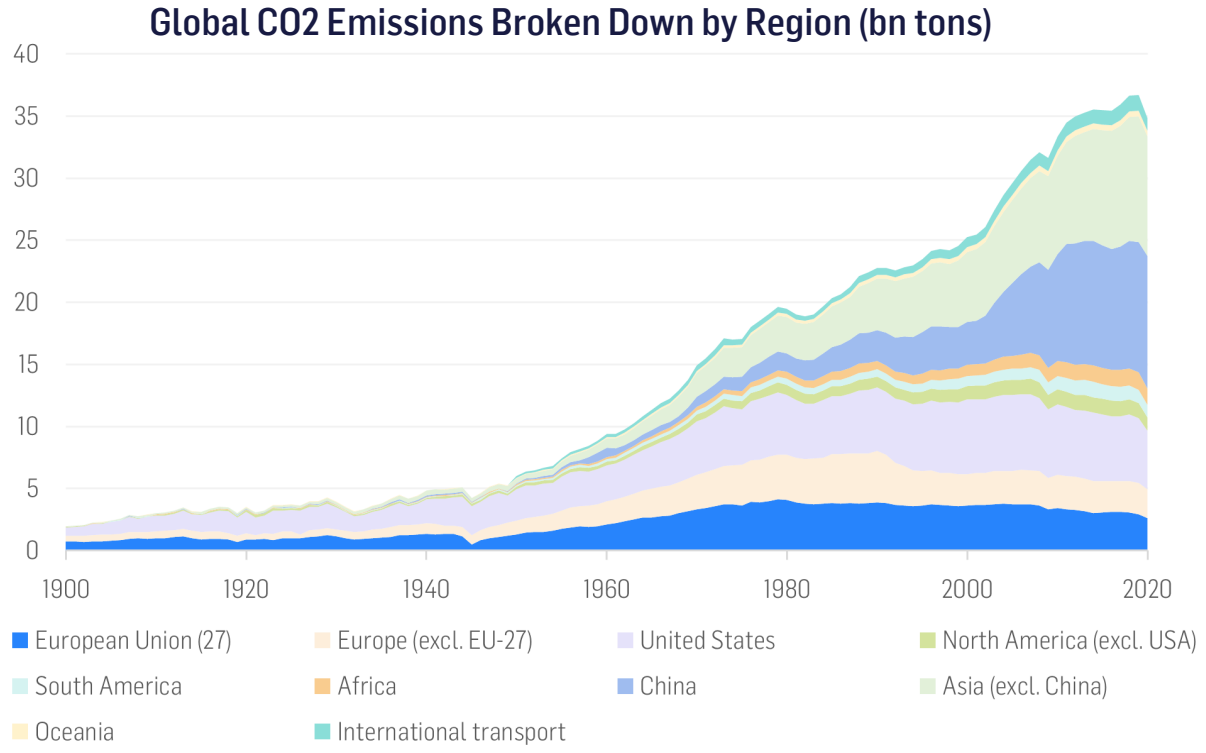
What is the EU Emission Trading System?

Global CO2 emissions are at dangerously high levels – rising from less than 2 billion tons of emissions per year in 1900, to a pre-covid high of almost 37 billion tons in 2019. The geographic distribution of this dramatic increase has tended to follow economic activity: concentrated in Europe and the US at the beginning of the 20th century, and shifting East as Asia has become more industrialized. [1]

Nevertheless, rising temperatures have made decarbonization a pressing issue for major economies worldwide. Nowhere can this trend be seen more clearly than in the European Union. Since the turn of the century, EU emissions have shrunk by 28% – leading the world in its path towards a Paris-aligned future. [1]



Source: Global Carbon Project

Even though the bloc's (still ongoing) decarbonization may have happened to a certain degree due to production moving offshore, European institutions and legislation have designed multiple policies and mechanisms intended to reduce carbon emissions locally. One such mechanism is the European Union Emissions Trading System (EU ETS).

