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(1) OECD Environment Directorate

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Abstract

This paper assesses the role of carbon pricing in a sustainable recovery from COVID-19. It tracks the policy changes in carbon pricing within OECD and G20 countries between January 2020 and August 2021 of the COVID-19 pandemic. Carbon pricing as defined here includes emissions trading schemes, fossil fuel support and carbon, fuel excise or aviation taxes. The paper also highlights the need for the recovery to be sustainable and discusses the advantages, limitations and uses of carbon pricing therein. In addition, it describes additional challenges to as well as increased rationale for carbon pricing in the pandemic. It provides evidence on the effects of carbon pricing on the challenges and discusses carbon pricing design elements to help overcome those challenges. The paper concludes that there were more policy changes with an expected negative impact on climate. However, it is likely that the impact of the climate-positive changes – which are broader in coverage and scope - will outweigh the climate-negative changes.

Keywords: sustainable recovery, COVID-19, carbon pricing, carbon tax, emissions trading system, ETS, Fossil fuel subsidies, revenue recycling, climate change, climate mitigation, NDC.

JEL Codes: H23, Q54, Q56, Q58.

Résumé

L’objet du présent rapport est d'étudier comment la tarification du carbone peut intervenir en faveur d’une reprise durable post-COVID-19. Y sont passées en revue les changements que les pouvoirs publics des pays de l’OCDE et du G20 ont opérés dans la tarification du carbone pendant la pandémie de COVID-19 entre janvier 2020 et août 2021. Selon la définition retenue ici, la tarification du carbone regroupe les systèmes d'échange de quotas d'émission, les aides aux énergies fossiles, les taxes carbone, les taxes d'accise sur les combustibles et les carburants et les taxes aéronautiques. Les auteurs du rapport attirent l’attention sur la nécessité d'obtenir une reprise durable et proposent une analyse des avantages, limites et utilisations possibles de la tarification du carbone à cet égard. Ils décrivent d’autres difficultés liées à la tarification du carbone ainsi que les raisons qui justifient de l’étendre à l’heure de la pandémie. Ils présentent des éléments attestant les effets de la tarification du carbone sur les défis à relever et traitent des éléments à prendre en considération au stade de la conception des dispositifs pour y remédier. Leur conclusion est que, dans la majorité des cas, les changements opérés par les pouvoirs publics devraient avoir une incidence néfaste sur le climat. En revanche, ceux aux effets favorables pour le climat - qui couvrent un champ plus vaste et plus détaillé - feront probablement contrepoids.

Mots-clés : reprise durable, COVID-19, tarification du carbone, taxe carbone, système d'échange de quotas d'émission, SEQE, subventions aux énergies fossiles, réaffectation des recettes, atténuation du changement climatique, CDN

Codes JEL : H23, Q54, Q56, Q58

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Executive Summary

This paper discusses the role of carbon pricing in a sustainable recovery from COVID-19. Governments' recovery packages put in place to address the economic and social consequences of COVID-19 will have significant effects on national emission trajectories of greenhouse gas (GHG) emissions. These recovery packages will thus affect the cost and likelihood of countries achieving their short-term and long-term climate goals. Recovery packages that 'build back better' would not only increase the chances of meeting both national and international climate goals, but also other important societal goals such as the Sustainable Development Goals. Carbon pricing as defined in this paper, i.e. emissions trading schemes (ETS), carbon, fuel excise or aviation taxes[1] or reforms of fossil fuel support (FFS), could help to contribute to countries' actions towards COVID-19 recovery and in reaching climate goals as it guides consumption and investment decisions towards low-carbon alternatives.

Carbon pricing has a number of advantages and limitations, but the price levels and coverage of carbon pricing are too low to be in line with the goals of the Paris Agreement. Indeed, only 45% of carbon dioxide (CO_2) emissions from the OECD and G20 countries were priced in 2018 despite some progress in recent years. FFS (i.e. a reduced carbon price) in 2020 was more than seven times higher than the global revenue from carbon taxes and ETS. Carbon pricing can reduce GHG emissions in a cost-effective way and can raise revenues, which could help countries support vulnerable population groups, reduce other distortive taxes, or reduce public debt. Carbon pricing is also associated with both positive short-term (e.g. improved public health) and long-term effects (e.g. increased innovation). Carbon pricing alone is, however, not sufficient. Other policies (e.g. innovation policies, support for low-carbon alternatives and infrastructure investments) are necessary to increase carbon pricing's effectiveness and acceptability and to address other market failures (e.g. knowledge externalities, asymmetric or limited information).

In 37 out of 47 OECD and G20 countries, carbon pricing policies changed between January 2020 (i.e. the start of the pandemic) and August 2021.[2] Some policy changes were significant (e.g. the implementation of China's national ETS, covering 40% of national CO_2 emissions), others were less so, or their level of emissions coverage unclear. Some countries changed carbon pricing provisions for a time-limited period only, while other changes were introduced on a more permanent basis. Carbon pricing changes were either enacted as part of governments' COVID-19 rescue and recovery measures (e.g. many changes in FFS and aviation taxes) or were planned before but implemented during the pandemic (most changes in ETS, fuel or carbon taxes).

In these 47 countries, there were 44 policy changes with an expected positive climate effect (climate-positive) and 55 changes with a negative one (climate-negative). The majority of the policy

[1] Aviation taxes or levies (e.g. passenger duty taxes or airport parking or usage fees) do not explicitly price carbon, but they increase the price of flying and can thus be interpreted as proxy for carbon pricing. The suitability as well as the political acceptability of carbon pricing as a policy tool is likely to vary by country as well as by sector.

[2] This paper tracks policy changes – i.e. deliberate changes of the coverage and/or pricing levels of carbon pricing instruments - that were planned or implemented from the start of the pandemic (January 2020) to August 2021 in 47 OECD and G20 countries.

changes in FFS and aviation taxes had negative climate impacts, were linked to countries' COVID-19 response measures and were focused in specific areas, e.g. support for hard-hit industries or vulnerable households. In contrast, almost all policy changes in ETS, carbon and fuel taxes were climate-positive. Most of these changes were designed to be permanent, were planned before COVID-19, and were broader in coverage and scope. Policy changes in selected sub-national carbon pricing schemes examined for this report showed the same patterns. The aggregate expected GHG impact of these measures was not available. However, it is likely that the impact of the climate-positive changes – which are broader in coverage and scope - will outweigh the climate-negative changes.

Policy changes varied across countries, with 12 (11) of the 47 OECD and G20 countries carrying out exclusively climate-negative (climate-positive) policy changes. In 14 further countries, governments sent mixed carbon pricing signals, strengthening the signal for some instruments, but weakening it for others. All countries that had initiated only or mainly climate-positive policy changes have a net-zero target either in law, as proposed legislation or in policy documents. Countries' GDP per capita, however, did not seem to influence the direction of policy changes in carbon pricing. In many countries, policy changes in carbon pricing and the 'greenness' of fiscal spending in recovery packages were inconsistent; they carried out climate-negative carbon pricing changes, but had a high share of green fiscal spending or vice versa.

COVID-19 did not derail progress on implementing or strengthening ETS, fuel taxes and carbon taxes. Indeed, most ETS, carbon and fuel taxes that had been announced pre-COVID were implemented as planned. Most ETS were robust through the pandemic as prices quickly recovered to pre-crisis levels after an initial drop in most ETS thanks to price or supply adjustment mechanisms. Since the start of the pandemic, some OECD and G20 countries (e.g. Canada, Indonesia, Israel) announced new or strengthened existing ETS or carbon taxes. Some announcements were also made outside of OECD and G20 countries (e.g. Vietnam). However, only few countries have explicitly integrated carbon pricing into their COVID-19 recovery plans so far. For example, as part of Denmark's national recovery and resilience plan, the Danish green tax reform includes a carbon price to be levied on all GHG emissions from 2025.

COVID-19 brought new challenges to carbon pricing, but also increased the rationale for countries to implement new or strengthen existing carbon prices. COVID-19 added to already existing challenges as it led inter alia to a global recession, increased inequality and an increased number of vulnerable households and businesses. However, actual impacts of carbon pricing on economic and social outcomes, including during crises, tend to be less severe than perceived impacts and depend on the choice of instrument and the carbon pricing design. At the same time, the potential rationale for carbon pricing also increased during the pandemic as public support for a 'green recovery' was high while governments announced new long-term climate goals and strategies and/or submitted updated NDCs. Governments were also seeking for new ways to generate revenue in a less distortive manner (e.g. taxing 'bads' rather than 'goods'). Carbon pricing can respond to the public support for climate mitigation, help countries progress towards their climate goals, and help generate revenue.

Governments have multiple design options available to mitigate the challenges associated with strengthening carbon pricing in the recovery, with each option having advantages and drawbacks. Signalling that carbon prices will increase in the near future (but not today) would not exacerbate the current situation of vulnerable groups while sending the right price signal to invest in low-carbon alternatives. Targeted exceptions or direct financial support for vulnerable population groups and businesses in new or strengthened carbon pricing schemes could mitigate any negative economic impacts for those groups, but it could also reduce carbon pricing's environmental effectiveness. Recycling revenue from carbon pricing can increase its public acceptability. The actual recycling mechanisms used by different carbon pricing policies varies substantially across pricing instruments. Yet, the revenue recycling mechanism is important as it affects who benefits from its revenues. In addition, there are synergies and trade-offs between public acceptability, environmental effectiveness, economic effects, and equity.

Figure 1. Carbon pricing in the economic recovery

Country	Carbon Tax	ETS	Fuel Tax	Aviation Tax	FFS
Australia					
Austria				2	
Argentina					2
Belgium				2	
Brazil				2	2
Canada	2	1*			1
Chile					
China		1			
Colombia				1	1
Costa Rica					1
Czech Republic			1		
Denmark	1		1		
European Union		2*			
Estonia					1
Finland			1	1	
France				1 / 3	2 / 1
Germany		1		2	
Greece					
Hungary					
Iceland				1	
India			2		1
Indonesia	1*	1			4 / 2
Ireland	2			1	1
Israel	1*				
Italy			1		1
Japan					
Latvia	1		1		1
Lithuania					
Luxembourg	1				
Mexico		1			1
Netherlands	1			1 / 1	2
New Zealand		2			
Norway	1*			2	5
Poland					
Portugal				1 / 2	
Russia				1	1
Saudi Arabia					
Slovakia					
Slovenia					
South Africa	1		1		
South Korea		1			
Spain					1
Sweden			1		
Switzerland	1	1		1	
Turkey				1	1
United Kingdom		1		2	1 / 1
United States				1	1 / 1

Permanent measures with climate positive effect
Temporary measures with climate positive effect
Permanent measures with climate negative effect
Temporary measures with climate negative effect

Note: ETS: Emission trading scheme
FFS: Fossil fuel support
Aviation taxes or levies: e.g. passenger duty taxes or airport parking or usage fees do not explicitly price carbon, but they increase the price of flying and can thus be interpreted as proxy for carbon pricing.
White: no policy changes observed
Number: the number of policy changes which occurred since the start of COVID-19 (time range studied: 1 January 2020 – 31 August 2021)
*: Proposed policy changes but not yet implemented during investigated time period.
Source: Authors.

1. Introduction

COVID-19 has had dramatic impacts on peoples' lives, societies, and economies across the globe. Governments have developed a number of policies and recovery packages to address the social and economic consequences (OECD, 2021[1]). These past, ongoing, and future recovery packages will have a significant effect on the pathways of greenhouse gas (GHG) emissions and the cost and likelihood of countries achieving their short-term (e.g. nationally determined contributions (NDCs)) and long-term climate goals (e.g. net-zero targets and the Paris Agreement). The latest IPCC report highlights that limiting global warming to the levels agreed in the Paris Agreement will not be feasible unless deep reductions of GHG emissions occur within the next decades (IPCC, 2021[2]). Hence, it is important to 'build back better' as this would not only increase the chances of meeting climate goals, but also other important societal goals, including the Sustainable Development Goals (SDGs), the envisaged post-2020 framework for biodiversity and reduced inequalities (Buckle et al., 2020[3]).

Carbon pricing (i.e. putting a positive price on GHG emissions) and reducing or removing fossil fuel support (FFS) (i.e. lowering the extent of reduced or negative carbon prices) can be important elements of the recovery from COVID-19. Carbon pricing is one of the potential policies that governments can put in place to guide investment and consumption decisions towards low-carbon alternatives, mitigating carbon lock-in and the risk of stranded assets. Carbon pricing can also raise revenues which countries could use in different ways, e.g. promote low-carbon alternatives, support vulnerable population groups or reduce public debt. Despite some progress in recent years carbon price levels and coverage is still too low to lead to emission reductions that are in line with the Paris Agreement (OECD, 2021[4]). Indeed, only 45% of energy-related CO_2 emissions from OECD and G20 countries were priced in 2018 through emissions trading schemes (ETS), carbon and fuel excise taxes, though recent policy changes have increased this number (OECD, 2021[4]). In addition, more than 80% of these emissions are priced below EUR 30 (OECD, 2021[4]). This implies that there is significant room for extending the scope of carbon prices and for increasing the price level, e.g. to USD 50-100 (EUR 43-86) per tCO_2e by 2030, which is the level deemed necessary to reach the Paris Agreement assuming favourable complementary policies (High-Level Commission on Carbon Prices, 2017[5]). Carbon pricing alone is, however, not sufficient. Other policies (e.g. improved enabling environment and infrastructure, support for innovation) are needed to address market failures and deliver emissions reductions where carbon pricing is not effective (Bertram et al., 2015[6]). Embedding carbon pricing in a holistic policy package can increase its effectiveness and acceptability, e.g. by supporting low-carbon alternatives (OECD, 2021[7]).

This paper tracks policy changes - i.e. deliberate changes of the coverage and/or pricing levels of carbon pricing instruments - that were planned or implemented between January 2020 (i.e. the start of the COVID-19 pandemic) and August 2021 in 47 OECD and G20 countries on national and selected sub-national carbon prices. It includes ETS, changes of FFS as well as carbon and fuel excise taxes. In addition, the paper also tracks developments in aviation taxes and levies. While aviation taxes or levies (e.g. passenger duty taxes, value added taxes on flights or airport usage and parking fees) do not explicitly price carbon, they increase the price of flying and can, thus, be interpreted as an imperfect proxy for carbon pricing. As there were many policy changes in this domain in 2020/2021, aviation taxes are included here. Assessing the amount of emissions affected by the policy changes, monitoring associated emission levels, and estimating the effect on GHG emissions from the different policy changes are all important issues – but are not included in the scope of this paper.

The carbon pricing landscape has changed significantly in some countries since the start of the COVID-19 pandemic. Besides significant policy changes in some countries (e.g. China's and Germany's launch of their ETS), G20 finance ministers and central bank governors recognised carbon pricing for the first time in the final communique as an instrument to tackle climate change in July 2021 (G20, 2021[8]). Policy changes were significant or minor, envisioned to be permanent or time-limited, and planned before COVID-19 or implemented as part of governments COVID-19 rescue or recovery measures.

Across all OECD and G20 countries, there were 44 policy changes with an expected positive climate effect (climate-positive) and 55 changes with a negative one (climate-negative). The majority of the policy changes in FFS and aviation taxes had negative climate impacts, were linked to countries' COVID-19 response measures and were focused in specific areas, e.g. support for hard-hit industries or vulnerable households. In contrast, the majority of policy changes in ETS, carbon and fuel excise taxes were climate-positive. Most of these changes were designed to be permanent, were planned before COVID-19, and were broader in coverage and scope. Policy changes in sub-national carbon pricing schemes show the same patterns. The aggregate expected GHG impact of these measures was not available. However, it is likely that the impact of the climate-positive changes – which are broader in coverage and scope - will outweigh the climate-negative changes.

COVID-19 has brought new challenges and perceived risks, but also increased the rationale for countries to implement new or strengthen existing carbon prices (Table 1.1). Implementing carbon prices has been challenging for most countries even before the pandemic. Indeed, the political barriers to establishing carbon pricing persist in several countries. For G20 countries, there seems to be an increasing gap between those countries who have implemented and strengthened carbon pricing and those who are not using carbon pricing (OECD, 2021[9]). Yet, there is a disconnect between the perceived and actual impacts of carbon pricing on economic and social outcomes. Carbon pricing's design options, including revenue recycling mechanisms, can mitigate the challenges associated with carbon pricing, with each option having advantages and drawbacks.

Table 1.1. Perceived risks of and increased rationale for carbon pricing related to COVID-19

Perceived risks	Increased rationale
Slow down economic recovery from COVID-19	Help national and sub-national governments and private actors progress towards their short and long-term climate goals
Exacerbate pre-existing social inequality	Respond to public support for increased levels of environmental protection
Exacerbate the financial situation of vulnerable households and businesses	Provide a much-needed source of revenue for governments to, e.g., refinance their emergency and recovery packages

Source: Authors.

This paper is structured as follows. Section 2. highlights the need for the recovery to be sustainable and discusses the advantages, limitations and uses of carbon pricing therein. Section 3. provides a state of play regarding national and sub-national carbon price changes between January 2020 and August 2021, including carbon taxes, ETS, fuel excise taxes, aviation taxes and FFS reforms. This section also carves out major trends in policy changes across instruments and countries. It also sheds light on the relationship between policy changes in carbon pricing and countries' wealth and greenness of countries' fiscal spending on rescue and recovery packages. Section 4. describes additional challenges to and increased rationale for carbon pricing in the pandemic. It also provides evidence on the effects of carbon pricing on the challenges. Section 5. discusses design elements to aid in overcoming those challenges (e.g. revenue recycling) and proposes a number of instruments related to carbon pricing that may be politically less challenging.

2. The need for a sustainable recovery and the role of carbon pricing therein

2.1. The need for a sustainable recovery from COVID-19

The COVID-19 health crises caused significant human suffering with the global death toll reaching almost 5 million by the end of October 2021 (WHO, 2021[10]). The crisis has also had significant social and economic ramifications across the globe while revealing multiple significant vulnerabilities of our current economic system. Global interconnectedness accelerated the spread of the virus in the early days of the pandemic while complex global value chains struggled to deliver key medical material in time to protect people, notably those on the front line (OECD, 2020[11]). In addition, the crisis has exposed key social inequalities, exacerbating those both across and within countries. Poor people were disproportionately affected by COVID-19 (Patel et al., 2020[12]), unemployment rates sharply increased across the world and more than 100 million people fell back to poverty, undoing several years of progress on eradicating poverty (Lakner et al., 2021[13]).

Other emergencies, notably environmental degradation including climate change, are unfolding in parallel to COVID-19, representing an even bigger threat to people's livelihoods in the future and risking to further entrench pre-existing inequalities. Even if these emergencies (air pollution, biodiversity loss, climate change) are unfolding at different time scales, some of the effects are already being felt. Air pollution kills 4 million people per year, species extinction rates are unprecedented and further accelerating and the physical and economic effects of climate change are increasingly felt across the globe (IPBES, 2019[14]). Even though 2020 saw reduced GHG emissions growth globally due to the lockdowns, the impacts of climate change materialised in extreme weather events that broke records across the world, including heatwaves in Australia, hurricanes and cyclones in the US and India, as well as wildfires in the US, notably in California, where the single-largest wildfire ever recorded burned more than 4% of total Californian land (WMO, 2021[15]). With continued accumulation of GHG emissions, the number and severity of those extreme events are expected to further increase, in addition to further spur biodiversity loss and threaten food security (IPCC, 2018[16]) (IPCC, 2021[17]). Again, the poor, especially in the global South, are expected to be most affected as climate change will reinforce vulnerabilities of which the poor have limited capacity to adapt, further exacerbating pre-existing inequalities (IPCC, 2019[18]).

Governments' responses to the pandemic will have potentially large environmental and social impacts in the short and long-term due to the sheer scale of recovery measures, amounting to more than 20% of global GDP (GRO, 2021[19]), yet significantly higher percentages of domestic GDP are seen in some jurisdictions (Buckle et al., 2020[3]). In order to meet international goals, avoid the worst impacts of climate change, and considering the scale and lasting impact of investments, recovery packages will need to take broader environmental goals into account. This framework would not only tackle climate change (and avoid carbon lock-in), but also advance the SDGs (notably income and jobs), improve resilience to environmental stress, limit the transgression of planetary boundaries (loss of biodiversity, and pollution from phosphorous and nitrogen), and address the growing inequality gap and the health crises, all of which are interrelated problems (Buckle et al., 2020[3]). Returning to 'business as usual' would seriously hamper efforts limiting global warming to 1.5°C or 2°C as per the goals of the Paris Agreement. Even if measures introduced to recovery from the pandemic have a strong climate focus (e.g. by advancing policies that would decouple emissions from GDP growth), failing to incorporate other well-being dimensions in the recovery would not advance broader well-being dimensions (Buckle et al., 2020[3]).

A sustainable recovery from COVID-19 that advances well-being requires a comprehensive policy package, touching on multiple dimensions. This includes the creation of (green) jobs in the short-term (e.g. through supporting buildings renovation and renewable energy), advancing new energy technologies (e.g. through research development and deployment) and limiting inequality (e.g. through targeting recovery measures on vulnerable households or communities). However, since the onset of the pandemic, the largest amounts of unconditional financial aid in OECD countries has been directed towards fossil fuel energy (Energy Policy Tracker, 2021[20]), further locking in carbon-intensive consumption and production modes and hindering the achievement of the SDGs.

2.2. Carbon pricing can be an important element of recovery packages

Carbon prices have a number of advantages

Carbon pricing can be an important element of a country's recovery package from COVID-19. Carbon pricing, either through ETS, carbon taxes, fuel taxes, or reform of FFS, internalises the negative climate externality, affecting the decisions of consumers and producers. Aviation taxes can reduce the demand for flying, resulting in lower emissions, but do not provide incentives for switching to cleaner technologies (Teusch and Ribansky, 2021[21]). Carbon pricing has a number of well-known advantages (Figure 2.1).

These advantages include:

1. Carbon pricing reduces emissions in a cost-effective way. Carbon pricing ensures flexibility by allowing firms and consumers to choose the most efficient method to abate emissions. In contrast, other policies (e.g. technology mandates, standards) may impose unnecessarily high costs for firms and consumers, notably if cheaper abatement options exist. In theory, a uniform carbon price across sectors would also ensure that marginal abatement costs (i.e. the additional costs of abating one additional unit of CO_2e) are harmonised across sectors so that emissions reductions cannot be carried out in a more cost-effective way. Cost-effectiveness is key in the recovery because public funds will be increasingly scarce as governments have accumulated massive debt during the crisis.
2. Carbon pricing – if at a sufficiently high level – can steer production, consumption and investment decisions towards low-carbon alternatives where these are available. By sending a price signal, consumers and firms have a monetary incentive to reduce consumption of carbon-intensive goods and to choose low-carbon alternatives over high-carbon alternatives. This price signal is particularly important as countries recover from the crisis and firms (and consumers) invest in long-lived assets or durables that will determine the emission pathways for years to come. By shaping the investment decisions, carbon pricing also reduces the risk of stranded assets.
3. Carbon pricing tends to have positive long-term effects. Countries with higher carbon prices are also associated with higher levels of GDP per capita (OECD, 2021[4]). Carbon pricing tends to have a positive effect on labour productivity, increasing the material conditions of workers (Venmans, Ellis and Nachtigall, 2020[22]). Carbon pricing also promotes innovation in low-carbon technologies (Calel and Dechezleprêtre, 2016[23]), advancing the competitiveness of innovating firms in an increasingly carbon-constrained world (OECD, 2018[24]). However, carbon pricing so far has failed to incentivise the innovations needed to trigger structural change (Tvinnereim and Mehling, 2018[25]), calling for other policies (see next section).

