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PRACTITIONER BRIEFING SERIES

Issue 17

Transboundary Carbon – Valuation

Transboundary Carbon
Valuation

"While a growing number of governments and non-State actors are pledging to be carbon-free, the criteria for net-zero commitments can have loopholes wide enough to "drive a diesel truck through". We must have zero tolerance for net-zero greenwashing.
— António Guterres, UN Secretary General

Introduction

The value and price of something are not always the same. Abundant public resources may seem cheap until there is scarcity, and its value comes into focus. Carbon has historically been undervalued and efforts to correct this have lagged behind. This impacts the comparative economic viability of renewable energy projects and carbon dioxide removal (CDR) versus often subsidized fossil fuels and business-as-usual.

New legislation and strategies like the US 'Inflation Reduction Act' or the EU's 'Fit for 55' are making some headway to provide the financial backing for large-scale greenhouse gas reductions by 2030. Still, more is required and at a faster pace.

The transition to a green economy is a $9 trillion question, with needs for 1,000 gigawatts of renewable energy power capacity every year up to 2030 according to the International Renewable Energy Association. Potentially 70% of this bill will need to be covered by the private sector, with governments supporting using every policy lever available to them.

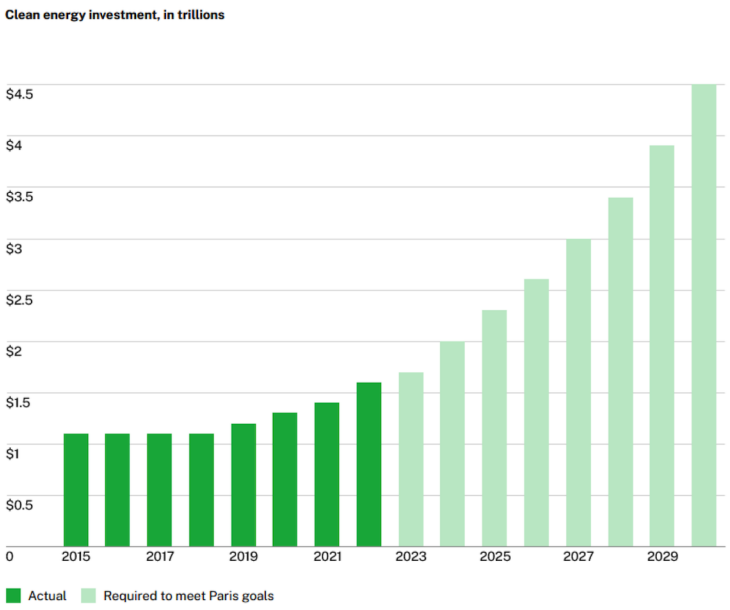
From a variety of carbon taxes and levies, to financial instruments in carbon credits, the costs of these methods are felt, but the value can be poorly understood. Valuing carbon emissions requires a full social accounting of its impacts in the near and long-term, while also accounting for a large amount of uncertainty about the future.

With each year that emissions are not sufficiently reduced in line with the 1.5°C pathway deeper cuts are required in the future, at a potentially higher cost. The recent COP28 outcome to divest from fossil fuels by 2050 and triple renewable energy is a step in the right direction, but not in line with the scale of investments required.

Shared Values:

Carbon emissions everywhere cause climate change anywhere. The true cost of carbon must fully internalize its externalities. Net Zero commitments from governments to companies are heavily reliant on buying carbon offsets. Are we valuing carbon correctly?

This issue will examine Transboundary Carbon *Valuation* and its impact on carbon pricing, carbon markets, carbon credits and offsets towards Net Zero. Prior briefs in this 3-part Transboundary Carbon series have focused on *Cooperation* and *Technology*, such as global climate diplomacy and novel methods of CDR.



Source: Generation Investment Management – Sustainability Trends Report 2023.

Practical Summary

- Cooperation, technology, and valuation must work in tandem to properly value the externalities of carbon emissions, send the appropriate price signals to companies and consumers, and support the CDR market.
- Carbon can be valued directly or indirectly through the use of carbon taxes, carbon permits, or a combination of both. To date taxes have had less overall impact on raising carbon prices.
- Cap & Trade or Emissions Trading Systems (ETS) are expanding globally and have shown to be potentially effective market-driven solutions to valuing carbon and reducing emissions. Prices to date have been overly depressed due to over allocation of permits and limited auctioning.
- Greenwashing oversells the environmental impact of products while doing real harm in delaying necessary transformations across the value chain. Legal standards and enforcement are currently limited, leading to lower consumer confidence.
- Corporate Net Zero strategies mostly set intentions and ambitions but lack detail and clarity on how they will fully decarbonize to Net Zero, with a heavy reliance on carbon offsets.
- An everything-everywhere-all-at-once approach is needed to address the greatest transboundary environmental issue of our time.

Valuing Carbon

Valuing carbon requires understanding what it means, for the individual, for a society or economy, and for the planet. This meaning can be expressed in terms of cost, such as through a tax or permit value, or in terms of benefits, such as a livable environment for future generations.

Carbon valuation is the process of assigning a monetary value or price to greenhouse gas emissions (GHGs), typically carbon dioxide, or CO2 equivalent (CO2e). This is generally done to compare the costs and benefits of different climate change mitigation or adaptation strategies.

There are several different methods for carbon valuation, each with their own strengths and weaknesses. In this brief we will explore the concepts and methods of valuing carbon, and what these valuations mean in practice with respect to Net Zero and reaching the climate goals of the Paris Agreement.

First, we must look to the origins of this analysis through the field of environmental economics. In environmental economics the linkages between economic activity and environmental quality are analyzed to understand how human economic activity affects ecosystems and social outcomes. It examines the external factors, in both the inputs and outputs that derive from an economic action. Key among these are 'externalities', which most commonly arise from the use of 'public goods' that are 'non-rival' and/or 'non-excludable'.

Externalities are impacts or costs that are not directly priced within the transaction itself. The cost may not be readily known, or are not sufficiently valued by the actors within an economic transaction. As such, they are not included in the price and occur externally to the activity or transaction. By attempting to quantify them, even in an approximate way, comparisons can be more easily made for the policies, taxes, or regulations that will *internalize* these externalities, and reach more efficient outcomes both socially and economically.

At its core, environmental economics examines 'market failures', where the most efficient use and distribution of resources is not achieved or breaks down, due to these externalities not being properly factored in. This often occurs with two types of goods or resources: public goods, and non-rival or non-excludable goods. The atmosphere and climate change are prime examples of this issue.

The atmosphere is a public good that we all use, to breathe, to live and to emit. It cannot be privately held or made exclusive to one person or group, making it non-excludable. It is also non-rival, in that the usage of this public good does not immediately exclude someone else from using it as well. Unlike a product, that once sold changes ownership and is now no longer for sale or use by another, the atmosphere is a living system that we all use continuously.

Public goods often suffer from the 'tragedy of the commons', whereby they are overused or polluted as no one is directly responsible, and the benefits from stewardship are shared by all, while the costs are not. Inverted, positive efforts by one party may be negated by another, diminishing the incentives to care for the resource and negatively affecting all. All these elements are seen with climate change and carbon emissions.

In environmental economic terms, the negative outcomes of emissions (climate change), are not priced into the cost of a good or activity as they occur externally, and with a time delay. As such, too many emissions are produced, creating negative outcomes that are worse for all. The externalities of costs are not reflected in market prices and resources are not allocated efficiently, creating market failure. Therefore, interventions are needed to correct these market failures and improve resource management for more efficient outcomes.

Assessing which interventions to make while being the most efficient requires methodologies that price these externalities (internalizing them), to compare the costs or benefits of various interventions or policy actions.

Carbon Valuation – Methodologies

SCC / MAC / LCA / CVM / Scope 1-3

Carbon valuation is a critical aspect of climate change mitigation efforts, aiming to assign economic value to carbon emissions or their sequestration. As the world increasingly recognizes the urgency of addressing climate change, various methodologies have emerged to quantify and value carbon emissions in different sectors.

The Social Cost of Carbon (SCC) is a method to quantify the monetary value of damages caused by each 1 additional ton of carbon dioxide emissions. It encompasses impacts like climate change-related damages, health effects, and economic disruptions. Calculations involve factors such as climate sensitivity and discount rates, providing a comprehensive framework for evaluating societal costs.

The SCC guides policymakers in assessing climate policies' costs and benefits and informs strategies for mitigating climate change. By setting carbon prices through mechanisms like taxes or cap-and-trade systems, it internalizes emission costs into economic decisions, aiding the transition to low-carbon economies. Despite some uncertainties in parameter estimation, understanding and incorporating a SCC into policymaking is crucial for sustainable development and climate change mitigation. It ensures informed decisions on emission reductions and adaptation measures, promoting responsible environmental policies.

Another common method for carbon valuation is the Marginal Abatement Cost (MAC). The MAC approach evaluates the cost-effectiveness of reducing carbon emissions by assessing the cost of each 1 additional unit of emissions reduction. It considers the costs of various mitigation technologies like renewable energy and energy efficiency, while adjusting for potential cost increases over time. A MAC analysis aids policymakers in prioritizing actions that achieve the desired emission reductions at the lowest cost and identifies economically efficient pathways for mitigation. However, it may not fully capture non-market benefits and distributional impacts.

