Carbon^Re

Carbon taxes set to revolutionise cement production

Strategic choices on how to abate carbon emissions will fundamentally change the competitiveness of each cement producer.

Who we are

We are a company pushing the boundaries of artificial intelligence to accelerate the decarbonisation of cement and other foundational materials. Carbon Re's innovative AI-powered software optimises cement production, specifically targeting the pyroprocess stage to reduce fuel-derived carbon emissions by up to 5%.

Our solution integrates seamlessly with plant Advanced Process Control (APC) systems like ABB Ability™ and FLSmidth ECS/ProcessExpert®, using AI models that continuously adjust in closed-loop control to optimise fuel use and manage fuel-mix variability.

By integrating with Carbon Re, plants can utilise a broader set of their process, laboratory and chemical data. Our advanced machine learning models enable real-time, dynamic optimisation of process targets, automating repetitive manual tasks and allowing process engineers to focus on more impactful work.

Carbon Re requires no capital investment, new equipment, or plant shutdowns. It supports ongoing plant optimisation, adapting to changing inputs and external pressures such as volatile fuel costs and emissions regulations. The result is significant energy savings, allowing operators to run plants at peak efficiency and realise substantial cost reductions.

Find out more at carbonre.com/product/

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Executive summary

Future changes to the Emissions Trading Scheme in the European Union will significantly impact carbon emissions from cement production, a process which is one of the top global sources of greenhouse gases. Cement producers will need a portfolio of short-term changes they can scale across all their cement plants alongside, in the longer term, as of yet uncertain new low carbon technologies. Strategic choices on how to abate emissions will fundamentally change the competitiveness of each cement producer.

Cement and steel production are industrial processes that produce a significant share of all global emissions, each creating around 8% of total global emissions every year. The primary vehicle to move to net-zero emissions from cement production will be the introduction of 'compliance markets', a regulated market for the pricing of carbon equivalent emissions which makes carbon intensity of cement production a fundamental factor in decision-making for clients and producers of cement. These are often referred to as 'Emissions Trading Schemes' or 'Cap and Trade Schemes'. With recent prices in the range of €60 to €90 / tonne of Net CO_2e, the scheme in the European Union has been effective at driving down carbon emissions in industry and energy production.

Cement production is included in the EU's Emissions Trading Scheme; however, they are issued a 'free allowance' of carbon credits at no cost, in line with their historical emissions. The amount of free allowances issued has gently declined over time, currently a fall of 2.2% per annum, as an incentive for cement producers to reduce emissions. Our analysis shows that cement producers have achieved a circa 1.0% p.a. reduction over the last three years, adjusted for changes in the volume of cement production. From 2005 to 2022, many cement producers received financial windfalls from the Emissions Trading Scheme by selling unused carbon credits issued to them as part of the free allowance.

The EU is currently negotiating the introduction of a 'Carbon Border Adjustment Mechanism', which will have the effect of removing all these free allowances worth around €8 billion the EU's cement producers at the current average price of €80 per tonne of Net CO_2e ("Net Carbon Equivalent emissions"). Given the competitive nature of the cement industry, we expect these increased costs from buying carbon allowances will be passed on to clients through raising cement prices. Some of the unintended consequences of how the Emissions Trading Scheme was originally designed for cement will be removed at the same time as these free allowances, such as an incentive to use a high proportion of 'clinker' in cement, which drives up carbon emissions.

Given the expected rapid changes to the industry environment for cement producers, scalable solutions are required to reduce carbon emissions quickly. Many technologies are in development but most of these solutions either will need time to be proven in use or are not widely scalable.

Cement producers outside the European Union also have an incentive to follow these changes closely. It may be significantly more or less attractive to export cement to the European Union, and the global roll-out of Emissions Trading Schemes is well underway.

Carbon taxes & cement: compliance and voluntary markets

Cement production, alongside steel production, is a process that creates a massive amount of greenhouses gases, with around 8% of total annual global emissions. Cement is the crucial ingredient in concrete, and demand for concrete remains globally consistent given rapid urbanisation in many countries. Attempts to move to less carbon-intensive building products are restricted by the limited availability of alternative materials (e.g. sustainable wood); and cost.

The primary mechanism for driving down carbon emissions has been in two forms of carbon pricing: a 'voluntary market' and a 'compliance market'.

In the voluntary market, organisations and individuals choose to pay others to reduce their net carbon emissions for them, such as through investment in the natural environment. Prices are typically in the range of €3 to €15 per tonne of Net Carbon Equivalent Emissions (t Net CO_2e). Whilst there are widespread concerns about the 'quality' of these savings, particularly in Asia,[1] the COP conference in Glasgow in 2021 finally agreed to implement plans developed in Paris in 2015 for an aligned approach on how offsets can feature as part of carbon emission reduction plans.[2] There are further concerns that a focus on offsetting emissions delays action to change the root causes of emissions.

Compliance markets are regulated environments such as in the European Union, UK, South Korea and California, often called 'Emissions Trading Schemes', where local or national laws control carbon emissions. These have much higher carbon prices, currently in the range of €60 to €90 / t Net CO_2e,[3] and have been highly successful at driving down carbon emissions.[4, 5]

CARBON PRICES IN THE EUROPEAN UNION (EURO PER TONNE CO_2e)

SOURCE: https://ember-climate.org/data/data-tools/carbon-price-viewer/

1 https://www.offsetguide.org/concerns-about-carbon-offset-quality/

2 https://www.reuters.com/business/cop/outline-carbon-markets-deal-emerges-un-climate-summit-2021-11-13/

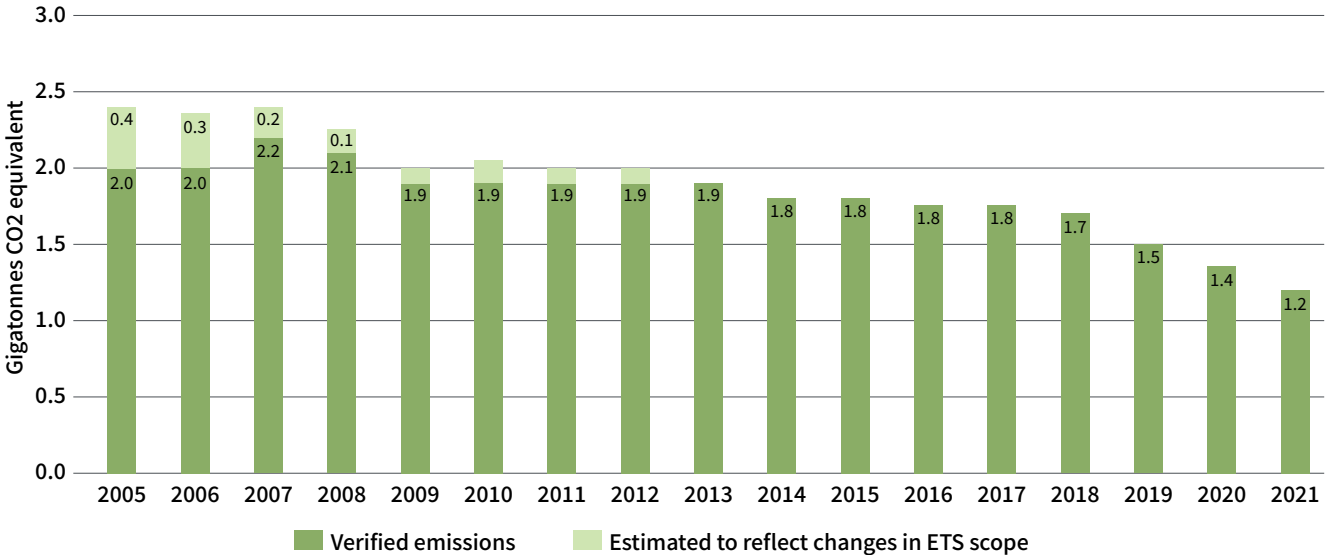
3 https://www.reuters.com/business/energy/europes-carbon-price-nears-100-euro-milestone-2022-02-04/

