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CLIMATE CHANGE ANALYSIS IN THE INVESTMENT PROCESS

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A PRICE ON CARBON: CARBON MARKETS

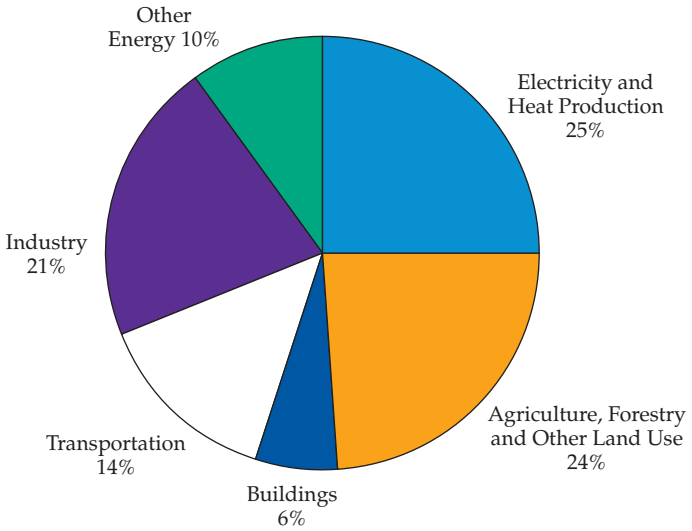
The most potent tool in combating climate change is undoubtedly a price on carbon. Putting a price on carbon emissions that considers the negative externality of climate change creates an incentive for the invisible hand of the market to move economies away from burning fossil fuels.

Politicians and policymakers around the world know that people do what they are incentivized to do. Tax codes are written with this axiom in mind, because financial incentives are understood as an efficient way to promote behavior that benefits society. A price on carbon that can incentivize a move away from the burning of fossil fuels that inject CO_2 into the atmosphere is arguably the most effective way to lower carbon emissions. Although CO_2 is not the only greenhouse gas, it does the most damage. The greenhouse gases methane and nitrous oxide stay in the atmosphere longer than CO_2 but are a much smaller part of the atmosphere. Methane makes up about 2 PPM of the atmosphere, and nitrous oxide makes up far less than 1 PPM. CO_2, on the other hand, is at about 415 PPM as of this writing—and rising.[23] **Figure 3** shows a rough breakdown of the world's main sources of CO_2. Although energy production is the biggest source of CO_2 emissions globally, policymakers will have to address all large sources of CO_2 to effectively mitigate climate change.

Currently, carbon pricing follows two main methods: a carbon tax and a cap-and-trade system. Under a carbon tax, a fee is placed on carbon-generating activities so that both industries and consumers have incentive to substitute cleaner energy solutions for fossil fuels. Consumers would pay more to fill up their cars with gas, motivating them to move to hybrid or electric vehicles. Energy generation from coal, gas, or other fossil fuels would also become more expensive, increasing demand for non-carbon-based energy sources. Policymakers must find a fine balance when using a carbon tax, however: They must set a rate that will create incentives to decrease the use of carbon-intensive fuels without damaging the economy. In other words, they risk hampering the economy by setting the rate too high or failing to change behavior by setting the tax too low.

The advantage of a cap-and-trade system over a carbon tax is that the total amount of CO_2 released by industry cannot legally exceed a set level. A cap-and-trade system sets a carbon budget for a market, and permits or credits to pollute are sold to users. Companies must buy permits in order to emit CO_2 (or whatever emissions are covered) above the level established by the cap, and these permits can be traded on a secondary market. The cap on emissions is lowered each year in order to incentivize a lower use of carbon-intensive processes. Firms that are low emitters can sell their credits to high emitters, because the carbon credits are assets.

FIGURE 3. GLOBAL GREENHOUSE GAS EMISSIONS BY ECONOMIC SECTOR



Source: Based on data from the Intergovernmental Panel on Climate Change (2014).

[23]"Atmospheric Composition," Open Source Systems, Science, Solutions. http://ossfoundation.us/projects/environment/global-warming/atmospheric-composition.

At What Price Carbon?

There is a wide band of carbon prices that experts feel are necessary to drive behavior that will create a "2° future," as envisioned by the Paris Agreement that sought to limit global warming to 2° Celsius by 2050. The Stern–Stiglitz Report of the High-Level Commission on Carbon Prices recommends that carbon prices reach the range of US$40–US$80/tCO_2 by 2020 and US$50–US$100/tCO_2 by 2030, when paired appropriately with complementary policies.[24] The 2020 number has not been achieved.

