G20 INDONESIA 2022

CLIMATE SUSTAINABILITY WORKING GROUP (CSWG) G20 2022

TOWARDS LOW GHG EMISSION AND CLIMATE RESILIENCE FUTURE THROUGH UTILIZING ECONOMIC VALUE OF CARBON

Final Report

September 2022

STUDY 3.2

TOWARDS LOW GHG EMISSION AND CLIMATE RESILIENCE FUTURE THROUGH UTILIZING ECONOMIC VALUE OF CARBON

Indonesia, September 2022

Recover Together, Recover Stronger

Authors :

Contributors :

Acknowledgements

Authors

This report is a joint publication led through the United Nations Development Programme (UNDP) and adelphi Consult. The researchers and experts from Adelphi are working together through research, policy assistance, and support.

Contributors

We thank the Ministry of Environment and Forestry of the Republic of Indonesia for its pivotal framing perspectives and all delegates of G20 CSWG for their detailed comments on the content of the report as well as all G20 members who provided valuable insights in virtual workshops and through a written survey in coordination with Global Green Growth Institute (GGGI) and NDC Partnership.

This project is mainly funded by UNDP Climate Promise, in coordination with Global Green Growth Institute (GGGI) and NDC Partnership (NDCP).

Executive Summary and Recommendations

Ever-high concentrations of greenhouse gas emissions will cause wide-ranging damages to our economies and societies, from reduced agricultural productivity and rising sea levels to adverse impacts on infrastructure and livelihoods from increased extreme weather events. These effects are already visible today, and without action, will only worsen in the coming decades. Failure to account for these current and future damages means that decisions made today are not necessarily aligned with those required for the low-carbon transition and to build a climate resilient future.

Through utilizing the economic value of carbon, the actions of decision-makers in the public and private sectors can become consistent with national targets, as well as the temperature goals of the Paris Agreement. Governments can use it to provide systemic, economy-wide signals to incentivize changes in behavioral and investment patterns away from carbon-intensive practices and towards low-carbon alternatives.

The role of G20 members – representing over 85% of the world's GDP, around two thirds of its population and responsible for around 75% of global GHG emissions – will be decisive. Many are already pursuing measures to utilize the economic value of carbon, or plan to do so soon. The ways in which they value carbon vary. One of the clearest is through placing a direct price on emissions. This approach has expanded significantly in recent years, with 11 of the G20 members having already implemented national-level carbon pricing instruments, with more members in the process of, or considering, doing so. A variety of subnational level systems are also in operation in G20 members.

Direct carbon pricing is not the only way of utilizing the economic value of carbon. Other policies – ranging from internal and shadow carbon pricing, through to fuel taxes and climate regulations – can, in different ways, use a value of carbon to influence consumption and investment decisions. These measures are numerous and varied within G20 members.

This study has been developed for the G20 Climate Sustainability Working Group (CSWG) to inform and make recommendations on enhancing the economic valuation of carbon within members. It focuses primarily on the experiences and lessons learned from 20 years of implementing direct carbon pricing instruments (CPIs) in a range of different member contexts. The focus on direct instruments is motivated by their theoretical appeal to deliver emission reductions cost effectively; their adoption among G20 members and beyond; as well as their efficacy in reducing emissions in practice. Broader approaches to carbon valuation are addressed where relevant, to give a fuller picture of the diversity of approaches currently pursued.

The study benefited from oral and written comments from G20 members in the preparation phase, as well as responses to a survey on their experiences with implementing carbon pricing.

The recommendations of this study fall under two categories, as follows:

Implementing measures to utilize the economic value of carbon

- Expand the coverage of the measures that utilize the economic value of carbon. As a first step, members must increase the share of emissions covered by measures that impose some form of carbon value in order to ensure more decision-makers are incentivized to reduce GHGs.
- Develop an approach that is appropriate to the member's objectives and circumstances. Introducing measures to utilize the economic value of carbon requires tailoring design features to the domestic context. It is often possible to work with rather than push against local constraints when designing successful measures.
- Start simply and build over time – both in ambition and complexity. Initially targeting sectors with few large emitters and pre-existing high-quality emissions data can help build experience with various instruments. Once the foundations are laid – and businesses as well as citizens become familiar with the idea of carbon costs and find low-carbon alternatives – the approaches can evolve, and ambition can be raised.
- Build facility-level and public sector MRV capacity, especially in developing country members, as a no-regrets measure. Even if these efforts do not lead to direct mandatory carbon pricing, they will improve the accuracy of emissions reporting in national inventories, facilitate countries' access to results-based finance and voluntary carbon markets, as well as participation in Article 6 mechanisms.
- Increase efforts to reduce and remove inefficient fossil fuel subsidies and aim to remove all fossil fuel subsidies in the long run. Such subsidies can act as a negative carbon price and undermine the effectiveness of approaches to create an economic value of carbon.
- Use revenues collected to support and engage the most vulnerable income groups and regions and communicate specific co-benefits of emissions reduction for them as key components of building public acceptance and enabling a just transition.
- Assess the performance of carbon pricing instruments regularly and reform them, when necessary, through an inclusive and transparent process. Socio-economic impact evaluations are a key tool to assess the effect of measures utilizing the economic value of carbon and to develop further measures to limit any adverse consequences.

Enhancing collaboration among G20 members

- Establish a more structured forum for sharing experiences to enable all G20 members, especially those at earlier stages of design and implementation, to learn from the wealth of experience of G20 members in the different approaches towards placing an economic value on carbon.

- Commence discussions on a collaborative framework to address carbon leakage during the low-carbon transition. G20 members should start discussions now on how to address the risk of carbon leakage in a cooperative manner at the international level, given the different national circumstances. The framework should aim to minimize the risks of carbon leakage while maximizing the benefits from international trade.
- Extend support beyond G20 members. Drawing on their extensive experience with CPIs as well as with carbon markets under the Kyoto Protocol, members should actively engage with and build technical capacity in developing countries outside the G20. This will facilitate a cost-effective low-carbon transition utilizing the economic value of carbon more broadly and enable these countries to participate equitably in Article 6 mechanisms.

Table of Contents

1. Introduction

Climate change has been labelled the "greatest market failure the world has ever seen". Its costs are not fully borne by those who emit greenhouse gas emissions (GHGs) and, as a result, there is a strong incentive to over-emit. Making the economic value of carbon explicit is central to correcting this market failure. It enables the costs of GHGs to be factored into decision-making today, increases the attractiveness of using and investing in low-carbon processes and technologies, and thus helps to ensure that current activities are consistent with those needed for the transition to a low-carbon and resilient society.

The role of G20 members – representing over 85% of the world's GDP, around two thirds of its population and responsible for around 75% of global GHG emissions – will be decisive in this transition. All G20 members have submitted updated nationally determined contributions (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC), most of which include an increased target for emissions reductions as compared with their previous NDC.[1] G20 members will meet their short- and long-term goals through a wide range of measures and for many, utilizing the economic value of carbon will play an important part.

Although approaches vary in their specifics and calculations in practice, the broadest notion of the economic value of carbon relates to the damages associated with additional GHGs in the atmosphere – and therefore the value or benefit of avoiding them. One way of considering it is as 'the net present value of future worldwide damages (often up to 100 years in the future or longer) avoided by removing or preventing an additional ton of CO_2 emissions at a certain point in time.' This monetary figure can then be used as 'benchmark or reference value to assess the impacts and effectiveness of low-carbon policies and actions within the public and private sectors' (UNFCCC Secretariat 2016).

The economic value of carbon can be utilized in different ways. One of the most effective is through pricing GHG emissions directly, as one of the tools in a broader climate policy mix. Direct carbon pricing provides a financial incentive to reduce emissions by encouraging changes in production, consumption, and investment decisions. The High-Level Commission on Carbon Prices concluded that 'an explicit carbon-price level consistent with achieving the Paris temperature target is at least USD 40–80/tCO_2 by 2020 and USD 50–100/tCO_2 by 2030, provided a supportive policy environment is in place' (CPLC 2017). Pricing carbon could also bring significant fiscal benefits for governments. An IMF/OECD report for G20 finance ministers concluded that 'a USD 50 per ton of CO_2 carbon price in 2030 would generate revenue increases of around 1% of GDP for many G20 members and substantially more than that in a few cases.' (IMF & OECD 2021). Recent years have seen progress, with an increasing portion of emissions covered by an operational carbon pricing instrument (CPI), estimated at around 23% of global GHG emissions in 2022 (World Bank 2022). With some exceptions, price levels remain outside of the range identified by the High-Level Commission, although have been on an upward trend in recent years.

1 Türkiye submitted its first NDC to the UNFCCC in October 2021.

Box 1: Different ways of utilizing the economic value of carbon

The economic value of carbon can be utilized in various ways. The first is to inform the design of **carbon pricing instruments (CPIs).** These apply a **direct price** on GHG emissions caused by an activity. There are two primary ways of realizing this price. **Emissions trading systems (ETSs)** place a limit on the total amount of GHGs, with regulated entities required to obtain and surrender an allowance for each ton of GHG they emit. ETSs can also function as a relative system, where entities earn allowances or credits if they outperform a given emissions performance standard. In both types of systems allowances can then be traded between participants, with the carbon (i.e. allowance) price determined by the market. Alternatively, the price of carbon is set directly by the government in the case of a **carbon tax** and is often levied based on the carbon content of fuels. **Crediting mechanisms,** which generate emissions reductions or 'offset' credits, can also establish a price on carbon, but to do so require a source of demand for the credits.

A carbon price can be realized **indirectly** through instruments or policies that affect the price of products or activities associated with GHGs – and therefore from which a carbon price can be implied. These policies are often implemented for reasons other than incentivizing emissions reductions. A common example in G20 countries are **fuel taxes,** which while primarily in place to raise revenues, also establish an implicit price of carbon.

Many actors utilize an economic value for carbon to inform decision-making processes, regardless of whether there is a direct carbon price in operation. Carbon valuation can be applied as part a cost-benefit analysis of **regulations and policies** to support better policy design and lay the groundwork for CPIs in the future. This could include determining appropriate levels for renewable energy generation support measures such as feed-in-tariffs. The public and private sectors can also use a value for carbon when **appraising projects and investments.** This helps align their actions with future climate policies and the economic opportunities associated with GHG reductions, as well as raising investor confidence that climate risks have been considered in their decisions. An increasing number of businesses use such **shadow carbon pricing** to support long-term strategic planning (UNFCCC Secretariat 2016).

Aside from direct carbon pricing the economic value of carbon can be and is utilized in other ways, as outlined in Box 1. Irrespective of the method pursued, tools to utilize the value of carbon form only one part of a broader policy mix. A well-balanced policy portfolio should also include complementary measures such as incentives for low-carbon technology R&D and deployment, investments in low-carbon public infrastructure such as smart grids and low-emissions transport infrastructure, as well as technology and performance standards and phase-out policies where required. The appropriate role and means of valuing carbon – as well its place within the broader policy framework – will naturally vary between members, reflecting the diversity of national circumstances of G20 members and their respective commitments under the Paris Agreement.

This report takes stock of the lessons learned from nearly 20 years of valuing carbon, primarily, but not exclusively, in the context of the developed G20 members. The focus lies foremost on direct carbon pricing. CPIs provide the clearest and most transparent way of correcting the market failure in a non-discriminatory manner. The geographical expansion of CPIs – particularly in the last half-decade – enables a comparison of their implementation in a wide variety of different member contexts. The lessons learned are drawn in the first instance from national-level instruments; sub-national systems, of which there are many in G20 members, are addressed where they provide relevant examples. Alternative ways of utilizing the economic value of carbon are also discussed where appropriate, to give a fuller picture of the diversity of approaches currently pursued within the G20.

2. Key principles and lessons learnt from implementation of carbon pricing instruments in G20 members

2.1 Status of carbon pricing instruments in G20 members

While implementing a carbon price is an effective way of utilizing the economic value of carbon to encourage emissions reductions, they are not necessarily the same thing. The economic value of carbon captures the cost of additional GHGs. This can then be used to inform the design of CPIs: for example, establishing a price level consistent with a government's climate goals by setting a carbon tax rate equal to the economic value of carbon. In practice, CPIs have not worked like this. Prices tend to be more influenced by political acceptability, economic circumstances, market dynamics and by the cost of available abatement technologies. Nevertheless, carbon pricing is still a useful way of internalizing some – if not always all – of the costs reflected in the economic value of carbon. Sections 2.1.1 – 2.1.3 provide an overview of the carbon pricing instruments currently in force in G20 members at both national and subnational levels, with further details included in the relevant member factsheets in the Appendix.