4. Carbon pricing is associated with a number of co-benefits, notably health benefits related to reduced air pollution. As carbon pricing reduces the combustion of fossil fuels (see point 1) and provides incentives for renewable energy and energy conservation (see point 2), it also delivers a number of local, regional and global co-benefits. Increased air quality increases labour productivity, labour supply, and crop yield, while reducing morbidity and mortality (Partnership for Market Readiness, 2021[26]). Reduced air pollution also improves biodiversity (Karlsson, Alfredsson and Westling, 2020[27]). Other co-benefits include improved water resources (e.g. increased water availability, decreased water extraction and water pollution),[3] enhanced soil health (e.g. decreased soil contamination and soil acidification), and transport-related benefits (e.g. reduced congestion and reduced road injuries) (Partnership for Market Readiness, 2021[26]). Benefits also include enhanced energy security as well as positive employment effects in renewable energy and energy efficiency industry, which may outweigh the negative employment effects in legacy industries (IRENA, 2020[28]). Reaping these benefits are key in the recovery from COVID-19 as they capture dimensions beyond mitigation benefits. As most of these dimensions materialise in the short term, this could potentially enhance public support.
5. Carbon pricing generates revenues or frees up fiscal space (in case of FFS reform). Despite the COVID-19 crises, global revenue from existing explicit carbon pricing schemes were USD 53 billion in 2020, USD 8 billion more than the previous year (World Bank, 2021[29]). Fossil fuel support, however, are estimated to amount to almost USD 350 billion in 2020 based on the joint OECD-IEA estimate; around seven times the revenues from carbon pricing (OECD, 2021[30]). The revenue from carbon pricing could be used in different ways, including financing part of the recovery packages, financing mitigation or adaptation measures, improving the efficiency of the tax system (e.g. through reducing labour taxes) or improving the sustainability of public debt by providing much needed additional revenue streams to the government in the post-COVID-19 era.
6. Carbon pricing reduces the need for subsidies or other public financial support in green investments in some sectors. Pricing carbon reduces the pay-back time of energy efficiency investments (e.g. building renovation), thus, enhancing the economics of energy efficiency measures and reducing the need for financial support. The relationship between green support and carbon pricing is most pertinent in the electricity sector. In many countries, governments guarantee a specific electricity producer price at which renewable energy producers can sell their electricity, paying the difference between this price and the electricity wholesale price if the wholesale price falls short of the guaranteed price. In a competitive electricity market, a carbon price would directly increase the wholesale price, reducing the need to compensate renewable energy firms, freeing up public funds that can be channelled towards other uses, which is an important aspect in the recovery.
7. If properly designed, carbon price revenues can also reduce inequality and protect vulnerable households or communities. In low-income countries, carbon pricing (or removal of FFS) is expected to be progressive as it is primarily rather rich households that consume carbon-intensive goods (Ohlendorf et al., 2020[31]). In emerging and developed countries, the distributional impact depends on several factors, including the pre-existing social security system. Evidence from Finland suggests that carbon pricing in countries with strong social security systems can be progressive as energy price increases are directly reflected in social security payments (SITRA, 2020). The distributional effects of carbon pricing also depend on the revenue recycling mechanism (section 5.).

[3] For example, a carbon price could increase costs of power generation, which provides incentives for end-users to lower water extraction.

Figure 2.1. Advantages of carbon pricing

Source: Authors.

2.3. Carbon pricing alone is insufficient

Policy packages are needed

Carbon pricing alone will not be enough to limit global warming to the temperature goals of the Paris Agreement (Rosenbloom et al., 2020[32]), (Hepburn, Stern and Stiglitz, 2020[33]). Thus, other policies are needed in the recovery from COVID-19 to increase the chances of meeting the Paris Agreement. Carbon pricing alone is insufficient for at least three reasons:

1. Addressing climate change is increasingly urgent (IPCC, 2021[2]), and politically acceptable carbon prices may not be high enough to deliver on the emission reductions required (Hepburn, Stern and Stiglitz, 2020[33]). By putting a price on CO_2 emissions, consumer and producer prices increase and these can be directly observed by consumers and producers, reducing the political

acceptability of carbon prices (Partnership for Market Readiness, 2021[26]). In addition, carbon pricing may also be unpopular due to distributional consequences (see section 5.).

2. Carbon prices could trigger structural change in some parts of the economy, but not everywhere (Rosenbloom et al., 2020[32]). Many structural changes that are needed for limiting global warming to 'well-below 2°C' (e.g. changes in urban form, supply chains, or production networks) are likely to respond only slowly and/or weakly to price increases (Hepburn, Stern and Stiglitz, 2020[33]).
3. Economic efficiency calls for a global carbon price covering all sectors (Rosenbloom et al., 2020[32]). Co-ordination on a carbon floor price could be an important step towards a global carbon price (Nachtigall, 2019[34]), although it is likely to face significant political obstacles in some countries. A carbon floor price could be facilitated by a carbon club, open to all countries. A global carbon price would, nevertheless, be politically challenging to establish in today's fragmented international policy landscape. In addition, a uniform global carbon price would not take into account differences in the cost and potential of mitigation in different sectors and countries.

While carbon pricing remains a key component of policy packages, other policies are needed to incentivise emissions reductions where carbon pricing is not (yet) sufficiently effective. At the same time, those policies can also make carbon pricing more effective and equitable (see below). Complementary policies to carbon pricing are likely to differ across sectors and are related to a number of other externalities (e.g. innovation externalities such as learning-by-doing or research and development spill-overs), behavioural or other barriers (e.g. limited information, myopia, split incentives, credit constraints, regulatory barriers) or enabling infrastructure investments (e.g. urban road reallocation to enable shift to active modes of transportation).

Figure 2.2 illustrates the different rationales for complementary policies in form of a stylised marginal abatement cost (MAC) curve that orders the emissions reduction potential according to abatement costs. This curve represents the abatement potential of carbon pricing derived from shifting to low-carbon modes of production or consumption. Carbon pricing typically also increases the cost of carbon-intensive products, reducing the demand of those products. Yet, income growth would potentially offset the positive effects of reduced demand in the medium term. This curve has four different areas:

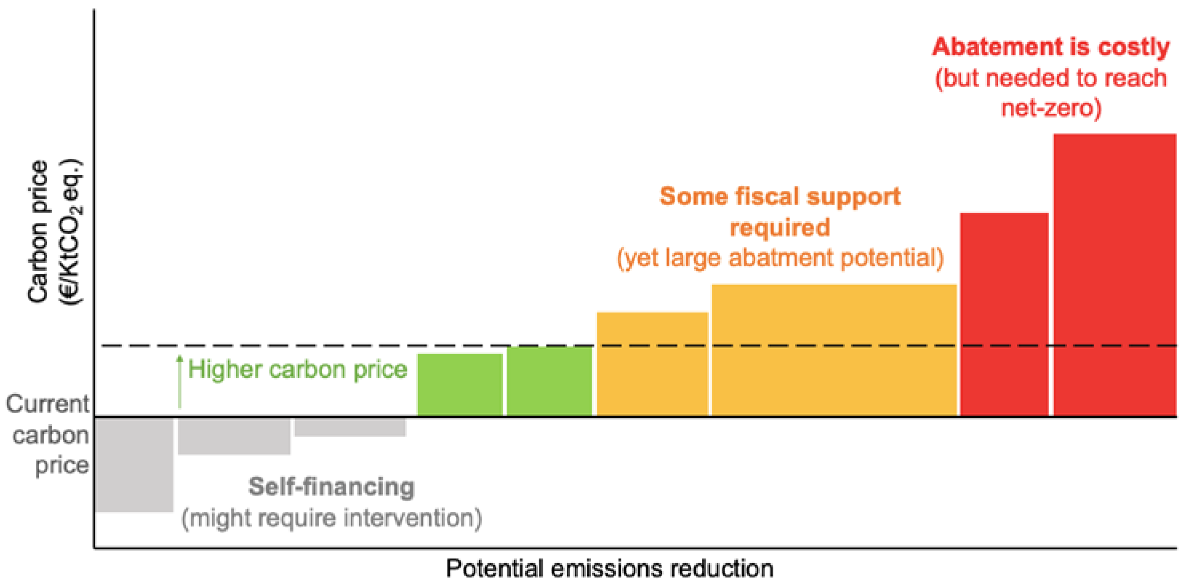
1. Grey area: MAC is below current carbon price. In this area, mitigation actions would be self-financing but are not carried out due to a number of factors (e.g. myopia, split incentives, capital constraints, lack of knowledge about abatement options). Typical examples include those related to energy efficiency improvements of equipment or buildings. Other policies could include information measures or technological standards that effectively address the underlying barrier of adoption.
2. Green area: MAC is between the current and the higher carbon price. This is the area where higher carbon pricing is indeed effective and reduces the emissions in a cost-effective and permanent way. In many jurisdictions (e.g. US, EU), emissions from the electricity sector are covered in this price range. A carbon price importantly affects operational decisions (i.e. the merit order), incentivising a fuel switch from high carbon-intensive coal to less-carbon intensive natural gas. With the costs of renewables plummeting and representing an affordable alternative to fossil fuels, a carbon price also provides investment incentives for renewables, which can earn higher market revenues. In sectors where the carbon price is passed through to consumers, the carbon price also effectively reduces emissions by encouraging energy conservation or the consumption of less carbon-intensive alternatives where they exist.
3. Yellow area: MAC is slightly above the higher carbon price. In this area, there are no expected effects of an even higher carbon price from technological substitution.[4] Examples include sectors (e.g. transport) where the lifecycle costs of alternative technologies (e.g. EVs) are still higher than those of fossil-based technologies (e.g. gasoline cars) even when taking the carbon price into

[4] There are, however, some temporary effects from reduced demand for carbon-intense products.

account. Other policies in this area would support the 'green' alternative by reducing the price through subsidies or feebates (see section 5.). This would spur demand for those clean alternative technologies, eventually further reducing the cost, enabling governments to phase out additional support. Once the cost of the alternative has been reduced sufficiently, applying a carbon price will be efficient as the alternative have become price competitive. This is also the area where slightly higher prices would reduce the public support for alternative technologies if existing, creating a double dividend for governments' budget by generating revenue from carbon pricing and reducing the need for public support for low-carbon alternatives.

4. Red area: MAC is much above the higher carbon price. In this area, the carbon price is ineffective to provide incentives for adopting low-carbon technologies.[5] Examples here include the 'hard-to-abate' sectors, including aviation or heavy industry such as steel and cement. Other policies in this area would focus on evolutionary processes, including policies related to dynamic innovation and research, development and deployment (e.g. technology funds) to bring down the abatement costs of existing and prospective technologies. Once the costs decrease, a combination of carbon pricing and public support (e.g. subsidies) for the low-carbon alternatives could effectively reduce the remaining emissions.

Figure 2.2. Marginal abatement cost curve and the effectiveness of carbon pricing



Source: Based on (Hood, 2011[34]).

Other policies can make carbon pricing more effective and accepted

Besides the policies focussing on the diffusion of low-carbon technologies outlined above, complementary policies to carbon pricing are also important to enhance the effectiveness and the acceptability of carbon pricing. This is particularly pertinent in the transport sector, where road transport demand does hardly respond to fuel price changes, at least in the short-term (Geman, 2019[35]) (Victoria Transport Policy Institute, 2013[36]). This is, among others, because private car use cannot be easily substituted by other modes due to lack of alternatives. People's demand for mobility cannot be satisfied by alternatives due to a lack of alternatives (Avner, Rentschler and Hallegatte, 2014[37]). Carbon pricing would increase the cost of car-based mobility, potentially causing strong opposition if people are car-dependent and lack alternatives. Complementary policies, including investments in quality infrastructure (e.g. for active modes of transport) and the provision of public transport, would provide alternatives, enabling people to switch modes while improving the effectiveness and the perceived fairness of carbon pricing (OECD, 2021[38]). In fact, public transport infrastructure has been found to significantly increase consumer's responsiveness of travel and energy demand (and related GHG emissions) to carbon pricing (Avner, Rentschler and Hallegatte, 2014[37]). Carbon pricing revenues could importantly be channelled towards supporting sustainable modes of transport. If combined in a larger package, this would enhance the political acceptability (OECD, 2021[38]).

In the electricity sector, electricity wholesale markets are an enabling condition for carbon prices to be effective. Electricity markets ensure that power plants are dispatched according to their operational costs (i.e. merit order) to meet electricity demand. Carbon prices would directly affect the operational costs of fossil power plants, enabling fuel switch (e.g. from coal to gas power plants) and sending a price signal to investors in renewable power plants. Importantly, the electricity market ensures cost-effectiveness, limiting the price increase consumers are facing due to the carbon price, potentially enhancing the acceptance of carbon pricing. Evidence from the UK suggests that the CPS has had a very minor impact on wholesale power prices and electricity bills in the UK (UCL, 2020[39]).

2.4. Carbon pricing levels and coverage were low before COVID-19

Despite some progress in recent years, carbon price levels and coverage were still too low to be in line with limiting global warming to agreed climate targets (OECD, 2021[4]). Before the outbreak of COVID-19, carbon pricing was in place in 57 national and subnational jurisdictions across the globe, up from 16 ten years beforehand (World Bank, 2021[29]). However, only 45% of energy-related CO_2 emissions from OECD and G20 countries were priced in 2018 through emissions trading schemes (ETS), carbon and fuel excise taxes (OECD, 2021[4]).

Effective carbon rates, comprising ETS, carbon taxes or fuel excise taxes, are still far below international benchmarks deemed to be necessary to reach the Paris Agreement pre-COVID-19.[5] Based on a benchmark price of EUR 60/tCO_2, recent OECD analysis reports the Carbon Pricing Score (CPS)[6] to be only 19% in 2018 based on 44 OECD and G20 countries, which jointly account for around 80% of energy-related global CO_2 emissions (Figure 2.3).[7] This implies that pre-COVID-19 there was significant room for extending the scope and coverage of carbon prices and for increasing the price levels. There is still a gap between actual carbon prices and those deemed necessary to reach the Paris Agreement, even though G20 countries made some progress in carbon pricing between 2018 and 2021 (OECD, 2021[9]). The next

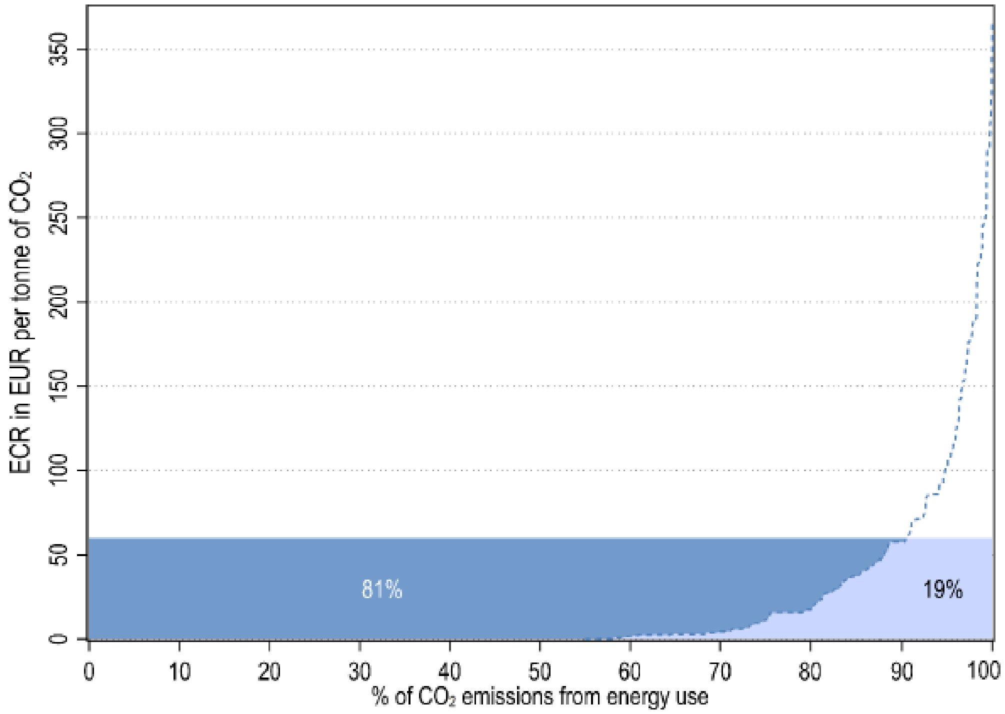
[5] International benchmarks of carbon pricing considered to be in line with limiting global warming to well-below or 1.5 degree compared to pre-industrial levels range between USD 30 and USD 120 (EUR 26-104). Estimations from the US suggest that decarbonising the US economy by 2060 would need a carbon price of USD 30 (EUR 27) by 2025 (Kaufman et al., 2020[288]). Estimates of the High-Level Commission on Carbon Prices suggest that carbon prices should be at a range of USD 40-80 (EUR 35-70) per tonne CO_2e in 2020 and USD 50-100 (EUR 43-86) in 2030 to be in line with the goals of the Paris Agreement assuming favourable conditions in complementary policies (High-Level Commission on Carbon Prices, 2017[5]). In the OECD Secretary General's climate lecture event, Nicolas Stern, one of the lead authors of the Commission, suggested that carbon prices should be rather at the higher end of those ranges as progress on mitigating emissions has been too slow in the last years (OECD, 2021[290]). In 2019, the IMF suggested that carbon prices would need to increase to USD 75/tCO_2e (EUR 66/tCO_2e) by 2030 to be in line with the goals of the Paris Agreement under the assumption of optimal complementary policies (IMF, 2019[287]).

[6] The CPS at EUR 60 measures the extent to which countries make progress towards pricing all energy-related carbon emissions at 60 EUR (OECD, 2021[4]).

[7] Figure 2.2 does not include Costa Rica, Saudi Arabia and the EU as a single country. The figure accounts, however, for all EU Member States. Costa Rica, Saudi Arabia and the EU are included in the analysis of this paper.

section provides an update of carbon pricing developments in 47 OECD and G20 countries between January 2020 and August 2021.

Figure 2.3. Carbon Pricing Score in 2018



Note: The area shaded in light blue shows the Carbon Pricing Score (CPS) at EUR 60 per tonne CO_2. It shows the extent to which the group of 44 OECD and G20 countries together reached the benchmark to price all emissions from energy use at least at EUR 60 per tonne CO_2 in 2018. The area shaded in dark blue shows the Carbon Pricing Gap, i.e. the shortfall to pricing all emissions at least at EUR 60 per tonne CO_2.
Source: (OECD, 2021[4]).

3. Carbon pricing in the economic recovery: State of play

This section synthesises policy changes in carbon pricing within 47 OECD and G20 countries during the COVID-19 pandemic from January 2020 until August 2021 to assess the role played by carbon pricing in a sustainable recovery. This includes positive carbon pricing policies, which put (or increase) a price on carbon such as carbon taxes, ETS, fuel excise and aviation taxes. It also includes policy changes in FFS, i.e. changes in reduced or negative carbon prices. Data have been retrieved from various sources, including OECD databases, ICAP, the World Bank Group, the global recovery observatory, and interviews with government officials.

This section tracks policy changes (i.e. increases or decreases of existing carbon pricing instruments[8] and the implementation of new ones) at a national level, as well as selected subnational schemes (section 3.6). The policy changes (see Figure 3.1) are those planned or implemented during the timeframe specified above. They include policy changes planned and prepared before the pandemic, but implemented during the specified time period as well as policy changes designed during the pandemic, and implemented as either permanent or temporary, i.e. time-limited policy changes. This assessment covers the **number** of policy changes, but it does not quantify the aggregate GHG impact of these policies as information on expected GHG impacts is not available for individual policy changes. This paper does not cover carbon pricing policies that have remained unchanged in nominal prices between January 2020 and August 2021. For example, Finland's and Sweden's carbon taxes are not included here as there was no change in these taxes during the pandemic.

3.1. Overall trends of carbon pricing during the pandemic

The impact on GHG emission trends of individual policy changes will vary widely (OECD, 2021[9]). Some policy changes were extensive, with the potential for significant impact on emission levels (e.g. the launch of China's national ETS, which put a carbon price on 40% of national CO_2 emissions). Other policy changes were narrower in coverage and scope, with a correspondingly lower level of likely impact on a country's overall GHG emission levels (e.g. a deferral of coal tax in the Netherlands) (ICAP, 2021[40]) (ICAP, 2021[41]) (OECD, 2021[42]). Some policy changes included annual price increases agreed in advance (e.g. EUR 5-10/tCO_2 annual increase for Germany's nETS[9]) while others were limited to a single instance (e.g. South Korea's one-month price floor in its ETS) (OECD, 2021[43]). Permanent policy changes included fuel excise tax increases on heating fuels (e.g. Finland), while time-bound policy changes were as short as three months (e.g. Costa Rica's COVID-19 tax on gasoline) (OECD, 2021[44]).

[8] Excluding ETS price changes that occurs without policy changes.

[9] Germany's nETS starts at EUR 25/tCO_2 in 2021, it then rises with EUR 5 annually for the first two years, and then EUR 10 annually for another two years before hitting EUR 55/tCO_2 in 2025.

Figure 3.1. Carbon pricing changes during the first 20 months of COVID-19 on a national level in OECD and G20 countries

Country	AUS	AUT	ARG	BEL	BRA	CAN	CHL	CHN	COL	CRI	CZE	DNK	EU	EST	FIN	FRA	DEU	GRC	HUN	ISL	IND	IDN	IRL
Carbon tax						2						1										1*	2
ETS						1*		1					2*				1					1	
Fuel Excise Tax											1	1			1						2		
Aviation tax		2		2	2				1						1	1 / 3	2			1			1
FFS			2		2	1			1	1				1		2 / 1					1	4 / 2	1

Country	ISR	ITA	JPN	LVA	LTU	LUX	MEX	NLD	NZL	NOR	POL	PRT	RUS	SAU	SVK	SVN	ZAF	KOR	ESP	SWE	CHE	TUR	GBR	USA
Carbon tax	1*			1		1		1		1*							1				1			
ETS							1		2									1			1		1	
Fuel Excise Tax		1		1													1			1				
Aviation tax								1 / 1		2		1 / 2	1								1	1	2	1
FFS		1		1			1	2		5			1						1			1	1 / 1	1 / 1

Note: Dark green: Permanent policy change with an expected climate-positive effect; Light green: Temporary policy change with an expected climate-positive effect; Light red: Temporary policy change with an expected climate-negative effect; Dark red: Permanent policy change with an expected climate-negative effect; White: no change; Number: the number of policy changes; *Proposed but not yet implemented policy changes: one for Canada (ETS), one for EU (ETS), one for Indonesia (carbon tax), one for Israel (carbon tax) and one for Norway (carbon tax).
Source: Authors.

The overall carbon pricing policy changes during the first 20 months of COVID-19 for the 47 OECD and G20 countries are the following:

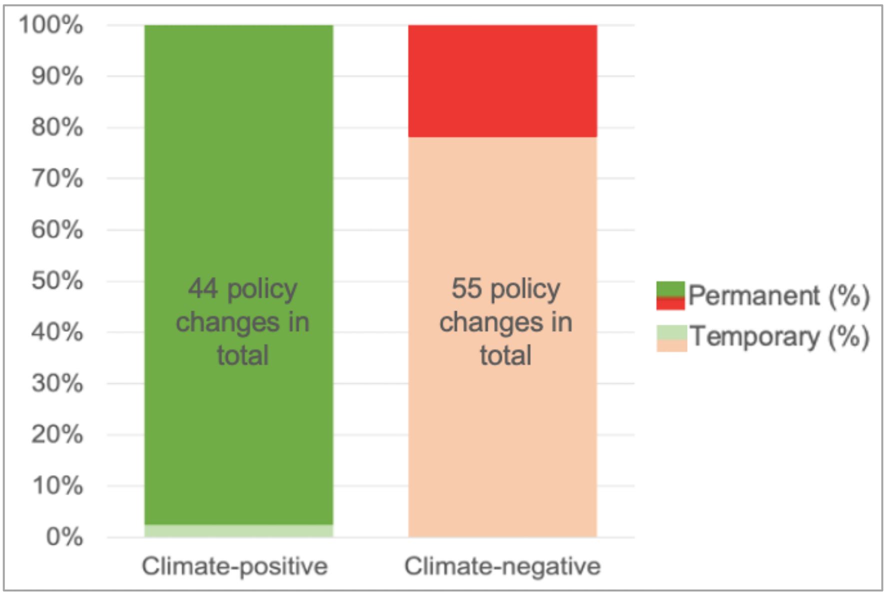
- The implementation or strengthening of carbon taxes, fuel excise taxes, and Emissions Trading Schemes (ETS) were expected to have climate-positive impacts. These changes were introduced as permanent changes, and were planned before the pandemic. For carbon taxes, policy changes mainly included increased price levels for existing carbon tax schemes (see section 3.3), while the policy changes for ETS entailed countries tightening the emissions cap for existing schemes, as well as launching new schemes (see section 3.5).
- A few ETS and carbon tax schemes experienced minor administrative delays due to COVID-19, such as the three month delay in South Africa's carbon tax and the six month delay in the Indonesian ETS. Policy changes relating to fuel excise taxes were permanent, with one policy change implemented due to COVID-19 to boost declining tax revenues (e.g. India) while the rest were implemented despite COVID-19.
- The pandemic did, therefore, overall not derail the planned implementation of carbon taxes, fuel excise taxes and ETS policy changes.[10]
- Announcements and proposals of the future implementation of carbon tax initiatives were observed in Denmark, Indonesia, Israel and Norway (see section 3.3), while ETS initiatives were announced for pre-existing ETS in Canada (Output Based Pricing System), and in the EU (see section 3.5).
- In contrast, FFS and aviation policy changes were mostly climate-negative, time-limited and enacted as a government response to the pandemic to aid hard hit industries and tackle low-oil prices. Aviation tax policy changes mainly included the deferral of rents and fees, while the FFS policy changes addressed both the production and consumption side.

In terms of numbers of policy changes, the majority of the individual changes assessed are expected to have a negative effect on climate mitigation (climate-negative) rather than a positive effect (climate-positive) as can be seen in Figure 3.2. However, the expected effect of the changes varies significantly by the type of carbon pricing instruments assessed. Out of the 99 policy changes assessed here, 55 were

[10] Examples of countries which experienced carbon tax increases are Canada, Ireland, and Latvia while the implementation of a carbon tax occurred in Luxembourg and the Netherlands. For ETS, a strengthening of existing schemes took place in e.g. the EU, New Zealand and Korea, while new ETS were launched in e.g. China, Mexico, and Germany.

climate-negative, stemming entirely from fuel excise taxes, aviation taxes and changes in FFS. 44 policy changes were climate-positive and originated mostly from policy changes in carbon taxes, ETS, and fuel excise taxes. 78% of the climate-negative policy changes are or were temporary policy changes, of which most can be explicitly linked to governments' response policy changes to COVID-19 induced challenges for the aviation and fossil fuel sectors. Whether some of these temporary policy changes will in practice be implemented on a permanent basis, as happened with the carbon tax in Iceland (see section 4.1), is not yet clear. However, it is likely to depend on the economic recovery and development of the aviation and FFS sectors in the various countries. Indeed 98% of the climate-positive policy changes were introduced as permanent policy changes, of which the majority had been planned and, in some cases, announced before the COVID-19 pandemic.

