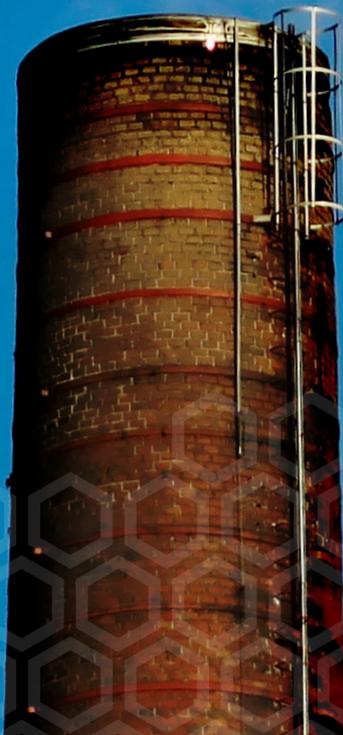


COMPENDIUM

Training session 2:

Cap-and-Trade Markets: All You Need to Know

By Frank Watson & Alessandro Vitelli



OUR TRAINING SESSIONS



Training Session

1

Carbon Markets Fundamentals

This card features a purple background with a photograph of wind turbines at sunset. A white hexagon with the number '1' is centered on the image.



Training Session

2

Cap-And-Trade Markets:
All You Need To Know

This card features a blue background with a photograph of an industrial smokestack against a blue sky. A white hexagon with the number '2' is centered on the image.



Training Session

3

Voluntary Carbon Market:
Key Principles

This card features a red background with a photograph of a solar panel array at sunset. A white hexagon with the number '3' is centered on the image.



Training Session

4

Voluntary Carbon Market:
A Deeper Dive

This card features a yellow background with a photograph of a jellyfish. A white hexagon with the number '4' is centered on the image.



Training Session

5

The UN and the Role of
International Agreements

This card features a green background with a photograph of colorful feathers. A white hexagon with the number '5' is centered on the image.

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SECTION 1:

What are 'compliance carbon markets' (aka emissions cap-and-trade systems)?

'Carbon markets' is a term that includes a wide array of policy instruments, some of which are underpinned by binding legislation, while others are entirely voluntary.

In this document, we focus on the compliance carbon markets, otherwise known as emissions trading systems or 'cap-and-trade systems.'

Firstly, and most importantly, compliance markets are established under national law. They require participating entities (usually companies) to participate by law, and they set stiff financial penalties for failure to comply with any of the regulations.

Carbon cap-and-trade markets set a maximum amount of carbon dioxide that can be emitted by all the companies participating in the market system per year.

This limit is then expressed as an equivalent number of carbon permits, or 'allowances,' each one representing the legal permission to emit one tonne of CO₂ in a specific jurisdiction.

Allowances are created as electronic certificates that are held in accounts on a central registry. They are either sold by governments at periodic auctions or handed out free of charge to companies.

These allowances are then bought and sold in a regulated marketplace, either in 'spot' transactions

for immediate transfer, or as 'futures' contracts for delivery at a later date.

At the end of each compliance period, regulated companies must measure and verify their emissions for the period, and surrender allowances matching that total to the regulator. Surrendered allowances are then permanently retired.

The key distinguishing element of cap-and-trade is that it is a closed system, with an absolute limit on the number of allowances in circulation, and that the annual supply of new allowances shrinks over time to reach a specific emissions reduction goal set out in the legislation.



SECTION 2:

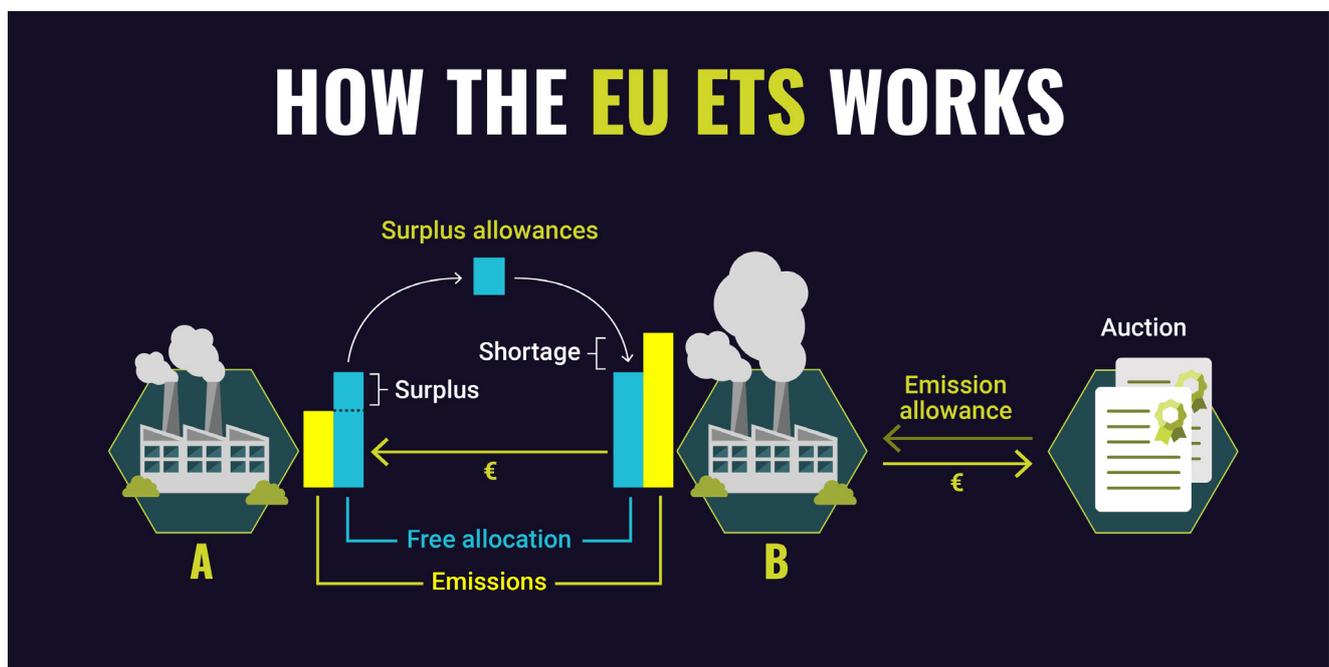
Case study: The EU Emissions Trading System (EU ETS)

The European Union's Emissions Trading System (EU ETS), the largest international cap-and-trade system in the world, regulates CO₂ emissions from the major carbon-intensive sectors. These include electricity and heat generation, iron and steel, non-ferrous metals, cement, chemicals, refineries, aviation, shipping and several other energy-intensive industries such as the production of ceramics, glass and bricks.

At various points in the past, the EU ETS became oversupplied with allowances, causing prices to fall. More recently, the system has been upgraded to include a flexible supply mechanism that monitors the number of allowances that have been issued and retired and adjusts supply accordingly.

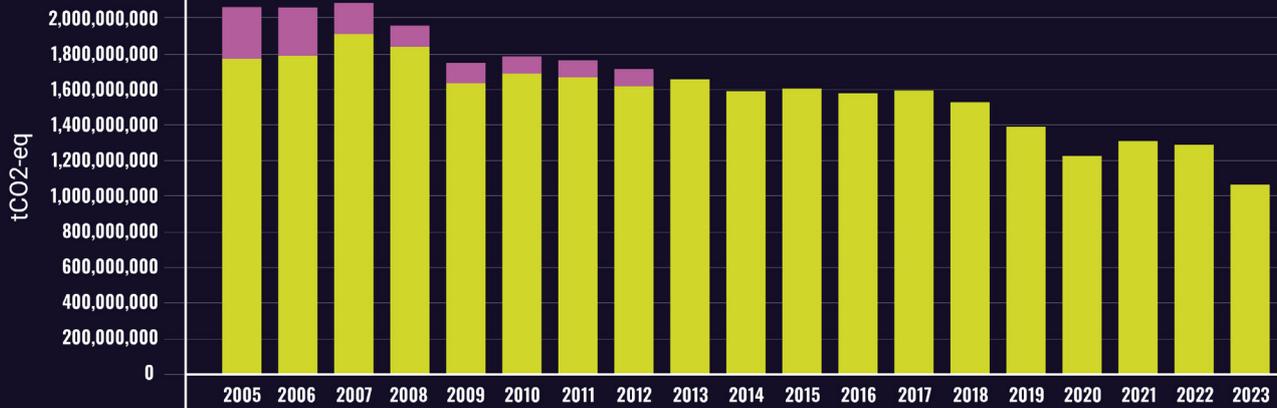
Maintaining a steadily tightening supply means that the price of allowances should increase over time, providing a strengthening incentive for companies to invest in cleaner fuels or lower-carbon technologies to replace old, carbon-intensive practices.