As such both the SCC and MAC can serve as two sides of the coin: the societal cost of +1 unit of emissions, and the economic cost of -1 unit of emissions.

The choice of a carbon valuation method depends on several factors, including the purpose of the valuation, the availability of data, and the level of uncertainty about the future costs of climate change. The SCC approach is generally considered to be the more comprehensive method for carbon valuation, but it can be difficult to estimate the SCC with a high degree of accuracy. The MAC approach is less comprehensive than the SCC approach, but it is often easier to estimate and relates more directly to industries seeking to lower emissions. Whatever the method chosen, the key is its usefulness for decision-making.

Decision-makers considering regulatory proposals that could either raise standards or reduce carbon emissions can employ the Social Cost of Carbon (SCC) as a factor in their deliberations. For instance, if implementing a policy to avert 1 ton of carbon emissions proves to be less expensive than the SCC, then the benefits of the policy exceed its costs, rendering it financially viable in the long term. Conversely, if the policy's cost surpasses the SCC, the drawbacks outweigh the advantages and other avenues should be considered. Presently, both the United States and Canada's federal governments, along with various states, integrate the SCC into their assessments of potential climate policy pathways.

A Life Cycle Assessment (LCA) is a method for evaluating the environmental impact of a product or activity throughout its entire life cycle. This includes the emissions associated with producing the product, using it, and later disposing of it. LCAs can provide a comprehensive view of the carbon footprint of a product or activity and can inform decisions about carbon reduction strategies. One such example is the comparison of an ICE (internal combustion engine), hybrid, or an electric vehicle across its full lifetime, which shows that the length of use or KMs traveled determines its true carbon footprint.

Other methods for carbon valuation include the use of Contingent Valuation Surveys, which ask people how much they would be willing to pay to avoid climate change impacts, and the use of damage functions, which estimate the economic costs of climate change impacts in the future.

Another tool of growing influence is GHG Accounting, with Scope 1, 2, and 3 categories. GHG accounting refers to the categorization of emissions based on their source: Scope 1 includes direct emissions from owned or controlled sources, Scope 2 covers indirect emissions such as from purchased electricity, and Scope 3 encompasses indirect emissions spanning the full value chain.

Valuing carbon involves assigning a monetary value to these emissions, typically through mechanisms like direct or indirect carbon pricing or calculating the social cost of carbon (SCC). Understanding GHG emissions across scopes aids in accurately assessing the carbon footprint of an organization or activity, thereby informing decisions regarding their best emission reduction strategies, and determining the financial implications of their carbon emissions.

"Despite multiple pledges and commitments, rapid progress in key technologies, and a total of over 4,500 climate policies introduced to date, the world is not on track to meet the objectives of the Paris Agreement." – World Bank, "Within Reach: Navigating the Political Economy of Decarbonization"

Carbon Valuation – Tools

Taxes / Trading

Alongside the methods discussed above are the practical tools of implementing carbon valuation, which come in two main forms: taxes and trading.

Carbon taxes impose a fixed price per ton of emitted carbon, providing a straightforward method to internalize the external costs of emissions.

Carbon trading systems ('cap-and-trade') on the other hand, set an artificial 'cap' on total allowable carbon emissions and allocate emission permits that can be then traded among entities, allowing for flexibility and market-driven emission reductions. Paired with this system is a set penalty for exceeded limits, which sets a carbon price per ton that should discourage this behavior.

Carbon taxes are a direct form of carbon pricing intervention and are useful in their simplicity and transparency, providing a price signal for carbon emissions that ideally reflects their true environmental cost (or will over time), are likely to be predictable and stable indicators for decision making, and can also be a key source of revenue generation that further finances climate change initiatives. They provide cost-effective abatement, raise public revenue, and decentralize decision making.

In practice, carbon taxes have been shown to be relatively flat and can be politically sensitive, thereby lagging behind inflation and not truly reflecting their environmental costs as intended. It is also likely limited in application to only specific sectors and actors, and the tax rate and total carbon cost can vary greatly across markets, leading to 'carbon leakage'.

Carbon trading systems are an indirect form of carbon pricing intervention, which allow for greater flexibility in the emission reduction strategies and choices of actors. The cap, while artificially set, should decrease over time to put increasing cost pressure on actors to lower their emissions, and has been shown to increase carbon prices more than carbon taxes. Such emission trading systems are growing in popularity for their flexibility in implementation, their greater emission certainty, and as a market-based approach that incentivizes innovation while still generating public revenue.

The origins of cap-and-trade also have a success story in their application to Sulfur Dioxide emissions and the elimination of 'acid rain' caused by power plants. The overall impact of an ETS as always depends on its details; if the cap is too high or decreases too slowly, if permits are freely allocated or not, if the penalty for exceeding limits it sufficiently high, and by how many sectors are covered in a mandatory system.

Effective Carbon Prices

So, what exactly is the price of carbon ($/ton)? The most comprehensive answer to this comes from the OECD's annual Effective Carbon Rates report, which examines the carbon taxes, trading systems, and coverage of carbon price intervention schemes across 72 countries accounting for 80% of global emissions.

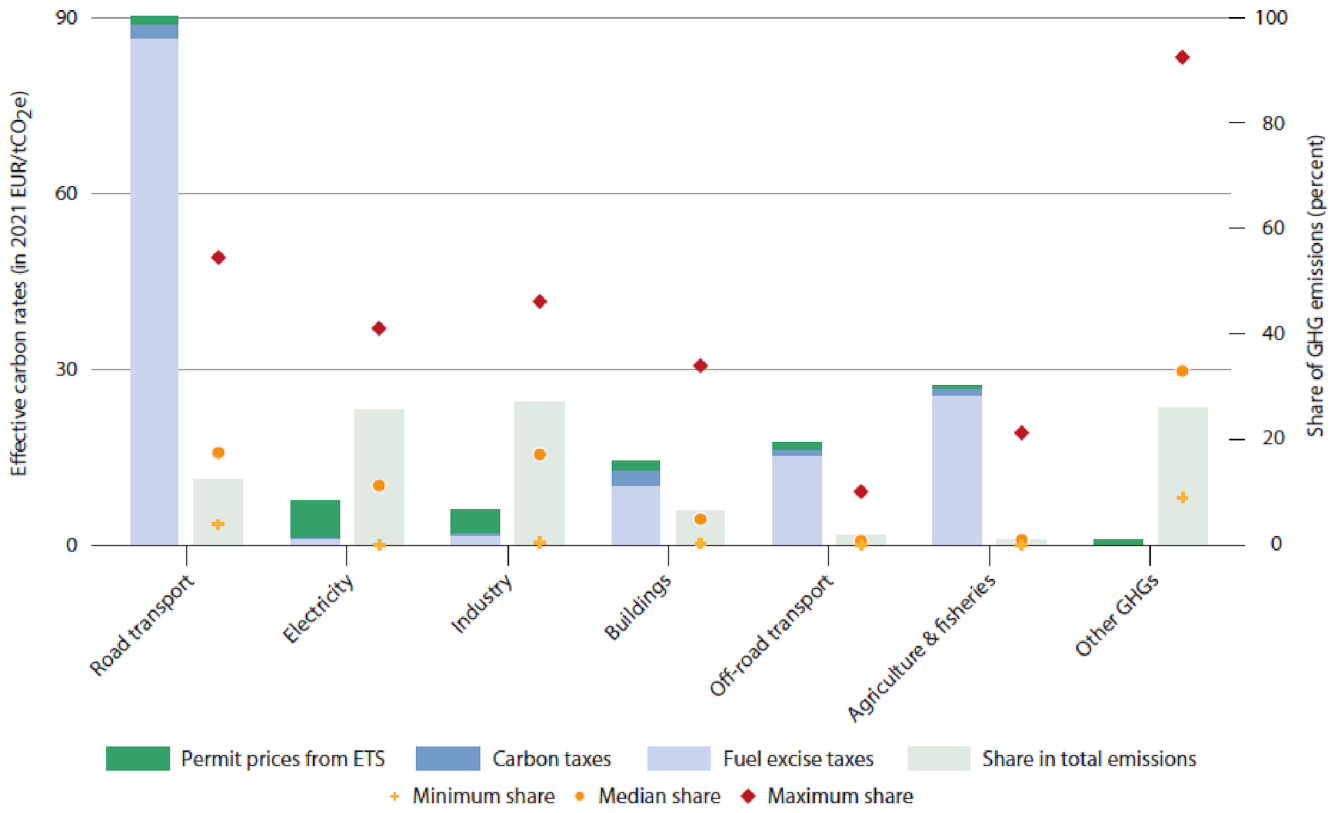
Unfortunately, the answer is—it depends. For 2021, just 42% of the ~40 GtCO2e of annual GHG emissions were priced in the 72 countries covered in the report, but with significant variation of coverage, prices and pricing instruments across sectors and countries. (OECD Effective Carbon Rates 2023)

One answer is ~$25–35/ton, while another is between $0.07–155.86/ton. This is not a great price signal.