4 https://www.pnas.org/doi/10.1073/pnas.1918128117

5 https://energytransition.org/2020/11/the-eus-emissions-trading-scheme-is-finally-becoming-a-success-story/

The European Union has the largest Emissions Trading Scheme. Having tackled big emission producing sectors such as electricity production, it has only partly attempted to deal with other sectors such as cement, steel, aviation and maritime. It covers around 45% of the EU's greenhouse gases with this scope.[6] Cement producers have so far avoided the significant negative impact of carbon taxes on their carbon emissions as they have been issued with free allowances to cover their typical average emissions: they only have to buy credits if they emit more than average, and they can sell credits if they emit less than usual.

EMISSIONS IN THE EUROPEAN UNION FROM 15,000 INDUSTRIAL SITES REPORTING THROUGH THE EMISSIONS TRADING SCHEME



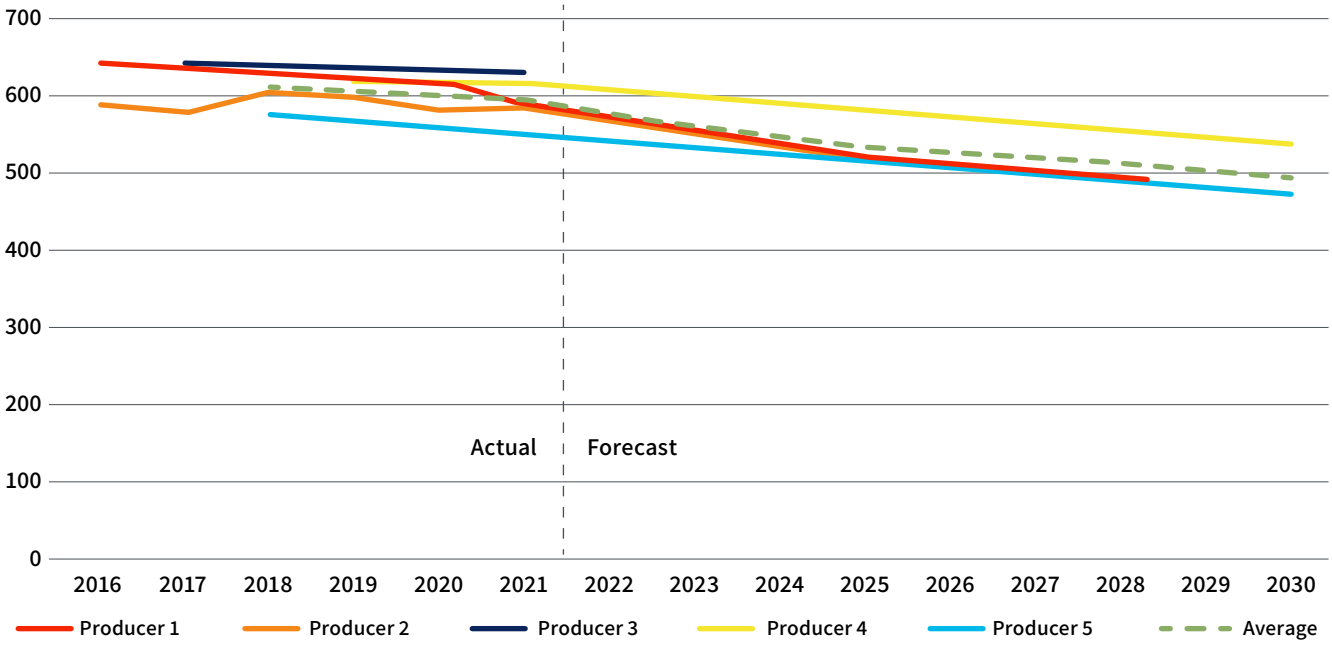
SOURCE: https://www.eea.europa.eu/data-and-maps/dashboards/emissions-trading-viewer-1

6 https://energytransition.org/2020/11/the-eus-emissions-trading-scheme-is-finally-becoming-a-success-story/

Performance trends against increasing targets

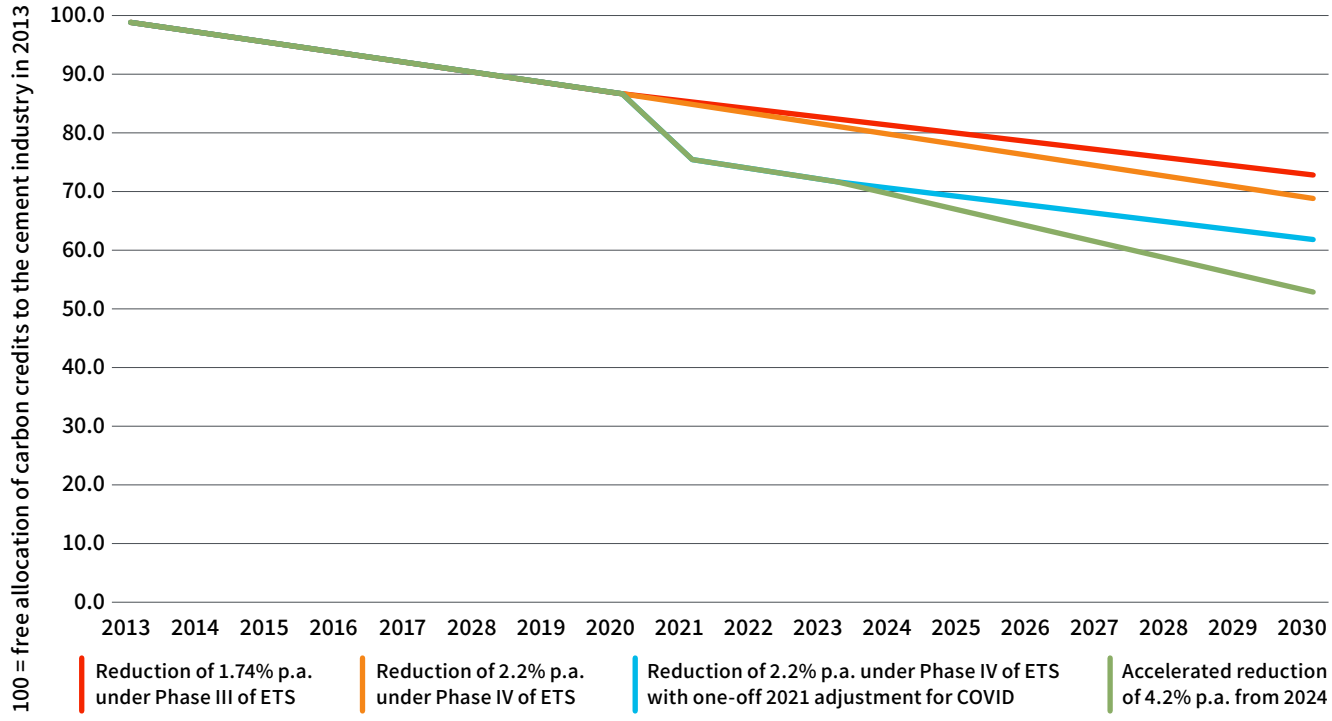
The level of free allowances has gone down slowly over time at 2.2% p.a, as an incentive for producers to reduce their emissions. Our analysis of five large European cement producers shows that they have so far not managed to reduce their emissions in line with this target, achieving a 0.9% p.a. reduction on average over the last three years. Three of these producers have published targets through to 2030 which, if achieved, would lead on average to a 2.0% p.a. reduction over the period.