The EU ETS set a cap in [2021](#) of 1.571 billion tonnes of CO₂. This represents the total supply of carbon allowances provided that year. Under the EU ETS legislation, this cap will shrink each year, so that total regulated emissions by 2030 will be 62% below 2005 levels. This is part of a wider suite of EU legislative measures that aim to reduce the bloc's economy-wide emissions by 55% below 1990 levels by 2030.



EU EMISSIONS TRADING SYSTEM VERIFIED EMISSIONS DATA 2005-2023

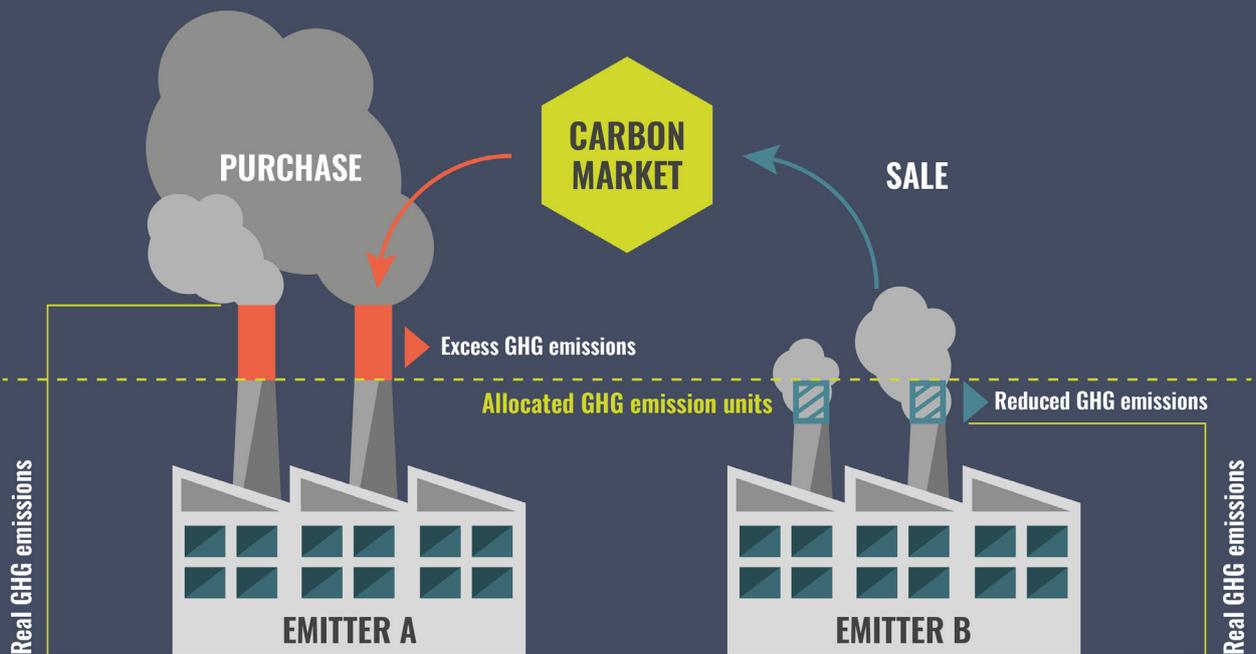
All stationary installations EU27



ETS INFORMATION: ■ Estimate to reflect current ETS scope for allowances and emissions ■ Verified emissions

Source: European Environment Agency

HOW AN EMISSION TRADING SYSTEM WORKS



SECTION 3:

Other cap-and-trade systems around the world

Cap-and-trade requires companies to account financially for their climate impact – their carbon emissions.

Creating this new cost offers industrial companies the choice between paying for emissions allowances, or investing in cleaner processes and technology that reduce their carbon footprint, and consequently their purchases of carbon allowances.