The reason for this is that the practical price of carbon varies across sectors and economies, and even within an economy. Permit prices can experience significant volatility within a single year and a single economy. Some methods to mitigate this include direct price floors or ceilings, or indirect market-making methods. To further confuse matters, many non-CO2 GHGs are not covered by carbon pricing measures but represent a significant share of total emissions, from 8-92%. Ultimately, the Paris temperature targets don't care which GHG is doing the radiative forcing.

As shown in the chart below, about 16% of GHG emissions were priced at least €30 per ton or *more*, and only 7% were priced at over €60 per ton. For industry, the average price was €27.10 per ton, , while for electricity it averaged €11.50 per ton. Average

Figure 2: **Carbon pricing instruments and share of GHG emissions by sector, 2021**



Note: The left-hand side bars of this graph show ECR components and levels by sector. Together, emissions from the road transport, electricity, industry, buildings, off-road transport and agriculture and fisheries sectors make up CO_2 emissions from energy use. Other GHG emissions cover CH_4, N_2O and F-gas emissions as well as CO_2 emissions from industrial process. The right-hand side axis presents shares of emissions from these sectors in total emissions, as well as their variation across countries. "Minimum share" (resp. "Maximum share") indicates the minimum share this sector may represent in a country's total GHG emissions. "Median share" is the median of such shares across countries. For instance, the median share in the road transport sector indicates that half of countries in the sample have a road transport sector that accounts for more than 17.5% of national GHG emissions.

Source: OECD (2023), *Effective Carbon Rates 2023*.

permit prices across six sectors, excluding China, was €29.38 per ton.

Across sectors and economies, the actual price of carbon over just the past decade has ranged from zero or near-zero per ton, and up to over $100 per ton, depending on the sector, the market or country, and the national rules that determine this price.

For the EU, since the launch of the ETS system in 2005, the carbon permit price has varied from ~€20 per ton down to €0, back to €40, all within its first few years of existence, due to the global financial crisis. Until 2021, the EU carbon price didn't break this €40 threshold for over a decade, while it now hovers above €70 per ton.

Emissions trading systems (ETS) have become the main carbon pricing instrument over the past several years and have shown to be more dynamic and resilient than direct carbon taxes. From 2018 to 2021, carbon tax coverage increased only 0.2% from 6.7% to 6.9%, while ETS coverage more than doubled from 13% to 27%. In addition to this increase in coverage, the marginal explicit carbon rate (price per ton) increased 38% from €11.2 per tCO2 to €15.5, while carbon taxes over the same period increased only 7% from €11.6 to €12.4 per tCO2.

Overall, less than half of global annual emissions are covered by a carbon pricing instrument, and for those that are, just 5% are priced above the range recommended by the High-Level Commission on Carbon Prices. As will be discussed later the disparity of this emerging carbon price marketplace allows for carbon emission leakages between economies that ultimately delay emission reductions and prevent progress towards the Paris temperature targets.

Carbon valuation methodologies play a crucial role in shaping climate policy and incentivizing emission reductions. While each approach has its strengths and limitations, a combination of carbon pricing, SCC

assessments, MAC analysis, LCA analysis, and carbon offsetting can provide a comprehensive framework for valuing carbon emissions. As the global community intensifies its efforts to combat climate change, continued refinement and integration of these methodologies will be essential for driving meaningful emission reductions and transition to a low-carbon economy.

Carbon Markets

To further explore the price of carbon as determined by markets, some terminology must first be defined and separated. The terms carbon credits, carbon allowances, carbon permits, or carbon offsets can all seem to mean the same thing—the sticker price of 1 ton of CO2 or CO2 equivalent. However, there are key differences.

A carbon credit or carbon allowance are those generated and issued by a regulatory cap-and-trade system, which is typically a mandatory compliance system, with credits allocated or auctioned to specific entities or industries in a regulated and verified framework. These credits or allowances are then a legal right to emit GHGs, or if unused, surplus credits are a tradeable asset that can be sold or transferred to others exceeding their cap. The registry and verification of these credits is critical to the functioning of an ETS's efficacy. The measurement and integrity of emissions must be accurate and consistent with established baseline levels to make the chosen carbon cap level effective.

Carbon offsets on the other hand are directly connected to a specific project or scheme that either removes or avoids GHG emissions. These 'offset credits' are purchased voluntarily and can be more of a 'wild west' market with various standards to establish they are real, measurable, verifiable, durable, or constitute true additionality.

As recent reporting and analysis around carbon offsets has shown, the quality of a particular carbon offset can greatly vary depending on the project, the technology, or the standards surrounding its issuance. The planting of new trees, the avoidance of cutting down old trees, the seeding of oceans to trap more carbon, or the removal of CO2 directly from the air and turning it to stone are all carbon offset projects, with variance in carbon avoidance vs. carbon removal, and their durability over long periods of time.

Where a formal emissions trading system does not yet exist, proactive companies can look to address their carbon footprints in the voluntary offset market. In practice, carbon credits and ETS markets help to serve different purposes with the same goal of reducing GHG emissions. The flexibility of voluntary markets can be a key benefit, while large and major industries like the power sector are addressed through a formal ETS that coordinates between industry, government, and international institutions.

A recommended source of information for this sector is the International Carbon Action Partnership (ICAP) and its comprehensive *Emissions Trading Worldwide; Status Report 2024*.

More and more carbon markets are emerging around the world and in new and innovative ways, depending on the specific opportunities offered by local, regional, economic, and political contexts. In Indonesia, a 'cap-tax-and-trade' system is being introduced, while Japan and India are moving first from a voluntary system to a compliance ETS over time. China's national ETS aims to ramp up with time as an intensity-based ETS, while Canada pursues an output-based ETS.

There is tremendous variance in the carbon emissions trading market, both in terms of its coverage and the actual price of its carbon in practice, which varies greatly with policy choices. In 2021, nearly 60% of the 40 billion tons of GHG emissions were unpriced in the 72 countries that have some form of carbon tax or trading systems. In the energy sector in New Zealand, its ETS system covered 99% of CO2 emissions, while Japan in the same year covered just 1.7%.

The varying maturity and size of these markets, and the economic and political contexts they operate in, makes for large discrepancies in their effective prices. Such variance also lends itself to arbitrage by global companies, to move carbon intensive operations and products to markets with the lowest cost or regulation coverage. A national or even regional carbon trading system can only go so far, and carbon diplomacy has shown how far away we are from a global carbon price in theory or in practice.

European Union Emissions Trading Platform (EU ETS) – In 2005 the European Union rolled out its Emissions Trading System or 'ETS', which is now one of the largest and the longest-running emissions trading platforms. The EU ETS has effectively become the benchmark for all other ETSs to compare against, in

terms of trading market size, enforcement and verification, and implementation of carbon allowance trading with sliding targets for emissions reduction. The EU ETS covers CO2, N2O, HFCs, PFCs, and SF6, which were covered in part 1.

As a cap & trade system, allowances are issued each year according to the set carbon cap that progressively decreases over time. The primary objective of the EU ETS is to reduce GHGs from particularly energy intensive industries like power generation using a linear percentage reduction. This has been done in phases over nearly two decades, and is currently in its fourth phase.

At its outset however, the EU ETS over allocated allowances for carbon emissions to smoothly introduce the system without putting too much pressure on its targeted industries. This overallocation of allowances leads to a surplus of credits and depressed the carbon price in the system, undermining its effectiveness at reducing emissions.

In 2023, the EU ETS received an overhaul to include additional sectors and expand in scope, including buildings and road transport, as part of the 'Fit for 55' package that aligns 2030 climate targets and EU Green deal objectives, with 55% net reductions to 1990 levels. Together they are ETS 1 and ETS 2, providing greater sectoral coverage and updated reporting requirements, while also moving further towards auctioning from free allocation.

The free allocation of carbon allowances in an ETS means they are provided by the government to an industry or company at no cost. This is intended to protect industries that face international competition and lower their initial compliance costs, while setting goals and pathways to lower emissions over time. The distribution of free allowances can be done via **grandparenting**, which favors historic polluters, or by **benchmarking**, which ties benefits to performance indicators. This has been a criticism of the EU ETS that initial reliance on free allocation weakened its impact, and created the potential for windfall profits, as some firms are granted credits at no cost that they can sell even without reducing their emissions due to overallocation.

Other than being freely allocated, as is more common for industry, in areas like the power sector carbon credits are often sold via an auction, which can be implemented in several different ways, including in combination with free allowance. Auctioning is the most straight forward and market efficient method of allocation that gives a clear price signal, while free allocation is appealing for new and emerging carbon markets. The balance of this choice varies with the market size and context, or with market linkages allowing for a greater number of participants and thus liquidity, while minimizing the risk of carbon leakage.

For the EU, ETS free allowances made up nearly 40% of allowances across all sectors from 2013-2020, with 80% being given to manufacturing, as well as a large majority for airlines, while the power sector has not received any since 2013. Compared to other carbon markets in competing economies like China, where free allocation has been far more common and its carbon price far lower as a result.

