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What's Driving Unprecedented Growth in Carbon Markets

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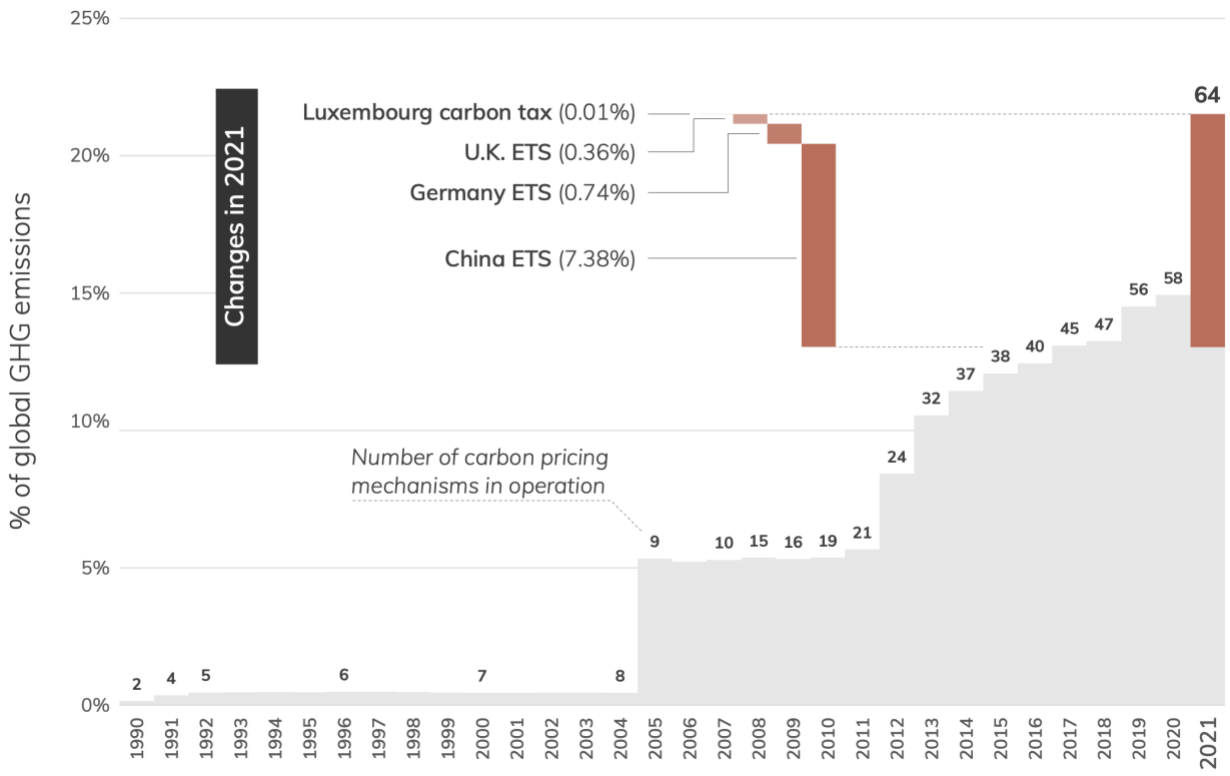
The concept of pricing carbon was introduced less than twenty years ago, when the first carbon allowance market launched in 2005 in Europe. Today, there are over 60 carbon pricing initiatives across the globe covering approximately 20% of global greenhouse emissions.[1] This growth reflects increasing regulatory support and political momentum for urgent action on climate change. Carbon pricing is often the central mechanism policymakers use to address climate change. With a combination of carbon taxes and Emissions Trading Systems (ETS) increasingly covering a large portion of global emitters, carbon pricing initiatives now cover 12 gigatons of global greenhouse gas (GHG) emissions, as seen in Figure 1 below:

Figure 1. Share of global emissions covered by carbon pricing initiatives (ETS and carbon tax)



Source: World Bank State and Trends of Carbon Pricing 2021

While tremendous progress has been made establishing and growing Emission Trading Systems, we are still in the early stages of carbon pricing. With more markets coming online, there is room for greater advancements and progress. According to the High-Level Commission on Carbon Prices, a UN and World Bank-backed initiative,

[1] World Bank State and Trends of Carbon Pricing 2021

"carbon prices encourage producers to decrease the carbon intensity of the energy and industrial sectors and manufactured products, and consumers to choose less carbon-intensive goods. By creating opportunities to increase profitability or lower operation costs by reducing greenhouse gas emissions, carbon pricing also promotes innovation and incentivizes the generation of new ideas and solutions." To achieve this objective, the International Monetary Fund (IMF) and Organization for Economic Cooperation and Development (OECD) report on tax policy and climate change has estimated that to limit global temperature increases to 1.5 degrees Celsius (as called for in the Paris Agreement), a carbon price of $144 is needed by 2030.[2] This is much higher than the average price of global emissions, $24.00.[3]

The target carbon price levels from the IMF/OECD report closely relate to the cost of abatement technologies in the marketplace. While carbon prices remain well below abatement levels for technologies such as those needed to transition to green hydrogen or carbon capture and sequestration, the switch to new technologies will be slower, leading to lower emission reductions by industrial polluters. This, in turn, will keep demand for carbon allowances high, while the supply will shrink as Emission Trading Systems reduce their caps every year, with more sectors potentially coming in scope and competing for allowances. This creates a supply/demand imbalance that puts upward pressure on prices to achieve equilibrium.