Compliance carbon markets tend to cover heavier, carbon-intensive industries like power generation, cement, fertiliser, chemicals and metals, and can sometimes extend to transportation fuels. Europe is going further by including aviation and maritime shipping in its flagship carbon market.

Other cap-and-trade systems operate in [California](#), [Quebec](#), [Washington state](#), ten northeastern US states (the [Regional Greenhouse Gas Initiative](#)), [New Zealand](#), [South Korea](#), the [United Kingdom](#) and [Switzerland](#).

Some of these markets cooperate among each other, so that companies in one jurisdiction can buy and surrender permits from another. For example, the California and Quebec markets and the EU and Swiss markets are linked.

Some legally-binding carbon markets exist that don't use cap-and-trade as their model. For example, China's emissions trading system sets a limit on carbon intensity – that is, the amount of carbon dioxide emitted per unit of production. Plans are

being drawn up to upgrade China's system, so that it may include a hard cap on carbon in future.

And the international airline industry operates a global offsetting market, the Carbon Offsetting and Reduction Scheme for International Aviation ([CORSIA](#)).

This market does not set an overall limit on airline emissions, but it requires that operators offset any emissions over and above a 2019 baseline. (You can learn more about CORSIA in training session 4 'Voluntary Carbon Market: A Deeper Dive'.)



SECTION 4:

Why are carbon prices higher under cap-and-trade systems?

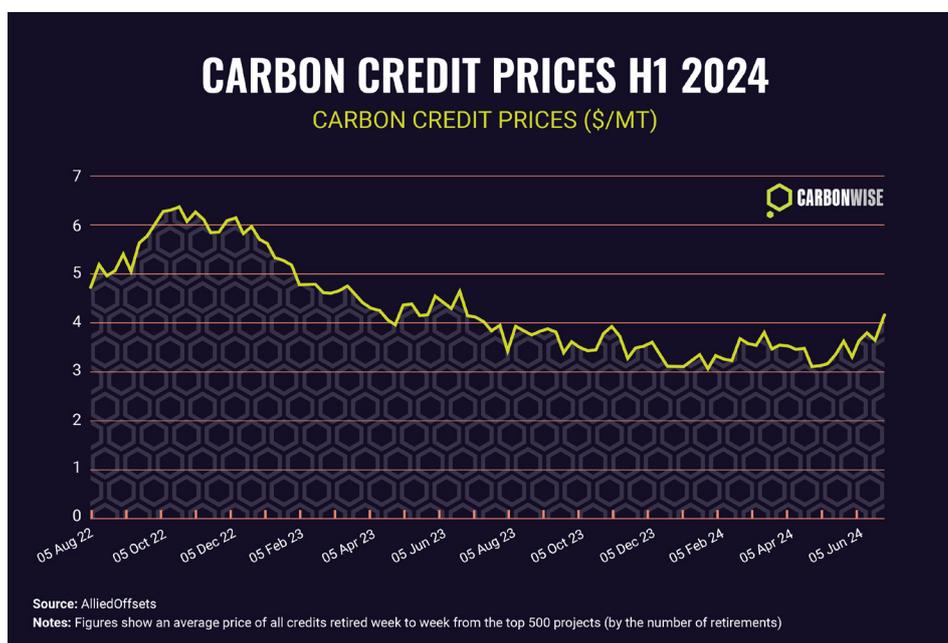
In most cases, the price of carbon allowances under cap-and-trade systems has been higher than the price of carbon credits in the voluntary carbon market, with some exceptions. This is principally because the supply of allowances under carbon compliance markets is fixed each year and falls over time, while the supply of credits from voluntary carbon market projects has no absolute limit and can continue to increase as long as new projects are approved and generate credits.

This declining supply of allowances in the compliance markets creates a relative scarcity. This forces companies to compete to acquire allowances, which they need to surrender each year to avoid financial penalties. This relationship between supply and demand tends to create more robust prices than those seen in the market for carbon credits.

For example, the price of carbon allowances (EU Allowances) under the EU ETS moved in a range of roughly Eur50 to Eur100 per tonne from 2023 to 2024. In sharp contrast, most standard carbon credits under the voluntary carbon market traded at around \$3.00 to \$6.00 per tonne over the same period.