EU Carbon Border Adjustment Mechanism (CBAM) – As of October 1, 2023, a further measure to address issues of 'carbon leakage' around such emissions trading systems is the implementation of the EU's Carbon Border Adjustment Mechanism (CBAM) which places a carbon tax on imported goods to equalize the cost of GHGs from foreign markets. Functioning like a carbon tariff, the CBAM serves to protect the EU market's industries that are negatively affected by their own carbon tax that is higher than those in other markets, thereby working in tandem with its own ETS to lower overall carbon emissions.

Under the CBAM system, importers of goods to the EU will be required to report quarterly on the embedded carbon emissions of their imported products. The time and cost burden of this reporting will not come into enforcement until 2026, giving some time for phase-in of the new system. From 2026, EU importers will be required to purchase CBAM certificates, which are tied to the weekly average carbon price of the EU ETS. In addition, the phase-in of CBAM will correspond with the full phase-out of 'free allowances' in the EU ETS.

The risks of carbon leakage for sectors that are both heavy in carbon intensity and trade intensity has been a limiting factor in the overall effectiveness of the EU ETS to reduce emissions. Still, it has continued to make progress and show the proof of concept that other markets have since followed. With continued improvements, linkages to other markets, and a more level playing field with CBAM, other large markets will hopefully follow suit. With the US, UK, and Australia considering CBAMs of their own, a form of carbon protectionism could help to hasten the adoption of

levelized carbon prices and give greater incentives to reduce emissions.

China's National Carbon Trading Scheme (CN-ETS) – China's ETS began in 2021 after a decade of preparation, with formal reporting requirements only set to begin in 2025. It is an intensity-based carbon market and trading system, meaning allowances are freely allocated according to benchmarks based on actual emission production levels. From its rollout, it immediately became the largest carbon market in the world covering ~5,000 MtCO2, or 40% of the country's emissions, but only with respect to CO2. The EU ETS covers just ~1,400 MtCO2e by comparison.

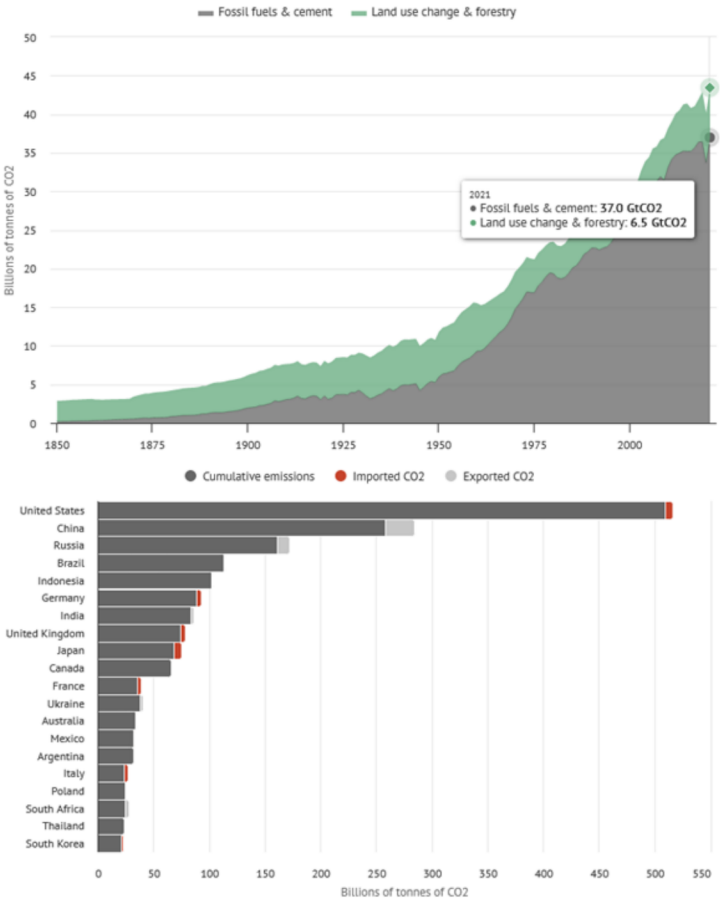
As noted, compared to the EU ETS that is moving away from the free allocation of permits or allowances, China's system (although much newer) is almost entirely based on free allocation. In addition, there is concern that the system has also been far too generous and thus will be slow to cap emissions, by providing excessive credits that provide little to no incentive to reduce emissions for its first two years. This also leads to a much lower carbon price, of effectively $10/ton. For China, the national ETS builds upon 8 pilot markets in smaller regional areas, and rollout and compliance are the first steps before expansion or ramping up. Only the power sector is currently covered, with variations based on types of power generation. In time, more sectors will be added to cover further emissions.

The form and performance of China's ETS is critically important as it is already the world's largest carbon market thanks to the size of China's economy and it will continue to grow in the coming years, alongside its emissions, unless there are rapid reforms to the power sector and heavy industries. The slow and steady approach is not well aligned with the Paris temperature targets. Today, China is the largest emitter of GHGs by some margin, and while its historic share of cumulative emissions is still lower than that of the US, it is rapidly closing this gap each year.

The **China Certified Emission Reduction (CCER)** is China's national voluntary carbon *offset* market, which looks to complete its carbon market approach of reaching Net Zero by ***2060***—10 years later than IPCC requirements for the Paris temperature targets. Hosted by the Beijing Green Exchange, credits trading began in early 2024 with a price of around $9/ton of CO2e, again markedly lower than most offsets or other markets.

The scale of these markets and related offset projects must be viewed in global context. In 2023, China accounted for 95% of the world's new coal power construction activity, with 70 gigawatts of new capacity added, and over 200 gigawatts in the past 5 years, which is outpacing the shutdown of the same sorts of coal plants in the United States.

Whether produced in the East or the West, the same emissions are depleting our shared carbon budget while a different value for it is placed in different markets, well beyond general purchasing power parity differences. One option to support the right carbon price signal is by placing a price floor underneath it.



UK Carbon Price Floor (CPF) – To better support the EU ETS in the United Kingdom, back in April 2013 a carbon price floor was introduced that would apply a minimum Carbon Price Support (CPS) rate, effectively a carbon tax, set under the 'Climate Change Levy'. Whatever the EU ETS carbon price was trading at, a CPS would be added on top, to reach the CPF target. Similar to a Feed-in-Tariff for a renewable energy producer. This allows for more ambitious policy goals to be set while the ETS is under-performing in terms of efficient price signaling. A target of £30/tCO2 by 2020 was set, and the CPS 'top-up' component was capped at being £18/tCO2 from 2016-2021.

UK Emissions Trading Scheme (UK ETS) – With the departure of the UK from the European Union in 2015, a new system would be required to replace and hopefully align with the EU ETS. After the end of the Brexit transition period on December 31, 2020, the UK ETS began from January 2021, covering CO2, N2O, and PFCs, with a cap of 92.1 MtCO2 covering the power, industry, and aviation sectors.

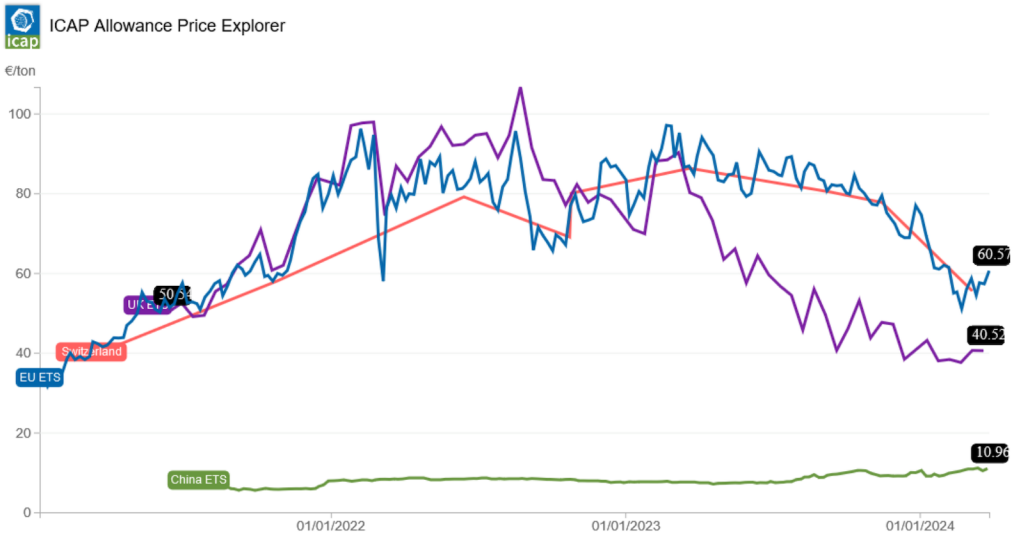
Like other systems discussed, but now with national flexibility, most allowances are obtained through auctioning while a portion are freely allocated, if deemed at risk from carbon leakage. The stated aims of the UK have been a progressive reduction of net GHG emissions from 1990 levels until reaching Net Zero by 2050. From 2021 to 2023, the EU, UK, and Swiss market carbon prices tracked one another without much difference. Since 2023 however, a price divergence has formed, with the EU ETS carbon price now 40% higher than the UK ETS carbon price.