2.1.1 Carbon pricing experience in G20 members

G20 members are using carbon pricing instruments as part of their climate policy portfolio. A majority of G20 members have either a carbon tax or an ETS at the national or subnational levels.[2] Seven members have carbon taxes implemented at the national level and three at the subnational level. Seven members have emission trading systems implemented at the national level and five at the subnational level. Figure 1 and Figure 2 provide key facts and an overview of the carbon taxes and ETSs that have been implemented in G20 members at the national level, with Table 1 providing a more detailed overview of instruments implemented at the national level and supplementary information of instruments implemented at the subnational level.

2 In the case of the EU, the EU ETS is considered a 'national' instrument, with non-G20 EU member state CPIs considered to be 'subnational'. The separate CPIs of Germany and France are here counted as 'national'.

Carbon pricing instruments in G20 members

Most G20 members are implementing either a carbon tax or an emissions trading system.

USD 16 billion raised from national carbon tax revenues in 2021.

USD 52 billion from auction revenues from national ETSs in 2021.

National carbon pricing instruments cover ca. 38% of the aggregate emissions of G20 members

Figure 1: Key facts regarding carbon pricing instruments
Source: Author's calculations based on World Bank Carbon Pricing Dashboard and ICAP ETS Map.

Several G20 members implement both a carbon tax and ETS on a national or subnational level. This is evidence that different instruments can be implemented simultaneously to complement each other. For example, the EU has an ETS which covers all the EU members, and Norway, Iceland, and Liechtenstein. Meanwhile, several EU members such as **France** also implement carbon tax, while **Germany** implements a complementary ETS.

Other G20 members are planning or exploring the implementation of carbon taxes or ETSs. Indonesia is planning to implement a carbon tax and ETS in 2022 and **Russia** intends to launch a pilot ETS in the island of Sakhalin soon. In **India**, in 2021 the government published a blueprint for a national carbon market, which is initially voluntary but is intended to transition to a mandatory ETS. In July 2022, the federal government has moved to launch a national carbon market by proposing to amend the Energy conservation Act of 2001.

At the state level, government of Gujarat recently signed a memorandum of understanding with external partners for the implementation of an ETS. Moreover, other G20 members, such as **Türkiye** and **Brazil,** are considering the role that a carbon pricing instrument could have in their climate policy portfolios.

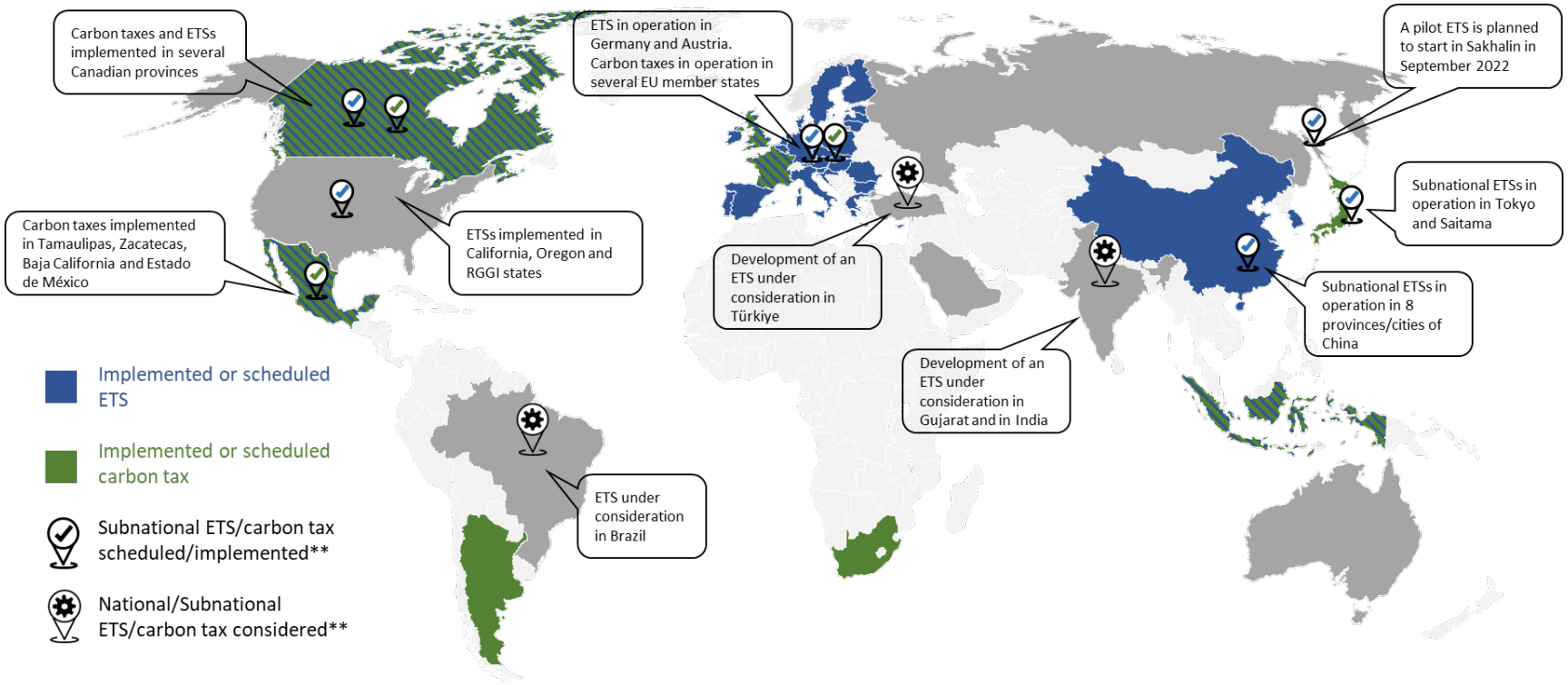


Figure 2: Overview of national carbon tax and ETS in G20 members*

* In the case of EU, national refers to EU level instruments and subnational refers to member state level instruments.

** For a full list of subnational jurisdictions with a carbon pricing policy implemented or planned for implementation, consult the factsheets in Section 5.

Source: Authors' own work based on World Bank Carbon Pricing Dashboard and ICAP ETS Map.

Table 1: Overview of national and subnational CPIs in force in G20 members

		Country	Instrument (start year)	Sector coverage	Revenues in 2021	Coverage of national emissions	Subnational CPIs (revenues in million USD 2021)
National ETSs		China	National ETS (2021)		n/a	33%	ETS Pilots: Beijing (n/a), Chongqing (39.7), Fujian (n/a), Guangdong (n/a), Hubei (13.3), Shanghai (3.4), Shenzhen (n/a), Tianjin (11.7)
		Republic of South Korea	National ETS (2015)		USD 257.7 million	73%	n/a
		European Union	National** ETS (2005)		USD 37000 million	41%	ETS: Austria (n/a), Germany (8500) Carbon taxes: Denmark (468), Estonia (2), Finland (1547), France (8400), Ireland (542), Latvia (7), The Netherlands (n/a), Poland (1), Portugal (331), Slovenia (145), Spain (77), Sweden (2267)
		Germany	National ETS (2021)		USD 8500 million	40%	n/a
National ETS and carbon taxes		Mexico	National ETS (2020) National carbon tax (2014)		n/a USD 314 million	40% 44%	Carbon taxes: Baja California (1), Estado de México (n/a), Tamaulipas (2), Zacatecas (0.5)
		United Kingdom	National ETS (2021) National carbon tax (2013)		USD 5900 million USD 690 million	28% 21%	n/a
		Canada	National ETS (2019) National carbon tax (2019)		USD 264 million USD 4798 million	7% 22%	ETS: Québec (902), Nova Scotia (35.7), Newfoundland and Labrador (n/a), New Brunswick (n/a), Alberta (294), Saskatchewan (n/a), Ontario (n/a), Carbon taxes: British Columbia (2293), Northwest Territories (25.9), Newfoundland and Labrador (78.5), New Brunswick (98.9), Prince Edward Island (24.5)
National carbon taxes		Argentina	National Carbon tax (2018)		USD 272 million	20%	n/a
		Japan	National Carbon tax (2012)		USD 1800 million	75%	ETS: Tokyo, Saitama
		South Africa	National Carbon tax (2019)		USD 94 million	80%	n/a
		France	National Carbon tax (2014)		USD 8400 million	35%	n/a
Sub-national only ETS		United States	Only sub-national ETS	n/a	n/a	n/a	ETS: RGGI (926), California (44 258), Massachuetts (44), Oregon (n/a)

Legend: Industry, Power, Buildings, Waste, Domestic aviation, Transport, Fuels

** *See footnote 1 for the special case of the EU.*

Source: Authors' own work based on World Bank Carbon Pricing Dashboard and ICAP ETS Map.

2.1.2 National ETSs and their features in G20 members

Seven G20 members implement national ETS.[3] The first ETSs in G20 members are around two decades old, with the UK ETS starting its implementation as a voluntary system originally in 2002 and the EU ETS starting its first phase in 2005. The most recent systems were launched in 2021 (China, Germany, UK) and have significantly increased the coverage of carbon pricing instrument not only among G20 members, but worldwide. Summary information on the national ETSs implemented by G20 members is presented in Table 1.

Scope and coverage of ETSs in G20 members varies among systems. Sectoral coverage depends on the role of an ETS within the policy mix. Major emitting sectors such as power and industry are commonly covered.[4] The scope of GHG gases that systems cover also varies; while all ETS cover CO_2 – which is relatively easy to monitor – some systems also cover other GHGs.

ETSs in G20 members in which allowances are auctioned have generated substantial revenues for governments. Collectively, auctioning of allowances in G20 members generated over USD 52 billion in 2021. Revenues raised varied from close to USD 260 million in Republic of Korea (where at least 10% of allowances must be auctioned) to USD 37,000 million in the EU (where 57% of allowances are auctioned). In 2021, carbon prices hit record highs in the markets of some G20 members such as EU, the UK and California (in the US) (ICAP 2022).

2.1.3 National carbon taxes and their features in G20 members

Seven G20 members across all five regions implement national level carbon tax.[5] Although carbon taxes have been implemented in some European countries since the 1990s, the use of carbon taxes in G20 members is a more recent development, with the oldest instrument starting in **Japan** in 2012. A carbon tax on emissions from the power sector has been legislated for in Indonesia in 2022 and is scheduled to come into force soon.

Most of these taxes cover the power sector, and some of them, such as the **French** and Japanese taxes, have used existing tax structures for their collection. In **Japan, France** and **South Africa,** existing carbon taxes also cover transport sector emissions. Carbon taxes in G20 members typically apply to CO_2 emissions from the combustion of all fossil fuels but there are exemptions, for instance for natural gas in **Mexico** which is considered a transition fuel from oil and coal to renewables.

G20 members raised over USD 16 billion in 2021 from carbon tax revenues. Revenues raised varied from USD 94 million in **South Africa,** to USD 8,400 million in **France.** Three G20

3 Members implementing a national ETS: Canada; China; EU; German; Mexico; Republic of Korea; and UK.

4 Coverage of industrial sectors differ across systems but could include refineries, steel works, and production of iron, aluminum, metals, fertilizers, cement, lime, glass, ceramics, pulp, paper, cardboard, acids and bulk organic chemicals among others.

5 Members implementing a national carbon tax include: Argentina; Canada; France; Japan; Mexico; Republic of Korea; and UK.

members raised over USD 1 billion in 2021: **Japan, France** and **Canada** (Table 1). Revenues from carbon taxes are used for several purposes. In **Canada** they are redistributed to the subnational jurisdictions in which they were raised, and the governments of the provinces and territories can use them as they see fit. In **France,** they help finance the energy transition. In **Argentina,** they fund social security, transport, housing, and other programs.

2.1.4 Subnational carbon taxes and ETSs in G20 members

Subnational carbon pricing instruments are being implemented in six G20 members. The oldest of these instruments is the ETS program that spans 11 north-eastern US states ("RGGI") which came into force in 2009. The most recent is the Austrian national ETS, which started operation in 2022.

Subnational carbon pricing instruments can complement, reinforce or provide valuable lessons learned for national instruments. In some cases, such as in China, the regional ETSs served as pilots, provided lessons for the national ETS, and now are in operation alongside with the national ETS to complement it. In others, such as the **German** and Austrian national ETSs, they serve to cover emissions not covered by the **EU** ETS. Subnational carbon pricing instruments can additionally serve as a local mechanism to control GHG emissions, therefore reinforcing climate policy measures that national governments put in place, such as the subnational carbon taxes in **Mexico,** or the California cap-and-trade program and RGGI in the **US.** In **China,** years of experience with regional pilots covering nearly 3,000 installations in more than 20 industries provided value lessons learned for the national ETS in 2021.

2.2 Utilizing the economic value of carbon: lessons learned from designing and implementing CPIs in the G20

In the past 20 years both ETSs and carbon taxes have been successfully implemented in varied circumstances and at different levels. Having started out in developed countries, progress in recent years shows CPIs can also be an appropriate tool for developing country members. An important enabler for this progression has been the adaptability of CPIs to suit local circumstances, with design features of the same instruments varying between members. Progress has also been made at the sub-national level (e.g. **Canada, US**) and experience shows that this may be a more appropriate in some member contexts.