However, certain carbon credits have traded as high as \$200 per tonne, for example those generated by technology-based carbon capture and storage projects. This very high price reflects the cost of operating such projects and the willingness of companies to pay for this type of credit. Such prices may fall in future as these emerging technologies become more widespread, reflecting economies of scale.

In general, however, the price of carbon allowances under compliance markets is likely to continue to exceed that of carbon credits from projects under the voluntary carbon market due to material constraints on supply.



SECTION 5:

Does cap-and-trade work?

Carbon cap-and-trade markets are springing up all over the world, in various guises. But do these market-based environmental policies actually work? Do they deliver the emissions reductions that they aim to?

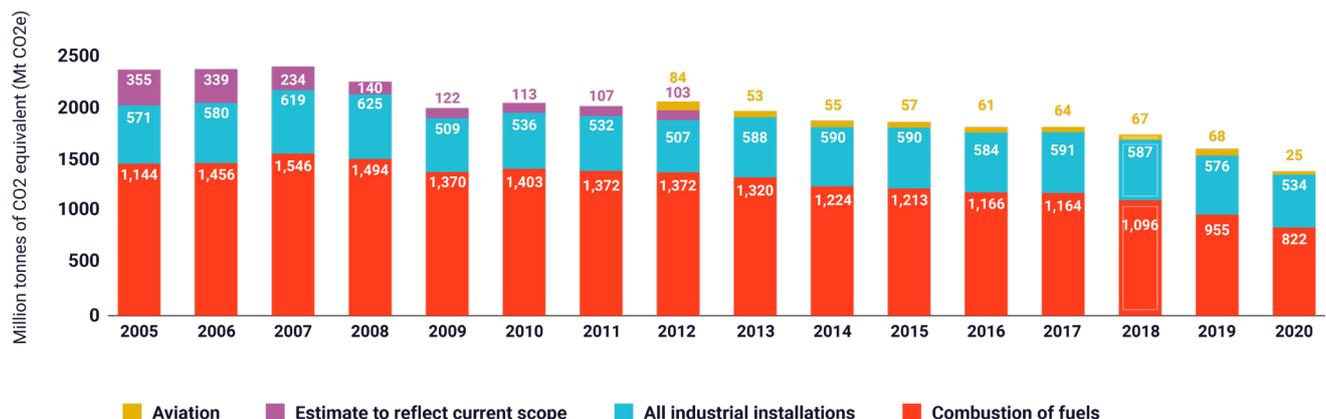
Evidence so far from around the world shows that the answer in most cases is yes. Independently-verified emissions data from the major cap-and-trade systems currently in operation show that emissions have indeed come down since these markets were launched.

However, it should be cautioned that the complex interactions between cap-and-trade programs and other environmental policies, and levels of economic growth and technological development, can make it

difficult to ascribe emissions reductions purely to one policy framework alone. Nevertheless, emissions are declining in the most established carbon compliance markets.

For example, under the EU ETS, total CO₂ emissions fell 15.5% in 2023 compared with 2022, and were down by around 47% compared with 2005 levels, the year the system was launched. This means regulated emissions in the EU ETS are well on track to achieve the 2030 target of minus 62% from 2005 levels. This target is part of the wider EU economy-wide goal (which includes other sectors such as agriculture) to reduce emissions by at least 55% below 1990 levels by 2030.

ETS EMISSIONS BY ACTIVITY TYPE FOR ALL COUNTRIES IN THE EU ETS



Source: European Environment Agency

In addition, the link between CO₂ emissions and economic growth is beginning to break down, as renewable energy increases its share of total energy, according to the International Energy Agency: [The relationship between growth in GDP and CO₂ has loosened; it needs to be cut completely – Analysis - IEA.](#)

For example, in the EU, economy-wide emissions were 30% lower in 2023 than they were in 1990, while the economy has grown by 66% in the same period, according to IEA data.