The decoupling of UK and EU carbon market prices will make UK carbon-intensive products more competitive in the near term, but will soon have an impact on UK exports with the implementation of the EU CBAM. From 2026, UK products will face a border tax to levelize their lower carbon rates, increasing their cost. Cooperation therefore is key for the UK, either through full linkage of the UK ETS to the EU ETS (coming full circle), or the use of targeted exemptions to the EU CBAM for high-carbon products. The UK now plans to introduce its own CBAM from 2027, which while protecting UK industry from other lower cost carbon markets, it will create further challenges and complications to Northern Ireland in balancing between EU and UK regulatory environments. The further these carbon markets and their carbon price diverge the more difficult it will be to realign them.

Germany's National ETS – Naturally Germany is already covered by the EU ETS, but like the UK CPF, it has taken additional measures to implement its own national ETS system that is wider in scope, covering sectors not included in the EU ETS. National regulations are also tailored to its own domestic needs and priorities, giving both more flexibility and autonomy in how it addresses its GHG targets. The carbon price in these additional sectors has also been lower than the EU ETS average but has converged more recently.

The German national system as well as neighboring Austria, uses 100% auction-based allocation with no free allowances—the opposite approach of the Chinese ETS. The initial price was fixed at €30/ton CO2 until 2025, with a price corridor of minimums and maximums to be introduced thereafter. Sectors covered include waste, transport, buildings, and industry, in addition to the EU ETS coverage. In January 2024 a €15/ton price increase was added, bringing the price to €45/ton, between the UK, EU and Swiss ETS carbon prices.

California Cap & Trade Program (CA ETS) – The state of California in the United States, as well as the Northeastern US states, have taken their own initiative to create an ETS in lieu of a national system. With no US ETS in place, the state of California is the largest sub-national economy in the world, effectively the 5th largest economy in the world on its own, ahead of India and the UK at $3.9 trillion USD. The size and influence of its economy has allowed California to help set the environmental standards for the rest of the USA via its own state laws and mandates that push for higher fuel efficiencies or safety standards. Companies then meet these standards to smooth their USA product lineups and limit regulatory discrepancies.



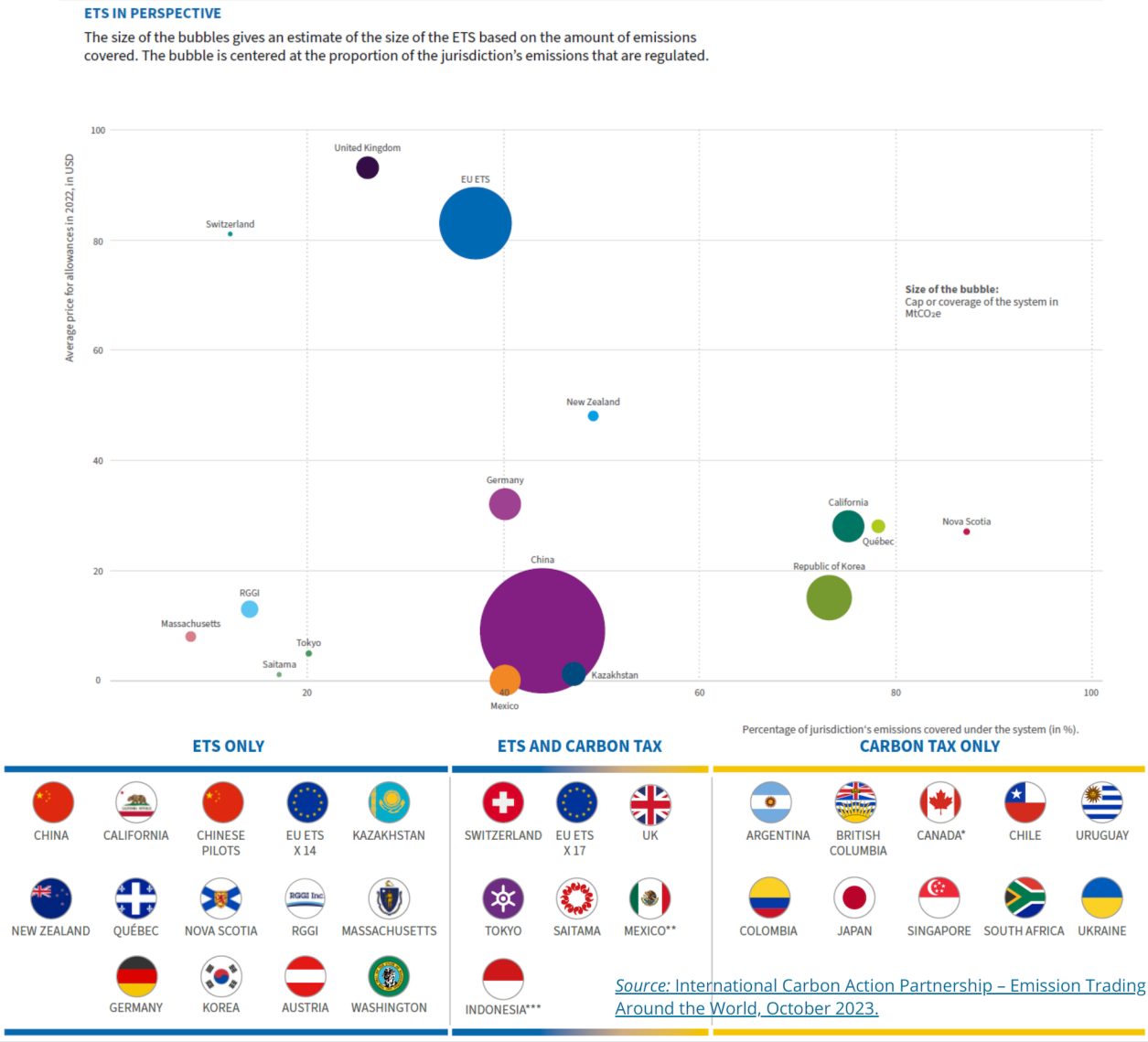
The CA ETS covers four sectors—power, industry, buildings, and transport—and a wide spectrum of GHGs including CO2, CH4, N20, SF6, HFCs, PFCs, NF3 and other fluorinated gases, making it far reaching in terms of GHG coverage. Nearly 75% of the state's emissions are covered by the system, with an average carbon price of $33/ton at auction.

Japan's GX League (GX-ETS) – Launched in April 2023 as a fully voluntary carbon credit market. This platform, along with an existing carbon tax and future carbon levy from 2028 underpins Japan's Green Transformation (GX) Policy. With over 600 companies pledged to participate and covering more than half of its emissions, it appears to be a good start, but is a highly cautious approach that will take 3 years to roll out by 2026. A similar approach is seen across the region with Vietnam, Thailand, and Malaysia looking to slowly implement an ETS in the coming years, with an initial focus on voluntary markets as opposed to mandatory and enforced systems.

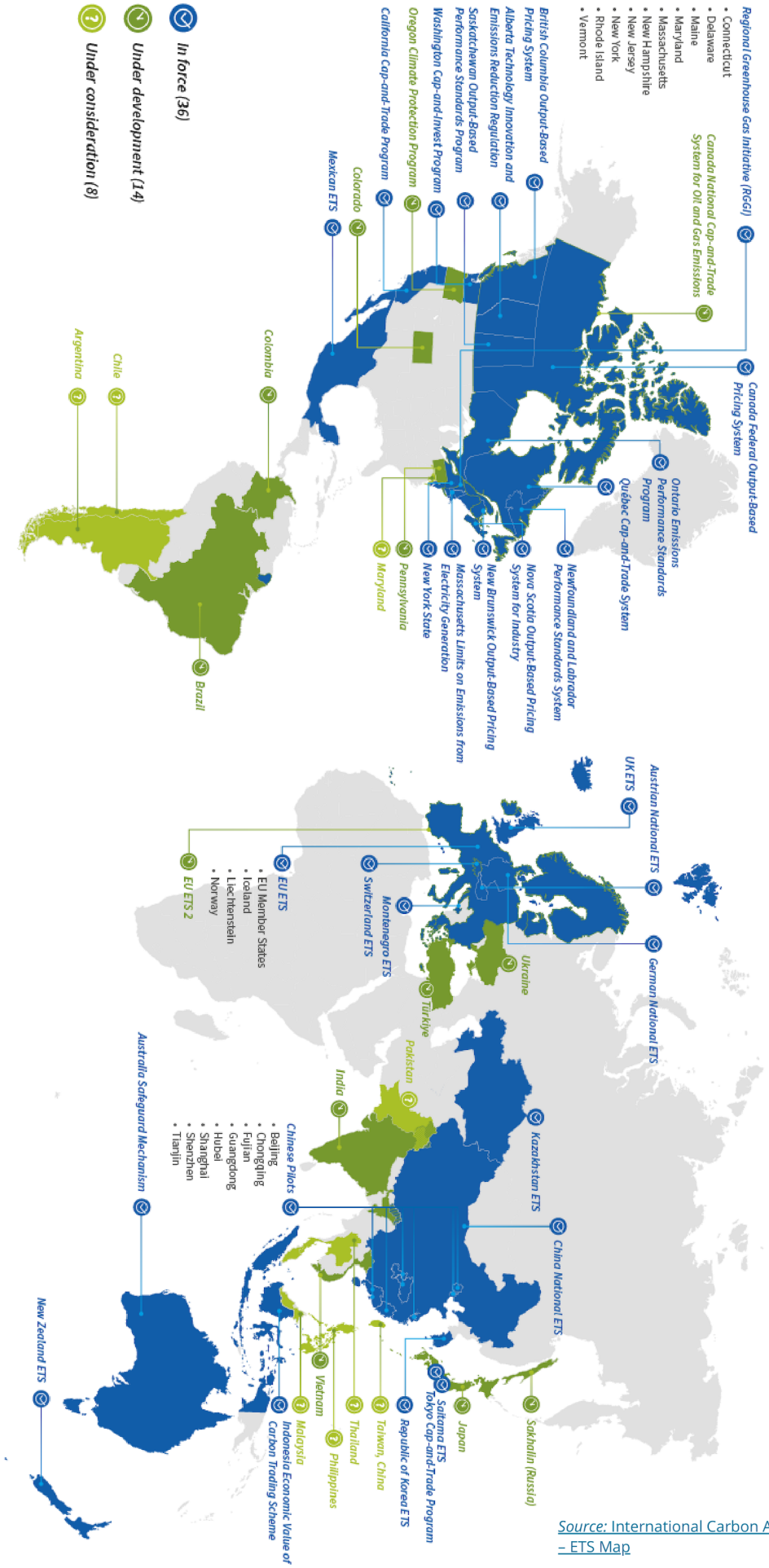
For a major economy like Japan's, the rollout of its ETS can be seen as 'too little, too slow' as the UNEP woud say, as it takes a wait-and-see approach towards carbon markets. Even after coming into enforcement, carbon credit auctioning won't take place until 2033. Meanwhile though, there is also a great deal of focus on rolling out decarbonizing technology for Japan, and a broad transition to a Green Hydrogen economy that should help it achieve its Net Zero goals.

