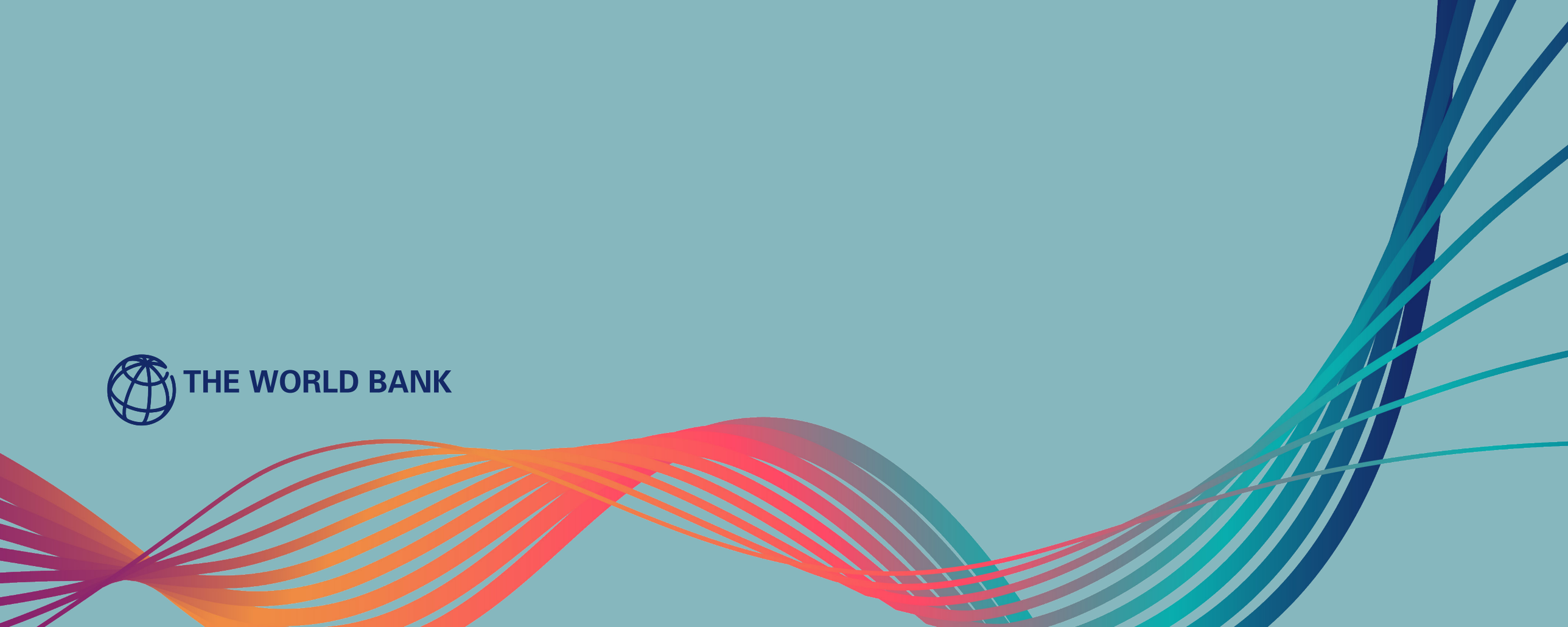
State and Trends of
Carbon Pricing
2022



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BC	British Columbia
BCA	Border carbon adjustment
CAD	Canadian dollar
CBAM	Carbon Border Adjustment Mechanism
CCM	Cost containment mechanism
CCR	Cost containment reserve
CDM	Clean Development Mechanism
CHF	Swiss franc
CNY	Chinese yuan
CO_2	Carbon dioxide
COP	Conference of the Parties
COP26	2021 United Nations Climate Change Conference (26th Conference of the Parties)
COP27	2022 United Nations Climate Change Conference (27th Conference of the Parties)
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CPI	Carbon pricing instrument
EDGAR	Emissions Database for Global Atmospheric Research
EITe	Emissions-intensive trade exposed
EPE	Empresa de Pesquisa Energética (Energy Research Corporation, Brazil)
ETS	Emissions trading system
EU	European Union
EUR	Euro
G7	Group of Seven
G20	Group of 20
GBP	British pound
GHG	Greenhouse gas
$GtCO_2$	Gigatons (a billion metric tons) of carbon dioxide
HFLD	High Forest Low Deforestation
ICAO	International Civil Aviation Organization
ICP	Internal carbon price
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
ITMO	Internationally transferred mitigation outcome
JCM	Joint Crediting Mechanism
KCU	Korean Credit Unit
KOC	Korean Offset Credit
LPG	Liquefied petroleum gas
MRV	Monitoring, reporting, and verification
MSR	Market stability reserve
$MtCO_2$	Million metric tons of carbon dioxide
NbS	Nature-based solution
NDC	Nationally determined contribution
nEHS	National Emissions Trading Scheme (Germany)
NOK	Norwegian krone
NZD	New Zealand dollar
OBPS	Output-based pricing system (Canada)
OECD	Organisation for Economic Co-operation and Development
PMI	Partnership for Market Implementation
REDD+	Reducing Emissions from Deforestation and Forest Degradation
RGGI	Regional Greenhouse Gas Initiative
SBTi	Science-Based Targets Initiative
SDG	Sustainable Development Goal
SGD	Singapore dollar
SLCCS	Sri Lanka Carbon Crediting Scheme
TCI-P	Transportation and Climate Initiative Program
tCO_2	Metric tons of carbon dioxide
tCO_2e	Metric tons of carbon dioxide equivalent
TEPA	Taiwan Environmental Protection Administration
UAH	Ukrainian hrynia
UK	United Kingdom
UKA	United Kingdom Allowance
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
USD	United States dollar
UYU	Uruguayan peso
VCMI	Voluntary Carbon Markets Integrity Initiative
VCS	Verified Carbon Standard
WTO	World Trade Organization
ZAR	South African rand

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Foreword

The climate crisis continues to escalate amid a prolonged pandemic, increasing economic instability and geopolitical tensions. Commitments made at the 2021 United Nations Climate Change Conference (COP26) keep hope alive that avoiding the worst effects of climate change is within our reach, but the peril remains stark. The latest work from the Intergovernmental Panel on Climate Change makes plain that we must arrest rising emissions now to ward off climate danger. Meeting this challenge in uncertain times calls for ambitious, just, and comprehensive action by policymakers. In this regard, carbon pricing, within an integrated policy mix, is one of the most powerful tools available for guiding economies toward low-emission paths. To maximize the benefits, carbon price signals must be sustained, strengthened, and extended to a greater portion of global emissions, three-quarters of which are currently untouched by carbon pricing instruments. However, recent economic instability, volatile energy markets, and rising energy prices exacerbate the political challenges for policymakers.

The World Bank's annual report on the State and Trends of Carbon Pricing continues to provide a trusted global snapshot of carbon pricing developments from year to year. The past year has seen some positive signs, particularly in relation to higher carbon prices, increased revenues, and the adoption of new rules for international carbon markets (under Article 6 of the Paris Agreement). However, as in previous years, progress has been far from adequate. As of April 1, 2022, only four new carbon pricing instruments had been implemented in the past year and despite record-high prices in some jurisdictions, the price in most jurisdictions remains well below the levels required to deliver on the Paris Agreement temperature goals.

In 2021, higher carbon prices, revenue from new instruments, and increased auctioning in emissions trading systems resulted in a record USD 84 billion of global carbon pricing revenue, around 60% higher than in 2020. Such an impressive increase highlights carbon pricing's burgeoning potential to reshape incentives and investment toward deep decarbonization. Further, it illustrates carbon pricing's potential role as a broader fiscal tool to contribute toward broader policy objectives, such as to restore depleted public finances, aid pandemic recovery, or support vulnerable sectors and communities to adapt to climate impacts and achieve just transitions.

During this year, cross-border approaches for carbon pricing and international cooperation have made significant strides forward. The European Union moved closer to adopting its Carbon Border Adjustment Mechanism (CBAM), while Canada and other jurisdictions reaffirmed their commitments to investigate border carbon adjustments (BCAs) and bring down hitherto daunting technical and political barriers to such reforms. The COP26 agreements on new rules for international carbon markets will help pave the way for more cross-country collaborations and trade.

Encouragingly, more countries continue to explore options to introduce a carbon price, including low- and middle-income countries. The World Bank is gearing up to meet this increased demand from client countries for technical support on carbon pricing—and is helping countries mainstream it into wider fiscal policy and long-term decarbonization strategies. This includes developing advisory services, analytics, innovation, and hosting initiatives such as the Partnership for Market Implementation (PMI). The PMI will provide technical assistance to at least 30 countries in developing and implementing domestic carbon pricing and operationalizing Article 6 of the Paris Agreement.

The World Bank Group's Climate Change Action Plan (2021-2025) committed to increase the World Bank's climate finance target, align financing flows with the goals of the Paris Agreement, and achieve results that integrate climate and development. Through this Action Plan, the World Bank Group is well positioned to leverage its convening power, knowledge and research, and country program support to help countries make informed climate decisions, including on carbon pricing.

BERNICE VAN BRONKHORST
Climate Change Global Director, World Bank Group

Executive summary

CARBON PRICING CAN PROVIDE THE IMPETUS FOR ECONOMIC TRANSFORMATION AND RECOVERY

- More ambitious carbon prices can help close the gap between pledges and policy and “keep 1.5 alive.”
- Along with lowering emissions, carbon pricing can improve energy and industrial efficiency, limit reliance on imported energy, promote cleaner air, protect and regenerate landscapes, and provide a valuable source of government revenue.
- But adopting carbon prices remains politically challenging, particularly amid rising inflation and energy prices. There is a clear need to ensure policies are fair, effective, and embedded within integrated climate and social policies.

CARBON PRICES HAVE HIT RECORD HIGHS IN MANY JURISDICTIONS

- Record ETS prices were observed in the European Union (EU), California, New Zealand, and Republic of Korea, among other markets, while several carbon taxes also saw prices hit their highest levels yet.
- A combination of policy reforms, anticipated changes, speculative investment interest, and broader economic trends, especially in global energy commodity markets, are driving these ETS price spikes.
- Nonetheless, prices must rise considerably more to meet the Paris Agreement temperature goals, as less than 4% of global emissions are currently covered by a direct carbon price within the range needed by 2030.

DIRECT CARBON PRICING CONTINUES TO BE ADOPTED BUT GLOBAL COVERAGE REMAINS LOW

- Worldwide, 68 carbon pricing instruments (CPIs), including taxes and emissions trading systems (ETSs), are operating and three more are scheduled for implementation.
- CPIs in operation cover approximately 23% of total global greenhouse gas (GHG) emissions. This represents a small increase in total global coverage as a result of four new systems commencing in the past year.
- The International Maritime Organization is considering placing a price on emissions from international shipping activities. If adopted, this would represent a major step in tackling global GHG emissions.

CARBON REVENUES HAVE INCREASED SHARPLY

- Global carbon pricing revenue increased by almost 60% in the past year, to around USD 84 billion.
- With prices rising and reduced free allocation, ETS revenues surpassed carbon tax revenues for the first time.
- Increasing carbon pricing revenues can support sustainable economic recovery, finance broader fiscal reforms, or help buffer countries from economic and international turbulence.

Executive summary

CROSS-BORDER APPROACHES TO CARBON PRICING ARE INCREASINGLY GAINING TRACTION

- The EU moved closer to adopting its Carbon Border Adjustment Mechanism, and Canada and the United Kingdom (UK) are exploring options for similar mechanisms.
- The International Monetary Fund (IMF) and World Trade Organization (WTO) are advocating for an international carbon pricing floor.
- Some countries have moved toward the adoption of international climate clubs, including the proposed United States (US)–EU Carbon-Based Sectoral Arrangement on Steel and Aluminum Trade.
- These approaches can fortify domestic support, prevent carbon leakage, and encourage mitigation beyond national borders.

DIVERSE PURCHASER PREFERENCES MAKE MARKET GROWTH UNEVEN

- Nature-based credits are in especially high demand: Forestry and land use transactions more than doubled between 2020 and 2021.
- Increasing demand for carbon removals has resulted in price increases for these credits.
- The voluntary carbon market continues to be strongly diverse, with purchasers placing widely different values on characteristics such as sector, geography, and perceived co-benefits.

MARKETS FOR CARBON CREDITS ARE GROWING RAPIDLY

- Credits from independent crediting mechanisms clearly dominate the carbon market.
- Annual voluntary carbon market value exceeded USD 1 billion for the first time, driven by corporate commitments.
- Compliance demand for carbon credits remains limited, though new rules for international carbon markets under Article 6 of the Paris Agreement provide clarity that may enable future growth.

NEW FINANCIAL SERVICES, TECHNOLOGIES, AND GOVERNANCE FRAMEWORKS ARE SHAPING CARBON MARKETS

- Financial actors are becoming more active in the carbon market, while blockchain has enabled a new wave of decentralized financial innovations that show the technology's potential but have reignited some long-standing concerns about transparency and quality.
- Diverse governance frameworks are emerging from stakeholders and institutions that aim to address concerns regarding the integrity of carbon credits and how companies use them.
- New rules on Article 6 increase certainty while also adding complexity to carbon credit markets and may lead to increasingly divergent approaches emerging across actors and geographies.

Chapter 1

Introduction

1.1 DRIVING TRANSFORMATION AND SHAPING ECONOMIC RECOVERY

The past year has seen efforts to tackle the climate crisis gather steam, as its effects become more severe and the challenge it presents moves closer to the top of political agendas.

The Intergovernmental Panel on Climate Change's latest report, its Sixth Assessment Report, painted a stark picture of the impacts already being felt, including loss of life, humanitarian crises, and irreversible damage to ecosystems.[1] It highlighted the impact of every additional increment of global warming, such as the major difference between restricting the temperature rise to 1.5°C instead of 2°C. According to the report, global emissions would need to fall by 43% by 2030 in order to limit temperatures rising to 1.5°C.[2] This would require rapid emissions reductions across all economic sectors. Despite this, emissions continued to rise in the decade up to 2019.

In late 2021, world leaders met in Glasgow for what was billed as the most important climate conference since the Paris Agreement was adopted in 2015. The conference achieved significant outcomes, including agreements to phase down coal power and remove inefficient fossil fuel subsidies, as well as finalizing rules on international carbon markets. Coalitions of countries announced greater action on forests, methane, and climate finance. Nevertheless, combined nationally determined contributions (NDCs) as they stand today would, if fully implemented, still lead to 2.4°C of warming,[3] and the Glasgow Pact called on countries to update their targets by the 27th session of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC),[i] due to take place in November 2022. An analysis of NDCs, longer-term net zero targets, and global initiatives such as the Global Methane Pledge painted a slightly more positive picture indicating they would, if implemented in full and on time, amount to 1.8°C of warming, bringing them closer to Glasgow's goal of "keeping 1.5 [degrees] alive."[4]

While increasing the ambition of NDCs and net zero pledges is a key part of the picture, delivering on them is even more crucial. Analysis by the International Energy Agency indicates a significant gap between what countries have pledged and what existing policies can achieve.[5] The Intergovernmental Panel on Climate Change's latest report similarly confirms that many countries would need additional policies to meet their own NDC targets.[6] And while emissions briefly decreased during the COVID-19 pandemic, energy demand has bounced back to pre-pandemic levels and global energy-related emissions rose to a record high in 2021.[7]

i The 2022 United Nations Climate Change Conference, more commonly referred to as COP27.

The current state of carbon pricing clearly reflects the gap between policies and pledges. While carbon prices reached record highs across a number of ETSs and carbon taxes over the past year, the majority of carbon prices remain significantly below what is needed to achieve net zero by 2050 and meet the goals of the Paris Agreement.[ii] Greater carbon pricing ambition can play a crucial role in closing the policy gap when part of a comprehensive climate policy package and grounded in robust long-term strategies. An increasing interest in cross-border carbon pricing policies reflects attempts to realize such ambition while addressing concerns related to economic competitiveness and carbon leakage.

Adopting ambitious carbon prices remains politically challenging, particularly in the context of rising energy commodity prices and continued pressure on economies from the ongoing COVID-19 pandemic. Developing and maintaining carbon pricing approaches in this context requires a strong emphasis on ensuring carbon pricing is fair, inclusive, and well communicated. At the same time, high energy commodity prices coupled with current geopolitical tensions may also provide an additional incentive for governments to speed up their transition to alternative energy sources. Moreover, recent research highlights that environmental taxes can be less distortionary than other taxes, particularly in times of economic recovery.[iii]

The private sector, meanwhile, has seen a sharp rise in voluntary mitigation targets, many of which rely to at least some extent on using carbon credits. This has contributed to record issuances, trades, and prices, though it has also triggered increased scrutiny. A growing number of initiatives are emerging to assess ambition in voluntary pledges and carbon credit quality. In addition, international carbon market rules set at COP26 provide flexibility to countries to authorize international transfers of credits from voluntary carbon projects. Host countries that opt to require such authorization will in turn apply a corresponding adjustment for such transfers, which must be reflected in their NDC reporting emissions balance. These factors are likely to lead to increasing heterogeneity in the voluntary carbon market as buyers place different values on host country authorization as well as credit quality. The adoption of international carbon trading rules also provides a framework for greater intergovernmental carbon trading, although the potential demand for such trading is uncertain.

1.2 WHAT IS CARBON PRICING?

Carbon pricing is a cost-effective policy tool that governments can use as part of their broader climate strategy.[8] A price is placed on greenhouse gas emissions, which creates a financial incentive to reduce those emissions or enhance removals. By incorporating climate change costs into economic decision-making, carbon pricing can help encourage changes in production, consumption, and investment patterns, thereby underpinning low-carbon growth.[9]

CPIs are aimed at addressing price barriers to low-carbon development, but these are often not the only type of barrier that should be addressed for effective climate policy. As such, CPIs typically need to be complemented and enhanced by other types of policies that address a broader set of climate change challenges and market failures. These may include research and development, sector-specific regulations, investment in technologies and infrastructure, removal of regulatory barriers, and market reforms to enable incentive-based approaches. Additional measures may also be needed to mitigate unwanted effects of climate policies on specific sectors or groups in society.

Governments can price carbon using a variety of policy instruments, which can all be tailored to domestic circumstances, priorities, and needs. The climate impact of carbon pricing depends on how broadly the price is applied, the price level, and the availability of abatement opportunities. Economy-wide carbon pricing policies are more effective than carbon prices restricted to certain sectors or goods and higher carbon prices incentivize greater emission reductions.[iv] Creating a credible and more predictable price signal over the longer term will support long-term investments and incentivize low-carbon development.

ii *The* Report of the High-Level Commission on Carbon Prices *indicates that the carbon price needs to be in the USD 50-100/tCO_2e range by 2030 to keep global heating to 2°C.*

iii *World Bank research in 75 countries indicates that, on the whole, higher environmental taxes do not lead to reduced employment in times of economic recovery, though they may have some impact in times of recession. This is in contrast to personal income tax increases, which have been shown to reduce employment during both recessions and recoveries. World Bank (April, 2021). Regime-Dependent Environmental Tax Multipliers: Evidence from 75 Countries.*

iv *Consumer responses require market frameworks that allow carbon costs to be passed through the supply chain or the inclusion of CPI design adjustments to improve the operation of a carbon price under regulated market settings. Further, other policies and investments (for example, public transport infrastructure) are often also needed improve the ability of consumers to respond to higher prices by switching to lower-emission alternatives.*

BOX 1

Direct carbon pricing instruments

A **carbon tax** is a policy instrument through which a government levies a fee on GHG emissions, providing a financial incentive to lower emissions. Under a carbon tax, the price of carbon is set by the government, and the market determines the level of emission reductions incentivized by the price.

An **emissions trading system** involves placing a limit or cap on the total volume of GHG emissions in one or more sectors of the economy. A government then auctions or distributes tradable emission allowances to entities covered by the cap, where each allowance represents the right to emit a certain volume of emissions (typically a metric ton of carbon dioxide equivalent), and the total volume of allowances equals the emissions cap. Covered entities are required to surrender allowances for their emissions during a compliance period. They can choose to buy additional allowances if necessary or sell surplus allowances. This policy type is also known as a "cap-and-trade" system.

Alternatively, an ETS may use a "baseline-and-credit" system, where there is no fixed limit on total emissions per sector, but covered entities can "earn" emission credits if they produce fewer emissions than the baseline. These credits can then be traded with covered entities that need additional credits to cover their surplus emissions relative to the baseline. Examples of these systems include intensity standards and tradable performance standards.

In an ETS, the price of carbon is not fixed by a government but determined by the supply and demand of emission allowances or credits.

Carbon crediting mechanism refers to a system where tradable credits (typically representing a metric ton of carbon dioxide equivalent) are generated through voluntarily implemented emission reduction or removal activities. Carbon crediting mechanisms operate differently to carbon taxes and ETSs—rather than requiring businesses to pay for emitting (i.e., the polluter pays principle), businesses and other organizations can generate carbon credits (and hence revenue) by demonstrating that emissions have been reduced or sequestered relative to a counterfactual baseline.

Carbon pricing instruments can broadly be grouped into two categories: direct and indirect carbon pricing.

Direct carbon pricing (Box 1) refers to CPIs that apply a price incentive directly proportional to the greenhouse gas emissions generated by a given product or activity, primarily through a carbon tax or an ETS. By applying the same price per metric ton of carbon dioxide (CO_2) across multiple sources, direct carbon pricing ensures that abatement incentives are consistent and cost-effective.[v] Carbon crediting mechanisms are another form of carbon pricing, and are included in the scope of this report, but operate differently from ETSs and carbon taxes. Participation in crediting mechanisms is generally voluntary, and unlike carbon taxes and ETSs, these mechanisms do not in themselves create a broad-based carbon price. Instead, they offer a subsidy to emissions abatement among selected eligible activities. Crediting mechanisms function in concert with initiatives that create demand for emission-reducing activities at either the domestic or the international level.[vi]

Indirect carbon pricing refers to instruments that change the price of products associated with carbon emissions in ways that are not directly proportional to those emissions. These instruments provide a carbon price signal, even though they are often (primarily) adopted for other socioeconomic objectives, such as raising revenues or addressing air pollution.[10] Examples of indirect carbon pricing include fuel and commodity taxes, as well as fuel subsidies affecting energy consumers. For example, fuel excise taxes that apply a flat tax amount to gasoline by the liter indirectly place a price on the carbon emissions from the combustion of that gasoline. Inversely, fuel subsidies that reduce the price of fossil fuels create a "negative" indirect carbon price signal, which incentivizes higher consumption and therefore increases carbon emissions. All policy instruments that focus on the price incentive for using fuels and commodities can be considered indirect carbon prices. However, regulations and investment incentives—which may address non-price related market failures but do not translate into a price equivalent—are not considered indirect carbon pricing.[vii]

v A number of jurisdictions, including in Argentina, Mexico, and most recently Uruguay, have introduced carbon taxes but these instruments have been implemented with varying tax rates (per metric ton CO_2) across fuels. Therefore, while these policies are called "carbon taxes" and have been historically included within the State and Trends Reports, they meet the definition for indirect taxes and provide incentives akin to traditional fuel taxes.

vi For instance, crediting mechanisms can provide additional flexibility to ETSs and taxes by expanding mitigation options for those regions and/or sectors covered directly.

vii Other policy instruments and investments (for example, public transport, power transmission infrastructure) are crucial to complement carbon pricing and to further enable consumers to respond to higher prices by switching to lower-emission alternatives. These policies directly and indirectly lead to emission reductions and decarbonization. However, classifying the instruments primarily aimed at addressing other aspects of climate action as indirect carbon pricing would blur important distinctions that are essential for designing smart policy mixes. Accordingly, indirect carbon pricing is assumed to be limited to those instruments which advance the original purpose of carbon pricing (i.e., addressing pricing market failures).

The State and Trends of Carbon Pricing report has traditionally focused on direct carbon pricing and the 2022 edition continues this approach. However, indirect carbon pricing also influences production, consumption, and investment decisions. Thus it is valuable to consider both direct and indirect pricing instruments to better understand the progress toward reflecting the social costs of greenhouse gas emissions in market prices. Direct and indirect carbon prices interact globally and in specific jurisdictions. This means, for example, the price signal provided by a direct carbon price would be diluted if it were offset by an effective decrease to indirect carbon pricing, such as through the introduction of a subsidy that reduced fuel prices. An integrated view of a country's direct and indirect CPIs will allow policymakers to assess the landscape of incentives and what new instruments might work to achieve vital climate change goals. Several institutions, including the World Bank, are exploring avenues to present more data on indirect pricing and give better visibility of how different pricing incentives apply and interact in coming years.

Direct carbon pricing systems (through carbon taxes and ETSs) have, to date, largely been concentrated in high- and middle-income countries. Indirect carbon pricing systems, such as fuel excise systems, are more commonly implemented than direct carbon pricing, including in many developing countries. Thus, measuring indirect carbon prices is particularly useful for understanding the state of play and progress in many developing countries. In Africa, for example, some countries have achieved major increases in indirect carbon prices through fuel tax and subsidy reforms.

Agreement was reached at COP26 to phase down inefficient fossil fuel subsidies. This is a significant milestone and it is the first time such an approach has been included in a global agreement. Actions to wind down negative indirect carbon pricing could potentially be seen as early steps toward reaching a global carbon pricing agreement.

Public officials are often cautious about implementing direct carbon pricing if their country has never had such measures. It can feel new and complex. But most countries already have decades of experience with introducing fuel excise taxes and phasing out subsidies on fuels and commodities and are familiar with the design, administration, and challenges of such reforms. Measuring the indirect carbon price from these systems can promote familiarity with the concept of carbon pricing and can help policymakers better understand the potential impacts from introducing a direct carbon price.

Even cross-country comparisons of overall or "effective" carbon prices that include both direct and indirect pricing tools do not provide perfect insight into relative climate effort or ambition levels. Other dimensions of climate action, such as structural reforms and public investments, are not easily translated into carbon price equivalents. Carbon price indicators measure progress on the price element of climate action and should not be misconstrued as an indicator of overall climate ambition.

Chapter 2

Carbon taxes and emissions trading systems

Following years of limited growth, carbon prices rose quickly in 2021. Prices in carbon taxes and ETSs alike hit record levels across multiple jurisdictions, driven by more ambitious climate policies, as well as broader economic factors such as global energy commodity prices. The rapid rise in ETS carbon prices, in conjunction with the operation of new ETSs, has seen ETS revenue surge, surpassing carbon tax revenue for the first time. However, prices in most jurisdictions remain below what is needed to meet the goals of the Paris Agreement and "keep 1.5 [degrees] alive." With few new instruments or sector expansions this year, the global coverage of carbon pricing increased only marginally in the year leading up to April 2022, following major changes in the previous two years. Meanwhile, jurisdictions are increasingly looking toward cross-border policies and initiatives that enable higher carbon prices while ensuring the continued competitiveness of their economies.

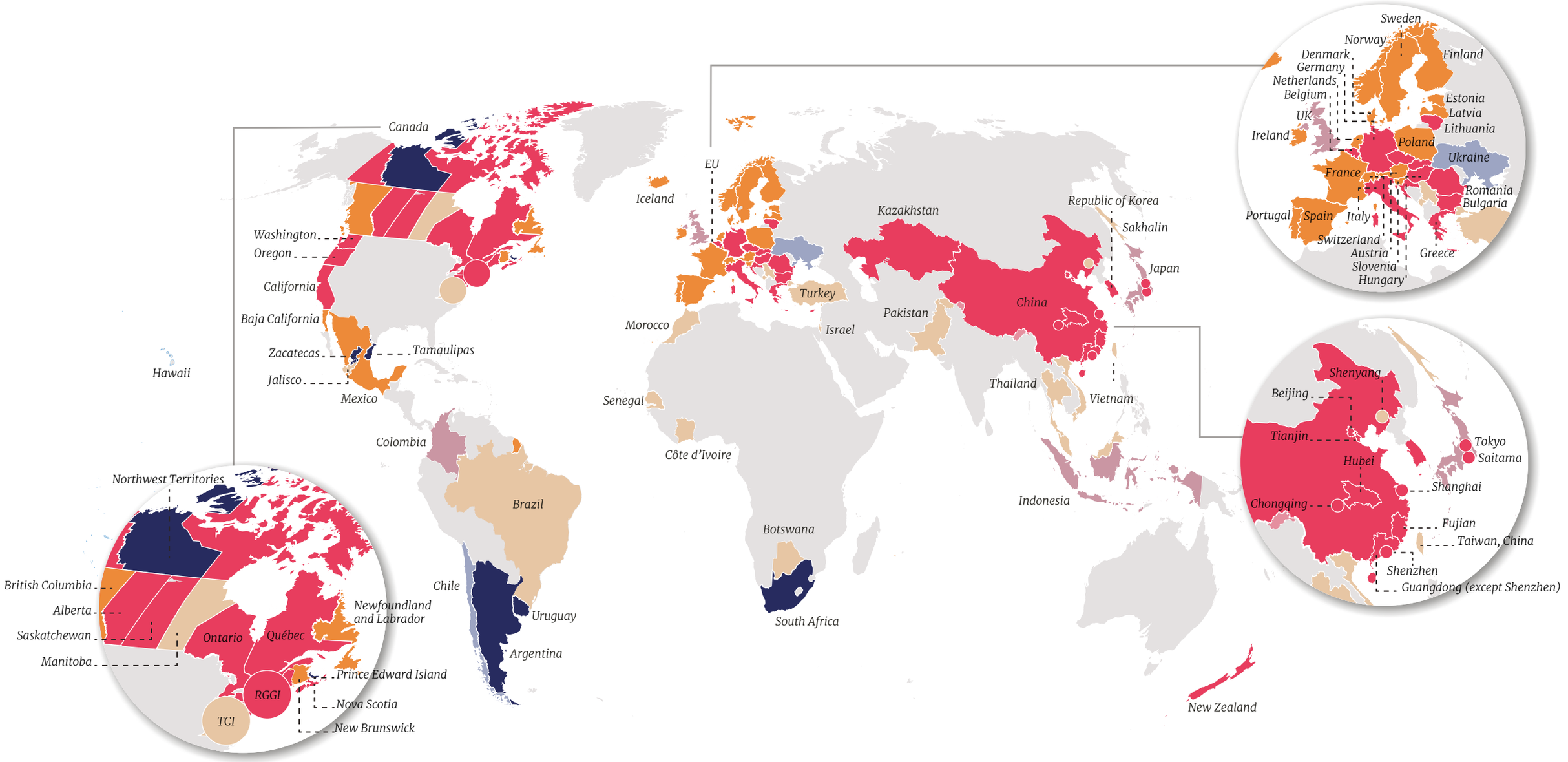
2.1 ADOPTION OF DIRECT CARBON PRICING CONTINUES BUT GLOBAL COVERAGE REMAINS LOW

The past year saw fewer changes in the volume of global emissions covered by direct carbon prices than previous years and a greater focus by major emitters on consolidating their existing instruments. However, various countries are considering new CPIs.