The increased focus on carbon markets led to 2021 being a record year for carbon allowance markets. All major carbon allowance markets, including the European Union ETS and the California cap-and-trade, experienced significant gains. The IHS Markit Global Carbon Index, which tracks the futures of the four major global carbon markets to create a single global reference price for carbon, returned an extraordinary 107% annualized return in 2021.[4]

As these markets become more established globally, carbon allowances have also become an area of focus for

[2] IMF/OECD (2021), Tax Policy and Climate Change: IMF/OECD Report for the G20 Finance Ministers and Central Bank Governors, April 2021, Italy, https://www.oecd.org/tax/tax-policy/tax-policy-and-climate-change-imf-oecd-g20-report-april-2021.pdf. EUR/USD FX rate used for the USD target carbon price is from Investing.com as of 4/30/2021, the report issue date.
[3] The World Bank, Carbon Pricing Dashboard, https://carbonpricingdashboard.worldbank.org/map_data, Climate Finance Partners, 2021
[4] Data from Bloomberg as of 12/31/2021

institutional investors. This white paper seeks to be a resource to help investors understand the dynamics of carbon allowance markets, the potential portfolio diversification benefit of a portfolio allocation, as well as the impact case for investment in carbon allowances.

I. Where are the largest tradable carbon allowance markets globally?

The four largest and most liquid carbon allowance markets are the European Union ETS, the United Kingdom ETS, the California Cap-and-Trade Program, and the Regional Greenhouse Gas Initiative (RGGI) covering the Northeastern United States. These markets have an aggregate market value of $684 billion as of December 2021 (Figure 2) and continue to grow in both volume of credits and total market value.

Figure 2: Top 4 Carbon allowance futures markets annual trading volume and market growth by annual trading volume
July 31, 2014 – December 31, 2021

Year	EUA volume (billions)	UKA volume (billions)	CA volume (billions)	RGGI volume (billions)	Total volume	EUA YoY growth	UKA YoY growth	CA YoY growth	RGGI YoY growth	Total growth
2021	652.6	17.6	12.4	1.3	**683.9**	158.25%	-	125.45%	195.45%	**165.14%**
2020	252.7	-	5.5	0.44	**257.94**	68.71%	-	35.19%	13.52%	**65.5%**
2019	149.8	-	5.6	0.4	**155.8**	39.40%	-	120.38%	34.95%	**41.23%**
2018	107.5	-	2.5	0.3	**110.3**	348.83%	-	66.55%	134.80%	**330.97%**
2017	23.9	-	1.5	0.1	**25.6**	2.20%	-	36.62%	78.23%	**3.99%**
2016	23.4	-	1.1	0.1	**24.6**	-27.80%	-	3.13%	-	**-26.57%**
2015	32.5	-	1.1	-	**33.5**	-26.25%	-	267.38%	-	**-24.31%**
2014	44	-	0.3	-	**44.3**	-	-	-	-	**-**

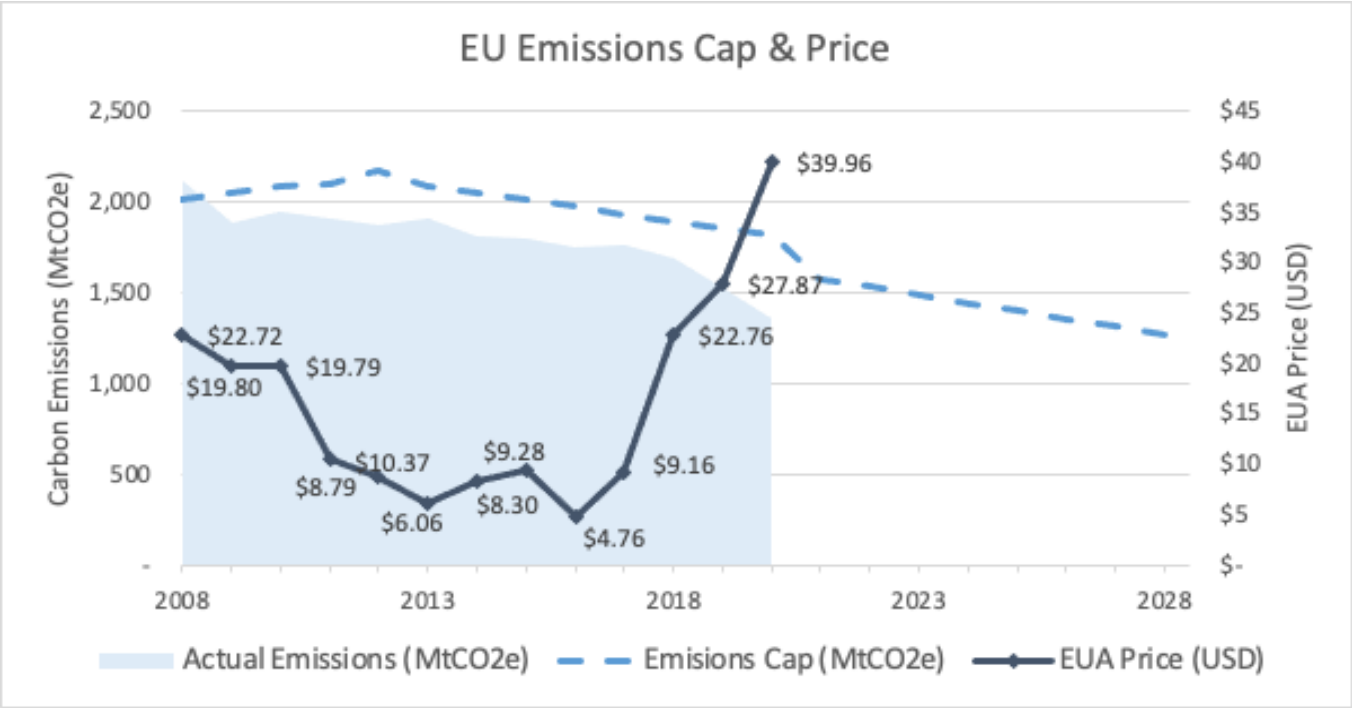
Source: IHS Markit, December 2021

European Union Emissions Trading System (EU ETS)

The European Union Emissions Trading System is the oldest, largest, and most liquid carbon market globally. Launched in 2005, the EU ETS consists of the EU's 27 member states (and four European Economic Area states) and covers 40% of the region's GHG emissions. Over 12,000 entities must participate in the ETS across power, industrial, agricultural, and aviation sectors. The price per ton of carbon has fluctuated over the past decade, with a significant increase since 2017. Total EU ETS emissions have dropped by 660 million tCO_2e (33%) since the program's inception. Figure 3 shows the declining cap in the EU market, the price impact on generally declining

emissions, and the trajectory of the supply and demand.