As we have seen, there are a variety of ways to approach carbon markets, which have an influence on the ultimate carbon price, the level of emissions coverage contained, their impact or disruption on businesses, and their overall effectiveness at lowering GHG emissions and transitioning to a sustainable economy.

Direct and indirect carbon pricing mechanisms give a diverse range of options to achieve the same goal, internalizing the externalities of carbon emissions.



Source: International Carbon Action Partnership – Emission Trading Around the World, October 2023.



Source: International Carbon Action Partnership – ETS Map

Net Zero Greenwashing

Corporate Carbon Offsets

Without a global carbon price, or a universal ETS with coverage for nearly all GHG emissions globally, emissions will remain and be external to their costs.

As we have covered, there is a difference between value, market value, a price, or an economic value. Failing to fully account for the real value of carbon in carbon credits and offsets can lead to a 'race to the bottom', which makes the highest quality of carbon offset projects actually fail first, as has been noted by the offset verifier Gold Standard.

While mandatory ETS systems produce carbon credits or allowances, voluntary carbon removal and abatement projects generate carbon offsets, to remove CO2 emissions for others at a given price. This price depends on many factors including the technique and technology involved, the input costs such as its own energy use or raw materials, and the market demand for these credits.

As covered in part 2 of this series, carbon dioxide removal technology (CDR) has the potential to remove CO2 and generate carbon credits that are truly *additional* and *durable,* to undo the pollution of the past. However, many of these solutions require scale and subsidies to be ready for the market at this time, and not be quickly undercut by cheaper but more dubiously verifiable or durable offset projects.

Not all carbon credits are created equally. This is reflected both in their price, which can vary wildly from a <$1/ton, to several hundred, or +$1,000/ton, and in their durability, which may be permanent, a few decades, or potentially reversed through a single forest fire or parasite outbreak. In the example of planting trees, a typical beech tree takes ~80 years to sequester 1 ton of carbon, while its offset credit is being sold for *annual* emissions today.

Carbon is becoming increasingly visible in our day-to-day lives from products to policies, as the impact of GHG emissions becomes better and more widely understood. This visibility is translated into marketing by companies that wish to show how they are being more environmentally conscious via their products. Terms like carbon neutral, sustainable, 'eco', circular, Net Zero, or green colors tones abound.

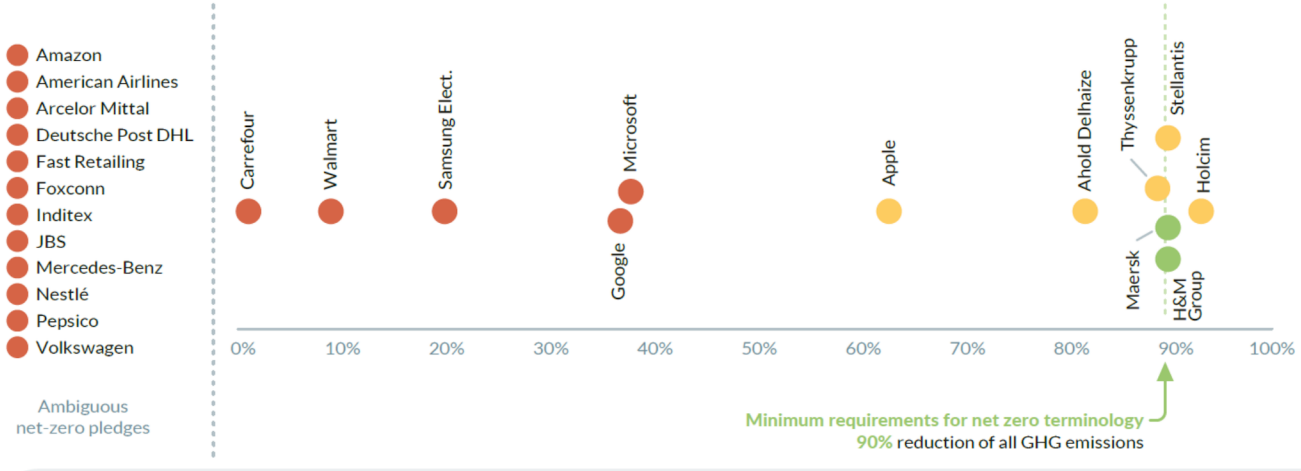
Another term aligns with this new moral projection—*greenwashing*. It is when an organization spends more time or money on marketing itself as environmentally friendly, than on actually minimizing its environmental impact. It can come in many forms, from exaggeration, to misdirection, or scams. Corporate greenwashing is where environmentalism meets paying taxes.

Offset verification outfits like Gold Standard or Verra are helping to set the rules of the road for this nascent voluntary market, and after increased scrutiny on projects in recent years many changes are ongoing to improve measurement and verification, to ensure that carbon offsets don't simply amount to greenwashing.

Figure S3: Just 5 of 24 companies commit to deep decarbonisation with their net-zero pledges

*This chart shows the **proportion of full value chain GHG emissions that companies commit to reduce with their net-zero pledges.***
Data includes 12 companies. For 12 other companies the meaning of the net-zero target is ambiguous.

Source: Carbon Market Watch - Corporate Climate Responsibility Monitor 2023



LEGEND ◌ Poor integrity ◐ Moderate integrity ● High integrity

The colour of the data points represents our assessment of the integrity of company's long-term targets, based on their sufficiency compared to sector-specific 1.5 °C aligned benchmarks, and the appropriateness of the terminology used in the pledge communication. Data presented on a single x-axis. Placement on y-axis has no significance.

For many companies, they are merely symptoms of the extractive-based economy they operate within, and have little choice in the nature of their grid connection. Small performative wins are what's available. But just 57 entities account for 80% of global CO2 emissions. The world's top-3 CO2 emitting companies from 2016-2022 were Saudi Aramco, Gazprom of Russia, and Coal India, all of which are state-owned firms and energy giants. The main focus of greenwashing should be directed to MNCs—multi-national corporations.

Greenwashing is the deliberate misleading of consumers or customers by over selling environmental efforts to seem more *green* than they actually are. Upholding an image over doing the work. A misdirection example of this points to a single product or segment of a business, highlighted as being sustainable or carbon-neutral, while ignoring the company's overall footprint, which can still be growing.

Customers are becoming increasingly aware of climate issues and how their consumption contributes. Per the Wall Street Journal, products labeled sustainable have increased 30% over the past decade, while over 60% of consumers say they are willing to pay more for a product that is sustainable/environmentally friendly. As the market notices this desire, more follow suit to virtual signal their shared values. However, walking the environmental talk requires tough choices for companies that must secure profits. Greenwashing looks to profit from an environmental image while doing the least work that harms the bottom line.

'Doing something is better than nothing', but the counter argument is that the false pretense of doing something, while actually not doing much at all, creates a slower reaction to issues like climate change and thereby does more harm through delaying actual required transformations.