The EU ETS is the world's largest carbon market. It is a cap-and-trade system launched in 2005, whose primary goal is to cost-effectively reduce greenhouse gas emissions across Europe. As of 2022, all EU member states, as well as Iceland, Norway, and Liechtenstein are participating in the system (the UK left it in 2020 as a consequence of Brexit). [2]

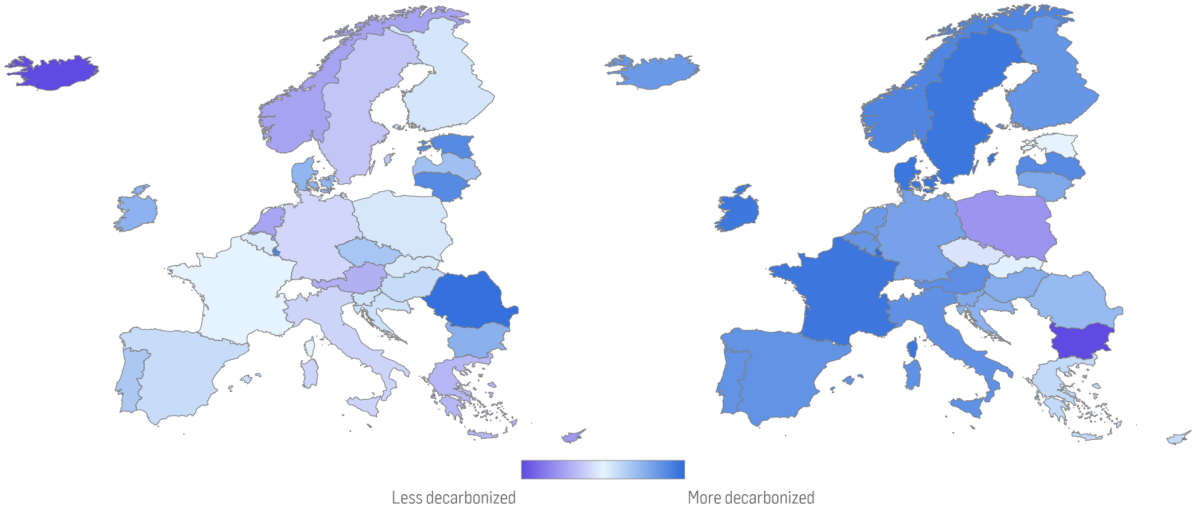
Under this system, companies operating energy-intensive installations, as well as those involved in European aviation, have to acquire a capped quantity of EU Emission Allowances (EUA's) for free or through auctions. An EUA allows its holder to emit one ton of CO2. Every year, companies must surrender a number of allowances corresponding to their amount of emissions during the previous year. Companies that do not surrender their required number of EUA's on a timely manner must pay an inflation-linked fine (set at EUR 100 per excess ton of emissions in 2013[3]), on top of submitting their missing allowances. Participating members in the system can then either bank or trade non-surrendered EUA's.

According to European Environment Agency data, aggregate CO2 emitted from participating countries (excluding the UK) fell by 37% between 2005 and 2021. Remarkably, when accounting for economic growth, participating countries' carbon emissions to GDP ratio fell by 56% over the same period. [4] This sharp decline has been most pronounced in relatively heavy carbon emitting countries at the inception of the system. Eastern Balkan and Baltic countries, led by Romania, are among the ones whose economies

have grown most carbon-efficiently since 2005 – whereas the opposite is the case for countries that were comparatively green in 2005, such as Iceland, Norway, and the Netherlands.

Decarbonization Rate of EU ETS Participants' Economies

Carbon Intensity of EU ETS Participants' Economies (2021)