Figure 3. EU ETS Market Price, Actual Emissions and Emission Caps



Source: Climate Finance Partners, December 2021

EU ETS Market Mechanics

The EU ETS has several mechanisms to control dramatic price volatility as carbon allowance supply is reduced. From 2021 to 2030, 57% of carbon allowances are intended to be auctioned at market price to compliance actors, determined by supply/demand dynamics, with the remaining allocated for free across sectors. Beginning in 2021, the number of free allocations was reduced, which is expected to gradually shift the market away from a historical over-supply of allowances to a likely market shortage, increasing demand and transaction volume.

After a period of meager prices, the European Commission implemented the Market Stability Reserve (MSR) to help avoid extreme market volatility. The MSR holds allowances out of the auction when excess volumes are available on the market and reinjects them when there is low circulation. There is no predetermined price floor or ceiling; however, this mechanism creates stability in the market and improves resilience to future spikes in supply/demand. In addition, continued European Union economic growth coupled with stricter emissions, reductions targets will drive a shortage of allowances in the market, theoretically driving up the price and making

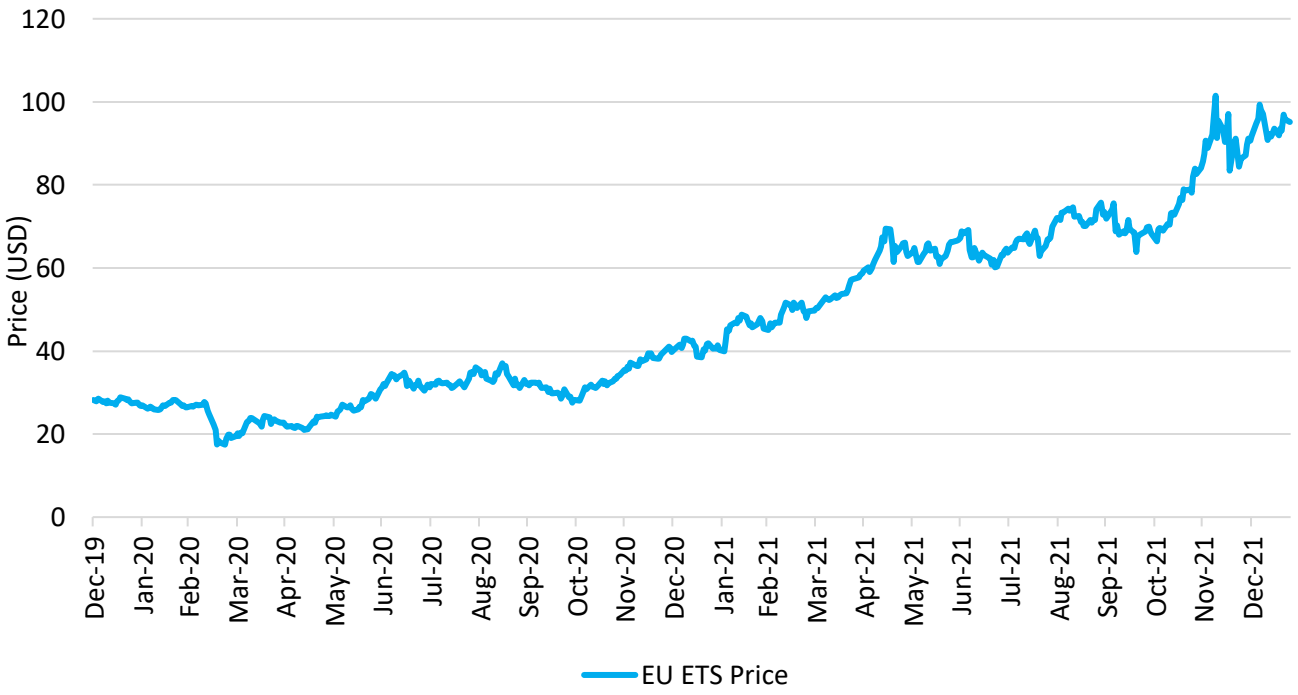
carbon emissions more expensive.

Since 2012, the EU ETS has raised €57 billion, which accrues to EU member states - at least half of which is required to be used for climate and energy-related purposes. Integration of this secondary revenue-generating benefit into long-term infrastructure development reduces short-term policy risk.

EU ETS Market Liquidity

The EU ETS is the most liquid carbon allowance futures market. This market has experienced total notional trading volumes of over $650 billion USD in 2021 and has grown exponentially in recent years, increasing by more than 2.5 times from the prior year. As shown in Figure 4 below, the price of EU ETS carbon allowances has increased dramatically since early 2017, which has amplified program recognition among media outlets and commodity investors.

Figure 4. European Union ETS Futures Price



Source: ICE Exchange, December 2021

United Kingdom Emissions Trading System (UK ETS)

The United Kingdom Emissions Trading System is the newest national cap-and-trade market, which was

established after the UK's exit from the European Union. The market was designed to resemble the EU ETS in all its key parameters, including auctioning off a large share of allowances, a market stability mechanism, and a cost-containment mechanism. UK carbon allowances rose from £45.00 at the market's opening in May 2021 to over £80/ton as of January 2022.[5] Trading volume and liquidity are considerably less than in the EU ETS, which is not unusual given that the EU ETS is 10 times larger than the UK market. The UK ETS had a trading volume of more than 200 million tons in its first year.[6]