NET KG CO2e PER TONNE OF CEMENTITIOUS MATERIALS



SOURCE: Carbon Re analysis of listed cement producers operating in the European Union, 2022

CHANGE IN EUROPEAN UNION ETS ALLOWANCE FREE ALLOCATION TO CEMENT INDUSTRY FROM 2013 BASELINE



SOURCE: Carbon Re analysis, 2022

As free allowances are issued according to historical production levels, step falls in production in 2008 (from the financial crash) and 2020 (from COVID) have given Cement producers one-off financial windfalls. Free allowances were allowed to slowly reduce to match the reduced production levels following the crash in 2008, whilst in 2020 the European Union chose to make a one-off step change down of 13% so that allowances adjusted more quickly to the new production levels. In 2021, the EU agreed that the free allocation of carbon credits would fall by an accelerated level of 4.2% p.a[7] from 2024 At this increased rate, the difference between the free allowances (falling 4.2% p.a.) and cement producers' emissions (declining 2.0% p.a.) at current carbon pricing levels will be worth around €180m p.a., either impacting producer's profit levels or driving up cement prices.

7 https://hsfnotes.com/energy/2021/07/27/fit-for-55-eu-proposal-for-amendments-to-the-ets-system/

After a long period of being net sellers of carbon credits, cement producers will become net purchasers

Take the example of CRH, a building materials company based in Ireland. Globally, cement accounts for $5bn of their total $31bn revenues, with 70% of this in Europe and the remaining 30% in the US. Annually they make around 36 million tonnes of cement and produce approximately 21 million tonnes of net CO_2 equivalent emissions from the cement plants.[8] At current typical prices of €80/t Net CO_2e, if the companies had to pay for all their emissions, they would need to purchase around €1.2bn in carbon credits each year for their European cement plants. Whilst cement is only a third of their revenues in Europe, these €1.2bn of carbon credits would significantly outweigh their operating profits in the region from all activities of €0.8bn in 2021.

Accounting for free carbon credit allowances

The **International Financial Reporting Standards** foundation (IFRS) has removed its guidance on how companies should account for any carbon credits issued for free. As a result, all listed cement companies in the European Union have chosen to consider them as having nil value, allowing them to exclude them from their annual reports and financial balance sheet. One exception is Vicat, which declared they hold a balance of 4.8 million tonnes of unused credits, worth €0.4bn at current prices: equivalent to their total work-in-progress and inventories for all their operations.

Whilst we do not know how many credits each company holds, we can see recent transactions:

- Cemex profits from the sale of €600m worth of carbon credits in 2021, making up most of their €731m operating profit.
- FCC profits from the sale of €59m worth of carbon credits in 2021, making up a large part of their €140m operating profit.
- Buzzi Unicem in Italy profits from the sale of €6m worth of carbon credits in 2021, out of their total €40m operating profit for the year.

8 https://www.crh.com/media/4081/crh-annual-report-2021.pdf

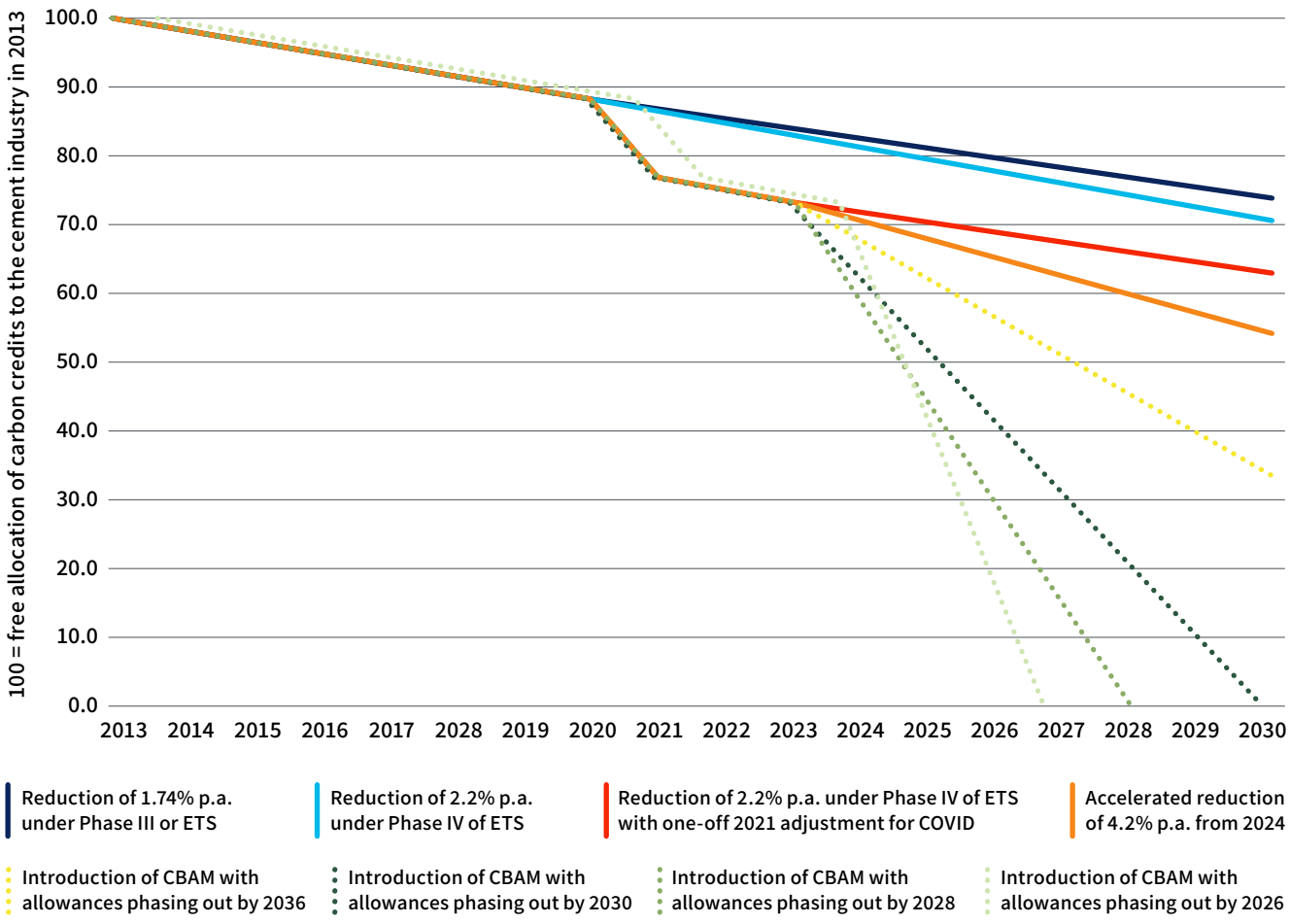
Free allowances will start to go soon and could be gone within three years