As of April 2022, there are 68 CPIs operating with three more scheduled for implementation. This includes 37 carbon taxes and 34 ETSs (see **Figure 1**). A new carbon tax in Uruguay commenced in January 2022 and three new ETSs also commenced in the past year in subnational jurisdictions in North America—Oregon, New Brunswick, and Ontario. One US state, Washington, as well as Indonesia and Austria, have CPIs scheduled for implementation. Approximately 23% of total global GHG emissions are currently covered by operating CPIs (see **Figure 2**), which is similar to global coverage in 2021 (see **Box 2**).

While there have only been four new CPIs implemented since last year's State and Trends report, more jurisdictions took steps toward implementing or expanding carbon pricing. In addition to the instruments scheduled for introduction (i.e., in Austria, Indonesia, and Washington State), Israel, Malaysia, and Botswana announced their intentions to develop new CPIs and Vietnam outlined steps to set up an ETS. A number of other jurisdictions in Africa, Central Europe, and Asia continue to assess the potential to implement CPIs.

FIGURE 1
Map of carbon taxes and ETSs

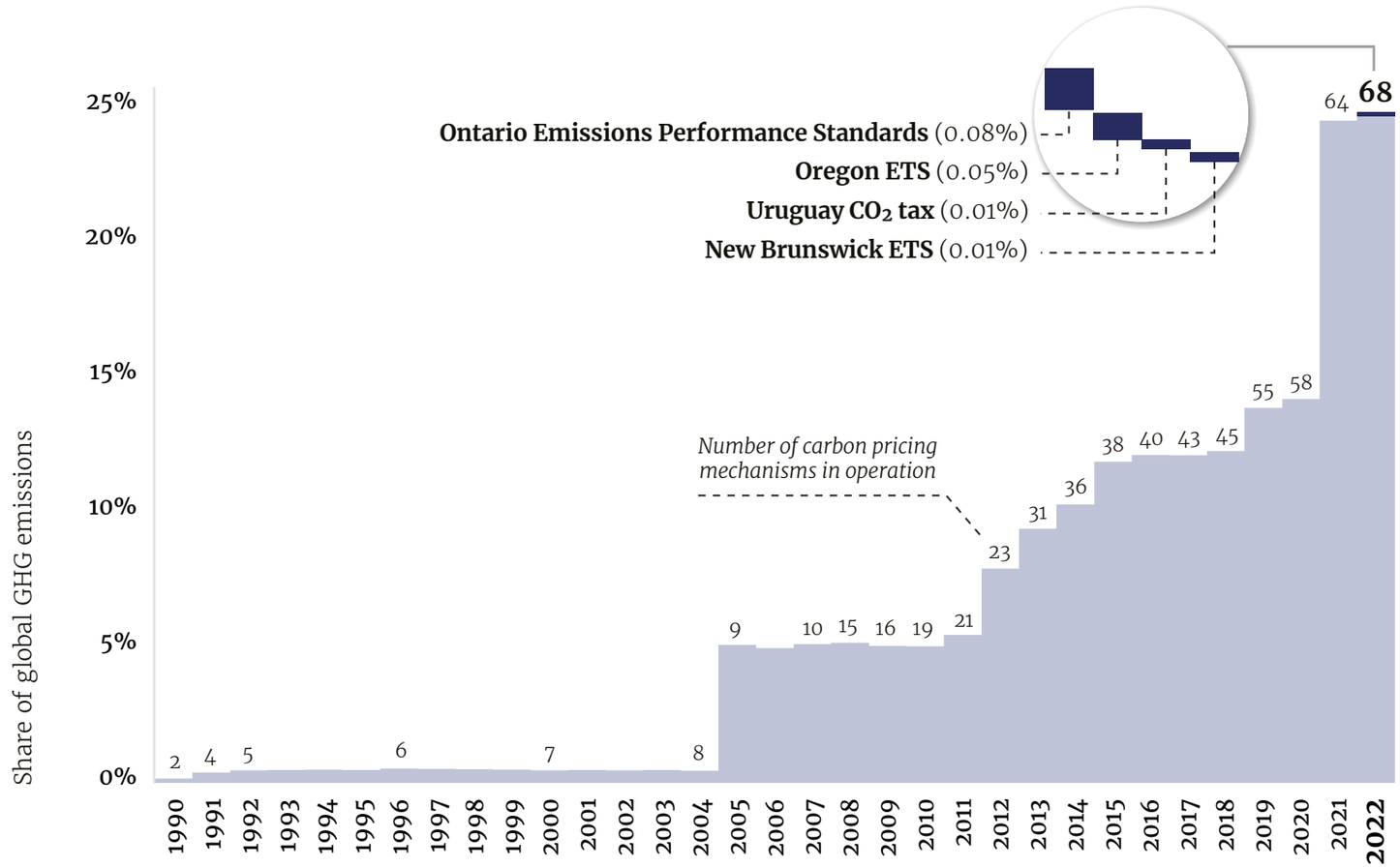


- ETS implemented or scheduled for implementation
- Carbon tax implemented or scheduled for implementation
- ETS and carbon tax implemented or scheduled
- ETS implemented or scheduled, carbon tax under consideration
- Carbon tax implemented or scheduled, ETS under consideration
- ETS or carbon tax under consideration

Carbon pricing initiatives are considered "scheduled for implementation" once they have been formally adopted through legislation and have an official, planned start date. Carbon pricing initiatives are considered "under consideration" if the government has announced its intention to work towards the implementation of a carbon pricing initiative and this has been formally confirmed by official government sources. TCI refers to Transportation and Climate Initiative. RGGI refers to the Regional Greenhouse Gas Initiative.

FIGURE 2

Share of global GHG emissions covered by carbon pricing instruments



BOX 2

Revisions to global GHG coverage estimates in this year's report

Each year the State and Trends of Carbon Pricing report estimates the proportion of global GHG emissions covered by a direct carbon price. This estimate is intended to help track the progress of uptake and coverage of direct carbon pricing. It is underpinned by three main components: GHG emissions in a jurisdiction, the proportion of a jurisdiction's emissions covered by a carbon price, and the potential overlap in a jurisdiction covered by multiple CPIs.

To promote consistency across jurisdictions, country GHG emissions are taken from the Emissions Database for Global Atmospheric Research (EDGAR) (https://edgar.jrc.ec.europa.eu/). The EDGAR database is updated every few years. The current report uses the most recent EDGAR GHG estimates (version 6.0), which were released in October 2021 and refer to 2018 emission values; version 5.0 only included up to 2015. The most recent update to the EDGAR database reflects updated methodologies and revised activity data, including updated data from the International Energy Agency and the Food and Agriculture Organization.[11]

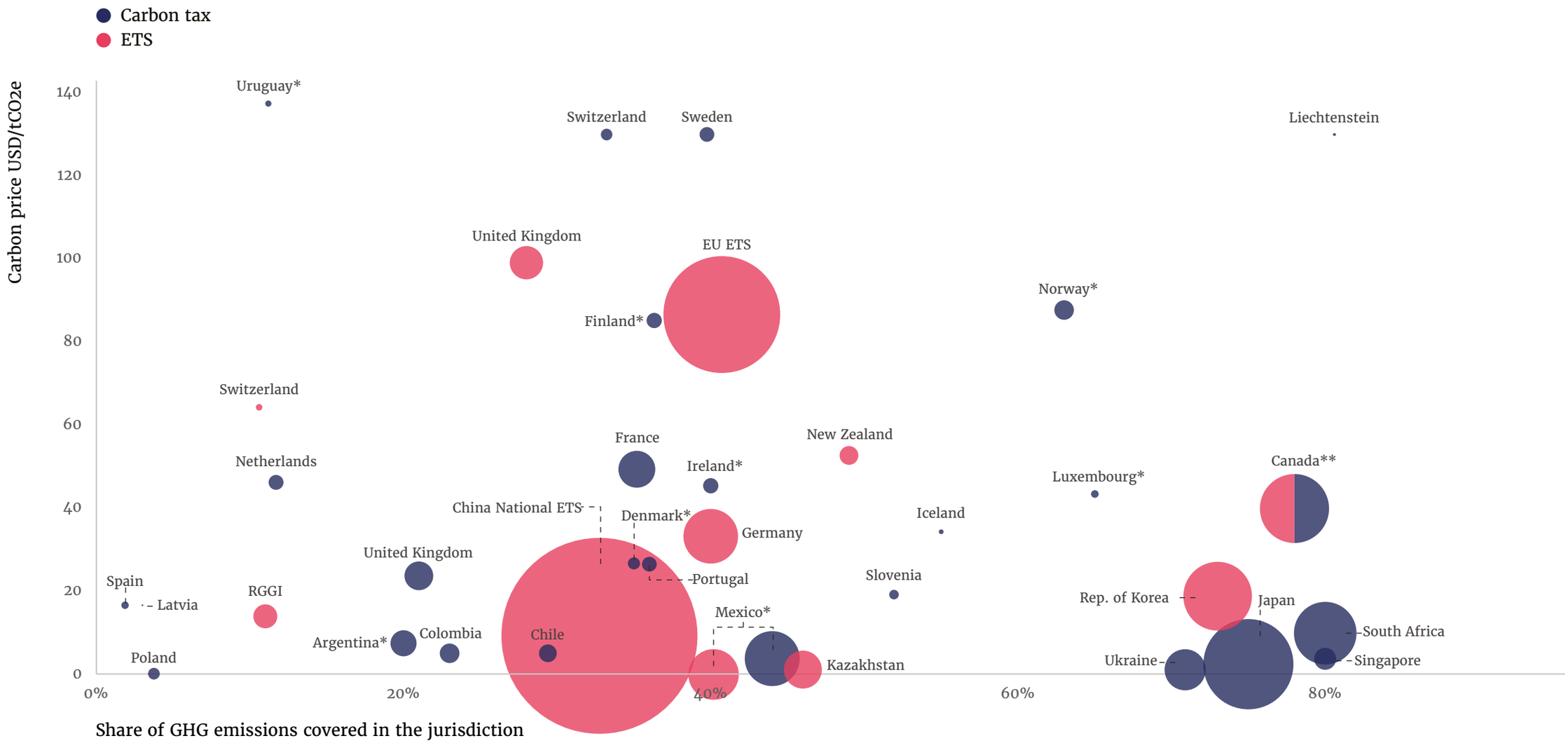
The estimate for the proportion of global emissions covered in the State and Trends of Carbon Pricing report 2021 was 21.5%. Incorporating up-to-date EDGAR GHG emission values, combined with revisions to the estimates of covered emissions, particularly for the Chinese national ETS, have resulted in a minor recalibration of the coverage estimate. This year's estimate indicates approximately 23% of goal emissions are covered by a CPI in operation. Around 0.2% of the reported increase since 2021 occurred because of additional coverage from the four new carbon pricing instruments (in Uruguay, New Brunswick, Ontario, and Oregon). The remainder of the increase is due to other factors, such as fluctuations in GHG emission estimates, revisions to GHG emissions data, and refined coverage assumptions in specific jurisdictions.

China hosts the world's largest carbon market by emissions, and 2021 saw its national ETS complete the first full compliance cycle, with a reported compliance rate of 99.5%. Over 2,100 liable power stations participated during this cycle, covering about 4.5 billion metric tons of CO_2 equivalent (tCO_2e) per year—over 30% of China's total GHG emissions. While the prices for emissions allowances remain relatively low compared to other pricing systems, the closing price for the year of 54.2 yuan (USD 8.5) per metric ton of CO_2 (tCO_2) translated to an increase of around 13% over the six months since trading commenced. A total of 179 million tCO_2e of allowances were traded in 2021, representing a cumulative turnover of close to 7.7 billion yuan (USD 1.2 billion).[12] While this represents relatively low volumes for a market the size of the Chinese ETS, it is not insignificant given the Chinese ETS is still taking key phase-in steps—compliance trading only commenced in earnest in October 2021 and currently only covered entities (i.e., not financial institutions) are allowed to make trades.[13] While the overall compliance rate for the scheme is reported to be 99.5%, there have also been important challenges, with the Ministry of Ecology and Environment confirming several firms had falsified emissions data.[14]

The largest carbon market by traded value, the EU ETS, saw record trading activity and prices in both spot and futures markets. Over 15 billion emission allowances were traded on the Intercontinental Exchange, the largest secondary market platform for EU allowances, with spot prices increasing almost threefold over the calendar year. The EU Climate Law entered into force in July 2021, which set the binding new EU-wide climate target to reduce GHG emissions by 55% in 2030 compared to 1990 levels and achieve net zero emissions by 2050. The package of measures that has been proposed to meet the new commitment (known as "Fit for 55") includes the addition of a new, separate ETS covering transport and buildings. This would exist in parallel to the existing EU ETS, which covers the power, industry, and aviation sectors, though it would share some common elements, such as the market stability reserve (MSR). The proposed package of measures would also extend the scope of the existing EU ETS to include shipping emissions beginning in 2023 and covering 100% of emissions for voyages between member state ports and 50% for voyages between EU ports and third-country ports by 2026.[15] The EU legislature is currently debating these proposals; the presidency for the Environment Council meeting in March 2022 indicated that the proposal to include shipping has broad support but the proposal to include transport and buildings has generated significant debate among member states and in the EU Parliament.[16]

FIGURE 3

Absolute emissions coverage, share of emissions covered, and prices for CPIs across jurisdictions



Bubble size represents absolute covered total greenhouse gas emissions.

*For CPIs that have multiple price levels, the price applying to the larger share of emissions is used.

**This is a composite presentation representing total emissions covered by carbon pricing instruments under the Pan-Canadian Framework. It includes a combination of ETS-like and carbon tax-like instruments, implemented at both provincial and federal levels.

The International Maritime Organization is currently considering market-based measures, including carbon pricing, to reduce GHG emissions from international shipping. In 2018, the International Maritime Organization committed to halve GHG emissions from international shipping relative to 2008 levels by 2050 through a combination of measures. The current focus of negotiations is midterm measures, for which several market-based measures have already been proposed, including a carbon levy and a cap-and-trade system. The carbon levy would be applied to bunker fuels, starting at USD 100/tCO_2e from 2025 with upward ratchets on a five-year review cycle.[17] The cap-and-trade system would be combined with a fuel GHG limit, the latter of which would act as a command-and-control measure.[18] Industry stakeholders, such as the International Chamber of Shipping, shipping's largest trade association,[19] a major charterer,[20] and various maritime think tanks,[21] have expressed their support for a market-based approach and outlined their own ideas for carbon pricing in international shipping. At COP26, the Climate Vulnerable Forum presented the Dhaka-Glasgow Declaration, with about 50 developing countries calling for a mandatory GHG levy on bunker fuels to be adopted by International Maritime Organization member states.[22] Potential carbon revenues are deemed significant, with estimates of the total by 2050 being between USD 1 trillion and USD 3.7 trillion, or USD 40-60 billion annually. Strategically using these carbon revenues could become key to accelerating shipping's decarbonization and ensuring an equitable transition toward zero-carbon shipping among countries.[23]

2.2 CARBON PRICES ARE RISING BUT ARE GENERALLY TOO LOW

Direct carbon prices have reached record levels across multiple jurisdictions over the past year, driven by a combination of policy decisions, increased speculation, and broader economic trends, in particular global energy prices. However, prices in most jurisdictions remain below what is needed to meet the Paris Agreement's goals.

Direct carbon prices rallied to all-time highs in several systems in 2021. The largest share of this growth has been seen in ETSs (particularly those in advanced economies), where prices react to market conditions (see **Figure 4**). Record prices were seen in the linked EU and Swiss ETS markets, the linked California and Québec markets, the Regional Greenhouse Gas Initiative (RGGI), and the New Zealand ETS. Prices in the UK ETS have also increased significantly since its launch in mid-2021. In the China ETS, prices recovered in early 2022 following a dip in late 2021. In the Republic of Korea, as of February 2022 prices were edging back toward the record highs witnessed in early 2020 before the COVID-19 pandemic, driven by improved market sentiment as a result of higher global carbon prices and improved domestic ambition set out in the Republic of Korea's enhanced NDC and the passage of a carbon neutrality law.

Sharp price drops were recorded in several systems in early 2022, though prices have since begun to recover. Prices in the EU ETS, the New Zealand ETS, the UK ETS, and the Republic of Korea ETS saw dramatic falls following the invasion of Ukraine in February. Prices in all four systems have since begun to recover but they remain below the heights recorded before the war.

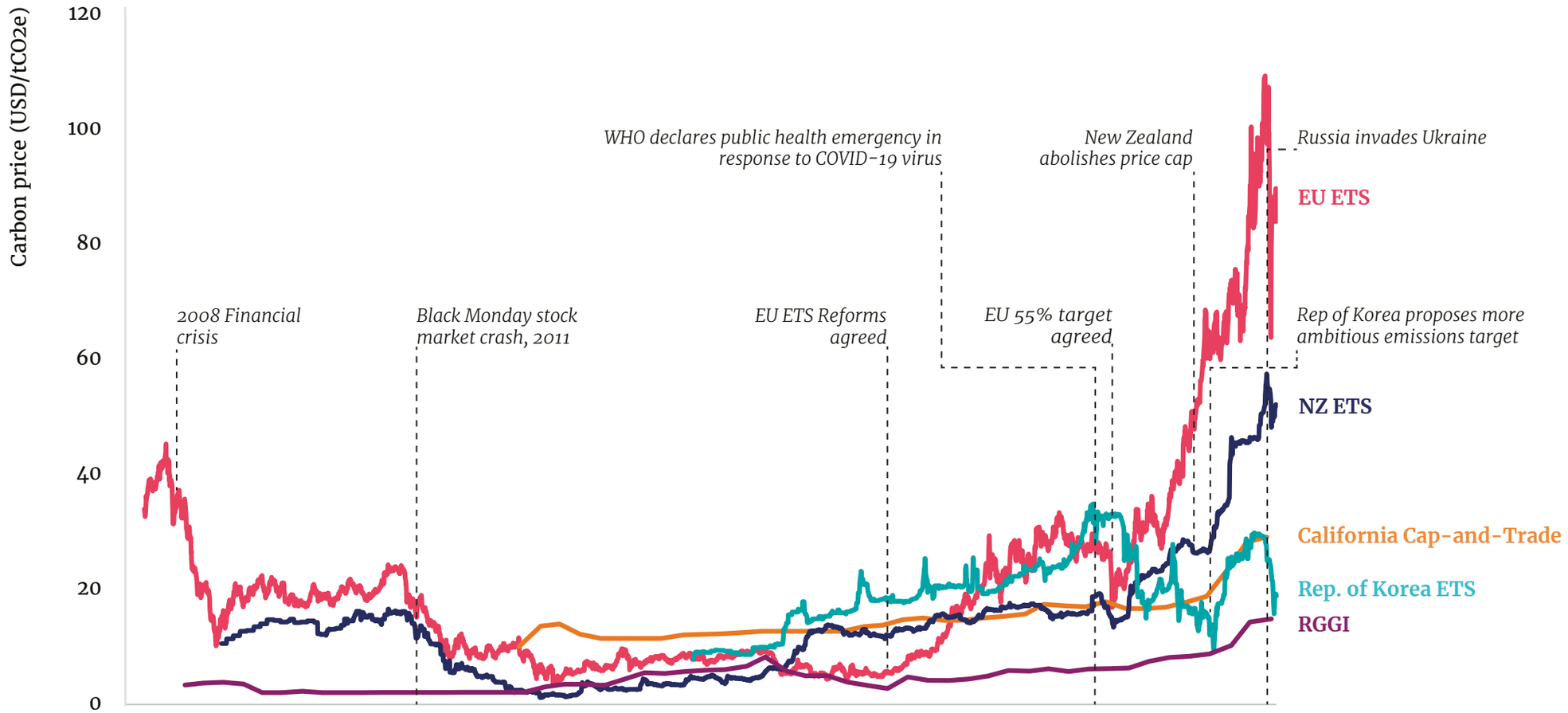
The role of price and supply adjustment mechanisms has gained more prominence in the context of rising prices. While California allowance auction prices hovered around the floor price for years, prices began to take off in August 2021 and an increase in the floor price was introduced in 2022. In February 2022, the California allowance auction price was still 48% above the new floor price. In the New Zealand ETS, the price cap was removed in 2021, along with an increase in the floor price and the implementation of a cost containment reserve (CCR) threshold.[ix] The old and new CCR thresholds were exceeded in September 2021[24] and March 2022,[25] resulting in the release of an additional 12.7 million units. UK ETS prices also reached CCR levels in December 2021[26] and January 2022,[27] but the UK ETS authority decided not to issue additional units. Finally, EU legislators are currently considering proposals from the European Commission to reform the EU ETS, which include proposals to strengthen the Market Stability Reserve (MSR) by increasing the number of allowances that are drawn from the market into the reserve each year.

Carbon tax rates also increased during 2021 and in the beginning of 2022, albeit by less than ETS prices. While carbon tax rates remained relatively flat in 2020, they increased by an average of roughly USD 6/tCO_2e in 2021, and by an additional USD 5/tCO_2e as of April 1, 2022, with most carbon tax jurisdictions increasing their carbon tax rates compared to the previous year. Several jurisdictions observed their highest domestic carbon tax rates, including British Columbia and other Canadian provinces, Ireland, Latvia, Liechtenstein, South Africa, Switzerland, and Ukraine (see **Figure 5**).

ix Floor price in the NZ ETS increased from NZD 20 to NZD 30 in 2022, increasing toward NZD 39 in 2026; and CCR threshold increased from NZD 51 to NZD 70, increasing toward NZD 110 in 2026.

FIGURE 4

Price evolution in select ETSs from 2008 to 2021[viii]



viii Based on data from ICAP Allowance Price Explorer.

Most of the observed price increases are due to previously scheduled changes, such as in the Canadian provinces[x] and Ireland.[xi] In other cases, the revised rate was part of a broader fiscal reform, as in Norway[xii] and Ukraine.[xiii] Finally, Switzerland and Liechtenstein's 2022 rate increase from CHF 96/tCO_2 (USD 101/tCO_2) in 2021 to CHF 120/tCO_2 (USD 130/tCO_2) stands out, as it was triggered by the automatic adjustment mechanism that raises the rate whenever intermediate GHG targets in the CO_2 law are not met.

Several jurisdictions have also established more ambitious price trajectories for the coming years. For instance, Singapore proposed to progressively increase the carbon tax rate (currently SGD 5) to SGD 25 (USD 18)/tCO_2e in 2024 and 2025, and SGD 45 (USD 33)/tCO_2e in 2026 and 2027, with a view to reaching SGD 50-80 (USD 37-59)/tCO_2e by 2030. The government of South Africa has also announced a proposal to increase the carbon tax rate from the current level of just under USD 10/tCO_2e to reach USD 20/tCO_2e by 2026, USD 30/tCO_2e by 2030 and USD 120/tCO_2e, beyond 2050. These increases follow on last year's announcement by Canada to increase minimum carbon prices by CAD 15 (USD 12)/tCO_2e annually such that it will reach or exceed CAD 170 (USD 136)/tCO_2e by 2030. While jurisdictions have and will continue to announce and schedule increases to carbon tax rates, jurisdictions' reaction to energy commodity price spikes, accelerated by the war in Ukraine, may influence the timing. As of April 2022, Indonesia had announced it will delay the introduction of its carbon tax due to the economic impact of high energy prices[28] and Mexico announced exemptions to the carbon tax applied to gasoline and diesel.[29]

Spikes in ETS prices have been driven by more ambitious climate targets and tightened ETS rules. Recent price increases in the EU ETS have coincided with several significant policy changes and proposals, beginning with the temporary removal of 900 million allowances from the market in 2018 and, more recently, the 2021 decision to increase the 2030 mitigation target and the publication of proposals to tighten the ETS cap, among other reforms. In New Zealand, prices rose sharply after it abolished the "fixed-price option" (which allowed participants to pay a fixed price of NZD 35 (USD 24) instead of surrendering allowances) in June 2021. Prices in the Republic of Korea ETS spiked sharply in June 2021 as the government proposed a tightening of the country's 2030 emissions target.[30]

The COVID-19 pandemic did not have a major impact on prices and ambition. Analysis of changes to carbon prices in Organisation for Economic Co-operation and Development and Group of 20 (G20) countries from the beginning of the pandemic up to August 2021 indicates that the majority of changes adopted were likely to lead to overall positive climate impacts.[31] While most of these were planned before the pandemic, it is notable that most governments did not roll back or delay introducing these changes due to the health crisis. Many governments did, however, introduce measures likely to lead to overall negative climate impacts, including increasing fossil fuel subsidies and suspending aviation taxes.

In addition to actual policy shifts, demand from participants and speculators alike betting on prices increasing further has driven rising ETS prices. In some cases, specific developments create this expectation, such as the 2021 publication of recommendations by the New Zealand governmental advisory body the Climate Change Commission, which were expected to lead to the government further tightening the ETS.[32] Similarly, investors anticipated that the Republic of Korea would pause the use of international offsets in its ETS in 2021 and adopt a more ambitious climate target.[33] The broader pressure on jurisdictions to adopt more ambitious mitigation targets, as collective commitments continue to fall short of what is needed to meet the Paris Agreement's temperature goals, may also play a role.

Opening up ETS markets to non-liable entities can influence prices and market dynamics (see Box 3). Investment firms purchasing credits with the hope of turning a profit on their resale have at least partially driven recent price increases in the California-Québec market.[34,35] Record prices in the RGGI in the United States have also coincided with increased participation by speculators.[36]

x The Pan-Canadian Framework on Clean Growth and Climate Change established price benchmarks for provinces starting at CAD 10/tCO_2 in 2018 increasing annually at CAD 10/tCO_2, to reach CAD 50/tCO_2 in 2022.

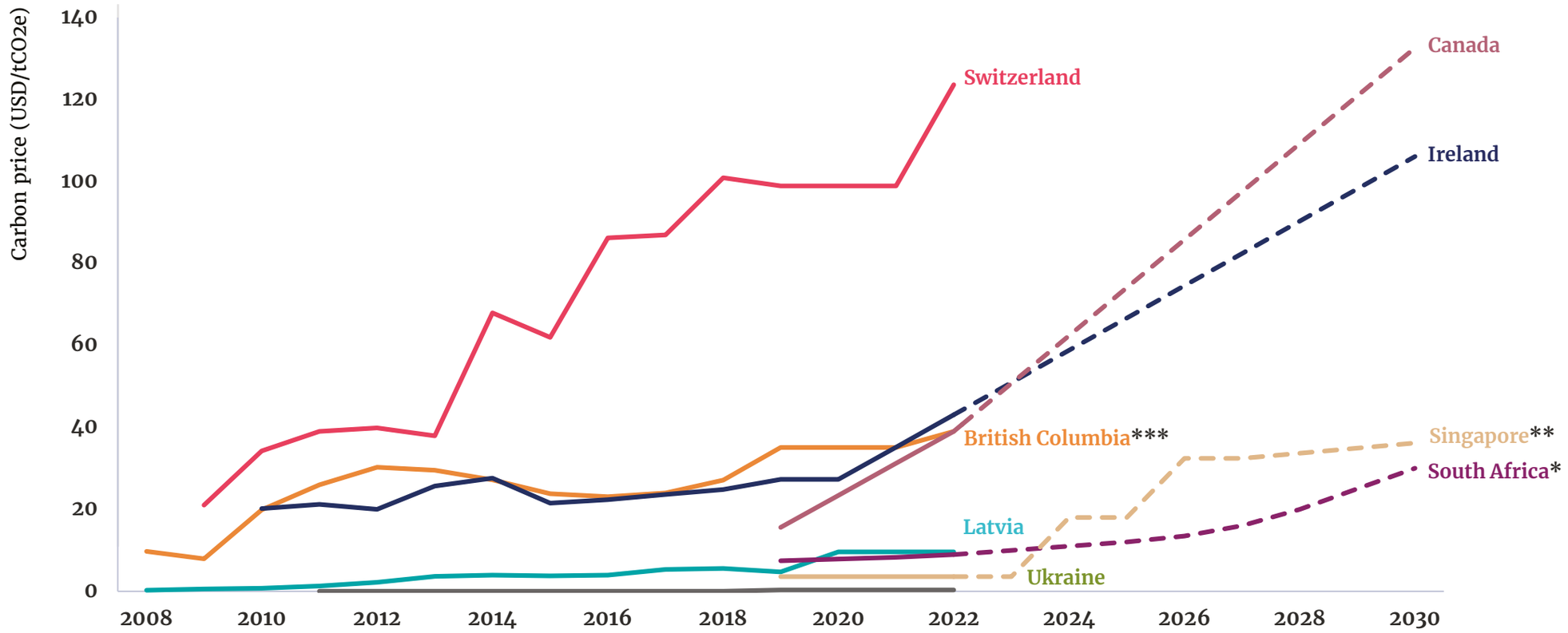
xi Ireland Finance Act stipulates a yearly carbon tax rate increase of GBP 7.50/tCO_2 in 2021-2029 and an increase of GBP 6.50/tCO_2 in 2030.

xii In December 2021 Norway announced an increase of 28% reaching NOK 766/tCO_2 (USD 87/tCO_2) in 2022.

xiii In November 2021, Ukraine announced a threefold tax rate increase to UAH 30/tCO_2 (USD 1/tCO_2) for 2022.

FIGURE 5

Record high carbon tax rates in six jurisdictions



Dotted line indicates scheduled price increases for those jurisdictions that have communicated future price trajectories.

*Estimated path based on the government's ambition to increase the tax rate by at least USD 1 per year, and to increase the rate more rapidly from 2026 to reach USD 30/tCO2e in 2030 and USD 120/tCO2e beyond 2050.

**This is a low range projection as the Singapore government plans to reach a carbon tax rate of SGD 50–80/tCO2e (36–58 USD/tCO2e) by 2030.