Similar progress is being made elsewhere. The US Regional Greenhouse Gas Initiative (RGGI) regulates CO₂ emissions from the power-generation sector only, in eleven north-eastern states including New York, New Jersey, Maine and Vermont. Emissions under RGGI have been reduced by 50% since 2005, which is almost 50% faster than the US as a whole, and the system has also raised over \$7 billion to invest in local communities, according to its regulators: [RGGI_101_Factsheet.pdf.](#)

In the California cap-and-trade system, emissions have fallen by 14% since the program started, although this success in reducing emissions is also partly linked to other state-level climate change efforts, according to the California Legislative Analyst's Office: [California's Cap-and-Trade Program: Frequently Asked Questions.](#)

Emissions reductions are only one measure of success when assessing the effectiveness of cap-and-trade systems. The other is whether the system can deliver reductions at a lower cost than other policy frameworks. Again, the evidence so far suggests compliance markets are doing well on this front too.

For example, based on auction prices, California's cap-and-trade program has a cost of about \$30 per tonne of CO₂ equivalent. By contrast, a large state program that subsidises low-emissions vehicles has cost an estimated \$193 per tonne of CO₂, according to the state's Legislative Analyst's Office: [California's Cap-and-Trade Program: Frequently Asked Questions.](#)

WAYS ENTITIES CAN COMPLY WITH THE CAP-AND-TRADE PROGRAM¹



REDUCE EMISSIONS

Entities can **reduce their emissions**



OBTAIN ALLOWANCES

Entities can **buy allowances** - essentially permits - to cover their emissions²



BUY CREDITS

Entities can **purchase credits**, which are investments in projects intended to counter-balance their emissions.

^a "Covered entities" subject to the cap include large GHG emitters such as oil refineries, electricity generators and importers, and manufacturing facilities.

^a Some covered entities receive free allowances, such as some utilities, natural gas suppliers, and industrial facilities.

Source: California's Cap-and-Trade Program: Frequently Asked Questions - Legislative Analyst's Office



SECTION 6:

Shortcomings & unintended consequences

However, the roll-out of cap-and-trade systems has not been without controversy, and the implementation of these policies has led to various shortcomings and unintended outcomes.

The initial years of operation for carbon compliance markets have in some cases been challenging, with problems emerging including windfall profits for some major carbon polluters, overallocation of allowances (albeit temporarily), hacking attacks against emissions registries and VAT fraud.

Many of these shortcomings occurred as regulators were rolling out new policies that had previously been untested at such a large scale, and the expansion of the value of carbon markets attracted the attention of organised criminal actors. In most cases, these problems have been dealt with effectively through coordination between national legislators and law enforcement agencies, and this has been a key element in the evolution of carbon markets as the systems came up against problems that required more robust regulations and stronger oversight.

In addition, in some carbon markets, some sectors have been more successful in reducing emissions than others. For example, in the EU ETS, emissions have fallen significantly in the electricity-generating sector, but much less so in other sectors such as metals, chemicals and refining.

This sharp difference in emissions performance is largely a result of the need to protect trade-

exposed industries from competitiveness issues linked to carbon prices, in particular where EU-based industries facing a carbon price must compete with those in other jurisdictions who face no such cost.

EU regulators needed to protect these industries by issuing them free carbon allowances, and while this was effective at avoiding so-called 'carbon leakage' it also reduced the incentive to cut emissions. This issue is currently being tackled by the EU's Carbon Border Adjustment Mechanism (CBAM) which from 2026 will place a border charge on the carbon content of certain imported goods.

The CBAM aims to replace the issuance of free carbon allowances gradually under the EU ETS and this is expected to create an incentive for relevant sectors to reduce CO₂ emissions.

In addition, the cost of abating carbon emissions can vary greatly across the different covered sectors. Fuel-switching in electricity generation, from coal to natural gas for example, is cheaper than decarbonising steel, which requires a step change in technology with potentially large up-front costs, such as switching from a blast furnace to electric arc technology.



SECTION 7: New Carbon Markets

Building on the success of cap-and-trade systems in Europe, the US, Asia and Australasia, new carbon markets are springing up around the world.

This is being driven by pressure on national governments to deliver on their emissions reduction pledges under the Paris Agreement and to upgrade these targets on a periodic basis. Moreover, citizens broadly support measures that improve air quality in cities and many companies want clear legislative frameworks that allow them to make cleaner investments with confidence.

Some of the new carbon markets are compliance markets (emissions cap-and-trade systems), while others are based on project-based carbon credits.