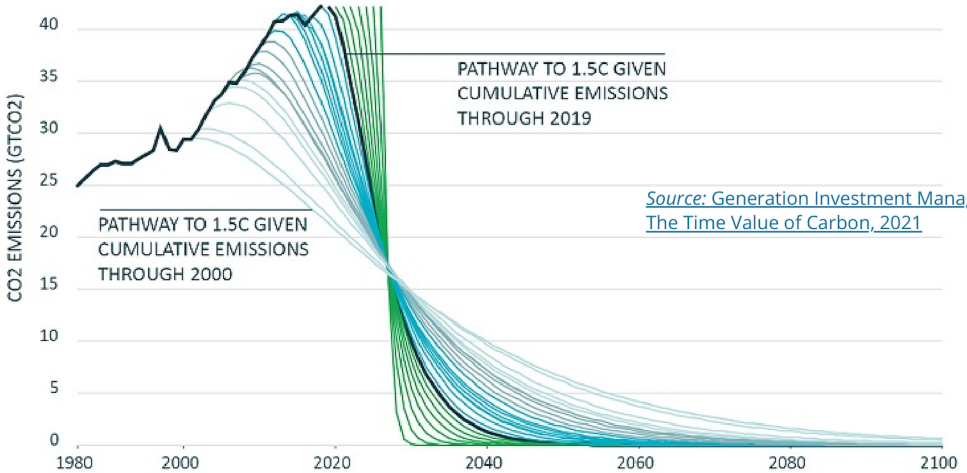
To combat this trend, in 2023 the EU announced new requirements that marketing claims from companies need to be backed up by evidence. In the US, the FCC is looking towards updated regulations around green marketing and potential punishment for its misuse.

The UN's High Level Expert Group on Net Zero have laid out their recommendations for integrity in this area, with an emphasis on *comprehensive* and *detailed* plans, detailing what they intend to do to meet their targets, with a first order priority focus on deep emission cuts over the use of voluntary carbon credits. Plans need to be clear, credible, reported on, and updated every 5 years.

Today however, companies face little to no negative impact from greenwashing or false environmental marketing, but have clear incentives to meet consumer expectations now, without raising product prices or reducing profits from operational overhauls.

Legally, most jurisdictions lack precise definitions of what constitutes greenwashing or a definition for the term at all. The EU has gone the farthest to regulate it, with California and France just behind. The proposal for a Green Claims Directive seeks to implement international standards for the process of substantiating environmental claims. Effectively, the world needs a *greenwashing-CBAM* or nutritional label for product marketing and corporate overreach.

A related concept for companies is the **Time Value of Carbon**. Every year of delayed actions on emissions steepens the curve of the 1.5°C pathway, which increases the future costs and uncertainty of reducing emissions in the future. New regulations, bans, and quotas may cause sudden and significant harm to firms that delayed in reducing their emissions and continued investing in legacy assets.



Source: Generation Investment Management, The Time Value of Carbon, 2021

Corporate Net Zero Strategies

We will now look at 3 different examples of Net Zero sustainability strategies and the use of carbon offsets —the good, the bad, and the ugly.

Frontier – Accelerating CDR Technology

As covered in the part 2 of this carbon briefing series on *Transboundary Carbon Technology*, the payments company Stripe and its partners seek to support the novel CDR market to help bring methods to market sooner and at greater scale, to reduce their carbon credit's costs and increase their viability. Their methodology for backing is focused on *durability* and *additionality* of carbon removal, guaranteeing an off-taker market for promising technologies, based on the vaccine development model.

By increasing the scale, options, and rigor of the carbon offsets market, Frontier is hoping to generate a tide that lifts all boats and to get ahead of the emissions curve. As other actors delay their emission cuts the requirements of carbon offsets will continue to rise, and more methods beyond land-use will be required at large scale to keep on the 1.5°C path.

Amazon – The Climate Pledge

The Climate Pledge Fund is a $2 billion USD fund started by Amazon and Global Optimism, which boasts 488 signatories in 43 countries. Companies include some major names like Microsoft, Mercedes, JetBlue, Uber, Visa, and IBM.

The purpose of The Pledge is for environmentally conscious companies to get ahead of the curve and decarbonize their companies faster than the Paris climate targets of Net Zero by 2050, reaching this a decade earlier by 2040. It is an ambitious and commendable goal, which also lacks accountability.

Amazon itself, since pioneering the Climate Pledge in 2019 saw its emissions continue to grow year over year, with a total increase of +40% since 2019. Each of the past two years emitting more than 71 million tons of CO2, which is referenced in their media as a first ever decline in emissions, of -0.4%. Much of their emissions growth has been driven by data centers with insufficient renewable energy to match.

Amazon is now the world's largest corporate buyer for renewable energy, and it's carbon intensity (CO2 per $ sold, an indicator of emissions efficiency) fell by a respectable 7%. Having slowed it emissions growth, now it must bend the curve and continue apace to 0.

Some companies like Amazon do major sponsorships to promote their brand with a large visibility such as stadiums, and live events are also a source of emissions. Amazon has taken its own approach to this by building its own flagship arena project, the Climate Pledge Arena in Seattle, Washington.

The sustainable venue serves as a concert hall, a sports stadium for an NHL and WNBA team, and serves as a showcase example for how other establishments can be built and operated in a climate friendly manner. It hopes to serve as a constant reminder to guests of the need for climate action and awareness while hosting events.

"*Our goal to be the most progressive, responsible and sustainable arena in the world. It might sound ambitious, but that's the point. We aren't named after a corporation. We are named after The Climate Pledge, founded by Amazon and Global Optimism in 2019, which is a commitment from companies globally to be net zero carbon by 2040.*"

The build first took an old landmark building from the 1962 World's Fair, and built anew under the same roof. Sustainability efforts include 'zero waste', '100% renewable energy', 'water conservation', a public transport emphasis, and the purchase of certified offsets to be a 'carbon positive building'. The International Living Future Institute is the verifier for its Zero Carbon Certification, and it is the first for an arena in the world. This takes into account both its operational carbon, as well as embedded carbon emissions from its construction—about 34,000 tons. Using Verra's registry for verified carbon credits, 37,835 tons of CO2 were purchased and retired.

From 2021-2025, its power needs have been sourced through Renewable Energy Certificates tied to a regional wind farm project in Puget Sound, and from 2025 it will be a client for a new wind and solar energy scheme to develop brand new energy projects that meets its power needs. Throughout the arena, everything from mechanical systems to heating, cooking, or even forklifts run fully on electric power.

While Amazon the company may still have a long way to go (71 mtCO2/yr), the Climate Pledge Arena takes the right approach to reduce all emissions across Scope 1-3 emissions, and to then offset what it cannot with verified nature-based solutions. For the reminder to not be misdirection, the parent company must live up to its own pledge.

Formula 1 – Net Zero by 2030

Motorsport is an unlikely example for sustainability, historically built upon the rather liberal use of fossil fuels for the sake of entertainment and competition. However, it is also a reflection of how priorities and technology are evolving, from bespoke race fuels and unlimited excess decades ago, to a hybrid system with complex energy recovery and regenerative braking, and now on to sustainable fuels that are 'carbon neutral'. A stated aim of this evolution in its approach is to help inform the next generation of car development and help bring the costs of sustainable fuel production down for all manufacturers.

Yet, the actual car racing of F1 emissions is less than 1% of their total annual carbon footprint, which stood at 256,551 tons CO2e in its 2019 baseline. Making 1% of your business model sustainable hardly seems relevant, but it serves as an exercise for the wider car industry that may have knock-on effects.

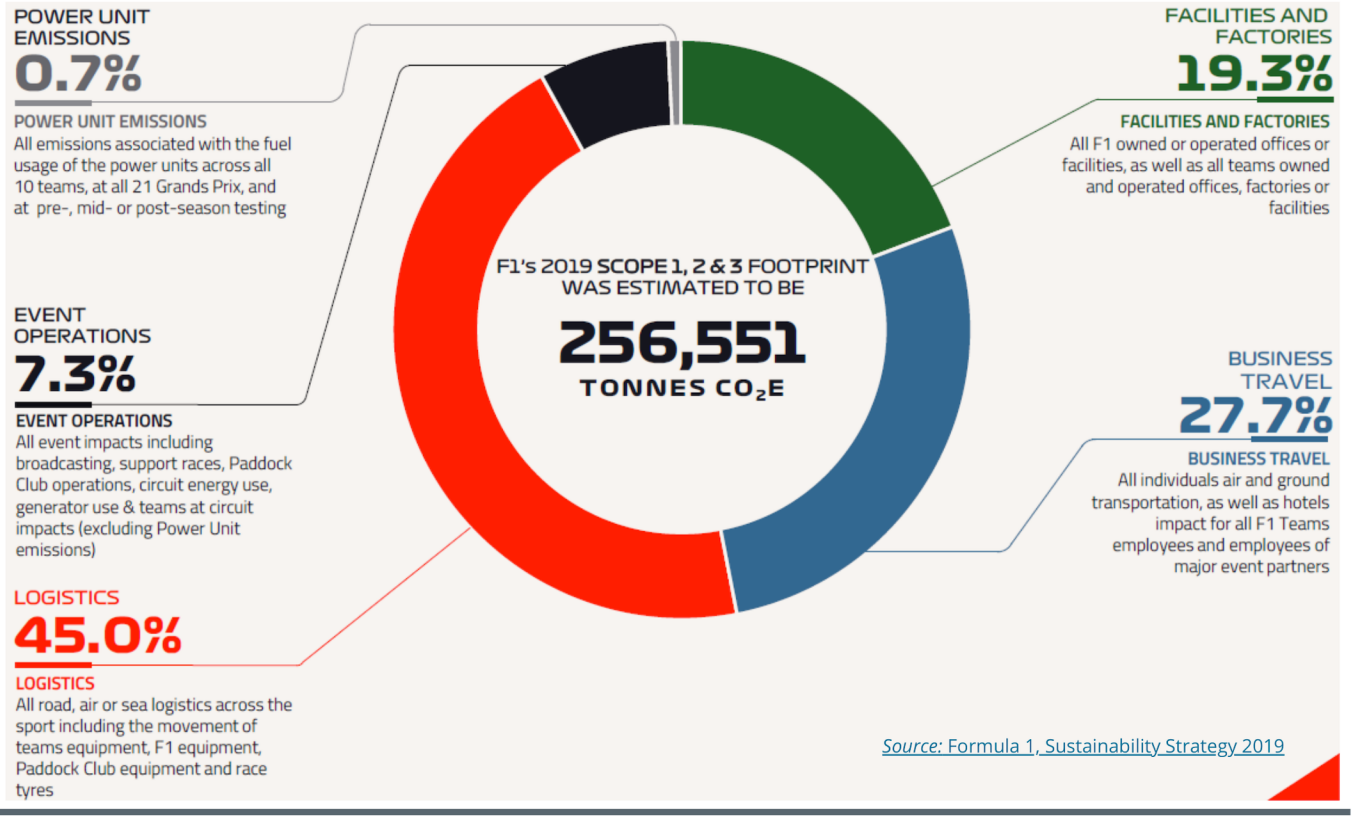
F1's other emissions relate to the building of the cars, factory facilities, and copious amounts of tyres used at each event. In another 'ugly' example, while the overall tyre allowance and usage has declined in recent years, they have also been intentionally designed to wear out faster, to encourage pit stops and add more variability in the races for better entertainment value. Their sustainable solution for this is to burn them for energy in the processing of cement.