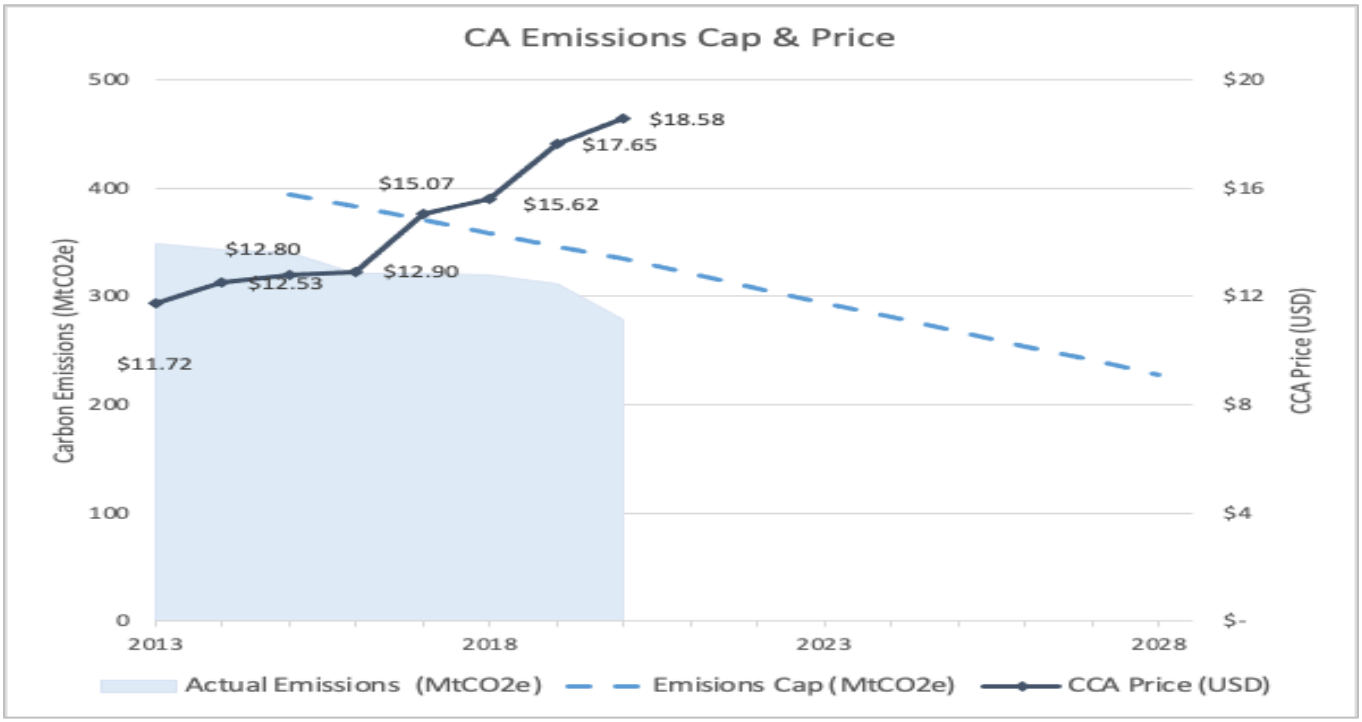
California Cap-and-Trade Program

California has always been at the forefront of climate policy. State goals have historically been higher than US Federal regulations in clean air, clean fuels, and environmental protection. Established in 2013, the California Cap-and-Trade Program is a key element of the state's climate plan, developed under the framework of the California Global Warming Solutions Act of 2006 (Assembly Bill 32). The state has set up the target to reduce GHG emissions to 260 million metric tons of CO_2 equivalent ($MMTCO_2e$) by 2030.[7]

The program started in 2013 and currently covers approximately 85% of the state's GHG emissions.[9] There are approximately 450 covered entities across the sectors of large stationary sources, electricity generation (including imports), fuel distributors, and large industrial facilities.[10] Emissions covered under the cap-and-trade program fell in 2020 from the impact of the COVID-19 pandemic. 2020 covered emissions decreased from 311 $MMTCO_2e$ in 2019 to 278 $MMTCO_2e$ in 2020.[11] 2022 emissions are expected to touch 300 $MMTCO_2e$ as the state's GDP increases in the recovery. The program is expected to achieve a target of 200.5 $MMTCO_2e$ by 2030.[12]

[5] https://www.theice.com/marketdata/reports/278
[6] IHS Markit data as of December 31, 2021
[7] https://sgp.fas.org/crs/misc/R41836.pdf
[9] https://ww2.arb.ca.gov/sites/default/files/cap-and trade/guidance/cap_trade_overview.pdf
[10] https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems[]=45
[11] CRAB Cap-and-Trade Program Data: https://ww2.arb.ca.gov/our-work/programs/cap-and-trade-program/cap-and-trade-program-data
[12] https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list&systems[]=45

Figure 5. California Cap-and-Trade Emissions Market Price, Actual Emissions and Emission Caps



Source: California Air Resource Board, IHS Markit, California Carbon, Climate Finance Partners, December 2021

California Cap-and-Trade Program Market Mechanics

The California Cap-and-Trade Program was specifically designed to control about one-third of the state's overall quota of cumulative emission reductions required to achieve their 2030 target. The objective is to provide a market-based price signal that drives the energy transition with innovation and with a mechanism that discourages the risk of entities leaving the system.[13]

California and Quebec have linked cap-and-trade programs. Each jurisdiction has its own annual emissions cap, allowance supply, price containment reserve, and 2030 emissions target. Still, the base commodity or the California Carbon Allowance (CCA) is usable and tradable by all entities in either jurisdiction.

The California Cap-and-Trade Program maintains a restrictive lower price floor that increases by 5% plus inflation year-over-year. The price floor ($19.70 in 2022) sets the minimum price for carbon allowances in the auctions. A percentage of reserve allowances (3.7% of the annual CA cap, 7% of the annual QC cap) are set aside into two

[13] https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/about

carbon allowance reserve tiers or Allowance Price Containment Reserves (APCR) for sale in reserve auctions. If a previous auction settlement price exceeds 60% of the reserve trigger price, they are offered. The APCR is designed to contain prices should the demand for carbon allowances exceed auction supply. The APCR tier prices also increase at the same annual rate as the price floor.