The rationale for issuing free allowances of carbon credits in Europe is to avoid the risk of encouraging lower-cost imports from outside the region, from producers who do not need to pay the total cost of carbon emissions. **The EU has now designed a mechanism to deal with this called the 'Carbon Border Adjustment Mechanism' (CBAM)**: whilst its final details are still taking shape, CBAM is effectively a carbon tax on all imports that should create a level carbon playing field. Companies that pay a carbon tax locally in their market don't have to pay.

Cement is the #1 priority for the CBAM and is likely to be the test case with other industries such as steel to follow later. Unlike steel, it is uneconomical to ship cement over long distances due to its weight compared to its value. This makes 'carbon leakage' less likely if the Carbon Border Adjustment mechanism doesn't work as planned. The estimate for cross border trade in cement is currently only around 3% of total production.[9, 10]

The question for cement and the CBAM is not 'if' all the free allowances will be removed but when. As

CHANGE IN EUROPEAN UNION ETS ALLOWANCE FREE ALLOCATION TO CEMENT INDUSTRY FROM 2013 BASELINE



SOURCE: Carbon Re analysis of listed Cement producers operating in the European Union, 2022

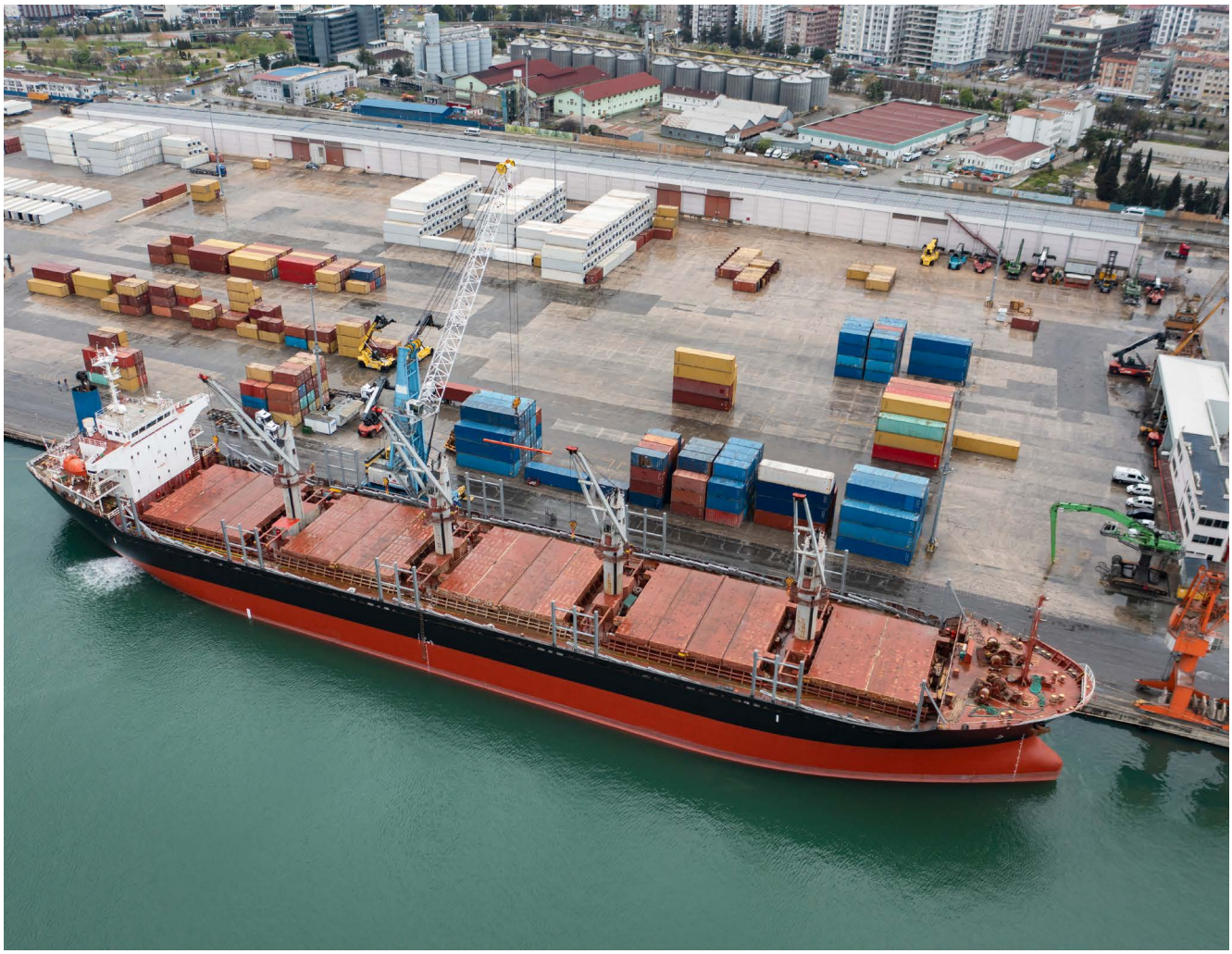
9 https://tradeviews.net/understand-global-cement-trade-101-guide/

10 https://www.worldcement.com/africa-middle-east/29042013/cement_global_trading_patterns_961/

shown in the chart opposite, four end dates have been proposed so far, with the phasing out due to start possibly as soon as 2024.