Overall, while making all aspects throughout the sport more sustainable is good and well intended, it is borderline greenwashing when it is the events themselves—and the immense travel and shipping requirements of the sport on its annual world tour—which is only getting longer by adding more events.

Currently ~75% of F1's emissions relate to just logistics and business travel. Even with the regional clustering of events to cut down on the global criss-crossing waste, its people are still traveling home between events and on multi-week breaks.

A recent update on their progress states that they are on track for their 2030 goal, cited by an 18% reduction in emissions from their 2018 baseline, from 13% in 2022. Some examples of how the remaining *82%* will be achieved in just the next 6-year period are well intended, but may not live up to scrutiny. They rely on the use of sustainable aviation fuels and Boeing 777F planes to tackle shipping costs, using biofuel shipping trucks for certain events (only available in Europe), investing in renewable energy projects elsewhere, and claiming the *annual* production of solar PVs for the energy needs of a single 3-day event.

A large bulk of efforts will depend on encouraging spectators to travel to and from events in greener ways. Whatever remains, will need to be bought off via carbon offsets, which may be good or bad.



Source: Formula 1, Sustainability Strategy 2019

Across it's sustainability strategy is a heavy reliance upon sustainable fuels, from the racing cars to the freight trucks to the planes moving the show from point to point. The transferability of this model at scale has many skeptics due to the large land-use requirements necessary to produce this much biomass for biofuels. Unless produced from waste, something else of value must stop being produced in order to make it. Two major alternatives are food production, and natural carbon sinks.

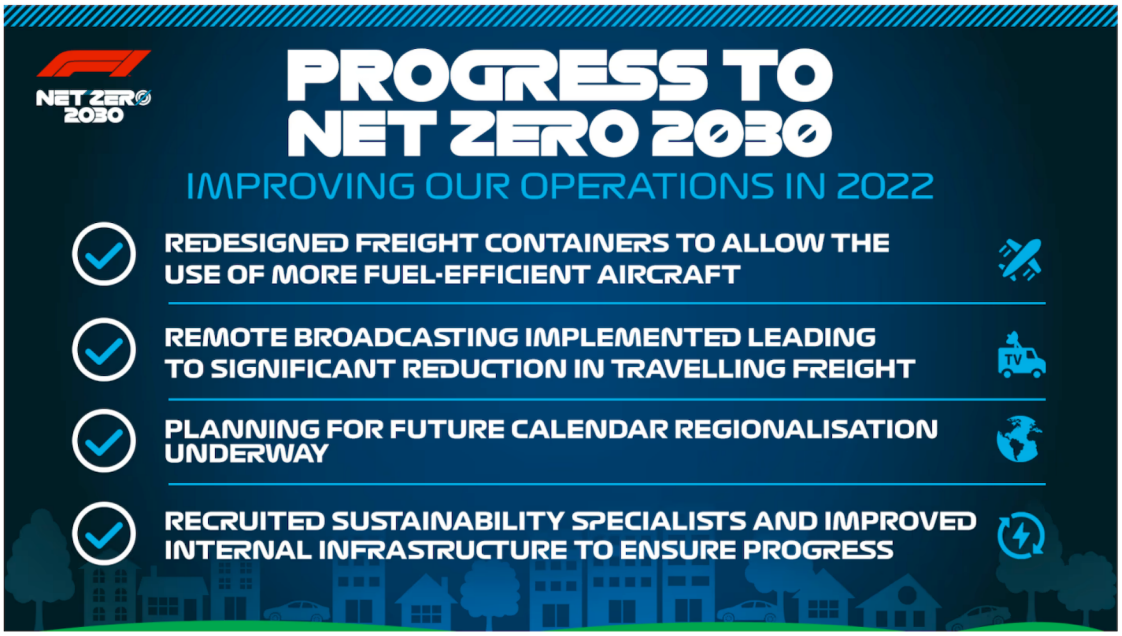
In the end, racing is a rather easy target when discussing GHGs and sustainability strategies, and there are much larger fish to fry when it comes to keeping us all on the 1.5°C pathway. There is also a limit to counting others' efforts towards your own. Racetracks are used for various series and events throughout much of the year, while all trackside solar power (where available), has already been used up by just one weekend event.

The problems for F1 and carbon emissions are the same problems for all live events or sporting events—the travel and logistics of the events and their fans. Reforming this aspect requires an overhaul that the International Energy Agency has correctly termed an 'unprecedented transformation.'

Conclusion

Global climate diplomacy is slow and currently failing. Carbon technology has some real promise, but is too small-scale and requires a sufficient carbon price. Carbon pricing is fragmented and varies widely, while global climate diplomacy has been unable to reach agreements on emissions, carbon pricing, or funding to help reach Net Zero on a 1.5°C pathway.

Cooperation, Technology, and Valuation need to work together to effectively address climate change.



Sources for Further Learning

International Carbon Action Partnership (ICAP) – https://icapcarbonaction.com/en

Carbon Pricing Dashboard – World Bank – https://carbonpricingdashboard.worldbank.org/

Net Zero Tracker – https://zerotracker.net/

Emissions Trading Extra – EU ETS 101 – https://etxtra.org/publications/eu-ets-101-a-beginners-guide-to-the-eus-emissions-trading-system-2024-update/

Gold Standard – https://www.goldstandard.org/

Greenhouse Gas Protocol – World Resources Institute (WRI) – https://ghgprotocol.org/

Key Reports

[1] Broken Record: Temperatures hit new highs, yet world fails to cut emissions (again) – UN Environment Program (November 2023) https://www.unep.org/resources/emissions-gap-report-2023

[2] Effective Carbon Rates 2023 – Organisation for Economic Co-operation and Development (November 2023) https://www.oecd.org/tax/tax-policy/effective-carbon-rates-2023.htm

[3] Emissions Trading Worldwide: 2024 Status Report – International Carbon Action Partnership (April 2024) https://icapcarbonaction.com/en/publications/emissions-trading-worldwide-2024-icap-status-report

[4] Integrity Matters: Net Zero Commitments by Businesses, Financial Institutions, Cities and Regions – United Nation's High-Level Expert Group on the Net Zero Emissions Commitments of Non-State Entities (November 2022) https://www.un.org/sites/un2.un.org/files/high-level_expert_group_n7b.pdf

[5] Net Zero Roadmap: A Global Pathway to Keep the 1.5°C Goal in Reach, 2023 Update – International Energy Agency (September 2023) https://www.iea.org/reports/net-zero-roadmap-a-global-pathway-to-keep-the-15-0c-goal-in-reach

[6] State and Trends of Carbon Pricing 2023 – World Bank (May 2023) https://openknowledge.worldbank.org/handle/10986/39796

[7] State of Finance for Nature 2023 – UN Environment Program (December 2023) https://www.unep.org/resources/state-finance-nature-2023

[8] State of the Global Climate 2023 – World Meteorological Organization (March 2024) https://library.wmo.int/idurl/4/68835

Acknowledgements

MEDRC's Transboundary Waters Practitioner Briefing series has been developed for industry practitioners and government officials at the request of MEDRC's member countries, with sponsorship provided by the Netherlands. The briefings are meant to be informative and practical, providing an overview of the subject matter material, while remaining accessible to various backgrounds and disciplines. The briefings serve to develop shared knowledge and serve as a basis for further discussions between partners. If you would like to learn more about these subjects, please see the section 'Sources for Further Learning'.

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