Figure 3.2. Share of temporary and permanent policy changes by climate category in OECD and G20 countries during the first 20 months of the COVID-19 pandemic.



Note: Dark green/red refers to permanent policy changes; Light green/red refers to temporary policy changes.
Source: Authors.

Different countries vary widely in terms of the climate direction of their overall carbon pricing policy changes to the COVID-19 pandemic. Categorising the countries according to whether their policy changes are only or mostly climate-positive or negative, highlights that 12 countries had only climate-negative policy changes, 11 countries had only climate-positive policy changes and 14 countries had mixed price signals with both climate-negative and positive policy changes (Figure 3.3).

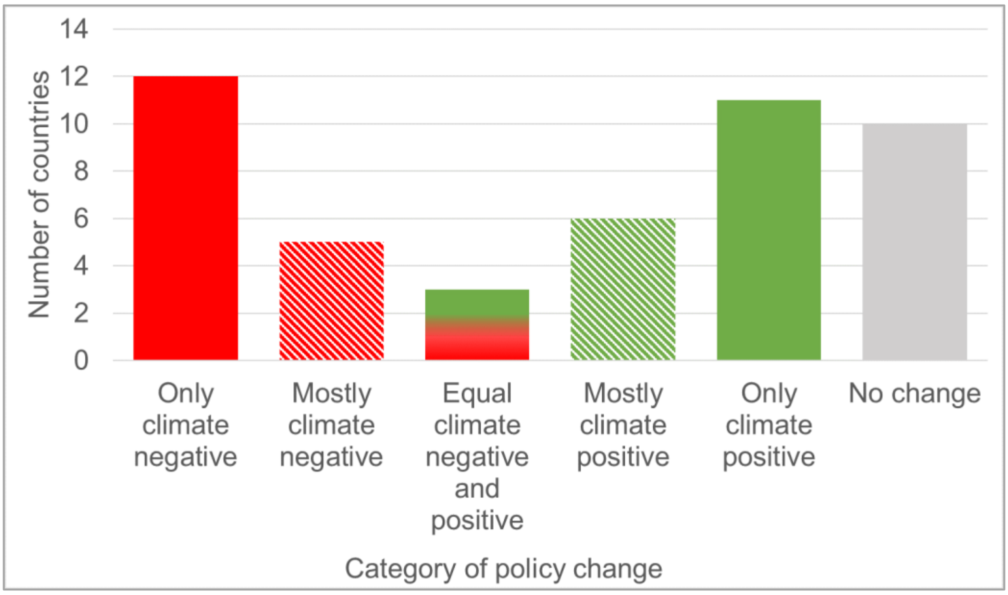
Comparing the countries with climate-positive or climate-negative carbon pricing policy changes with the political efforts on net-zero targets, as according to the ECIU[11] (ECIU, 2021[45]), indicates that countries with mainly climate-positive policy changes are more ambitious in terms of GHG mitigation ambition. All countries (100%) that have implemented mainly climate-positive policy changes[12] have a net-zero target either in law, as proposed legislation or in policy documents, whereas a smaller majority (71%) is seen for

[11] As per the status of countries net-zero pledges on 25th of November 2021.

[12] Countries which are categorised as only and mostly climate-positive in Figure 3.3.

countries with mainly climate-negative policy changes.[13] A link, therefore, exists between countries with mainly climate-negative policy changes and countries with a lower net-zero ambition.

Figure 3.3. Number of OECD and G20 countries by various climate-positive or negative policy change categories during the first 20 months of the COVID-19 pandemic.



Note: Red refers climate-negative policy changes; Green refers to climate positive policy changes; Grey: no observed policy changes.
Source: Authors.

3.2. Potential determinants of carbon pricing policy changes

This section investigates whether there is a correlation between carbon pricing policy changes and countries' a) fiscal spending or b) wealth. The findings of this paper are contrasted with those of the Energy Policy Tracker (EPT). The EPT has collected information for 28 of the 47 OECD and G20 countries on public money commitments and supporting policies for five overall categories: *conditional* and *unconditional clean energy*, *conditional* and *unconditional fossil fuel*, and *other energy*. *Conditional clean energy* entails that spending is potentially clean if appropriate environmental safeguards are implemented (e.g. clean energy for electric vehicles) while *unconditional* spending is clean. *Other energy* policies include financial commitments to e.g. nuclear energy and bioenergy (Energy Policy Tracker, 2021[46]). For comparison, only the clean energy (*conditional* and *unconditional*) spending percentage of the total spending have been used – as a proxy of how green countries' recovery have been. Comparing the findings of analysis here with that in the EPT highlights that while these two sets of analyses are consistent for most countries examined, they are not for all countries (Figure 3.4).

Countries where the different analyses align:

1. Countries (e.g. ARG, COL, RUS) who are categorised here with mostly or only climate-negative carbon pricing measures (x-axis) and are below the 30% clean energy spending line (y-axis) (red area); and,

[13] Countries which are categorised as only and mostly climate-negative in Figure 3.3.

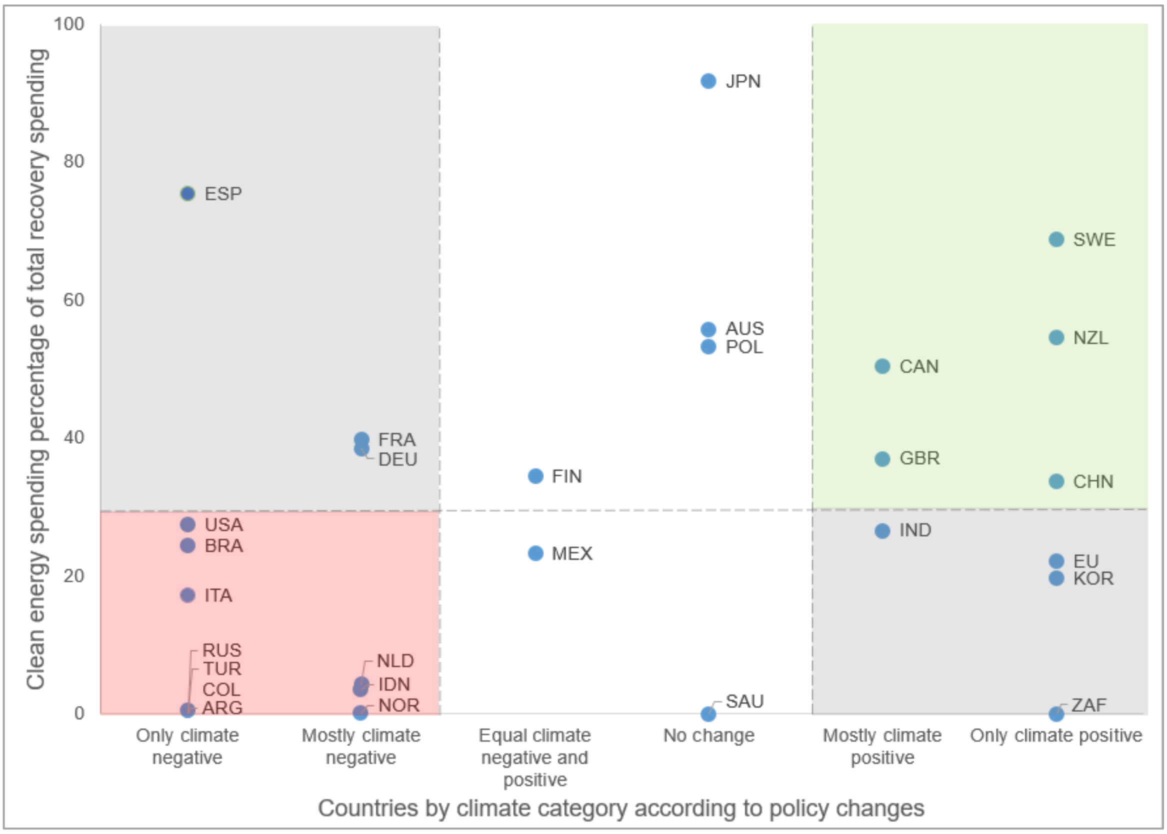
2. Countries (e.g. SWE, NZL, CAN) who are categorised here with mostly or only climate-positive carbon pricing measures (x-axis) and are above the 30% clean energy spending line (y-axis) (green area).

Countries where the different analyses misalign (grey areas):

1. Countries (e.g. ZAF, KOR, EU) who are categorised here with mostly or only climate-positive carbon pricing measures (x-axis) and are below the 30% clean energy spending line (y-axis); and,
2. Countries (ESP, FRA, DEU) who are categorised here with mostly or only climate-negative carbon pricing measures (x-axis) and above the 30% clean energy spending line (y-axis).

For the latter categories of countries, misalignment of findings arise as a low (high) clean energy spending percentage should not match the climate-positive (climate-negative) rating, but rather a climate-negative (climate-positive) rating. For countries who were rated equal climate-negative and positive (FIN and MEX) (white areas) a spending percentage around the 30% line is expected to indicate the equal attention attributed to both climate-positive and negative policies changes. For countries where data aligns, the greenness of countries' recovery is confirmed by this paper and the EPT.

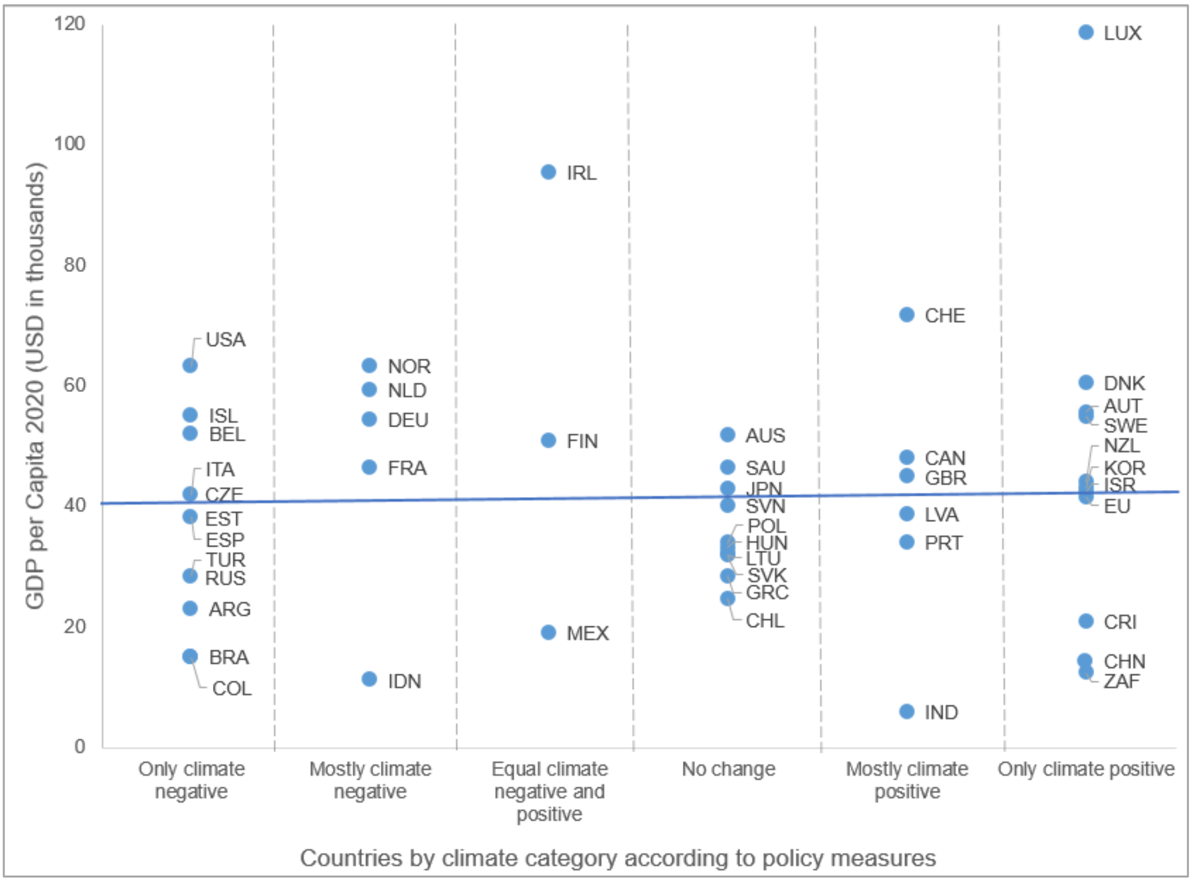
Figure 3.4. Clean energy spending percentages compared with countries' overall climate category of carbon pricing policy measures introduced during the first 20 months of COVID-19



Note: In the Energy Policy Tracker database, data for AUT, BEL, CHL, CRI, CZE, DNK, EST, GCR, HUN, ISL, IRL, ISR, LVA, LTU, LUX, PRT, SVK, SVN, and CHE were unavailable, and they are, therefore, excluded from this graph. On the x-axis the country climate categories are listed, along with *No Change* indicating countries without any observed policy changes for the specified period. On the y-axis, the clean energy spending percentage of the total energy spending is indicated. The *clean energy* spending category includes *conditional* and *unconditional* spending, but does not include spending on the other categories: *other types of energy* (e.g. nuclear energy and bioenergy) and *fossil fuels*. The y-axis has been separated by a 30% line to indicate a low spending percentage defined as <30%, and a high spending percentage defined as >30%.
Source: (Energy Policy Tracker, 2021[46]) and Authors.

An assessment was also made on whether there was any correlation between countries' wealth and their overall level of climate-positive or climate-negative carbon pricing policy changes between January 2020 and August 2021 (Figure 3.5). Richer countries might have more (economic) capacity to positively change carbon prices, including in times of the pandemic. Countries' GDP/capita was, therefore, plotted against their climate category based on the number and direction of carbon pricing policy changes within countries. However, almost no correlation between these two variables were found, as indicated by the almost horizontal regression line. This indicates that a greater economic freedom to implement climate-positive carbon pricing changes does not always correspond with whether such carbon pricing changes have been put in place. One reason for this may be that rather wealthy countries face the same political economy challenges as emerging economies. While there is no evidence between countries' wealth and the direction of carbon pricing policy changes, countries' net-zero targets seem to be a determinant for climate-positive policy changes (see above).

Figure 3.5. Correlation between carbon pricing changes and GDP per capita



Note: The figure displays on the y-axis the GDP per capita in US dollars for 2020 for most countries, however, for countries where 2020 data was unavailable, the most recent available year was taken. These countries are: ARG (2019), BRA (2018), CHN (2017), IND (2016), IDN (2017), JPN (2019). On the x-axis the country climate categories are listed, along with *No Change* indicating countries without any observed policy changes for the specified period. The regression line is almost zero, thus, there is very little correlation between the y and x-axis.
Source: (OECD Stat, 2021[47]) and Authors.

3.3. Carbon taxes

Since the start of 2020, only climate-positive changes have been seen for carbon taxes in the 47 OECD and G20 countries, of which most of these change can be attributed to new or increased carbon taxes. A total of eleven countries have proposed or launched new taxes, or they have changed existing taxes. Of these, five countries proposed or implemented new carbon taxes (see Table 3.1) while six countries increased or proposed to increase their carbon taxes (see Table 3.2).

Table 3.1. Overview of new carbon taxes during the first 20 months of COVID-19

	Luxembourg	The Netherlands	Indonesia	Israel	Denmark
Status	Implemented by January 2021	Implemented by January 2021	Planned implementation by April 2022	Planned implementation by 2023-28	Planned implementation by 2025
Price level 2021	EUR 20/tCO_2	EUR 30/tCO_2	EUR IDR 30,000/tCO_2e (EUR 1.83/tCO_2e*	Unknown	Unknown
Price trajectory	EUR 5 increase per year for 2022 and 2023, reaching EUR 30/tCO_2	EUR 10.6 increase per year until 2030, reaching EUR 125-130/tCO_2	No	No	No
Sectors	All energy producers except electricity	Industry and power sectors	Power plants	All fossil fuels (e.g. coal, fuel oil, and natural gas)	All sectors
COVID-19 impact	No	No	No	No	No

Note: *Price level for Indonesia is for 2023.
Source: Authors.

Luxembourg and the Netherlands both implemented new carbon taxes by January 2021, while Indonesia and Denmark announced the prospective implementation of a carbon tax, and Israel announced it as a key element in its future climate action plan.

In Luxembourg the tax increases beyond 2023 are to be announced in a forthcoming planned tax reform. Petrol and diesel have separate carbon taxes at EUR 31.6/tCO_2 and EUR 34.2/tCO_2, respectively. These applied from January 2021, and future increases are also yet to be announced. The revenue from the carbon tax will be recycled and used for climate action, targeted social relief (e.g. tax credits) and social justice measures[14] for low-income households (Le Governement du Grand-Duché de Luxembourg, 2018[48]).

The Netherlands' Industry Carbon Tax applies to the industry and power sector which is also covered by the EU ETS - a positive development as the percentage of emissions priced in the industry tends to be low (OECD, 2021[49]). The rationale for this double taxation is that the Dutch have a more ambitious GHG reduction goal than the EU, and the carbon price trajectory is hence steeper resulting in a higher carbon price. The Dutch carbon tax, therefore, fills the gap between the EU ETS price and the Dutch carbon tax of the specific year, thereby, acting as a price floor similar to the Carbon Price Support in the UK (Dentons, 2020[50]) (Hirst and Keep, 2018[51]). The industry, therefore, only pays the difference between the two, and are exempted to pay the carbon tax if the EU ETS price is equivalent to the price of the Dutch tax (Deloitte, 2021[52]). The carbon tax and the EU ETS combined are estimated to achieve a 14.3 MtCO_2 reduction by 2030 (Government of the Netherlands, 2019[53]).

In Indonesia, the government passed the Tax Regulation Harmonization law in ultimo September 2021, which includes the implementation of a carbon tax that will compliment a forthcoming ETS (Carbon Pulse, 2021[54]). The hybrid system is referred to as a cap and tax system, where power plants are allowed a

[14] These measures include the creation of affordable housing through e.g. the provision of housing for low-income groups, and the counteraction of energy poverty through e.g. climate support measures and social assistance for a minimum amount of energy for low-income households (Le Governement du Grand-Duché de Luxembourg, 2018[48])

certain set of emission (the ETS cap), and if exceeded, the carbon tax applies (Reuters, 2021[55]) (Jakarta Globe, 2021[56]). In advance of its forthcoming ETS, Indonesia launched an ETS pilot during COVID-19 (see section 3.5) (ICAP, 2021[57]).

As part of Denmark's Recovery and Resilience Plan (see section 3.9) a prospective uniform carbon tax for all sectors' emissions (including agriculture's non-energy related emissions) will be implemented (Ministry of Finance, 2021[58]).

Israel announced in July 2021 that a carbon tax will be a key element in its new climate action plan. An additional tax will not be put on diesel and gasoline for now, as tax levels on these are amongst the highest in OECD countries (Ministry of Finance, 2021[59]). The tax will be designed with mechanisms to assist household, businesses, and industry, by for instance ensuring that energy prices do not increase more than 5% throughout 2028, while also taking measures to protect the industry's competitiveness. The carbon tax will cover approximately 80% of Israel's GHG emissions (Carbon Pulse, 2021[60]).

Carbon tax increases took place in Canada, Ireland, Latvia, South Africa, and Switzerland, while a carbon tax increase is proposed in Norway (see Table 3.2). All the increases, except for in Switzerland and Norway included legislated price paths, meaning that the carbon tax price increase for 2020, 2021 and the following years was planned before and legislated during COVID-19. These carbon tax changes only affected price levels - not coverage.

Table 3.2. Overview of carbon tax increases during the first 20 months of COVID-19

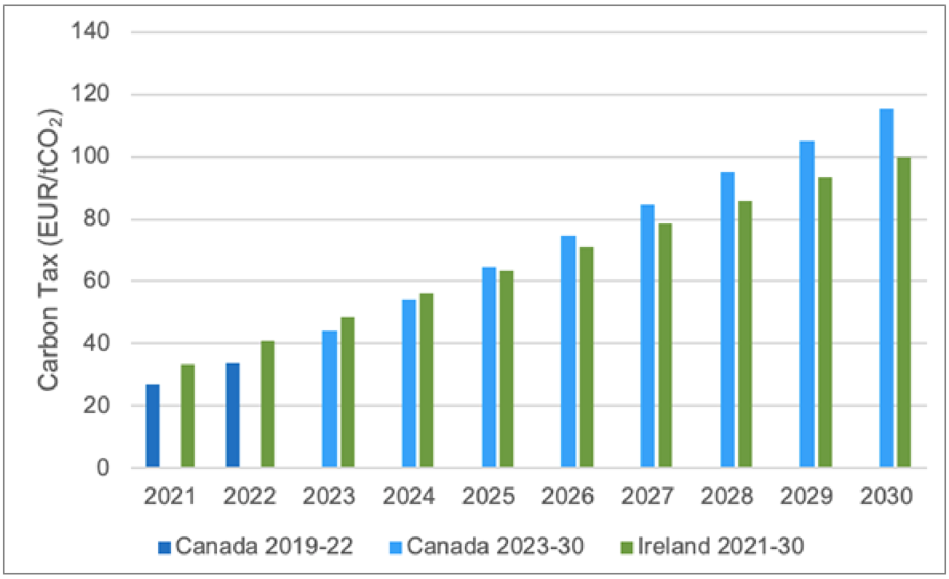
	Canada	Ireland	Latvia	South Africa	Switzerland	Norway**
Status	Increase implemented 2021	Increase implemented 2021	Increase implemented 2021	Increase implemented 2021	Increase planned 2022	Increased proposed
Price level 2021	CAD 40/tCO_2 (EUR 27.1/tCO_2)	EUR 33.5/tCO_2	EUR 12/tCO_2	ZAF 134/tCO_2 (EUR 8.07/tCO_2)	CHF 120/tCO_2 (EUR 110/tCO_2)*	NOK 590/tCO_2e (EUR 59/tCO_2e)
Price trajectory	2018-22: CAD 10/tCO_2 increase per year (EUR 6.78/year) 2023-30: CAD 15/tCO_2 increase per year (EUR 10.2/year) 2030 target rate CAD 170/tCO_2 (EUR 115/tCO_2)	2021-30: EUR 7.50/tCO_2 increase per year until 2029, and EUR 6.50/tCO_2 increase per year from 2029-30 2030 target rate EUR 100/tCO_2	2019-20: EUR 4.50/tCO_2 increase per year 2020-22: EUR 3/tCO_2 increase per year 2022 target rate EUR 15/tCO_2	2019-22: Consumer Price Index (CPI) + 2% 2023-onwards: CPI	No	Gradual increase, unknown price trajectory Target rate NOK 2000/tCO_2 (EUR 200/tCO_2) by 2030
Sectors	GHG emissions from all sectors (with some exemptions), and with some regional variation	CO_2 emissions from non-EU ETS sectors (except power, industry, transport and aviation sectors, mineral oils, natural gas and solid fuels	All fossil fuels (excluding peat)	All GHG emissions from the industry, power, buildings and transport sectors (with partial exemptions)	CO_2 emissions from all fossil fuels (mainly industry, power, buildings and transport sectors)	GHG emissions from all sectors (with some exemptions) and emissions from petroleum activity and aviation.
COVID-19 impact	No	No	No	Yes, two delays in 2020***	No	No

Note: *The price level for Switzerland is for 2022. **Norway's carbon tax is a proposal. ***South African delays due to COVID-19: 1) The physical (online) submissions of GHG emissions report delayed from March 2020 to April (May) 2020; 2) The payment of the carbon tax was delayed from July to October 2020 due to COVID-19 induced cash flow issues for companies.
Source: Authors.