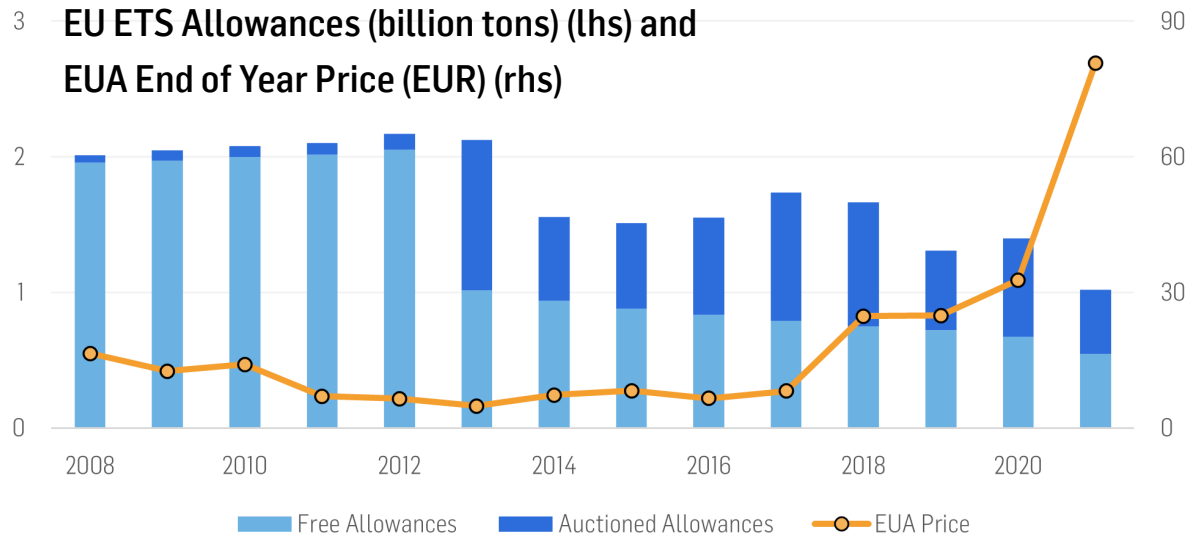
Source: European Environment Agency, the World Bank, and Solactive

As time has passed, the ETS's requirements have become more stringent and widespread across different industries. Additionally, its mechanisms have progressively become more and more sophisticated. Four distinct phases encompass the system's history: [5]

- **Phase 1** (2005-2007) was a "learning by doing" period in anticipation to Phase 2. During this period, allowances were (mostly) given out for free and it wasn't possible to carry over excess EUA's to the next phase.
- **Phase 2** (2008-2013) coincided with the first commitment period of the Kyoto Protocol.
- **Phase 3** (2013-2020) relied more heavily on auctioning as an allocation mechanism (rather than allocating EUA's free of charge).
- **Phase 4** (2021-2030) is currently in operation. In this phase emission allowances are expected to be reduced at a faster clip than previously.

Ever since its inception, EUA prices have experienced multiple periods of high volatility. Among these time windows is 2006, when EUA prices crashed significantly in response to its participants' first publication of verified emissions, as well as the years following the Great Financial Crisis and the Euro Crisis – due to a lower degree of industrial activity reducing the need to surrender allocated allowances (which in turn increased the number of banked EUA's and dampened the need to buy new ones).

However, a myriad of factors, such as a decreased supply of EUA's and soaring gas prices raising the attractiveness of coal, have caused the price of EUA's to rise sharply since the beginning of the current decade (peaking at over EUR 98 in August 2022).



Source: European Environment Agency, FactSet, and Solactive

Multiple sources of pressure could potentially bid up EUAs' value moving forward. On the supply side, the Market Stability Reserve is expected to diminish EUA auction sizes over the remainder of the decade. On the demand side, sustained exorbitant gas prices in Europe may increase the necessity to use carbon intensive sources of energy across the region.

Furthermore, the proposed Carbon Border Adjustment Mechanism (CBAM) currently being legislated in the EU – intended to disincentivize carbon leakage – would represent an additional carbon-related stressor for companies exporting goods to Europe. If approved, exporters of carbon-intensive products would have to pay a tariff linked to the price of EUA's (proportional to the emission intensity of products imported into the EU). [6]

For interested readers, our strategic partner SparkChange provides a more in-depth report covering the history, structure, and additional details of the EU ETS. [7]

Introducing CarbonAlpha by SparkChange

Due to the aforementioned headwinds, both corporates and investors should be increasingly willing to factor in carbon costs into their decision making processes when valuing companies.