2.2.1 Choosing an approach

Carbon taxes have been easier to implement from a technical perspective and may be more attractive to developing country members – but low public acceptability remains a major challenge. Most G20 members with carbon taxes levy it 'upstream', i.e. at the point of distribution, import or production of the fuel. This significantly simplifies administration, as the carbon tax can utilize existing tax processes (e.g. for collecting fuel excise duties) and fiscal infrastructure, minimizing the administrative burden for both public authorities and liable entities. Levying it downstream i.e. at the point of emissions (e.g. **South Africa, UK**) is more complex and requires a robust emissions monitoring, reporting and verification

(MRV) system. Carbon taxes can also effectively be introduced as part of a program of tax reform: **Argentina's** carbon tax was introduced as part of a wider package, which simplified the overall approach to taxing liquid fuels (Republic of Argentina 2018).

ETSs are significantly more complex to implement and require supporting infrastructure to function properly. ETSs give certainty over emissions reductions and should in theory support cost-effective abatement. In practice, experience has shown that they are significantly more complex to establish and administer than carbon taxes and therefore rely on greater capacities in both public and private sectors. They also require supporting infrastructure to function: a registry to track holdings and transactions of allowances, as well as an exchange on which to trade them; and robust MRV and enforcement systems are critical for the integrity of an ETS. ETSs are therefore often developed in a stepwise manner: for example, in **Mexico** a mandatory MRV system pre-dated the start of the pilot ETS, and the registry entered into operation after the ETS had formally begun. In **China** systematic training was provided for local authorities, other relevant institutions and for companies on topics including data collection and submission, allowance allocation methods and administrative operation of the ETS.

Crediting mechanisms will continue to be an important means of mobilizing finance to support NDC implementation and deliver adaptation and sustainable development co-benefits. Developing country G20 members have been major beneficiaries of crediting mechanisms. Out of the top ten countries with the highest number of registered Clean Development Mechanism (CDM) projects, six are G20 members (**China, India, Brazil, Mexico, Indonesia, Republic of Korea**). The UNFCCC estimates that the CDM has mobilized more than USD 300 billion of investment, much of which has involved G20 members (UNFCCC 2018). G20 members could continue to benefit under Article 6 of the Paris Agreement. Independent modelling of the potential benefits of Article 6 suggests that B**razil, India, Indonesia,** and **Russia** could be among the largest suppliers of credits, implying significant financial inflows (Edmonds J.A. et al. 2021). Crediting mechanisms need a reliable source of demand to be effective. The demand could come from international buyers (e.g. Article 6 mechanisms and CORSIA) or generated domestically by implementing a crediting mechanism alongside an ETS/carbon tax. Examples include **China, Mexico,** and **South Africa** where domestically generated offsets can be used to meet a portion of CPI obligations. In **Australia,** the government competitively procures offset credits generated through the national crediting mechanism.

Other ways to utilize the economic value of carbon can function alongside – or even in the absence of – CPIs. G20 members pursue different routes to value carbon – directly or indirectly – regardless of whether there is a CPI in place. As shown in Figure 3 the indirect price applied through fossil fuel taxes is higher, often significantly, than the direct price in nearly all G20 members. Incentives to deploy carbon capture and sequestration (CCS) technologies to reduce emissions, or to remove CO_2 from the atmosphere, also place an economic value on carbon. The US provides tax credits, known as the Section 45Q credit, for geologically sequestering or other qualified use of CO_2 (Jones and Sherlock 2021; Beck and

Lee 2020). REDD+ provides similar incentives for the land use sector to reduce emissions and increase removals of CO_2 from the land use sector and has active projects in several G20 members. During its G20 presidency, **Saudi Arabia** advanced the notion of a carbon circular economy, which can be supported by utilizing the economic value of carbon (Al Shehri et al. 2022). **India's** Perform Achieve Trade (PAT) scheme, a tradeable performance standard, primarily targets energy efficiency and places an implicit price on carbon and could evolve into a national carbon market under the current plans (Bureau of Energy Efficiency 2021). The country also has an renewable energy certificate (REC) market which supports the generation of carbon-free power and indirectly contributes to emissions reductions from the power sector.

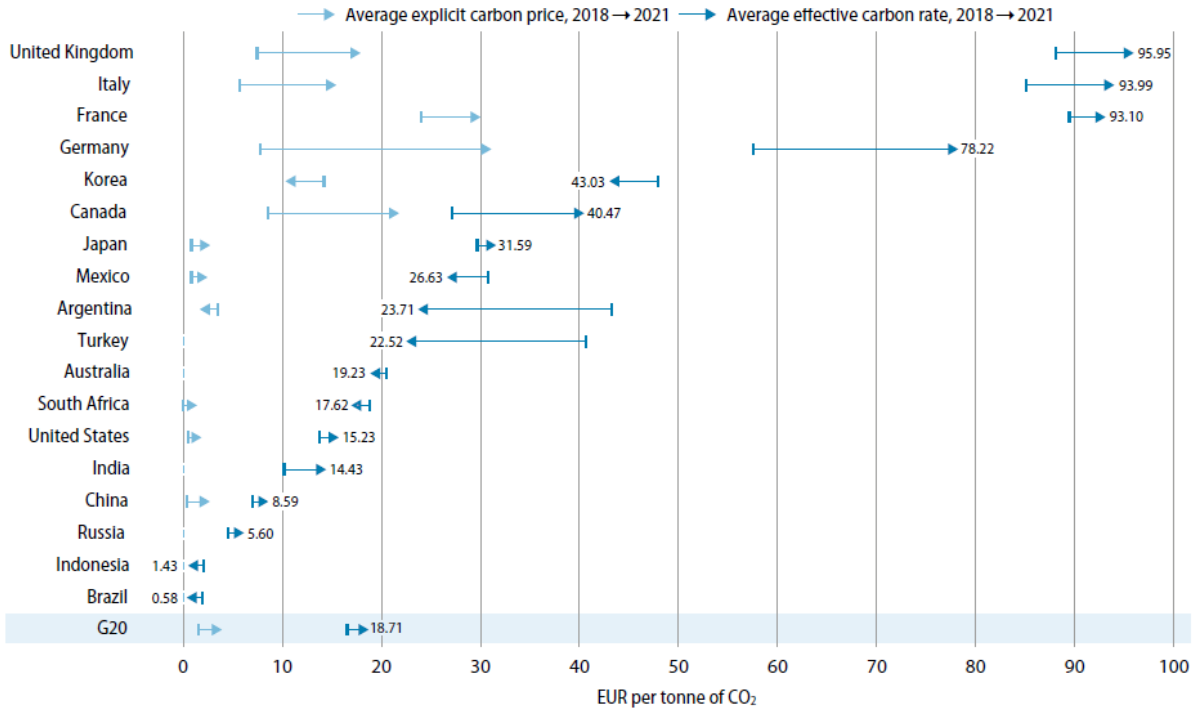


Figure 3: Average carbon prices (€) in G20 members, 2018-2021[6]
Source: OECD (2021), Carbon Pricing in Times of COVID-19: what has changed in G20 economies?

Internal carbon pricing is expanding, but largely in response to current and expected future government action. As of 2020, more than 2000 companies with a combined market capitalization of over USD 27 trillion disclosed their current or planned use of an internal carbon price, up 80% in five years. This is mostly implemented through a shadow carbon price – with a median value of USD 25/tCO_2 – to drive low-carbon investment, energy efficiency improvements and behavioral change. Expectation of near-term carbon pricing

6 Excludes Saudi Arabia. Explicit carbon prices reflect ETS auction price and carbon tax rates. Effective carbon prices are the total of explicit prices and indirect prices levied through fuel taxes. Prices are averaged across all energy-related CO_2 emissions, including those not covered by a CPI.

regulation makes a company more than five times more likely to use an internal carbon price; where there is no such expectation, only 14% of companies reported using or planning to use an internal carbon price. This suggests that there may be limited to scope for internal carbon pricing as a means of utilizing the economic value of carbon on a widescale without accompanying government action (CDP 2021).

2.2.2 Choosing the scope

Energy-related CO_2 emissions are the biggest source in the G20 and are the primary target of CPIs. Energy-related CO_2 emissions make up around 80% of all GHG emissions from G20 members and lie at the heart of the transition (OECD 2021). Covering energy-related emissions under an ETS or carbon tax is both common practice and relatively simple. All national-level G20 ETSs cover energy-related emissions from electricity generation and industry.[7] Carbon taxes, which are mostly levied upstream on fuels, also target energy-related emissions by design. CPIs can be particularly effective for reducing emissions from electricity generation, where they drive fuel switching and, increasingly, a shift to renewable generation. The clearest example is the **UK**, where the carbon price played an important role alongside other policies in reducing the use of coal, which fell from 40% of generation in 2012 to 1.8% in 2020.[8] Other energy-related emissions – for instance from road transport, which is a significant and growing source in G20 members – have so far proven less responsive to carbon pricing, as consumers have fewer available alternatives. Reducing emissions in these and other sectors requires complementary policies some of which are listed in Figure 4.

Expanding explicit carbon pricing beyond energy-related emissions poses challenges. Pricing emissions other than energy and from industrial processes – which are covered in the ETSs of **EU, Republic of Korea** and **UK** – will be challenging. The agriculture, land use, land use change and forestry (LULUCF), and waste sectors are often characterized by lots of small emitters and are sources for which robust MRV is harder to ensure. At present the waste sector is only covered in one ETS (**Republic of Korea**). For some G20 members this could materially impact the attractiveness and effectiveness of carbon pricing. In **Brazil** emissions from agriculture, LULUCF and waste represented more than more than 60% of national GHG emissions in 2016.[9] In this instance, crediting mechanisms or other ways of valuing carbon – such as payments for ecosystem services or behavioral incentives, for example, to reduce meat consumption – may be more appropriate. Figure 4 assesses the relative effectiveness of carbon pricing in different sectors and appropriate companion policies, some of which can also give an economic value to carbon.

7 Currently, China National ETS only covers the power sector but is expected to expand to industrial sectors.

8 See for a press release from the UK government: https://www.gov.uk/government/news/end-to-coal-power-brought-forward-to-october-2024

9 https://unfccc.int/sites/default/files/resource/BUR4.Brazil.pdf

Figure 4: Relative effectiveness of carbon pricing in driving emissions reductions in different sectors and relevant companion policies

Source: adapted from ICAP (2020b), Emissions Trading Worldwide: Status Report 2020; Burke et al. (2019), How to price carbon to reach net-zero emissions in the UK

2.2.3 Setting the ETS cap or carbon tax rate

Good ETS design – including setting the cap – starts with good data. An ETS cap is the total amount of allowances issued by government over a particular period. It can be determined ex-ante by setting an upper limit on allowable emissions (e.g. **EU** and **Korean** ETSs) or ex post based on benchmarks and levels of production (e.g. **China** National ETS and **Indonesia** pilot ETS). The cap is the crucial component in determining the ambition of the system and the carbon price it delivers. Calculating the cap requires accurately measured and truthfully reported data. Decision making based on poor data can lead to a cap higher than actual emissions – as happened in the first phase of the **EU** ETS – eliminating the incentive for companies to abate. A mandatory prior MRV system and an initial pilot ETS phase – both of which were pursued in **Mexico** – are ways of addressing this. The robustness of cap setting, as well as the stringency of the cap, can develop over time in line with improved data.

Recent innovations in ETS design mean that they can now offer greater price stability. A common criticism of ETSs over the past decade has been that persistently low prices, caused by a surplus of allowances, have provided a weak incentive to reduce emissions. Recent reforms (e.g. **EU, UK**) have made systems more responsive, for instance by removing allowances from the market in the case of a surplus and introducing more allowances in the event of price spikes. These new mechanisms – to support prices when they drop too low and to respond flexibly when they rise too high – allow for greater influence over the carbon price, ensuring it remains at a politically acceptable level consistent with the member's targets.

Appropriate and politically acceptable carbon tax rates vary between members, although specific design features can help their introduction. Whether the tax targets a certain level of revenue or aims to achieve a certain amount of emission reductions will impact the rate at which it is set. Like all taxes, they are subject to political constraints: in both **Argentina** and **Mexico** the legislated tax rates were lower than those originally proposed by the government. Designing carbon taxes to be impact-neutral – at least in the initial stages – can ease their introduction and political acceptability. In **South Africa,** the tax was designed so as not to have an impact on energy prices in the first phase (2019-22).