According to the 2019 Climate Leadership Council report "The Case for an Economy-Wide Carbon Fee," however, less than 10% of existing carbon prices in 70 jurisdictions with some active carbon market are at or above US$40/$tCO_2$. Furthermore, when carbon prices are weighted to account for the percentage of domestic CO_2 emissions they actually cover, that number falls to less than 5%.[25]

A price on carbon is not a magic bullet to solve climate change. Governments, companies, and individuals must take other, complementary action to transition the world economy away from carbon-intensive activities at a pace necessary to create meaningful change. Nonetheless, a price on carbon offers a market-based solution as a key step in setting incentives around the world to decrease emissions and eventually bend the PPM curve.

A **carbon tax** is a fee applied to each unit of greenhouse gas emissions. Finding the right level is key:

- too high, damages economy
- too low, no behavior change

A **cap-and-trade** system places a limit on total emissions but allows participants to trade permits and credits for carbon use, thereby setting a market price.

The major carbon markets are large and liquid, trading in excess of US$200 billion in 2019.

One Last Thing … a Carbon Border Tax

At the time of this writing, the European Commission is considering a carbon border tax as a potential tool in its efforts to mitigate climate change. Such a mechanism addresses the problem of one country or market adopting a carbon pricing scheme while other markets do not, which gives a potential competitive advantage (and implicit carbon subsidy) to the market without a price on carbon.

A carbon border tax allows a country that prices carbon to adjust the prices of products from countries that do not, which would eliminate the implicit carbon subsidy enjoyed by the non-carbon-pricing country. The country with a price on carbon would therefore not face a competitive disadvantage caused by carbon pricing if it implemented a carbon border tax. Such a mechanism would also theoretically incentivize markets without a price on carbon to implement a carbon pricing system in order to avoid paying such a tax on their carbon-intensive exports.

As of the date of this report, no market has adopted a carbon border tax or the less negatively phrased "carbon border adjustment." Still, policymakers continue to consider this tool as a means to help push markets to a meaningful price on carbon.

What Investors Can Do

Investors should educate themselves about how carbon markets work in order to better incorporate a likely higher price on carbon into their analysis. Analysts and portfolio managers should run their own scenario analysis to better understand how a carbon price of US$50–US$100/tCO_2 in 2030, as recommended by the Stern–Stiglitz Report of the High-Level Commission on Carbon Prices, would affect the companies they analyze or hold in their portfolios.

CFA Institute recommends analysts begin factoring expected carbon prices into their financial analysis so they can be prepared for a world with more-explicit carbon pricing, whatever form those prices take. See the case study "Carbon as an Emerging Asset Class" for a more in-depth look at the issue of carbon pricing and carbon markets.

[24]J. Stiglitz and N. Stern, "Report of the High-Level Commission on Carbon Prices" (Washington, DC: Carbon Pricing Leadership Coalition, 2017).
[25]Climate Leadership Council, "The Case for an Economy-Wide Carbon Fee," (October 2019). https://clcouncil.org/media/The-Case-For-An-Economy-Wide-Carbon-Fee.pdf.

Carbon Cap Management LLP

CARBON AS AN EMERGING ASSET CLASS

Mike Azlen, Alex Child, and Glen Gostlow

Emissions trading systems (ETSs) have proven to be an effective and efficient form of carbon pricing and are an important climate policy instrument, with the ability to mitigate climate change on a large scale. Achieving Paris Agreement climate targets will require the widespread use of carbon pricing to steer the world onto a low-carbon pathway. ETSs cap and reduce emissions through tradable emissions allowances that induce emissions reductions at the lowest total cost to society.

All long-established ETSs have exchange-listed futures markets to enhance liquidity and price discovery, facilitating greater market efficiency and increasing demand within the market. Compliance entities can also hedge their exposure to future price increases. A listed and liquid market allows investors to actively participate in these markets. In 2019, the traded value of three major programmes—the EU ETS, the Regional Greenhouse Gas Initiative (RGGI),[38] and the Western Climate Initiative (WCI)[39]—exceeded $250 billion.

For investors, carbon traded in these markets can be viewed as an attractive asset class with well-understood risk premium drivers. This case study provides a high-level introduction to ETSs as a policy tool for mitigating emissions and also highlights carbon as a potentially attractive asset class for investors.