Jurisdictions planning or implementing new carbon markets include:

Mexico

A legally binding cap-and-trade program. The first country in Latin America to develop a carbon compliance market. Organised by the Secretariat of Environment and Natural Resources. Pilot phase 2020-2021, transition phase in 2022, started operations in 2023. Covers power and industry (direct

CO₂ emissions from fixed sources). Covers 40% of national emissions. Mexico is also developing an offsetting mechanism for potential compliance with its national carbon market.

Turkey

A national emissions trading system. Pilot ETS phase to start in October 2024 with publication of a National Allocation Plan. Coverage to include energy, industrial processes, agriculture and waste.

Indonesia

Indonesia launched a voluntary carbon market in 2023 and is developing a binding compliance carbon market to cover emissions-intensive industries initially, such as steel, cement, fertilizers and paper, starting in 2027.

Malaysia

A market based on carbon credits, in the early stages of trading in 2024. Hosted by the government-backed Bursa Carbon Exchange (BCX). Covers energy companies, industrials, manufacturing, forestry. Malaysia considering future carbon taxes and/or a cap-and-trade system.

Vietnam

Vietnam is developing a carbon market to include a pilot phase from 2025 to 2028, with full implementation to start in 2029. Sectors to be covered include electricity generation, iron and steel and cement, with potential to include transportation, construction, industrial processes and agriculture/forestry. Vietnam's carbon market will be based on emissions intensity targets, rather than a hard 'cap' on total emissions. Project-based credits will also be allowed, within limits, according to legislative proposals.

China

Work under way to include a possible carbon cap in the country's existing national carbon market, which currently has no hard cap, and is based on emissions intensity only. As it stands, this means China's emissions can still rise as its economy grows. A hard cap would for the first time force a gradual reduction in China's emissions every year, among covered sectors.

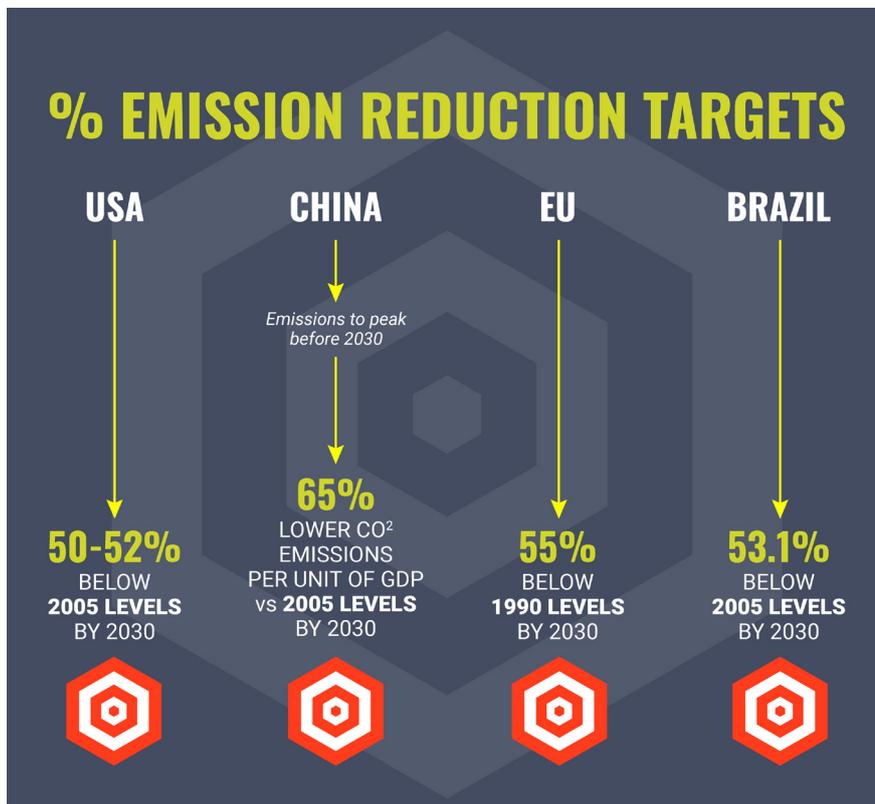
Brazil

Ahead of hosting COP30 in Belem in 2025, Brazil is working on a national carbon market, with draft legislation currently moving between the two houses of congress.