A carbon tax price trajectory offers longer-term certainty but can be difficult to follow in practice. A price trajectory – setting out in advance by how much the tax will increase over a given period – provides businesses with longer-term certainty and can help support investment. Many G20 members (e.g. **Canada, South Africa**) have taken this path; however trajectories are not always easy to follow. The **UK** carbon tax, intended to reach GBP 30/tCO_2 by 2020, has been frozen at GBP 18/tCO_2 since 2014.[10] The **French** carbon tax, which was due to reach EUR 86.2/CO_2, was abandoned following protests in 2018 and is currently frozen at EUR 44.6/tCO_2. Concerns over energy prices, the impact on households and effects on industrial competitiveness can prove compelling reasons to not to increase a carbon tax as originally planned.

2.2.4 Approach to leakage protection

Leakage has been a big ex-ante concern, although empirical evidence establishing its existence ex-post is quite weak. The risk of carbon leakage – i.e. of emissions being displaced from countries with a stringent climate policies to those without – has been a major concern. It has largely been addressed by limiting the compliance costs of energy intensive and trade-exposed companies, through tax exemptions, compensation, and distributing emissions allowances for free. These measures aim to level the playing field for industrial sectors competing in international markets and increase political acceptability. They may have also reduced the incentive to reduce emissions (Zetterberg 2014; Venmans 2016). Empirical evidence for actual carbon leakage is quite weak (Dechezleprêtre and Sato 2017). Ex-ante approaches, simulating potential carbon leakage effects, tend to find some carbon leakage effects in relevant sectors, while ex-post studies, analyzing existing policies, usually find limited to no evidence (ICAP 2020a). The lack of clear findings may be explained by the effectiveness of current carbon leakage protection instruments or the fact that prices have been relatively low until recently. Experience highlights the importance of moving away from carbon tax exemptions or free allocation amounts in an ETS based on historical emissions towards output-based rebates and allocations as quickly as possible. The long-term goal remains eliminating exemptions and free allocations (Quirion 2022).

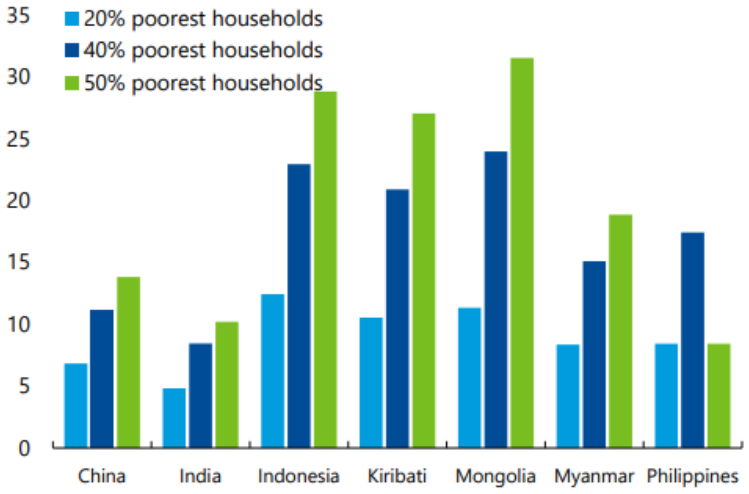
10 The UK carbon tax is levied on fossil fuel electricity generation, in addition to the price imposed by the UK ETS. https://researchbriefings.files.parliament.uk/documents/SN05927/SN05927.pdf

New approaches to address carbon leakage will be needed in the years ahead. The industrial sector is responsible for around 30% of global GHGs, with 60-80% coming from the production of trade-exposed basic materials (e.g. aluminium, cement, iron and steel) (Ahman et al. 2017). The low-carbon transition will require the economic value of carbon to be considered in these production processes. As a result, in the coming decades carbon leakage and competitiveness will become ever-greater political issues. Finding a balance between these two will require new approaches. One – a border carbon adjustment – is being developed for implementation by the **EU,** but other options, such as climate clubs,[11] product standards, consumption charges and the role of innovation support for breakthrough technologies may also be explored.

2.2.5 Revenue use

Revenue use for income redistribution can be a powerful and effective approach to protect vulnerable households, reduce inequality, and build support for carbon pricing. In the context of a socially just transition, reducing or eliminating the regressive impact of carbon pricing on the poorest households is a common concern among members, particularly in developing countries, where failing to do so may push citizens into poverty. In practice, revenue redistribution through simple cash transfers can prove a powerful and effective tool to address these concerns. In **Canada,** eight out of ten households in provinces covered by the federal carbon pricing backstop system receive more money back than they pay in additional fuel charges (Ammar 2019). Such approaches could also apply in developing country G20 members. Findings from the IMF, summarized in Figure 5, suggest that, with a carbon tax of USD 50/tCO_2, the poorest 40% of households could be protected through cash transfers equal to about 11%, 8% and 23% of revenue raised in **China, India** and **Indonesia,** respectively (Alonso and Kilpatrick 2022). In the case of **Brazil,** with a tax of USD 30/tCO_2 offsetting the impact on the poorest 40% of households through a universal rebate (i.e. to all households) would require 34% of revenues, and less if the support could be better targeted at the most vulnerable (Vogt-Schilb et al. 2019).

11 In its original conception, Nordhaus (2015) defines a climate club as a collection of countries which would like to reduce their GHG emissions by setting mutually recognized and ambitious targets, and which exempt each other from climate-related trade tariffs that non-members of the club would be subject to.



Source: IMF staff calculations based on household surveys.

Note: Compensation is assumed to take place through a targeted cash grant to the poorest 20%, 40%, and 50% using proxy-means testing (that is, using easily verifiable characteristics).

Figure 5: Percentage of revenue from USD 50 carbon tax needed to compensate the poorest households on average in selected Asian countries

Source: Alonso and Kilpatrick (2022) The Distributional Impact of a Carbon Tax in Asia and the Pacific

Revenues can also be used to help consumers respond to price increases and drive the innovation needed for the low-carbon transition. Revenues can support measures to help consumers improve their energy efficiency and limit the impact of any increase in energy prices caused by carbon pricing. In **France,** proceeds from the EU ETS help fund a program of subsidized energy efficiency improvements for poorer households. Compensation can also be provided to industrial entities to reduce any negative competitiveness impacts resulting from higher electricity prices.[12] Revenues can provide crucial support for early-stage and innovative technologies to reach market readiness. The **EU** ETS's Innovation Fund will provide around EUR 38 billion from 2020 to 2030 to support innovative projects in areas including carbon-neutral iron and steel production using green hydrogen and developing end-to-end carbon capture and storage value chains.[13] In **China,** the allowances in the national ETS are freely allocated at the time of writing but some of the pilot ETSs (e.g. Guangdong, Hubei) do raise revenues. An important lesson learned is that transparent and targeted revenue use that help impacted citizens and industries switch to low-carbon alternatives and reduce the impact of higher energy prices can be a powerful tool to ensure the durability of the carbon pricing instruments.

12 For additional details see, https://ec.europa.eu/clima/eu-action/eu-emissions-trading-system-eu-ets/free-allocation/carbon-leakage_en#financial-compensation-for-indirect-emissions for the EU & https://www.gov.uk/government/publications/uk-emissions-trading-scheme-and-carbon-price-support-apply-for-compensation/compensation-for-the-indirect-costs-of-the-uk-ets-and-the-cps-mechanism-guidance-for-applicants for the UK.

13 For additional details see: https://ec.europa.eu/clima/eu-action/funding-climate-action/innovation-fund_en

2.2.6 Stakeholder Engagement and Communications

Different types of engagement are appropriate for different types of stakeholders at different phases of the policy process. Figure 6 illustrates the diversity of objectives, actors and considerations for stakeholder engagement and communications in the context of an ETS, but a similar assessment applies for carbon taxes. Stakeholder engagement helps to build understanding and expertise among all parties, enhances credibility and trust by providing useful information to those involved, and encourages acceptance and active participation (PMR and ICAP 2021). Engagement of external stakeholders – e.g. companies and industry groups, trade unions, civil society groups – is a vital part of the policy design and implementation process and is common in G20 members. It can take many forms: hearings with selected stakeholders that have implemented (e.g. **EU** ETS and **Korea** ETS), workshops and bilateral meetings (e.g. **South Africa**), public meetings (e.g. **Tokyo** ETS), regular meetings with consolidated working groups (e.g. **Mexico**) (PMR & CPLC 2018). Although most countries organize external stakeholder consultations in the design or review phases of the CPI, these consultations can also take place on an ongoing basis (e.g **Germany's** Working Group for Emissions Trading (AGE) regular meetings).

Figure 6: Objectives and actors for effective stakeholder engagement

Source: Reproduced from: PMR and ICAP (2021) Emissions Trading in Practice: a Handbook on Design and Implementation

Planning on how to communicate effectively should start early and revolve around messages that connect to the audience's core values. Communicating the benefits of carbon pricing in a way that speaks to different audiences is an essential part of developing public acceptability and policy longevity. The use of revenues is often key. Spending revenues on areas of public concern – and communicating this clearly – can be more persuasive than economic arguments about the instruments' efficiency (PMR & CPLC 2018). The message should resonate with the audience. In **Canada** the federal government has used effective framings tailored to the local context, emphasizing a moral and fairness narrative based around "our responsibility to do the right thing", as well as clearly explaining revenue use. The **French** yellow vest ('Gilets jaunes') protest movement in response to the announcement of an acceleration of the planned carbon tax increase shows how public pressure can form against carbon pricing. While good communications is not the only tool to address this – substantive policy responses, such as revenue use and social protections must be in place – it is a key part building and retaining public acceptability (Conway et al. 2019).

3. Utilizing the economic value of carbon: approaches in the G20 to carbon pricing assessment

3.1 Assessing the socio-economic impact of carbon pricing in G20

Ex-ante modelling exercises have been an important tool for policy makers to understand the socio-economic impacts of planned or existing CPIs, but they need to be adapted to local needs. G20 members have used modelling extensively to understand the socio-economic impacts that planned policies will have on the economy and society. Key questions that modelling exercises have sought to answer refer to impacts on GHG emission reductions and imports and exports in **Indonesia** (Deloitte Tohmatsu Financial Advisory); possible price trajectories and projected revenues for the government in **France** (Callonnec, Gaël, et al. 2009); income distribution in **South Africa** (Ward et al. 2016); and impact on net present social value from the introduction of **UK** ETS (BEIS 2020). An important lesson is that no single modelling approach can adequately assess the diverse set of socio-economic impacts and that complementary approaches will be necessary for a robust ex-ante assessment.

Options to mitigate potential negative impacts can already be identified at the impact assessment stage. Socio-economic impact assessments will typically look to understand possible negative impacts, such as on household incomes or on industrial sectors. Solutions to potential problems can be identified and tested concurrently. When analyzing the implementation of the ETS in **Mexico,** a study on the potential for carbon leakage from the introduction of an ETS assessed and recommended different design measures that could mitigate the competitiveness concerns (Vivid Economics 2018). In **France,** before the introduction of the carbon tax, the final recommendations of a study included the incorporation of a compensation system that would target the most affected economic sectors and categories of households (Comité pour la Fiscalité Écologique 2013).

Multiple stakeholders contribute to understanding the impacts of carbon pricing. Typically, governments either undertake or commission analyses on the socioeconomic impacts of CPIs. For developing country members, international development organizations have played a key role in supporting such studies. In **Argentina, Mexico, South Africa** and **Indonesia,** organizations such as the World Bank and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) have supported the development of modelling studies and other research to understand the impact of carbon pricing on society and the economy. Other projects supported by the World Bank, among others, include the Finance Ministers' "Coalition for Climate Action"", an initiative of 72 ministers working on measures leading to effective carbon pricing reflecting the diverse interests of both the global north and south. The coalition includes 11 ministers from G20 members (e.g. **Canada, France, Indonesia, Republic of Korea**). Engaging directly with affected stakeholders is an important complementary way of understanding the impacts. For example, **Türkiye,** with support from the World Bank, held extensive consultations with a diverse set of stakeholders to consider different carbon pricing options and their implications in developing its approach to utilizing

an economic value of carbon.[14]

3.2 Assessing how carbon pricing can support NDC implementation

CPIs are an increasingly important part of members' climate policy portfolios to achieve their NDCs and other long-term climate goals. G20 members such as **China** and the **EU** have made clear how their ETSs are a core policy tool to achieve their climate goals. Following the announcement of their updated NDCs and net-zero commitments, both the **EU** and **UK** are in the process of reforming their systems to ensure they are consistent with their emissions reduction targets. Socio-economic impacts assessments are a key tool to assess how CPIs will support NDC implementation, through estimating not only GHG impacts but important co-benefits such as improved air quality. Other G20 members – for example **Indonesia** and **Brazil** – have highlighted the role Article 6 could play in their NDC achievement, particularly in the land use sector.