***British Columbia has committed to meet or exceed the federal benchmark carbon price.

BOX 3

The role of the financial sector in emissions trading

A number of markets, including the linked EU-Swiss market, the California-Québec market, the New Zealand ETS, RGGI, and (more recently) the Republic of Korea ETS, permit nonparticipants to trade in emissions allowances and often also in financial instruments derived from them. Opening markets up to more actors can increase liquidity, which can enable a clearer price signal. However, it can also increase the risk of market manipulation.

Nonparticipants typically include brokers and traders who purchase credits with the intention to on-sell in the short term and banks that help companies covered by the ETS to hedge their exposure to price developments. Increasingly, however, investors looking to buy and hold credits in anticipation of future price increases are entering the market. Other investors are buying allowances to diversify their portfolios or to hedge against inflation, as traditional inflation hedges such as oil are increasingly unreliable. This has been seen in the EU ETS and in California. Recent years have also seen offerings of exchange-traded funds that invest in emissions allowances, providing a vehicle for retail investors and even individuals interested in environmental and social governance to participate in a market that may not have been previously accessible to them.

As prices have reached record highs in the EU market, the role of speculation is coming under close political scrutiny. Financial entities have long played a role in the EU ETS but this has increased in recent years as more investment firms have entered the market amid rapid price growth, triggering concerns about a possible "carbon bubble."[37] The European Securities and Markets Authority found no evidence of insider trading or similar activities in either a preliminary report in late 2021 or an in-depth analysis in March 2022, but it set out a number of recommendations to improve transparency and oversight in the market.[38] Despite this, EU lawmakers have signaled they will take measures to address possible manipulation as part of upcoming ETS reforms,[39] and some have gone so far as to propose limiting trading to cover participants and those trading on their behalf.[40]

Conversely, some jurisdictions are hoping that opening trading to financial players will provide much-needed liquidity to the market. In 2021, the Republic of Korea opened trading to a limited number of financial entities with a view to increasing liquidity, which has been lacking in the Korean market over the past years. By December 2021, 20 financials had entered the market and analysts predict that this will help give the market a liquidity boost once these actors become more acquainted with the system.[41]

Rising allowance prices come amid strong increases in the prices of other financial assets in 2021. Other assets, including real estate, stocks, and cryptocurrency, also showed strong growth.[xiv] Where carbon units (including emission allowances) are viewed as an investment vehicle, broader factors influencing investor demand (such as monetary policy and cost of capital) are more likely to affect buying or selling behavior. These broader trends are examples of the myriad factors that can influence prices in emissions markets and point to the challenges of determining the precise factors that have led to a given set of market movements.

Rising gas prices are also likely to have played a role in both pushing allowance prices upward and contributing to price crashes. This is perhaps most notable in Europe, where a tripling of natural gas prices amid tightened supply from Russia led to a larger share of coal in the electricity mix. This put upward pressure on allowance prices as increasing EU emissions led to higher demand for cap-limited allowances.[42]

xiv Double digit percentage price increase year-on-year were common through 2021 in real estate markets across Europe, Asia-Pacific, and North America, and nominal house prices have risen in almost 90% of countries that have published housing statistics so far (Global Property Guide, 2021). MSCI's World Index increased its value by 20%, and the total cryptocurrency market cap increased by almost 200%. Data retrieved from CoinMarketCap. See https://coinmarketcap.com/.

At the same time, sharp price drops following Russia's invasion of Ukraine may be partially explained by investors selling emissions allowances in a bid to respond to capital needs generated by rising gas prices.[43] Some analysts have also pointed to gas prices as being among the drivers of the record prices recorded in RGGI in late 2021.[44]

Despite prices increasing across a number of major CPIs in the past year, on the whole current prices remain short of levels needed to drive the transformative change needed to reach the 1.5°C target or unlock investment in essential decarbonization pathways (see Figure 6). The Report of the High-Level Commission on Carbon Prices identified a USD 50-100/tCO_2e range (or "carbon price corridor") as the price needed by 2030 to keep global heating to below 2°C—the upper end of the limit agreed in the Paris Agreement—as part of a comprehensive climate policy package.[xv,45] But less than 4% of global emissions in 2022 are covered by a direct carbon price at or above the estimated range required by 2030. Further, more recent estimates indicate even higher prices may be needed to reduce emissions to net zero by 2050—which the Intergovernmental Panel on Climate Change says is necessary to meet the 1.5°C goal. A survey of 30 climate economists conducted in 2021 estimates prices of USD 50-250/tCO_2e would be needed to meet this goal, with a median forecast of USD 100/tCO_2e.[46]

Higher prices coupled with a coherent set of complementary policy measures will be needed across most jurisdictions to achieve both short-term mitigation goals and long-term net zero strategies. This is particularly the case for driving decarbonization in hard-to-abate sectors where low-carbon approaches are less developed, particularly expensive, or simply unavailable. Some analysts suggest transformative action in hard-to-abate sectors will require carbon prices on the order of USD 100-170/tCO_2e by 2030.[47] Such sectors often require technology solutions involving low-carbon hydrogen and carbon capture and storage, as these options can compete with traditional technologies and practices only if carbon prices are very high or other supporting polices are in place.[48] Achieving economic break-even points—through a combination of carbon pricing and technology incentives—would be a major enabling development for investment in deep decarbonization pathways, which are increasingly targeted for their importance in "keeping 1.5 alive."[49] Increased technology deployment can trigger a virtuous cycle by driving improved economies of scale, learning, and further cost reductions.

Carbon pricing alone is unlikely to spur early investment in these decarbonization pathways.[50] Policymakers must implement targeted measures including investing in research, development, and demonstrations, capital and operational subsidies, and public support for green hydrogen infrastructure or high-voltage transmission lines to achieve net zero transformation.

2.3 CARBON PRICING REVENUES INCREASE SHARPLY, PARTICULARLY FROM ETSs

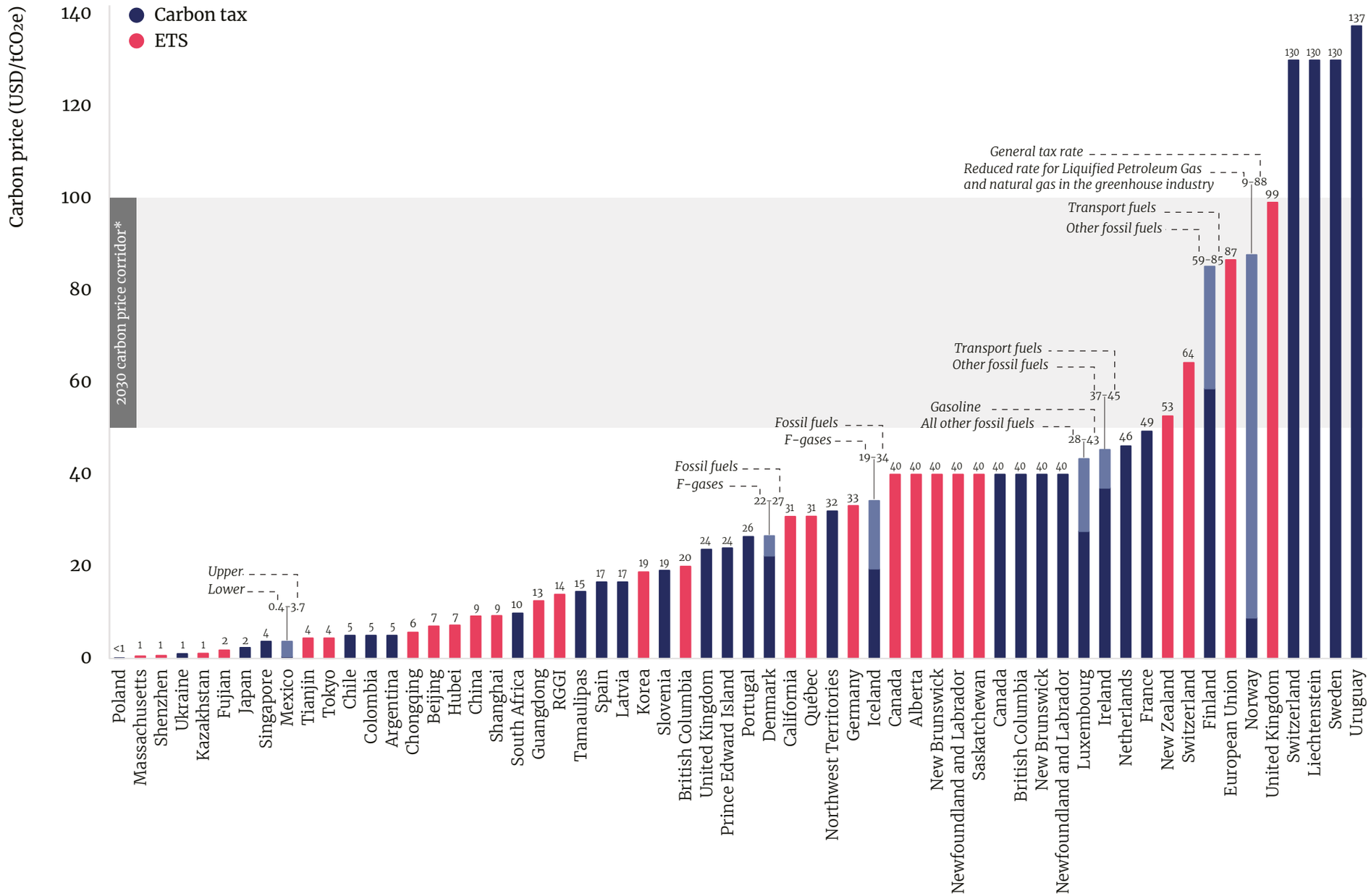
Carbon pricing revenues increased sharply in 2021, driven largely by higher carbon prices, as revenues generated by ETSs surpassed revenue generated by carbon taxes for the first time.

Global carbon pricing revenue collected in 2021 was around USD 84 billion, representing an increase of over USD 31 billion compared to 2020.[xvi] As with previous increases, higher carbon prices, including in the EU ETS, which accounts for around 41% of all carbon pricing revenue, as well as the New Zealand ETS (which commenced auctioning allowances) and the California Cap-and-Trade Program, drive the increase in carbon revenue. Two ETSs that began operation in 2021, the UK ETS (which includes revenue previously collected under the EU ETS) and the Germany ETS, together accounted for over 16% of total carbon pricing revenue generated in 2021. It is worth noting that the Chinese national ETS freely allocated all allowances during 2021. As a result, even though it is the largest ETS in operation (in terms of amount of emissions covered), there was no revenue generated from the Chinese national ETS.

xv The High-Level Commission's report argues that a well-designed carbon price is an indispensable part of a strategy for reducing emissions in an efficient way. However, it also emphasizes that carbon pricing will only be effective when adopted as part of a comprehensive policy package that includes measures to tackle market failures other than the GHG externality.

xvi Note that carbon pricing revenue refers to the amount of revenue collected by governments through direct carbon pricing instruments—that is, from carbon taxes paid or allowances sold through auctions.

FIGURE 6
Carbon prices as of April 1, 2022



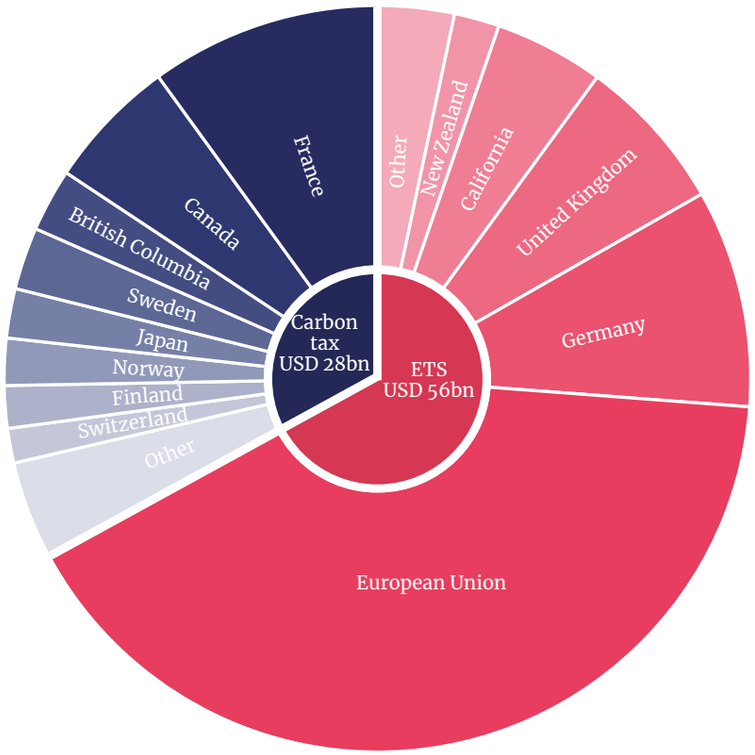
Nominal prices on April 1, 2022 are shown for illustrative purpose only. Prices are not necessarily comparable between CPIs because of (for example) differences in the sectors covered and allocation methods applied, specific exemptions, and compensation methods.

*The 2030 carbon price corridor is based on the recommendations in the report of the High-Level Commission on Carbon Prices.

**Several jurisdictions apply different carbon tax rates to different sectors or fuels. In these cases, we have indicated the range of tax rates applied, with the dark blue shading showing the lower rate and the combined dark blue and light blue shading representing the higher rate.

FIGURE 7[XVII]

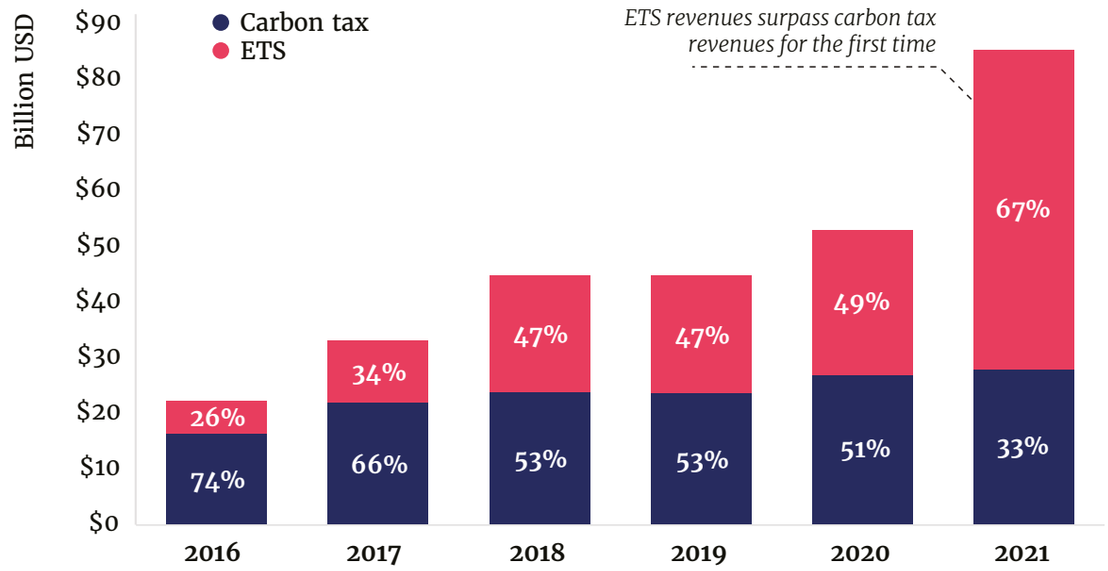
Revenue generated per carbon pricing instrument in 2021



For the first time ever, revenues generated by ETSs surpassed revenues generated by carbon taxes. While carbon taxes have historically generated more revenues than ETSs, the gap has narrowed in recent years and in 2021 ETSs generated over two-thirds of total revenue (see **Figure 7** and **Figure 8**). This largely reflects the fact that ETS prices are rising faster than fixed-price instruments (see **section 2.2**). A second factor is the increasing share of auctioned allowances rather than free allocation. A good example is New Zealand, which ramped up auctioning in 2021 as part of broader reforms to its ETS, as well additional revenue from ETSs that began operation in 2021. Data collected by the Institute for Climate Economics indicates that most ETS revenue collected in 2020 was earmarked and channeled to specific projects, for instance environmental or development projects. Revenue from carbon taxes also tends to be earmarked, although a higher proportion is allocated to consolidated revenue and, to a lesser extent, redistributed through tax exemptions or direct transfers.[51] However, categorizing revenue use has complexities. There is limited ability to account for nuances in fiscal policies, such as where revenue use could potentially be assigned to multiple categories or where revenue is in practice set aside for specific purposes, but not legally earmarked.

FIGURE 8

Evolution of global carbon pricing revenues over time



Carbon pricing revenue presents opportunities to support a sustainable recovery, or to finance broader fiscal reforms. Reforming existing fuel excise frameworks is a fundamental part of Israel's proposed carbon tax, and Uruguay's newly implemented carbon tax has replaced existing fuel excise charges, with the carbon revenue being allocated to finance policies that promote GHG mitigation and adaptation.

xvii The size of the respective wedges reflects the revenues generated by the relevant instrument(s).

2.4 CROSS-BORDER APPROACHES TO CARBON PRICING ARE INCREASINGLY IN THE SPOTLIGHT

Countries are increasingly moving toward cross-border approaches proposed in academic and policy literature, including border carbon adjustments (BCAs), climate clubs, and minimum carbon pricing arrangements. These novel approaches can help resolve asymmetrical ambition but raise political and technical challenges, particularly around determining the equivalency of carbon pricing and climate policies, more generally.

As countries increase the ambition of their carbon prices and other climate policies, carbon leakage[xviii] risks present important political concerns. While to date evidence of carbon leakage occurring in practice is minimal, it remains an important concern for politicians and industry stakeholders. These concerns can be heightened by the present context of increasing inflation and rising energy commodity prices.

Countries are increasingly looking at trade measures as a way to protect against potential carbon leakage as a result of carbon pricing. Most countries have addressed leakage concerns by providing exemptions, rebates, or free allocation of allowances to exposed industries. However, these approaches have drawbacks: reducing the carbon cost signal passed through the supply chain can help level the playing field vis-à-vis foreign products, but it also reduces the incentive to use energy more efficiently or switch to lower-carbon products and processes. In addition, these approaches tend to become less effective at managing carbon leakage risks at deeper levels of decarbonization, when embodied emissions need to approach zero. Consequently, countries are increasingly looking for other ways to even the playing field and equalize carbon prices for imports and domestically produced goods. Cross-border collaboration is one approach, such as through the unilateral implementation of a BCA, which would apply domestic carbon pricing to imports. Implementing a BCA requires the development of methodologies to estimate the emissions embodied in goods,[xix] as well as the degree to which those embodied emissions have already faced carbon pricing. Despite challenges, the potential to adapt existing and emerging technical developments on measuring embodied emissions makes cross-border pricing approaches appear feasible.

The European Union came a step closer to adopting a Carbon Border Adjustment Mechanism. In July 2021, the European Commission published its much-anticipated proposal for a CBAM (see **Box 4**). While not the first such mechanism in existence,[xx] the EU's mechanism would be by far the largest. Several jurisdictions, including Ukraine,[52] Uruguay,[53] and Taiwan, China,[54] have already cited the CBAM proposal as a driver for their efforts to adopt a direct carbon price. And though several trading partners have expressed concerns about the mechanism and highlighted the potential to take legal action or retaliatory measures against the EU, there have as of yet been no concrete moves toward either response.[55]

Several other jurisdictions are also pursuing the adoption of BCAs. Canada undertook consultations on a border mechanism in the fall of 2021 and in December Prime Minister Justin Trudeau mandated the finance minister to develop an approach to applying a border adjustment to emissions-intensive imports, such as steel, cement, and aluminum.[56] In the United Kingdom, a parliamentary committee is currently exploring the possibility of adopting a border mechanism.[57] And in July 2021 lawmakers in the United States, which does not have a carbon price, introduced legislation to apply a carbon tariff to fossil fuel imports, as well as products such as aluminum, steel, iron, and cement. However, it is unlikely this proposal will obtain the support it needs to become law.[58]

BCAs are raising important questions around responsibility for climate action. The principle that countries have common but differentiated responsibilities for tackling climate change according to their abilities and historical responsibilities has long been enshrined in international climate cooperation. Developing countries have argued that, in unilaterally applying carbon pricing to products they produce, wealthy countries adopting BCAs are violating this long-established principle.[59] At the same time, there are also calls for developed countries to take responsibility for the carbon footprint of their consumption, toward which a BCA would play a part. In the context of the EU CBAM, some have proposed exempting least developed countries, though others argue that this would reduce the effectiveness of the mechanism.[60] An alternative approach to promoting equity is to dedicate CBAM revenues to supporting developing countries with low-carbon development. While the EU's initial proposal would allocate most revenues to the EU budget, lawmakers have proposed channeling revenues to least developed countries in order to compensate for the costs the mechanism will imply for them.[61]

xviii Carbon leakage refers to the risk that emissions reduced in one jurisdiction are offset by increased emissions elsewhere. This can be the result of production increasing in or being relocated to another jurisdiction with laxer emission constraints (e.g., a jurisdiction with a lower, or zero, carbon price). Carbon leakage is an economic, political, and environmental concern: It can potentially translate into loss of GDP, jobs, and tax revenue in the most ambitious countries, creating a disincentive to act, and also reduce the efficiency of climate policies by shifting emissions to laxer countries, which can lead to an increase in global carbon emissions. There is little empirical evidence of carbon leakage occurring to date. This is likely, in part, due to historically low carbon prices and that most existing climate policies have included measures (such as exemptions) to reduce carbon leakage in high-risk sectors.

xix Embodied emissions refers to the carbon content of a product. It relates to the GHG emissions released during the production of the good (not the carbon physically contained in a product).

xx California already operates applies a carbon price to electricity imports.

BOX 4

The EU's proposed carbon border adjustment mechanism[xxi]

The adoption of a CBAM is a key component of the EU's climate strategy and its ambition to achieve net zero emissions by 2050 while safeguarding competitiveness and avoiding carbon leakage. Under the draft regulations released in July 2021, the CBAM would effectively involve applying a carbon price to imports of certain goods to the EU, proportionate to the goods' "embodied emissions," or the GHG emissions generated during their manufacture. Importers of covered goods would be required to purchase emission certificates proportionate to their embodied emissions. The price of these certificates would mirror that of EU ETS allowances.

The CBAM is intended to gradually replace the current free allocation of allowances as the main measure to combat carbon leakage in the EU ETS. Under the draft proposal, the mechanism would be phased in proportionate to the phase-out of the existing free allocation. The European Commission would adjust the number of CBAM certificates to be surrendered to reflect the extent of free allowances allocated under the EU ETS, which would decline by 10% each year over the period to 2035.

According to the proposal, the CBAM would apply to the import of electricity and specified goods in the steel, iron, cement, fertilizer, and aluminum sectors. The proposal would initially only apply the CBAM to Scope 1 emissions, though importers would need to report on embodied Scope 2 indirect emissions from electricity consumption, leaving the door open to include these emissions in future years. Embodied emissions for products would be determined in two ways: Calculations would be based on actual emissions recorded at installation level, verified by accredited verifiers, while default values would be applied where importers cannot show actual emissions generated. For electricity, calculations would primarily rely on third-country default values that correspond to average CO_2 emission factors in the country.

Importers would be able to avoid or reduce potential costs imposed by the CBAM in a number of ways. First, imports from countries that participate in the EU ETS, or have a domestic ETS linked to them, would be fully exempt.[xxii] Second, goods that are subject to a direct carbon price (i.e., a carbon tax or ETS) in their country of origin would be eligible for a rebate equal to the price already paid prior to export. Third, electricity imports from countries whose electricity markets are integrated with that of the EU would be exempt.

The proposal for the CBAM is currently under review by the European Parliament and the European Council. Potential amendments proposed in the parliament include making the 2025-2028 transitional period shorter and sooner, to 2023-2024, eliminating EU ETS free allocation much more rapidly. Scope 2 emissions from electricity use might be included, and use of CBAM revenues might be better targeted to support climate action outside the EU bloc. In March 2022, the Council released a draft text pushing for CBAM issues relating to free allocation phase-out and export rebates to be part of the upcoming EU ETS review. This move has been suggested to streamline the finalization of the CBAM regulation and shift decision-making power from finance ministers to environment ministers, considered better positioned to address these issues. The French Presidency of the EU is aiming to achieve agreement on the measure among lawmakers by June 2022, though it is as yet unclear if this will be achieved.

xxi The European Commission presented its final draft regulations for the CBAM in July 2021. See European Commission, "Proposal for a Regulation of the European Parliament and of the Council Establishing a Carbon Border Adjustment Mechanism," July 14, 2021.

xxii The proposed regulation allows for the possibility of further acts which increase the number of CBAM exemptions. Such cases would include a third country's inclusion into the EU ETS, or a linkage agreement between the EU ETS and the country's own emission trading system (as is the case for Switzerland).

Challenges in determining the equivalency of climate policy instruments are fueling debates over the design of BCAs. Applying BCAs fairly and effectively requires the development of methodologies to estimate the emissions embodied in imports, as well as the degree to which those embodied emissions have already faced carbon pricing or similar policies. While methodologies for domestic output-based allocation have long offered ways to estimate embodied emissions,[xxiii] estimating whether they have already been subject to equivalent carbon pricing measures is less straightforward, given the presence of free allocation, small-firm exclusions, or energy tax exemptions. Indirect carbon prices (see **section 1.2**), such as those related to fuel excise taxes or fuel subsidies, also have complex interactions with direct carbon pricing and can influence carbon leakage risks. This debate is currently playing out in the design of the EU CBAM, where key trading partners argue that strong climate policies, rather than only carbon pricing, should be recognized. However, the EU has so far been reluctant to recognize other policies, arguing that determining equivalency between policies is fraught with complications.

The potential establishment of "climate clubs"[xxiv] could provide a forum to adopt mutual agreements on decarbonization that could provide an alternative path to recognizing equivalency. For example, the proposed US-EU Carbon-Based Sectoral Arrangement on Steel and Aluminum Trade aims to establish common definitions of low-carbon steel through mutually agreed trade arrangements. Germany has, moreover, included the establishment of "an open and cooperative international climate club" among its policy priorities for its presidency of the Group of Seven (G7) in 2022,[xxv] a proposal that has gained support among other EU countries.[62] It is as yet unclear whether such arrangements would be complementary or alternative to other trade mechanisms, such as the CBAM. While these types of climate club approaches potentially provide a model for sidestepping some of the complex considerations around policy equivalency, they will likely require some way of differentiating between low- and high-carbon exporters. While BCAs can offer incentives to exporting producers to adopt more climate-friendly practices (i.e., improve emissions intensity of goods), climate clubs would leverage trade measures to incentivize foreign jurisdictions to adopt more ambitious climate policies. However, climate clubs have the potential to disadvantage lower-income countries, where they are not able to meet membership criteria set by more advanced economies. This could be addressed through policy design, such as through a tiered pricing structure reflecting level of development.

Interest in the establishment of common or minimum standards for carbon pricing across jurisdictions is increasing. The most ambitious of these approaches would be the adoption of a minimum price on carbon or "international carbon price floor," either globally or among large emitting countries. The latter could provide a more manageable "mini-lateral" approach, to allow scaling ambition by addressing concerns that competitors will gain an unfair advantage due to lower (or no) carbon prices. In addition, a minimum carbon price can be applied more broadly than other approaches (such as BCAs), which only target traded products. The IMF[63] and the WTO[64] have called for the establishment of such a mechanism, as have various academics and a UN-convened group of global asset owners responsible for managing USD 6.6 trillion.[65] Both Canada[66] and France[67] have recently joined the call for an international price floor, though the French proposal only covers EU member states. Germany's proposed climate club would focus, among other things, on "uniform standards" for carbon pricing, which could include the establishment of a minimum price floor.[68] However, an international carbon price floor poses some challenges, including the need to understand equivalency of coverage between jurisdictions' carbon prices and to account for equity issues across participating countries.

Moves to link emissions trading systems in the past year have been limited. While linking has been a focus in the recent past for international cooperation on carbon pricing, it presents a host of complex challenges and only a small number of jurisdictions have so far managed to link their systems. Developments over the past year have been limited in this regard. California and Québec announced their intention to explore opportunities for future carbon market alignment with New Zealand under the Western Climate Initiative.[69] Washington State, which will launch its new cap-and-trade program on January 1, 2023,[70] will not link to the initiative at the outset, although it may develop a regulation enabling future such linkage.[71] However, the international carbon market rules agreed at COP26 in Glasgow provide some welcome certainty regarding the implications of linking for countries' national mitigation targets (see **Box 5**).

xxiii For example, emissions intensity benchmarking approaches in the EU, Canada, and New Zealand.

xxiv The term "climate club" has been used in different circumstances and can capture a range of frameworks. William Nordhaus developed the concept of a climate club as "an agreement by participating countries to undertake harmonized emissions reductions," with members receiving benefits, while nonmembers are penalized. In this report, the term "climate clubs" is used in a general way to capture formalized agreements between countries aimed at promoting climate mitigation outcomes. W. Nordhaus, "Climate Clubs: Overcoming Free-riding in International Climate Policy," American Economic Review 105, no. 4, (2015).

xxv While the initial proposal has been launched in the context of the G7, it would in principle be open to all nations and Germany is considering broadening the proposal to the G20, which includes major emerging economies such as China, India, and Brazil.

BOX 5

Article 6 rules on linking emissions trading systems

The finalized Article 6 Rulebook allows countries to establish the linking of their domestic ETSs as a "cooperative approach" under Article 6.2.[xxvi] Doing so requires linking partners to estimate the increase or reduction of emissions in their jurisdiction incentivized by the trade of allowances, and translate this net amount into internationally transferred mitigation outcomes (ITMOs). These ITMOs are then accounted for in the Article 6 reporting structures, enabling the linking partner that has reduced its emissions through a linked ETS to use these reductions toward achieving its NDC target. Inversely, the linking partner that has effectively increased its emissions through the linking program will need to reflect this increase in emissions in its reporting as well.[72]

xxvi Countries may also decide not to account for the link or communicate two separate NDC targets for ETS and non-ETS sectors. See e.g., L. Schneider, J. Cludius, and S. La Hoz Theuer, Accounting for the Linking of Emission Trading Systems under Article 6.2 of the Paris Agreement, International Carbon Action Partnership, 2018.

2.5 RISING ENERGY PRICES CREATE CHALLENGES AND OPPORTUNITIES FOR CARBON PRICING

Existing political challenges in adopting and expanding carbon pricing have been amplified as global energy prices have increased, putting pressure on individual household budgets. Ensuring carbon pricing is fair, and seen to be fair, will be crucial in building and maintaining public support.