Brazil is the world's sixth largest emitter of GHGs and has set a target to cut emissions by 53% by 2030 from 2005 levels.

Its ability to achieve the target will largely depend on reducing emissions from deforestation and agriculture, but the inclusion of agriculture in the planned ETS has been controversial.

It will also need to cut emissions from heavy industries such as steel and cement. Consultancy firm McKinsey has estimated that Brazil could receive \$15 billion per year from the voluntary carbon market alone, by implementing nature-based offset programs. So far, agriculture has been entirely exempt from the proposed system. It could take years before Brazil's national carbon market is fully operational.



Global

United Nations market for carbon credits under Article 6 of the Paris Agreement. Countries can establish bilateral deals to trade sovereign-level Internationally Transferred Mitigation Outcomes (ITMOs), as well as carbon credits from UN-approved reduction or removal projects.

Glossary

- Article 6:** A section of the 2015 Paris Agreement which sets out how countries can pursue voluntary cooperation to reach their climate targets. It enables international cooperation to address climate change, including trading of emissions reductions, and to unlock financial support for sustainable development.
- Carbon allowances:** Refers to the tradable certificates given or sold by governments under legally binding carbon compliance markets, also known as emissions trading systems or cap-and-trade systems.
- Carbon credits:** Refers to the tradable credits generated by projects that reduce, avoid or remove carbon or other greenhouse gas emissions.
- Carbon leakage:** The transfer of production of energy or goods to jurisdictions with less stringent environmental regulations, potentially causing carbon dioxide emissions to increase.
- Carbon markets:** A collective term for systems that put a price on emissions of carbon dioxide (CO₂) or other greenhouse gases, and which allow the trading of carbon allowances or credits. They are normally classified as compliance markets, voluntary markets, or compliance credit markets.
- Climate change:** Refers to the long-term changes in the Earth's climate attributed to human activity, chiefly the burning of fossil fuels and resulting release of greenhouse gases into the atmosphere. Methane from livestock is also a significant contributor to the build-up of greenhouse gases in the atmosphere.
- Compliance carbon market:** A regulated carbon market, usually created by a state or national government, involving a legally binding requirement to surrender carbon allowances each year. Compliance markets usually involve an annual 'cap' on the total allowable emissions, which shrinks over time to deliver an overall reduction in system-wide emissions. Can cover one or more sectors of the economy, depending on political decisions.
- Compliance credit markets:** A legally binding form of carbon markets that requires the surrender of project-based carbon credits rather than government-administered carbon allowances. One example is the UN's CORSIA program for international aviation emissions.



CORSIA:

Carbon Offsetting and Reduction Scheme for International Aviation. An international carbon market operated by the International Civil Aviation Organisation to ensure that net emissions from the global aviation sector do not increase above a 2019 baseline. Under CORSIA, all participating airlines must offset any emissions over and above their 2019 verified total, by purchasing and retiring credits that are approved by the CORSIA regulator.



EU ETS:

The EU Emissions Trading System. One of the largest and best-known compliance carbon markets in the world. A legally binding system covering CO₂ emissions from more than 11,000 individual stationary installations in sectors such as power and heat generation, production of metals, cement, chemicals and refining, as well as aviation and shipping.



Paris Agreement:

An international treaty on climate change adopted by 196 governments at the COP21 summit in Paris in 2015 under the United Nations Framework Convention on Climate Change (UNFCCC). Signatories agreed to reduce greenhouse gas emissions in order to limit the global average temperature increase to well below 2 degrees Celsius compared with pre-industrial levels, and to pursue a goal of 1.5 degrees C.



RGGI

The US Regional Greenhouse Gas Initiative – a compliance carbon market which regulates CO₂ emissions from the power-generation sector only, in eleven north-eastern US states.



UNFCCC:

The United Nations Framework Convention on Climate Change. An international treaty agreed in 1992 among more than 150 states at the time, with a goal to avoid a build-up of greenhouse gases in the atmosphere to a level that would destabilise the global climate system.



VCM:

The Voluntary Carbon Market. Describes a market where project-based carbon credits are traded voluntarily and outside the scope of any national law (and regulation). Buyers can voluntarily purchase these carbon credits to offset part their own carbon emissions.

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Turkish ETS:

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