NDCs and broader climate commitments have helped build the case for CPIs. The adoption of NDCs and domestic climate targets have helped policymakers make the case for implementing CPIs. In **South Africa,** an assessment in 2007 of future emissions scenarios and mitigation options – including a carbon tax – informed the country's announcement at COP15 in 2009 of a voluntary commitment to reduce GHGs 34% and 42% below business-as-usual emissions in 2020 and 2025 respectively. Building on this commitment, the government launched a public consultation on a carbon tax in 2010, with the tax forming an integral part of the 2011 National Climate Change Response Policy (National Treasury of South Africa 2010; van Heerden et al. 2016; Department of Environmental Affairs 2011). In **Mexico,** in the early stages of planning for the implementation of an ETS, government officials used the sectoral climate commitments that the country had declared in its NDC to respond to the initial reluctance of private sector representatives (PMR and ICAP 2021).

3.3 Aligning multiple domestic carbon pricing instruments

CPIs can effectively be combined to achieve different policy objectives. G20 members have implemented CPIs in different combinations to achieve their goals. The **UK's** carbon tax was introduced in 2013 on fossil fuel inputs in the electricity generation sector as an effective 'top up' to the **EU** ETS price, which was considered too low. The tax has remained in place even with the subsequent rise in **EU** and now **UK** ETS allowance prices. A recent study found this has contributed to the faster decarbonization of the UK power sector (Leroutier 2022). Different instruments can also tackle different emissions. In **Germany** and **France** respectively, an ETS and a carbon tax have been introduced on many of the emissions not already covered by the **EU** ETS, to expand the coverage of carbon pricing in their economies. Under its "fit-for-55" package the **EU** itself is considering the adoption of a new emissions trading system for buildings and road transport. When launched, Indonesia's hybrid approach - which combines emissions trading and carbon taxation – will provide important lessons for other developing countries in the G20 and more broadly.

14 See PMR Türkiye website for additional details: https://pmrturkiye.csb.gov.tr/.

Crediting mechanisms can be combined with ETS/carbon taxes to provide flexibility and extend emissions coverage. Allowing offset credits from domestic projects to be used for compliance under an ETS/carbon tax can give regulated entities greater flexibility and allow for mitigation to be achieved at lower cost. The Mexican and South African carbon taxes both allow a portion of the compliance obligation to be met through offset credits, as does China's national ETS. This approach effectively extends the coverage of carbon pricing, incentivizing activities (e.g. reforestation, low-carbon farming) that may not be suitable for direct inclusion in a CPI. A tax-and-offset model is a way of introducing some of the flexibility in mitigation offered by an ETS without the administrative complexity.

It is important to understand the interactions between CPIs and other measures to value carbon, particularly when they imply substantially different values for different emissions. It can help preclude unintended consequences and improve cost effectiveness. For example, Mexico undertook an assessment of the economic impacts of different carbon pricing mixes on variables like carbon price levels over time, projected revenues and administrative costs to industries (Mehling and Dimantchev 2017).

3.4 Aligning carbon pricing with other fiscal, energy and climate policies

The role of carbon pricing within a broader policy mix should be defined early on. CPIs always exist within a broader, often complex, landscape of other related policies. These policies can be complementary (e.g. energy efficiency awareness campaigns), overlapping (e.g. renewable subsidies), or counterproductive (e.g. fossil fuel subsidies) to the objectives of carbon pricing. Policy mapping is therefore an important first step, for example in **Türkiye,** where a roadmap for ETS implementation assessed the interactions with existing policies and strategies (PMR 2019). With the policies mapped, the role and contribution of carbon pricing can be determined. The **US** state of California has designed its climate policy portfolio so that each policy, such as the Renewable Portfolio Standard and the Low Carbon Fuel Standards, will generate a significant contribution to emission reductions in different sectors of the economy. In this policy mix, the cap-and-trade (or ETS) program acts as a backstop measure to guarantee overall targets are met (CARB 2017).

Carbon pricing is adaptable and can be designed to operate within a variety of existing policy mixes. Ideal market conditions for optimum carbon pricing do not reflect conditions on the ground. G20 members have varied local contexts, with different policy mixes and priorities, some of which may complicate the introduction of CPIs. In general CPIs have proven adaptable to these different circumstances. One of the clearest examples is their operation in regulated electricity markets (e.g. China, Republic of Korea). Unlike in the textbook models of carbon pricing where costs are passed through and influence the behaviour of end users, generation costs cannot be passed on freely to the consumer in most real-world settings. Despite this, **China** and **Republic of Korea** adapted their ETS design to ensure that end users – by having to also surrender allowances – continued to face a carbon price and hence an incentive to mitigate.

Ensuring the coherence of measures utilizing the economic value of carbon and other climate and energy policies is crucial for maximizing emissions reductions while limiting the socio-economic impacts. When introducing or reforming measures which operationalize the economic value of carbon to affect the decisions of key actors, a detailed and careful assessment of the broader policy landscape is critical. Crucially, any reform of the instruments in the climate and energy policy portfolio, must be based on a transparent review process and developed considering the views of key stakeholders so as not be a source of uncertainty. For example, in the **EU** the reforms under consideration as a part of the "fit-for-55" legislative package is accompanied by ex-post evaluations of past policy efforts, stakeholder consultations and impact assessments, which are all publicly available.[15] In exercises like this, aiming for a consistent, or at least comparable, economic value of carbon across the economy can act as a focal point, enhance cost effectiveness and coordinate the public and private efforts which necessarily span decision-makers with extremely diverse interests.

3.5 Assessment on the impact of existing carbon markets/pricing

Higher carbon prices are needed to meet the objectives of the Paris Agreement. The High-Level Commission on Carbon Prices concluded that a Paris-compatible carbon price was in the range of 'at least at least USD 40–80/tCO_2 by 2020 and USD 50–100/tCO_2 by 2030, provided a supportive policy environment is in place' (CPLC 2017). Within the G20 direct carbon prices range from range from less than USD 1/tCO_2 to almost USD 100/tCO_2. Direct carbon prices averaged EUR 3.62 per tCO_2 across 2018 to 2021 when averaged across all energy-related CO_2 emissions, including those not covered by a CPI; including indirect pricing through fossil fuel raises the figure to EUR 18.71 per tCO_2 (OECD 2021).[16] According to an IMF/OECD report for the G20 finance ministers, 'the carbon price increases that are estimated to be needed for G20 members to achieve their NDC commitments through pricing alone vary from less than USD 25 per ton of CO_2 in 2030 in five countries, to between USD 25 and USD 75 per ton of CO_2 in four countries, and over USD 75 per ton of CO_2 in ten other cases' (IMF & OECD 2021).

Assessments find that CPIs work and have reduced emissions – but there is more potential to unlock. There have been relatively view ex-post assessments of how CPIs have impacted GHG emissions. Most existing studies focus on Europe. While the results vary for different countries, generally low carbon prices have led to modest emissions reductions: one literature review found that 'the aggregate reductions from carbon pricing on emissions are limited—generally between 0% and 2% per year' (Green 2021); while another assessment across five sectors in 39 OECD countries concluded there was decreased growth in carbon emissions by 1% to 2.5% on average (Rafaty et al. 2022). The assessments also show that higher prices can unlock more emissions reductions. In the **UK** between 2013 to 2016 the tax was found to have lowered emissions by 6.2% at an average cost of EUR 18/tCO_2 (Abrell et al. 2022). In **France** the carbon tax reduced manufacturing CO_2 emissions in 2018 by 5% compared to a no-tax scenario (Dussaux 2020).

15 See European Commission webpage on the European Green Deal for additional details at https://ec.europa.eu/clima/eu-action/european-green-deal/delivering-european-green-deal_en#documents.

16 Calculation excludes Saudi Arabia.

4. Recommendations on leveraging the economic value of carbon for NDC implementation and low-carbon transition

The understanding of climate change as a negative externality has been recognized for decades. However, the failure to account for the value of carbon – and to internalize its costs – has led to an overproduction of GHGs, a situation which continues to this today. In the years and decades ahead, if the world is to succeed in transitioning to a low-carbon economy, the economic value of carbon must be a central component of decision-making and policy frameworks.

G20 members have made progress in this area. The ways of utilizing carbon's economic value are varied and look set to play an important role in reaching members' NDC targets. Both when broadly defined, or when considering only the CPIs on which this report focuses, it is clear there is no one-size-fits-all approach. Carbon must be valued in a way that is consistent with the local economic, social and political context. In many G20 members this is with a national-level CPI; in others, action is happening at sub-national level. In all members there is a great diversity of policies which give incentives to reduce or remove emissions and therefore place an economic value on carbon, however indirectly.

G20 members must now go further. Carbon prices – even when considering both direct and indirect pricing – cover fewer than half of GHGs in the G20 and, with some exceptions, are at price levels largely outside the range identified as being consistent with the Paris Agreement temperature goals. The wider ways G20 members value carbon – e.g. through regulations, subsidies, regulations, tax incentives – often imply different types and levels of implicit prices for different decision-makers. As such they do not provide the broad, economy-wide incentive a CPI can offer. Carbon valuation in its various forms must therefore become more consistent and systematic.

Giving an economic value to carbon alone is not sufficient. GHGs are not the only relevant market failure. Other critical failures include: a lack of information; imperfect risk and capital markets; undervaluation of research and development; support for necessary networks and systems (e.g. electric vehicle charging infrastructure, upgrading electricity grids); valuing mitigation co-benefits (e.g. air and water quality) (Stern and Stiglitz 2022). Separate policies are needed to address these and other market failures.[17] They should nevertheless work in tandem with measures that give an economic value to carbon, without which resources will continue to be allocated to emissions-intensive activities and policies inconsistent with the Paris Agreement temperature goals within countries and internationally.

The following recommendations for G20 members are grouped into two categories: actions related to the implementation of economic carbon valuation measures; and priority areas for coordination at the G20 level.

17 See also Figure 4 for an overview of complementary polices.

4.1 Recommendations on implementation of measures to utilize the economic value of carbon

- **Expand the coverage of the measures that utilize the economic value of carbon.** As a first step, members must increase the share of emissions covered by measures that impose some form of carbon value in order to ensure more decision-makers are incentivized to reduce GHGs. CPIs provide an economically efficient way of applying a single price signal across many entities. National-level CPIs may not be appropriate for all members and not for all sectors. Some members already implement sub-national CPIs; in these instances, the priority is to expand the reach and consistency of the various instruments chosen, with carbon valuations in line with those needed for NDC achievement.

- **Develop an approach that is appropriate to the member's objectives and circumstances.** Introducing measures to utilize the economic value of carbon requires tailoring design features to the domestic context. It is often possible to work with rather than push against local constraints when designing successful measures utilizing the economic value of carbon. This means that the measure must be carefully selected in inclusive consultations with stakeholders, its scope of application is appropriate for the national context, and its level of ambition does not compromise its durability.

- **Start simply and build over time – both in ambition and complexity.** Initially targeting sectors with few large emitters and pre-existing high-quality emissions data can help build experience with various instruments. Once the foundations are laid – and businesses as well as citizens become familiar with the idea of carbon costs and low-carbon alternatives to status quo emerge – the approaches can evolve over time, and ambition can be raised in due course.

- **Build facility-level and public sector MRV capacity, especially in developing countries members, as a no-regrets measure.** Even if these efforts do not lead to direct mandatory carbon pricing, they will improve the accuracy of emissions reporting in national inventories, facilitate results-based finance activities and participation in Article 6 mechanisms. They also underpin the environmental integrity of emissions reduction projects which generate credits for voluntary and international compliance markets such as CORSIA.

- **Increase efforts to reduce and remove inefficient fossil fuels subsidies and aim to remove all fossil fuel subsides in the long run.** These subsidies can act as a negative carbon price and undermine the effectiveness of approaches to create an economic value of carbon. The G20 agreed in 2009 to phase out inefficient fossil fuel subsidies, a goal reaffirmed more broadly in COP26; however, the IMF estimates global subsidies (explicit and implicit) amounted to USD 5.9 trillion in 2020 and are forecast to rise further (IMF 2022).

- **Use revenues collected to support and engage the most vulnerable income groups and regions, and communicate specific co-benefits of emissions reduction for them.** These are key components of building public support and enabling a just transition. Carbon pricing can be a powerful way not only to reduce emissions but also inequality and comes with many co-benefits. Many members have existing social schemes for identifying and targeting support at the most vulnerable. Revenue redistribution can utilize these existing structures to ensure those who need it most are supported.

- **Assess the performance of carbon pricing instruments regularly and reform them, when necessary, through an inclusive and transparent process.** Socio-economic impact evaluations are a key tool to understand the effect of measures utilizing the economic value of carbon and to develop measures to limit any adverse consequences. Reviews should be inclusive and transparent so that all stakeholders feel their voices are heard and appreciate that the recommendations emerging from them represent compromises. Open and transparent review and reform processes ensure that any changes to the instruments do not create undue uncertainty.

4.2 Recommendations on enhanced collaboration among G20 members

- **Establish a more structured forum for sharing experiences** to enable all G20 members, especially those at earlier stages of design and implementation, to learn from the wealth of experience of G20 members in the different approaches towards valuing carbon.