The cap shrinks within the California Program by 4% annually, leading to a proportional shrinkage in free carbon allowance allocations. In the second half of this decade, free allocations to the industry will fall below 50-60% of entity annual emission obligations, increasing the compliance demand for allowances.

The auction mechanism acts as a righting mechanism for any reduced allowance demand. In 2020, the COVID-19 pandemic negatively impacted prices in the emissions market, and prices fell to a low of $12 on the ICE secondary market. The following two auctions of 2020 were undersubscribed, and carbon allowances from those auctions were withheld from the auction supply. Following two oversubscribed auctions, the withheld carbon allowances were re-introduced. By this time, CCA prices had recovered to above $20.

This price recovery, along with a diminishing free allocation or program cap, has attracted increasing financial participation with a "buy and hold" strategy, adding more upward price pressure. The market once traded within a dollar above the price floor, and it now sells over ten dollars above.

The increasing value of carbon allowances has resulted in greater revenue for the state. In the November 2021 auction alone, the state received $1.3 billion in revenue. Compared with the May 2021 auction, a $5 increase in the settlement price resulted in an additional $200 million of revenue. Most revenue is funneled into California's Greenhouse Gas Reduction Fund, which invests in low carbon transportation, infrastructure, and disadvantaged communities. Like the EU ETS, capital from California's Cap-and-Trade Program is earmarked for long-term infrastructure development, reducing downside policy risk.[14]

The California Cap-and-Trade Program will be reviewed this year. The 2022 Scoping Plan Update will assess progress towards achieving the Senate Bill 32 2030 target and lay out a path to achieve carbon neutrality by 2045.

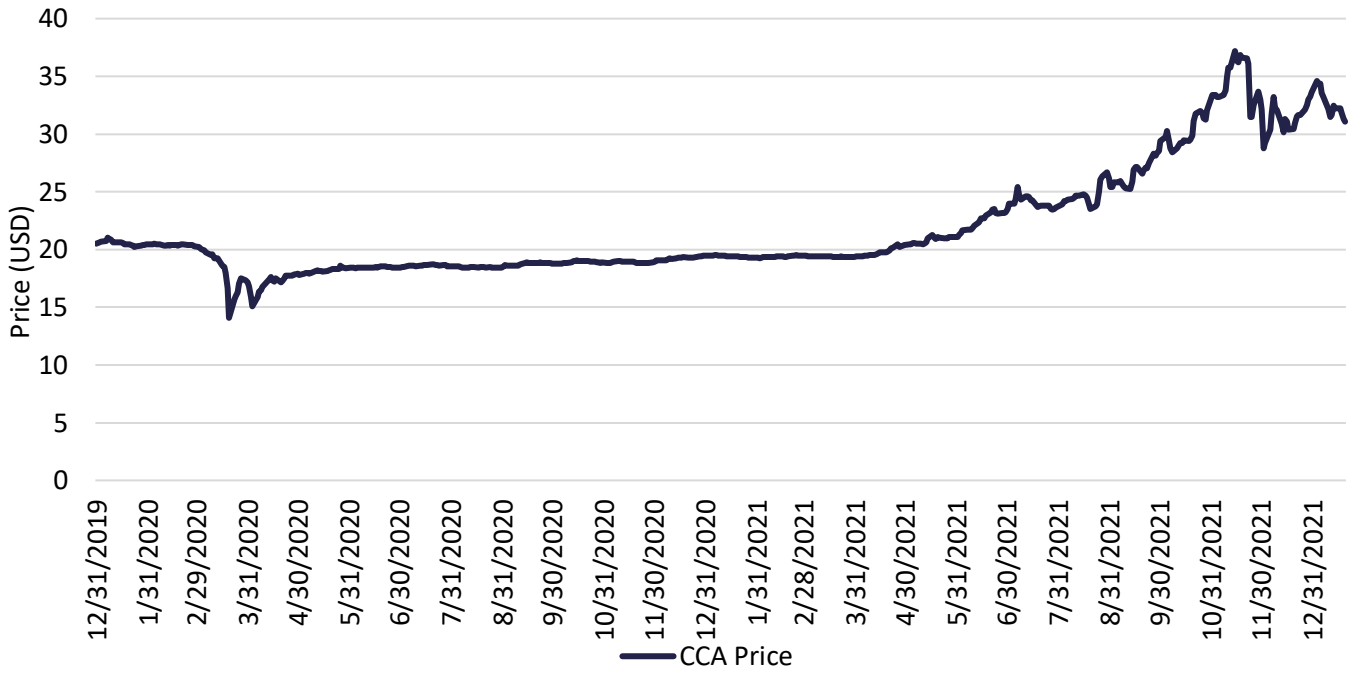
[14] https://lao.ca.gov/Publications/Report/4480

The review may lead to tighter caps starting in 2030.

California Cap-and-Trade Program Market Liquidity

The ICE CCA futures market saw trading volumes of ~12.5 billion in 2021. Trading activity peaked in the second half of 2021 around the approaching expiry of the December 2021 contracts. Market liquidity has improved dramatically post-2019 as market makers and hedge funds have moved into the market, signaling an increasing interest in carbon as an asset class. A consistent trend of the cap-and-trade is the tendency to recover from lows with V-shaped recoveries. Over time, CCA futures prices have increased steadily apart from a significant step up in 2021 when increased financial participation turned the overall market sentiment bullish.