- In Canada, the carbon tax increased from CAD 20/tCO_2 (EUR 13.9/tCO_2) to CAD 30/tCO_2 (EUR 20.3/tCO_2) in 2020 and then to CAD 40/tCO_2 (EUR 27.1/tCO_2) in 2021, equivalent to a 50% and 33.3% increase, respectively (Government of Canada, 2016[61]).
- Ireland's carbon tax increased from EUR 26/tCO_2 to EUR 33.5/tCO_2 in 2020 for auto fuels and in 2021 for solid fuels - equivalent to 28.8% increase. The increase follows Ireland's newly legislated price path (outlined below) (OECD, 2021[43]).
- In Latvia, the carbon tax increased from EUR 4.50/tCO_2 to EUR 9/tCO_2 in 2020, and to EUR 12/tCO_2 in 2021 – a 100% and 33.3% increase (The Republic of Latvia, 2020[62]). Latvia has not clarified a carbon tax price trajectory beyond 2022.
- South Africa's carbon tax increased from ZAR 120/tCO_2 (EUR 7.23/tCO_2) to ZAR 127/tCO_2 (EUR 7.65/tCO_2) in 2020 while reaching ZAR 134/tCO_2 (8.07/tCO_2) in 2021 - an increase of 5.83% and 5.5%, respectively (World Bank, 2021[29]). During the COVID-19 induced recession, the need for the tax itself was questioned (NBI, 2020[63]) (Bowmans, 2020[64]).
- In Switzerland, the carbon tax is connected to fulfilling intermediate GHG mitigation targets, and as the target for 2020 (33% emissions reduction compared to 1990 levels) was missed by 2 percentage points (pp), a 25% carbon tax increase from CHF 96/tCO_2 (EUR 88.5/ tCO_2) to CHF 120/tCO_2 (EUR 110/tCO_2) by January 2022, was announced in July 2021 (Federal Office for the Environment, 2021[65]).
- Norway proposed to gradually increase its carbon tax, and it intends to offset the tax increase by reducing other taxes for affected groups (Ministry of Climate and Environment, 2021[66]).

In Canada and Ireland, the legislated price paths have both been exposed to significant changes that entails carbon tax price increases above EUR 5/tCO_2 annually until 2030. In Ireland the 2030 target rate of the carbon tax increased from EUR 80/tCO_2 to EUR 100/tCO_2 in October 2020 (Figure 3.6) (Government of Ireland, 2020[67]). The carbon tax revenue over the next ten years is expected to be EUR 9.5 billion, thus an average of 0.95 billion a year, equivalent to about 44% of Ireland's environmental tax revenue in 2018 (OECD Stat, 2020[68]).

Figure 3.6. Carbon tax price paths in EUR for Ireland and Canada from 2021 to 2030



Note: Canada has two categories as its price path consists of two individually agreed price paths, whereas Ireland has one.
Source: Authors.

In Canada, a new price path for the federal charge on fossil fuels from 2023-30 (Figure 3.6), was announced in July 2021. The new carbon tax price path takes over after the 2018-22 price path (see above) (Government of Canada, 2016[61]) (Government of Canada, 2021[69]).

3.4. Fuel excise taxes

Since the start of 2020, mainly climate-positive and permanent changes have been seen for fuel excise taxes in eight of the 47 OECD and G20 countries. India, Latvia, and South Africa increased a fuel tax, Finland increased a heating fuel tax, while Sweden decreased it and Denmark increased the energy tax on fossil fuels. Czech Republic and Italy each had one climate-negative and permanent policy change (Table 3.3).

Table 3.3. Fuel excise tax changes during the first 20 months of COVID-19

	Change	Status	Type	Permanent or time-limited	COVID-19 impact
Czech Republic	Decrease	Implemented 2020	Excise duty (diesel)	Permanent	No
Denmark	Increase	Planned implementation 2023-25	Tax on fossil fuel emission from energy use for certain sectors*	Permanent	No
Finland	Increase	Implemented 2021	Tax on heating fuel (light and heavy fuel, oil, LPG, hard coal, and natural gas)	Permanent	No
India	Increase	Implemented** Mar 2020 – Mar 2021	Tax on fuel (petrol and diesel)	Permanent	No, but created due to COVID-19 to boost sagging tax revenues
	Decrease	Implemented Apr 2021	Subsidy on kerosene	Permanent	No
Italy	Elimination	Implemented Jan 2021	Automatic annual increase in fuel excise tax	Permanent	No
Latvia	Elimination	Implemented 2020	Tax exemption on natural gas (in agriculture)	Permanent	No
South Africa	Increase	Implemented 2021	Tax on fuel (petrol and diesel)***	Permanent	No
Sweden	Elimination	Implemented 2020	Tax reduction on heating fuel****	Permanent	No

Note: *The Danish fuel excise tax is applied to Industrial businesses, horticultural and agricultural businesses, as well as businesses conducting mineralogical processes. **India increased the fuel tax twice within a year (March 2020 – March 2021). ***South Africa: The tax increased 4.6% for petrol and 4.7% for diesel. **** Sweden: heating fuels for industry, agriculture and forestry
Source: Authors.

As part of Denmark's Recovery and Resilience Plan (see section 3.9), the energy tax on fossil fuels will be increased by DKK 6/GJ (EUR 0.81/GJ) which, according to the plan, is approximately DKK 100/tCO_2 (EUR 13.5/tCO_2) in each sector where it already exists (Ministry of Finance, 2021[58]). Different tax levels currently apply to industrial businesses (DKK 75/tCO2; EUR 10/tCO2), horticultural and agricultural businesses (DKK 25/tCO2; EUR 3.36/tCO2) and businesses conducting mineralogical processes (DKK 0/tCO2; EUR 0/tCO2), thus, the increase will result in an elevated, yet differentiated, carbon tax level for all. The tax increase is expected to generate DKK 715 million (EUR 96.1 million) from 2023-25 (Skatteministeriet, 2020[70]). In 2018, 52% of domestic CO_2 emissions from energy use had a carbon price of at least EUR 30/tCO_2,[15] thus, elevating the energy tax level will increase this percentage even more (OECD, 2021[49]).

For the climate-positive changes, Finland, increased the energy content tax by 35% for heating fuels, meaning that the individual taxes on the energy content of the specified fuels increased (OECD, 2021[43]) (Statistics Finland, 2021[71]). Latvia abolished its excise tax exemptions for natural gas used for agricultural greenhouses and industrial poultry holdings, while India raised the fuel tax twice within a year (OECD, 2021[72]) (OECD, 2021[43]) (OECD, 2021[42]). During COVID-19 in India, the revenue from the fuel excise tax generated 12.2% of the budget estimate of total gross revenue from April 2020 to January 2021, compared to 4.3% for 2013-14 (Mongabay-India, 2021[73]). The two climate-negative policy changes entailed Czech Republic's excise duty decrease and Italy's removal of an annual tax increase.

Some countries also lowered their fuel taxes temporarily during the pandemic, and as this gives preferential treatment to fossil fuels, these are considered FFS policy changes according to the OECD FFS definition and are, therefore, present in section 3.7 (OECD, 2019[74]).

3.5. Emissions Trading Schemes

Countries who had planned prior to the pandemic to implement or strengthen ETS followed through with their initial plans. 10 of the 47 OECD and G20 countries, including the EU, initiated planned ETS policy changes during the pandemic. Five countries launched new ETS of which two were pilot schemes, while five existing schemes implemented new policy changes. An overview of the ETS and their coverage can be seen in Figure 3.7.

Newly-launched Emissions Trading Schemes

China, Germany, UK,[16] Mexico, and Indonesia all launched new ETS during the pandemic. Delays were experienced in Indonesia in relation to the pandemic (Carbon Pulse, 2021[75]), in Mexico regarding the allocation registry (World Bank, 2021[29]), and in China due to data falsification issues (Carbon Pulse, 2021[76]). While most of the schemes cover around 40% of domestic CO_2 emissions, the UK and Indonesian ETS covers approximately 31% of GHG emissions and 20% of CO_2 emissions, respectively (ICAP, 2021[40]). When it comes to the allocation of allowances, Germany and the UK price their allowances and the latter also allocate some for free, whereas China, Indonesia, and Mexico allocate these for free as can be seen in (see Table 3.4).

[15] Including emissions from the combustion of biomass.

[16] The UK ETS replaces the EU ETS due to the UK's Brexit, and although the system is new, there are no changes in coverage from the EU ETS to the UK ETS.

Table 3.4. Overview of newly-launched ETS in China, Germany, UK, Indonesia, and Mexico.

	Chinse ETS	German nETS	UK ETS	Indonesian ETS (pilot)	Mexican ETS (pilot)
Cap	Flexible*	Forthcoming (ultimo 2021)**	Fixed	Flexible*	Fixed
Domestic GHG/CO_2 coverage	40% (CO_2)	40% (CO_2)	31% (GHG)	20% (CO_2)	40% (CO_2)
Sectoral Scope	Power sector	Heating, transportation and industry** sector	Industry, power, and domestic and intra-EEA aviation sectors	Coal power plants	Energy*** and industry sector
Allocation method	Free allocation (benchmarks)	Purchase (fixed price)	Auction and free allocation (industrial and aviation entities at risk of carbon leakage)	Free allocation (benchmarks)	Free allocation (verified emissions)
Auction price level (2021)	CNY 48 - 51.2/tCO_2 (EUR 6.44 - 6.87 /tCO_2)****	EUR 25/tCO_2	GBP 48.55 (EUR 57) /tCO_2 (August Average)	None	None
Price Trajectory	No	Yes, 2022-23 :EUR 5 increase 2024-25: EUR 10 increase 2025 Target EUR 55/tCO_2 2026: price corridor with auction EUR 55-65/tCO_2	No	No	No
Market stability mechanisms	Yes, price restrictions (volume-based)	Yes, Excess allowances available	Yes, Auction Reserve Price (ARP), Carbon Price Support (CPS), Cost Containment Mechanism (CCM)	No	No
Planned before COVID-19	Yes	Yes	Yes	Yes	Yes
Delays due to COVID-19	No, due to falsification issues not COVID-19	No	No	Yes, the implementation was delayed six months by COVID-19 and market design issues	Yes, delays occurred in the registry for the first allowance allocation
Linked to long-term goals	Yes, key instrument in peaking emissions before 2030 and carbon neutrality before 2060	Yes, part of a measures to help reach 2030 targets and carbon neutrality by 2050	Yes, it will help reach domestic carbon neutrality by 2050	No	No

Note: *Flexible cap: The cap is intensity-based, meaning different allowance limits are distributed to different types of participants based on benchmarks, and the total of these makes up the overall cap of the system. **Germany: The annual emissions cap of the German nETS will be put forward ultimo 2021 and will be based on the EU Effort Sharing Regulations (ESR) specifying Germany's reduction targets for non-ETS covered sectors; the industry sectors will be covered by the nETS if not covered by the EU ETS. ***Mexico: The energy sector encompasses electricity (generation, transmission, and distribution) and fossil fuels (extraction, production, transport, and distribution) (ICAP, 2021[40]). **** China: The price level for the Chinese ETS is the trading price and not the auction price (IISD, 2021[77]).
Source: Authors and (ICAP, 2021[40]).

The national Chinese ETS launched in 2021, applies to more than 2,200 power sector entities, covering approximately 4,000 MtCO_2 making it the largest ETS regarding the number of emissions covered (ICAP, 2021[40]). Although the Chinese ETS launched in the start of 2021, trading amongst participants were delayed by three weeks due to falsification issues in some submitted reports, thus trading first started in June 2021 (Carbon Pulse, 2021[76]). Prices restrictions apply to trading and are based on the transaction volume, thus, if the allowance volume is above (below) 100,000 the price is subject to change +/-10% (+/-30%) of the daily price. Prospectively, there are no price mechanisms outlined for the trading price, neither are auctions expected in the current phase (ICAP, 2021[78]). At the end of each annual cycle, participants must surrender permits equal to their allocated emissions. If participants do not comply or forge information they are fined a total fine of maximum CNY 30,000 (EUR 4,024), a fine which have been stated to be relatively low as it enables companies to compare compliance costs with penalty costs. A revised draft have, nevertheless, increased this to CNY 50,000-200,000 (EUR 6,853 – 27,412) (Carbon Brief, 2021[79]). In 2022 the sectoral coverage is expected to expand to include the cement and aluminium industries (Carbon Pulse, 2021[80]).

Germany launched its national ETS (nETS) in January 2021, an ETS complementary to the EU ETS as it applies to non-EU ETS covered sectors, however, there is a slight overlap on fuel emissions between the two systems. The EU ETS-covered facilities are, thus, either exempt from paying the nETS or compensated for the payment (DEHSt, 2021[81]). Together the two ETS cover round 80% of domestic GHG (ICAP, 2021[40]) (Handke, 2021[82]). The Fuel Emissions Trading Act establishes an upstream emissions trading system for fuel suppliers. No allowances are allocated for free (DEHSt, 2021[83]).[17] In 2025 it will be announced if a price corridor continues to apply beyond 2026 (DEHSt, 2020[84]). A declining cap will be determined annually and it will be based on the EU Effort Sharing Regulations (ESR) specifying Germany's reduction targets for non-ETS covered sectors. Nevertheless, if purchased allowances exceed the coming cap, additional allowances are available via the ESR's flexibility mechanism (ICAP, 2021[40]). The cap will, therefore, be flexible, though overall declining, during the fixed-price and price corridor phases, however, once the price becomes market-based, the cap becomes absolute (ICAP, 2021[40]). Germany expects that the nETS will reduce CO_2 emissions by 3.1 $MtCO_2$ in 2025, 7.7 $MtCO_2$ in 2030, and 12.4 $MtCO_2$ in 2035 (Deutscher Bundestag, 2020[85]).

After having left the European Union and the EU ETS, the UK launched their own UK ETS in January 2021. Many features of the UK ETS are similar to those of the EU ETS to ensure stability for participants transitioning between the two systems (UK ETS Authority, 2021[86]). The UK ETS cap is 156 $MtCO_2$ for 2021, which decrease 4.2 $MtCO_2$ annually until 2030. The cap is 5% lower than it would have been under the EU ETS to align the UK ETS with the domestic 2050 carbon neutrality target. The UK ETS mainly uses auctioning for allowance distribution, along with some free allocations for industrial and aircraft operator participants with carbon leakage risks. The transitional Auction Reserve Price (ARP) at GBP 22/tCO_2 (EUR 25.90/tCO_2) is a price floor that prohibits allowances to be sold. It is a temporary measure that will be withdrawn when the ETS matures or if a supply adjustment mechanism becomes operational (UK ETS Authority, 2021[86]). Together with the Carbon Price support at GBP 18/tCO_2 (EUR 21.1/tCO_2), the minimum price will be GBP 40/tCO_2 (EUR 46.8/tCO_2) (PV Europe, 2021[87]). The Cost Containment Mechanism (CCM) operates via monthly triggers to avoid price spikes, thus acting as a price ceiling. If the average allowance price of three consecutive months is above the trigger price set for the first month, the CCM is activated. If triggered, the UK ETS authorities must decide if and how to intervene. However, this has not been the case in the studied time period (January 2020 – August 2021) (UK ETS Authority, 2021[86]).

In March 2021 Indonesia launched their six-month pilot ETS for 80 coal power plants, covering more than 75% of domestic power sector CO_2 emissions (ICAP, 2021[40]) (OECD, 2020[88]). Indonesia has been working on its ETS since 2018 where it passed a regulation to implement a mandatory ETS by 2024 at the latest (Carbon Pulse, 2021[75]). In the pilot, participants could trade allowances and use offsets via renewable energy (ICAP, 2021[40]).

[17] Carbon leakage compensation is, nevertheless, available for companies who are negatively impacted by the carbon price in international trade. Yet, the majority (80%) of the compensation cannot be used freely but must be invested in climate protection measures for the company (Clean Energy Wire, 2021[295]).

Mexico launched its pilot ETS in January 2020 which applies to approximately 300 entities. The pilot will run for two years, followed by a transition year in 2022 to the full operational ETS starting in 2023 (ICAP, 2021[40]). The pilot ETS utilises an annual cap that was slightly increased from 2020 (271 $MtCO_2$) to 2021 (273 $MtCO_2$) due to an increase in the allocation for industrial subsectors. All allowances for the pilot are distributed according to recent verified emissions of each entity. If entities do not comply they lose the opportunity to bank unused allowances and receive fewer allowances prospectively. All allowances are allocated for free to mitigate potential negative economic impacts on regulated firms. The ETS, however, still sends a marginal price signal to producers, providing incentives to reduce emissions (World Bank, 2021[29]).

Existing Emission Trading Schemes

Changes in existing ETS occurred in the EU, Switzerland, New Zealand, Korea, and Canada of which the most important policy changes are summarised in Table 3.5, and Canadian changes can be found below. Most noticeably were the tightened caps in all schemes, except for in the New Zealand ETS where a cap was established.

Table 3.5. Important changes from existing ETS in the EU, Switzerland, New Zealand, and Korea.

	EU ETS	Swiss ETS	NZ ETS	K-ETS
Cap	Tightened cap	Tightened cap	Established cap	Tightened cap
Sectoral Scope	Proposal to expand scope* (Maritime transport and separate ETS for transport and buildings)	Expanded scope (domestic and intra-EEA aviation and power plants)	No change	Expanded scope (uncovered transport subsectors and construction industry)
GHG/CO_2 Coverage increase	0% GHG	1% GHG[▪]	0% GHG	4% GHG****
Price and supply adjustment mechanism	Increased MSR intake rate from 12% to 24% in 2019-23 (24% through phase four)	No change	Established CCR** and price floor	No change
Free allocation	Decreased free allocation through phase four (only for participants on updated carbon leakage risks document)	No change	Decreased free allocation	No change
Use of offsets	No change	No change	No change	Reduced use of offsets
Planned before COVID-19	Yes	Yes	Yes	Yes
Delayed due to COVID-19	No	Yes, 2020 auctions closed twice. 1) A COVID-19 induced closing of the emissions registry, postponing the compliance deadline a few months. 2) Not COVID-19 related but due to the Swiss ETS prices being lower than the EU ETS.	No	No
Linked to long-term goals	Yes, to help the EU reduce GHG emissions by 55% by 2030 compared to 1990 levels	Yes, the ETS is part of Switzerland's climate legislation "the CO_2 Act"***	Yes, the ETS is aligned with the Paris Agreement and the domestic net zero target by 2050	Yes, the ETS is linked to fulfilling the domestic 2030 GHG reduction target of 24.4% compared to 2017 levels

Note: *Items belonging to the *EU fit for 55* proposal is outlined in brackets ( ). ** The Cost Containment Reserve (CCR) mechanism releases additional New Zealand units at certain trigger prices. ***The Swiss CO_2 Act had the emissions reduction target of 20% by 2020 as compared to 1990 levels, with an additional 1.5% for 2021. In an amendment of the act, the new reductions target would have been at least 50% by 2030 and net zero by 2050. However, the amendment was rejected in 2021, and it is not yet clear whether the 50% reduction goal will be reintroduced with other legislation (Congress, 20211[89]) (Office fédéral de l'environnement, 2020[90]). ****Numbers from (ICAP, 2021[40]). . ▪The 1% additional GHG coverage for Switzerland excludes EEA-intra aviation emissions. Canada's OPBS have been excluded from the table as it is a hybrid systems and no changes have taken place yet.
Source: Authors, (ICAP, 2021[40]), and (World Bank, 2021[91]).

The EU ETS underwent changes when it transitioned to phase four (see below), however, the European Commission has already proposed changes to this phase, to align the ETS with the EU's 2021 adoption of the Climate Law and its updated 2030 reduction target of 55% (European Commission, 2021[92]) (Reuters, 2021[93]). The proposed revisions were published in July 2021, however, a legislation and approval process by the European Parliament is still ahead before their implementation (European Commission, 2021[94]). The proposed revisions for instance include an increased linear reduction factor of 2.2% to 4.2% annually.

The EU ETS transitioned to phase four (2021-30) by January 2021, which entailed changes to ensure the fulfilment of the EU 2030 emissions reduction goal (45% compared to 1990 levels at the time). The cap's annual emission reduction percentage is increased from 1.74% to 2.2%, translating to 43 million allowances per year. For sectors excluded from the updated carbon leakage list, free allocation will be phased out from a maximum of 30% in 2026 to 0% by 2030 (European Commission, 2020[95]). Finally, phase four entails the establishment of two new funds, the Innovation and the Modernisation Fund, which both supports the transition to a low-carbon economy for the EU energy-intensive industry and the power sector (European Commission, 2021[96]). Revenue from the EU ETS could also help refinance the EUR 2 trillion recovery package (European Commission, 2021[97]).

The Swiss ETS linked with the EU ETS by January 2020. The linking of the two systems included aligning them, thus the Swiss ETS has many of the new EU ETS introduced mechanisms such as the annual 2.2% cap reduction factor (ICAP, 2021[40]) (Federal Office for the Environment, 2020[98]). The Swiss ETS is linked to the domestic climate legislation, *The CO_2 Act*, which had a 2020 emissions reduction target of 20% compared to 1990 levels, with an additional 1.5% for 2021. In an amendment of the act, a new reduction target was 50% by 2030 and net zero by 2050, however, this was rejected in a 2021 referendum, thus the future emissions reduction target is unclear (Congress, 20211[89]) (Office fédéral de l'environnement, 2020[90]).

New Zealand shifted its NZ ETS to a new phase (2021-2025) in January 2021, which entailed aligning the ETS with climate targets, the establishment of an emissions cap,[18] auctions, price control mechanisms and the phase-out of free allocations. The NZ ETS revision was passed with the *Climate Change Response (Emissions Trading Reform) Amendment Act* in June 2020, despite political and participant opposition regarding COVID-19 challenges. (ICAP, 2021[40]). The Cost Containment Reserve (CCR), a price control mechanism, releases additional NZUs at certain trigger prices acting as a form of a price ceiling. Another price control mechanism, the hard price floor, prevents the sale of NZUs if the price falls below a certain level. Unsold NZUs are carried over to the next auction in the same calendar year, and otherwise cancelled (New Zealand Government, 2021[99]). The free allocation also faces changes, where maximum 90% (60%) of units to high (medium) emissions-intensive trade-exposed industrial entities will decrease by minimum 1% from 2021-30, 2% for 2031-40, and 3% for 2041-50, thus 0.11% annually (ICAP, 2021[40]). Since the establishment of these features, New Zealand have announced forthcoming changes to the CCR and the price floor, which will increase from 2022, and to the cap which will decrease from 2024-26 (see 5.2.Annex

[18] Previously, the NZ "cap" was flexible as entities could buy unlimited New Zealand Units (NZUs) or they could generate these by registering and participating in the removal activities scheme (e.g. forestry activities). The previous ETS phases was, therefore, restrained by price rather than by an emissions cap.

A). The changes came upon a recommendation from New Zealand's independent Climate Change Commission to maintain a strong carbon price to reach the domestic net zero target (New Zealand Government, 2021[100]).

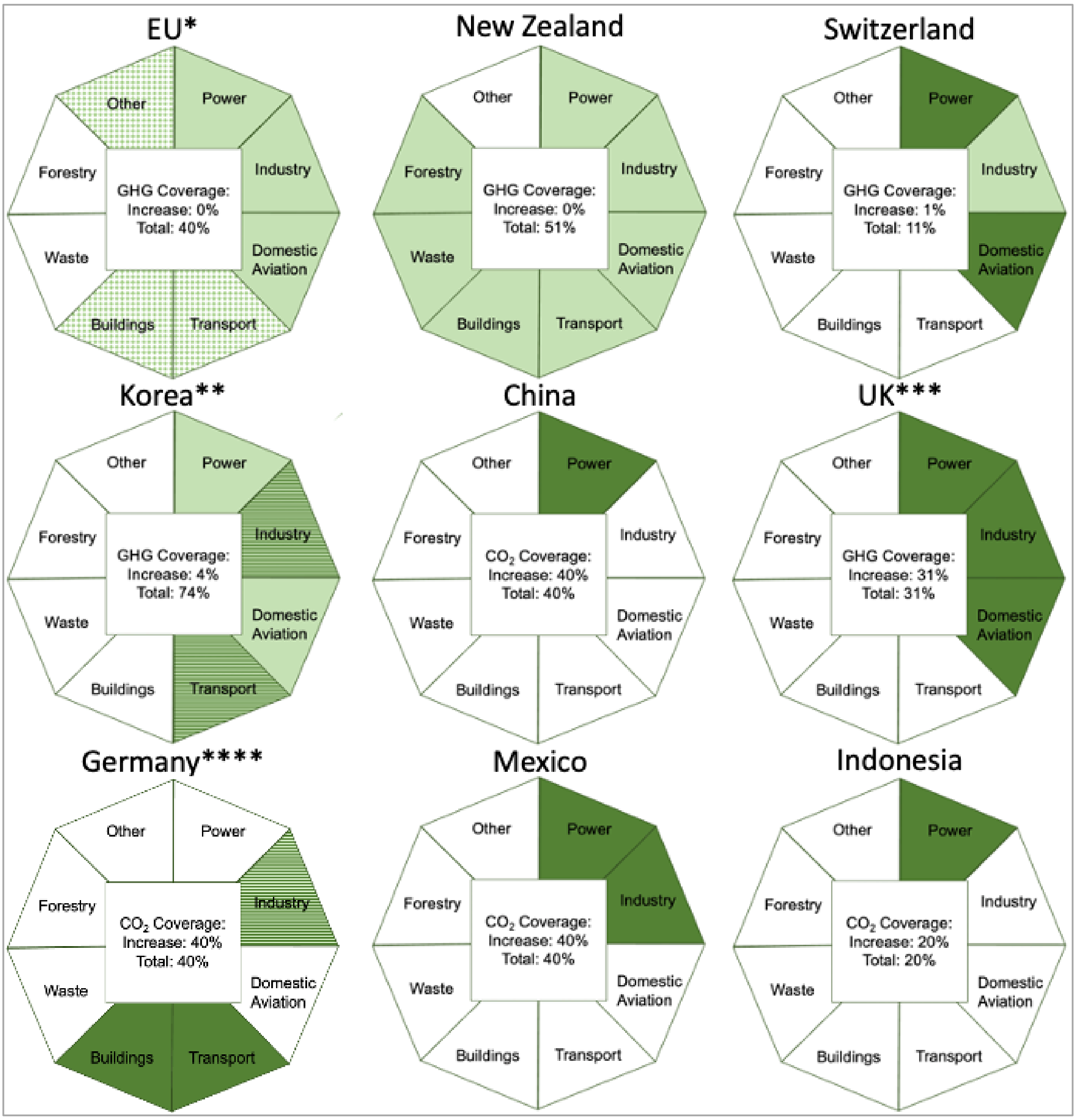
The Korean ETS (K-ETS) entered phase 3 (2021-25), after changes to the *Emissions Trading Act* took place in September 2020. Important additions for phase 3 entails the expansion of the system's scope, a stricter cap, an increased share of allowances for available for auctioning, and the linking of the ETS to Korea's 2030 GHG reduction (Republic of Korea, 2020[101]). The scope expansion increases the total number of subsectors from 64 to 69, including an expansion of previously uncovered subsectors in the transport and industry sectors (ICAP, 2021[40]). Due to the inclusion of new sectors the emissions cap have increased 3.2%, however, in comparison to the 2017-19 baseline allowance, it represents a 4.7% emissions reduction, thus, the cap is considered reduced. For 41 out of 69 industries without carbon leakage risks, the share of allowances for auctioning has been increased from 3% to 10%. The remaining 28 industries with carbon leakage risks continue to receive 100% free allowance allocations for phase 3. The possibility to offset emissions have also been reduced from 10% to 5% of an entity's allocated allowances (ICAP, 2021[40]).