- **Commence discussions on a collaborative framework to address carbon leakage during the low-carbon transition.** As the world decarbonizes, carbon leakage and competitiveness will become ever-greater political issues. G20 members should start discussions now on how to address the risk of carbon leakage without compromising the benefits of international trade. Designing an inclusive framework in a cooperative manner and ensuring that it reflects the different national circumstances and commitments of members is essential. This could draw on ideas such as the climate club, recently agreed among the G7.

- **Extend support beyond G20 members.** For many developing countries outside the G20, Article 6 of the Paris Agreement will play a central role in giving an economic value to carbon. Many are also interested in exploring domestic CPIs to decarbonize. Drawing on their extensive experience with CPIs as well as with international carbon markets under the Kyoto Protocol, G20 members should actively engage with and build technical capacity in non-members to ensure a cost-effective low-carbon transition more broadly and enable them to participate equitably in Article 6 mechanisms

5. Appendix

5.1 G20 member country factsheet

Note for readers

The following factsheets provide information on carbon pricing instruments currently operational in G20 members. Unless otherwise stated, all information is drawn from the World Bank's Carbon Pricing Dashboard.[18] In members in which there is currently no explicit CPI in operation a description of selected policies relevant to the economic value of carbon is provided. These are based on direct inputs from G20 members and the authors' own research and are not intended to be comprehensive. The categories for members with explicit CPIs are as follows:

- **Carbon pricing instruments:** either an ETS or a carbon tax
- **Scope and coverage:** which sectors are covered and what % of national emissions
- **Recent price level:** the nominal prices on 1 April 2022. For carbon taxes, it corresponds to the carbon tax rate. When the carbon tax rate varies by fuel type, the range is presented. For ETSs, it corresponds to the price of an allowance. For the Canadian OBPS, it corresponds to the excess emissions charge payment rate
- **Revenue raised:** revenues raised in 2021 either through levying a carbon tax or auctioning ETS allowances
- **Use of revenues:** where relevant, if tax/ETS auctioning revenues are used for specific purposes
- **Offset use:** whether offset credits can be used to meet some or all of an entity's compliance obligation
- **Competitiveness/exemptions:** How the risk of carbon leakage is addressed, alongside any other exemptions
- **Notes:** any other relevant information

18 https://carbonpricingdashboard.worldbank.org/map_data

Argentina	
Carbon pricing instrument 1. Argentina carbon tax (2018)	
Scope and coverage 1. All sectors are covered (with partial exemptions), covering 20% of national emissions	
Recent price level 1. USD 0.003 – USD 5 tCO_2e	Revenue raised (2021) 1. USD 272 million
Use of revenues 1. There is no earmarking of carbon tax revenues	
Offset use 1. No	
Competitiveness/exemptions 1. Exemptions include international aviation and international shipping, fuels export, the biofuel content of liquid fuels, and fossil fuels as inputs in chemical processes	

Australia

An ETS – the Carbon Pricing Mechanism (CPM) – operated between 2012 and 2014. It covered around 60% of Australia's emissions, including those from electricity generation, stationary energy, landfills, wastewater, industrial processes, and fugitive emissions. Allowances could be bought at the fixed price of AUD 23 and 24.15/tCO_2e in the first and second years respectively. There was free allocation of allowances to trade exposed sectors.[19] The CPM was repealed in 2014. In the same year the Emissions Reduction Fund (ERF) was introduced. The ERF purchases Australian Carbon Credit Units (ACCUs), which represent emissions avoided or stored in Australia from a variety of different project types. Project operators can bid for an options contract, which gives them the right, but not the obligation, to sell their credits to the government.[20] AUD 2.7 billion has so far been committed to 528 projects with an expected total reduction of 217 $MtCO_2e$[21]. The ERF also includes a safeguard mechanism. This establishes a baseline emissions level for covered entities, which are facilities with annual emissions of more than 100,000 tCO_2e. Around 50% of national emissions are covered. Entities must ensure net emissions do not exceed their baseline, with any excess covered by surrendering ACCUs. The safeguard mechanism started operation in July 2016.[22]

19 https://www.cleanenergyregulator.gov.au/Infohub/CPM/About-the-mechanism
20 https://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund/How-does-it-work
21 https://www.cleanenergyregulator.gov.au/ERF/auctions-results/april-2022
22 https://www.cleanenergyregulator.gov.au/ERF/About-the-Emissions-Reduction-Fund/the-safeguard-mechanism

Brazil

Brazil has been a major participant in international carbon markets under the Kyoto Protocol, hosting 344 registered Clean Development Mechanism projects, behind only China and India. The expected emissions reductions from these projects are around 50 $MtCO_2e$ per year.[23] Brazil also participates in the UNFCCC's Warsaw Framework for REDD+, which provides results-based finance for countries that reduce emissions from deforestation and forest degradation. In 2019 Brazil received USD 96 million from the Green Climate Fund for avoiding around 19 $MtCO_2e$ between 2014 and 2015.[24] The proceeds were used in part to establish the Floresta+ Programme. Established in 2020, Floresta+ seeks to provide monetary and non-monetary incentives to preserve and enhance native vegetation.[25] Floresta+ is one among many such Payment for Environmental Services programs in Brazil, which provide voluntary financing for defined environmental services.[26] The possibility of establishing an ETS is also currently being discussed under two different processes, under Law 14,120/2021 and Bill 528/2021.The possibility of implementing an ETS in the power sector is under consideration. Since 2013, a group of leading companies has been participating in a voluntary ETS simulation to gain experience and develop proposals for an ETS in Brazil.[27]

Canada[28]

Carbon pricing instruments
1. Canada federal fuel charge (2019)
2. Canada federal output-based pricing system (OBPS) (2019)

Scope and coverage
1. The fuel charge applies to 21 types of fuel, covering 22% of national emissions
2. The OBPS applies to industrial facilities that emit 50 $KtCO_2e$ per year or more in emissions-intensive and trade-exposed sectors. Similar facilities that emit 10Kt CO_2e per year or more may participate voluntarily. The system covers 7% of national emissions

Recent price level	Revenue raised (2021)
1. USD 40/tCO_2e	1. USD 4,798 million
2. USD 40/tCO_2e	2. USD 264 million

23 https://cdm.unfccc.int/sunsetcms/Statistics/Public/CDMinsights/index.html#reg

24 https://www.greenclimate.fund/project/fp100

25 https://www.in.gov.br/en/web/dou/-/portaria-n-288-de-2-de-julho-de-2020-264916875%20

26 https://documents1.worldbank.org/curated/en/554361468020374079/pdf/862700NWP0ENGL00Box385172B00PUBLIC0.pdf

27 https://icapcarbonaction.com/system/files/document/220408_icap_report_rz_web.pdf

28 https://www.canada.ca/en/environment-climate-change/services/climate-change/pricing-pollution-how-it-will-work/putting-price-on-carbon-pollution.html

Use of revenues
1. In provinces and territories that requested the application of the fuel charge, all direct proceeds are returned. Where the fuel charge is applied as a backstop, around 90% of revenues support families directly through Climate Action Incentives payments
2. Provinces and territories that voluntarily adopt the OBPS can choose to receive revenues directly. Where the OBPS is applied as a backstop, revenue is returned to the provinces and territories through funding provided by two programs aimed at industrial decarbonization and clean electricity

Offset use
1. No
2. Credits from the GHG Offset Credit System can be used for compliance in the OBPS

Competitiveness/exemptions
1. Exemptions apply for some uses in agriculture and transport, as well for farmers and off-grid communities. Industrial facilities are covered by the OBPS.
2. The OBPS establishes intensity-based benchmarks. Its design therefore responds to the carbon leakage risk for emissions-intensive trade-exposed industries.

Notes

The two components of the Canadian federal pricing system – the fuel charge and OBPS – serve as minimum national standards. Provinces and territories can choose to implement their own explicit CPIs or apply the federal system. For those that do not apply any carbon pricing – or whose policies do not meet the benchmark – the federal system will apply in full or in part as a 'backstop'. ETSs are currently operating in Nova Scotia and Quebec, with carbon taxes in place in British Colombia and Northwest Territories. New Brunswick and Newfoundland and Labrador operate a provincial OBPS with a provincial fuel charge and carbon tax respectively. The federal system partly applies alongside provincial measures in Alberta, Ontario, Prince Edward Island and Saskatchewan. The federal system applies as a backstop in Manitoba, Nunavut, and Yukon.

China

Carbon pricing instruments
1. China national ETS (2021)

Scope and coverage
1. The ETS applies to CO_2 emissions from the power sector, including combined heat and power and captive power plants from other sectors. It covers 33% of national emissions.

Recent price level	Revenue raised
1. USD 9/tCO_2e	1. N/A

Use of revenues
1. Although there has been no revenue raised to date, draft regulations from 2021 propose a gradual introduction of auctioning and a new national ETS fund.

Offset use
1. Up to 5% of emissions through China Certified Emissions Reductions (CCERSs), generated from projects not covered by the national ETS.

Competitiveness/exemptions
1. All allowances are freely allocated. Compliance obligations are currently limited to a portion of emissions above the benchmark value.

Notes

Eight ETSs currently operate at provincial or city level: Beijing, Guangdong, Shanghai, Shenzhen, Tianjin (started in 2013); Chongqing, Hubei (2014); and Fujian (2016). These systems will gradually be integrated into the national ETS. Aside from explicit carbon pricing through ETSs, China provides other economic incentives to pursue low-carbon practices. These include: taxes on coal, crude oil, natural gas and other fossil energy; a renewable energy tariff surcharge subsidy; new more efficient vehicles exempted from vehicle purchase taxes.

France	
Carbon pricing instruments 1. France carbon tax (2014)	
Scope and coverage 1. The carbon tax applies to CO_2 emissions from mainly the industry, buildings, and transport sectors. It covers 35% of national emissions.	
Recent price level 1. USD 49/tCO_2e	Revenue raised (2021) 1. USD 8,400 million
Use of revenues 1. In 2016 EUR 3 billion (out of EUR 3.8 billion) contributed to financing tax credits for competitiveness and employment. In 2017, EUR 1.7 billion was directed towards financial support for renewable energy.[29]	
Offset use 1. No	
Competitiveness/exemptions 1. Partial exemptions for certain industrial processes, power production, shipping, aviation, public transport, freight transport and agriculture. Fishing vessels are fully exempt, as are operators already covered by the EU ETS.	

Notes

Aside from the carbon tax, France implements a range of measures to support emissions reductions. These include: energy taxation in line with the European Directive on Energy taxation as part of the EU ETS; subsidies for retrofitting buildings and for clean transportation; an energy certificate scheme for energy providers that induce energy savings for customers. France has also established the Low Carbon Label ("label bas carbone") framework to certify emissions reductions/absorptions for carbon projects. Domestic flights must offset their emissions.

Germany
Carbon pricing instruments 1. Germany national ETS (2021)
Scope and coverage 1. CO_2 emissions from buildings and road transport, covering 40% of national emissions.

29 https://www.ecologie.gouv.fr/fiscalite-carbone

Recent price level 1. USD 33/tCO_2e	Revenue raised (2021) 1. USD 7.94 billion
Use of revenues 1. Revenues accrue to the Energy and Climate Fund, which funds activities to support the low-carbon transition. In the 2021 financial year, EUR 4.7 billion raised through the German ETS was used to lower the renewable energy surcharge, thus reducing consumers' electricity bills.	
Offset use 1. No	
Competitiveness/exemptions 1. Activities deemed to be at risk of carbon leakage in the EU ETS are also eligible to receive compensation based on sectoral fuel benchmarks and fixed compensation levels under the German ETS. Additional sectors/sub-sectors may qualify upon request if they meet thresholds for emissions and trade intensity.	
Notes As part of the "Fit for 55" package, the EU Commission has proposed a new ETS for the buildings and road transport sectors. Should this be agreed Germany will then work on a transition from the national ETS towards the new EU-wide ETS. Aside from the national ETS, Contracts for Difference are considered a potentially useful option to support emissions reduction in certain industries by paying the difference between older, emissions-intensive and newer, low-carbon production methods.	

India

India has been a major participant in international carbon markets under the Kyoto Protocol, hosting 1,685 registered Clean Development Mechanism projects, second only to China. The expected emissions reductions from these projects are around 120 $MtCO_2e$ per year and come primarily from renewable energy activities.[30] India also operates several market-based measures to enhance energy efficiency and promote renewable energy generation, both of which implicitly place a price on carbon. The Perform, Achieve and Trade (PAT) is a market-based mechanism to reduce energy intensity in selected industries. It covers around 50% of primary energy consumption in 13 sectors. Entities that outperform their specific energy consumption standard are issued 'ESCerts', which can be traded and used by underperforming facilities.[31] India also operates a market for renewable energy certificates (REC). State-level electricity regulators must determine local renewable purchase obligations, which can then be met by obligated entities through purchasing RECs. RECs are one part of a wider policy package to support renewable generation, which also includes generation subsidies and feed-in-tariffs.[32] In a 2021 discussion paper, the Bureau of Energy Efficiency set out a roadmap for developing a national carbon market. The first stage would see measures to strengthen demand within the PAT and REC markets. This would be followed by efforts to increase supply of offsets in a voluntary carbon market. This could then transition into an intensity-based cap-and-trade system.