Global oil and gas prices have sharply increased in the past year, fueled by a combination of growing demand due to post-COVID economic recovery, supply constraints, and, more recently, the war in Ukraine. European gas prices are now at their highest levels ever, while global oil prices are at their highest levels in almost a decade.[xxvii] A EU commitment to reduce reliance on Russian oil and gas in the wake of the invasion of Ukraine meanwhile has the potential to increase gas prices further.[73] The sudden energy price increases and corresponding inflation is putting pressure on governments to shield consumers and vulnerable households from energy poverty, by regulating or capping energy prices, introducing subsidies, or scrapping surcharges. While typically only applied for a limited time, any measures that directly reduce the price of energy would dampen incentives to reduce emissions.

The current political and economic context presents both challenges and opportunities for carbon pricing. In economies highly exposed to fuel prices, new, expanded, or increased carbon prices would result in additional price pressure on consumers in a context where citizens and businesses are already struggling to pay their energy bills. In the EU, some member states have either expressed unease or asked to suspend extension and reform plans of the EU ETS, due to worries about the effect of the policy on the energy poor.[74] In the short term, high prices may lead to reduced energy use but will not provide investors in low-carbon projects with the kind of long-term certainty that a stable carbon price does. Governments can also use carbon pricing to provide a longer-term incentive to increase domestic renewable energy production, which can help reduce reliance on foreign energy and provide some protection against global energy price shocks.

Backlash against energy price increases is particularly strong when they are perceived to disproportionately affect vulnerable populations. Widespread protests triggered by the removal of liquified petroleum gas (LPG) subsidies in Kazakhstan in

xxvii Data obtained from https://tradingeconomics.com/.

early 2022 sprang from the western Mangystau region. This region produces most of the country's oil but is among its poorest regions, and a high share of residents' vehicles run on LPG.[75] The protests exposed deep underlying discontent amid rising inequality and food costs and a sense that the government was not acting in the best interests of the community, and protestors' demands quickly expanded beyond fuel prices to encompass broader political reform.[76] This is in line with previous studies, including recent research from the IMF, which indicates that introducing CPIs in countries with high inequality and lower social spending tends to trigger a stronger backlash. The Kazakhstan government ultimately agreed to roll back the energy policy reforms and place a cap on fuel prices.[77]

Aligning carbon pricing and related policy around achieving a "just transition" is central to building and maintaining support amid high energy prices, inflation, and the continued need for deeper transformation. Key imperatives of a just transition include creating reliable work and quality jobs, and ensuring at-risk regions, industries, communities, workers, and consumers share in the benefits of a green transition.[78] Policymakers increasingly recognize a just transition as key not only to ensuring equity in climate policy, but also in building the support needed to adopt and sustain it. Washington State's cap-and-trade program was adopted as part of a broader climate package that also seeks to tackle environmental racism.[79] In Canada, civil society is increasingly calling for a Just Transition Act as part of stronger climate action, including the recently increased carbon price.[80] Indonesia's Ministry of National Development Planning recognized the importance of allocating a share of their future carbon tax revenues for investments that will support a just transition in a recent report,[81] and in South Africa, the president has established a Presidential Climate Commission, which, among other priorities, is tasked with defining the Just Transition Framework for the country. Finally, the EU has adopted a range of funds and policies designed to offset the impacts of its climate strategy—of which the EU ETS is a key part—on vulnerable populations and sectors (see **Box 6**), and some lawmakers see the inclusion of targeted social investments as crucial to supporting a proposed second ETS for buildings and transport.[82]

Implementing just transition strategies can be partially financed through carbon pricing revenues. In Pennsylvania, the US state that has signaled joining the RGGI in 2022, revenue raised through the proposed cap-and-trade system will, among other things, be used to support employees in the fossil fuel industry to transition to other sectors.[83] Ireland also announced that the additional revenues from the 2022 carbon tax increase will be used to support initiatives that ensure a just transition, including through increased spending on social welfare and prevention of fuel poverty.[84]

BOX 6

Just transition in the EU's climate policy

The EU's Fit for 55 Package includes a number of measures to strengthen the EU's climate performance. EU ETS revenues will benefit the Social Climate Fund, which will provide funds to address the impacts of extending the EU ETS to the road transport and building sector on vulnerable households, micro-enterprises, and transport users to cushion the financial impacts on citizens and businesses.[85] The European Commission also issued guidance for a fair and inclusive transition.[86] Earlier, the European Green Deal also introduced the Just Transition Mechanism to provide targeted support to regions affected most by the transition to a climate-neutral economy.[87]

Chapter 3

Carbon crediting – markets and mechanisms

Carbon credit markets are at a crossroads. Strong voluntary demand and broadening market diversity—expressed through new buyers, market niches, trading infrastructure, and distinct pricing and preferences—have driven the market dynamics of the past year. At the same time, as the market grows, the role of carbon crediting in meeting emissions goals is attracting higher scrutiny. To sustain current growth, market actors will need to collaborate to support high standards, protect environmental integrity and credibility, and deepen liquidity. Specialized governance bodies, financial services, and new technological infrastructures are emerging to support solutions to scaling up markets and ensuring integrity.

3.1 CARBON CREDIT MARKETS ARE GROWING RAPIDLY, LED BY VOLUNTARY MARKET ACTIVITY

The growth of carbon credit markets has accelerated further over the past year, with issuances, transactions, and prices all rising sharply. New carbon market rules set at COP26 in Glasgow have created additional certainty that may help international compliance markets develop further in coming years. For now, most market activity remains centered on the voluntary carbon market.

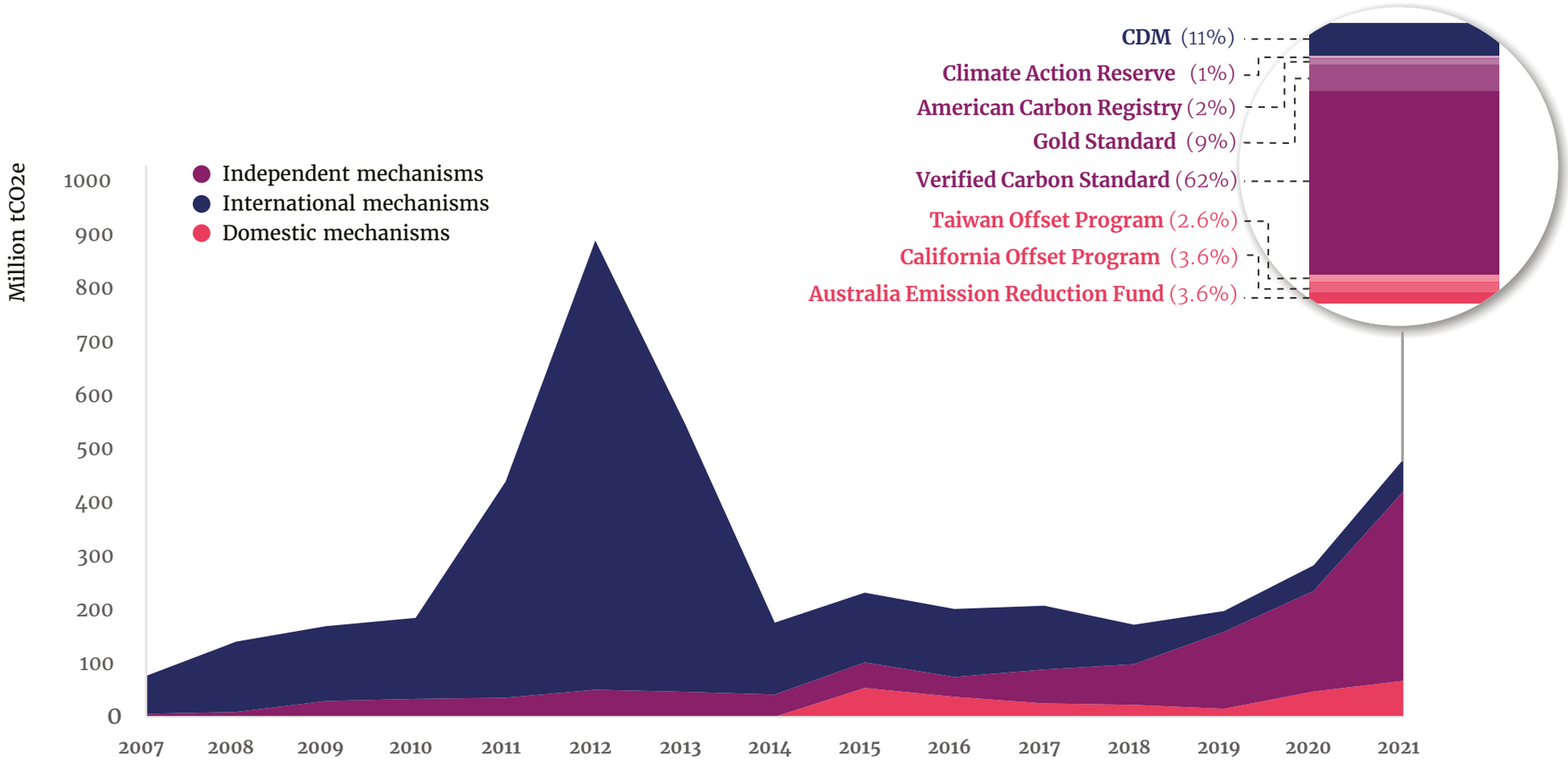
Carbon credit markets grew 48% in 2021. The total number of credits issued[xxviii] from international, domestic, and independent credit mechanisms[xxix] increased from 327 million to 478 million. This is the biggest year-on-year increase since 2012, the peak of carbon credit issuance (**Figure 9**). The total number of credits issued since 2007 is around 4.7 billion tCO_2e.

xxviii Credits may be generated from projects as soon as the emissions removals or reductions take place; however, credits will only be officially issued once they have been reviewed and verified by the respective authorities.

xxix The independent mechanisms included are those with the highest issuances: American Carbon Registry, Climate Action Reserve, Gold Standard, the Verified Carbon Standard from Verra, Plan Vivo, and the Global Carbon Council.

FIGURE 9

Global volume of issuances by crediting mechanism category



BOX 7

Understanding carbon credit markets

Global carbon credit markets consist of a diverse range of sources of supply, sources of demand, and trading frameworks.

Supply derives from different types of crediting mechanisms, including the following:

- *International crediting mechanisms* established under international treaties—the Kyoto Protocol (including the Clean Development Mechanism [CDM]) and the Paris Agreement.[xxx]
- *Domestic crediting mechanisms* established by regional, national, or subnational governments, such as the California Compliance Offset Program and the Australia Emissions Reduction Fund.
- *Independent crediting mechanisms* includes standards and crediting mechanisms managed by independent, nongovernmental entities, such as Verra and Gold Standard.

Demand derives from a range of compliance obligations established under international agreements and national laws, as well as voluntary commitments adopted by companies, governments, and other organizations.

While most carbon credits tend to attract a range of different kinds of buyers, meaning that few sources of supply can be matched with only one source of demand, it is possible to identify **four broad segments**, largely based on demand drivers:

1. International compliance markets primarily respond to commitments made under international agreements. They primarily consist of (i) countries voluntarily purchasing/utilizing credits or "mitigation outcomes" recognized under international treaties to help meet their emission reduction commitments (previously established under the Kyoto Protocol and more recently the Paris Agreement); and (ii) airlines purchasing credits eligible for meeting their obligations established under the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA).[xxxi]
2. Domestic compliance markets involve companies purchasing credits that are eligible for meeting their obligations under a domestic law, usually an ETS or a carbon tax. These may include credits issued under international, domestic, or independent crediting mechanisms depending on the rules established by respective governments.
3. Voluntary carbon markets consist of (mostly private) entities purchasing carbon credits for the purpose of complying with voluntary mitigation commitments. They largely consist of credits issued under independent crediting standards, though some entities also purchase those issued under international or domestic crediting mechanisms.
4. Results-based finance refers, in the context of the carbon market, to purchases of carbon credits by governments or international organizations for the purpose of incentivizing climate change mitigation or meeting national targets. Results-based finance can also refer to broader payments in return for the achievement of emissions reductions, without any transfer of credits or other ownership.

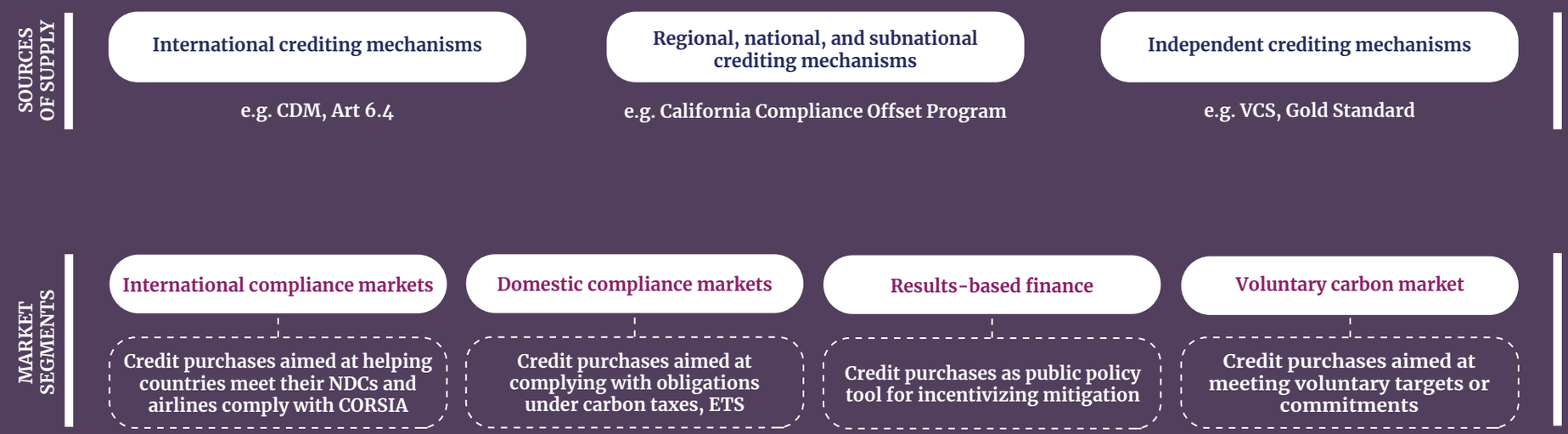
The linkages and overlaps across compliance and voluntary markets, as well as international and domestic markets, continue to evolve.

xxx Article 6 of the Paris Agreement provides the framework for international carbon markets: Article 6.4 establishes a centralized mechanism supervised and governed by the UNFCCC, which is expected to be administratively similar to the CDM of the Kyoto Protocol, and Article 6.2, on the other hand, provides a basis for bilateral or plurilateral voluntary cooperation among countries, which potentially offers flexibility to reduce GHG emissions from a variety of processes, mechanisms, and standards.

xxxi One of the key features that distinguishes international compliance markets from voluntary markets is the mandatory authorization by the governments in whose jurisdiction the credits are generated and transferred from. Under the Paris Agreement, the sale and purchase of carbon credits requires accounting by Parties to the Paris Agreement through a "corresponding adjustment." While international compliance markets exclusively trade credits that are authorized (i.e., include a commitment for corresponding adjustments by the seller government), voluntary carbon markets may also trade in credits that are not accompanied by such authorization.

FIGURE 10

Stylized representation of types of carbon crediting mechanisms and market segments[xxxii]

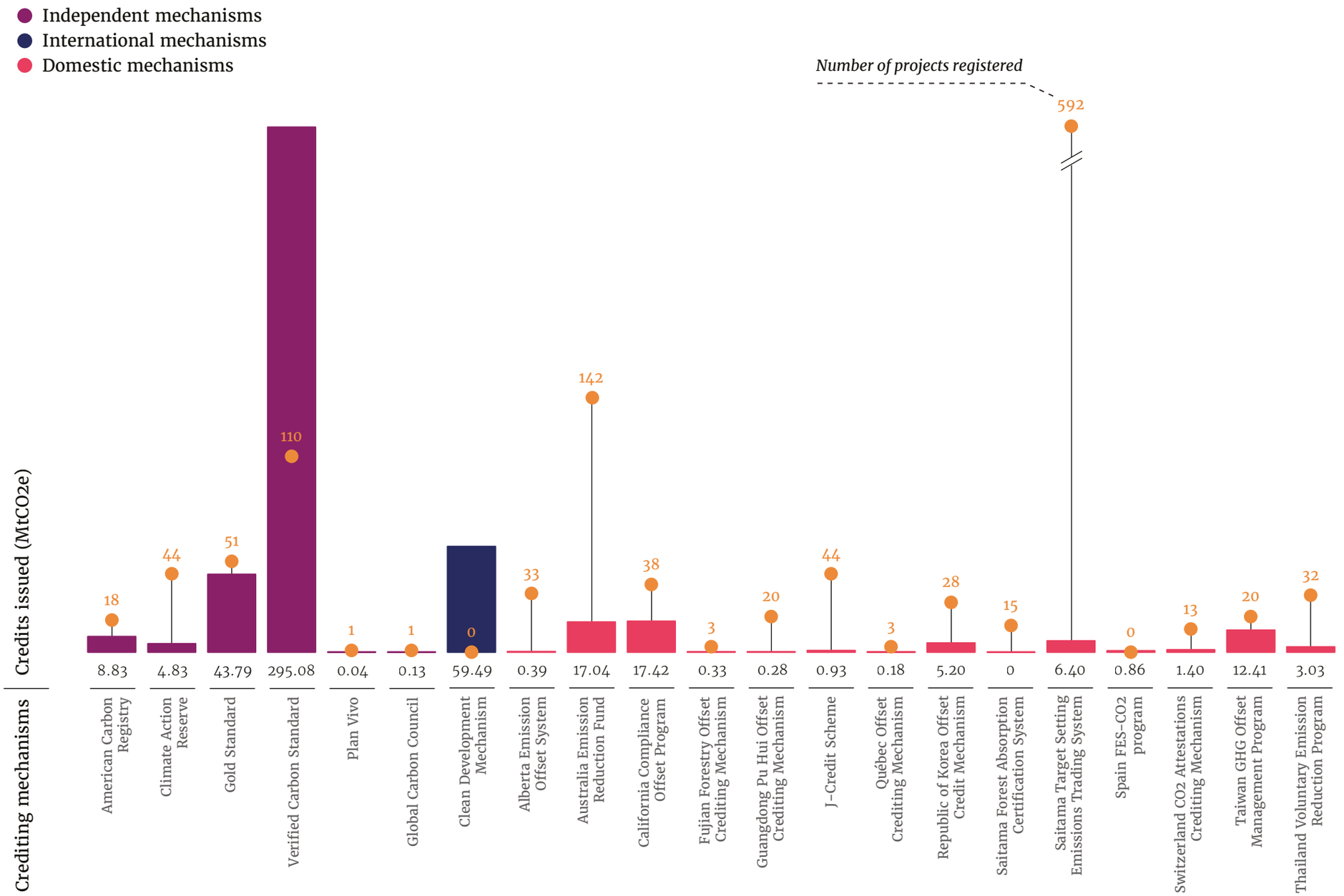


xxxii *Due to the heterogeneity and interaction between the different carbon markets (described in Box 7) there may be a potential overlap between issuances from international and independent mechanisms with domestic mechanisms, as some jurisdictions reissue credits from independent mechanisms where they meet specific domestic criteria. To reduce this duplication, issued credits registered in more than one registry are accounted for under the relevant domestic mechanisms (e.g., credits issued by the Climate Action Reserve and American Carbon Registry that meet specific requirements to be used in the cap-and-trade are counted for by the California Offset Program).*

The vast majority of new issuances came from projects registered under independent crediting mechanisms, while issuances from international and domestic crediting mechanisms increased at a slower pace. This represents a major turnaround in the past decade (see **Figure 9**). In 2021, credit issuance from independent standards grew by 88%, totaling 352 million credits and representing 74% of the supply of carbon credits that year. In contrast, issuance under the CDM represented 11% of total issuances and grew by 25% in the same period, with no new registered projects in 2021. This reflects the uncertainty over the mechanism's future prior to clarification at COP26 on whether some CDM projects would be able to transition to the new Article 6.4 mechanism. The CDM will likely continue its gradual phasedown over the coming years, pending its replacement by a new international market mechanism. Issuance from domestic mechanisms represented 15% of total issuances, led by the California Compliance Offset Program and Australia's Emissions Reduction Fund (see **Figure 11**).

FIGURE 11

Credit issuance and number of projects in 2021, by category of mechanisms



*There is potential for overlap where domestic mechanisms rely on credits initially issued by other existing mechanisms.

For the first time, the total value of the voluntary carbon market exceeded more than USD 1 billion in November 2021.[88] The market has further grown to USD 1.4 billion as of the writing of this report, according to Ecosystem Marketplace.[xxxiii] This rapid increase in value reflects both rising prices and rising demand from corporate buyers leading to higher transacted volumes. Global average carbon credit prices[xxxiv] moved from USD 2.49/tCO_2e in 2020 to USD 3.82/tCO_2e in 2021, while the volume of credits transacted in the voluntary market exceeded 362 million credits, 92% more than in 2020.[89] While prices continued to rise in 2021, additional supply from surging project registrations, new credit issuance, and reduced retirements have slowed the rate of increase. At the same time, corporate interest in using credits to meet climate goals, along with traders and investors hoping to turn a profit on continued price increases, has supported increased market value and liquidity.

Demand from domestic compliance markets, such as carbon taxes and ETSs, remains small, but this may change over time with agreement on Article 6 rules. Many carbon pricing instruments allow entities to use carbon credits to meet their obligations. However, most restrict credits to those generated domestically or limit the amount that can be used for overall compliance.[xxxv] While many jurisdictions have established their own domestic crediting mechanisms for meeting tax or ETS obligations (see **Figure 12**), five countries so far rely on carbon credits issued by existing crediting mechanisms.[xxxvi] Rule changes in some ETSs, including new restrictions on the volume and type of carbon credits that can be used in California's Cap-and-Trade Program and the exclusion of credits from the Switzerland ETS and EU ETS from 2021, are likely to reduce demand.[90] While in the case of Switzerland, this move is part of a broader strategy to raise ambition and bring the national ETS in line with the EU ETS, in California, the restrictions were largely motivated by concerns over the impact of offsets on environmental justice issues. The amendment to the original cap-and-trade regulation specifies that 50% of all projects must, from 2021, directly benefit air and water pollution issues within the state.[xxxvii]

Demand from international compliance markets changed little over the past year. The International Civil Aviation Organization (ICAO) CORSIA pilot phase started on January 1, 2021, but demand from CORSIA remains very limited as international air travel remains depressed by the ongoing COVID-19 pandemic, as well as the ICAO Council's decision to use 2019 emissions as the baseline above which credits must be surrendered. While demand for flights recovered somewhat in 2021 compared with 2020, it was still 75% below 2019 levels.[91] Choices by ICAO[xxxviii] led to less-stringent short-term decarbonization requirements for airlines and has largely eliminated demand in the immediate term. More demand could emerge later this decade, and recent analysis suggests that even under a medium COVID-recovery scenario GHG emissions from global air travel will exceed 2019 levels by 2024.[92] In addition, Ecosystem Marketplace has reported that while CORSIA-eligible credits are not being purchased for compliance purposes, they are being bought and sold at a premium to non-CORSIA credits sold to corporate end-users and intermediaries, as some corporate buyers see CORSIA eligibility as a sign that minimum quality standards have been met.[93]

xxxiii Voluntary carbon market data is provided by Forest Trends' non-profit initiative Ecosystem Marketplace. Ecosystem Marketplace data contains trade details such as price, volume, and other carbon credit project and transaction attributes. The dataset for 2021 had not been finalized by the time this report was published and therefore market value figures do not represent a complete annual picture. However, Ecosystem Marketplace's dataset remains the most comprehensive available for the 2021 calendar year. Ecosystem Marketplace will release updated 2021 figures later in 2022 once data from all respondents has been collected.

xxxiv The prices shown here are from Ecosystem Marketplace and are a global representation of both over-the-counter (OTC) transaction prices and trading platform cleared transaction prices, combined. They are lower than standardized prices such as the Platt prices shown in Figure 13. This price difference may be due to the fact that prices for standardized contracts—transactions involving packages of carbon credits with certified common characteristics (project type, vintages, and/or issuing standards) and sold as standard products by carbon exchanges—incorporate the additional costs of ex-ante screening and quality assessment activities performed by standardized credit providers, which is not the case in OTC transactions. This price difference may also be due to differences the year of publication—Figure 13 shows prices for 2022 compared to Ecosystem Marketplace prices for 2021.

xxxv The exceptions include Korea's ETS and Mexico's Carbon Tax. Korea's ETS, as of 2021, permits emitters to use international credits for the full 5% of eligible offset use. International credits must be CDM projects that are in part owned, funded, or operated by a Korean company. See World Bank,) "Carbon Pricing Dashboard: Korea ETS," 2022; and ICAP, "Emissions Trading Scheme Dashboard," 2021. Mexico's Carbon Tax permits covered entities to use certified emission reductions from the CDM, providing they are eligible for compliance in the EU ETS. See World Bank, "Carbon Pricing Dashboard: Mexico ETS," 2022

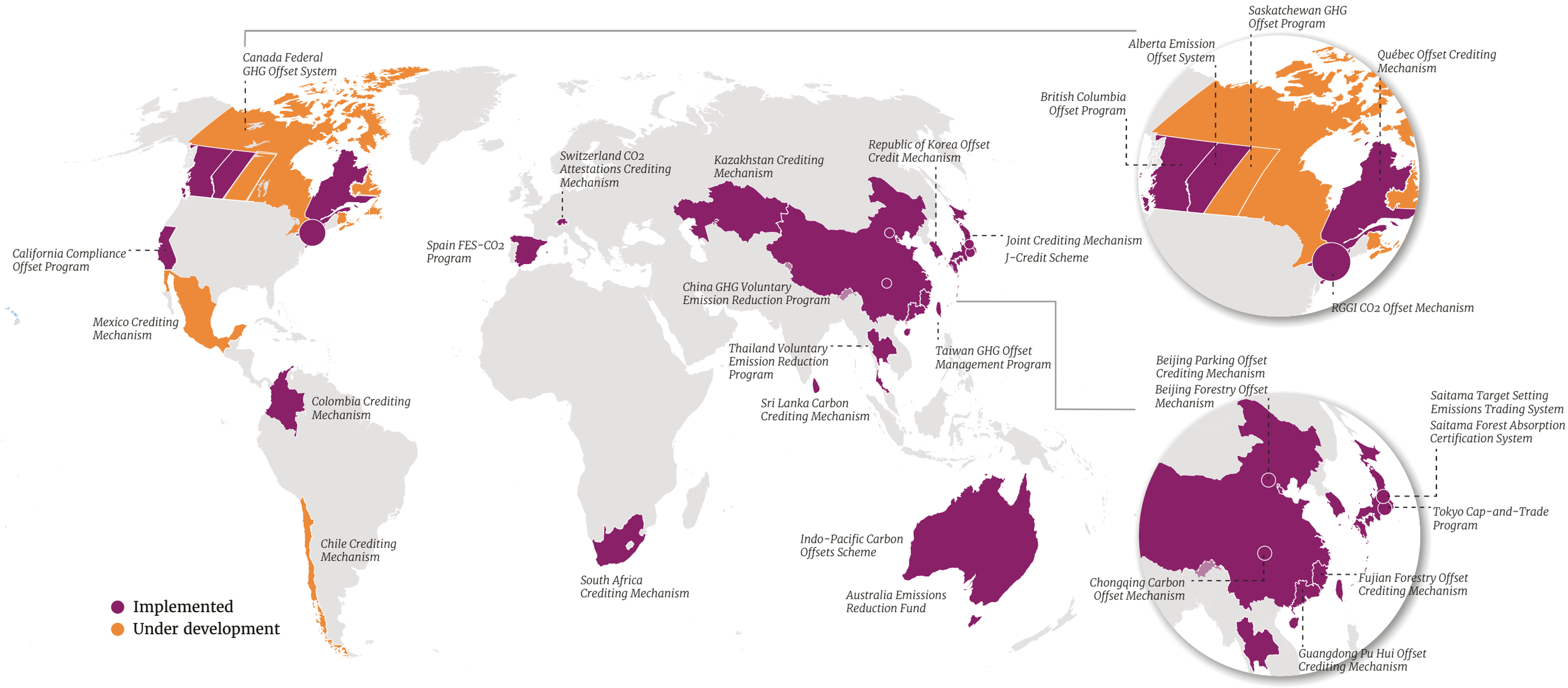
xxxvi These schemes are Colombia's Carbon Tax, South Africa's Carbon Tax, China's regional and national ETS schemes, Korea's ETS, and Mexico's Carbon Tax and pilot ETS.

xxxvii ICAP, "Switzerland Revises ETS Rules on Cap, Allocation, and Offsets," ETS News, December 3, 2020; see Section 5 of the AB-398 California Global Warming Solutions Act of 2006: Market-based compliance mechanisms: fire prevention fees: sales and use tax manufacturing exemption. (2017 amendment).

xxxviii The baseline was initially intended to be derived from average emissions over the 2019-2020 period. However, following the major drop in passenger numbers caused by the COVID-19 pandemic, the ICAO Council decided to build the baseline solely on 2019 emissions.

FIGURE 12

Map of national and subnational crediting mechanisms



Circles represent crediting mechanisms in subnational jurisdictions and cities. "Implemented" crediting mechanisms have the required framework (e.g., legislative mandate) as well as the supporting procedures, emission reduction protocols and registry systems in place to allow for crediting to take place.

Whether CORSIA will be a significant source of demand in the longer term remains unclear. While a quick recovery from the pandemic would result in compliance obligations for airlines in the short term, if the ICAO General Assembly extends the 2019 baseline to 2035, which it is considering doing, these obligations may be significantly reduced. Such an adjustment would considerably dampen the aviation sector's demand for credits over the next 13 years and compromise the industry's climate commitments further.[94] However, ICAO's requirements are already shaping the market. As ICAO's Technical Advisory Body approved eight standards as eligible for CORSIA purposes,[95] several contract types that track "CORSIA-eligible credits" have emerged. These include Xpansiv CBL's global exchange platform, Global Emission Offsets,[96] and AirCarbon Exchange CORSIA Eligible Token. The credits currently being traded do not have corresponding adjustments, which will be a requirement for CORSIA-eligible credits with vintages from 2021 onward, to avoid double counting.