- **2036:** The initial draft of legislation before the European Council has all free allowances phased out by 2036[11]
- **2030:** The European cement association, Cembureau, has publicly called for a transition period to 2030
- **2028:** The initial draft proposal before the European Parliament had an end date of 2028[12]
- **2026:** The European Parliament's 'rapporteur' evaluating the impact of the proposed legislation has said he considers a complete phase-out of free allowances by the end of 2025 as he considers European cement producers are not exposed to carbon leakage risks.[13,14]

In March 2022, the European Council made further progress in defining how CBAM will work but did not address the question of how and when the free allowances will be phased out.[15] In early June 2022, the European Parliament rejected the latest proposal due to divisions between those who wanted to accelerate the removal of free allowances, and others who wanted free allowances under the scheme to continue for much longer.[16]



11 https://icapcarbonaction.com/en/
12 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CONSIL:ST_7226_2022_INIT&from=EN
13 https://ukandeu.ac.uk/the-facts/what-is-cbam/
14 https://viewpoints.reedsmith.com/post/102hfs2/the-lead-rapporteur-at-the-european-parliaments-environment-committee-proposes-b
15 https://www.energymonitor.ai/policy/cbam-advances-but-big-battles-remain
16 https://balkangreenenergynews.com/european-parliament-delays-decision-to-introduce-carbon-border-tax-cbam/

Planning for a world where carbon is a real cost for cement

When considering the removal of free allowances, the European Commission estimated the cement industry would be allocated on average 100 million free credits p.a. until 2030. At current prices of €80 / tonne, that will be an additional €8 billion annual revenue for member states to invest in climate action.

The low profit margins typical for the cement industry are likely to mean that producers will try to pass on the cost of carbon credits to clients once the Carbon Border Adjustment Mechanism is introduced. Using the average 600 kg Net CO_2e per tonne of cementitious material, and a current carbon price of €80 per tonne emissions means a cement price increase of €48 per tonne over typical prices of €60 – €80 per tonne of cement, a 60 – 80% price increase.

AN EXAMPLE: A typical house of average size (120m²) will cost around €200,000 to build. Around 25 tonnes of cement will be required in its construction. The increase in construction cost per house arising from higher CO_2 costs will therefore be €1,200. This is a negligible increased cost of around 0.6% on the cost of the house. The real impact of passing on CO_2 costs to cement is to differentiate between high and low CO_2 cements.

In a competitive market focused on cost to produce rather than product differentiation, the ability to minimise the purchase of carbon credits is likely to lead to a significant cost advantage over competitors. Where this is achieved through efficiency gains in production, producers have the

added benefit of lower fuel costs. It is also likely to lead to a lower carbon product, more attractive to clients under pressure to minimise the carbon footprint of their buildings.

Government procurement policies are likely to support the change

Governments are the primary end purchasers of cement, driven by large infrastructure projects such as the HS2 high-speed rail line in the UK, the Genoa San Giorgio bridge in Italy and the Long Beach International Gateway in the USA. Therefore, government procurement policies could play a key role in defining standards for low carbon cement.

Taking the example of HS2, currently the largest infrastructure project in Europe, the overall programme is expected to use 13 million tonnes of cement in just the first phase,[17] greater than the total annual production in the UK of 10 million tonnes each year.[18] With no free allowances, the expected cost of carbon credits to cover emissions from cement production would account for €0.2bn on top of the total estimated budget of €44.6bn for the programme (0.4%). The Colne Valley Viaduct alone will use 140,000 tonnes of cement, equivalent to 82,600 tonnes of Net CO_2e emissions with a carbon credit value of €6.6 million at €80/tonne Net CO_2e.

The government in the Netherlands has successfully implemented a low carbon procurement policy where total CO_2 emissions have decreased beyond expected rates.[19] In the USA, there has been a noticeable uptick in state adoption of green procurement policies since 2019, with Hawaii leading the way. Green concrete procurement policies adopted by the City of Honolulu in 2019 (Council Resolution 18-283) became the blueprint for a unanimous resolution by the US Conference of Mayors.[20] As of 2020, the City of Portland, Oregon, requires disclosure of embodied carbon content for concrete used for all city-led projects and provides financial incentives to assist concrete producers in complying with this legislation. Also, in 2020, California's Marin County passed the Bay Area Low-Carbon Concrete Codes, which set maximum limits for the usage of cement in concrete based on carbon emissions. Finally in the USA, President Biden in 2022 has launched his 'buy clean' task force to promote the use of construction materials with lower lifecycle emissions.[21] Outside the USA, the UK and India are championing an "Industrial Deep Decarbonisation Initiative" (IDDI) to stimulate global demand for low carbon cement and steel through the power of procurement.

The cost of fuel needed to heat the kiln is a key factor in the overall cost of cement, at 25 – 50% of total production costs. It used to be that the cheapest fuel in terms of £/GJ was the most polluting and had the highest carbon footprint: coal. The impact of the war in Ukraine has made coal less attractive, with coal prices increasing from a 10-year average of $80 per tonne to over $400 per tonne.[22]

17 https://www.newcivilengineer.com/latest/concrete-shortages-blamed-on-hs2-and-hinkley-02-11-2021/

18 https://cement.mineralproducts.org

19 https://www.frontiersin.org/articles/10.3389/fclim.2021.686787/full#B23

20 https://www.usmayors.org/the-conference/resolutions/?category=a0D4N00000FDDPaUAP&meeting=87th%20Annual%20Meetinghttps://www.capitol.hawaii.gov/Archives/measure_indiv_Archives.aspx?billtype=HB&billnumber=1282&year=2019

21 https://www.reuters.com/business/sustainable-business/biden-launch-buy-clean-us-government-task-force-2022-02-15/

22 https://tradingeconomics.com/commodity/coal

A mix of short-term and long-term solutions

In our view, the winners in cement production over the next decade are likely to be those companies that can drive down their energy usage at the same time as constantly adjusting their fuel mix to balance both volatile fuel prices with the carbon cost of the different fuel choices.

A wide variety of alternative technologies are proposed to address the high carbon emissions from cement production. These include carbon capture and storage, green hydrogen as a primary fuel, carbon 'curing' injection in concrete, and the use of alternative cementitious materials such as blast furnace slag and fly ash from coal power stations. Whilst we expect all these technologies to have a role to play in the carbon reduction of cement, none are ready to have a material impact on the entire 200 million tonnes annual production[23] of cement in the European Union by the end of the free carbon credit allowances.

The consensus is that the first few phases of the Emissions Trading Scheme in the EU have inhibited innovative solutions to carbon emission reduction rather than driven a step change. The EU has recently become a net exporter of cement as a result of one of the unintended consequences of the current Emissions Trading Scheme, including:

1. Cement producers need to operate their plants at least at 50% of their maximum capacity to be eligible for free carbon credits. Given the value of these credits there is a strong incentive for producers to keep otherwise unprofitable plants going and at higher activity levels than they would otherwise.[24]

2. The metric used to define the amount of free allowances due to a cement producer is the amount of clinker production rather than cement production. A key way to reduce carbon emissions from cement production is to reduce the proportion of clinker[25] in the mix. As such limited progress has been made in the EU on using alternative cementitious materials. Our research shows that the four largest cement producers in the EU have an average ratio of 78% clinker in cement, compared to a global average of 72%.