30 https://cdm.unfccc.int/sunsetcms/Statistics/Public/CDMinsights/index.html#reg

31 https://beeindia.gov.in/sites/default/files/NCM%20Final.pdf

32 https://www.adb.org/sites/default/files/publication/794046/adbi-wp-1313.pdf

Indonesia

In 2021, the government issued Presidential Regulation No. 98, which among other things establishes carbon economic instruments as one of the tools to achieve Indonesia's NDC target. There are three mechanisms foreseen: carbon trading (cap-and-trade); carbon tax; and a system of results-based payments. Other mechanisms may subsequently be included. Around the same time, legislation on wider tax reforms was passed, which established a legal basis for the introduction of a carbon tax. This tax was intended to apply initially to coal-fired power plants at a rate of approximately USD 2/tCO_2e, covering 26% of national emissions. It was planned to enter operation in April 2022 but was delayed in response to rising price of energy commodities. The tax will work in tandem with an ETS, which will also cover the power sector, as a hybrid "cap-trade-and-tax" system. Facilities that exceed their emissions cap under the ETS will have the option to compensate for their surplus emissions through surrendering allowances and/or offsets, or paying the carbon tax. The rate of the tax will be linked to the price of the domestic carbon market. The ETS will build on the experience gained through a voluntary trial conducted between March and August 2021. This involved 80 coal-fired power plants, comprising over 75% of power sector CO_2 emissions.

Italy

Italy implements direct carbon pricing through its participation in the EU ETS (see EU factsheet). It covers around 1,300 installations in Italy, representing 33% of GHG emissions. Aside from the EU ETS, an implicit carbon price is realised through the taxation of fuels, which applies to diesel, gasoline, fuel oil, LPG, natural gas and coal and coke. In total around 85% of CO_2 emissions from energy use were priced – explicitly or implicitly – in 2021.

Japan[33]	
Carbon pricing instruments 1. Japan carbon tax (2012)	
Scope and coverage 1. The carbon tax applies to CO_2 emissions from the combustion of fossil fuels, covering 75% of national emissions.	
Recent price level 1. USD 2/tCO_2e	Revenue raised (2021) 1. USD 1.8 billion
Use of revenues 1. Revenue is used to support renewable energy projects and to enhance energy-savings measures.	
Offset use 1. No	
Competitiveness/exemptions 1. Certain uses of fossil fuels in the industry, transport, agriculture, and forestry sectors are exempt and eligible for refunds.	

Notes

In 2022 the government launched a call for endorsements for a new Green Transformation (GX) League. Anticipated to start operation in 2023, it would see participating companies establish their own emission reductions targets in line with national goals. Emissions can then be traded and used, alongside carbon offsets, to meet the reduction targets. While participation is voluntary, 440 companies accounting for more than 40% of Japanese emissions have endorsed the plan. It constitutes one of five pillars to mobilize the estimated JPY 150 trillion needed over the next ten years to finance the green transformation in Japan.[34] At the subnational level, two linked ETSs currently operate in Saitama and Tokyo. In 2013 Japan established the Joint Crediting Mechanism, which is a bilateral offset crediting mechanism to incentivize low-carbon technologies in 17 partner countries. The program can provide emissions reductions to help Japan and partner countries to meet their NDC targets through using Article 6 of the Paris Agreement.

33 https://www.env.go.jp/policy/tax/about.html

34 https://www.japan.go.jp/kizuna/2022/06/clean_energy_strategy.html

Republic of Korea	
Carbon pricing instruments 1. Korea ETS (2015)	
Scope and coverage 1. The ETS includes emissions from the industry, power, buildings, domestic aviation, waste and public sectors, covering 73% of national emissions.	
Recent price level 1. USD 19/tCO_2e	Revenue raised (2021) 1. USD 243 million
Use of revenues 1. The revenue from auctions is reinvested to support small- and mid-sized companies.[35]	
Offset use 1. Operators can meet up to 5% of compliance obligations through eligible offsets.	
Competitiveness/exemptions 1. Certain emission-intensive and/or trade-intensive sectors are eligible to receive free allowances up to 100% of the benchmark or historical emission level. Certain small emitters are exempt from the ETS.	

Mexico	
Carbon pricing instruments 1. Mexico carbon tax (2014) 2. Mexico pilot ETS (2020)	
Scope and coverage 1. The carbon tax covers CO_2 emissions from all sectors, and all fossil fuels except natural gas, covering 44% of national emissions. 2. The ETS covers CO_2 emissions from the power and industry sectors, covering 40% of national emissions.	
Recent price level 1. USD 0.42 – USD 4/tCO_2e 2. USD 0/tCO_2e	Revenue raised (2021) 1. USD 314 million 2. N/A
Use of revenues 1. Revenues are not earmarked and flow back into the general budget 2. There have been no revenues raised to date.	
Offset use 1. Credits from CDM projects developed in Mexico or Green Certified Emission Reductions that are traded in the European Energy Exchange. 2. Covered entities may utilize offsets or early action credits to meet up to 10% of compliance obligations.	
Competitiveness/exemptions 1. Natural gas is exempted from taxation and the tax is capped at 3% of the fuel sales price. 2. All allowances are currently allocated for free.	

35 https://ieta.org/resources/Resources/CarbonMarketBusinessBrief/CarbonMarketBusinessBriefsKorea2020.pdf

Notes

In addition to the national carbon tax and ETS, four subnational carbon taxes operate in Zacatecas, Baja California, Tamaulipas and Estado de México, introduced in 2017, 2020, 2021 and 2022 respectively.

Russia

A regional pilot ETS has been planned to launch in the Sakhalin region in September 2022, with the aim of ensuring that the region achieves net zero emissions by the end of 2025. This pilot is considered as a test to identify GHG regulation measures that could later be applied to other Russian regions. At the initial stage carbon caps will be applied to entities with emissions above 50,000 tCO_2e per year. The system will later cover smaller emitters. Entities will be able to use both ETS allowances and offsets to meet their obligations. In July 2021, the Federal Law "On Limiting GHG Emissions" was adopted, establishing the obligation of large emitters to account for and submit reports on GHG emissions, as well as the procedure for supporting activities for the implementation of climate projects. The approximate indirect carbon price in Russia is currently around 10 USD per tCO_2e, taking into account existing fuel taxation.

Saudi Arabia

During its G20 Presidency in 2020, Saudi Arabia launched the concept of the circular carbon economy (CCE) as a framework for reducing emissions in line with the Paris Agreement. Building on the three Rs of the circular economy – reduce, reuse, and recycle – CCE includes a fourth step of 'remove' and considers each of the Rs as of equal importance. For the CCE to become reality, enabling policies will be required. These could include public-private research and development funding, financial subsidies to de-risk investment in unproven technologies, tax incentives, direct capital investment subsidies and results-based financing. In particular, appropriate business models must be developed to support the deployment of carbon utilization or storage technologies.[36] Through incentivising the more efficient use of energy and carbon, these and other policies could provide an economic value to carbon.

36 https://www.cceguide.org/wp-content/uploads/2020/08/00-CCE-Guide-Overview.pdf

South Africa	
Carbon pricing instruments 1. South Africa carbon tax (2019)	
Scope and coverage 1. The carbon tax applies to all fossil fuels combusted by large businesses in the industry, power, and transport sectors. It covers 80% of national emissions.	
Recent price level 1. USD 10/tCO_2e	Revenue raised (2021) 1. USD 94 million
Use of revenues 1. There is no strict earmarking of revenues, but three priority areas for revenue use been identified: reducing/not increasing other taxes; tax incentives for e.g. energy efficiency; "soft earmarking" for free energy and public transport.[37]	
Offset use 1. Up to 10% of entities' GHG emissions from eligible projects located in South Africa.	
Competitiveness/exemptions 1. Tax exemptions of 60-95% may apply. This depends on the sector, as well as the level of trade exposure, fugitive emissions, emissions performance, offset use, and participation in the carbon budget program.	

Turkey
In 2020 Turkey published a draft legal and institutional framework to establish a pilot ETS. This would build on the existing MRV system, which has been in operation since 2015 and covers around 900 large emitters in the power and industrial sectors. With support from the World Bank's Partnership for Market Readiness, Turkey has identified an emissions cap and developed a national allocation plan, developed Turk-SIM (an ETS simulation with gamification features), developed a transaction registry for the pilot ETS, and assessed Article 6 and options for Turkey. The date for the introduction of the pilot ETS has not yet been confirmed.

37 http://www.treasury.gov.za/public%20comments/CarbonTaxBill2019/Final%20Response%20Document%20-%202018%20Draft%20Carbon%20Tax%20Bill.pdf

United Kingdom	
Carbon pricing instruments 1. UK carbon price support (CPS) (i.e., carbon tax) (2013) 2. UK ETS (2021)	
Scope and coverage 1. The tax applies to CO_2 emissions from the power sector, covering 21% of national emissions. 2. The ETS applies to energy-intensive industries, the power sector, and aviation in the UK and the European Economic Area. It covers 28% of national emissions.	
Recent price level 1. USD 24/tCO_2e 2. USD 99/tCO_2e	Revenue raised (2021) 1. USD 690 million 2. USD 5.7 billion
Use of revenues 1. Revenues are not earmarked and flow back into the general budget 2. As above	
Offset use 1. No 2. No	
Competitiveness/exemptions 1. Certain types of power generation are exempt, as is all power production in Northern Ireland which is instead covered by the EU ETS. 2. Some allowances are freely allocated to emissions intensive, trade exposed sectors. The government also provides compensation for eligible entities for higher electricity costs caused by the UK ETS and CPS.	
Notes The CPS was originally introduced to provide a stronger carbon price signal than that provided by the then EU ETS allowance price, which at the time was deemed to be insufficient. Together the two comprised a 'carbon price floor' (CPF). The CPS rate was to be confirmed three years in advance at a level which would "top up" the projected EU ETS price to reach the CPF target. Following the UK's departure from the EU and the establishment of the UK ETS the CPS continues to apply, although the rate has not been increased since 2016. The CPS rate has contributed to a significant shift in the economics of, and investment incentives for, renewable energy sources compared to coal for domestic power generation (coal-based generation fell from around 40% of electricity in 2012 to 5% in 2018).	

United States

Though there is no carbon pricing instrument at the national level, federal policies to reduce emissions give an economic value to carbon. An example is Section 45Q tax credit for for geologically sequestering or other qualified use of CO_2. Several explicit state-level CPIs are also in force. A cap-and-trade system has been in operation in **California** since 2012, covering power, industry, transport, and buildings, which amount to around 74% of the state's GHG emissions. The ETS has been linked to that of the Canadian province of Québec's since 2014. The **Regional Greenhouse Gas Initiative (RGGI)**, established in 2009, is an ETS covering 11 New England and Mid-Atlantic states with the aim of reducing GHG emissions from the power sector. Within the RGGI, Massachusetts has operated an ETS since 2018, also covering the power sector. The ETS in Oregon has since 2022 covered suppliers of liquid fuels and propane and natural gas utilities. Free compliance instruments are annually distributed to fuel suppliers according to the declining cap. The state of **Washington** plans to operate an economy-wide, cap-and-trade program from 2023.

European Union[38]	
Carbon pricing instruments 1. EU ETS (2005)	
Scope and coverage 1. Power, industry, and intra-EEA aviation, covering 39% of emissions.	
Recent price level 1. USD 87/tCO_2e	Revenue raised (2021) 1. USD 34 billion
Use of revenues 1. Revenues from auctioned allowances accrue to member states' national budgets, at least 50% of which should be used for climate- and energy-related purposes. Auction revenue also directly supports two dedicated funds: the Innovation Fund (supporting innovative and breakthrough technologies in industry) and the Modernisation Fund (supporting investments in ten lower-income member states)	
Offset use 1. No	
Competitiveness/exemptions 1. Sectors deemed at risk of carbon leakage received free allocation up to 100% of the relevant benchmark. Small emitters are exempted from participation	
Notes In 2021 the European Commission proposed its "Fit-for-55" package, to deliver on the EU's enhanced commitment to reduce emissions by 55% by 2030 and achieve carbon neutrality by 2050. As part of this a series of amendments were proposed to the EU ETS. These include increasing the rate at which the cap is reduced, including emissions from maritime transport, transitioning from free allocation of allowances to a new carbon border adjustment mechanism, and increasing funding available from ETS revenues to the Modernisation Fund and the Innovation Fund. It also proposed establishing a new emissions trading system for buildings and road transport, to be complemented by a new Social Climate Fund to support the transition in a socially just way	

38 The following EU member states have carbon pricing instruments in place: Denmark carbon tax, Estonia carbon tax, Finland carbon tax, France carbon tax, Ireland carbon tax, Latvia carbon tax, the Netherlands carbon tax, Poland carbon tax, Portugal carbon tax, Slovenia carbon tax, Spain carbon tax, Sweden carbon tax, Germany national ETS, Austria national ETS. As Germany and France are G20 countries in their own right, the German national ETS and the French carbon tax are presented in their own factsheets.