Figure 5. California Cap-and-Trade Futures Price



Source: ICE Exchange, December 2021

Regional Greenhouse Gas Initiative (RGGI)

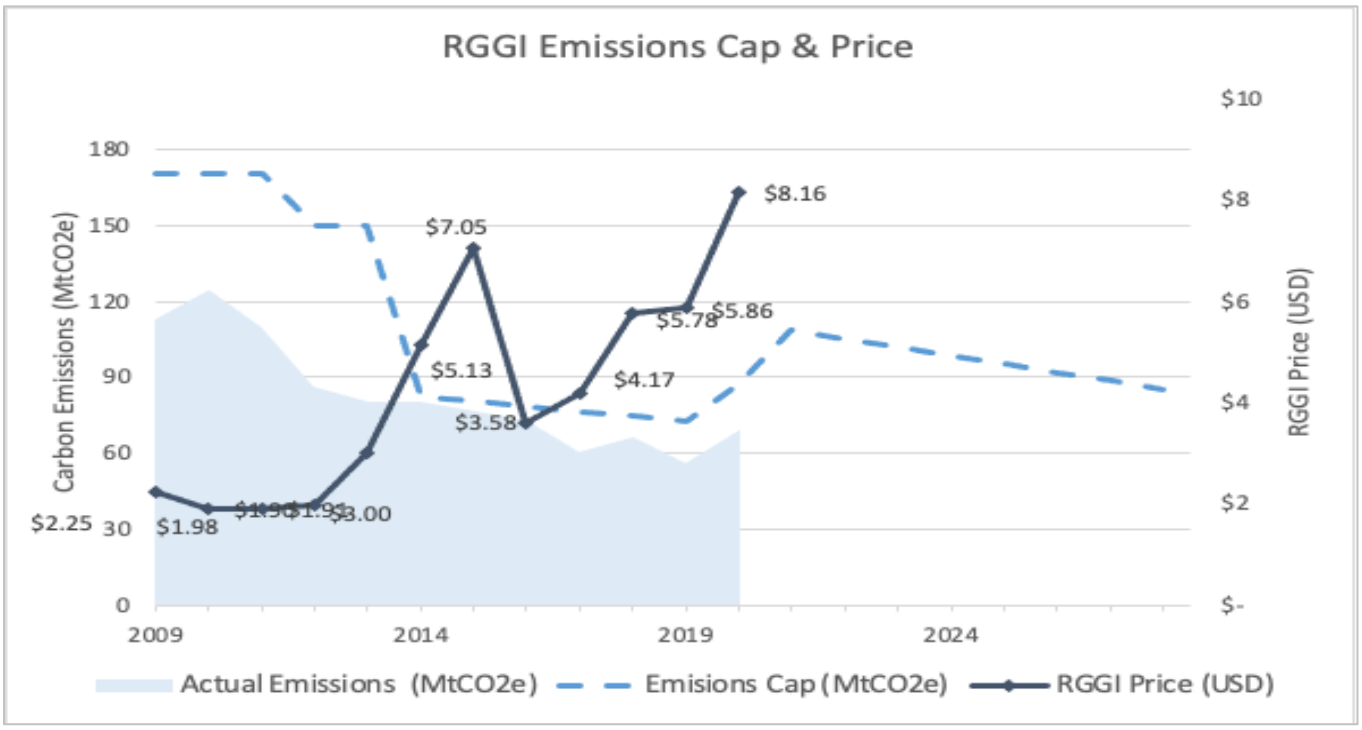
Established in 2005, the Regional Greenhouse Gas Initiative (RGGI) was the first ETS in the US, as an agreement between seven states in the Northeast. The initiative has since grown to eleven states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont, and Virginia). In the absence of a mandatory federal carbon market, RGGI was created as a test market to encourage the federal

government to take climate action. It was predicted that member states would increasingly use the market-based RGGI framework to meet climate objectives. The framework is built for regional expansion, broader industry coverage, the creation of more stringent targets, and increased demand for carbon allowances, ultimately contributing to the rise of prices over the next several years. Pennsylvania is expected to join the RGGI in early 2022[15], and North Carolina[16] has begun developing legislation.

RGGI covers the state's power sector emissions from generators larger than 25MW, which make up approximately 19% of the region's total GHG emissions from 217 fossil fuel generators.[17] RGGI mandates a 30% decline in carbon allowances, reducing the cap by 3.59M tons annually. Fewer carbon allowances are entering the market than provided for by the carbon allowance base budget, as RGGI introduced an adjusted budget to account for the excess allowances circulating in the market. Below, Figure 6 displays RGGI's actual emissions through 2020, the base carbon allowance budget, and the carbon allowance prices. The step-up in emissions caps in 2020 and 2021 is driven by expansion of the ETS to include New Jersey and Virginia, respectively.

[15] https://www.rggi.org/program-overview-and-design/design-archive
[16] https://www.nrdc.org/experts/luis-martinez/north-carolina-moving-forward-climate-regulations
[17] https://sgp.fas.org/crs/misc/R41836.pdf

Figure 6. RGGI Market Price, Actual Emissions and Emissions Caps



Source: Regional Greenhouse Gas Initiative, IHS Markit, Climate Finance Partners, December 2021

RGGI Market Mechanics

RGGI employs internal mechanisms to control price volatility and limit supply, including a price floor or minimum reserve price, Cost Containment Reserve (CCR), and an Emissions Containment Reserve (ECR). RGGI established a price floor of $2.20 in 2018 with a mandated 2.5% annual increase to reflect inflation. The reserve price for 2022 is $2.44. The CCR mechanism releases additional carbon allowances to the market when predefined price ceilings (trigger prices) are hit. A CCR trigger price of $10 was set in 2017, increasing to $13 in 2021 and increasing by 7% per year thereafter.[18] The CCR trigger price will nearly double within the decade to $24 in 2030, indicating that a higher cost of carbon allowances in the future is preferred.

RGGI introduced the ECR in 2021, which will automatically reduce the supply of allowances by 10% if prices fall below the ECR triggers. The ECR trigger price was $6.00 in 2021 and will rise at 7% per year after that. Since the program's inception, $4.7 billion in revenues have been collected and returned to RGGI states. The revenue is

[18] https://www.rggi.org/program-overview-and-design/elements

used for funding consumer benefit programs: energy efficiency, renewable energy, direct energy bill assistance, and other greenhouse gas reduction programs.[19]

The CCR and ECR mechanisms will act as a price band for future price movement. Currently, the futures price is trading at levels above the CCR, which will release from the reserve a maximum of 10% of the year's CO_2 allowance budget at the next auction, resulting in downward pricing pressure on the price as the supply of allowances increases.