23 https://cembureau.eu/about-our-industry/key-facts-figures/

24 https://assets.publishing.service.gov.uk/media/5329dfb440f0b60a730002d1/policy_and_regulation_cement_excised.pdf

25 "Clinker" is a solid lumpy grey intermediate material in cement production created from heating ground limestone to over 1500°C

Cement producers in the EU require immediately scalable solutions to minimise their emissions over the next three years

After re-considering production levels at each cement plant and optimising the amount of clinker in cement (the "clinker factor"), the critical factor in minimising emissions will be optimising cement kiln operations:[26]

- Optimising the current fuel mix
- Accelerating the use of alternative fuels
- Optimising production decision making and kiln through-put

All 2,309 cement plants worldwide are unique: using different equipment, different raw material sources, and different fuel mixes in different local environments. As such, local solutions are required, and there will be a limit to the company-wide changes the large cement groups will be able to roll out.

10% reduction in fuel consumption

Using scalable AI to deliver a step-change reduction in carbon emissions

Carbon Re has developed an AI-powered software platform that can optimise production control parameters in the cement plant kiln. The AI system learns by finding relationships between the plant operating data in the same way a human does. These data and insights are displayed so that the plant operator can visualise the information being used by the software to make the optimisation decision and build confidence that "the system thinks as we think."

The recommendations provided by the AI system allow the operator to consider optimisation decisions simultaneously with production targets and quality targets. The system acts as a co-pilot: it recommends settings, but the operator is always in control, and it is the operator who sets limits and authorises changes. Live performance reviews produce recommendations that plant operators can accept or reject.

Carbon Re can enable cement plant operators to achieve a 10% reduction in fuel consumption and up to 20% in fuel-derived carbon emissions.

Fuel consumption reductions are primarily achieved by optimising excess air ratios to minimise energy loss to the stack and tailoring heat input to the specific raw materials. In addition, performance improvements are achieved through changes to fuel mixes to achieve the same energy content with lower fuel-derived carbon emissions.

Optimisation is an hourly and daily process, not a one-off adjustment in control settings. Achieving the 10% savings in energy requires regular minor adjustments of parameters by a few percentage points. As the input parameters are constantly changing, so are the recommendations. These benefits result from powerful machine learning algorithms and artificial intelligence working through the massive plant datasets, finding optimisations as operating parameters change throughout the day.

26 From the 0.59 tonne CO_2e emissions per tonne cement, the chemical reaction to create clinker accounts for 0.33 t CO_2e / t cement, thermal fuel accounts for 0.24 t CO_2e / t cement, whilst electricity use accounts for only 0.03 t CO_2e / t cement [ref].

The complexity of alternative fuels

Being a cement plant operator has meant facing enormous and ever-increasing challenges in the last decade. To reduce fossil fuels (coal, petroleum coke, and natural gas) and take advantage of lower prices, cement producers are increasingly switching thermal energy for the kiln to a blend of alternative fuels such as biomass, industrial waste, domestic waste, or dried sewage.[27]

The composition of the alternative fuels will also affect the production process in different ways, from moisture levels to volatile contents and particulate size.[28] All these different interactions from alternative fuels add complexity to decision-making on plant control parameters.[29] AI can simulate the impact of potential fuel mix combinations and learn the relationship between performance and blending of different alternative fuels.

Our calculations show that for the global average cement plant, producing 1.8 million tonnes of cement p.a., an 8% saving in thermal fuel costs is worth US $1.3 million p.a., whilst an equivalent 20% saving in fuel-related carbon emissions from the kiln would be worth US$6.9 million p.a. at current carbon prices. Even before free allowances have been removed, the thermal fuel-related carbon emissions would have a similar value in unused free credits that could be traded on the open market.

27 Environment Agency (UK), David Baird, Sarah Horrocks, Jenny Kirton, Roland Woodbridge. Science Report: SCO30168 The use of substitute fuels in the UK cement and lime industries, February 2008
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/291698/scho1207bnna-e-e.pdf

28 Procedia Engineering 56 (2013) 393 – 400, Azad Rahman, M.G. Rasul, M.M.K. Khan, S. Sharma, Impact of alternative fuels on the cement manufacturing plant performance: an overview
https://pdf.sciencedirectassets.com/278653/1-s2.0-S1877705813X00074/1-s2.0-S187770581300492X/main.pdf

29 International Finance Corporation, 2017, Increasing the use of alternative fuels at cement plants: international best practice
https://www.ifc.org/wps/wcm/connect/33180042-b8c1-4797-ac82-cd5167689d39/Alternative_Fuels_08+04.pdf

Where in the world will Emissions Trading Schemes go next?

The global roll-out of carbon pricing is expected to accelerate as countries look for schemes that can provide rigour and structure to the emissions reduction commitments made in the latest COP26 held in Glasgow in 2021. In most cases, it is also a source of revenue for governments, which is particularly important in an economic environment of budgetary constraints.[30]

As of 2022, 25 emissions trading systems are in force worldwide, with another 15 scheduled for implementation or being considered. Domestic carbon markets now cover about 16 percent of global emissions and have generated more than USD 150 billion in auction revenues.[31]

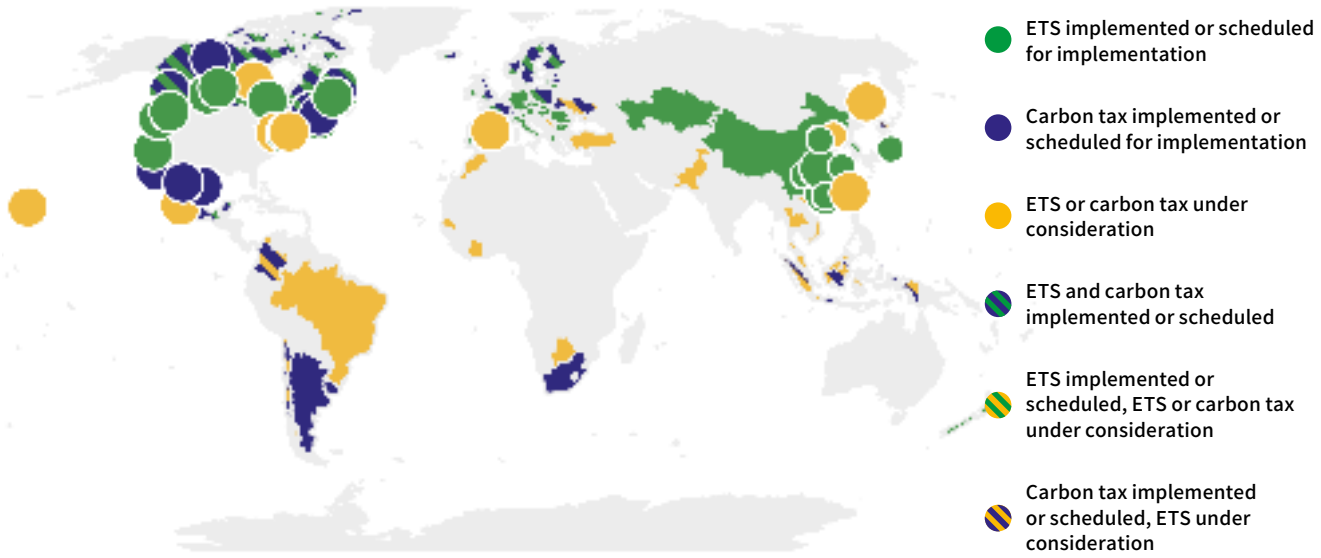
Emissions trading schemes usually work on the 'cap and trade' principle, where a cap is set on the total amount of certain greenhouse gases that sectors covered by the scheme can emit. This limits the total amount of carbon emitted and contributes to Net Zero and other legally binding carbon reduction commitments as it decreases over time. Typically, within this cap, participants receive free allowances and buy emission allowances at auction or on the secondary market, which they can trade with other participants as needed.