New rules governing international carbon markets have provided certainty that may lead to growth in these markets in the coming years. At COP26 in late 2021, countries agreed on rules for international carbon trading under Article 6 of the Paris Agreement (see **section 3.5** for further details). These rules provide greater certainty that will help progress existing collaboration efforts and may lead to the development of new approaches. For example, Switzerland, Japan, and Sweden,[xxxix] and more recently Republic of Korea,[97] are already engaging with potential partners to develop transaction structures. Other related initiatives include the World Bank Transformative Carbon Asset Facility and the Global Green Growth Institute, which both receive funding through various governments to explore and set up Article 6 transactions and implement capacity-building activities to facilitate the operationalization of the Article 6 market. An important distinction between the Paris Agreement and the Kyoto Protocol is the extent of national commitments. While only developed (or Annex I) countries had climate targets under the Kyoto Protocol, any country can have a voluntary climate pledge articulated in an NDC under the bottom-up framework of the Paris Agreement. Therefore, any country could conceivably act as a buyer or seller in Article 6 markets, depending on their needs at a given time.

However, it will take time before the potential size and scale of international compliance markets is known. While 87% of Parties to the Paris Agreement have signaled their interest in participating in the international compliance market, the potential levels and locations of supply and demand are uncertain.[98] While some major developed countries, including the EU and the United States, have signaled they will not use Article 6 for achieving their mitigation targets, a number of other countries have already started to develop their Article 6 strategies and at least 10 countries have already indicated their interest in using international mitigation outcomes to meet their NDCs.[99] Countries intending to participate in the international carbon credit market will, moreover, need time to become acquainted with the newly set Article 6 rules and prepare domestic capacity, administrative rules, and infrastructure to facilitate transfers of mitigation (see section 3.5). Moreover, the Article 6 rulebook contains several elements that introduce a different context for compliance trading compared to the Kyoto Protocol. Notably, the rulebook does not allow for the banking of ITMOs across NDC implementation periods. Questions about how such elements will play out further add to the uncertainty about how the international compliance market might evolve.

3.2 VOLUNTARY CORPORATE COMMITMENTS ARE THE MAIN DRIVER OF MARKET GROWTH

The voluntary climate targets from the corporate world are still the main force behind the increasing demand for carbon credits. These targets should commit to ambitious decarbonization in the company's own value chain while compensating or neutralizing residual emissions. The plans for achieving these targets, however, vary in terms of scope, coverage, timelines, and intended use of carbon credits.

Growing corporate net zero[xl] commitments are driving demand in the voluntary carbon market segment. Large purchasers in 2021 came from a range of sectors. Energy companies, mainly large oil and gas firms, led the way in purchasing credits, increasing their demand ninefold compared to the previous year. Food and beverage and tourism companies have also purchased credits at high prices, and other consumer goods firms are also active buyers.[100] The financial sector significantly increased its carbon credit purchases, as banks set climate targets for their operations and other financial institutions act as intermediaries for corporate clients and as speculators from the market.[101] The 2021 launch of the Glasgow Financial Alliance

xxxix Sweden will not use Article 6 credits to meet its target under the EU NDC but will rather use ITMOs for meeting its national commitment beyond the EU NDC.

xl According to the Voluntary Carbon Markets Integrity Initiative, net zero emissions are achieved when anthropogenic emissions of greenhouse gases to the atmosphere are balanced by anthropogenic removals over a specified period.

for Net Zero, a coalition grouping of financial institutions representing around 40% of global banking assets that have voluntarily committed to a state of net zero emissions, has bolstered this trend.

The growth in net zero targets has accelerated rapidly over the past years. Corporations can voluntarily buy carbon credits to contribute toward meeting their climate targets, to compensate for emissions, or to remove unabated emissions. The UNFCCC's Race to Zero initiative now reports 5,235 companies have made a commitment of this type, and pledges by Global Fortune 500 companies grew 17% between 2020 and the end of 2021. The sector level also shows progress-notably in the International Air Transport Association recently announcing a voluntary net zero target for the aviation sector by 2050.[102] Under current plans, 19% of the target will be met with carbon credits.

The increasing speed of corporate climate target adoption, combined with a diversity of net zero terms,[xli] claims, and target-setting approaches, is making it difficult to distinguish the current role of credits in deep decarbonization. Due to the absence of a globally recognized standard, corporate climate plans vary considerably in terms of scope, emissions coverage, timelines, and intended use of carbon credits for its compliance. This leads to some cases where companies are over-relying on carbon crediting to meet their climate targets or selling "carbon neutral" products or services without accounting for a significant share of emissions. One example is the introduction of "carbon neutral" liquified natural gas[103] and oil products.[104] There are other examples where claims could confuse consumers, such as the case of Deutsche Post DHL, which offers carbon neutral deliveries but less than 1% of the company's emissions were offset in 2020.[105] If the world is to reach net zero by 2050, companies must prioritize the decarbonization of their emission pathways and seek to compensate (through emission reductions) or neutralize (through removals) only residual emissions with carbon credits. An example of this approach is Maersk's commitment to reduce its value chain emissions by 90% through innovative technologies and fuels and to only rely on carbon credits for 5-10% of its residual emissions to achieve zero-carbon shipping by 2050.[106]

The rapid increase in corporate voluntary net zero commitments has led to strong growth forecasts for carbon credits demand. One recent analysis forecasts a 15-fold increase in demand to 1.5-2 gigatons of carbon dioxide ($GtCO_2$) per year by 2030, and a 100-fold increase to 7-13 $GtCO_2$ by 2050.[107] Other forecasts show similar trends, reaching demand of 2 $GtCO_2$ per year by 2030 if the outcomes of COP26 lead to effective coordination of global voluntary and compliance markets.[108] Under most forecast scenarios, growth is expected to be driven by the increasing number of corporate net zero commitments in combination with an increased supply of new technologies and nature-based solutions.[xlii] Growth in demand volume is expected to be mirrored in value, with some estimates forecasting the market to increase 7-20% in value in one year, to reach a total value of USD 1.5-1.7 billion in 2022.[109]

Philanthropic demand has historically represented a very small share of the carbon credit market; however, this is a potential growth area if philanthropists and corporations seek to scale up near-term climate finance. These entities may make voluntary contributions to the goals of the Paris Agreement beyond their own operations and supply chains by financing emission reductions. Rather than acquiring them and offsetting the company's GHG emission footprint, they purchase carbon credits and retire them. For example, PayPal has purchased carbon credits without making compensation claims and Walmart committed to protecting 50 million acres of land by 2030 without an offsetting claim.[110] While these contribution claims could represent a growing source of demand for carbon credits and help create a pioneering route for private actors to contribute to the Paris goals, further guidance is needed to inform when and how carbon credits can be used as part of credible contribution claims that go beyond entities' value chains. Other companies also continue to apply internal carbon prices, with some investing revenues in reducing emissions in their supply chain without necessarily claiming these as credits (see **Box 8**).

xli Corporates are using different terms for their climate commitments; others include net zero, zero emissions, carbon free, carbon neutrality, and climate positive, among others.

xlii As the significance of carbon removals is emerging, many market participants call a large part of them "nature-based solutions (NbS)." NbS provide projects that protect, transform, or restore land that absorbs CO2 emissions from the atmosphere becoming eligible for the issuance and sale of carbon credits. However, and as the International Union for Conservation of Nature defines them, NbS aim to protect, sustainably manage, and restore natural or modified ecosystems that address other major societal challenges, such as food security, water security, human health, or social and economic development.

BOX 8

Internal carbon pricing

The past year has seen a moderate increase in the number of companies reporting the use of an internal carbon price (ICP), but overall uptake remains limited. Motivations for implementing an ICP and uptake across geographies remain relatively unchanged, but new trends in sectoral spread can be seen since last year. The wide range of ICP prices remains, as does the small minority of companies implementing ICPs at prices needed to meet the temperature goals of the Paris Agreement.

TYPE AND USE OF ICP

Of all companies publicly disclosing to CDP[xliii] in 2021, 16% reported that they had already implemented an ICP, and a further 19% indicated that they have plans to implement such a price in the next two years. Of the companies that publicly disclosed to CDP in both 2020 and 2021, there has been a 16% increase in the number reporting the use of an internal carbon price.

The motivations for implementing an ICP remain consistent with previous years, with stimulating low-carbon investment and driving energy efficiency the most frequently cited drivers. The type of ICP used also reflects previous years, with shadow pricing—where companies apply an assumed cost to emissions associated with a given investment or project, in order to better understand their climate impacts—still representing by far the most common type of price applied.

ICP ACROSS SECTORS AND GEOGRAPHIES

The uptake of ICPs across geographies shows no major change, with Europe and Asia and Pacific continuing to host the highest number of companies reporting the use of an ICP. The past year has, however, seen a change in sectoral trends, with the service sector overtaking the energy sector as the industry with the highest number of companies implementing an ICP.

PRICING

Reported ICPs range anywhere between USD 0.8 and USD 6,000/tCO_2e. The majority, however, remain below the USD 50–100/tCO_2e price that leading economists say is needed to meet the temperature goals of the Paris Agreement. Of the approximate 950 companies disclosing their ICPs to CDP, 68% currently implement a price of USD 50/tCO_2e or below, and a further 18% implement a price between USD 50 and USD 100/tCO_2e. Fewer than 100 companies disclose that they are currently implementing a carbon price of over USD 100/tCO_2e.

xliii See CDP website for further details: https://www.cdp.net/en

FIGURE 13A
Type and use of internal carbon pricing, based on data from CDP

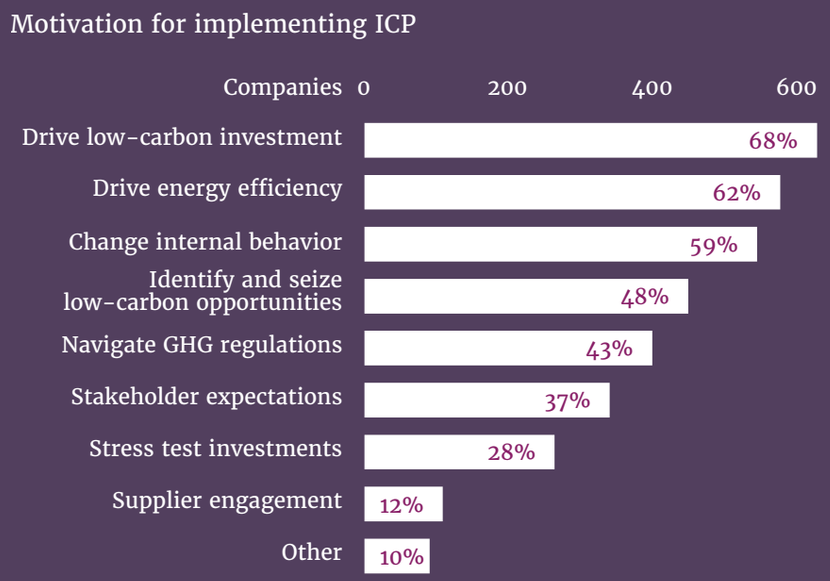
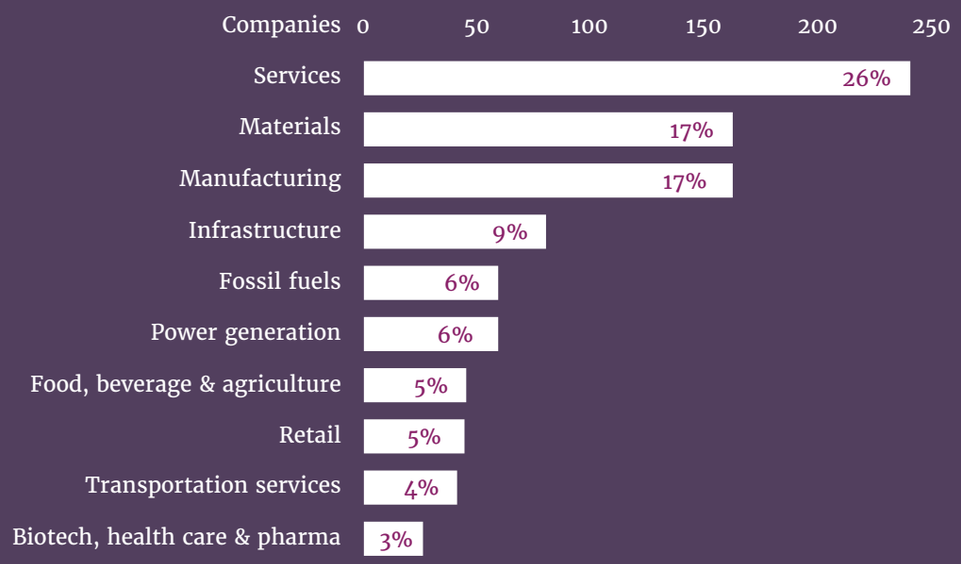


FIGURE 13B

Uptake of internal carbon pricing, based on data from CDP

Uptake across sectors



Uptake across geographies

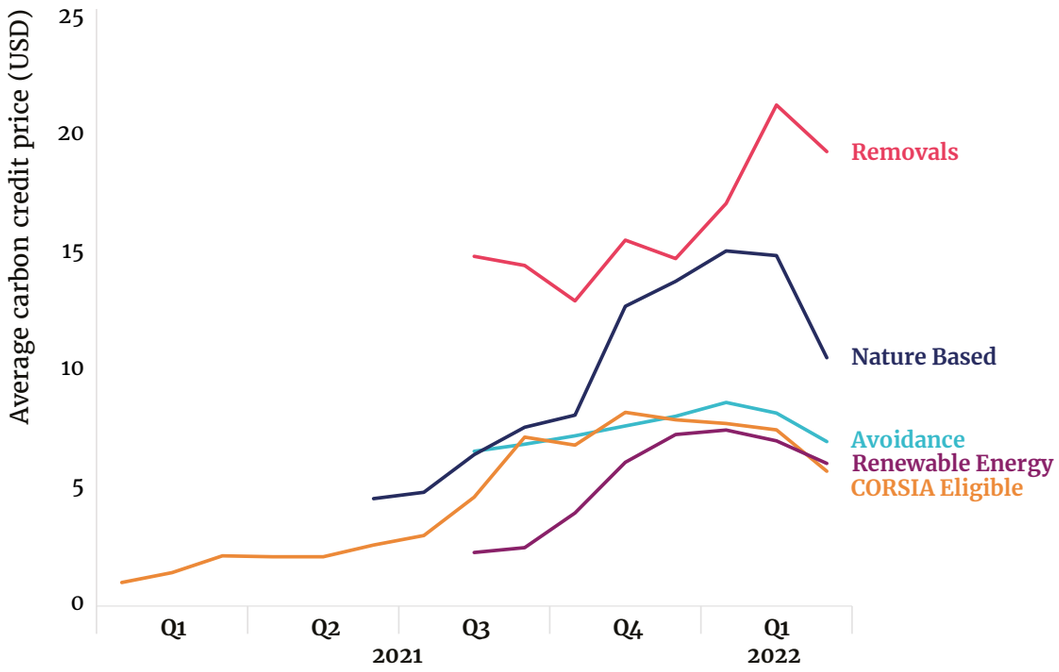
3.3 CARBON CREDIT MARKET GROWTH IS UNEVEN, REFLECTING DIVERSE BUYER PREFERENCES

Demand preferences and buyers' needs continue to incentivize a spectrum of alternatives for carbon credits with differentiated prices across project types, geographies, and co-benefits. A highlight this year is the increased interest in forest and land use-based credits.

Carbon credit prices have risen sharply, though prices continue to vary across different types of credits. The market for credits from independent crediting mechanisms is heterogeneous, with buyers placing a range of values on characteristics such as the sector (e.g., type of activity), geography, age/vintage, and co-benefits of credits. While recent years have seen some moves toward offering standardized contracts (see section 3.4), prices vary widely, with trading platforms offering contracts representing credits from different sectors. For instance, assessments by S&P Global Platts suggest that removal-based credits were priced well above credits from renewable energy-based projects (see Figure 14).

FIGURE 14

Prices of standardized carbon credit contracts[xliv]



xliv Source: Based on data from S&P Global Platts, 2022 by S&P Global Inc.

CORSIA eligible reflects carbon credits eligible for the International Civil Aviation Organization's CORSIA program (**Platts CEC** assessment).

Renewable energy reflects renewable energy carbon credits that avoid GHG emissions (**Platts CNR** assessment).

Nature based reflects nature-based carbon credits from projects that either avoid or remove GHG emissions (**Platts CNC** assessment).

Avoidance is a basket assessment that reflects carbon credits from projects that avoid GHG emissions. This includes the Platts Household Devices, Platts Industrial Pollutants, and Platts Nature-Based Avoidance assessments (**Platts CAC** assessment).

Removals is a basket assessment that reflects carbon credits from projects that remove GHG emissions from the atmosphere. This includes the Platts Natural Carbon Capture and Platts Technological Carbon Capture assessments (**Platts CRC** assessment).

More detail about the Platts' different assessments can be found in Platts' Specification Guide: https://www.spglobal.com/commodityinsights/PlattsContent/_assets/_files/en/our-methodology/methodology-specifications/method_carbon_credits.pdf.

The demand for removal-based credits is causing prices for these units to rise. High demand driven by the special role removals are set to play in meeting net zero targets[xlv] and technological feasibility challenges that limit current supply likely explain the high price assigned to removal-based credits. According to S&P Global Platts, despite a 9% fall in price between February and March 2022,[xlvi] removal-based credit prices increased by 48% in the past six months, rising to USD 19/credit in March 2022, whereas credits that reduce or avoid emissions were sold for only 40% of this price (see **Figure 14**).

However, increasing interest in removals has not yet translated into high transaction volumes. According to Ecosystem Marketplace, in 2021 the traded volume of credits from reduction-based projects in the voluntary carbon market was 21 times higher than the traded volume of credits from removal-based projects. Two factors likely explain the market dominance of reduction-based carbon credits. First, information on removal-based credit transactions may not be available or recorded in the market, as companies are starting to develop these projects themselves (see **section 3.4** for more detail). Second, it is possible that supply of removal-based credits is currently limited due to the long lead times for these projects to produce credits. Companies are also facing difficulties finding carbon credits from medium- and long-term removal projects, which guarantee that emissions will be stored for more than 100 years.[111]

Forest and land use credits are closing the gap on renewable energy credits in terms of credit issuance. Carbon credit issuances from forestry and land-use projects increased 159% over the past year, accounting for more than a third of total credit issuances in 2021.[xlvii] Around 70% of these credits were generated in Asia, primarily in Cambodia, Indonesia, and China, with most of the remainder generated in Latin America, led by projects in Brazil and Peru. Although most of these credits come from projects to avoid emissions from deforestation and land use conversion, projects to remove atmospheric emissions (such as afforestation, carbon sequestration in agriculture, and improved forest management) contributed to a fifth of this growth. While forest and land use credits have long been at the center of polarized debates regarding additionality, permanence, and baseline accuracy,[112] these projects are gaining popularity as more buyers adopt net zero targets that depend on removals to neutralize the emissions that cannot be reduced. However, moratoriums on the development of carbon projects, such as the moratorium on Reducing Emissions from Deforestation and Forest Degradation (REDD+) projects in Papua New Guinea[113] and the moratorium in Fujian Province in China issued on NbSs,[114] have raised concerns that other regions will follow suit, shrinking supply and causing price surges. Renewable energy credits remain, by a small margin, the most abundant credits in the market. They also offer some of the cheapest prices.[115] The two major independent crediting mechanisms (Verified Carbon Standard and Gold Standard) have since 2020

xlv Net zero is taken to be as per the Intergovernmental Panel on Climate Change definition: "human activities to result in no net effect on the climate system would require balancing residual emissions with emission removals."

xlvi According to market observers, this price drop might be attributed to the uncertainty faced by the beginning of the war in Ukraine. More recent data suggest that, as of April 2022, prices of nature-based carbon credits have started to rebound. See R. Manuell, M. Tilly, and S. Reklev, "VCM Report: Nature-based VERs Continue Rebound after Bearish 'Blip' in March," Carbon Pulse, April 11, 2022.

xlvii Forestry and land-use project types include afforestation/reforestation, avoided deforestation, improved forest management, avoided conversion, reduced emissions in agriculture, carbon sequestration in agriculture, and wetland restoration. Climate Focus, "The Voluntary Carbon Market Dashboard," 2022,

only accepted registrations of new large-scale renewable energy projects located in least developed countries due to these projects elsewhere not requiring carbon finance to be economically feasible. Still, several projects registered before this date have since increased their issuances substantially.[xlviii]

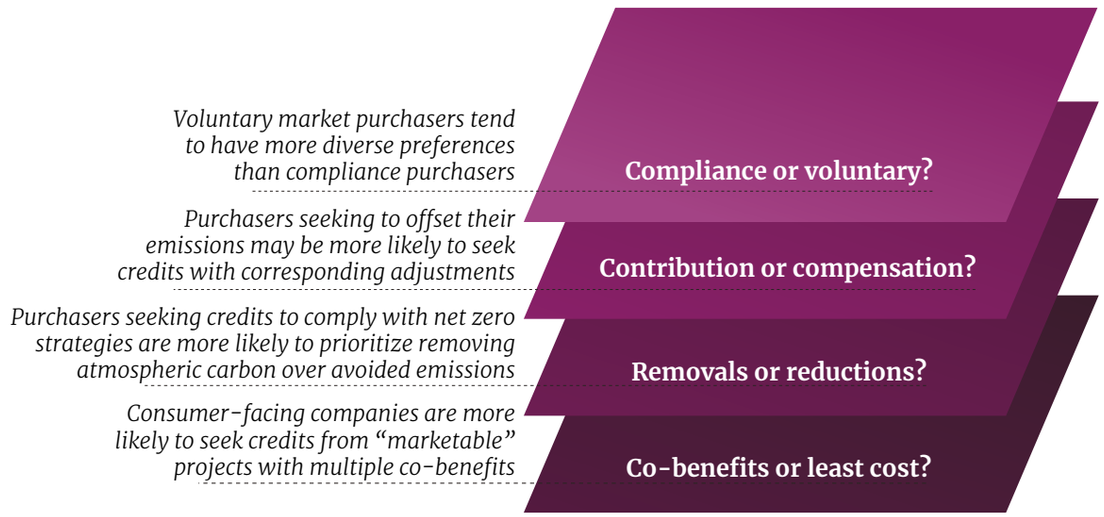
Projects in Asia, Latin America, and the Caribbean have supplied the majority of carbon credits. According to Ecosystem Marketplace, traded volumes of credits from projects located in Asia more than doubled in the past year, representing 56% of the total credits transacted in the market in 2021 due to volumes of renewable energy and forestry and land use credits, predominantly from Cambodia and Indonesia. Although credits from Asia have offered the lowest prices, these increased from USD 1.60/tCO_2e in 2020 to USD 2.97/tCO_2e in 2021.[116] Credits transacted from Latin America and the Caribbean accounted for 22% of total trade, dominated by forestry and land use credits. Credits from Africa represented 15% of the total, with transacted volumes of credits from the region reaching their highest levels yet, with prices also increasing from USD 4.24/tCO_2e in 2020 to USD 6.09/tCO_2e in 2021.[117]

Market heterogeneity is increasing, fueled by the diverse preferences and needs of buyers. In the context of significant growth in voluntary commitments and increasing diversity of buyers with different priorities and reasons for purchasing credits, voluntary buyers' purchasing decisions are likely to be increasingly heterogeneous, with different buyers prioritizing price, quality, integrity, and other characteristics differently. Buyers' options in international compliance markets are, for the most part, more limited because of the requirement to source only carbon credits with a corresponding adjustment. **Figure 15** illustrates the main purchasers' decisions shaping the market.

The market is evolving to highlight other benefits of credits beyond GHG emissions mitigation and to develop tools to verify them. For example, some co-benefits that purchasers value relate to whether the underlying project contributes to achieving one or more of the Sustainable Development Goals (SDGs). Credits with SDG benefits are attractive to buyers as they offer an opportunity to make additional contributions to sustainable development and for those contributions to be recognized in the social and economic agenda. From project developers' perspective, such credits increase the potential to obtain price premiums in the market. This market dynamic is reflected in the price increases for credits from project types considered to offer broader co-benefits, including forestry and land use and household energy efficiency project types, such as improved cookstoves.[118] Verifying these co-benefit claims is important, and there are increasing efforts to develop tools to validate them in an objective manner. Some efforts seen in the market include AirCarbon's Sustainable Development Token,[xlix] Verra's Sustainable Development Verified Impact Standard program,[119] and Gold Standard's SDG Impact Tool.[120]

FIGURE 15

Multilayered purchaser decisions shape diverse markets and prices



xlviii However, projects validated and submitted for project registration prior to December 29, 2019 are still eligible under the VCS for their full crediting periods.

xlix Each SDT represents a carbon emission unit accompanied by additional certifications or registry approved labels for sustainable development benefits that have been reviewed by third parties: AirCarbon, "Exchange Tradable Assets."

3.4 NEW FINANCIAL SERVICES AND TECHNOLOGIES ARE ENTERING CARBON CREDIT MARKETS

Rapidly growing credit demand is encouraging new players to enter the market and forcing market players to find creative ways to adapt to new dynamics. At the same time, the market's fragmented and decentralized nature continues to raise challenges in ensuring transparency and liquidity.

The role of financial actors in carbon credit markets has grown considerably in the past year. Financial actors are increasingly involved at the implementation phase of carbon projects, providing capital and risk-hedging mechanisms to project developers who previously had to rely primarily on equity and grants for their upfront investments.[121] Financial players are also increasingly acting as intermediaries for voluntary carbon credits transactions. In recent years, the institutional landscape of carbon credit markets has changed significantly with the creation of new carbon exchanges, the merger of preexisting ones,[122] and the entry into the market of other financial entities—such as commodity exchanges or banks—that were not originally linked to carbon markets.[123] These new players provide a range of services including trading platforms, derivatives, and carbon quality standards. This fundamentally changes the nature of transactions by introducing new mechanisms for price determination. The prices of standardized contracts are increasingly used as benchmarks, companies have begun to develop price assessments for different types of carbon credits,[l] and portfolio auctions for carbon credits have emerged.[li]

New players and financial services are moving the carbon credit market toward greater standardization, raising both opportunities and challenges. Transaction data from standardized contracts[lii] are scarce and scattered, making it difficult to assess their real importance in the market. While over-the-counter transactions remain the norm in carbon credit markets, available indicators suggest that, in recent years, standardized transactions have grown significantly. For example, in 2021 the total volume of carbon credits traded on one of the major carbon exchanges, the Xpansiv CBL exchange, exceeded 121.5 million, an increase of 288% from 2020.[124] The supply of standardized contracts has also diversified. For example, exchanges are increasingly offering standardized contracts that ensure compliance with quality criteria for nature-based, energy, or household device carbon projects. Greater standardization can bring more transparency and liquidity by facilitating the generation of accurate market data. However, it also increases the risk of various projects being lumped together under a larger type of contract, thus blurring the differences between them. Finally, greater standardization would also open the door to speculative practices that could ultimately be a major driver of carbon credit market growth but also volatility.[125]

Trading dynamics are changing, led by companies with long-term commitments seeking ways to secure future offsetting needs. In 2017, volumes of credit retirements were similar to reported volumes for transactions, but two years later reported transaction volumes were nearly 40% higher than retirement volumes. In 2021, reported transaction volumes were 129% higher than retirement volumes.[126] In a rising price context, this growing difference between transaction and retirement suggests that buyers are increasingly moving toward long-term buying to secure future needs or resell at a higher price later. One would expect the price and the volume of forward contracts traded to reflect this transition toward long-term buying. However, this is not the case: Available market data from Ecosystem Marketplace suggests that spot contracts still dominate the market, with nearly six times more volume traded than forward contracts, and forward contracts remain slightly cheaper than spot contracts (USD 3.57 and USD 4.08, respectively, as of the third quarter of 2021).[127] One reason for this might be that currently available market data do not capture specific types of deals that involve future purchases. In such deals, big corporations partner with project developers and provide capacity and upfront investment in carbon projects to secure future carbon credits and eventually sell extra credits to make a profit. For instance, in late 2021, multiple joint ventures between capital providers and developers announced the development of new nature-based projects, with some representing large financial values and issuance volumes.[128]

l See for instance S&P Global, "Platts Carbon Credit Assessments"; and Nasdaq's recently launched carbon removal indexes: Nasdaq, "Nasdaq Launches World's First Carbon Removal Indexes," March 24, 2022.

li For example, in November 2021, the global carbon credit exchange and marketplace Climate Impact X (CIX) conducted a first-of-its-kind portfolio auction of voluntary nature-based carbon credits: DBS, "CIX Completes First-of-its-Kind Portfolio Auction of Voluntary Nature-based Carbon Credits with Leading Global Companies," November 4, 2021.

lii Standardized contracts refer to transactions involving packages of carbon credits with certified common characteristics (project type, vintages, and/or issuing standards) and sold as standard products by carbon exchanges. Standardized contracts can be distinguished from (nonstandardized) over-the-counter transactions.

The development and diffusion of new technologies, in particular blockchain-related technologies, is shaping trading practices in carbon credit markets. While the mobilization of blockchain has gained traction in recent years, the past year has seen the emergence of a new phenomenon with efforts to make carbon credit markets interoperable with decentralized finance. Decentralized finance allows peer-to-peer financial transactions without third parties, enabled by cryptocurrency, smart contracts, and other digital technology innovations.

While the use of these technologies in carbon credit market transactions will likely continue to grow, it is critical to understand and address the potential risks before they are fully embraced. The deployment of these new technologies has the potential to help scale up the carbon credit market and break down silos between registries while providing traceability, liquidity, security, and trading efficiency. However, they may also provide opportunities for destabilizing speculative practices and add an additional layer of complexity in a market that is already intensely fragmented.[129] In compliance markets, these technologies are also being explored to ensure that emission reductions or removals are accounted for properly, avoiding "greenwashing" activities outside this market. Nevertheless, these new practices have gained traction and attracted the attention of major carbon credit markets players. While the use of blockchain-based structures for compliance markets has been increasingly explored for some years now,[130] the International Emissions Trading Association has recently formulated a set of initial recommendations and launched a Task Force on Digital Climate Assets to explore and work on guidelines for blockchain-based carbon markets.[131]

The automated processes embedded in blockchain networks encourage rapid, but not always smooth, technological and financial innovation. Digital infrastructure projects like the Toucan Protocol have provided a one-way "carbon bridge" for tokenizing carbon credits, by buying and retiring more than 18 million credits from the Verra registry while issuing new (notionally equivalent) on-chain assets called "Base Carbon Tonnes." In turn, tokenization through the Toucan Protocol has enabled efforts such as KlimaDAO, a decentralized autonomous organization aiming to accelerate price appreciation of carbon assets. Within weeks of its launch in November 2021, KlimaDAO acquired over 9 million tokenized carbon assets,[132] but triggered controversy within its developer and user community after bridging[liii] verified carbon units from a project type that was discredited in the early 2010s, a hydrofluorocarbon destruction project in Yingpeng, China.[133]

liii Bridging refers to the process of retiring a carbon credit on the originating parent registry and creating an un-duplicable digital representation of that credit through a blockchain-based process.