Canada has proposed to strengthen the emissions standards of its federal ETS, the Output-Based Pricing System (OBPS). The OBPS is not a cap-and-trade system and so differs from many other ETS. It applies to emissions-intensive and trade-exposed (EITE) facilities. Each facility must provide compensation for emissions that exceed a set limit, which is determined based on the facility's level of production and product-based emissions intensity standards. Facilities that outperform their limit earn credits. The OBPS carbon price follows the price path of the 2018-22 price path outlined above (see section 3.3), and will follow the updated 2023-30 trajectory. In 2022, a review which focuses on a number of issues, including ensuring the OBPS continues to align with Canada's GHG emissions reduction goals and the updated price trajectory will take place (Government of Canada, 2021[102]). The PBO, an office that provides independent analysis to the Canadian Parliament, has modelled a proposal based on these guidelines entailing a yearly increasing carbon price on excess emissions in line with the 2023-30 price trajectory,[19] and a decline of the emissions-intensity[20] standard by 2% annually to encourage decarbonisation (Office of the Parliamentary Budget Officer, 2021[103]). The PBO analysis found this could reduce national GHG emissions by 96 $MtCO_2e$ in 2030 compared to a reference scenario, but also reduce real GDP by 0.8% by 2030.

[19] Starting at CAD 50/tCO_2 (EUR 33.9/tCO_2) by 2022, increasing by CAD 15 (EUR 10.2) per year reaching CAD 170/tCO_2 (EUR 115.3/tCO_2) by 2030,

[20] Under the OBPS, a wide range of industrial products have emissions-intensity standards, measured as emissions per unit of output, and based on the national average emissions intensity of all facilities across Canada producing similar products.

Figure 3.7. ETS overview of sectoral and GHG coverage and increase in the EU, New Zealand, Switzerland, Korea, China, UK, Germany, Mexico, and Indonesia before and during the first 20 months of COVID-19

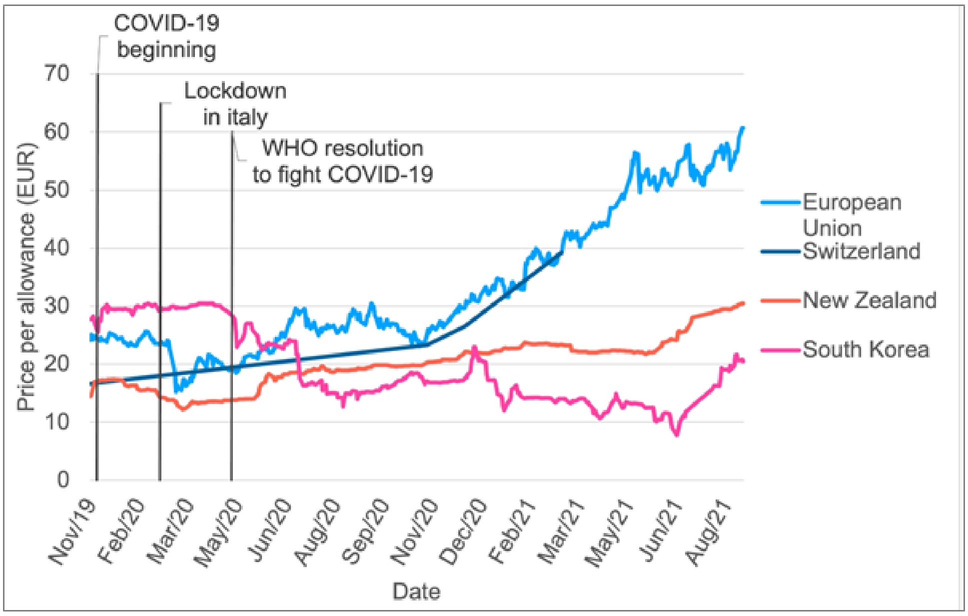


Note: Light green: ETS coverage before COVID-19; Dark green: extended ETS coverage during COVID-19; White: no ETS coverage; Light green dots: proposals. Dark green lines: country specific – see note further below. Sectors included are only those currently covered by any of these ETS and not sectors without current coverage (e.g., the agricultural sector). Total GHG/CO_2 coverage indicates the domestic GHG or CO_2 emissions covered by the ETS. *EU: The "Other" sector indicates the prospective ETS of the maritime transport sector from 2023-26..**Korea: dark green lines: previously uncovered subsectors were added to the transport and industry sectors, thus the sector coverage was expanded. ***UK: the UK ETS is new in theory, however, the sectors covered are still those which were covered previously by the EU ETS. ****Germany: dark green lines: industry sectors not covered by the EU ETS is covered by the nETS. The graph only displays the sectors covered by the German nETS, and not the sectors covered by the EU ETS (power, industry, and domestic aviation). If the EU ETS is taken into account the domestic GHG coverage in Germany increases to 80%.
Source: Authors with information based on (ICAP, 2021[40]).

Robustness of ETS during the first 20 months of COVID-19

The majority of existing ETS in the OECD and G20 countries have proved robust during the COVID-19 pandemic. Price drops were observed, however, for the majority of schemes, except South Korea, these drops were not prolonged as can be seen in Figure 3.8. The ETS which were launched during the first 20 months of COVID-19 (e.g. German and Chinese ETS), have only been marginally affected by COVID-19 (see section 3.5).

Figure 3.8. ETS Allowance Price Developments during the first 20 months of COVID-19



Note: No new auctions have been conducted for the Swiss ETS since March 2021, thus the short line. This graph only display the price level during the pandemic, but not the causes of these developments. Moreover, ETS which were launched during the pandemic (e.g. the Chinese and German ETS) are not included in this assessment, as these have been marginally affected.
Source: authors (based on numbers from ICAP ETS allowance price database (ICAP, 2021[104])).

In 2020 the EU ETS price dropped from an average of EUR 23.3/tCO_2 in the first half of March to an average of EUR 16.9/tCO_2 in the second half of March. However, by June 2020 the monthly average price rebounded at EUR 23.5/tCO_2, just surpassing the pre-pandemic level. From June 2020 the EU ETS price continued upwards, and despite a small dive around October 2020 when COVID-19 surged again in Europe, it reached an all-time high in August 2021 with an average monthly price of EUR 56.6/tCO_2.

A similar situation was observed for New Zealand where the average price in January 2020 fell from NZD 28.8/tCO_2 (EUR 19.1/tCO_2) to NZD 24.4/tCO_2 (EUR 14.8/tCO_2) in March 2020. The NZ ETS, however, recovered in June 2020 where the ETS price climbed to a monthly average of NZD 30.5/tCO_2 (EUR 19.7/tCO_2), and even reached a record-high price level in August 2021 with a monthly average of NZD 49.9/tCO_2 (EUR 34.8/tCO_2) (ICAP, 2021[104]) (Carbon Pulse, 2021[105])

Since the linking of the Swiss and the EU ETS, price developments during COVID-19 (January 2020 to August 2021) in the former have been similar as can be seen in Figure 3.8. However, the Swiss ETS has had very few auctions, providing the explanation for the missing curves in the Swiss data (ICAP, 2021[40]). However, the ETS price have increased during the pandemic from EUR 16.6/tCO_2 in November 2019, to EUR 23.3/tCO_2 in November 2020, and reached record-high levels at EUR 39.3/tCO_2 by March 2021, which is the latest price until a new auction takes place in end-October 2021 (ICAP, 2021[104]).

In South Korea the COVID-19 pandemic had a delayed but significant impact on the K-ETS primarily driven by the allowance surplus and the COVID-19 induced recession (Carbon Pulse, 2021[106]) (Carbon Pulse, 2021[107]). Since the end of 2019 the price level of the K-ETS have fallen steadily, but it was first in May 2020 that the K-ETS took a larger drop from a monthly April average of KOR 40,235/tCO_2 (EUR 32.8/tCO_2) to a monthly May average of KOR 35,042 (EUR 28.5/tCO_2) (Carbon Pulse, 2020[108]). By mid-June 2020 the K-ETS reached its lowest price since December 2015 at KOR 10,500/tCO_2 (EUR 9.35/tCO_2) (Carbon Pulse, 2021[109]). However, the price level has shown signs of recovery as the August 2021 monthly average price was KOR 25,475/tCO_2 (EUR 22/tCO_2).

When it comes to price supply mechanisms that may have helped stabilise the various ETS during the pandemic, these differ from scheme to scheme. In the EU the Market Stability Reserve (MSR) mechanism, installed in January 2019, have contributed to the resilience of the EU ETS (European Commission, 2021[110]) (Azarova and Mier, 2021[111]). The aim of the MSR is to improve the EU ETS' responsiveness to economic shocks by addressing supply-demand imbalances through a one-time annual temporary withdrawal or addition of allowances depending on the total number of allowances in circulation (TNAC). As the pandemic induced an economic recession, emissions dropped and fewer allowances were needed leading to an oversupplied market. In September 2020 the MSR mechanism, therefore, placed 332 million allowances in the reserve from September 2020 to August 2021, while it placed 378 million allowances in the reserve from September 2021 to August 2022 (European Commission, 2020[112]) (European Commission, 2021[113]). Despite the COVID-19 induced recession taking place in mainly 2020, the TNAC for 2021 was higher than that for 2020, and the 2021 MSR intake was, therefore, larger.

In Switzerland, there is not a market stability mechanism as such, but the legislation allows for the reduction of auction volumes if there is a significant increase of allowances in the market due to economic reasons. However, the mechanism has not yet been utilised (ICAP, 2021[40]).

In New Zealand, a CCR mechanism and a price floor (see Overview of New Zealand's 2022 price adjustments) is utilised. The New Zealand price level has, despite the pandemic, only been close to the price floor of NZD 20/tCO_2 (EUR 12.1/tCO_2) in March 2020 where it was NZD 22.2/tCO_2 (EUR 13.4/tCO_2), but not actually reached it. However, the CCR set at NZD 50 (EUR 30.5) for 2021, was triggered in end August 2021, and thereby an additional seven million units were released. All these units were sold at a record-high price of NZD 53.9/tCO_2 (EUR 32.8/tCO_2) and the CCR did, therefore, not put a big damper on the price level. The upwards trend of the price is said to be due to the New Zealand government's introduction of a cap in the beginning of 2021 (Carbon Pulse, 2021[114]).

In Korea, the pandemic caused the annual total GHG emission for the K-ETS participants to fall by 6% (35 MtCO_2) in 2020 as compared to 2019, and this contributed to an oversupplied market (Carbon Pulse, 2021[106]). In an attempt to stabilise the market, the Ministry of Environment, who oversees the K-ETS, established a one-month price floor in April 2021. Although successful, the price increase was short-lived. This, therefore, led to the cancellation of an auction with 5.1 million allowances, however, whether the allowances will be suspended or passed over to next year is yet undecided (Carbon Pulse, 2021[115]). Additional pressure was, furthermore, added from a non-market stability design mechanism, which allows participants to bank two times their allowances and offsets sold to others in year one and two (2021 and 2022). Due to COVID-19, the demand for allowances and offsets decreased and participants, therefore, had difficulties selling these. If allowances and offsets are unsold they are cancelled, thus, participants will have fewer allowances available in the following year. The aim of this design mechanism was to distribute unused allowances, however, in the time of COVID-19 it has contributed to participants desperately trying to sell unused allowances, to ensure next year's banking opportunity. Thus, it has contributed to an oversupplied market which has reinforced low price levels over several months (Carbon Pulse, 2021[115]) (ICAP, 2021[40]).

3.6. Aviation taxes

Table 3.6. Examples of policy changes in aviation taxes during the first 20 months of COVID-19

	Climate-negative aviation tax changes		Climate-positive aviation tax changes	
	Changing taxes	VAT changes	Changing taxes	Establishing taxes
Austria			Permanent change of air transport levy for short and long-haul journeys * 2020	
Brazil	Temporary six-month postponement of tax payments 2020			
Colombia		Temporary reduced VAT rates to tickets and aviation fuels Oct 2020 - Dec 2021		
Finland		Temporary waived interest charges on overdue VAT payments 2020		
France	Temporary postponement of tax payments Mar – Dec 2020		Permanent increase of cargo tax from EUR 2020 and 2021**	Permanent creation of travel tax (*Eco Tax*) 2020
Ireland		Temporary reduced VAT rate for the aviation industry Sep 2020 - Feb 2021		
Norway	Abolished passenger tax for 2020 and 2021	Temporary reduced VAT rate from 12-6% on domestic air transport Apr 2020 – Jul 2021		
Portugal				Permanent creation of EUR 2 fee per departing passenger*** 2021
Switzerland		Temporary reduced interest charges on overdue VAT payments to 0% Mar 2020 – Dec 2021		
The Netherlands	Permanently abolished planned cargo tax 2020		Permanent increase of air passenger tax 2021	
Turkey		Temporary reduced VAT rates to domestic flights Apr - Dec 2020		
US	Temporary suspension of arrival and departure tax Mar – Dec 2020			

Note: The table displays the changes in aviation taxes for some countries, but not for all 17 countries. * In Austria, the government changed the air transport levy for short to long-haul journeys, with the largest tax increase seen for short flights (bellow 350 km) where alternative train routes exist (CAPA, 2020[116]). **France, the only European country with a cargo tax, increased the price level in 2020 from EUR 1.33 to EUR 1.37/ton of goods and additionally to EUR 1.38/ton of goods in 2021 (EC, 2019[117]) (Ministère de la Transition écologique, 2021[118]). ***Portugal: The EUR 2/passenger only applies to commercial flights.
Source: Authors, (IATA, 2021[119]) and (IATA, 2021[120]).

Policy changes in aviation taxes occurred in 17 of 47 OECD and G20 countries, they mostly had a climate-negative effect and they were mainly temporary.[21] Tax reductions or abolitions for aviation (e.g. passenger duty taxes, value added taxes or airport usage and parking fees) occurred in 14 countries, of which most were time-limited within the period of March 2020 to December 2021. For example, the Netherlands abolished a planned cargo tax ranging between EUR 1.92 - 3.85 per ton of goods depending on the airplane type, however, this cancellation was not due to COVID-19 (Euractive, 2020[121]).[22] Compared to other cargo taxes such as the French EUR 1.38/ton of goods (see below), the Dutch tax's upper level was more ambitious, however, its cancelation obstructs this ambition (Ministère de la Transition écologique, 2021[118]).

Policy changes in aviation taxes which were climate-positive and introduced during the pandemic were all planned before COVID-19. These policy changes were observed in five countries, and were all permanent. In France a travel tax (*Eco Tax*) that varies with travel class and destination was introduced, with the highest tax charged to non-economy passengers travelling outside the EEA and Switzerland (EUR 63.1/person) (FCC Aviation, 2020[122]).[23] From July 2021, Portugal established a permanent carbon fee of EUR 2/passenger on commercial departing flights, while the Netherlands increased its air passenger tax from EUR 7 to EUR 7.45 per person by 2021 (Bloomberg Tax, 2021[123]) (Euractive, 2020[121]). The UK increased its air passenger duty for long-haul flights by GBP 2 (EUR 2.40) per passenger in 2020 and 2021 (UK government, 2021[124]) (OECD, 2022[125]).

3.7. Fossil Fuel Support

Policy changes in FFS have been mostly climate negative (94.4%) and temporary (72.2%). Policy changes increasing (decreasing) FFS occurred in 19 (2[24]) out of 47 OECD and G20 countries for both the production and consumption side. Most production side policy changes were observed for fossil fuel exporting countries, while most consumption side policy changes occurred in fossil fuel importing countries. As mentioned in the fuel excise tax section, policy changes have been categorised according to the OECD FFS definition (OECD, 2019[74]). This includes, i.a., (temporarily) reduced fuel excise taxes as explained in section 3.4. However, to avoid double counting, policy changes have only been recorded in one category.

Policy changes observed on the production side are all climate-negative and represent more than 50% (n=21) of the FFS policy changes. These were mainly introduced as a result of the low international oil prices which threatened the financial viability of domestic oil extraction. The climate-negative policy changes include the establishment of a temporary price floor of ARS 3,033 (EUR 42.5) per barrel of oil from April throughout 2020 in Argentina, a price almost equivalent to the lowest 2019 price of ARS 3,092 (EUR 44) per barrel, and yet under the August 2021 low price of ARS 4,988 (EUR 62) per barrel (Trading Economics, 2021[126]). This minimum price level was implemented alongside a four-year subsidy programme for gas producers in the Vaca Muerta oil field to avoid an increase in oil imports (OECD, 2021[44]). Colombia allowed drilling and mining companies to execute infrastructural projects in exchange

[21] Aviation taxes (e.g. passenger duty taxes, value added taxes or airport usage and parking fees) do not explicitly price carbon, however, they increase the price of flying and can, thus, be interpreted as an imperfect proxy for carbon pricing.

[22] The reason for the abolishment was that research showed that the tax was likely to drive cargo to other European airports, resulting in negative economic impacts for the Dutch cargo airports (Euractive, 2020[121]).

[23] Economy passengers pay EUR 2.63/person, whereas all other passengers pay EUR 20.3/person for destinations in the EEA and Switzerland, while it is EUR 7.51/person or EUR 63.1/person to other destinations.

[24] Overlap in the UK which has both a climate-positive and a climate-negative measure.

for reduced royalty payments. In Mexico, profit taxes were temporarily reduced for the state-owned company PEMEX from 58% to 54%, (OECD, 2021[72]) (OECD, 2021[42]).

Policy changes on the consumption side were mainly climate-negative, and accounted for less than 50% (n=15) of observed policy changes. These were mainly established to protect vulnerable households. Out of 15 policy changes, 13 were climate-negative while two were climate-positive. For the former, these included a one year postponement of the cancellation of the fiscal advantage for non-road diesel in France. Due to the financial difficulties posed to many by the pandemic, countries such as France and Italy, have lowered taxes on fossil fuel based-energy usage or conducted other actions to ensure access to essential services for vulnerable groups. France expanded their *cheques energies* (energy cheques) scheme to aid more households in paying utility bills, while Italy reduced energy bills by 20% for energy consumed between April to September 2020 (OECD, 2021[42]) (The Local, 2021[127]). Although these policy changes are important to protect vulnerable population groups and mitigate energy poverty during the pandemic, lowering taxes on fossil fuel-based energy encourages consumption and thereby increases GHG emissions – they are therefore classified as negative from a climate perspective.

Table 3.7. Examples of policy changes in Fossil Fuel Support during the first 20 months of COVID-19

	Climate-negative policy changes		Climate-positive policy changes
	Price control or royalty changes	**Tax or VAT changes**	**Tax or subsidy changes**
Argentina	Temporary price floor per barrel of oil		
Brazil	Permanent reduction of royalty payment		
Colombia	Permanent reduction of royalty payment		
Estonia		Temporary reduction of fuel excise taxes (diesel, gasoline, natural gas)	
France	Temporary aid for utility bill for vulnerable groups		
India	Temporary reduction of royalty payment		
Indonesia	Permanent reduction of royalty payment		
Italy	Temporary aid for utility bills for vulnerable groups		
Mexico		Temporary reduction of profit taxes	
Norway		Temporary tax reductions and exemptions for domestic oil industry	
Spain	Temporary freeze of liquefied petroleum gas price		
US	Permanent reduction of royalty payment		
UK		Temporary freeze of fuel tax rates	Permanently removed reduced excise rate (diesel)

Source: Authors, (OECD, 2021[72]), (OECD, 2021[42]), (OECD, 2022[125]), (UK Government, 2021[128]), and (IISD and GSI, 2020[129]).

For climate-positive policy changes on the consumption side, the UK permanently removed reduced rates on diesel used in off-road vehicles from 2022. However certain exemptions beyond the implementation have been put in place in 2021, e.g. diesel usage in power vessels for fishing and water freight and diesel usage for non-commercial power generation (OECD, 2022[125]), (UK Government, 2021[128]). Costa Rica introduced a COVID-19 fuel tax (see Box 3.1) (OECD, 2021[43]) (OECD, 2021[130]).

Box 3.1. Costa Rica's COVID-19 tax on gasoline

Costa Rica was, like many other countries during the COVID-19 pandemic hit financially and socially. As national lockdowns were implemented across the world, the global economic activity fell, as well as the international demand and price of oil. In Costa Rica the reduced oil price resulted in a large price drop for gasoline. However, Costa Rica decided to utilise this price gap and filled it by creating a COVID-19 tax on gasoline for approximately three months (April 28th to July 16th, 2020), thus, keeping a constant gasoline price. The generated revenue went to the protection of workers affected by the national lockdown, such as those who became unemployed, had their working hours reduced, or vulnerable people who received no other state support. The gasoline tax worked by establishing a price floor for gasoline equivalent to the price fall in international oil. The tax was EUR 0.71 (CRC 580) for superior gasoline (Petrol RON 96) and EUR 0.67 (CRC 555) for regular gasoline (Petrol RON91). It helped raise EUR 21 million (CRC 15.2 billion), equivalent to 11% on a yearly basis of the total tax revenue for energy and fuels in 2019. The tax was an example of a policy measure which was both climate-positive and which recycled the revenue to the benefit of those affected by the pandemic.

Source: (The Legislative Assembly of the Republic of Costa Rica, 2020[131]) (IISD and GSI, 2021[132]), and (OECD, 2021[130]).

3.8. Carbon pricing developments in selected sub-national pricing schemes

In addition to carbon pricing changes at the national level, several sub-national and regional jurisdictions also changed their policies related to carbon pricing. This section only displays sub-national policy changes for carbon taxes, ETS, aviation taxes (e.g. passenger duty taxes, value added taxes or airport usage and parking fees), and FFS measures in selected jurisdictions. Fuel excise taxes have been excluded as for most countries these are often regulated on national or federal level (Figure 3.9). Sub-national updates from seven sub-national and one cross-regional jurisdictions' policy changes have been included in this section, as a comprehensive assessment of all sub-national and regional measures in OECD and G20 countries which occurred during the specified COVID-19 period is beyond the scope of this paper. It is important to note that the opportunities for sub-national and regional policy changes will be determined i.a. by the jurisdiction's mandate, which is likely to vary from country to country.[25]

The policy changes in subnational measures during COVID-19 (January 2020 to August 2021) mainly reflects the trends in the national policy changes, which occurred during the same period. Sub-national carbon tax and ETS mainly included changes that were introduced as permanent changes, likely to have climate-positive impacts. However, one temporary climate-negative policy change occurred in these categories, unlike at the national level. The pattern of sub-national policy changes relating to sub-national aviation taxes and FFS was similar to the pattern for these policy types at national level, i.e. changes were temporary, and likely to result in climate-negative impacts. One key difference between national and sub-national measures are that the sub-national measures did not include any permanent and climate-negative measures for FFS and aviation taxes (for more details on sub-national policy changes see 5.2.Annex B).

[25] Sub-nationals might not be able to implement a carbon tax or an ETS on their own, but initiatives to price carbon intensive activities are possible in other areas. In Paris, France, the number of parking spaces are reduced and parking fees are increased (Raoul-Réa, 2021[292]). In Oxford and London, UK, vehicle taxes are introduced or expanded to establish zero or low emissions zones (Oxfordshire County Council, 2021[293]) (Transport for London, 2021[294]).