As well as national-level schemes, there is also a growing international consensus that carbon pricing is the right direction of travel. Last year the G20 made headlines by endorsing for the first time some form of carbon pricing mechanism to bring down global greenhouse gas emissions if deemed appropriate. This move raised the stakes among G20 countries to either adopt a carbon pricing mechanism or enforce policy measures to reduce sectoral emissions.

Parallel to this, the International Monetary Fund (IMF) proposes a carbon price floor agreement between major emitters as an alternative way to spur decarbonisation.

STATUS OF THE GLOBAL ROLL-OUT OF EMISSIONS TRADING SCHEMES

Summary map of regional, national and subnational carbon pricing initiatives



SOURCE: World bank: https://carbonpricingdashboard.worldbank.org/ and ICAP: https://icapcarbonaction.com/en/ets

30 https://carbonpricingdashboard.worldbank.org/what-carbon-pricing

31 https://icapcarbonaction.com/en/news-archive/811-out-soon-icap-status-report-on-emissions-trading-worldwide-and-webinars

Our conclusion

The roll-out of carbon pricing, and the phasing out of free allowances, will bring environmental performance on a par with operating cost-efficiency in terms of defining commercial success for cement and steel producers. Currently, cement producers in the EU appear to be lagging behind their overseas counterparts in terms of key elements affecting environmental performance, such as the 'clinker factor'. Changes planned between now and 2030 will help them become innovators and leaders. It also opens up the door for highly carbon-efficient producers outside the EU to import into the region and compete with local producers on cost if they can buy fewer carbon credits by demonstrating a better carbon performance.

Appendix 1 – Summary of current and planned carbon tax legislation affecting cement producers in the UK, EU and USA

JURISDICTION	REGULATION	TIMELINE	IMPLICATIONS FOR CEMENT COMPANIES
EU	Fit for 55 package	Expected in law in 2023. Phased implementation	Rising production costs. Free allowances to EU cement producers will be phased out by 2030 (potentially earlier if the EU parliament gets its way). Cement importers to the EU will have to pay a price on carbon per tonne equivalent to that paid by EU producers, OR their home countries can introduce a similar ETS scheme. Carbon Border Adjustment mechanism alongside tightening the ETS scheme – a one-off reduction to the cap and increased linear reduction factor (from 2.2% to 4.2%); a faster phase-down of free allocations.
	Sustainable Finance Disclosure	Expected in October 2022	Investor pressure and constraints on access to capital. Increased public scrutiny of plans and reputation risk of inaction. Listed EU companies will be required to publish detailed decarbonisation plans – likely across Scopes 1, 2 and 3. Investors seeking to move their portfolios to net zero will use this information to decide whether or not to invest. Companies will apply pressure on supply chain to decarbonise (Scope 3).
UK	UK Emissions Trading Scheme	2021–2030	
	Sustainable Finance Disclosure legislation	Expected in Queen's speech in May 2022 and to be implemented in 2023	Investor pressure and constraints on access to capital. Increased public scrutiny of plans and reputation risk of inaction. Listed UK companies will be required to publish detailed decarbonisation plans – likely across Scopes 1, 2 and 3. Investors seeking to move their portfolios to net zero will use this information to decide whether or not to invest. Companies will apply pressure on supply chain to decarbonise (Scope 3).
	Public Procurement	Expected in Queen's speech in May 2022 and to be implemented in 2023	Likely preferential public procurement for low carbon cement. Environmental and 'public good' considerations will be introduced to public procurement. Given the UK is co-chair of the IDDI, it should include green procurement principles for cement and steel.
USA	Carbon Pricing at state level	Increase in ETS schemes across US	Rising costs of production in implementing States. Creation of new norm as more states join.
	Sustainable Finance Disclosure legislation	2022	Investor pressure and constraints on access to capital. Increased public scrutiny of plans and reputation risk of inaction. Listed UK companies will be required to publish detailed decarbonisation plans – likely across Scopes 1, 2 and 3. Investors seeking to move their portfolios to net zero will use this information to decide whether or not to invest. Companies will apply pressure on supply chain to decarbonise (Scope 3).
	Green Public Procurement at state level	Ongoing, with increase from 2019 onwards	Low carbon cement will receive preferential treatment in public procurement.
International	International Deep Decarbonisation Initiative	2021–2024	Accelerated uptake of green public procurement in key markets for cement and steel. Low carbon cement will receive preferential treatment.

Appendix 2 – Background on the European Union's 'Emission Trading Scheme'

The EU Emission Trading Scheme (EU ETS) is a cornerstone of the EU's policy to combat climate change and a vital tool for reducing GHG emissions from the regulated sectors. It covers the 27 EU Member States and three European Economic Area European Free Trade Association (EEA-EFTA): Iceland, Liechtenstein and Norway.

The system covers ~40% of the EU's emissions from the power sector, manufacturing industry, and aviation within the European Economic Area. It is the oldest and now second-largest ETS in force. Introduced in 2005 and now in its fourth trading phase, the EU ETS has gone through several reforms.

While the ETS worked relatively well to encourage decarbonisation in some sectors like power, its design created perverse incentives elsewhere. For the cement sector, the allocation of free allowances based on clinker production, not cement, resulted in increased emissions and was unfavourable to the introduction of low carbon cement.[32] The latest reform of the ETS was proposed in July of 2021 as a part of the European Green Deal and will – if approved – remove this incentive.