BOX 9

What is tokenization?

Tokenization is the process by which an issuer creates a digital representation of something of value on a distributed ledger or blockchain, which represents either digital or physical assets. Tokens can only be sold or transferred by their owners, ensuring they represent unique and unforgeable representations. Tokens may also confer governance rights to users, dictating how they should be used and what type of information should be encoded with them. Many blockchain platforms have developed standards to help ensure interoperability across platforms and tools, as well as to promote security properties of the token. Carbon tokens can incorporate provenance data and information about how the token may be used or traded, which has been provided by the issuer.

If tokens are created through a standardized process, their increased accessibility can improve traction and support overall market liquidity. Information about the movement of carbon tokens as they are traded can be made visible and tracked, including when the token is retired and can no longer be transacted. In this context, when a token is marketed as providing the impact a carbon credit represents (i.e., a GHG reduction or removal) it must be independently verified against a set of rules and requirements. This process aims to guarantee that any token billed as reducing or offsetting GHG emissions has all fundamental attributes of carbon credits, such as namely real, additional, permanent, robustly quantified, independently verified, or uniquely claimed.

The entrance of new financial services and technologies into carbon credit markets has drawn criticism, resulting from the perceived potential to obscure integrity and quality in decentralized carbon markets. A number of efforts, including the World Bank's Climate Warehouse initiative, are aiming to demonstrate the viability of decentralized approaches to connecting carbon markets, while

enhancing transparency and trust.[134] In addition, blockchain technology companies are attempting to improve the perceived quality of credits brought to the chain by restricting access to old vintages[135] and emitting tokenized units following specific quality criteria.[136] Some public registries have suggested that simply issuing a token does not confer legal rights to the underlying credit or impact that a token is stated to represent.[137] For instance, the Gold Standard Registry stressed that the registry of the standard that issued the credit is the "source of truth" for the status of that credit.[138] In addition, it highlighted that any secondary market, blockchain-based or otherwise, needs to comply with the issuing standard's terms and conditions to ensure legal ownership of the credit and communicate any change in status of the credit back to the registry[139]—a statement echoed in IETA's recommendations on the use of digital climate assets.[140]

3.5 THE GOVERNANCE OF CARBON MARKETS CONTINUES TO EVOLVE

Governance frameworks are emerging that seek to promote integrity and clarity in an increasingly complex and diverse market. These come alongside the adoption of rules under Article 6 of the Paris Agreement.

Six years after Paris, at COP26, attending nations agreed on the modalities, procedures, and guidelines for implementation of carbon markets under Article 6 of the Paris Agreement. These rules represent a major milestone, creating a path for international carbon markets to contribute to meeting NDC goals and support scaling up climate ambition through voluntary cooperation. The share of parties indicating planned or possible use of voluntary cooperation mechanisms under Article 6 has nearly doubled, from 44% to 87% in the new or updated NDC submissions.[141] According to an analysis carried out by IETA, implementing NDCs cooperatively rather than independently through Article 6 could save governments more than USD 300 billion per year by 2030.[142] Some countries have already initiated procurement of emission reduction credits in this context. The Article 6 rules agreed upon in Glasgow explicitly embrace the diversity of carbon markets. Under the new rules, governments will be able to decide the type of projects that will be developed in their countries and have control over whether to authorize the emissions reductions from those projects (see **Box 10**). This decision is likely to lead to further divergence in approaches, credit types, and prices.

BOX 10

The finalized Article 6 Rulebook provides room for flexibility in voluntary transactions

The finalized Article 6 rules provide flexibility to project host countries in how voluntary carbon market transactions can take place. These may range from not requiring corresponding adjustments for using carbon credits for voluntary commitments to a blanket requirement for Article 6 authorization and thereby the application of a corresponding adjustment for any carbon credit that is transferred out of the jurisdiction.

A number of countries have already committed to the principle of correspondingly adjusting carbon credits certified under independent standards and used by corporate actors for voluntary climate commitments, led by a group of countries that signed on to the San José Principles.[liv] Some countries have also already committed to applying corresponding adjustments for individual projects,[lv] although such commitments do not represent a streamlined country strategy for corresponding adjustments yet. Other countries have been reluctant to commit to corresponding adjustments for credits used in the voluntary carbon market.

liv The San José Principles Coalition recommitted after COP26 to Principles for High-Integrity Carbon Markets, including to corresponding adjustments for all compliance uses, as well as applying corresponding adjustment to support voluntary corporate climate commitments. The endorsers include Colombia, Costa Rica, Fiji, Finland, Marshall Islands, Peru, and Switzerland.

lv Including Nepal and Rwanda.

How purchasers and host governments prioritize corresponding adjustments will significantly shape market transactions of carbon credits. Some governments may be predisposed to absorb as many of the lower-cost emission reduction opportunities for their own NDCs before allowing corresponding adjustment for carbon credits from independent standards and exporting the abatement outcome. On the other hand, focusing on hosting projects without corresponding adjustments would allow governments to leverage voluntary commitments and attract investments to help achieve their NDCs, though these credits may be less attractive to buyers.

Given the capacity and information needs for host countries, project developers, and carbon credit buyers to adapt to new Article 6 infrastructure, it will take time for Article 6 to become fully operational. For project host countries, developing an international carbon credit market strategy requires extensive knowledge, capacities, and infrastructure to understand how participation in the international carbon market contributes to achieving their mitigation targets. For project developers, the emerging context of fragmented and interacting markets means that they need to deal with different strategies and requirements in different host countries. Securing a commitment to corresponding adjustments from host countries for their projects may require an extra step, which may imply longer timelines for project development and implementation. A number of project developers have already secured such a commitment to corresponding adjustments from host country governments in which their projects are situated.[lvi]

The flexibility provided by the Article 6 rules gives the voluntary carbon market more scope to scale quickly, but carries risks. Unless consumers and investors can navigate terminology and differentiate project claims, the market's flexibility could facilitate greenwashing.[143] The different bifurcations may create additional uncertainty for buyers on identifying which credits or offsets they can credibly claim among their climate commitments. Inconsistent claims on the role and legitimacy of credits may confuse and discourage potential voluntary purchasers, especially retail customers, which could cloud transparency and dampen demand.[144] Many observers, particularly institutional investors, still prefer a more uniform carbon credit market, to minimize inefficient fragmentation and consolidate liquidity around a smaller set of commonly understood credit types.[145] Getting the balance right will be a major determinant of the long-term scale and success of carbon markets.

Despite the consensus that carbon credits will play a role in corporate decarbonization, their role must also balance the need for direct action by businesses to reduce emissions. A recent analysis of net zero targets found that headline targets are often ambiguous, emission reduction commitments are limited, and corporate plans to offset their emissions are quite controversial.[146] The research pointed to, among others, major oil companies claiming fossil-based activities as carbon neutral by relying on carbon credits. Some environmental groups are pushing for governments to set stronger regulations on the demand side to encourage corporations to invest in innovation and accelerate decarbonization. Civil society and consumers are increasingly examining the carbon neutrality claims of corporates and in some cases filing lawsuits citing misleading claims, such as the case of Arla's carbon neutrality claim reported by the Swedish Consumer Agency.[147]

There remain significant debates about how to ensure the quality and integrity of carbon credits. The fundamental challenge is that the climate benefits from carbon credits can only be estimated against a reference scenario, never observed.[148] Ensuring integrity requires a strong additionality case—which is extremely difficult to operationalize across project types—and robust and conservative baselines and quantification of emission reductions or removals. For example, concerns[lvii] have been raised regarding ICAO's recent acceptance of High Forest Low Deforestation (HFLD) credits under the Architecture for REDD+ Transactions standard as eligible for CORSIA.[149]

A range of initiatives are emerging to address ongoing integrity concerns by guiding the supply and demand toward high-integrity credits and net zero strategies. This includes the Integrity Council for the Voluntary Carbon Market, a private-sector-led initiative working on scaling up the transactions for voluntary commitments by promoting high-quality credits and standardization of contracts to improve liquidity.[lviii] The Integrity Council for the Voluntary Carbon Market's Phase II report contains guidance for establishing a global governing body for voluntary carbon transactions, standardizing the legal framework for the market, and implementing core carbon principles for credit integrity.[lix]

lvi These include Atmosfair, a German nongovernmental organization, which signed deals with Nepal for corresponding adjustments for credits from its projects. Atmosfair, "Government of Nepal and German NGO Atmosfair Agree on Landmark CO2-offset Cooperation," October 29, 2021.

lvii HFLD represents jurisdictions with extensive forests and historically low levels of deforestation. In this case, concerns are focused on the challenges of proving additionality and setting credible baselines where countries have only experienced limited amounts of deforestation in the past.

lviii The Integrity Council was formed in October 2021 based on the initial work of the Taskforce on Scaling Voluntary Carbon Markets in 2020-2021. It released its Phase II report in 2021.

lix The IC-VCM is the new governance body convening government, financial markets, NGOs, science, academia, civil society, business, and local communities with the aim of setting and enforcing global standards for the voluntary carbon market. Phase II of the Taskforce on Scaling Voluntary Carbon Markets informed the formation of the Integrity Council. Taskforce on Scaling Voluntary Carbon Markets, Phase II Report, July 8, 2021.

BOX 11

Article 6 Activities

Operationalization of the Article 6 market is highly dependent on the readiness of participants. The adoption of the Article 6 Rulebook at COP26 has provided greater certainty on the applicable rules, and provided the clarity on the capacity, infrastructure, and system requirements that are needed to support strategic engagement and transactions under Article 6. The importance of building Article 6 readiness is reflected in the COP26 decision and the subsequent UNFCCC Secretariat work program to design and implement a capacity-building program for developing countries that wish to participate in Article 6.

While no ITMOs have been transacted to date, countries looking to become Article 6 hosts have started to develop their engagement strategies and needed processes, including for ITMO authorizations, with potential buyer countries participating in Article 6 transactions. Today, Article 6 readiness activities focus on strengthening participants' capacities, developing policy frameworks, and building the necessary infrastructures for Article 6 transactions. Examples include

- the work of the Global Green Growth Institute to support countries in designing policy and governance frameworks for engaging in Article 6 transactions,[lx] completing transactions from scalable projects and programs,[lxi] and developing approaches to foster private sector engagement;[lxii]
- the World Bank's Partnership for Market Implementation support to develop infrastructures, strategies, and policy frameworks for countries' participation in international carbon markets;
- the UNDP's country support to develop Article 6 regulatory frameworks and the establishment of ITMO process flows;
- Japan's funding capacity building for participating in the Joint Crediting Mechanism (JCM); and
- the West African and Eastern Africa Alliances on Carbon Markets both continue to support countries in their regions to create an enabling environment for Article 6 collaboration.

Article 6 activities are steadily moving closer to transactional stages and potentially offer an opportunity to test different contractual structures. And while no blueprints or templates for Article 6 transactions have yet fully emerged, bilateral collaboration frameworks that have been developed to date typically include similar elements such as a commitment to apply corresponding adjustments and reporting modalities. Several agreements, in different shapes and forms, have been formalized by countries throughout 2021.[150,151]

In parallel, early movers have started to design mitigation outcome purchase agreements, which set out commercial arrangements around prices, payment structures, and delivery modalities for Article 6 transactions. It is proving challenging to translate Article 6 transaction structures into contracts, for example linking or conditioning payments for mitigation outcomes to the application of corresponding adjustments and managing and allocating transaction risks. Contractual options continue to be theoretical and poorly understood. Stakeholders also struggle with a lack of information on opportunity costs for meeting NDCs in the future.

Recognizing that Article 6 rules at COP26 permit countries to authorize ITMOs for use in voluntary carbon markets, independent crediting standards such as the Gold Standard are getting more engaged in Article 6 activities and are taking steps to facilitate Article 6 transactions. This includes, for example, adapting their registry systems and improving overall transparency and trackability of credit transactions linked or not linked to a corresponding adjustment. The recent partnership announcement by the Swedish Energy Agency and Gold Standard, under which the Swedish Energy Agency will use adapted Gold Standard rules, framework, and infrastructures to facilitate its Article 6 transactions,[152] is an example of the blurring lines between the voluntary and compliance markets.

lx The Designing Article 6 Policy Approaches program is supported by and implemented together with the Norwegian Ministry of Climate and Environment and looks to develop programs in Indonesia, Morocco, Vietnam, and Senegal.

lxi The Mobilizing Article 6 Trading Structures program is supported by and implemented together with the Swedish Energy Agency. Activities are currently underway in Cambodia and Nepal.

lxii The Supporting Preparedness for Article 6 Cooperation is supported by and implemented in collaboration with the International Climate Initiative, and expected to start in 2022. The program anticipates implementing more than eight Article 6 pilot programs across Colombia, Pakistan, Thailand, and Zambia.

In addition, the Voluntary Carbon Market Initiative, a multistakeholder initiative developed to drive credible engagement with the crediting market, released initial guidance for aligning the voluntary carbon market with the Paris Agreement's goals and for maintaining market integrity from the demand side. Priorities include providing robust approaches to set companies' targets, defining claims, and using high-integrity credits.[153] These initiatives are sharpening recommendations on promoting higher integrity offsetting claims, including which types of credits can be used for which types of claims.

Several governance initiatives that offer carbon credit quality assessments are beginning to emerge.[lxiii] For instance, the World Wildlife Fund, the Öko-Institut, and the Environmental Defense Fund launched the Carbon Credit Quality Initiative, which aims to deliver an interactive web application for scoring carbon credit quality. Private companies such as BeZero, Sylvera, and Calyx Global are providing similar services. The World Bank provides an assessment framework for assessing differing qualities of mitigation activities in four areas—environmental integrity, management entity, financial structure, and sustainable development benefit.[154] Along with initiatives rating the quality of carbon credits, this will likely see credit pricing linked to whether credits meet a given set of quality standards.

Another set of initiatives is supporting companies in setting and meeting their climate targets and increasing their ambition while setting specific rules on how carbon credits can be used for compliance. Examples include the Climate Action 100+, Transform to Net Zero, the Climate Pledge, and the UN Race to Zero. Over the past year, the Science-Based Targets Initiative (SBTi), a multistakeholder initiative developed to promote best practice in corporate climate target setting in line with climate science, saw considerable progress. In July 2021, the initiative published its Corporate Net Zero Standard, which specifies restricted scenarios in which the use of carbon credits will be accepted for meeting net zero targets.[lxiv] It also announced upcoming changes to its definition of "science-based," which will change from 2°C or below to 1.5°C or below. Starting in June 2022, the initiative will no longer accept target submissions that fall below this level, in a bid to drive up ambition. Despite these positive developments, the SBTi came under criticism from civil society voices and companies for a range of transparency and methodological issues in 2021, including concerns that its target-setting approach may not align with global temperature goals.[155]

Based on this guidance, an increasing number of companies are seeking to demonstrate their climate ambition. Globally, just under 2,500 companies worldwide have now signed up to the SBTi, and just under half (1,155) have approved science-based targets.[156] By the end of 2021, following the SBTi's updated guidance and its "Business Ambition for 1.5°C" campaign, 1.5°C-aligned targets were the most common target type submitted by the corporate sector, accounting for 75% of all targets submitted throughout the year. Although many of the net zero targets announced by different groups are less ambitious than the Paris Agreement requires, overall 1,045 companies representing USD 23 trillion in market capitalization have committed in the past year to set targets that align with a 1.5°C pathway.[157]

Several groups are prioritizing the role of removals versus reductions for limiting global warming to 1.5°C and achieving net zero; however, the deployment of certain removal technologies at the time and scale needed has not yet occurred. Initiatives such as the Oxford Principles for Net Zero Aligned Carbon Offsetting and the SBTi have encouraged companies to prioritize offsets that remove carbon from the atmosphere (for instance through reforestation or direct air carbon capture) over reduction-based offsets that derive from efforts to prevent extra carbon emissions entering the atmosphere. However, as described in section 3.3 meeting this demand is challenging due to limited supply and the difficulty in guaranteeing the permanency of those emissions underground in the long term. Supplying removal-based credits based solely on new technologies such as direct air capture still has prohibitive prices, up to USD 600/tCO_2 sequestered.[158]

lxiii Some of these initiatives are relatively new and are still in the pilot stage, and only a few have publicly disclosed their assessment methodology.

lxiv The standard specifies that the only instance in which the use of offsets will be accepted is to compensate residual emissions that lie outside the scope of a company's science-based and net zero targets. The guidance restricts the use of offsets by companies for compensation purposes that replace direct emission reduction activities.

Annex A

Methodologies and sources

1. **Sources and timelines:** The State and Trends of Carbon Pricing 2022 report draws on a range of sources, including official reporting (i.e., government budget documents), related legislation that underpins the carbon pricing initiative, statements from governments and public authorities, and information provided by jurisdictions. Data and updates in the report represent the situation as of April 1, 2022, unless stated otherwise.

2. **Carbon pricing instruments:** The authors recognize that classifications of carbon pricing instruments other than those used in this report are possible. "ETS" refers not only to cap-and-trade systems but also to baseline-and-credit systems.

3. **Emissions:** Information on GHG emissions is based on 2018 EDGAR v6.0 GHG emissions data,[159] where available, or 2018 emissions data from official sources to be consistent across jurisdictions.
   - GHG emissions values for Canadian provinces and territories are taken from Canada's submission to the UNFCCC.[160]
   - GHG emissions values for US states are based on official subnational GHG inventory reports of each of the respective states.

4. **Coverage:** The proportion of global GHG emissions covered by a direct carbon price is calculated based on direct carbon pricing instruments in operation. The calculation of emissions coverage by carbon pricing instruments is based on official government sources but does not necessarily factor in exemptions and/or emissions thresholds.

5. **Status of carbon pricing instruments:** Carbon pricing instruments are considered "scheduled for implementation" once they have been formally adopted through legislation and have an official, planned start date. Carbon pricing instruments are considered "under consideration" if the government has announced its intention to work toward the implementation of a carbon pricing initiative and this has been formally confirmed by official government sources.

6. **Price:** Additional price information is further clarified here:
   - As Mexico is currently operating its pilot ETS with 100% free allocation, there is no price information currently available.
   - Massachusetts ETS price data is equal to the March 18, 2022 auction clearing price.[161]
   - California and Québec cap-and-trade price data is the California Carbon Allowance Vintage 2022 Futures for April on April 1, 2022.[162]
   - RGGI price data is the weighted average of the allowance transfer transaction prices on March 31, 2022 for 01/01/2021-12/31/2023 allowance control period converted from USD/short tons CO_2e to USD/metric tons CO_2e.[163]
   - UK ETS price data is the UK Allowance (UKA) Futures Price for December 2022 contract on April 1, 2022.[164]

7. **Revenue:** For jurisdictions with fiscal year starting on April 1, the revenue between January 1, 2021 and December 31, 2021 is estimated by the addition of one-quarter of the April 1, 2020–April 1, 2021 revenue and three-fourths of the April 1, 2021–April 1, 2022 revenue estimate. French carbon tax revenue for fiscal year 2021 was not released before the report was finalized. The revenue figure estimate is provided by the French Treasury officials.

8. **Exchange rate conversions**: Price and revenue data are converted from national currency to USD using the IMF exchange rates on April 1, 2022.[165]

9. **2021 ETS price developments:** Price development data is taken from the International Carbon Action Partnership's Allowance Price Explorer, which has up-to-date information on allowance prices in ETSs. The following sources were also drawn upon: California (the California Air Resources Board website), EU ETS (spot price data is provided by the European Energy Exchange group), Québec (the Ministry for the Fight Against Climate Change website), RGGI (RGGI website), Switzerland (Intercontinental Exchange and the Swiss Emissions Registry).

10. **Crediting mechanisms:** In the Republic of Korea's offset crediting mechanism, the number of issued credits refers to credits converted to Korean Credit Units, which can be surrendered for compliance in the national ETS.

11. **Crediting demand data:** Voluntary carbon market data is provided by Forest Trends' non-profit initiative Ecosystem Marketplace. Ecosystem Marketplace data contains trade details such as price, volume, and other carbon credit project and transaction attributes. The dataset for 2021 had not been finalized by the time this report was published and therefore market value figures do not represent a complete annual picture. However, Ecosystem Marketplace's dataset remains the most comprehensive available for the 2021 calendar year. Ecosystem Marketplace will release updated 2021 figures later in 2022 once data from all respondents has been collected.

Annex B

Carbon tax and ETS updates

This section outlines significant developments in regional, national, and subnational carbon taxes and ETSs worldwide. Where no significant changes occurred over the past year, these mechanisms/jurisdictions are not included. For more detailed information on all carbon taxes and ETSs, please refer to the Carbon Pricing Dashboard, an interactive online platform that provides up-to-date information on existing and emerging carbon pricing instruments around the world.

ARGENTINA

The quarterly tax rate update for 2021 was postponed until 2022 for gasoline and gasoil.

AUSTRIA

Austria will implement a carbon levy of of EUR 30 (USD 33)/tCO_2e in July 2022 under its national ETS as part of broader fiscal reforms in the Eco-Social Tax Reform Act 2022 (Ökosoziales Steuerreformgesetz 2022) that also plans to reduce corporate and income tax rates. The national emission trading system covers mainly heating and transportation emissions not covered under the EU ETS.

The rate is planned to rise to EUR 35 (USD 39)/tCO_2e in 2023, to EUR 45 (USD 50)/tCO_2e in 2024, and to EUR 55 (USD 61)/tCO_2e in 2025 during the fixed-price phase. A market phase will follow from 2026, subject to a review in 2024 and considering developments on the EU level.

BOTSWANA

Parliament approved Botswana's National Climate Change Policy during 2021, which establishes a commitment to explore the development of a carbon price, including adopting and enforcing a carbon tax.

BRAZIL

At the end of 2021, the presidency of the Republic released for public consultation a draft law creating the National Policy on Climate Change and Green Growth, which would establish the objectives, principles, and guidelines of a potential carbon pricing instrument.

Two parallel and ongoing processes are considering the implementation of an ETS in Brazil. One is the "Consideration of Environmental Benefits in the Electricity Sector" under Law 14,120/2021, coordinated by the Energy Research Corporation (Empresa de Pesquisa Energética [EPE]) and the Ministry of Mines and Energy, with the support of the International Energy Agency. In workshops organized by the EPE in 2021, stakeholders discussed the possibility of implementing an ETS in the power sector, as well as different design options.

Another process is the discussion of bills at the Brazilian National Congress, including Bill 528/2021. This bill would create the Brazilian Market of Emission Reductions and give the government a period of five years to develop regulations for the national program of emission reductions. One version of this bill, which is currently being discussed, would provide for an ETS in Brazil. In this context, several proposals from the private sector and civil society have also emerged around the establishment of an ETS in the country.

BRUNEI

In 2021, Brunei Darussalam explored a preliminary scoping for carbon pricing which includes an emission threshold as well as targeted sub-sectors. The government also conducted a workshop on carbon pricing policies that aims at shaping the direction for carbon pricing policy in the country as well as learning from the experiences of other countries. The workshop was co-organized by the Brunei Climate Change Secretariat and the ASEAN Centre for Energy with support from the Institute of Policy Studies of the University of Brunei Darussalam.

CANADA

On February 2021, the federal government launched its review of the output-based pricing system (OBPS) regulations. The consultation paper proposes an annual tightening rate of up to 2% for facilities under the OBPS from 2023 (depending on carbon leakage risk). More stringent performance standards are proposed to contribute to Canada's strengthened GHG emissions reduction goals. Proposed amendments are anticipated to enter into force in 2023.

In August 2021, the federal government released updates to its benchmark, which confirms the minimum national carbon prices for the period 2023 to 2030 and strengthens the minimum national stringency criteria for carbon pricing systems in Canada.

The federal Greenhouse Gas Pollution Pricing Act, which sets a minimum national standard on GHG emissions pricing, has been subject to recent court challenges by multiple provinces. On March 25, 2021, the Supreme Court of Canada ruled that the legislation is constitutional.

The fuel charge rates are based on a carbon price of CAD 50 (USD 40)/tCO_2e in 2022. The recent revision to the policy extended the price trajectory up to 2030, with the minimum rate increasing by CAD 15 (USD 12)/tCO_2e each year, until it reaches CAD 170 (USD 136)/tCO_2e in 2030.

TABLE B.1
Carbon pricing developments in selected Canadian provinces and territories

JURISDICTION	RECENT DEVELOPMENTS
Alberta	The fixed-price compliance option under the Technology Innovation and Emissions Reduction Regulation increased from CAD 40 (USD 32)/tCO_2e in 2021 to CAD 50 (USD 40)/tCO_2e in 2022.
British Columbia	On April 1, 2021, BC's carbon tax rate rose from CAD 40 to CAD 45/tCO_2e. The rate is scheduled to increase to CAD 50/ tCO_2e on April 1, 2022. BC recently committed to exceeding the federal backstop rate, which is scheduled to rise to CAD 170 by 2030.
New Brunswick	The New Brunswick OBPS has replaced the federal OBPS in this jurisdiction.
Newfoundland and Labrador	Adjustments to carbon tax rates took effect on July 1, 2021.
Nova Scotia	The current federal approval for the province's carbon pricing system expires after 2022 and Nova Scotia is reviewing options for post-2022 carbon pricing. Nova Scotia held a public consultation in 2021, which covered carbon pricing as well as broader environmental goals and climate change policies.
Ontario	Ontario transitioned from the federal OBPS to the Ontario Emissions Performance Standards program as of January 1, 2022.
Québec	The fourth compliance period began in January 2021 and new regulations took effect, including amended price tiers for allowances in the reserve account, to align with the California Cap-and-Trade Program. For the 2021–2023 period, assistance was adjusted based on each sector's carbon leakage risks. Emissions-intensive trade exposed (EITE) sectors are categorized as having low, medium, or high risk, with assistance factors of 90%, 95%, and 100% respectively. Prior to 2021, assistance factors for all EITE sectors were set at 100%. In early 2021, Québec also announced potential changes to the free allocation rules for the period 2024–2030.
Saskatchewan	Changes to the federal backstop have forced a redesign of Saskatchewan's OBPS. The province is currently developing OBPS 2023, to be implemented on January 1, 2023.

CHILE

Chile's draft Framework Law on Climate Change was approved by the Senate in October 2021 and was passed to the Chamber of Deputies to continue its legislative process. The draft Framework Law defines a system in which the Ministry of Environment would establish GHG emissions limits for individual or groups of emitting sources (in tCO_2e/year).

In December 2021, the Chilean government recommended a carbon tax of at least USD 35/tCO_2 by the end of the decade as part of an updated Energy Policy 2050. The new president-elect proposed a Green Tax Reform including a gradual increase of the carbon tax up to USD 40/tCO_2, but no timeframe was specified.

CHINA

2021 saw China's national ETS complete its first full compliance cycle, with a reported compliance rate of 99.5%. Over 2,100 large emitters in the power sector were obligated to participate during this cycle, covering about 4.5 billion tCO_2e per year—over 30% of China's total GHG emissions. Prices for emissions allowances remain relatively low compared to other pricing systems, closing at around CNY 54.2 (USD 8.5)/tCO_2 on December 31, 2021, the last day of the first compliance cycle.

TABLE B.2
Developments in China's subnational pilots

JURISDICTION	RECENT DEVELOPMENTS
Chongqing	Auctioning was introduced in 2021, with two auctions held at the end of 2021. The first auction, held in November 2021, sold 3.5 million allowances on offer while the second auction in December sold 5.3 million allowances. In addition, from October 2021 liable entities can use carbon credits from the Chongqing carbon offset mechanism to offset up to 8% of their emission liabilities.
Fujian	The Fujian ETS achieved 100% compliance for 2020. The province's first integrated carbon market service platform was launched in December 2021. The Fujian Provincial Department of Ecology and Environment released the latest publicly available detailed allocation plan, for 2020, in October 2021.
Guangdong	The Guangdong ETS achieved 100% compliance for 2020. Power sector entities transitioned to the national ETS after 2020, which was reflected in the 2021 allocation plan released in December 2021. The allocation plan also stated that, from 2022 onwards, the threshold to enter the compliance market will drop from 20,000 tCO_2 to 10,000 tCO_2/year.
Hubei	The Hubei Department of Ecology and Environment released the 2020 allocation plan in September 2021, which included adjustments to the cap to reflect the transfer of power sector entities into the national ETS. Two auctions were held in 2021, with close to 2.8 million allowances auctioned.

Shanghai	Shanghai released its 2020 allocation in January 2021, which reflected the transition of the power sector (including 19 coal-fired power plants) to the national ETS and the addition of 27 new companies, representing a record for the highest number of companies included in the Shanghai regional carbon market since its launch. Auctions were held in August and September 2021, generating a total revenue of CNY 21.59 million.
Shenzhen	The Shenzhen ETS achieved 100% compliance for 2020. In June 2021, the Shenzhen Municipal Bureau of Justice released draft Interim Measures for the Management of Carbon Emissions Trading for public consultation, which included (among other things) a potential transition to an absolute cap and an increase in the number of allowances auctioned.
Tianjin	The Tianjin ETS achieved 100% compliance for 2020. The Tianjin pilot held two auctions in 2021 and sold 3.5 million allowances. In September 2021, the Standing Committee of Tianjin Municipal People's Congress issued the Tianjin Carbon Peaking and Neutrality Promotion Regulations. For the first time, this regulation formally introduces financial penalties for noncompliance in the regional carbon market through high-level regional legislation.

COLOMBIA

Law 2169 of December 2021 established that, as of 2023, half of carbon tax revenues will be used, among others, in coastal erosion management, conservation of water sources, and the protection of ecosystems. The other half of revenues will be used for financing the Program for the Substitution of Illicit Use Crops (Programa Nacional Integral de Sustitución de Cultivos de Uso Ilícito).

The ETS design is currently being analyzed by the government. The Climate Action Law (Ley de Acción Climática), which came into force in December 2021, consolidates the commitments presented in Colombia's NDC and sets a goal to fully implement the ETS by 2030. This law has also set an obligation for legal persons to report direct and indirect GHG emissions, following criteria to be set by the Ministry of Environment and Sustainable Development (Minambiente).