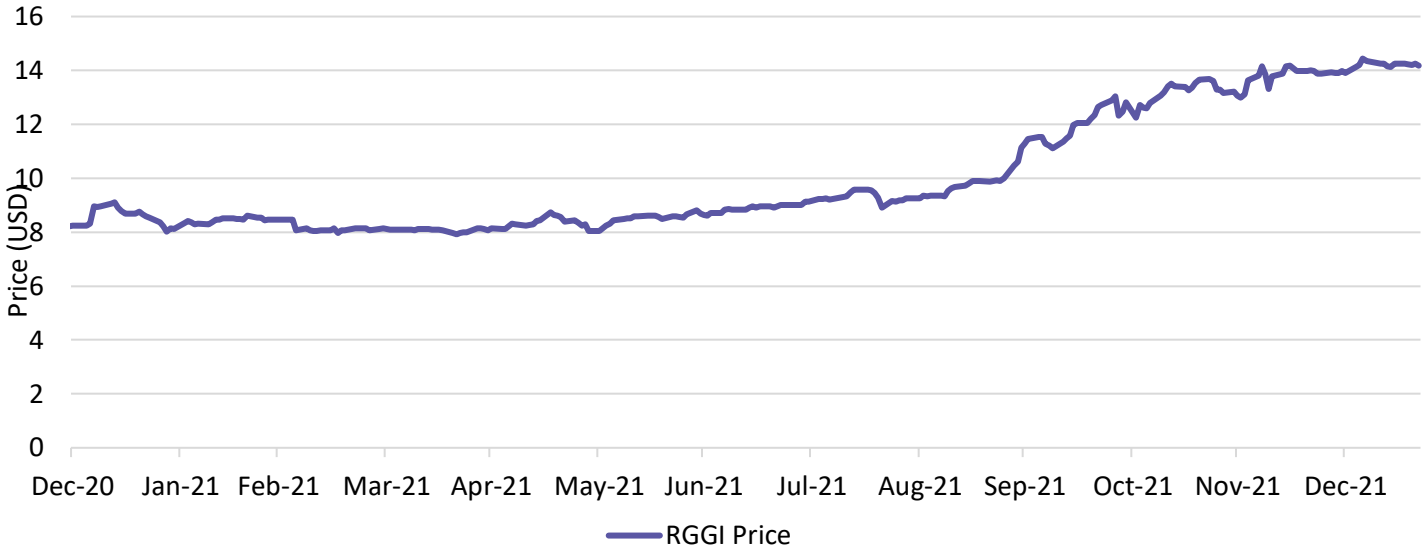
The RGGI market continues to expand. The potential addition of Pennsylvania and North Carolina will bring traditional fossil fuel giants under the ETS framework. RGGI is a multi-state program and tends to be less aggressive in pricing carbon emissions. The rate of GHG emissions in RGGI has decreased faster than that of the cap, and the historical trend is expected. Significant investments into offshore wind, battery technology, and ambitious electricity sector net-zero goals by RGGI states will boost renewable energy and further reduce carbon emissions.

RGGI Market Liquidity

The RGGI futures market has had total notional trading volumes of roughly $1.6 billion in 2021. In 2021, investors bought 47% of auctioned carbon allowances steadily pushing the ICE secondary market above the CCR. The potential addition of Pennsylvania[20] and North Carolina[21] will include more participants under the ETS framework, increasing market liquidity.

[19] https://www.rggi.org/investments/proceeds-investments
[20] https://www.dep.pa.gov/Citizens/climate/Pages/RGGI.aspx
[21] https://www.nrdc.org/experts/luis-martinez/north-carolina-moving-forward-climate-regulations

Figure 7. RGGI Futures Price



Source: ICE Exchange, December 2021

II. Portfolio Diversification

Given the growth and liquidity in the largest markets, many investors are now considering the potential portfolio implications of an investment in carbon allowances. As a newer area of focus from the investment community, carbon allowances stand out for their continued growth potential and low correlation to major asset classes. Let us look at how carbon prices performed versus traditional asset classes since index inception, from August 2014 through December 2021. Table 1 shows return and risk statistics for carbon allowances and other key asset classes over the period, while Table 2 shows correlations:

Table 1. Performance of Carbon Allowances vs. major asset classes, Aug 2014 - Dec 2021

	Global Carbon Allowances	US Equities	Bonds	Commodities
Annualized Return (%)	31.7%	15.2%	3.1%	-1.4%
Annualized Volatility (%)	29.7%	14.2%	3.1%	24.0%
Sharpe Ratio	1.06	1.01	0.77	0.03

Sources: Bloomberg, IHS Markit, Yahoo Finance. Equities: S&P 500; Bonds: The Barclays Aggregate Bond Index; Commodities: The S&P GSCI. Index returns are for illustrative purposes only and do not represent actual Fund performance. Index returns do not reflect management fees, transaction costs, or expenses. Indexes are unmanaged, and one cannot invest directly in an index. Past performance does not guarantee future results.

Table 2. Correlation of Carbon Allowances vs. major asset classes, Aug 2014 - Dec 2021

Correlation	Global Carbon Allowances	US Equities	Bonds	Commodities
Carbon Allowances	1.00	0.35	0.01	0.33
US Equities	0.35	1.00	0.00	0.54
Bonds	0.01	0.00	1.00	-0.18
Commodities	0.33	0.54	-0.18	1.00

Sources: Bloomberg, IHS Markit, Yahoo Finance. Equities: S&P 500; Bonds: The Agg; Commodities: The S&P GSCI.