Figure 3.9. Sub-national and regional carbon pricing changes during the first 20 months of COVID-19 in selected OECD and G20 countries

Country	Canada		Japan	Mexico		Russia	USA	
Subnational jurisdiction	British Columbia	Québec	Tokyo	Baja California	Tamaulipas	Sakhalin	California,	Transport & Climate Initiative Program (TCI-P)
Carbon tax	1			1	1			
ETS		1	1			1	1	1
Aviation tax	2	1					1	
FFS	3	3						

Note: Dark green: Permanent measure with climate-positive effect; Light green: Temporary measure with a climate-positive effect; Light red: Temporary measure with climate-negative effect; Dark red: Permanent measure with climate-negative effect; White: no change; Number: the number of measures. The TCI-P (includes Connecticut, Massachusetts, Rhode Island, Washington D.C.) might not be considered a sub-national scheme but rather a cross-regional scheme, and have been included as it is an example of how sub-nations or regions can cooperate.
Source: Authors.

Sub-national **carbon tax** schemes have undergone climate-positive and negative changes during COVID-19 (January 2020 to August 2021), although the former involved permanent changes whereas the latter entailed temporary changes. Climate-negative policy changes took place In British Columbia, Canada, while climate-positive policy changes occurred in Baja California and Tamaulipas, Mexico. Delays due to COVID-19 were observed in British Columbia's carbon tax scheme, causing the delay of a planned price increase (World Bank, 2021[91]).

Only climate-positive and permanent policy changes took place for the subnational **ETS**. These occurred in Québec, Canada; California and the Transport & Climate Initiative Program (TCI-P), USA; Sakhalin, Russia; and Tokyo, Japan. The policy changes included the establishment of new ETS, emission cap reductions for existing ETS, and increased revenue attributed to climate action. Only the ETS in Tokyo experienced delays due to COVID-19 which resulted in the submission deadline for annual reports to be pushed back by two months (ICAP, 2021[133]).

Policy changes for **aviation taxes** were climate-negative, yet temporary, and occurred in British Columbia and Québec, Canada, as well as in California, USA (IATA, 2021[120]).

For **FFS**, the sub-set of policy changes identified on the subnational level were all climate-negative and temporary, of which the majority of policy changes are addressing the production side. All policy changes identified took place in British Columbia and Québec, Canada (OECD, 2021[72]).

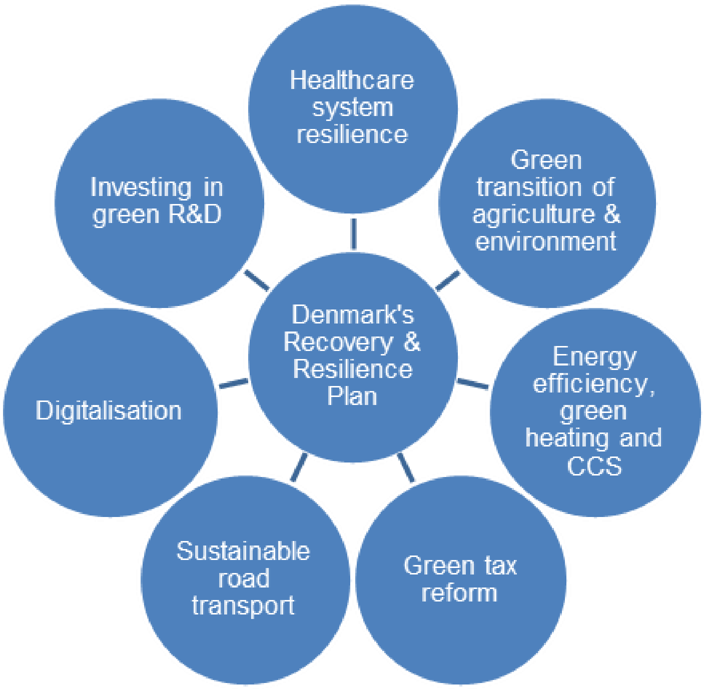
3.9. Carbon pricing in recovery plans and development: Selected case studies

Carbon pricing in Denmark's national recovery and resilience plan

In April 2021, Denmark submitted its Recovery and Resilience Plan (RRP) to the EU Recovery and Resilience Facility (RRF), a temporary COVID-19 recovery instrument from the European Commission

(European Commission, 2020[134]) (European Commission, 2021[135]). The Danish RRP is based on a DKK 11.5 billion (EUR 1.55 billion) budget and incorporates the pathway to reach the nationally legislated GHG reduction target of 70% by 2030 compared to 1990 levels for total domestic emissions while recovering sustainably. The plan aims at stimulating the economy to support and boost investments in the green transition through a holistic policy package consisting of seven components, each with various policy changes (Figure 3.10) (Ministry of Finance, 2021[58]) (European Union, 2021[136]).

Figure 3.10. The seven elements of Denmark's Recovery and Resilience Plan



Source: authors based on Denmark's Recovery and Resilience Plan (Ministry of Finance, 2021[58]).

One of the plan's main components is the green tax reform, which is allocated a third of the total budget, DKK 3.9 billion (EUR 524 million). This reform aims at putting a uniform tax on GHG emissions, frontload investments in the green and digital transition, and create jobs. It intends to do so via two tax reform measures (an energy tax increase and a prospective uniform CO_2e tax) relevant for carbon pricing, and two investment measures (an increased investment window and an accelerated depreciation of fixed assets[26]) which will be executed in two phases to ensure a smooth transition and recovery.

Phase one of the green tax reform entails an increase of DKK 6/GJ (EUR 0.8/GJ), equivalent to DKK 100/tCO_2 (EUR 75/tCO_2), to the existing energy tax on fossil fuels for industrial businesses (current level DKK 75/tCO_2; EUR 10/tCO_2), horticultural and agricultural businesses (current level DKK 25/tCO_2; EUR 3.36/tCO_2) and businesses conducting mineralogical processes (current level DKK 0/tCO_2; EUR 0/tCO_2). To ensure a smooth transition, the tax increase will first apply from 2023 and then gradually rise towards 2025. As evident, the tax is unevenly distributed as some sectors face a reduced or zero energy tax rate

[26] An *investment window* has been created as the depreciation basis of investments for non-fossil fuel operated fixed assets has been increased by 16% of the investment cost (investments made between November 2020 and ultimo 2022), resulting in temporary lower capital costs for companies' fixed assets (Ministry of Finance, 2021[70]). The threshold for the accelerated depreciation of fixed assets has been increased to incentivise companies' investments in a green and digital transition (Ministry of Finance, 2021[58]).

(Skatteministeriet, 2021[137]). By increasing the energy tax, phase one aims at increasing the incentive for the affected sectors to reduce emissions. The differentiated energy tax levels will, therefore, persist, however, at a higher price rate for all affected sectors. The energy tax increases along with an easing of other business policies from 2021-25 is part of Denmark's COVID-19 recovery and green transition plan. The total value of these measures are worth DKK 4.5 billion (EUR 0.61 billion) which is significantly more than the DKK 715 million (EUR 96.1 million) generated in revenue by the increased energy tax in phase one (2023-25) (Skatteministeriet, 2021[137]). The DKK 715 million (EUR 96.1 million) generated in tax revenue, is equivalent to 0.06% of Denmark's tax revenue in 2019 (OECD Stat, 2021[138]).

Phase two starts in 2025 and includes a uniform and supposedly high, yet undetermined, CO_2e tax for all sectors, including tax exempt emissions such as oil extraction and refining emissions but also a first of a kind tax on agriculture's non-energy related emissions. It has not yet been decided if EU ETS covered sectors will be included under the carbon tax, however, an expert group consisting of researchers and practitioners, has been established to assess this. The Danish government has acknowledged that the implementation of this tax entails consequences, including shifts in the business structure, carbon leakage for all sectors, and distributional and fiscal effects. These impacts will be considered carefully by the expert group before implementation (Ministry of Finance, 2021[58]).

Vietnam's carbon pricing developments during the first 20 months of COVID-19

Since the start of the pandemic, a number of developing countries outside the scope of this paper announced new carbon pricing schemes (e.g. Vietnam, Kenya, (Carbon Pulse, 2021[139])) or advanced in implementing carbon pricing schemes that were announced pre-COVID-19 (e.g. Thailand, (ICAP, 2021[140])) in order to limit GHG emissions and align the recovery with climate mitigation targets. This section provides more details on the developments in Vietnam.

In November 2020, the National Assembly of Vietnam passed a law that mandates the Ministry of Natural Resources and Environment and the Ministry of Finance to design a domestic ETS. This has been underway since 2012, where Vietnam published its 'Green Growth Strategy' that aimed for a low-carbon transition via market-based instruments such as an ETS. Vietnam has since 2013, been working with the Partnership for Market Readiness (PMR) to develop a roadmap, policy proposals for carbon pricing, a MRV system, and a GHG registry (ICAP, 2020[141]).

Both ministries still needs to reach a decision on the cap, the distribution of allowances, criteria on the use of domestic and international offsets as well as the sectoral scope. Technical preparations for sectors to be covered have started for the waste sector and some industrial sectors (ICAP, 2020[141]). The law will be effective as of 1 January 2022. While no timeline is specified in the law, a pilot ETS is expected implemented in 2025 and may become fully operational in 2027 (ICAP, 2021[142]).

4. Challenges to and rationale for carbon pricing due to COVID-19

4.1. Additional challenges to carbon pricing related to COVID-19

COVID-19 has brought new challenges for countries to implement new or strengthen existing carbon prices. The pandemic added to already existing challenges as it led i.a. to a global recession, increased inequality and it increased the number of vulnerable households and businesses. However, the benefits of carbon pricing mean that it can still play a significant role in countries' economic recovery by generating revenue for national deficits as seen during the Global Financial Crisis (GFC), it can shape investment decisions in the short and medium-term which can impact GHG emissions prospectively, and it can contribute to addressing increasing inequalities. This section displays the potential economic effects of carbon pricing, outline its challenges but also the potential solutions and the increased impetus for carbon pricing.

Potentially negative short-term economic effects of carbon pricing

COVID-19 lockdown measures restricted the movement of people as well as goods and services across the globe. These restrictions – whose duration varied by country - have led to decreased income for many businesses resulting in a spike in unemployment rates and reduced global economic activity. GDP contracted by 3.1% in G20 economies, 4.8% in OECD economies, while world GDP shrank by 3.5% in 2020 as compared to 2019 (OECD, 2021[143]). The contraction of global GDP after the GFC in 2007-09 was approximately just below 0.1% for 2009, yet no negative GDP on a global level was observed for 2007 or 2008 (IMF, 2020[144]). The pandemic also impacted unemployment levels which for OECD countries increased 2.7 pp in 2020, compared to 2019 levels (5.4%) (OECD, 2021[143]) and increased 2.6 pp in 2009 during the GFC compared to 2007 levels (5.6%) (OECD, 2010[145]) (OECD, 2011[146]). The pandemic, furthermore, had differentiated impacts on different countries, sectors, and income groups (see Exacerbated inequality, increased vulnerability, and energy poverty).

The economic impact of the pandemic in 2020 on countries have been shaped by the number of COVID-19 outbreaks, the composition of country sectors, and the COVID-19 policy response measures. Countries who had more extensive COVID-19 impacts, have mostly seen more frequent and longer lockdowns leading to extended periods of decreased economic activity (IMF, 2021[147]). This has for instance been seen in the UK which experienced three extensive lockdown periods (Brown and Kirk-Wade, 2021[148]), that impacted supply and demand contributing to a 9.8% GDP contraction in 2020 compared to 2019 (OECD, 2021[149]) (Stephens, Wright and Luckwell, 2021[150]). Italy also experienced extensive COVID-19 lockdowns in 2020, impacting the Italian GDP which fell by 8.9% in 2020 compared to 2019 (OECD, 2021[149]). In countries heavily reliant on tourism and the service sector, economic impacts have also been severe. Spain, for instance, received 72.4% fewer tourists from January to July 2020 as compared to 2019 (Moreno-Luna et al., 2021[151]), and the economy, therefore, contracted by 10.8% (OECD, 2021[152]). Lastly, countries' COVID-19 policy response measures, being their ability to implement economic support measures have also impacted national economies (UN, 2020[153]). In many European countries, income support for more than 50% of lost salaries have been provided, whereas other countries e.g. most African countries, and Mexico had no income support (Our World in Data, 2021[154]). The impacts induced by the COVID-19 recession have been deep and extensive, and COVID-19 is considered the worst economic crisis experienced since the 1930s' Great Depression (OECD, 2020[155]).

Carbon pricing is perceived to further aggravate the negative short-term economic impacts and/or to slow down the economic recovery from crises (Driscoll, 2020[156]) (House of Representatives, 2011[157]) (Murphy, Michaels and Knappenberger, 2016[158]). However, implementing carbon pricing does not need to come at the expense of economic performance. Indeed, carbon pricing has previously played a role in countries' recovery from economic recessions, such as seen in Iceland and Ireland in the aftermath of the GFC. Both countries had accumulated large national debts after the crisis and decided to introduce carbon pricing in 2010 to reduce national deficits. The Icelandic government introduced a temporary carbon tax on liquid fossil fuels, yet exempting international aviation, shipping, and certain industries[27] at the time of introduction, equivalent to approximately 50% of total domestic GHG emissions (World Bank, 2014[159]). To ensure a smooth implementation, the tax rate was initially set low: at 50% of the EU ETS price in 2010 (around EUR 7/tCO_2), 75% in 2011 (around EUR 13/tCO_2) and reached 100% in 2014 (around EUR 15/tCO_2) (OECD, 2021[160]). Iceland initially established the tax as a temporary measure, set to expire at the end of 2012. However, on advice from the IMF, the tax became permanent (Partnership for Market Readiness, 2017[161]). Ireland implemented a permanent carbon tax in 2010 of EUR 15/tCO_2. The tax covered mainly combustion from residential and commercial heating, as well as industry and transport emissions not covered by the EU ETS, equivalent to 38.5% Ireland's total emissions in 2011 (Convery, Dunne and Joyce, 2013[162]). In the year of its introduction, it raised EUR 246 million, equivalent to less than 1% of Ireland's total tax revenue from that year, yet during 2011 the revenue grew to EUR 329 million and EUR 344 million in 2012, but it still remained less than 1% of tax revenue for the specific years[28] (Convery, Dunne and Joyce, 2013[162]) (OECD Stat, 2021[163]).

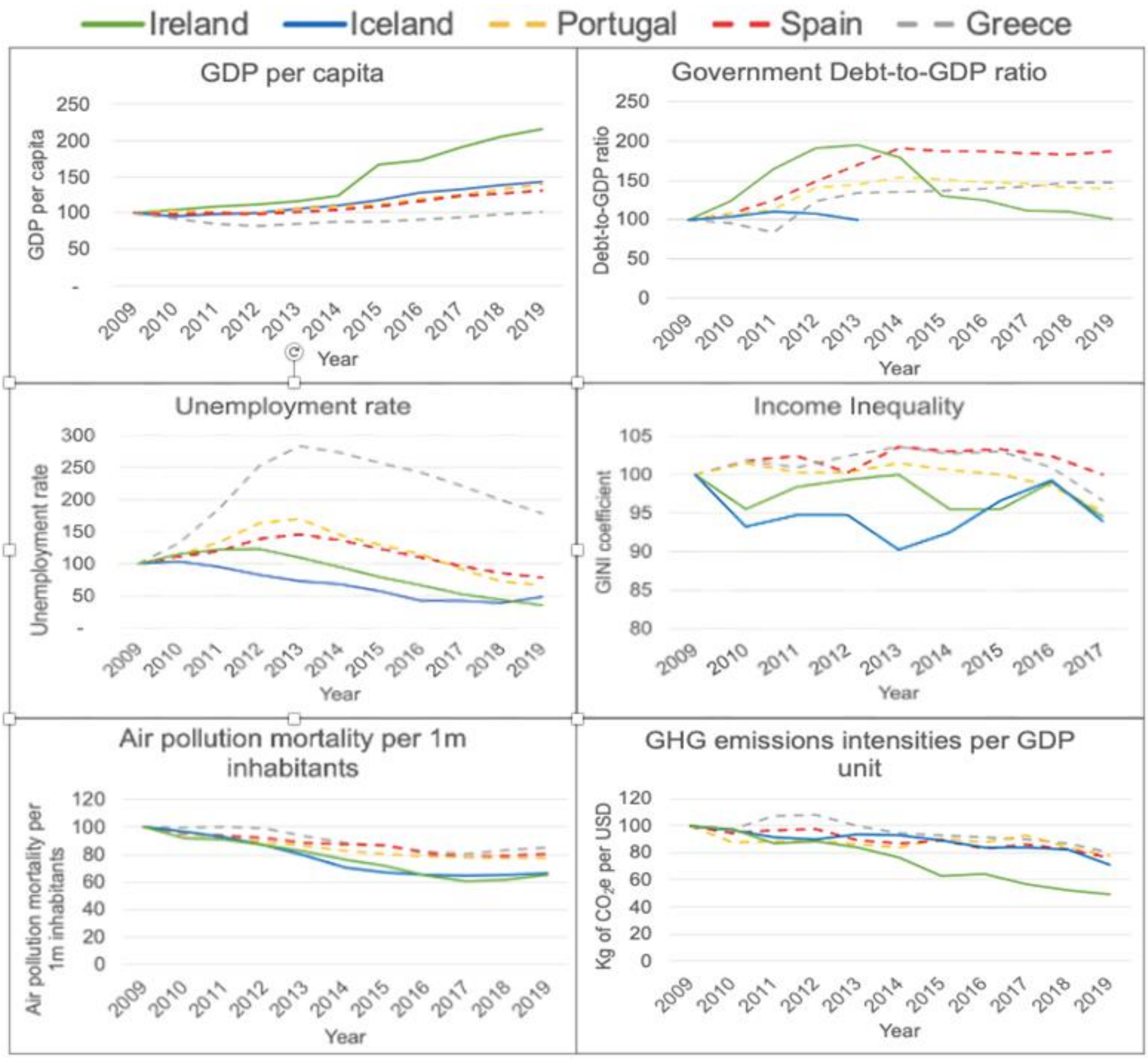
After the GFC, Ireland, and Iceland both performed better in several indicators compared to other European countries, which were also heavily impacted by the GFC (e.g. Portugal, Spain, and Greece). In contrast to Ireland and Iceland, these countries did not implement a national carbon tax shortly after the GFC, although they were covered by the EU ETS. In fact, Ireland and Iceland both seemed to have performed better in economic (GDP per capita and Government Debt-to-GDP ratio), social (unemployment rate and income inequality), and environmental (air pollution mortality and carbon emissions per USD) indicators after the GFC (Figure 4.1). Yet, this analysis does not establish a causal relationship.

Carbon pricing is often perceived to negatively impact economic growth or other economic dimensions (e.g. competitiveness) compared to a *business-as-usual* scenario (Driscoll, 2020[156]) (House of Representatives, 2011[157]) (Murphy, Michaels and Knappenberger, 2016[158]) However, evidence on this is not supported by the literature, although the evidence found is for historical price levels which have been low and where free allocation have been used extensively (Ellis, Nachtigall and Venmans, 2019[164]) (OECD, 2021[165]). In fact, scientific studies find little to no statistically significant evidence of a negative GDP impact of a carbon price compared to a counterfactual without carbon pricing (Metcalf and Stock, 2020[166]) (Elgie and McClay, 2013[167]).

[27] E.g. cement and aluminium

[28] Calculated on 24th November 2021 using number from OECD on Ireland's tax revenue (OECD Stat, 2021[163]).

Figure 4.1. Economic, social and environmental performance for countries with and without national carbon taxes in the recovery from the Global Financial Crisis



Note: The y-axis uses the year 2009 as the Index year (equal 100) for each data indicator. The x-axis presents the time range from 2009 to 2019 (2017 for income inequality due to data availability). For Government Debt-to-GDP ratio, data is only available for Iceland until 2013. On the Income inequality figure a higher number (y-axis) equals more inequality. For the air pollution mortality graph, the link to CO_2 is connected to fossil fuel-based transport usage. This type of transport emits CO_2, particulate matter and NO_x, of which the latter two increases the risk of air pollution morbidity and mortality (OECD, 2014[168]). A carbon tax can help decrease fossil fuel-based transportation, lowering air pollutants and, thereby, mortality rates.

Source: Authors based on (OECD Stat, 2021[169]), (OECD, 2021[170]), (OECD Stat, 2021[171]), (OECD Stat, 2021[172]), (OECD Stat, 2020[173]) and (OECD, 2021[174]).

The evidence on the short-term impact of carbon pricing on GDP is limited to ex-ante studies, varies with policy design, and is overall inconclusive. For short-term impacts, a study in France with a simulated carbon tax found that it could speed up the economic recovery from COVID-19 while it could reduce CO_2 emissions (Malliet et al., 2020[175]). Another ex-ante study found that a projected carbon price increase in the EU ETS of USD 40/tCO_2 (EUR 34.3/tCO_2), covering 30% of domestic emissions, in 31 European countries could lead to a relative increase in the GDP growth rate of 0.48 to 0.53% for the first and second year, and a

0.38% relative increase for year three to five, though none of these were statistically significant (Metcalf and Stock (2020[166]). Despite the statistical insignificance, positive impacts could also be seen for employment for year one and two where a relative increase of 0.42 to 0.44% is estimated, while the estimated increase for year three to five is more mixed as it ranges from -0.08% to 0.10% (Metcalf and Stock (2020[166]). An ex-ante study by Diamond and Zodrow (2018[176]) investigated several carbon tax designs on a federal level in the US, and found that economic effects depend on the revenue recycling mechanism, yet all results were statistically insignificant. If revenues were used to reduce income (payroll) taxes, this would result in a relative negative GDP (-0.12%) impact, a relative positive employment (0.11%) and investment (0.36%) impact in the first year. If it was used for debt reduction, it resulted in a relative negative GDP (-0.43%) and employment (-0.30%) impact in the first year, but a relative positive investment impact (0.40%). Thus, the short-term impacts are inconclusive and all from ex-ante studies. Although the results are statistical insignificant, a slight majority point towards a positive impact of carbon pricing on GDP and employment.

In the medium to long-term several ex-ante and ex-post studies found no statistically significant GDP impacts of carbon pricing. Yet, as above, the examined studies found positive impacts but these varied with policy design (see section 5.). In the aforementioned ex-ante study by Diamond and Zodrow (2018[176]), a carbon tax which uses the revenue for income tax reductions continues to have a positive GDP (0.18%), employment (0.12%), and investment (1.03%) impact after nine years and remains positive hereafter. Whereas the relative GDP impact (0.07%) turns positive when using the revenue for debt reduction after 19 years and remains positive henceforth.

Two ex-post studies in British Columbia, Canada, did not find statistically significant impacts of carbon pricing on GDP over a longer period. However, some of the effect which was found, was attributed to the revenue-neutral policy design of the carbon tax (Metcalf, 2019[177]) (Bernard, Kichian and Islam, 2018[178]). Metcalf (2019[177]) also investigated the ex-post EU ETS impact on the 31 participating countries, by analyzing their GDP before and after the ETS implementation in the time period of 1985-2017 and found a statistical insignificant GDP increase of 3.89% in European countries. Overall, the medium to long-term economic impact of carbon pricing displays no statically significant results. Despite this, the generated results displays mainly positive impacts, yet the extent of this is related to policy design.

Carbon pricing is also perceived to be detrimental to firms' competitiveness (EC, 2021[179]) (CPLC, 2016[180]) (Chatham House, 2009[181]). As COVID-19 impacted different countries to different degrees (see above), leading to reduced competitiveness of some firms, and carbon pricing could exacerbate competitiveness concerns. However, the anticipated negative effects of carbon pricing have not materialised as feared so far, as shown in earlier analysis for the Carbon Market Platform (Ellis, Nachtigall and Venmans, 2019[164]). In fact, in most studies carbon pricing was even found to improve some dimensions of competitiveness, including increased labour productivity and innovation. However, the absence of negative short-term effects are to be interpreted with caution as carbon prices have been low in general and even more so for industries that benefited from tax breaks or free allowances. There is to date no studies on how the competitiveness of EITE industries could be impacted if free allowance allocation is removed or a higher carbon price is applied, although ex-ante studies indicate a significant negative competitiveness effect in the form of carbon leakage (Ellis, Nachtigall and Venmans, 2019[164]). Importantly, market-based policies, including carbon pricing, are more effective in terms of mitigating negative effects and enhancing positive ones compared to non-pricing policies (OECD, 2021[165]). For example, using market-based policies instead of command-and-control policies would help offset potentially negative productivity effects associated with environmental policy (Albrizio, Kozluk and Zipperer, 2017[182]). However, for countries whose energy costs are relatively higher than in other countries, carbon pricing can still pose negative competitiveness impacts on an international level, despite the potential return of carbon pricing revenue (see section 5.1) or a prospective carbon price reduction. Due to these differences and in the absence of a global carbon price, it is equally important to avoid the double pricing of CO_2 emissions (ICC, 2021[183]).

Exacerbated inequality, increased vulnerability, and energy poverty

The economic and health effects of COVID-19 have exacerbated pre-existing inequalities both across and within countries (OECD, 2020[11]). Vulnerable groups such as the poor within countries have been disproportionately affected by COVID-19, unemployment rates have sharply increased across the world, and 119-124 million people have fallen back to extreme poverty in 2020, undoing several years of progress on this front (UN, 2021[184]).