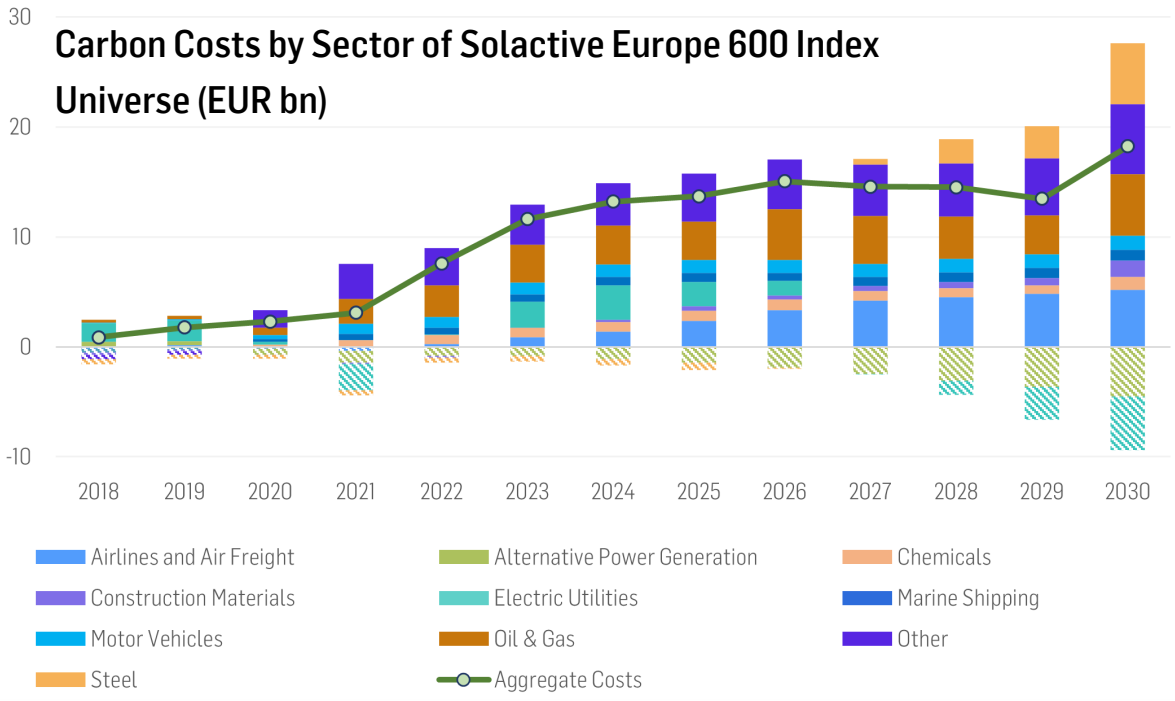
Against this backdrop, SparkChange has developed CarbonAlpha: a model designed to quantify and forecast the carbon-related profits-and-losses (P/Ls) of companies across multiple sectors. Currently, historical and forecasted P/L data is available for around 6,000 companies including those in the Solactive Europe 600 Index.

The model is based on a robust framework developed in collaboration with leading academics and relies on relevant proprietary and third-party data (regarding corporate emissions, carbon positioning, and fundamentals, among others).

Through these pillars, CarbonAlpha estimates carbon-related corporate P/Ls tied to EUA compliance requirements. The model is able to measure this financial impact by integrating variables such as Scope 1 and Scope 2

emissions, CBAM costs, and the ability of corporates to pass on carbon costs to customers – as well as to country-specific energy market dynamics. Estimations are currently available for a time window starting in 2008 and ending in 2030.

According to the model, the index constituents' aggregate carbon P/L was relatively muted throughout most of the ETS's history. However, as EUA prices started to rise and their allocation volumes started to decrease, carbon costs have become more material for companies affected by the EU ETS. In 2018, aggregate yearly carbon-related costs amounted to less than EUR 860mn. By 2021, this value had increased to over EUR 3bn – growing at a compounded annual growth rate of 53%.



Source: SparkChange, and Solactive

This pattern may intensify over the upcoming years if EUA prices continue with their upward trend and as the EU ETS's industry scope broadens and allocations diminish. In this context, one of the industries most sensitive to

higher European carbon prices over the near future is the electric utilities one – as widespread adaption of clean energy may take time to ramp up throughout Europe, as well as due to the high energy intensity of the sector.

Nonetheless, as carbon price pressures rise and renewable energy technologies become more advanced, power generation across the region is expected to steadily greenify. As this transition materializes in the energy sector, the burden of the EU ETS is expected to shift to industries with a less developed pipeline of green technological innovations. Such is the case for steel and construction material manufacturers, as well as for the oil and aviation industries, among others. By the end of the decade, carbon costs for companies operating in these sectors are expected to increase significantly and stay at a relatively high level.

CarbonAlpha Investment Use Cases

CarbonAlpha's broad set of data sources allows for the analysis of not only sector-level carbon P/Ls, but also of a given company's sensitivity to carbon prices on an individualized basis. Therefore, the model's output makes it possible to visualize how a given company is able to face higher carbon prices relative to industry peers – allowing for the identification of better- and worse-off companies due to their exposure to carbon compliance regulations.