CÔTE D'IVOIRE

Five preliminary studies have been developed on the following topics:

- Benefits beyond climate: Economic co-benefits of carbon taxation in Côte d'Ivoire,
- Proposals for a fiscal bonus-malus mechanism for the promotion of sustainable cocoa in Côte d'Ivoire,
- Fiscal instruments to internalize the environmental costs of solid waste in Côte d'Ivoire,
- Vehicle taxation reform in Côte d'Ivoire: The ecological bonus-malus,
- Environmental taxation in Côte d'Ivoire: Inventory and identification of carbon pricing opportunities.

These studies are expected to be presented and disseminated to local stakeholders in 2022 and the next steps will be informed by feedback provided through this consultation process.

DENMARK

In December 2020, related to the Climate Act, the Danish government announced a Green Tax Reform to achieve Denmark's emissions reduction goal. The reform did not include any provisions on the Danish carbon tax.

EUROPEAN UNION

The European Climate Law entered into force in July 2021, setting new binding EU-wide climate targets for 2030 (55% cut in GHG emissions compared to 1990 levels) and 2050 (net zero emissions), and initiating a process to develop a 2040 target.

As part of the broader package of legislation under the European Green Deal that was announced in 2020, the European Commission put forward a policy reform package to deliver on the European Green Deal and align decarbonization efforts with the updated 2030 climate target.

The package places the EU ETS at the heart of the EU's decarbonization agenda with major changes that include

- an increased linear reduction factor from 2.2% to 4.2%, and a one-off reduction to the cap to be applied retroactively when the legislative process for the revision is concluded;
- the inclusion of the maritime sector into the market's scope from 2023, and a separate fuel ETS for buildings and road transport;
- the introduction of uniform product benchmarks to support breakthrough technologies, more stringent benchmark values, and a provision that would render free allocation conditional on low-carbon investment by the receiving entity;
- the gradual phase-out of free allocation to aviation sector;
- the introduction of a CBAM that prices imported goods based on their embedded emissions from 2026;
- updated parameters of the MSR including a new buffer threshold and an extension of the current intake rate of 24% beyond 2023; and
- new regulations around revenue use to address distributional effects and spur innovation, including the creation of the Social Climate Fund.

The updates, split into several legislative proposals, follow an extensive process that included multiple consultation rounds. The Council and the European Parliament need to agree on their final form before they can take effect.

FINLAND

From January 1, 2019, Finland changed the methodology to calculate the CO_2 emissions for heating fuels and fuels for work machines covered under its carbon tax, whereby full life cycle emissions of the fuels are now included instead of only combustion emissions. To limit the additional tax burden due to this change, the carbon tax rate of these fuels decreased from EUR 62 (USD 69)/tCO2e to EUR 53 (USD 59)/tC_2e. In addition, the partial carbon tax exemption for combined heat and power plants was turned into a partial energy tax exemption, resulting in a small increase of the tax burden on coal to support the transition away from coal use.

The electricity tax class II (industry, agriculture, mining, data centers) was lowered to the EU minimum in 2021 and at the same time the tax refund for energy-intensive enterprises will be abolished over the four-year transition period 2021–2025 (refund from all energy taxes including CO_2 component of the energy tax rate). Taxation on heating fuels, such as coal, natural gas, peat, and fuel oil, was increased by EUR 2.7/megawatt-hour from the beginning of 2021 (the increase was made to the energy content tax).

GERMANY

Germany successfully launched its national fuel ETS on January 1, 2021 at a fixed price of price of EUR 25 (USD 28)/tCO_2e and the sale of National Emissions Trading Scheme (nEHS) allowances started in October 2021. All fuel emissions not regulated under the EU ETS (mainly heating and road transport) are covered. These emissions stem from a variety of sources, such as heating, oil, natural gas, petrol, and diesel. Some fuels (e.g., coal and waste) will be phased in subsequently in 2023.

The national ETS will be phased in gradually with a fixed price on emission allowances from 2021 to 2025. In the next years, the fixed price will continuously rise to EUR 55 (USD 61)/tCO_2e in 2025. In 2026, allowances will be auctioned in a price corridor ranging between EUR 55 (USD 61)/tCO2e and EUR 65 (USD 72)/tCO_2e. From 2027 onwards, allowance prices will be set by the market unless the government proposes a new price corridor in 2025. The cap is set based on Germany's mitigation targets for sectors not covered by the EU ETS as outlined in the EU Effort Sharing Regulation. Revenue will be used for a variety of measures, in particular to support decarbonization, to lower electricity rates for consumers, and to deduct transport costs from income taxes for commuters.
In July 2021, a Carbon Leakage Regulation was adopted that aims to ensure cross-border competitiveness of firms regulated under the nEHS.

The next steps in the implementation of the nEHS include amending the Fuel Emissions Trading Regulation by determining the annual cap of the nEHS and introducing hardship provisions. A first draft was published in October 2021.

INDONESIA

In October 2021, the Indonesian House of Representatives passed a law on tax regulation harmonization. While the law includes a suite of broader tax reforms, it also includes the introduction of a carbon tax. The introduction of a carbon tax is part of Indonesia's broader Carbon Pricing Roadmap, set out in a presidential umbrella regulation also signed in October 2021, which includes a longer-term plan for introducing an ETS and a carbon crediting mechanism. The carbon tax was initially set to commence in April 2022 but was pushed back to commencing in July in light of rising energy commodity prices. The Ministry of Energy and Mineral Resources is looking to determine emission caps for coal-fired power stations in 2022. The

government is further assessing the potential to apply a carbon price to other sectors (according to sector readiness), with the aim of having a broad-coverage carbon pricing policy mix implemented by 2025.

A presidential regulation that provides a national legal umbrella for the development of carbon pricing instruments, including an ETS, was signed in October 2021. As of March 2022, the government is working on a set of draft regulations to guide the development and implementation of carbon pricing instruments in Indonesia, including on the procedures for implementing an ETS in the power sector. The ETS regulation, prepared by the Ministry of Energy and Mineral Resources, will outline the broad compliance requirements and high-level design aspects.

IRELAND

The Finance Act 2020 legislated for annual increases in carbon tax to EUR 100 (USD 111)/tCO_2 by 2030. A series of annual increases of EUR 7.50 (USD 8.3) apply to the amount charged per metric ton of CO_2 emitted coming into effect from 2021 and for each year thereafter up to and including 2029 with a final increase of EUR 6.5 (USD 7.2) in 2030.

Carbon tax for petrol and diesel increased from EUR 26 (USD 29)/tCO_2 to EUR 33.5 (USD 37)/tCO_2 on October 14, 2020. The increase extended to all other fuels on which the tax is applied in May 2021. The second increase of EUR 7.50 (USD 8.3)/tCO_2, from EUR 33.50 (USD 37)/tCO_2 to EUR 41.00 (USD 45)/tCO_2 emitted applies from October 13, 2021 for auto fuels and May 1, 2022 for all other fuels.

ISRAEL

In August 2021, the Israeli Ministers of Environmental Protection, Finance, Energy, and Economy announced the intention to implement a carbon tax in 2023. The carbon tax is anticipated to be applied through the existing fuel excise system and will cover coal, LPG, fuel oil, petcoke, and natural gas from 2023. Other initiatives are planned to address GHG emissions from waste and landfills and other sources.

Diesel and gasoline used for road transportation will not be taxed further and the carbon tax will replace a share of the existing excise tax. Also, the implementation of the tax rates is not intended to cause the price of electricity to increase by more than 5% until 2028 under the proposed legislation.

JAPAN

Japan's prime minister has asked two different ministries to develop and propose a carbon pricing mechanism that can contribute to growth. The Ministry of the Environment resumed discussions at the Subcommittee on Utilization of Carbon Pricing on February 1, 2021 while the Ministry of Economy, Trade and Industry started a carbon pricing study group in mid-February 2021. One option being progressed is a detailed design for the implementation of the Green Transformation League, a baseline-and-credit system for companies setting voluntary targets. This new mechanism will likely build on existing carbon trading systems such as the JCM or J-Credit scheme.

Saitama

The Saitama ETS is in its third compliance period (FY2020–2024), which requires facilities to reduce emissions by 20% or 22% below baseline emissions, depending on their category.

Tokyo

In June 2021, the Tokyo Metropolitan Government released emissions data for FY2019. Data indicates that covered facility emissions were reduced by 27% during the five years of the second compliance period (FY2015–FY2019) compared to base-year emissions. This represented an overachievement on the target set for the period.

MALAYSIA

The Malaysian Ministry of Environment and Water is working with other relevant ministries, including the Ministry of Finance, to develop an ETS policy and implementation framework. At the same time the Government of Malaysia continues to consider the potential for implementing other carbon pricing policies, including a carbon tax and voluntary carbon markets.

MEXICO

In March 2022, the Secretaría de Hacienda y Crédito Público announced exemptions to the carbon tax applied to gasoline and diesel.

MONTENEGRO

In October 2021, along with other Western Balkan states, Montenegro agreed with the EU on a roadmap for implementation reflected in the Green Agenda Action Plan. The EU will support such efforts with EUR 9 billion (USD 10.6 billion) in grants and EUR 20 billion (USD 26.3 billion) in investments. Under the agreement, Montenegro will need to fully align its national legislation with the EU's by 2024. The start date of the ETS has not yet been announced.

NETHERLANDS

On January 10, 2022 the new Dutch government was sworn in and its climate action

plans are set out in the 2021–2025 coalition agreement. Referring to the carbon tax, the agreement states that the government intends to increase the rate of the marginal levy. Also, to maintain price certainty, a gradually increasing price floor will be introduced for the EU ETS price, preferably in agreement with neighboring countries.

NEW ZEALAND

A number of reforms to the ETS were introduced during 2021 in line with the approval of the Climate Change Response (Emissions Trading Reform) Amendment Act 2020. The reforms include a new cap on unit supply and the introduction of an auctioning mechanism (coinciding with the withdrawal of the fixed-price option, which previously acted as a price ceiling). Auctioning began in March 2021, with 19 million allowances made available for auctioning (plus an additional 7 million allowances that were released from the cost containment reserve).

NORWAY

In its Climate Plan for 2021-2030, the former government announced its plans to increase the carbon tax rate on non-ETS emissions to NOK 2000 (USD 229)/tCO_2e (in 2020 terms) by 2030. The current government has stated that it intends to follow up on this measure. To keep up with the price increase trajectory, Norway increased the rates of carbon tax for approximately 30% for most fossil fuels in 2022. The general tax rate on non-ETS emissions increased from NOK 591 (USD 68)/tCO_2e in 2021 to NOK 766 (USD 88)/tCO_2e in 2022.

Norway also introduced a tax on waste incineration at the rate of NOK 192 (USD 22)/tCO_2e and natural gas and LPG used in greenhouses which was previously exempt from the carbon tax, at the rate of NOK 77 (USD 9)/tCO_2e.

The government removed certain exemptions for natural gas and LPG for certain industrial processes as of January 1, 2020 to strengthen its climate policy and improve the cost-effectiveness of its carbon tax. However, in relation to the COVID-19 disruption in the first half of 2020, the parliament has decided to reinstate the exemption for natural gas and liquefied petroleum as of April 1, 2020. The tax was reintroduced by the parliament in 2021, but not put into effect due to concerns that the exemption for undertakings subject to the ETS would be considered to constitute state aid under the European Economic Area Agreement. The tax will be put into effect as soon as the measure has been notified and accepted by the European Free Trade Agreement Surveillance Authority. As of February 2022, the tax has not yet been put into effect.

PORTUGAL

As part of the package of measures to respond to the extraordinary increase in fuel prices, the Portuguese government decided to suspend the increase of the CO_2 tax until March 31, 2022. The rate remained at EUR 23.921 (USD 26.4)/tCO_2e until March 31, 2022 and a potential increase to the tax is still under consideration. Portugal started to implement a carbon tax on air and sea travel (Taxa de carbono sobre viagens aéreas) on July 1, 2021. A tax of EUR 2 (USD 2.2) will be levied on all air and sea travel passengers departing from Portugal. Noncommercial flights are exempt from this tax.

REPUBLIC OF KOREA

Phase 3 of the ETS commenced in 2021 with a stricter cap and an increased proportion of allowances distributed via auction. Phase 3 has also seen third-party participation, with the government approving 20 financial institutions to enter the market for the first time.

SINGAPORE

The government announced the outcomes of the carbon tax review as part of the National Budget Statement delivered on February 18, 2022. The carbon tax rate will be increased to SGD 25/tCO_2e (USD 18/tCO_2e) in 2024 and 2025, and SGD 45/tCO_2e (USD 33/tCO_2e) in 2026 and 2027, with a view to reaching SGD 50-80/tCO_2e (USD 37-59/tCO_2e) by 2030. The revised tax levels and trajectory provide an appropriate price signal for businesses and individuals to reduce their carbon footprint and enable the transition to a low-carbon future. The early announcement provides businesses with greater certainty in planning while enhancing the business case to invest in low-carbon technologies and carbon markets. The government has put in place schemes to financially support businesses' decarbonization efforts and will continue to review the support measures for businesses to implement needle-moving decarbonization solutions to increase competitiveness.

Companies will also be able to surrender high-quality international carbon credits to offset up to 5% of their taxable emissions from 2024. This will cushion the impact for companies that are able to source for credible carbon credits in a cost-effective manner. This will also help to create local demand for high-quality carbon credits and catalyze the development of well-functioning and regulated carbon markets. A transition framework will also be introduced to give existing EITE companies more time to adjust to a low-carbon economy. To help maintain business competitiveness in the near term and mitigate the risk of carbon leakage, existing facilities in EITE sectors will receive transitory allowances for part of their emissions, based on efficiency standards and decarbonization targets. The government recognizes that

existing investments were made amidst a different operating context and there are near-term challenges in transitioning to low-carbon operations (e.g., decarbonization technologies need time to mature). New investments will not qualify for the transition framework.
The government is currently consulting affected companies on the framework. The details will be finalized by 2023, ahead of the increase of carbon tax level in 2024.

SOUTH AFRICA
As part of the 2022 budget, the government announced a range of updates to the carbon tax. These changes include an increase in the carbon tax rate from ZAR 134 (USD 9.2)/tCO_2e to ZAR 144 (USD 9.8)/tCO_2e for the 2022 tax period. The budget also proposes a range of potential reforms to the transitional phase of the carbon tax. Under the proposal, the transitional phase would be extended by three years to December 31, 2025 and would include other changes to the available support measures, including adjusting the threshold for the maximum trade exposure allowance from 30% to 50% from January 1, 2023; extending the electricity price neutrality commitment until December 31, 2025; and adjusting the carbon tax rate applied to GHG emissions exceeding the (yet to be legislated) carbon budgets to address concerns regarding double penalties to companies covered by both the carbon tax and carbon budgets.

At the same time the government's proposal includes measures to help promote the transition to a climate-resilient economy and to improve the long-term carbon price signal. This includes a proposal to revise how future carbon tax rates are set. The proposal would increase the carbon tax rate by at least USD 1 each year to reach USD 20/tCO_2e by 2026 and then for the carbon price to increase more rapidly thereafter to at least USD 30 by 2030 and up to USD 120 beyond 2050. The government also intends to gradually reduce the basic tax-free allowances in the period from 2026 to 2030 and to increase the carbon offset allowance by 5% from January 1, 2026 to encourage investments in carbon offset projects. These and other proposals will form part of a review for the second phase, to inform future budget announcements.

SPAIN
A consultation process to modify some elements of the tax on fluorinated gases started in 2021.

Catalonia
The vice presidency of economy and finance of Catalonia started a public consultation process on a possible carbon tax on March 1, 2022. The public consultation aims to guarantee the applicability of the tax on greenhouse gas emissions generated by economic activities and to achieve the energy transition objectives established by Law 16/2017 on climate change.

SWEDEN
On August 1, 2019, Sweden eliminated or reduced exemptions to its carbon tax as part of a set of measures to reach its climate target of net zero emissions by 2045. The partial exemption for diesel used in mining, which stood at 40% of the carbon tax rate, was abolished. In addition, the exemption for fuels used to generate heat in cogeneration facilities that fall under the EU ETS is reduced from 89% to 9% if this heat is not used in industrial manufacturing processes. This is in line with other heat generation plants in the EU ETS. Heat generated by facilities outside of the EU ETS remain taxed at the full carbon tax rate, which sits at SEK 1222 (USD 130)/tCO_2 in 2022. The annual adjustment by gross domestic product has been paused for 2021 and 2022 for gasoline and diesel.

SWITZERLAND
Switzerland's CO_2 levy automatically increased to CHF 120 (USD 130)/tCO_2e starting on January 1, 2022, since emissions of fossil heating and process fuels in 2020 were beyond 76% of the sector's emissions in 1990.

In September 2020, the Swiss Parliament adopted the legal framework for Swiss climate policy until 2030 through the fully revised CO_2 Act (Federal Act on the Reduction of Greenhouse Gas Emissions), which set out a 50% emission reduction target and reinforced measures for the transport, buildings, and industry sectors. The fully revised CO_2 Act was planned to enter into force in 2022. However, voters rejected the revised CO_2 Act in a referendum held on June 13, 2021.

In response to the referendum, in December 2021 the Swiss Parliament adopted a prolongation of the CO_2 Act through a partial revision of the CO_2 Act until 2024. It guarantees a continuation of existing measures, including the CO_2 levy at its current rate of of CHF 120 (USD 130)/tCO_2e. This partial revision could be subject to a referendum call, if handed in by April 2022.

TAIWAN, CHINA
Since the beginning of 2021, the Taiwan Environmental Protection Administration (TEPA) has been in the process of revising the act. In July 2021, the TEPA established a new climate change office under it to accelerate policy development. In late October 2021, the draft of revision of the Greenhouse Gas Control Act was published for public consultation and renamed as Climate Change Response Act. The draft legislation proposes a new carbon fee for domestic emissions, which would commence ahead of an ETS mechanism. The proposed carbon fee would potentially cover direct and/or indirect emissions with the potential to use domestic offsets to cover carbon fee liabilities. Carbon fee revenues would be directed toward supporting domestic climate mitigation and a low-carbon economy.

After public consultation, the Climate Change Response Act is expected to be submitted to the Legislative Yuan in the first half of 2022 for further review and finalization. Further details of the carbon fee and ETS will be developed via sub-laws. Regulatory discussions are pending on the specific design of the carbon fee and ETS system, the timeline of implementation, and how the carbon fee could transition to (or coexist with) an ETS.

THAILAND

Following COP26, the government is developing rules and guidelines for carbon credit trading, expected to be released in 2022. As part of this work, the Thailand Greenhouse Gas Management Organization is collaborating with the Federation of Thai Industries to develop a carbon credit trading platform.

UKRAINE

Ukraine's parliament approved new amendments to the tax code—the carbon tax rate increased from UAH 10 (USD 0.3)/tCO_2e to UAH 30 (USD 1)/tCO_2e starting from January 1, 2022, and up to 70% of budget revenues from carbon taxes will be directed to reduce CO_2 emissions and to encourage decarbonization in certain sectors. By the end of June 2022 the Cabinet of Ministers of Ukraine plans to develop and submit a draft law to the parliament on further use of such budget revenues.

UNITED KINGDOM

The first UKA auction took place in May 2021, with all of the more than 6 million allowances on offer sold at the market clearing price of GBP 43.99 (USD 58), well above the auction reserve price of GBP 22.00 (USD 29). The same day marked the start of UKA futures trading and, a week later, the government transferred the first free UKAs for the 2021 scheme year to eligible regulated entities. The introduction of new allowances to the market has since continued through twice-monthly auctions.

An auction in early October 2021 of just under 5.19 million UKAs partially cleared, with about 4.15 million UKAs being sold at GBP 60.00 (USD 79). As per the scheme's rules, the bids below this price level were deemed too far below the secondary market price at the time and the 1.04 million unsold UKAs were distributed across the four subsequent auctions. All other auctions in 2021 cleared fully.

To avoid instability in allowance prices, the UK ETS has a cost containment mechanism (CCM) that allows auctioning of additional allowances. While the monthly average UKA prices in September, October, and November 2021 were above the CCM trigger price of GBP 52.88 (USD 69.5), the UK ETS Authority decided not to intervene. The CCM was triggered again in January 2022 and an announcement was made in mid-January that, again, no intervention would be made.

UNITED STATES

Most carbon pricing developments in the United States are taking place on the subnational level, as summarized below.

California

Major changes to the program took effect in January 2021, including 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 that do not provide direct environmental benefits in the state), and a steeper allowance cap decline to 2030.

The California Air Resources Board launched the Climate Change Scoping Plan update process during 2021, which seeks to develop policy strategies to achieve 2030 and 2045 targets. The scoping plan will be published in 2022.

By May 2021, prices reached record highs for California Carbon Allowances, as observed by the auction settlement price and in reported prices for commodity exchange futures contract for near-month delivery and brokered transactions.

Massachusetts

The share of ETS allowances distributed through free allocation was 50% in 2020. The system changed to full auctioning in 2021. In March 2021, Massachusetts passed a new climate law with binding emission reduction targets of 50% below 1990 levels by 2030 and 75% below 1990 levels by 2040, as well as net zero emissions by 2050.

The first program review (required by regulation) was in 2021, with a review every 10 years thereafter. To address potential liquidity issues, the program review considered the following actions: limits on allowance banking, auctioning of future allowances, and adjustment of auction bid limits.

Oregon

In December 2021, the Environmental Quality Commission adopted the rules for the Climate Protection Program that started in January 2022. The Climate Protection Program places a declining limit on GHG emissions from suppliers of liquid fuels and propane and natural gas utilities, also dubbed local distribution companies.

Regional Greenhouse Gas Initiative

In May 2021, the final regulation to establish an ETS in Pennsylvania covering CO_2 emissions from the power sector and to join RGGI was released alongside updated modeling results of the effects of the ETS. It would allow for RGGI participation starting 2022, barring litigation or action from the state legislature. Pennsylvania's share of emissions in the 2022 RGGI cap is approximately 45%.

An emissions containment reserve started operating in 2021. The emissions containment reserve is an automatic adjustment mechanism that will adjust the cap downward when carbon prices are lower than expected.

The RGGI states initiated the Third Program Review in summer 2021 to analyze program successes, impacts, potential additional reductions to the cap post-2030, and other design elements. The review is expected to be concluded in 2023.

Transportation and Climate Initiative Program
In June 2021, the four participating jurisdictions released a final model rule for the implementation of the Transportation and Climate Initiative Program (TCI-P), with reporting of emissions and fuel shipment data under the program scheduled to start in 2022.

In the second half of 2021, most of the participating states halted participation in the proposed TCI-P. According to the final memorandum of understanding, the first compliance period of TCI-P will commence January 1, 2023 or once "at least three jurisdictions have completed the legal processes required to implement their individual programs."[166] After the recent developments, it is unlikely that the implementation of TCI-P in its current form will continue.

Washington
In May 2021, Governor Jay Inslee signed into law the Climate Commitment Act, which puts in place an economy-wide cap-and-invest program that begins in January 2023.

URUGUAY
Uruguay's carbon tax was implemented on January 1, 2022, following Presidential Decree 441/021. The carbon tax rate for 2022 is UYU 5,645.45 (approximately USD 137.29).

VIETNAM
In November 2020, Vietnam's revised Law on Environmental Protection was issued. The revised law confirmed the role of carbon pricing in Vietnam's mitigation policy mix, provided the legal mandate for the development of a domestic emissions trading scheme and a national crediting mechanism, and assigned ministerial responsibilities. The revised law will also be supplemented by a Prime Ministerial roadmap for CPI implementation, which is currently under development and is expected to be issued in 2022. The framework legislation also empowers the Ministry of Natural Resources and Environment to set the emissions cap and determine the method of allowance allocation, and allows for the inclusion of domestic and international offsets.

In January 2022, the government of Vietnam issued a decree, which provides a comprehensive set of regulations under the revised Law on Environmental Protection and outlines a roadmap for their implementation. The decree sets forth rules for monitoring, reporting, and verification (MRV) systems and includes provisions for developing a national ETS with a declining cap corresponding to Vietnam's NDC and the establishment of a national crediting mechanism.

Vietnam anticipates launching a pilot ETS in 2026, before launching a full ETS in 2028.

Annex C

Crediting mechanism updates

This appendix presents significant developments in carbon crediting mechanisms in the year up to April 1, 2022. Where no significant changes occurred over the past year, these mechanisms are not included. Figure 16 presents an overview of domestic and independent crediting mechanisms included in this report.

FIGURE 16

Credits issued, registered activities, average 2021 price, and sectors covered by crediting mechanisms

Name of the mechanism	Credits issued ($MtCO_2e$)	Registered activities	Average price (USD)
American Carbon Registry	8.8	18	11.4
Climate Action Reserve	4.8	44	2.1
Gold Standard	43.8	51	3.9
Verified Carbon Standard	295.1	110	4.2
Plan Vivo	0.01	1	11.6
Clean Development Mechanism	59.5	0	1.1
Alberta Emission Offset System	0.4	33	32
Australia Emission Reduction Fund	17.1	142	11.9 - 12.7
Beijing Forestry Offset Mechanism	-	0	8.9
Beijing Parking Offset Crediting Mechanism	0.002	0	7.6
British Columbia Offset Program	-	0	N/A
California Compliance Offset Program	17.4	38	14.9
China GHG Voluntary Emission Reduction Program	-	0	0.6 - 8.2
Chongqing Crediting Mechanism	-	7	2.7 - 4.6
Fujian Forestry Offset Crediting Mechanism	0.3	3	1.6 - 3.1
Guangdong Pu Hui Offset Crediting Mechanism	0.3	20	3.5 - 6.6
J-Credit Scheme	0.9	44	13 - 20.8
Kazakhstan Crediting Mechanism	0.1	3	N/A
Québec Offset Crediting Mechanism	0.2	3	15.5
Republic of Korea Offset Credit Mechanism	5.2	28	10.7 - 29
RGGI CO2 Offset Mechanism	-	0	N/A
Saitama Forest Absorption Certification System	0	15	N/A
Saitama Target Setting Emissions Trading System	6.4	592	3.8
Spain FES-CO2 program	0.9	0	8.8
Switzerland CO2 Attestations Crediting Mechanism	1.4	13	128.2
Taiwan GHG Offset Management Program	12.4	20	N/A
Thailand Voluntary Emission Reduction Program	3	32	N/A
Tokyo Cap-and-Trade Program	0.01	5	39 - 52.4
Joint Crediting Mechanism	0.001	6	N/A

Sectors covered

- Agriculture
- Carbon capture and storage and Carbon capture and utilization
- Energy efficiency
- Forestry
- Fuel switch
- Fugitive emissions
- Industrial gases
- Manufacturing
- Other land use
- Renewable energy
- Transport
- Waste
- Blue carbon

Crediting mechanisms:

- Independent
- International
- Domestic

C.1 DOMESTIC CREDITING MECHANISMS

This section outlines significant developments in regional, national, and subnational crediting mechanisms. Where no significant changes occurred over the past year, these mechanisms/jurisdictions are not included. For more detailed information on all carbon taxes and ETSs, see Annex B and the Carbon Pricing Dashboard, an interactive online platform that provides up-to-date information on existing and emerging carbon pricing instruments around the world.

ALBERTA EMISSION OFFSET SYSTEM

Quantification protocols have been updated over the past year to cover emissions reductions from capturing vented methane and for emissions reductions associated with carbon capture and storage.

AUSTRALIA EMISSIONS REDUCTION FUND

The Australian government is seeking to increase the number of methods available to potential project proponents. For example, a new method for carbon capture and storage was made available in October 2021, and a Blue Carbon Method became available during January 2022.

BEIJING FORESTRY OFFSET MECHANISM

While there were no additional credits issued during 2021, the government's 2022 Action Plan on Climate Change reaffirms the commitment to increase the carbon sink capacity of forestry and green spaces.

CHILE CREDITING MECHANISM

The government of Chile published a draft climate change law in January 2021 that would set up a baseline-and-credit scheme to drive emissions reductions among individual companies or groups of companies as a policy to achieve sectorial compliance with Chile's long-term emission reduction goals. The regulation for the crediting mechanism has been under public consultation and is subject to change.

CHINA GHG VOLUNTARY EMISSION REDUCTION PROGRAM

China's GHG Voluntary Emission Reduction Program was implemented in 2012 but was suspended in 2017, meaning that new projects have not been added since that time. The government is currently considering a re-relaunch of the program.

CHONGQING CARBON OFFSET MECHANISM

The Chongqing carbon offset mechanism was launched in September 2021. A Chongqing Certified Emissions Reductions platform for realizing the value of ecological products was released at the first China (Chongqing) Guangyang Bay Green and Low-carbon Development Summit.

GUANGDONG PU HUI OFFSET CREDITING MECHANISM

New Pu Hui Certified Emissions Reductions trading rules on the quantity and price of certain transaction types were established in June 2020, following a suspension by the provincial government in August 2018. In early 2022, the Guangdong government consulted on options to deepen and improve the crediting mechanism.

INDO-PACIFIC CARBON OFFSETS SCHEME

The Indo-Pacific Carbon Offsets Scheme is designed to help partner countries generate and trade high-integrity carbon offsets under the Paris Agreement. In November 2021, the Australian government announced four draft design principles: transparent and inclusive governance; aligned with the Paris Agreement and SDGs; responsibility and cooperation amongst parties; and high-integrity units.

JOINT CREDITING MECHANISM

After COP26, Japan's Minister of the Environment announced that Japan will expand the JCM partner countries and strengthen project development and implementation in collaboration with international organizations, and scale up the JCM by mobilizing further private finance.

QUÉBEC OFFSET CREDIT COMPONENT OF THE CAP-AND-TRADE

The government of Québec established a crediting program that issues Québec offset credits intended for organizations wanting to meet compliance obligations under the ETS. In 2021 draft regulations for afforestation and reforestation projects were released, and significant technical work toward crediting for anaerobic manure digestion.

REPUBLIC OF KOREA OFFSET CREDIT MECHANISM

The Republic of Korea offset credit mechanism was implemented to provide offset credits for use within Korea's ETS. Korean Offset Credits (KOCs) must be converted into Korean Credit Units (KCUs) by the Korean government before they can be used for compliance obligations. Limitations have been introduced on the issuance and conversion of offset credits in Phase 3, which commenced in 2021. For example, KOCs must be converted into KCUs within two years after the end day of the KOCs' issuance year.