Emissions Trading Systems Explained

Carbon pricing is a policy that aims to reduce carbon emissions by requiring emitters to internalise the societal costs of emissions. Putting a price on externalities, such as carbon emissions, is the most widely accepted means to efficiently correct for this type of "market failure." Pricing emissions provides a direct economic incentive to reduce them or seek low-carbon alternatives. The two main carbon pricing policy instruments are carbon taxes and ETSs (cap-and-trade programmes, also called compliance carbon markets). A carbon tax places a fee on the carbon emissions content of fossil fuels, and the market then determines the resulting quantity of emissions reductions. An ETS places a cap on the total quantity of emissions and allows the market to determine the price for tradable emissions allowances.

ETSs allow for environmental certainty and least-cost emissions reductions. In an ETS, polluting entities covered by the instrument must submit an emissions allowance for each tonne of greenhouse gas (GHG) they emit. Compliance is mandatory for eligible entities, and their emissions are tightly monitored and audited, with penalties for non-compliance. Entities either purchase allowances through government auctions or, in the case of industries exposed to international competition, receive a portion of allowances through free allocation. A total cap on emissions allowances guarantees that emissions reduction targets will be met, whereas the trading of emissions allowances ensures that the reductions will occur at the lowest total cost to society. Emissions trading incentivises firms with lower abatement costs to maximise their emissions reductions and sell allowances to firms that can only reduce emissions more expensively.

Table 1 summarises the three generic types of carbon markets. ETSs are the most liquid and robustly regulated form of carbon markets. International carbon markets allow the transfer of project emissions reductions among different countries. Voluntary carbon markets provide carbon "offsets" that individuals and companies typically use to offset their carbon footprint. These markets aim to increase the cost-effectiveness of achieving global emissions reductions.

ETSs have helped stimulate significant emissions reductions and other co-benefits without reducing economic growth. The EU, RGGI, and WCI ETSs are among the longest running ETSs globally. The jurisdictions covered in each of these markets have experienced positive GDP growth with reductions in emissions since their inception, as shown in **Figure 1**. In achieving the emissions reductions, the EU ETS has facilitated significant levels of coal-to-gas fuel

[38]The RGGI currently covers 10 US states: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

[39]The WCI is the California cap-and-trade programme, which has been combined with the Quebec ETS since 2014.

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TABLE 1. THREE TYPES OF CARBON MARKETS

Market Elements	ETS Carbon Markets	International Carbon Markets	Voluntary Carbon Markets
Description	• Mandatory participation for large emitters • Some allow limited amount of international Clean Development Mechanism (CDM) credits	• The CDM was the first major international market under the Kyoto Protocol • Emissions reductions transferred across countries	• Independent markets for non-regulated entities to voluntarily reduce emissions • Variety of industry-created standards
Current Status	• Covers 8% of global emissions, growing to 14% with the launch of the China ETS	• Large market, currently stagnating • Article 6 of the Paris Agreement aims to reignite international markets	• Mainly used for corporate social responsibility (CSR) activities • Attractive for small projects
Regulation	• Highly regulated, with robust monitoring, reporting, and verification (MRV)	• UN-recognised accounting methodologies, such as Gold Standard (GS) accounting	• Low to no regulation, different accounting methodologies with varying degrees of rigour
Liquidity	• Highly liquid • In 2018, more than US$200 billion traded in the WCI, RGGI, and EU ETS	• Medium liquidity • Average of US$14 billion traded per year since 2006	• Low liquidity • In 2018, nearly US$300 million traded
Carbon prices	• Range from US$5.7–US$31.5/tCO_2e	• Range from US$0.2–$US0.4/tCO_2e	• Range from US$0.1–US$70/tCO_2e

switching in the power sector, which also provided substantial health benefits from reduced particulate matter and improved local air pollution. In the RGGI, emissions reductions in the power sector were accompanied by power price reductions, even as power prices rose in the rest of the United States.[40]