6. Publication bibliography

Abrell, Jan; Kosch, Mirjam; Rausch, Sebastian (2022): How effective is carbon pricing?—A machine learning approach to policy evaluation. In Journal of Environmental Economics and Management 112. Available online at https://www.sciencedirect.com/science/article/abs/pii/S0095069621001339, checked on 7/5/2022.

Ahman, Max; Nilsson, Lars J.; Johansson, Bengt (2017): Global climate policy and deep decarbonization of energy-intensive industries. In Climate Policy 17, pp. 634–649. Available online at https://www.tandfonline.com/doi/full/10.1080/14693062.2016.1167009, checked on 7/28/2022.

Alonso, Cristian; Kilpatrick, Joey (2022): The Distributional Impact of a Carbon Tax in Asia and the Pacific. International Monetary Fund (International Monetary Fund, 2022/116). Available online at https://econpapers.repec.org/paper/imfimfwpa/2022_2f116.htm.

Ammar, Nasreddine (2019): Fiscal and Distributional Analysis of the Federal Carbon Pricing System. Parliamentary Budget Officer. Available online at file:///C:/Users/ortizrivera/Downloads/Federal_carbon_pricing_EN.pdf, checked on 7/28/2022.

Beck; Lee (2020): The US Section 45Q Tax Credit for Carbon Oxide Sequestration. An Update. Global CCS Institute. Available online at https://www.globalccsinstitute.com/wp-content/uploads/2020/04/45Q_Brief_in_template_LLB.pdf, checked on 7/28/2022.

BEIS (2020): The future of UK carbon pricing impact assessment, checked on 6/30/2022.

Bureau of Energy Efficiency (2021): National Carbon Market. Release Draft Blue Print for takeholder Consultation. Ministry of Power. Available online at https://beeindia.gov.in/sites/default/files/NCM%20Final.pdf, checked on 7/28/2022.

Burke, Joshua; Byrnes, Rebecca; Fankhauser, Sam (2019): How to price carbon to reach net-zero emissions in the UK. The London School of Economics and Political Science; University of Leeds. Available online at https://www.lse.ac.uk/granthaminstitute/wp-content/uploads/2019/05/GRI-POLICY-BRIEF_How-to-price-carbon-to-reach-net-zero-emissions-in-the-UK.pdf, checked on 7/29/2022.

Callonnec, Gaël, et al. (2009): Eléments d'analyse sur la Contribution Climat Energie. Synthèse des études de l'ADEME et du MEEDDAT. Rapport ADEME MEEDDM CCE 260609, checked on 6/30/2022.

CARB (2017): California's 2017 Climate Change Scoping Plan. Available online at https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf, checked on 7/22/2022.

CDP (2021): Putting a Price on Carbon. The state of internal carbon pricing by corporates globally. Available online at https://cdn.cdp.net/cdp-production/cms/reports/documents/000/005/651/original/CDP_Global_Carbon_Price_report_2021.pdf?1618938446, checked on 7/28/2022.

Comité pour la Fiscalité Écologique (2013): Travaux du comité pour la fiscalité écologique, checked on 6/30/2022.

Conway et al. (2019): Tipping the balance - Lessons on building support for carbon pricing. Available online at https://climatefocus.com/sites/default/files/Tipping%20the%20balance.%20Lessons%20on%20building%20support%20-%20adelphi%20Climate%20Focus%20Perspectives.pdf.

CPLC (2017): Report of the High-Level Commission on Carbon Prices, checked on 5/7/2022.

Dechezleprêtre, Antoine; Sato, Misato (2017): The Impacts of Environmental Regulations on Competitiveness. In Review of Environmental Economics and Policy 11 (2), pp. 183–206. DOI: 10.1093/reep/rex013.

Deloitte Tohmatsu Financial Advisory: Assessment of Market-Based Policy Options for Scaling Up Mitigation Actions in Indonesia. Kementerian Koordinator Bidang Perekonomian Republik Indonesia; Kementerian Lingkungan Hidup dan Kehutanan; United Nations Development Program (UNDP), checked on 6/30/2022.

Department of Environmental Affairs (2011): National Climate Change Response White Paper. Department of Environmental Affairs. Available online at https://www.gov.za/sites/default/files/gcis_document/201409/nationalclimatechangeresponsewhitepaper0.pdf, checked on 7/28/2022.

Dussaux, Damien (2020): The joint effects of energy prices and carbon taxes on environmental and economic performance. Evidence from the French manufacturing sector. OECD, checked on 6/30/2022.

Edmonds J.A.; S. Yu; H.C. McJeon; D. Forrister; J. Aldy; N. Hultman et al. (2021): How much could Article 6 enhance Nationally Determined Contribution Ambition towards Paris Agreement Goals through Economic Efficiency? In Clim. Change Econ. 12 (02), p. 2150007. DOI: 10.1142/S201000782150007X.

Green, Jessica F. (2021): Does carbon pricing reduce emissions? A review of ex-post analyses. In Environ. Res. Lett. 16 (4), p. 43004.

ICAP (2020a): Carbon Leakage and Deep Decarbonization. Available online at https://www.adelphi.de/en/system/files/mediathek/bilder/ICAP_CarbonLeakage%26DeepDecarbonization_FullReport.pdf.

ICAP (2020b): Emissions Trading Worldwid. Status Report 2020. Edited by International Carbon Action Partnership. Available online at https://icapcarbonaction.com/system/files/document/200323_icap_report_web.pdf, checked on 7/22/2022.

ICAP (2022): Emissions Trading Worldwide: Status Report 2022. Available online at https://icapcarbonaction.com/system/files/document/220408_icap_report_rz_web.pdf, checked on 5/7/2022.

IMF (2022): Fossil Fuel Subsidies. International Monetary Fund. Available online at https://www.imf.org/en/Topics/climate-change/energy-subsidies, updated on 7/28/2022, checked on 7/28/2022.

IMF & OECD (2021): Tax Policy and Climate Change. IMF/OECD Report for the G20 Finance Ministers and Central Bank Governors, September 2021, Italy, checked on 1/7/2022.

Jones, Angela C.; Sherlock, Molly F. (2021): The Tax Credit for Carbon Sequestration (Section 45Q). Congressional Research Service. Available online at https://sgp.fas.org/crs/misc/IF11455.pdf, checked on 7/28/2022.

Leroutier, Marion (2022): Carbon pricing and power sector decarbonization: Evidence from the UK. In Journal of Environmental Economics and Management 111, p. 102580. DOI: 10.1016/j.jeem.2021.102580.

Mehling, Michael; Dimantchev, Emil (2017): Achieving the Mexican Mitigation Targets: Options for an Effective Carbon Pricing Policy Mix. Available online at https://www.giz.de/de/downloads/giz2019-EN-Achieving-Mexican-Mitigation-Targets.pdf, checked on 4/7/2022.

National Treasury of South Africa (2010): Discussion Paper for Public Comment. Reducing Greenhouse Gas Emissions: The Carbon Tax Option. Available online at http://www.treasury.gov.za/public%20comments/discussion%20paper%20carbon%20taxes%2081210.pdf, checked on 5/7/2022.

Nordhaus, William (2015): Climate Clubs: Overcoming Free-riding in International Climate Policy. In American Economic Review 105 (4), pp. 1339–1370. DOI: 10.1257/aer.15000001.

OECD (2021): Carbon Pricing in Times of COVID-19. What Has Changed in G20 Economies. Available online at https://www.oecd.org/tax/tax-policy/carbon-pricing-in-times-of-covid-19-what-has-changed-in-g20-economies.htm?_ga=2.200681454.1966055701.1657121846-2109574438.1657121845, updated on 3/27/2020, checked on 7/6/2022.

PMR (2019): Implementation completion and results report on a small grant in the amount of USD 3.5 million to the Republic of Turkey. Available online at https://documents.worldbank.org/en/publication/documents-reports/documentdetail/342831561748220110/implementation-completion-and-results-report-icr-document-pmr-turkey-p126101, checked on 4/7/2022.

PMR & CPLC (2018): Guide to Communicating Carbon Pricing. Available online at https://openknowledge.worldbank.org/bitstream/handle/10986/30921/132534-WP-WBFINALonline.pdf?sequence=9.

PMR and ICAP (2021): Emissions Trading in Practice: a Handbook on Design and Implementation. Available online at https://openknowledge.worldbank.org/handle/10986/35413.

Quirion, Philippe (2022): Chapter 7: Output-based allocation and output-based rebates: a survey. In Michael Jakob (Ed.): Handbook on Trade Policy and Climate Change. Elgar Handbooks in Energy, the Environment and Climate Change. Cheltenham, UK: Edward Elgar Publishing, pp. 94–107.

Rafaty, Ryan; Dolphin, Geoffroy; Pretis, Felix (2022): Carbon Pricing and the Elasticity of Co2 Emissions. In SSRN Journal. DOI: 10.2139/ssrn.4057209.

Republic of Argentina (2018): Argentina's comprehensive tax reform its new carbon and liquid fuels taxes, 2018. Available online at https://www.thepmr.org/system/files/documents/Argentina%2018-04-11%20Tax%20reform%20-%20Carbon%20tax.pdf, checked on 6/7/2022.

Stern, Nicholas; Stiglitz, Joseph (2022): The economics of immense risk, urgent action and radical change: towards new approaches to the economics of climate change. In Journal of Economic Methodology. Available online at https://doi.org/10.1080/1350178X.2022.2040740, checked on 7/28/2022.

UNFCCC (2018): Achievements of the clean development mechanism. Harnessing Incentive for Climate Action, 2001-2018. Available online at https://unfccc.int/sites/default/files/resource/UNFCCC_CDM_report_2018.pdf, checked on 6/7/2022.

UNFCCC Secretariat (2016): The social and economic value of carbon and the promotion of efficient public transport and energy efficiency of vehicles. Mitigation benefits and co-benefits of policies, practices and actions for enhancing mitigation ambition and options for supporting their implementation. UNFCCC. Available online at https://unfccc.int/resource/climateaction2020/media/1267/161010_mitigation_tp_final.pdf, checked on 7/22/2022.

van Heerden, Jan; Blignaut, James; Bohlmann, Heinrich; Cartwright, Anton; Diederichs, Nicci; Mander, Myles (2016): The economic and environmental effects of a carbon tax in South Africa: A dynamic CGE modelling approach. In SAJEMS 19 (5), pp. 714–732. DOI: 10.4102/sajems.v19i5.1586.

Venmans, Frank Maarten Jan (2016): The effect of allocation above emissions and price uncertainty on abatement investments under the EU ETS. In Journal of Cleaner Production 126, pp. 595–606. Available online at https://doi.org/10.1016/j.jclepro.2016.02.108, checked on 7/28/2022.

Vivid Economics (2018): Emissions Trading in Mexico: Analysis of Carbon Leakage Risks. Available online at https://www.gob.mx/cms/uploads/attachment/file/415521/Analysis_of_Carbon_Leakage_Risks.pdf, checked on 4/7/2022.

Vogt-Schilb, Adrien; Walsh, Brian; Feng, Kuishuang; Di Capua, Laura; Liu, Yu; Zuluaga, Daniela et al. (2019): Cash transfers for pro-poor carbon taxes in Latin America and the Caribbean. In Nat Sustain 2 (10), pp. 941–948. DOI: 10.1038/s41893-019-0385-0.

Ward, John; Battista, Gaia de; van Heerden, Jan; Bohlmann, Heinrich; Blignaut, James; Cartwright, Anton et al. (2016): Modeling the Impact on South Africa's Economy of Introducing a Carbon Tax. Edited by Partnership for Market Readiness (PMR).

World Bank (2022): State and Trends of Carbon Pricing 2022. Available online at https://openknowledge.worldbank.org/bitstream/handle/10986/37455/9781464818950.pdf?sequence=7&isAllowed=y, checked on 5/7/2022.

Zetterberg, Lars (2014): Benchmarking in the European Union Emissions Trading System: Abatement incentives. In Energy Economics 43, pp. 218–224. Available online at https://www.sciencedirect.com/science/article/pii/S0140988314000437?via%3Dihub, checked on 7/28/2022.