Phase 3 has also seen international KOCs being traded in the market for the first time.

SASKATCHEWAN GHG OFFSET PROGRAM

Due to changes in federal backstop requirements, Saskatchewan's proposed provincial Offset Program is being redesigned. A modified Offset Program will be launched in conjunction with the province's updated OBPS in 2023.

SOUTH AFRICA CARBON TAX OFFSET SYSTEM

The South African Carbon Tax Offset system currently operates through a "gatekeeping" model, whereby projects in South Africa developed under the CDM, the VCS, and the Gold Standard are potentially eligible. The South African carbon offsetting regulations were amended in July 2021.

The government is also considering developing its own crediting mechanism. In January 2022, the South African Department of Mineral Resources and Energy released for public comment a draft framework to develop domestic carbon offset standards. The draft framework sets out the requirements, criteria for selection, evaluation, and approval of domestic standards.

SPANISH CARBON FUND FOR A SUSTAINABLE ECONOMY

In late 2020, the scope of the Spanish Carbon Fund for a Sustainable Economy was broadened in line with the national policy on climate change and the incoming additional efforts needed to achieve carbon neutrality by 2050. The government still intends to acquire credits coming from activities carried out through the UNFCCC and the Paris Agreement framework. Those changes will be fully operational from 2022 onwards.

SRI LANKA CARBON CREDITING SCHEME

The Sri Lanka Carbon Crediting Scheme (SLCCS) was initiated as the Sri Lanka Carbon Standard in 2013, but was restructured as the SLCCS in 2016. Updated program guidelines were released in 2021, which include revised requirements for project validation, verification, and registration.

C.2 INDEPENDENT CREDITING MECHANISMS

GOLD STANDARD

The Gold Standard is seeking to launch an initiative to develop digitization technologies for setting up the MRV processes of carbon markets. The aim is to develop a tool that can also monitor other benefits beyond emission reductions, like the progress achieved toward the SDGs.[167]

This development takes place in a context where much of the project development and MRV is still conducted manually, and it aims to blend a spectrum of technologies, including digital methodologies and workflows, internet of things for data gathering, distributed ledger technology, and smart contracts that can enhance data quality, reduce time and costs, and provide access to smaller or less experienced project supporters. The initiative is going to be supported by Google.org Charitable, which provided a grant of USD 1 million to the Gold Standard.[168]

VERIFIED CARBON STANDARD

Verra is in the process of updating its Verified Carbon Standard Avoiding Unplanned Deforestation and Degradation methodologies to show the latest best practices on carbon credits for REDD+ activities. The updated methodologies will include standardized processes for activity data generation, baseline development, monitoring, and leakage. These processes aim to guarantee that individual REDD+ projects continue to direct carbon finance to endangered forests while the evolution of jurisdictional REDD programs is still in progress.[169]

Consultation on the new methodologies will close in May 2022. These consultations will inform the revision of the methodologies and will be followed by an assessment of a validation/verification body. Verra intends to publish the revised methodologies by the end of 2022.

CLIMATE ACTION RESERVE

The Climate Action Reserve launched a process to develop a Biochar Protocol for quantifying, monitoring, reporting, and verifying the climate benefits from the production of biochar.[170] Biochar production sequesters CO_2 and relates to activities such as producing feedstocks from agricultural residues and other waste biomass sources such as timber harvests. The protocol will define eligible biochar production operations, as well as end uses for which the permanence of sequestered carbon can be reasonably estimated. The protocol is developed through a multistakeholder workgroup with representatives from industry, project developers, nongovernmental organizations, verification bodies, and others, and is expected to be approved and launched in 2022.[171]

AMERICAN CARBON REGISTRY

The American Carbon Registry introduced a new functionality in its registry to label credits as "carbon removals," distinguishing them from emission reduction credits, with the aim of increasing transparency regarding credit attributes for credit buyers.[172] Projects that generate both carbon removals and emission reductions, such as improved forest management projects, can distinguish between the two credit types upon issuance. Here, removal credits represent the carbon sequestered in new trees being grown in the project area, whereas emission reductions represent the carbon reduced through improved harvesting techniques.[173]

C.3 INTERNATIONAL MECHANISMS

CLEAN DEVELOPMENT MECHANISM

With the end of the second phase of the Kyoto Protocol, the CDM begins its transition to the mechanisms created under the Paris Agreement. Activities registered under the CDM are eligible to transition to the Article 6.4 mechanism under the following circumstances:[174]

- The request to transition the CDM activity to Article 6.4 must be made by December 31, 2023. Host country approval for such transitions must be made by December 31, 2025.
- Once approved, the activity may continue to follow its current methodology until the end of its current crediting period or December 31, 2025 (whichever is earlier). After this date, it will have to follow the methodologies approved under Article 6.4.
- The certified emission reductions issued under the CDM may be used to achieve first NDCs, provided that the activity was registered on or after January 1, 2013. The host country will not be required to apply a corresponding adjustment.

Although the Article 6.4 mechanism is built on the previous experience of the CDM, it will have its own set of rules, modalities, and procedures.

CORSIA

The ICAO CORSIA pilot phase started on 1 January 2021. However, aviation emissions remain below baseline levels following the decision to use 2019 emissions as the baseline, and are unlikely to exceed these levels until at least 2023, which marks the end of CORSIA's pilot phase.[175] As of March 2021, 108 states have signed up for CORSIA's pilot phase. At the end of 2021, eligible emission units were approved from eight programs: American Carbon Registry, Architecture for REDD+ Transactions, China GHG Voluntary Emission Reduction Program, Clean Development Mechanism, Climate Action Reserve, Global Carbon Council, Gold Standard, and Verified Carbon Standard. During 2022, the Technical Advisory Body will reassess interested eligible CORSIA Eligible Emissions Unit Programs to inform the ICAO Council on which emissions units should be eligible for use under CORSIA in the first phase starting in 2023.[176]

Endnotes

1 Intergovernmental Panel on Climate Change, *WGII Sixth Assessment Report: Summary for Policymakers*, 2022.

2 M. Pathak, R. Slade, P.R. Shukla, J. Skea, R. Pichs-Madruga, D. Ürge-Vorsatz, "Technical Summary," in *Climate Change 2022: Mitigation of Climate Change. Contribution of Working Group III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*, edited by P.R. Shukla, J. Skea, R. Slade, A. Al Khourdajie, R. van Diemen, D. McCollum, M. Pathak, S. Some, P. Vyas, R. Fradera, M. Belkacemi, A. Hasija, G. Lisboa, S. Luz, J. Malley. (Cambridge, UK and New York, NY, USA: Cambridge University Press, 2022).

3 Climate Action Tracker, "Home page," accessed March 3, 2022, https://climateactiontracker.org/.

4 International Energy Agency, "COP26 Climate Pledges could Help Limit Global Warming to 1.8°C, but Implementing Them Will Be the Key," November 4, 2021.

5 International Energy Agency, *World Energy Outlook—Executive Summary*, 2021.

6 Pathak et al., "Technical Summary."

7 International Energy Agency, "Global CO2 Emissions Rebounded to Their Highest Level in History in 2021," March 8, 2022.

8 United Nations Committee of Experts on International Cooperation in Tax Matters: Environmental Tax Issues, "Chapter 2: An Introduction for Policymakers—Carbon Taxation Handbook. Note by the Secretariat," April 12, 2020.

9 High-Level Commission on Carbon Prices, *Report of the High-Level Commission on Carbon Prices* (Washington, DC: World Bank, 2017).

10 I. Parry, C. Veung, and D. Heine, "How Much Carbon Pricing Is in Countries' Own Interests? The Critical Role of Co-Benefits," *Climate Change Economics* 6, no. 4 (2015): 1–26.

11 J.C. Minx, W.F. Lamb, R.M. Andrew, J.G. Canadell, M. Crippa, N. Döbbeling, P.M. Forster, D. Guizzardi, J. Olivier, G.P. Peters, J. Pongratz, A. Reisinger, M. Rigby, M. Saunois, S.J. Smith, E. Solazzo, and H. Tian, "A Comprehensive and Synthetic Dataset for Global, Regional, and National Greenhouse Gas Emissions by Sector 1970–2018 with an Extension to 2019," *Earth System Science Data* 13, no. 11 (2021): 5213–52.

12 Chinese Ministry of Ecology and Environment, "The First Compliance Cycle of the National Carbon Market Ended Successfully," January 1, 2022.

13 T. Luyue, "The First Year of China's National Carbon Market, Reviewed," China Dialogue, February 17, 2022.

14 M. Xu and D. Stanway, "China Slams Firms for Falsifying Carbon Data," Reuters, March 15, 2022.

15 European Commission, Proposal for a Directive of the European Parliament and of the Council amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union, Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading scheme and Regulation (EU) 2015/757, September 14, 2021.

16 Council of the European Union, "Presidency Report for the Environmental Council Meeting of 17 March 2022," March 8, 2022.

17 Marshall Islands and Solomon Islands. 2021. MEPC 76/7/12.

18 Norway. 2021. MEPC 76/7/2.

19 International Chamber of Shipping, "International Chamber of Shipping Sets Out Plans for Global Carbon Levy to Expedite Industry Decarbonisation," September 6, 2021.

20 Trafigura, "A Proposal for an IMO-led Global Shipping Industry Decarbonisation Programme," 2020.

21 D., Baresic, I. Rojon, A. Shaw, and N. Rehmatulla, "Closing the Gap: An Overview of the Policy Options to Close the Competitiveness Gap and Enable an Equitable Zero-Emission Fuel Transition in Shipping," January 2022; *We Show the World It Is Possible: Industry Transition Strategy* (London: Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping, 2021).

22 Climate Vulnerable Forum, "Dhaka-Glasgow Declaration of the CVF," November 2, 2021.

23 G. Dominioni, D. Englert, R. Salgmann, and J. Brown, "Carbon Revenues from International Shipping: Enabling an Effective and Equitable Energy Transition – Summary for Policymakers", April 2022.

24 O. Wannan, "Soaring Demand to Pollute Blows Government's First Limit on Carbon Units," Stuff, September 2, 2021.

25 O. Wannan, "Everyone Wants to Buy Carbon—So Why Does No One Want to Sell?," Stuff, March 18, 2022.

26 Government of the United Kingdom, "UK ETS Authority Statement: Cost Containment Mechanism Decision—December 2021," January 18, 2022.

27 Government of the United Kingdom, "UK ETS Authority Statement."

28 L. Yulismanm, "Indonesia Delays Carbon Tax till July to Help Economic Recovery," *The Straits Times*, March 30, 2022.

29 Milenio, "Hacienda elimina impuesto a gasolina Magna y diésel ante alza de precios por conflicto en Ucrania," March 4, 2022.

30 I. Gerretsen, "South Korea Proposes Cutting Emissions 40% by 2030," *Climate Home News*, June 16, 2021.

31 D. Nachtigall, J. Ellis, and S. Errendal, "Carbon Pricing and COVID-19: Policy Changes, Challenges and Design Options in OECD and G20 Countries," OECD, March 2022.
32 ANZ Research, "Carbon Markets 101: Pricing Climate Change Solutions," July 29, 2021.
33 S. Reklev, "SK Market: KAUs Climb to 19-mth High as Financials Enter Market," Carbon Pulse, December 20, 2021.
34 Legislative Analyst's Office, "Cap-and-Trade Auction Update and GGRF Projections," December 6, 2021
35 International Emissions Trading Association, "Carbon Market Business Brief," May 2021.
36 International Emissions Trading Association, "Carbon Market Business Brief."
37 See, e.g., Euractiv, "Europe's Energy Price Hike Fuelled by Speculators, Spain and Poland Say," November 25, 2021.
38 European Securities and Markets Authority, *Final Report: Emission Allowances and Associated Derivatives*, March 28, 2022
39 F. Di Sario and B. Garside, "Key EU Lawmaker Plans to Propose Steps to Curb Carbon Market 'Manipulation,'" Carbon Pulse, January 14, 2022.
40 F. Di Sario, M. Szabo, and B. Garside, "EU Lawmakers Muster Efforts to Curb Carbon Market Speculation," Carbon Pulse, February 4, 2022.
41 Ecoeye, *Korean ETS Market Review 2021*, February 11, 2022.
42 L. Oliver, "Carbon Markets—Everything You Need to Know as 2022 Takes Off," KraneShares, January 27, 2022.
43 A. Vitelli, R. Manuell, and M. Szabo, "ANALYSIS - Autopsy of a Crash: Europe's Carbon Collapse Said Caused by Cash Call, Fuelled by Bearish Technicals and Sentiment," Carbon Pulse, March 9, 2022.
44 M. Lithgow and M. Szabo, "Q4 RGGI Auction Clears at Record High, Taps Cost Containment for 1st Time in 6 Years," Carbon Pulse, December 3, 2021.
45 High-Level Commission on Carbon Pricing, Report.
46 P. Bhat, "Carbon Needs to Cost at Least USD100/tonne Now to Reach Net Zero by 2050: Reuters Poll," Reuters, 2022.
47 C. Nelder, "Green Hydrogen and Carbon Prices (No. 149)" [Audio podcast episode], *The Energy Transition Show*, XE Network, June 9, 2021.
48 M. Lewis, "Deep Decarbonization—Green Hydrogen, Net Zero and the Future of the EU ETS," BNP Paribas: Investors Corner, February 10, 2020; S. Nasralla, "Carbon Capture Services could Break Even in Next 10 Years—Equinor," Reuters, December 1, 2021.
49 Government of the United Kingdom, "World Leaders Join UK's Glasgow Breakthroughs to Speed Up Affordable Clean Tech Worldwide," November 2, 2021.
50 International Energy Agency, "Report Extract: Accelerating Deployment," 2020.
51 S. Postic and M. Fetet, "Global Carbon Accounts in 2021," Institute for Climate Economics, October 2021.
52 I. Holovko, A. Marian, and M. Apergi, *The Role of the EU CBAM in Raising Climate Policy Ambition in Trade Partners: The Case of Ukraine*, IASS, October 2021.
53 Ferrerre, "El proyecto de Ley de Rendición de Cuentas prevé la modificación del Impuesto Específico Interno (IMESI) aplicable a las gasolinas," September 9, 2021.
54 L. Pei-chi and K. Wang, "Taiwan Plans to Introduce Carbon Pricing Mechanism by 2023," Focus Taiwan, October 13, 2021.
55 J. Loe, "Emerging Economies Share 'Grave Concern' over EU Plans for a Carbon Border Levy," EURACTIV, April 12, 2021.
56 Prime Minister of Canada Justin Trudeau, "Deputy Prime Minister and Minister of Finance Mandate Letter," December 16, 2021.
57 UK Parliament, "Environmental Audit Committee Inquiry: Carbon Border Adjustment Mechanisms," 2021.
58 L. Friedman, "Democrats Propose Carbon Border Tax Based on Countries' Greenhouse Gas Emissions," *New York Times*, October 17, 2021.
59 A. R. Mishra, "BRICS Summit Is Likely to Strongly Oppose Carbon Tax Proposed by EU," Green Fiscal Policy Network, September 16, 2021.
60 T. Gore, "The Proposal for a Carbon Border Adjustment Mechanism Fails the Ambition and Equity Tests," Heinrich Boell Stiftung, September 13, 2021.
61 European Parliament, "DRAFT OPINION of the Committee on Development for the Committee on the Environment, Public Health, and Food Safety on the Proposal For A Regulation Of The European Parliament and of the Council Establishing a Carbon Border Adjustment Mechanism," January 1, 2022.
62 K. Taylor, "EU Countries Agree World's First Carbon Tariff, but Leave Out Controversial Issues," EURACTIV, March 16, 2022.
63 I. Parry, S. Black, and J. Roaf, "Proposal for an International Carbon Price Floor Among Large Emitters," International Monetary Fund, June 18, 2021.
64 N. Okonjo-Iweala, "Adopting a Global Carbon Price Is Essential," *Financial Times*, October 14, 2021.
65 UN Environment Programme Finance Initiative with World Wildlife Fund and Global Optimism, "U.N.-Convened Net-Zero Asset Owner Alliance Discussion paper on governmental carbon-pricing," 2021.
66 Prime Minister of Canada Justin Trudeau, "Mandate Letter."
67 F. Simon, "France Calls for Carbon Price Floor to Counter Oil Crash," EURACTIV, April 27, 2020.
68 G7 Germany, "Policy Priorities for Germany's G7 Presidency in 2022," January 2022.
69 he Government of California, The Government of New Zealand, and The Gouvernement du Québec, "Joint Declaration on Cooperation in the Fight Against Climate Change," November 2021.

70 State of Washington Department of Ecology, "Climate Commitment Act," 2021.
71 M. Lithgow, "Washington May Seek California Cap-and-Trade Adjustments to Facilitate Linkage—Senator," Carbon Pulse January 7, 2022.
72 L. Schneider, J. Cludius, and S. La Hoz Theuer, *Accounting for the Linking of Emission Trading Systems under Article 6.2 of the Paris Agreement*, International Carbon Action Partnership, November 2018.
73 E. Rauhala, R. Noack, and V. Guinan-Bank, "Europe's Plan to Wean Off Russian Energy could Lead to Price Shocks and Political Blowback," *Washington Post*, March 9, 2022.
74 W. Van Gaal, "Poland Threatens to Veto the EU's Fit for 55," EUObserver, December 21, 2021.
75 A. Kumenov and J. Lillis, "Kazakhstan Explainer: Why Did Fuel Prices Spike, Bringing Protestors Out Onto the Streets?," Eurasianet, January 4, 2022.
76 P. Jones and R. Smyth, "The Kazakhstan Protests Escalated Quickly. Here's Why," *Washington Post*, January 8, 2022.
77 A. Abdurasulov, "Kazakhstan Unrest: Government Restores Fuel Price Cap after Bloodshed," BBC News, January 6, 2022.
78 United Nations, *Paris Agreement to the United Nations Framework Convention on Climate Change*, December 12, 2015; European Bank for Reconstruction and Development, 'What Is a Just Transition?," 2022.
79 L. Pulkkinen, "Washington Passed its Cap-and-Trade Climate Legislation. Now What?," USNEWS, May 20, 2021.
80 IISD, *Building Momentum for a Just Transition in Canada: Perspectives from Civil Society*," April 2021.
81 Ministry of National Development Planning Indonesia, *A Green Economy for a Net-Zero Future: How Indonesia can build back better after COVID-19 with the Low Carbon Development Initiative (LCID)*, 2021.
82 F. Di Sario, "Opposition to Second EU ETS Deepens, as Divisions Emerge among Largest Political Group," Carbon Pulse, March 3, 2022.
83 City and State EPA Pennsylvania, "Pennsylvania Set to Publish Final Carbon Pricing Regulation," April 22, 2022.
84 Department of Public Expenditure and Reform Ireland, *Budget 2022: The Use of Carbon Tax Funds 2022*.
85 European Commission, "Social Climate Fund," 2022.
86 European Commission, "Commission Presents Guide for a Fair Transition toward Climate Neutrality," December 14, 2021.
87 European Commission, "The Just Transition Mechanism: Making Sure No One Is Left Behind. "
88 The EM Insights Team,"Voluntary Carbon Markets Top USD1 Billion in 2021 with Newly Reported Trades, a Special Ecosystem Marketplace COP26 Bulletin," Ecosystem Marketplace, November 10, 2021.
89 The EM Insights Team, "Voluntary Carbon Markets Top USD1 Billion."
90 ICAP, *Emissions Trading Worldwide: Status Report 2021*, International Carbon Action Partnership, 2021.
91 IATA, "Passenger Demand Recovery Continued in 2021 but Omicron Having Impact," January 25, 2022.
92 M. Lithgow, "ICAO Moves forward CORSIA Emissions Recovery Forecast, Drops Offset Cost Estimates," Carbon Pulse, July 6, 2021.
93 The EM Insights Team, "CORSIA Carbon Market Data from Ecosystem Marketplace. ICAO Environment CORSIA Newsletter," Ecosystem Marketplace, December 1, 2021.
94 M. Lithgow, "ICAO Moves forward."
95 ICAO, "CORSIA Eligible Emissions Units," November 2021.
96 Xpansiv, *GEO—A Clear Path to Carbon Neutral*.
97 S. Reklev, "South Korea Looking to Fund Article 6 Pilot Projects," Carbon Pulse, April 4, 2022.
98 UNFCCC Secretariat, *Nationally Determined Contributions under the Paris Agreement. Synthesis Report by the Secretariat*, September 17, 2021.
99 A. Michaelowa, A. Espelage, L. 't Gilde, N. Kramer, P. Censkowsky, S. Greiner, H. Ahonen, G. Victoria, S. Hoch, S. Ombuya, S. Dalifume, "Article 6 Readiness in Updated and Second NDCs," Perspectives Climate Group and Climate Focus, October 27, 2021.
100 Ecosystem Marketplace, '*Markets in Motion', State of the Voluntary Carbon Markets 2021: Installment 1*, Forest Trends Association, 2021.
101 S. Zwick, "Increased Financial Sector Participation to Dramatically Change Voluntary Carbon Market—Panel" Carbon Pulse, April 27, 2021.
102 IATA, "Net Zero Carbon 2050 Resolution: Fact Sheet," 2021; IATA, "IATA Members," 2022.
103 B. Cahill, "Credibility Gap for Carbon-Neutral LNG," CSIS, January 19, 2022.
104 T. Solsvik and N. Adomaitis, "Lundin Sells Its First 'Carbon Neutral' Oil as Climate Activism Grows," Reuters, April 26, 2021.
105 New Climate Institute, *Corporate Climate Responsibility Monitor 2022*, February 2022.
106 A.P. Moller, "A.P. Moller—Maersk Will Operate the World's First Carbon Neutral Liner Vessel by 2023—Seven Years ahead of Schedule," February 17, 2021.
107 A. Azil, V, Barnard, C. Blaufelder, C. Levy, T, Nielsen, B. Ramanathan, *Putting Carbon Markets to Work on the Path to Net Zero*, October 28, 2021.
108 Shell Global, *Exploring the Future of the Voluntary Carbon Market*, 2021.
109 Trove Research, *Voluntary Carbon Market: 2021 in Review and 2022 Outlook*, 2022.
110 New Climate Institute, *Corporate Climate Responsibility Monitor 2022*, February 2022.
111 Microsoft, *Microsoft Carbon Removal—Lessons From An Early Corporate Purchase—*

January 2021.
112 S. Favasuli, "Debate on Avoidance and REDD+ Carbon Projects to Dominate Next UN Climate Conference," S&P Global, January 12, 2022.
113 S. Reklev, "Papua New Guinea to Put Moratorium on REDD+ Projects for Voluntary Market," Carbon Pulse, March 2, 2022.
114 J. Liu and S. Reklev, "Chinese Province Slams Brakes on Forestry Offset Projects for the International Voluntary Market," Carbon Pulse, March 2, 2022.
115 Ecosystem Marketplace, 'Markets in Motion'.
116 Ecosystem Marketplace, "Voluntary Carbon Markets Top USD1 Billion in 2021 with Newly Reported Trades, a Special Ecosystem Marketplace COP26 Bulletin," November 10, 2021.
117 Ecosystem Marketplace, 'Markets in Motion'.
118 Ecosystem Marketplace, 'Markets in Motion'.
119 Verra, "Sustainable Development Verified Impact Standard."
120 The Gold Standard, "Rule Update: The SDG Impact Tool," 2021.
121 M. Filmanovic, "The Carbon Project Development Curve," Abatable, March 17, 2022.
122 S. Choudhury, "A New Global Carbon Exchange Will Be Launched in Singapore This Year," CNBC, May 21, 2021.
123 NatWest Group, "Banks Join Forces to Create Voluntary Carbon Marketplace," July 7, 2021.
124 Business Wire, "2021 Xpansiv Carbon Volume Rises 288% Driven by Surge of Corporate Net-Zero and ESG Demand," January 13, 2022.
125 S&P Global, "INTERVIEW: Speculative Capital Offers Growth Opportunity for Carbon Market—AirCarbon," September 14, 2021.
126 Ecosystem Marketplace, 'Markets in Motion'.
127 Ecosystem Marketplace, 'Markets in Motion'.
128 M. Filmanovic, "The State of the Carbon Developer Ecosystem 2021," Abatable December 22, 2021.
129 H. Holger, "Cryptocurrency Traders Move Into Carbon Markets," *The Wall Street Journal*, January 10, 2022.
130 See e.g., World Bank, *Blockchain and Emerging Digital Technologies for Enhancing Post-2020 Climate Markets*, March 2018; World Bank, *Summary Report: Simulation on Connecting Climate Market Systems*, 2019; UNEP, "Designing a Blockchain Model for the Paris Agreement's Carbon Market Mechanism," 2020; Air Carbon Exchange, "UNFCCC Partners with the AirCarbon Exchange to Promote Carbon Offsetting," January 12, 2021.
131 M. Grady, L. DeMarco, R. Saines, E.A. Serra, and J. Shopley, "COMMENT: IETA Council Task Group on Digital Climate Markets—Key Findings and Recommendations," Carbon Pulse, March 28, 2022.
132 G. Terzo, "Mark Cuban Thrusts Carbon Economy Crypto Project Into Spotlight," Yahoo!Finance, November 16, 2021.
133 S. Reklev, "Crypto Carbon Demand Brings Back Shunned HFC-23 Credits," Carbon Pulse, December 13, 2021.
134 Climate Warehouse, "Exploring the Potential of Emerging Technologies for Connecting Climate Markets," accessed March 29, 2022.
135 S. Reklev, "Blockchain Door Closing for Older Carbon Credits," Carbon Pulse, March 3, 2022.
136 S. Reklev, "Tech Firm Raids BCT Pool Ahead of Nature-based Carbon Token Launch," January 31, 2022.
137 S. Leugers, "COMMENT—Blockchain for Better: Untangling Tokenisation and Carbon Markets," Carbon Pulse, March 8, 2022,
138 Leugers, "COMMENT."
139 See e.g., Gold Standard, "Terms of Use," 2019,
140 Grady et al., "COMMENT."
141 UNFCCC, *Nationally determined contributions under the Paris Agreement: Synthesis report by the secretariat. Conference of the Parties serving as the meeting of the Parties to the Paris Agreement. Third session Glasgow*, 31 October to 12 November 2021 (Bonn, Germany: UNFCCC, 2021).
142 IETA, *The Anatomy of the Carbon Market. Maximising Climate Ambitions*. Article 6, 2021.
143 R. Macquarie, "Searching for Trust in the Voluntary Carbon Markets," *LSE Business Review*, February 16, 2022.
144 F. Schwartzkopff, "Crazy Carbon Offsets Market Prompts Calls for Regulation," Bloomberg, January 6, 2022.
145 Azil et al., Putting Carbon Markets to Work.
146 New Climate Institute, Corporate Climate Responsibility Monitor.
147 D. Ingemar Hedin, "Net Zero and Carbon Neutral Claims Under Scrutiny," Euromonitor International, January 21, 2022.
148 D. Cullenward and D. Victor, "Chapter 6: Offsets," in *Making Climate Policy Work* (Cambridge, England: Polity Press, December 2020).
149 C. Streck et al., "We Must Protect Intact Forests, but CORSIA Got It Wrong," Carbon Pulse, April 14, 2022.
150 Federal Office for the Environment of Switzerland, *Agreements Article 6*.
151 Swedish Energy Agency, "COP26: Ghana and Sweden Signs Agreement for Cooperation under the Paris Agreement," November 10, 2021.
152 Gold Standard, "Gold Standard and Swedish Energy Agency Partner to Ensure Integrity International Cooperation under the Paris Agreement," August 25, 2021.
153 VCMI, *Feedback on VCMI Consultation Report*, 2021; VCMI, *Roadmap: Ensuring High-Integrity Voluntary Carbon Markets*, 2021.

154 The World Bank, "Mitigation Action Assessment Protocol."
155 See e.g., A. Bjørn, S. Lloyd, and D. Matthews, "From the Paris Agreement to Corporate Climate Commitments: Evaluation of Seven Methods for Setting 'Science-Based' Emission Targets," *Environmental Research Letters 16*, no. 5 (2021): 054019.
156 Science-Based Targets Initiative, "Companies Taking Action," 2021.
157 SBTi, "Business Ambition for 1.5°C."
158 J. Hall and J. Bednar, "Carbon Removal Will Cost as Much Annually as the NHS Budget—but Oxford Research Shows Polluters could Pay," University of Oxford News, October 6, 2021.
159 European Commission, *EDGAR—Emissions Database for Global Atmospheric Research. Global Greenhouse Gas Emissions*. EDGAR v6.0.
160 Environment and Climate Change Canada, "National Inventory Report 1990–2020: Greenhouse Gas Sources and Sinks in Canada," *Canada's Submission to the United Nations Framework Convention on Climate Change*, April 14 2022.
161 Massachusetts Department of Environmental Protection on behalf of the Commonwealth of Massachusetts, "Market Monitor Report on the Electricity Generator Emissions Limits Program (310 CMR 7.74): Auction 2022-2," March 18, 2022.
162 Intercontinental Exchange, Inc., "Report Center."
163 RGGI, Inc., "RGGI CO2 Allowance Tracking System. Transaction Price Report."
164 Intercontinental Exchange, Inc., "ICE Futures Europe. UKA Futures."
165 International Monetary Fund, *Exchange Rate Archives by Month.*
166 Transportation and Climate Initiative Program, "Transportation and Climate Initiative Program – Memorandum of Understanding", December 2020.
167 Gold Standard, "Google.org Backs Gold Standard to Build Digital Solutions to Help Carbon Markets Work for Climate Justice" [Media Release], February 10, 2022.
168 Gold Standard, "Google.org Backs Gold Standard."
169 Verra, "Public Consultation: Updates to VCS Avoiding Unplanned Deforestation and Degradation (AUDD) Methodologies," March 31, 2022.
170 Climate Action Reserve, "Biochar Protocol," June 23, 2021.
171 Climate Action Reserve, "Biochar Protocol."
172 Climate Action Reserve, "Biochar Protocol."
173 American Carbon Registry, "ACR Launches Innovative Registry Infrastructure for Removal Credits," April 18, 2022.
174 UNFCCC, "Matters relating to Article 6 of the Paris Agreement: Rules, modalities and procedures for the mechanism established by Article 6, paragraph 4, of the Paris Agreement," 2021.
175 ICAO, *CORSIA Newsletter May 2021*, May 2021.
176 ICAO, *CORSIA Newsletter March 2022*, March 2022.