Moreover, given the fact that individual companies' EUA stock and sector-wide emission reduction trends are factored into the model, it also allows to assess the evolution of a given company's carbon price sensitivity across the model estimation window.

In other words, CarbonAlpha's design integrates multiple dimensions of the carbon market. This forward-looking approach allows to translate the complexity of estimating emission costs across multiple dimensions into a set of easy to digest financial outputs. By using these estimates, one can visualize yearly changes of a given company's carbon P/L, as well as how it stands relative to that of comparable firms.

Given the growing relevance of carbon costs in light of the EU ETS, signals derived from CarbonAlpha may be used to make better informed investment decisions or as the basis of systematic investment strategies. The following case studies showcase two examples of the former use case.

Case Study 1: Carbon Beneficiaries May Change Over Time

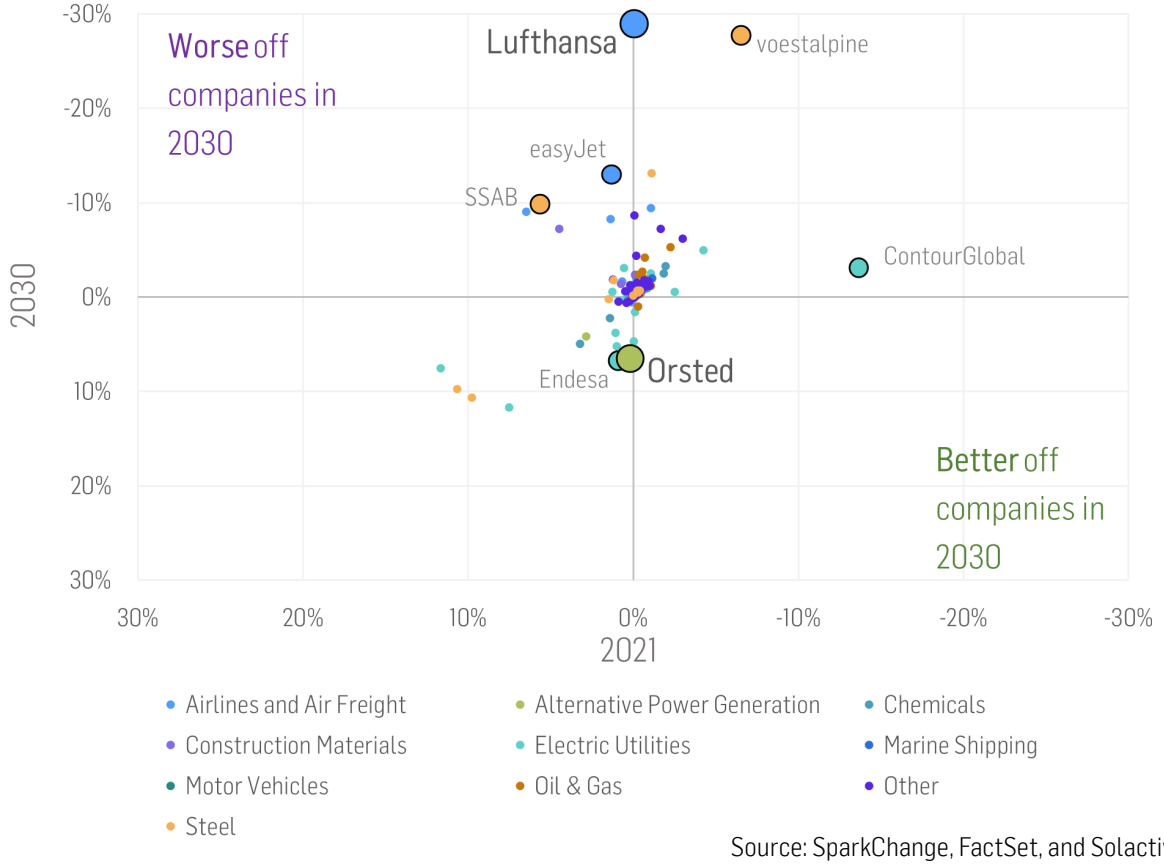
As aforementioned, the time variation of company-level sensitivity to carbon prices can be estimated with CarbonAlpha. These changes can be staggering.