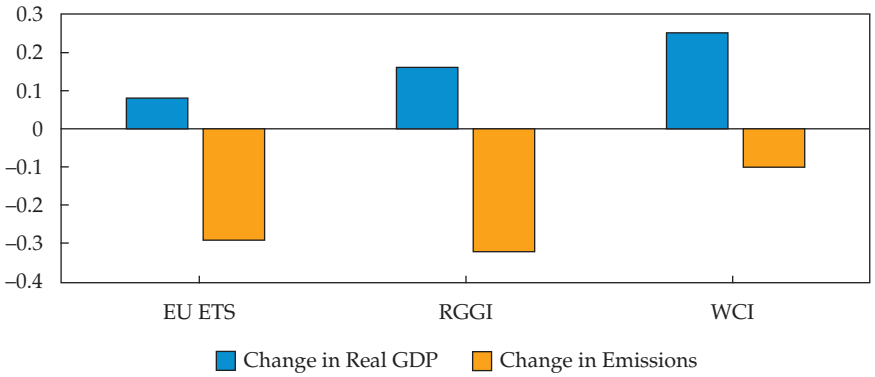
Policymakers have now widely implemented several key policy design improvements that strengthen both the resilience and the environmental effectiveness of ETSs. During the 2008–09 recession, EU ETS GDP declined by around 10% and the carbon price declined from a high of around €30 to a low of around €10. Although a prolonged global recession could still negatively impact carbon prices, modern markets have enhanced features to reduce the impact of an economic downturn on carbon prices and support the robust functioning of this market. These key design features of ETSs, including increasing use of auctioning, free allocation based on efficiency benchmarks, and supply adjustment mechanisms, determine the stringency of a market and influence the expected future trajectory of carbon prices.

Carbon as an Asset Class

Carbon has become a liquid and investable asset class that now trades approximately US$1 billion per day across physical carbon, futures, and options. Carbon has exhibited attractive historical returns and a low correlation with other asset classes, making it potentially attractive within a diversified portfolio. Because of the design parameters of an ETS, including the objective of higher prices and lower emissions, there is a well understood and logical case for a forward-looking risk premium for carbon. At Carbon Cap Management LLP (Carbon Cap), we have created an equally weighted multi-market Carbon Composite time series of allowances prices across

[40]Acadia Center, "The Regional Greenhouse Gas Initiative: Ten Years in Review" (2019). https://acadiacenter.org/document/the-regional-greenhouse-gas-initiative-ten-years-in-review/.

FIGURE 1. CHANGE IN EMISSIONS AND REAL GDP IN THREE CARBON MARKETS SINCE THEIR INCEPTION



Note: Dates covered include EU ETS: 2005-2018, RGGI: 2009-2018, WCI: 2012-2018.

Source: Carbon Cap based on Eurostat (2019); European Environment Agency (2019); RGGI Inc (2018); Bureau of Economic Analysis (2019); California Air Resources Board (2018); ICAP (2019).

four major long-standing ETSs:[41] the EU, RGGI, WCI, and New Zealand ETSs. We use this composite to examine the statistical properties of carbon markets from an investment perspective, and for the 2012–19 period, we find the following:[42]

- The Carbon Composite has generated an annualised return of 22% since 2012 and a Sharpe ratio of 1.08, reflecting a higher risk-adjusted return than traditional asset classes.
- Carbon as an "asset class" has exhibited no correlation with other asset classes, making it potentially attractive as a portfolio diversifier.
- Carbon has a prospective annualised risk premium up to 2030 of between 6% and 12%, based on current prices and climate policy objectives.

The Composite generates significant annualised returns and higher risk-adjusted returns relative to global equity and bond markets. **Table 2** illustrates the performance of the Carbon Composite against traditional equities, bonds, and commodities. Aggregating the carbon markets significantly reduces the overall volatility of carbon as a commodity: The Composite exhibits a standard deviation of 19.7%, compared with the average standard deviation of the four individual markets at 39%. Although the Composite still has a high volatility, its Sharpe ratio—measuring risk-adjusted returns—is higher (1.08) than those seen in traditional asset classes, which range from –0.70 to 1.02. Further analysis indicates that there is no statistically significant correlation between the Composite and traditional and alternative asset classes.

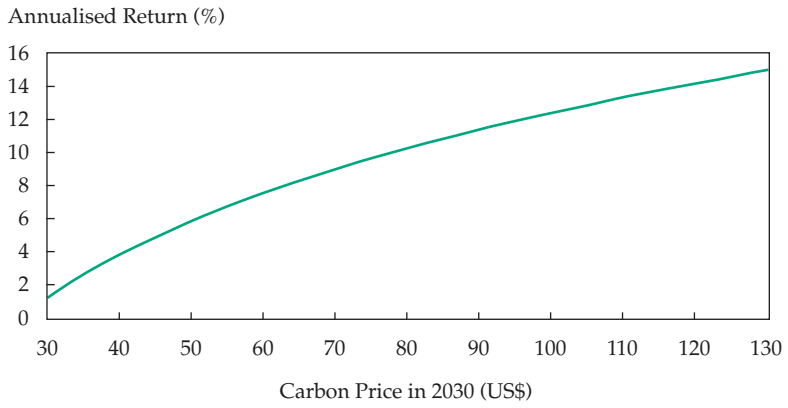
Although carbon pricing, particularly emissions trading, is becoming increasingly widespread, prices will need to rise significantly over the next decade in order to stimulate the emissions reductions required to stay below the Paris Agreement temperature threshold. A total of 36 national and 23 sub-national jurisdictions have currently implemented some form of an ETS,