COVID-19 mainly affected the already disadvantaged societal groups, worsening the pre-existing inequality gaps. Unemployment, inactivity, and reduced working hours increased globally in 2020 compared to the fourth quarter of 2019. Collectively, this loss amounts to 255 million full-time jobs equivalent to an 8.8 % reduction of global working hours and a 2.2 % reduction of global labour force participation, which mostly occurred in lower-middle-income countries in Latin America, the Caribbean, Southern Europe, and Southern Asia (ILO, 2021[185]). For OECD countries, unemployment rates peaked at almost 9% in April 2020, while it fell to almost 6% after one year (April 2021), still higher than pre-pandemic levels at around 5% (OECD, 2021[186]). The industries most affected were the service sectors such as leisure, transport, and retail, while the most affected employment types have been the informal and self-employed, who often do not have social protection measures, increasing their vulnerabilities (OECD, 2021[187]) (The World Bank, 2020[188]). In addition to this, women, youth and low-educated people have been mostly affected on the global job market. Women experienced a 5% job loss in 2020 compared to a 3.9% job loss for men, while the 2020 unemployment rate for youth were 8.7% versus 3.7% for adults (ILO, 2021[185]). Lower-educated people, who often have low-skilled jobs, also faced a greater risk of unemployment as compared to higher-educated people, with high-skilled jobs (OECD, 2021[186]).

Besides the temporary or permanent employment loss induced by COVID-19, the confinement measures also caused the energy needs of residential consumers to grow. This was both due to a rise in conventional demand (e.g. space heating, hot water, and cooking) and new energy demands (e.g. teleworking-related). This combination of factors aggravated energy poverty problems and increased the amount of people unable to pay their energy bills as seen in Spain and Italy, but also in Sub-Saharan Africa where 30 million people became energy poor in 2020 (Buckle et al., 2020[3]) (Mastropietro, Rodilla and Batlle, 2020[189]) (IEA, 2020[190]). The increased energy poverty rates and the increased unemployment rates have contributed to increasing the inequality gap globally.

Carbon pricing can exacerbate pre-existing inequalities globally, but the distributional impacts of carbon pricing also differ between developed and developing countries. In addition, the distributional effects also differ within countries and depend on the carbon intensity of products consumed by various income groups and on the revenue recycle design (see section 5.).

In developing countries, carbon pricing mainly has proportional or progressive impacts, meaning that the tax affects people equally or affects high-income earners proportionately more (Wang et al., 2016[191]) (Dorband et al., 2019[192]). This is because low-income groups have, in general, a relatively smaller share of energy products on total household expenditure, whereas high-income groups spend a higher share of their income on energy products. For example, low-income households generally have lower levels of car ownership and, thus, lower transport fuel consumption, meaning that a carbon price on fuel would have a smaller impact on these households. However, even small carbon price increases still raises consumer prices, which elevates the risk of poverty for low-income households. This could, nevertheless, be offset by revenue recycling to low-income households (Ohlendorf et al., 2020[31]).

In developed countries, carbon pricing mainly has regressive impacts, meaning that it disproportionately impacts low-income households (Ohlendorf et al., 2020[31]) (Flues and Thomas, 2015[193]). Although low-income households consume less carbon intensive products compared to high-income households within a country, the proportion of income spent on carbon intensive products decreases with rising income levels. Wealthier households are, therefore, less affected (Wang et al., 2016[191]). For instance, the carbon tax in

Paris, France, accounted for 6.3% of poorer households' income compared to 1.9% for richer households (Bureau, 2011[194]). Similar findings were also reported in the US and Ireland, however, also here revenue recycling could mitigate the effect (Hassett, Mathur and Metcalf, 2009[195]).

In developed and developing countries, a carbon tax is not only regressive and progressive according to the income distribution, but also according to spatial distribution, meaning that the vulnerability of low-income households differs according to whether they are located in rural or urban areas. For developed countries, rural areas often have decreased public transport availability compared to urban areas, and rural people are, therefore, more dependent on vehicles, thus, more vulnerable to an increase in fuel prices (Mattioli et al., 2019[196]). In developing countries, rural households have decreased access to public transport and lower levels of car ownership compared to urban households. A fuel price increase would, therefore, mainly impact urban households in developing countries (Zhao and Bai, 2019[197]) (Gwilliam, 2013[198]). There are, nevertheless, still car ownership amongst rural households, and as these most often have lower income levels, a price increase in fuel will, as mentioned above, also affect rural households and raise the risk of poverty for low-income households (Ohlendorf et al., 2020[31]).

The distributional effects of carbon pricing also depend on other factors such as the social security system, the type of fuel already taxed in countries, and the adaptive capacity (e.g. the availability of public transport, or energy efficient buildings to keep heating costs low) (Klenert et al., 2018[199]) (Pizer and Sexton, 2019[200]). For example, taxes on electricity and heating fuels are typically highly regressive, whereas kerosene taxes are progressive because it is predominantly rich households who fly (Marten and van Dender, 2019[201]). Carbon prices may not be regressive if energy price increases are automatically reflected in social security payments as seen in Finland (SITRA, 2020). In addition, carbon pricing design options, such as those for revenue recycling and means tested welfare systems, could make carbon pricing progressive, including in developed countries (see section 5.).

4.2. Rationale for carbon pricing

Although COVID-19 has brought about new challenges, it has also been an element which has contributed to increasing the rationale for ambitious climate policy, including the implementation of carbon pricing. The year 2020 was not only the start of the COVID-19 pandemic, but also the year in which many governments submitted updated short-term national climate targets, i.e. Nationally Determined Contributions (NDCs). Many countries have also announced long-term net-zero goals as well, and it remains important that countries' short-term plans take these long-term goals into account, to ensure that short-term policy packages become stepping stones to achieve the long-term goals (Falduto and Rocha, 2020[202]). In addition, public pressure for ambitious climate action and environmental protection could be observed in many countries during the crisis (The Guardian, 2020[203]) (AA, 2020[204]) (Verkuijl and Shawoo, 2020[205]). Finally, countries' spending for emergency and recovery packages have had large effects on governments' budgets, elevated their debt levels, increasing the need for new revenue sources. Carbon pricing can respond to public support for climate mitigation and help countries progress towards their climate goals while generating revenues.

Increased number of net-zero goals and enhanced Nationally Determined Contributions

Countries' medium-term targets and carbon pricing trajectories continue to fall far short of what is needed to meet the goals of the Paris Agreement (UNEP, 2014[206]). By mid-October 2021, 116 new or updated NDCs (representing 143 Parties) had been recorded in the interim NDC registry, collectively covering 94% of global GHG emissions in 2019, excluding land-use change and forestry emissions (UNFCCC, 2021[207]). These new or updated NDCs together represent an 11% reduction of total GHG emissions by 2030 as compared to the previous commitments of these NDCs. Furthermore, if these NDCs are implemented, along with their conditional elements, then there is the opportunity of global emissions peaking before 2030. Yet, despite the new or updated NDCs, all countries' short-term mitigation targets would collectively lead to increased GHG emissions that are almost 16% higher in 2030 than 2010 levels (UNFCCC, 2021[207]). The NDC commitments are, therefore, far short of the 45% emission reductions from 2010 levels needed to limit global warming to 1.5°C. Moreover, this emissions trajectory would use up the vast majority (89%) of the emissions budget estimated to be compatible with a 50% chance of keeping warming to below 1.5°C (UNFCCC, 2021[207]).

Despite the global pandemic, the momentum toward adopting net-zero targets has not stopped but accelerated, of which most countries with such targets announced these in 2020 or 2021. As of October 2021, 51 countries have enshrined net-zero targets in laws or policy documents, or have proposed legislation to do so, and several more have such targets under discussion (Jeudy-Hugo, Lo Re and Falduto, 2021[208]) (ECIU, 2021[45]). The list of countries with net-zero targets is increasingly diverse, with at least one target on each continent. The majority of targets aim for achieving net-zero by 2050, though China and Kazakhstan are aiming for 2060 and a handful of European nations (e.g. Finland and Germany) are targeting earlier dates. Bhutan, which in 2009 was one of the first countries to adopt a carbon neutrality goal, has already achieved net-zero (Kingdom of Bhutan, 2020[209]) (ECIU, 2021[45]). Although, this is an impressive achievement, Bhutan is a low-income country, and its total emissions may change when it develops further.

The increased number of net-zero targets is a promising sign; but strategies and plans are needed to put them into operation**.** Approximately 40 countries have submitted a long-term low emissions development strategy (LT-LEDS) to the UNFCCC - and some of these countries specifically link their LT-LEDS to carbon neutrality or net-zero (UNFCCC, 2021[210]). The UK has, for instance, laid out sector-specific strategies and policies that they will pursue in order to get to net-zero (HM Government, 2021[211]). However, other countries with similar targets do not yet have such strategies in place to meet these targets (Jeudy-Hugo, Lo Re and Falduto, 2021[208]).

Despite the increased short and long-term ambitions in the form of updated or new NDCs and net-zero targets, medium-term strategies connecting the two, such as through carbon pricing, are lagging. Some countries' updated NDCs (e.g. Indonesia, South Africa) explicitly link their increased mitigation ambition with an increased role for carbon pricing (Republic of Indonesia, 2021[212]) (Republic of South Africa, 2021[213]). Other countries (e.g. Pakistan) indicate that they will explore the use of carbon pricing instruments, while several NDCs do not mention carbon pricing at all (Government of Pakistan, 2021[214]). However, some updated NDCs (e.g. Barbados) specifically indicate that the country is not planning to use a carbon price to meet its targets because of the perceived regressive nature of carbon pricing (Government of Barbados, 2021[215]). Furthermore, of the 51 countries that have adopted net-zero targets in current or planned legislation (Jeudy-Hugo, Lo Re and Falduto, 2021[208]), 34 mention the actual or potential use of carbon pricing in their latest NDCs.[29] Although, these are positive developments, most of the carbon pricing systems do not have price levels sufficiently high enough to reach the goals included in the Paris Agreement,[30] despite carbon pricing's efficacy.

Carbon pricing has demonstrated effectiveness at reducing GHG emissions (EC, 2001[216]) (EC, 2006[217]) (Laing et al., 2013[218]). Evidence for a positive – but limited – effect has been found across different types of carbon pricing instruments (Green, 2021[219]). For example, studies of the impact of the EU ETS have highlighted that it resulted in a reduction of overall EU emissions by 3.8% between 2008-16 compared to

[29] The number of ETS counted includes the EU itself and the relevant member states included in the 51 countries, and the latest NDC's refer to NDCs from the end of October 2021.

[30] Calculated on 02 April 2021 based on information from (UNFCCC, 2021) and price data presented earlier in this chapter. This calculation counts the European Union as one country since its Member States submit one collective NDC.

a situation without the EU ETS (Bayer and Aklin, 2020[220]). An OECD paper even found this effect of the EU ETS to have been a 10% reduction in carbon emissions from 2005-12 (Dechezleprêtre, Nachtigall and Venmans, 2018[221]). There is also evidence that carbon taxes work in reducing GHG emissions. For example, the Swedish carbon tax on road transport fuels was estimated to have reduced transport emissions by 6% in an average year (Andersson, 2019[222]). The effectiveness of carbon pricing, nevertheless, also depends on the sector and the availability of alternatives within it, and thereby also on the price elasticity of energy products (Labandeira, Labeaga and López-Otero, 2017[223]). The impact of carbon pricing instruments can also be weakened if the price signal is dampened, e.g. through exemptions (for carbon taxes (Bruvoll and Larsen, 2004[224])) or free allocation (for ETS) (Flues and van Dender, 2020[225]). Such a dampened price signal was commonplace in individual carbon pricing systems, particularly in the initial years of operation (Ellis, Nachtigall and Venmans, 2019[164]). Carbon pricing is, therefore, still an underutilised tool in countries' NDC and net-zero targets.

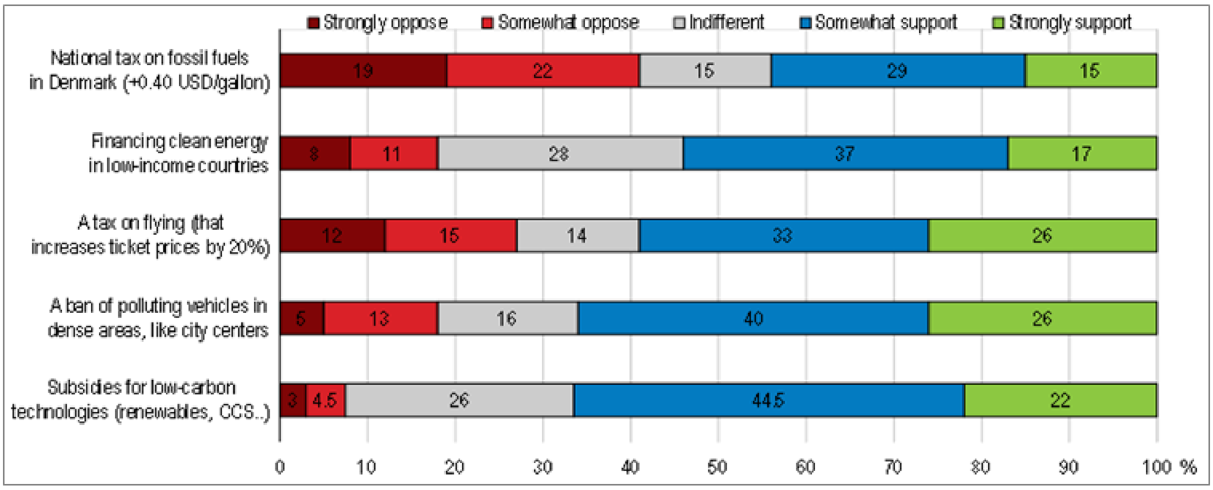
Enhanced public support for climate action and sustainability

Public support for climate action has continued through the pandemic. In fact, public support for a "green recovery" from the COVID-19 pandemic is high globally (65%), with the most extensive support found in India (81%), Mexico (80%), and China (80%) (Long, Gordon and Townend, 2020[226]). Globally 71% sees climate change as big of a problem as COVID-19, and 65% globally feel that their government will be failing them by not acting on climate change (Townend and Skinner, 2021[227]). In a survey conducted in Europe in 2021, 93% view climate change as a serious problem, while 90% agree that GHG emissions should be reduced to make the EU climate neutral by 2050 (EC, 2021[228]).

While public support for climate action is currently high, support for the introduction or expansion of concrete measures such as carbon pricing is generally lower (Klenert et al., 2020[229]). An OECD study in Denmark conducted in 2021 showed that a carbon tax on fossil fuels received the most opposition compared to other climate policies (e.g. subsidies for low-carbon technologies) (Figure 4.2) (OECD, 2021[230]). In the US, a carbon tax on corporations' emissions was the fourth most popular climate change solution (73% in favour) out of five, whereas planting trees to absorb CO_2 was the most popular (90% in favour), and tougher fuel standards the least (71% in favour) (Pew Research Center, 2020[231]).

Prior to the pandemic, this decreased support was also visible as the public in several countries reacted to carbon pricing increases or implementations. In France, an increase in carbon prices on fuel in 2019 sparked the *Yellow Vest Movement*, leading the French government to eventually abolish the increase and freeze the tax rate (Douenne et al., 2020[232]). In Switzerland, a proposal of an increased carbon tax and the introduction of an aviation tickets tax were narrowly rejected by 51.6% of voters in June 2021 - a proposal which would have helped cut Swiss emissions in half by 2030 as compared to 1990 levels. The proposal would have increased the maximum carbon tax rate from CHF 120/tCO_2 (EUR 110/tCO_2) in 2022 to CHF 210/tCO_2 (EUR 195/tCO_2) until 2030, resulting in the increase of the tax if the emissions reduction target was not reached (Carbon Pulse, 2021[233]). In Mexico, the government's introduction of *gazolinazo* in 2017 – a 20% increase in fuel prices - led to citizen protests and blocked streets (The Guardian, 2017[234]). In Australia, the announced plan to implement a carbon tax in 2011, resulted in big demonstrations in several cities (BBC, 2011[235]). The carbon tax was, nevertheless, implemented in 2012, however, it was only operational for two years before it was repealed in 2014 (The Guardian, 2014[236]).

Figure 4.2. Stated support to climate policies in Denmark during the pandemic (2021)



Source: (OECD, 2021[230]).

Nevertheless, experience has demonstrated that governments can increase public support for carbon pricing (Klenert et al., 2018[199]) (Maestre-Andrés, Drews and van den Bergh, 2019[237]). This includes carbon pricing design options, such as putting in place revenue recycling mechanisms (see section 5.). Political aspects are also important, as countries with higher political trust have been associated with stronger climate policies and lower amounts of GHG emissions than countries with low political trust. This is exemplified in countries such as Sweden, where a positive relationship exists between higher trust in politicians and higher carbon tax support (Fairbrother, Johansson Sevä and Kulin, 2019[238]). Introducing a carbon tax with revenue recycling mechanisms (e.g. lump sum rebates) can, nevertheless, increase public support (Klenert et al., 2018[199]).

A gradual phase-in of carbon pricing may, furthermore, help overcome opposition because the initial resistance seems to decline over time. This was the case in British Columbia, Canada, where a carbon tax covering 75% of GHG emissions in the province was gradually introduced at a rate of CAD 10/tCO_2 (EUR 6.78/tCO_2) in 2008 to CAD 30/tCO_2 (EUR 20.3/tCO_2) in 2012. The tax featured a lump-sum revenue recycling mechanism, which returned up to CAD 116 (EUR 77.9) per adult and CAD 34.5 (EUR 23.3) per child through quarterly payments to households with annual incomes of less than CAD 31,700 (EUR 21,384) for singles or CAD 37,000 (EUR 21,959) for couples. Since the implementation of the tax, polls have been conducted regularly from 2008-14 in British Columbia and in the rest of Canada to follow the public support of the tax in areas with and without it. Results displayed that the public support for the carbon tax increased from 39% in 2008 to 57% in 2014 within British Columbia. Similar results were shown in the rest of Canada, where support increased from 41% in 2008 to 56% in 2014 (Murray and Rivers, 2015[240]).

Other elements increasing public support includes relabelling *carbon taxes* as e.g. *climate contribution*, as the term *tax* has negative associations (Baranzini et al., 2016[239]). Moreover, a good communication strategy for governments considering a carbon tax can increase public support (CPLC, 2018[240]). Such a communication strategy entails addressing voters' concerns and it should be used before and after a carbon tax introduction (Carattini, Carvalho and Fankhauser, 2017[241]). Although public support for carbon pricing is often contextual, there are, nevertheless, various opportunities and challenges related to different design elements (see section 5.).

Raising revenues to respond to COVID-19 and potential reduction of public debt levels

COVID-19 has reduced public tax revenues and increased expenditures of governments. As of July 2021, recovery spending in the 50 leading economies amounted to almost USD 17 trillion (EUR 14.6 trillion), equivalent to almost 20% of global GDP (GRO, 2021[19]). In the years to come, countries are expected to need tax revenues to respond to the social and economic ramifications of COVID-19. At the same time, countries have accumulated large amounts of public debt due to the recession caused by the pandemic and the cost of the rescue and recovery packages already put in place. In 2020, OECD countries issued debt securities worth EUR 18 trillion – 60% more than in 2019 (OECD, 2021[242]). The debt-to-GDP ratio of OECD countries increased by 16 percentage points (pp) in 2020, a sharper increase than that observed during the GFC (12pp).[31] GDP-to-debt ratios are projected to further increase by 4pp in 2021 (OECD, 2021[242]). As a result of the increasing debt, 36 developing countries have been downgraded by one or more of the four largest credit rating agencies (Dooley and Kharas, 2020[243]), increasing the costs of financing capital-intensive public infrastructure and hampering the recovery of the most vulnerable countries.

Some countries are considering carbon pricing to boost government revenues that have fallen during the pandemic. For example, both India and Costa Rica increased pre-existing fuel excise taxes on transport fuels and have explicitly linked the increases to raising public revenue to respond to COVID-19 (IISD, 2020[244]). In 2021, Indonesia's Ministry of Finance put forward a major plan to overhaul the current tax system, including increasing the value added tax, introducing an excise tax on plastic products and introducing a carbon tax which would amount to IDR 30,000/tCO_2e (EUR 1.83/tCO_2e) (Reuters, 2021[55]) (Jakarta Globe, 2021[56]). If implemented, Indonesia would be the second Southeast Asian country after Singapore to implement a carbon tax.

Carbon pricing generates revenues for governments that can be used for multiple purposes, including financing recovery packages or reducing public debt. A uniform global EUR 30 or EUR 60/tCO_2 carbon price on energy-related CO_2 emissions would generate annual revenues worth more than 1% or 2% of global GDP in 2019. Extending pricing towards all sectors (e.g. agriculture, LULUCF) and all GHGs (e.g. methane, nitrous oxide) would increase these figures to 1.7 or 3.4% of global GDP.[32] Governments could use revenues in multiple ways, including public debt service, support for low-carbon technologies or vulnerable households, each of which has its advantages and drawbacks (section 5.).

Revenues from carbon or GHG taxes are, however, expected to decline once countries start decarbonising. Based on the first round of NDCs submitted to the UNFCCC, a global EUR 30/tCO_2 carbon price on all GHG emissions would generate annual revenues worth 1.3% of expected global GDP in 2030. This is almost 25% lower than the revenue potential in 2019. For pathways compatible with limiting global warming to 'well-below 2°C', the revenue raising potential of a EUR 30 carbon price would decrease to 0.9-1.1% of global GDP (UNEP, 2019[245]). For 1.5°C pathways, the potential would further drop to 0.5-0.7%.[33] Despite this decline, carbon pricing revenues could provide governments a much needed source of finance in the medium term.

[31] Note that the interest rate during the GFC was substantially higher than the interest rate in 2020/2021, implying that countries ability to repay the debts might be relatively greater for debts accumulated during the pandemic.

[32] These figures assume no behavioural change due to carbon pricing and global energy-related CO_2 emissions of 33 GtCO_2 (IEA, 2021[296]), global GHG emissions of 55.6 GtCO_2e (Olivier and Peters, 2020[297]) and a global GDP of USD 87 trillion (WBG, 2021[298]).

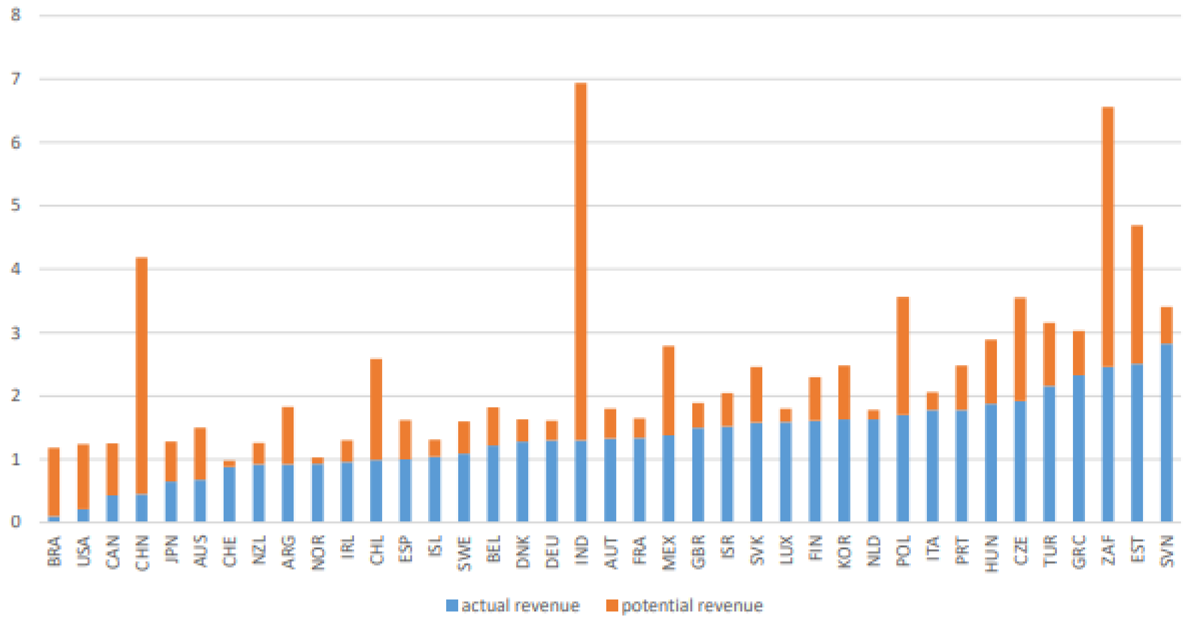
[33] Numbers are based on a global GDP of USD 121 trillion in 2030. Expected GHG emissions are taken from UNEP Emissions Gap report, amounting to 59GtCO_2e for the conditional NDCs, 38-45GtCO_2e for 2°C pathways and 22-30GtCO_2e for 1.5°C pathways in 2030 (UNEP, 2019[245]).

The revenue potential, i.e. the sum of actual and potential revenue, from pricing energy-related CO_2 emissions as share of GDP differs widely across countries (Figure 4.3). This reflects mainly the GHG intensity of the economy. For example, the revenue potential of a EUR 30/tCO_2 carbon price in Switzerland or Norway is around 1% of the countries' GDP, mainly because both countries have an almost 100% decarbonised power sector and limited industrial activities. In contrast, for countries that heavily rely on coal in power generation, the revenue potential from the same carbon price could be as high as 4.2% (China), 6.5% (South Africa) and 6.9% (India).