Over the past 7 years, global carbon allowance prices have returned over 31% with around 30% volatility. Market dynamics partially explain the increased volatility in response to supply-demand factors, making carbon allowances behave similarly to commodity markets, which exhibit higher volatility than equity markets. The amplified market response to new information may also be due to the low penetration of financial actors, who typically bring stabilizing effects in commodity-like markets. The latter point may indicate that fundamental signals are primary drivers in these markets. The comforting factor is that carbon allowance futures have exhibited a low correlation to other asset classes: 0.35 to equities and 0.33 to commodities (Table 2). Consequently, the diversification benefits of carbon allowance exposure can more than compensate for the commodity-like volatility in a portfolio context. To demonstrate that, let us see what happens to a traditional equity portfolio represented by the S&P 500 if one allocates 5% to carbon allowance futures, using the same historical data as above. Table 3 presents the results, where the first column shows the original equities portfolio, the second column shows this portfolio with a 5% allocation to carbon allowance futures, and the third column displays the percent change in performance statistics:

Table 3. Impact of adding Carbon Allowances to an Equities Portfolio, Aug 2014 - Dec 2021

	Original Portfolio	5% Allocation to Carbon Allowances	% Change
Annualized Return (%)	15.2%	16.2%	6.6%
Annualized Volatility (%)	14.2%	14.0%	-1.4%
Sharpe Ratio	1.01	1.08	6.8%

Sources: Bloomberg, IHS Markit, Yahoo Finance. Equities: S&P 500. Index returns are for illustrative purposes only and do not represent actual Fund performance. Index returns do not reflect management fees, transaction costs, or expenses. Indexes are unmanaged, and one cannot invest directly in an index. Past performance does not guarantee future results.

One can see that due to the low correlation of carbon allowances with equities, the combined portfolio decreases its volatility by about 1.4%, while the expected percent change in the annualized return is increasing by 6.6%, with an overall percent change in the Sharpe Ratio increasing by 6.8%.

Similarly, let us see what happens to a more conservative portfolio with 60% in equities represented by the S&P 500 and 40% in bonds represented by the Bloomberg Barclays US Aggregate Bond Index ("The Agg"). Table 4 presents the results, where the first column shows the original 60/40 portfolio, the second column shows this portfolio with a 5% allocation to carbon allowances, and the third column displays the percent change in performance statistics.

Table 4. Impact of adding Carbon Allowances to a 60% Equities and 40% Bonds Portfolio, Aug 2014 - Dec 2021

	Original Portfolio	5% Allocation to Carbon Allowances	% Change
Annualized Return (%)	10.5%	11.7%	11.4%
Annualized Volatility (%)	8.6%	8.8%	2.3%
Sharpe Ratio	1.11	1.21	8.9%

Sources: Bloomberg, IHS Markit, Yahoo Finance. Equities: S&P 500; Bonds: The Agg. Index returns are for illustrative purposes only and do not represent actual Fund performance. Index returns do not reflect management fees, transaction costs, or expenses. Indexes are unmanaged, and one cannot invest directly in an index. Past performance does not guarantee future results.

While the percent chance of risk to the portfolio increases slightly by 2.3%, the expected return increases by

a much more significant percentage change of 11.4%, resulting in a Sharpe Ratio percent change improvement of 8.9%.

Another angle to the diversification benefit is that the world is tackling increased social costs of GHG emissions and climate change. The investment in carbon allowances may act as a hedge for the portfolios of companies exposed to the increases in the cost of emissions. According to an environmental data and research provider, Trucost, companies that pay a low price at present may face much higher costs in the future, with their profitability exposed to carbon price increases. At the same time, the rise in costs of carbon emissions is expected to drive up carbon allowance prices, providing hedging benefits to the portfolio.

One should note that the above examples were deliberately simplified for illustrative purposes, while the real-life allocation decisions may be more involved and complex. Nevertheless, they indicate the potential benefits of carbon allowances as an asset class that provides an attractive proposition for portfolio diversification.

III. Impact Investing: The Case for One Ton of Carbon Emissions and Investment in Carbon Allowance Futures

On top of being a potential portfolio diversifier, it is also worth examining investment in carbon allowance futures from an impact investment lens. Investing in carbon allowance futures supports liquidity and efficiency in the largest and most heavily traded emissions markets. Additional financial participants buying and selling increases the market's efficiency in doing what it does best: effectively allocating resources. These markets have a significant impact on reducing CO_2 emissions.

The EU Emissions Trading System, the California Cap-and-Trade Program, and the Regional Greenhouse Gas Initiative have been instrumental in enacting positive climatic change -namely, reducing GHG emissions - in their respective regions. To view a summary of emissions reductions, please reference Table 5 below.

Table 5. Actual Emissions Decrease in ETS Regions from the 1st Auction Year to 2019

	CCA	RGGI	EUA
ETS 1st Auction Year	2015	2009	2005
Actual Emission at 1st Auction Year	340.3	97.0	2,014.1
Actual Emissions 2020	278.7	69.6	1,355.0
Difference	61.6	27.4	659.1
Decrease %	18%	28%	33%

Source: European Environment Agency, California Carbon, Climate Finance Partners, December 2019

On a macro basis, establishing a carbon allowance price provides a valuable benchmark to businesses and government that will raise awareness and, in due course, cause a change in planning and behavior at all levels of society, business, government, and individuals (carbon footprint pricing). On a micro basis, an investment in carbon allowance futures will contribute to reducing carbon emissions by providing capital and liquidity to the underlying system designed to reduce carbon emissions efficiently.

IV. Conclusion

Carbon markets have come a long way over the last twenty years, and we expect to see these markets continue to grow and develop. 2021 stood out as a year with several significant achievements reflecting the increasing regulatory support and political momentum. Highlights from the year included Europe strengthening and tightening its compliance market with the "Fit for 55" package, positive developments from the COP26 Summit in Glasgow, and Virginia becoming the latest state to join the RGGI. New markets such as the UK and China also came online, with Korea opening to international access. Carbon allowances are emerging as a unique and investible asset class with significant growth potential, diversification benefits, and a positive impact story.

Contact Julian Daniels (julian.daniels@kraneshares.com) or Florence Moon (florence.moon@kraneshares.com) for carbon allowance investment opportunities.

Biographies

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