In July 2021, the European Commission released the "Fit for 55" package – a sweeping set of policy proposals spanning all major sectors of the economy to achieve emission reductions of at least 55% below 1990 levels. The package places the EU ETS at the heart of the EU's decarbonisation agenda with major changes that include: a one-off reduction to the cap and increased linear reduction factor (from 2.2% to 4.2%); a faster phase-down of free allocations; the introduction of a carbon border adjustment mechanism (CBAM) that prices imported goods based on their embedded emissions to become fully operational by 2026.[33]

The UK's 'Emission Trading Scheme'

The UK ETS came into effect on 1st January, 2021, replacing Britain's participation in the European Union's ETS. It is broadly similar and applies to energy intensive industries, the power generation sector and aviation. The first phase of the UK ETS will run until 2030.

In November 2021, the government announced new requirements for all listed companies in the UK to produce net-zero transition plans by 2023.[34]

32 The clinker podcast number 1

33 https://icapcarbonaction.com/en/?option=com_etsmap&task=export&format=pdf&layout=list

34 https://www.bbc.co.uk/news/business-59136214

There's not yet a commonly agreed standard on what a good transition plan looks like, but the UK government states at a minimum it should set out a) high-level targets the organisation is using to mitigate climate risk, including greenhouse gas reduction targets (e.g. a net zero commitment), b) interim milestones, and c) actionable steps the organisation plans to take to hit those targets.[35]

While transition plans will start on a voluntary footing, the government has clearly signalled its intention to make them mandatory. Initially, this will require asset managers, regulated asset owners and listed companies to publish transition plans that consider the government's net zero commitment or provide an explanation if they have not done so (i.e. comply or explain). As standards for transition plans emerge, the Government and regulators will take steps to incorporate these into the UK's Sustainability Disclosure Requirements and strengthen requirements to encourage consistency in published plans and increased adoption by 2023.

The Government intends to legislate to deliver this.[36] It's likely the legislation will be announced in the Queen's speech this May.

The Government will also set up a high-level Transition Plan Taskforce. This will bring together reps from British industry and academia with regulators and the third sector to develop a 'gold standard' for transition plans and associated cutting edge metrics, coordinating with international efforts under the Glasgow Financial Alliance for Net Zero (GFANZ) and others, and reporting by the end of 2022. This will set a robust standard and help to tackle greenwashing. The FCA will be formally involved and 'will have regard to its findings'.[37]

This announcement is hugely significant in the UK context because it will open up company plans to scrutiny and puts all FTSE 250 companies on notice that they need to develop detailed decarbonisation plans on how they will align to the UK's legal commitments to reach Net Zero by 2050.

Appendix 3 – Background on the USA

Although not a legal commitment, last year, the USA pledged to reduce its emissions by 50-52% from 2005 levels by 2030.

The USA has been debating whether to introduce a carbon tax for decades, and the idea was firmly on the political radar in 2021 with a carbon tax proposed as part of the Build Back Better plan. This tax would impose a $20 fee per metric ton of carbon[38] if successful.

The White House and 49 senators were on board with a carbon tax, but not the key vote from West Virginia Democratic Senator Joe Manchin, which effectively killed the bill as it needed all 50 Democratic senators to pass via reconciliation, and there are no further discussions with him to salvage its contents as of March 2022.

Despite the latest failure to adopt a national cap and trade system, the USA does have three active regional schemes and many more in development.

California cap and trade

California's Cap-and-Trade Program began operation in 2012, opening its tracking system

35 https://www.gov.uk/government/publications/fact-sheet-net-zero-aligned-financial-centre/fact-sheet-net-zero-aligned-financial-centre

36 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1031805/CCS0821102722-006_Green_Finance_Paper_2021_v6_Web_Accessible.pdf

37 https://www.gov.uk/government/publications/fact-sheet-net-zero-aligned-financial-centre/fact-sheet-net-zero-aligned-financial-centre

38 https://www.bloomberg.com/news/articles/2021-11-06/white-house-backed-carbon-tax-in-sight-for-biden-s-climate-bill and https://www.cnbc.com/2021/11/15/will-us-ever-put-a-price-on-carbon-as-part-of-climate-change-policy.html

for allocation, auction distribution, and trading of compliance instruments. The first compliance obligations started in January 2013.

The California program, which is implemented by the California Air Resources Board (CARB), covers sources responsible for approximately 80% of the state's GHG emissions. Key amendments to the system took effect in 2021, following the passage of legislation clarifying the role of the program after 2020 (Assembly Bill [AB] 398) and regulatory amendments adopted by CARB. Among the significant changes to the system that started in 2021 are the addition of a price ceiling, the inclusion of two allowance price containment reserve tiers below the price ceiling, reductions in the use of offset credits (especially for credits generated from projects which do not provide direct environmental benefits in the state), and a steeper allowance cap decline to 2030, aligned to a GHG reduction target of 40% from 1990 levels. The Cap-and-Trade Regulation sets a formula for declining caps after 2030 through 2050.

Massachusetts

The Massachusetts Limits on Emissions from Electricity Generators began operating in 2018 and covers CO_2 emissions from the power sector. It complements RGGI to help ensure that Massachusetts achieves its mandatory mitigation targets.

In 2016, a ruling by the Massachusetts Supreme Court established that the Massachusetts government would need to take additional action to guarantee it meets the state's climate targets – a 45% reduction by 2030 and an 80% reduction by 2050 (compared to 1990). The regulation establishing this system, '310 CMR 7.74,' is one of the responses to this ruling. The regulation is intended to ensure that emission reductions associated with other clean energy programs occur in Massachusetts. In 2020, the Massachusetts Executive Office of Energy and Environmental Affairs signed a determination of state-wide emissions limits for 2050, establishing a 2050 state-wide net-zero GHG emissions limit.

The Regional Greenhouse Gas Initiative

The Regional Greenhouse Gas Initiative (RGGI) is the first mandatory GHG ETS in the United States and covers emissions from the power sector. The system started operating in 2009 in 10 states (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont). Its development was based on the '2005 RGGI Memorandum of Understanding' (MOU) and the '2006 RGGI Model Rule.' Through statutes or regulations based on the Model Rule, each state then established individual CO_2 budget trading programs. New Jersey began participating in RGGI again in 2020, and Virginia became involved in 2021. Currently, Pennsylvania is looking into RGGI participation in 2022.

RGGI has gone through two review processes to date, which resulted in updating the Model Rule and enshrining tighter caps and adjustments to system design. Between 2021 and 2030, the RGGI cap will reduce by 30% compared to 2020. Furthermore, an emissions containment reserve (ECR) started operating in 2021. The ECR is an automatic adjustment mechanism that will adjust the cap downward in the face of lower-than-expected costs.

ETS under development

Pennsylvania, Washington and The Transportation and Climate Initiative (TCI), covering Connecticut, Massachusetts, Rhode Island, and Washington DC.

Other ETS schemes are under consideration in Oregon, New Mexico, New York City and North Carolina.

Complete information on all these schemes can be found at https://icapcarbonaction.com/en.

Contact us

To discuss this paper, its findings and implications, please get in touch.

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