For instance, Lufthansa's 2021 carbon costs are barely 0.1% of its 2021 end of year market capitalization. However, by 2030 these costs are estimated to exceed 28% of the company's (2021) value. This difference can be attributed to multiple factors. Among them is the fact that as of 2021, European aviation had not yet fully recovered from the effects of the coronavirus pandemic on travel. Thus, as the number of flights in Europe picks up, higher emissions from airlines will follow. Further, the phasing out of free allowances for aircraft operators from 2024 onwards is set to increase carbon price pressures for the aviation industry. [8]

On the other end of the spectrum, a company that may be among the main beneficiaries of the ETS is Orsted, one of the world's largest wind farm developers. Even though the company's carbon P/L is estimated to have

been relatively muted in 2021, at around +0.2% of its market value, this ratio may become an over 6% gain in 2030. One of the main drivers of this firm's potential profits are the ripple effects of merit order pricing. [9]

Solactive Europe 600 Index Universe's Normalized Carbon Profits-and-Losses (2021 vs. 2030)



Source: SparkChange, FactSet, and Solactive

In the merit order electricity market, sources of energy are ranked in ascending order according to their price. Based on this ranking, market supply is provided by the least expensive power sources until demand is met. All electricity providers that pass this supply-demand threshold can then sell their supplied electricity at a price proportional to the least efficient eligible supplier's unit cost of production.

One consequence of this pricing mechanism, as well as of renewable's low operating costs, is that green energy providers benefit substantially from higher electricity prices in markets in which the energy mix is less green [9] –

given that running costs of wind turbines and photovoltaics are much lower than those of traditional sources of energy, as renewables don't need fuel nor a significant degree of manpower in order to remain operational, as well as by the fact that they don't generate emissions (thus, there is no need to acquire EUA's for companies that operate them).

Therefore, it follows that the development of the Baltica 2 and 3 wind farms in the Polish Baltic Sea by Orsted, in a joint venture with Polish Energy Group, is posed to generate material revenues for the company. This is particularly the case given Poland's high share of coal and lignite on its energy mix, as well as the high amount of electricity these wind farms are expected to generate – amounting to 2.5 of Poland's 11 GW offshore wind target. [10]

Case Study 2: Carbon Risk Management Effect on P/Ls

Among the variables that most affect the degree of materiality of the EU ETS on P/Ls, there are two key factors: corporate carbon hedging strategies and decarbonization trends (both systematic and company-specific).

In order to quantify the impact of these two factors on carbon P/Ls, CarbonAlpha was run under two "business as usual" assumptions (BAU). First, emissions of companies in scope would remain constant relative to 2021 levels. Second, the studied firms would not hedge their carbon exposure nor use allowances banked before 2022 (implying that they would have to buy all needed EUA's at its forecasted spot price).

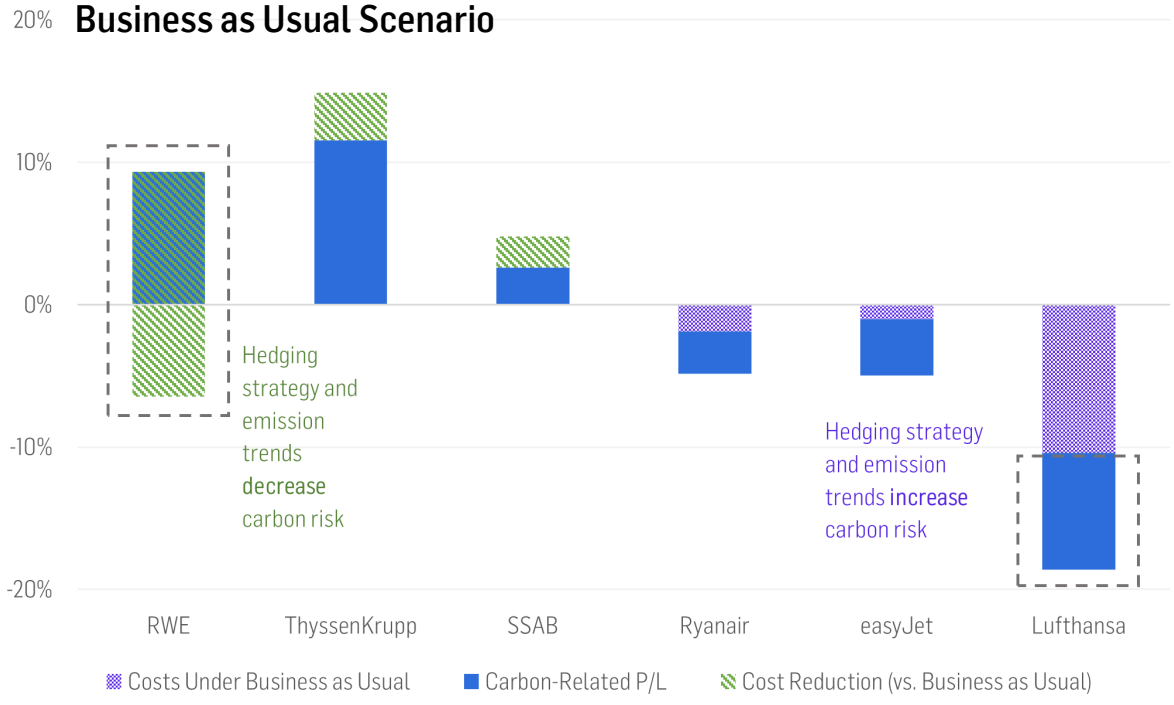
By subtracting these results from the ones obtained without the BAU assumptions, it is possible to quantify the combined effects of corporate carbon hedging and emission reduction strategies for the company universe. The resulting figures reveal that there's more to carbon-related