TABLE 2. CARBON COMPOSITE STATISTICS 2012–19

Financial Properties	Carbon Composite	MSCI World Index	Barclays Global Bond Index	Bloomberg Commodity Index
Annualised return	22.1%	10.8%	3.6%	–6.9%
Annualised volatility	19.7%	10.8%	2.6%	11.2%
Sharpe ratio	1.08	0.92	1.02	–0.70

[41]This continuous contract series reflects true returns to an investor based on the allowance price. Where futures contracts are used, we assess open interest and volume to determine the optimal roll window and combine futures time series to account for the roll yield.
[42]We begin the analysis from 2012 as this is the earliest date when all four markets operated simultaneously.

FIGURE 2. PROJECTED ANNUALISED RETURN VS. FUTURE CARBON PRICES



Source: Carbon Cap.

covering 9% of global annual emissions and 42% of global GDP.[43] A further 9 jurisdictions are in the process of putting an ETS in place, and another 15 jurisdictions are considering doing so.

The majority of emissions covered under a carbon price, however, have a price of less than US$10/$tCO_2e$. Numerous academic studies suggest that carbon prices need to rise between US$50 and US$100/tCO_2e by 2030 to be consistent with Paris Agreement goals.[44,45,46,47] As such, carbon prices will need to rise substantially if we are to successfully stimulate emissions reductions on the scale required. Based on these price targets, we calculate a prospective risk premium of 6% to 12%, based on a 2% risk-free rate, as shown in **Figure 2**.

Conclusion

The world's current greenhouse gas emissions trajectory will continue to result in dangerous and costly climate change impacts, both societally and economically. The earth is on course for an average temperature increase of 3–4°C by 2100 unless CO_2 emissions are reduced.[48] Climate change of this magnitude will result in substantial human migration, regional conflicts over increasingly scarce resources, and extreme weather events, causing devastating physical damages and economic costs. Carbon pricing is an essential tool that works within a market economy to change behaviour and reduce emissions at scale in order to avoid the worst damages of climate change.

ETSs are the most cost-effective means of carbon pricing, with a high degree of environmental integrity, and they have evolved substantially over the past decade. Through the combination of an annually declining emissions cap and emissions allowance trading, ETSs provide the environmental certainty of achieving emissions reduction targets with the economic benefit of incentivising this to occur at the lowest possible cost. ETS markets have evolved substantially since their inception, with modern policy design features providing for more stringent markets and greater market resilience in the event of unexpected demand shocks.

[43]International Carbon Action Partnership, "Emissions Trading Worldwide: Status Report 2020" (2020). https://icapcarbonaction.com/en/?option=com_attach&task=download&id=677.
[44]A. Brown, "UK REA Bioenergy Strategy: Phase 3—Delivering the UK's Bioenergy Potential" (2019). https://www.r-e-a.net/wp-content/uploads/2019/10/Bioenergy-Strategy-Phase-3.pdf.
[45]Carbon Pricing Leadership Coalition, "Report of the High-Level Commission on Carbon Prices" (2017). https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices.
[46]International Energy Agency, "Energy Technology Perspectives 2017: Catalysing Energy Technology Transformations" (2017). https://www.iea.org/reports/energy-technology-perspectives-2017.
[47]International Institute for Applied Systems Analysis, "IIASA SSP 2 Degrees Scenario," Shared Socioeconomic Pathways (SP) Scenario Database (2019). https://iiasa.ac.at/web/home/research/researchPrograms/Energy/SSP_Scenario_Database.html.
[48]Intergovernmental Panel on Climate Change (IPCC), "Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty" (2018). Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.). In Press.

Carbon (emissions allowances from ETSs) has emerged as a liquid and investable asset class that may be attractive for long-term investors because of its liquidity, correlation properties, and prospective risk premium. Carbon has generated impressive historical returns, and although it has exhibited high volatility, its risk-adjusted returns have outperformed traditional asset classes, such as equities, bonds, and commodities. If carbon prices rise to US$50–100 by 2020, which many estimate would be required for global emissions to be aligned with Paris Agreement goals, this would give rise to a prospective risk premium of between 6–12% to 2030.

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