expenses than meets the eye.

For example, on the one hand, under BAU assumptions, the average expected carbon costs of RWE would be among the largest ones of the company universe – at around 6.4% of its end-of-2021 market value (between 2022 and 2030). However, the company's mix of robust decarbonization and hedging strategies is expected to generate gains of over 9% of its market cap, on average, over the remainder of the decade. [11]

On the other hand, European airlines are expected to face increasing headwinds from the EU ETS in upcoming years. Similar to the above-mentioned Lufthansa case, a dramatic expected year-on-year increase in European air travel (in 2022 and 2023, particularly) would translate into commercial aircraft operators having to buy a rising number of allowances to compensate for their emissions. Nonetheless, it is important to highlight that the drastic increase in emissions expected in this sector is mainly driven by pandemic-related base effects.

Normalized Carbon Profits-and-Losses of Selected Companies vs. Business as Usual Scenario



Source: SparkChange, FactSet, and Solactive

Conclusion

Carbon markets are becoming ever more relevant by the day – a trend that is not expected to subside in light of global decarbonization targets. Among the most mature systems intended to incentivize decarbonization is the EU ETS.

In this paper, we analyze how the EU ETS, as well as its ripple effects, could affect companies composing the Solactive Europe 600 Index. We do so on a granular basis, by leveraging data from our strategic partner SparkChange. By using their data, we are able to visualize the evolution of expected market-wide carbon P/Ls (from 2008 until 2030), which companies may be most affected by carbon-related costs in the future relative to 2021, and the sensitivity of selected companies' P/Ls to corporate decarbonization and carbon hedging strategies.

SparkChange intends to investigate the effects of carbon-related costs on stock returns in a future publication. By doing so, they aim to determine if market participants are appropriately pricing-in carbon risk on an aggregate level or whether this risk is currently being approximated through an inadequate proxy (such as a company's carbon footprint).

The potential implications of this upcoming research may be especially relevant to forward-looking investors – as the carbon market is expected to become further established in the near term and the EU ETS expands into further industries.

[1] Global Carbon Project, "Data supplement to the Global Carbon Budget 2021".

[2] European Comission, "EU Emissions Trading System (EU ETS)".

[3] European Comission, "EU ETS Handbook".

[4] European Environment Agency, "EU Emissions Trading System (ETS) data viewer".

[5] European Comission, "Development of EU ETS (2005-2020)".

[6] European Comission, "Carbon Border Adjustment Mechanism: Questions and Answers".

[7] SparkChange, "An Overview of the EU Emissions Trading System".

[8] Eurocontrol, "The EU's "Fit for 55" Package: what does it mean for aviation?".

[9] Clean Energy Wire, "Setting the power price: the merit order effect".

[10] Orsted, "Poland awards Contract for Difference to the Baltica offshore wind farms".

[11] RWE, "Climate Protection".

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