Most countries have significant scope to increase the revenue from carbon pricing compared to actual revenue levels (Figure 4.3). This is particularly true for emerging economies like China, India and South Africa. If those countries implemented a EUR 30t/CO_2 carbon price on all energy-related CO_2 emissions, their revenues would increase by between 100% (South Africa) and 500% (India). In other countries, there is less scope for raising the revenue, notably in European OECD countries, which have already relatively high levels of carbon prices.

Figure 4.3. Actual and potential revenues from pricing energy-related CO_2 emissions in 2018

EUR 30t/CO_2 benchmark, as a share of GDP (%)



Note: Actual revenue estimates are based on the sum of fuel excise taxes, carbon taxes and ETS auction proceeds.
Source: (Marten and van Dender, 2019[201]).

5. Carbon pricing design related to challenges and increased rationale

COVID-19 has brought new challenges to carbon pricing, but also increased the rationale for countries to implement new or strengthen existing carbon pricing schemes. Agreeing to put a carbon price (at high enough levels to provide a proper price incentive) in place has been already challenging for most countries before the pandemic. This section presents insights on how carbon pricing can be designed to overcome the challenges, enhancing political acceptability. It also sheds light on how carbon pricing could advance other important agendas, including reducing inequality. Finally, the section also discusses a number of innovative instruments that may be less challenging to implement.

5.1. Carbon pricing design options to reduce challenges

Governments have several options available to mitigate the challenges of implementing carbon pricing, including signalling that carbon prices will increase in the future, (temporary) exemptions or targeted support, the recycling of revenue and the choice of the instrument. Yet, there is no silver bullet; each design option of carbon pricing has its advantages and disadvantages.

Signalling that carbon prices will increase in the future, but keeping prices constant in the short-term

Signalling that carbon prices will increase in the future (e.g. starting in 2024) without necessarily increasing carbon prices in the short-term would not exacerbate the situation of vulnerable groups. As carbon prices would not increase in the short-term, vulnerable households and firms would not face a short-term increase of energy prices. Signalling that carbon prices will increase in the future, however, would send a price signal for investment and expenditure decisions in the long-term as it shapes expectations about the future carbon price (Martin and Van Reenen, 2020[246]). In practical terms, the implementation of prospective rising price trajectories for carbon or fuel excise taxes is straightforward. For ETS, however, a more ambitious emissions cap trajectory in the future is likely to translate into higher permit prices in the short-term if market participants can bank allowances. This is because regulated entities could buy allowances today in anticipation of a more stringent future cap, leading to an increase of current permit prices. This was the case in the EU ETS, where permit prices surged during the pandemic from EUR 15/tCO_2 in March 2020 to EUR 60/tCO_2 in August 2021 (EEX, 2021[247]).

Carbon price announcements, however, are associated with some regulatory uncertainty which is detrimental to investments in long-lived low-carbon infrastructure (OECD, 2020[248]). Among other reasons, regulatory uncertainty can originate from the fact that announcements may be revoked, adjusted, or may not pass parliament. Enshrining a carbon price trajectory (e.g. a carbon tax trajectory or minimum carbon price trajectory for ETS) into law would reduce regulatory uncertainty for investors. Yet, despite a law, uncertainty amongst investors may still exist in countries where support for carbon pricing diverges across political party lines which may result in the overturning of the law with a new incoming government (OECD, 2020[248]). This was, for example, the case in the Canadian Province of Ontario, where the incoming government under Premier Doug Ford cancelled the newly established Ontario ETS and withdrew from the agreement to link the ETS with those of California and Québec (IISD, 2018[249]).

During the pandemic some countries signalled a rising carbon price path in the future without increasing current carbon prices. For example, Denmark announced to implement a uniform carbon price starting in 2025 with the level still to be determined (section 3.6). Similarly, Singapore brought forward the review of the carbon tax trajectory that would apply after 2023 (Government of Singapore, 2021[250]). Singapore introduced the carbon tax in 2019 at a rate of SGD 5 (EUR 3.12) per tCO_2e between 2019 and 2023. Singapore had also indicated at the time that the carbon tax rate would reach SGD 10-15 (EUR 6.25 – 9.38) per tCO_2e by 2030 and that the price trajectory would be reviewed in 2022 (NDEVR Environmental, 2021[251]). This review was, however, held in 2021 to provide an early signal to investors and consumers who can steer their consumption and investment decisions in the recovery towards low-carbon technologies.

Carbon price trajectories could be designed to depend on economic or social performance indicators related to the COVID-19 recovery. As there is still large uncertainty about the pandemic and the recovery, governments could announce that carbon prices will be implemented or strengthened depending on key economic or social variables. For example, the carbon price could automatically increase if countries' GDP or unemployment rate reaches the pre-crisis level or if the COVID-19 incidence rate reaches zero, both for a specified duration (e.g. three month). Automatic increases in carbon prices could also apply to specific sectors based on sector-specific variables, e.g. an increase in kerosene or passenger duty taxes if the flight volume reaches a predetermined level (e.g. 80% of pre-crisis traffic) for a specified period. Automatic increases in carbon prices would be ideally enacted for a time-limited period only (e.g. until 2023), after which a carbon price trajectory that does not depend on economic or social progress of the recovery would apply.[34] This approach would ensure that firms and household would not experience a rise in carbon prices during a recession. Yet, firms and households can anticipate an increase in carbon prices in the future to adjust their consumption and investment decisions during the recovery.

Signalling future increases in carbon prices could help to encourage decarbonisation of fossil fuel-intensive industries and recover some of the public expenses from bailouts in sectors that benefited from unconditional bailouts from domestic governments (Mintz-Woo et al., 2020[252]). For example, only 2 out of 32 bailouts in the hard-hit airline industry in Europe have had some environmental conditions on public financial support as of May 2021 (Transport & Environment, 2021[253]).[35] Besides other policy instruments (e.g. support for sustinable aviation fuels), increases in carbon pricing could compensate for the unconditional bailouts, putting some environmental strings on the airline industry once the financial situation is better. For example, long-term predictable kerosene taxes, as under discussion in the EU, could be an instrument for steering the airline industry towards low-carbon alternatives (Teusch and Ribansky, 2021[21]). However, the implementation will in some case require renegotiating air service agreements, which could often be done bilaterally. The Chicago Convention is not an obstacle to taxing kerosene that is taken on board at the point of departure (Teusch and Ribansky, 2021[21]). While solving the legal challenges, countries could implement, strengthen, or reform passenger duty taxes as an alternative to kerosene taxes, though these taxes are less targeted as they do not directly focus on GHG emissions (Teusch and Ribansky, 2021[21]). However, increasing taxes are not the only tool to decarbonize the aviation sector, investments in e.g. sustainable fuels and fuel efficiency is also necessary. Between January 2020 and August 2021, some countries implemented or strengthened carbon pricing in aviation

[34] This is to ensure that carbon prices will increase regardless of recovery indicators that may not reflect the true state of the recovery (e.g. if there is a shift in consumer behaviour so that air traffic does not reach pre-crises levels even in the foreseeable future).

[35] In addition, bailing out airlines tends to have very low long-term multipliers, meaning that government spending has little potential to raise national welfare (Hepburn et al., 2020[289]).

(section 3.3, taxes on air in France (Ministère de la Transition écologique, 2021[118]) or air passengers in Portugal (Bloomberg Tax, 2021[123]) (Euractive, 2020[121])).

Targeted and time-limited exemptions from carbon pricing

Exemptions from new or strengthened carbon pricing would protect vulnerable population groups or businesses, but would reduce the price signal and thus the effectiveness of carbon pricing. Exemptions differ from signalling prospective increases of carbon pricing, as exemptions are usually targeted to vulnerable sectors or groups. While exemptions can protect vulnerable groups, they also promote the consumption of fossil fuels (Oxford Institute for Energy Studies, 2021[254]). Supporting vulnerable groups through lump sum transfers or free allocation of allowances would be a better alternative to exemptions from carbon prices. This would restore the (marginal) price signal.

Exemptions or support for vulnerable groups needs to be used carefully, ideally being time-limited and well-targeted, based on indicators of vulnerability. For households, vulnerability indicators go beyond income measures and also take into account energy expenditure and/or adaptive capacity (e.g. the prevalence of and access to low-carbon alternatives to fossil-intensive consumption modes) (Mattioli et al., 2019[196]). In the industry sector, vulnerability to potential negative competitiveness effects can be accounted for by factors such as the share of energy on total costs and/or trade exposure. The EU uses these factors to determine whether such industries are fully or partially exempt from carbon pricing (EC, 2021[179]).

Other instruments, however, can mitigate the adverse competitiveness effects of carbon pricing and reduce carbon leakage, i.e. the increase of emissions abroad in response to implementing or strengthening domestic carbon pricing, more effectively. Among all the anti-leakage instruments (e.g. border carbon adjustments (BCA), free allowances, targeted support for green investments), BCA was found to be the most effective in terms of reducing carbon leakage (Nachtigall et al., 2021[255]).[36] By levying import tariffs on the embodied carbon of manufactured goods from countries without or with a lower carbon price, a BCA effectively levels the playing field between domestic and foreign firms, which could enhance domestic support for BCA. However, BCA is found to be challenging to implement legally and politically, notably regarding international trade rules (OECD, 2020[256]). BCA is discussed amongst other instruments, by some jurisdictions, e.g. the European Union as part of the EU New Green Deal. BCA could also generate revenue for the government that can be used for national or supranational purposes.[37]

Revenue recycling

Recycling revenue from carbon pricing can greatly influence the public acceptance as well as economic, social, and environmental outcomes of carbon pricing, including in the recovery from COVID-19 (Table 5.1). Some options for revenue recycling tend to increase public acceptance of carbon pricing. These forms of revenue recycling include targeted transfers to vulnerable groups, lump-sum transfers to all households and reinvesting the proceeds into green alternatives, such as renewable energy or energy efficiency (green spending) (Maestre-Andrés, Drews and van den Bergh, 2019[237])).

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[36] Yet, BCA is not able to eliminate leakage entirely (Nachtigall et al., 2021[255]). First, BCA would not address the so-called fossil fuel price channel. According to this channel, domestic carbon prices would reduce domestic energy demand which translates into lower international fuel prices, triggering increased energy consumption and emissions abroad. Second, BCA would typically not include export rebates due to WTO compatibility, reducing its effectiveness in levelling the playing field in markets abroad (OECD, 2020[256]).

[37] For the European Union, there are different proposals on the use of the revenue from BCA. While the European Parliament prefers the revenue to finance sustainable infrastructure in least developed countries, the current proposal of the European Commission foresees redistributing the revenues back to its Member States (IEEP, 2021[291]).

There tends to be an equity–economic efficiency trade-off for revenue recycling options that increase the public acceptance. These options would usually enhance equity and the support for carbon pricing. However, those recycling options would fail to improve the efficiency of the tax system, which could enhance economic growth deemed vital for most governments in their recovery plans. However, the magnitude of the trade-off depends on the target group of revenue recipients as well as on the exact use of the revenue and the respective multipliers, i.e. the additional economic activity that is generated per euro invested. For example, allocating the revenue of carbon pricing mainly to low-income households tends to spur economic growth as those households are likely to consume the largest share of the extra income (in contrast to high-income households, who are more likely to save). Determining the economic effects of green spending are complex as they depend on the respective multipliers. Recent evidence suggests that green spending in energy infrastructure (e.g. renewables) and the land sector (e.g. land conversion and restoration) have higher multipliers than respective investments in non-green alternatives (e.g. fossil fuel energy) (IMF, 2021[257]). The effect of green spending on equity also depends on the specific investments. For example, using the revenues from carbon pricing to subsidise electric vehicles (EVs) could reduce equity as this benefits mainly higher-income groups. In contrast, spending on sustainable transport modes would typically enhance equity because those modes are primarily used by lower-income groups (Klenert et al., 2018[199]), (Maestre-Andrés, Drews and van den Bergh, 2019[237]).

Table 5.1. Effects of recycling mechanisms on different dimensions of carbon pricing

Recycling mechanism	Environmental effectiveness	Economic growth	Equity	Acceptability
Targeted transfers	+	0	++	++
Lump-sum transfers	+	0	+	0/+
Green spending	++	0/+	-/0/+	++
Reducing labour taxes	+	+	0	0/-
Reducing corporate taxes	+	+	-	-
Government budget or debt relief	+	0/-	-	0/-

Note: Symbol code: ++ very positive; + positive; 0 neutral; - negative.
Source: Authors based on (Klenert et al., 2018[199]), (Maestre-Andrés, Drews and van den Bergh, 2019[237]) OECD (forthcoming).

Recycling the carbon price revenue to reduce distortionary taxes such as labour or corporate taxes[38] would improve the economic efficiency of the tax system and could generate a double dividend in terms of economic growth or higher employment (Freire-González, 2018[258]). This has been shown in several modelling scenarios for various countries (Asakawa et al., 2020[259]). In addition, ex-post evidence from the British Columbia carbon tax suggests that recycling revenue to reduce personal and corporate taxes would lead to a small but statistically significant increase in employment (Yamazaki, 2017[260]). However, reducing distortionary taxes with carbon pricing revenue tends to be less favourable on equity and public acceptability grounds. Reducing corporate taxes benefits shareholders, who are usually rather high-income households. Reducing labour taxes can benefit both high- and low-income households, but would not benefit the most vulnerable households such as the unemployed, disabled or low-income pensioners. Note, however, that carbon pricing revneue is expected to decline once economies increasingly decarbonise (section 4.2).

Using revenue for increased government spending or to reduce public debt has, in general, little support by the general public (Figure 4.2, (Klenert et al., 2018[199]) (Maestre-Andrés, Drews and van den Bergh, 2019[237])). The effects on economic growth are also inconclusive. On the one hand, a simulation study of

[38] Labour and corporation taxes are distortionary because they increase the cost of hiring an employee or having a business, which negatively affects the number of employees hired or businesses opened.

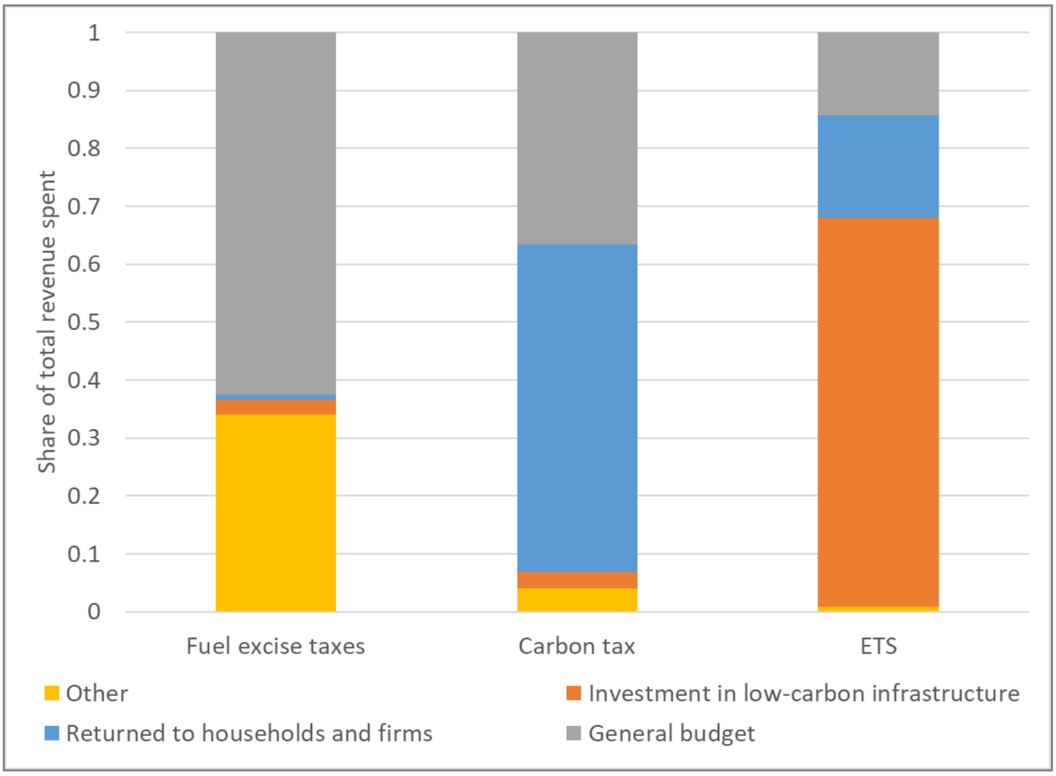
a potential US carbon tax shows that using carbon pricing revenue to reduce public debt would have a small negative effect on GDP compared to BAU in the short run (-0.04% after 10 years), but a positive effect in the long run (+0.07% after 20 years), albeit to a lower extent than reducing labour taxes (Diamond and Zodrow, 2018[261]). This is in line with an earlier study for the US (Carbone et al., 2013[262]). It is also in line with evidence from Spain that suggests a strong negative effect of carbon pricing within the first two years after introduction (-0.49%), but a smaller negative effect after 10 years (-0.16%) compared to BAU (Estrada and Santabárbara, 2021[263]). On the other hand, simulations from an increased carbon tax in Ireland concludes that revenue use for debt relief would have the most negative effect on GDP (compared to BAU) among all revenue recycling alternatives (ESRI, 2019[264]). Based on the same simulation, using revenue for increased government spending instead would still have a negative effect on GDP compared to BAU, but to a lower extent. The modelling results from the US and Ireland also suggest that revenue use to reduce public debt is moderately regressive, increasing the share of tax payments on total income for low-income households to a larger extent than that of high-income households (Diamond and Zodrow, 2018[261]), (ESRI, 2019[264]).

In 2016, the actual revenue use from carbon pricing varied significantly across instruments (Figure 5.1) based on data from 40 OECD and G20 countries (Marten and van Dender, 2019[201]) . Note that the numbers in Figure 5.1 and the following may have changed between 2016 and November 2021 due to the implementation of new large carbon pricing schemes (e.g. China ETS).

- For the 40 countries with fuel excise taxes, 62% of the total revenue went to the public government budget, while 34% was spent on other purposes, including intergovernmental transfers (e.g. in Japan, France, and Mexico) or funding and maintenance for road infrastructure (e.g. in Australia, Czech Republic and Brazil). This reflects the different rationale for fuel excise taxes that were not primarily introduced to tackle climate change, but rather to raise revenues or encourage energy savings, notably in the road sector after the oil crises in the 1970s. Despite the different rationale, fuel excise taxes still put a positive price on carbon, encouraging emissions reductions.
- For the 18 countries with carbon taxes the major share (57%) of total revenues from carbon taxes was returned to households and firms. This was realised in different forms, such as lump-sum payments (as under the Canadian backstop), reduction of labour and/or corporate taxes or social security contributions (as in Switzerland) or compensation to low-income households (as in British Colombia, Canada). A significant share (37%) of the total carbon tax revenue was not earmarked, flowing to the public budget. Only a minor share (3%) of expenditure was earmarked for green spending.
- For the 28 countries with ETS, green spending accounts for the major share of total revenue recycling, accounting for almost 70% of total ETS auction revenue. Most of the ETS revenue originates from the EU ETS or the subnational North American ETS (RGGI, California, Quebec). Green spending includes inter alia spending on energy efficiency, renewable energy, sustainable mobility, green research and development, or climate mitigation in the LULUCF sector. Around 14% of total auctioning revenue from all ETS flows to the public budget, but this varies considerably across countries. Some countries recycle 100% of the revenue to the public budget (e.g. Iceland, Norway and the Netherlands) whereas other countries recycle less than 20% to the public budget (e.g. Spain, UK, and Austria). 18% of total auction revenue across all schemes is distributed back to households or firms while less than 1% is used for other purposes.

Figure 5.1. Use of revenue from different carbon pricing instruments

Based on 40 OECD and G20 countries, 2016 or latest available date



Note: Returned to households and firms include reductions in labour or corporate taxes, lump-sum transfers or targeted transfers to compensate energy users. Green spending includes inter alia spending on energy efficiency, renewable energy, sustainable mobility, green research and development, or climate mitigation in the LULUCF sector. Others can include intergovernmental transfers or transport-related funding and maintenance (mostly for fuel excise taxes).
Countries with fuel excise taxes include ARG, AUS, AUT, BEL, BRA, CAN, CHL, CHN, CZE, DNK, EST, FIN, FRA, DEU, GRC, HUN, IND, ISL, IRL, ITA, ISR, JPN, KOR, LUX, LVA, MEX, NLD, NZL, NOR, POL, PRT, SVK, SVN, ESP, SWE, CHE, TUR, GBR, USA, ZAF.
Countries with carbon taxes include AUS, CAN, CHL, DNK, FIN, FRA, ISL, IRL, JPN, LVA, MEX, NOR, POL, PRT, SVN, SWE, CHE, GBR.
Countries with ETS include AUT, BEL, CAN, CZE, DNK, EST, FIN, FRA, DEU, GRC, HUN, ISL, IRL, ITA, LUX, LVA, NLD, NOR, POL, PRT, SVK, SVN, SWE, ESP, CHE, GBR, USA, CHN.
Source: Authors based on (Marten and van Dender, 2019[201]).

The carbon pricing policy changes tracked in this paper also use the revenues in various ways. Most countries attribute some part or all revenue of new or strengthened carbon pricing instruments to green spending. In line with the general picture outlined above, most of the revenue use for green spending originates from ETS, including New Zealand ETS, EU ETS' Innovation and Just Transition fund, Korea ETS, part of the German nETS (for energy efficiency improvements) and potentially UK ETS' Industrial Decarbonisation fund (still to be decided). Also the Irish carbon tax and some part of the Swiss carbon tax (Hintermann and Zarkovic, 2020[265]) attribute some of its revenue for green spending (e.g. for sustainable farming in Ireland). In addition, the greatest part of the cumulated revenue from the Irish carbon tax (EUR 5 billion out of EUR 9.5 billion) is earmarked for a national retrofitting programme for all but especially low-income households (Government of Ireland, 2020[67]).

In some carbon pricing schemes that have changed since the start of the pandemic, the revenue from carbon pricing flows to the government budget (e.g. the fuel tax increase in India (IISD, 2020[244])). Others used the revenues to address the social and economic consequences of the pandemic (e.g. the carbon tax revenues in Costa Rica used for the protection of workers).

Some carbon pricing schemes redistribute the revenues back to household and firms. This includes the German national ETS (reduce electricity surcharge for consumers and relieve transport costs for commuters) (ICAP, 2021[40]), the Swiss carbon tax (reduction of social security contribution of Swiss households) (Hintermann and Zarkovic, 2020[265]) or the proposed Austrian carbon tax (redistribution to Austrian households). Revenues from the Canada backstop carbon price will be paid to Canadians quarterly through the Climate Action Incentive. Rural citizens receive an additional 10% to compensate for increased car use due to an unequal access to green public transportation alternatives as compared to urban citizens (ECCC, 2020[266]).

FFS reforms lead to a reduction of government expenditure. The savings from former expenditure on FFS could be used to enhance political support for the reform. Since FFS disproportionately benefits medium- to high income groups in developing countries, FFS removal tends to be progressive. However, low-income households are usually still affected by the reform because they face higher consumer prices for energy products after the FFS removal and their monthly budgets are more limited. This may create strong opposition against FFS reforms, as was the case in Nigeria, where most of the reduced FFS during 2012-2014 were reinstated after massive protests (Klenert et al., 2018[199]). Also Indonesia suspended its fuel pricing reform in 2018, partly as a reaction to rising international fuel prices (OECD/IEA, 2021[267]). Compensation for low-income or vulnerable households in developing countries either through lump-sum rebates or through expanding already existing social programmes or designing new social programmes have proven to enhance the political acceptability of FFS removal (Vagliasindi, 2012[268]).

Instrument choice

Policy makers can choose among different instruments for carbon pricing, including ETS, carbon taxes, or fuel excise taxes, each with its advantages and drawbacks. Implementing new instruments generally requires a longer lead time than strengthening existing instruments as governments can legislate a prospective adjustment to the price trajectory of a carbon tax or the cap of an ETS within a few months. Setting up new ETS is usually more complex than implementing carbon taxes or fuel excise taxes due to higher administrative requirements (Haites, 2018[269]), but support and knowledge sharing, including through international co-operation, can speed up the process.

In contrast to ETS, carbon taxes provide price certainty for investors, reducing the price volatility and increasing investments in low-carbon technologies (Flues and van Dender, 2020[225]). However, carbon taxes do not necessarily meet a given emission reduction target, making it challenging to align carbon tax levels with short- and long-term climate mitigation targets. Yet, policy makers can connect the carbon price trajectory with actual national emissions reduction targets. Such a design increases the likelihood of meeting mitigation targets, but also adds some uncertainty for investors in low-carbon technologies because the price trajectory is not certain, but rather depends on the success of mitigation policies. The Swiss carbon tax follows this approach. In Switzerland, the carbon tax (on heating fuel, natural gas, hard coal and propane) was introduced in 2008 at CHF 12 (EUR 11) per tCO_2e jointly with interim emission reduction targets. If these interim targets are not met, the CO_2 tax automatically increases by multiples of CHF 12 (EUR 11) per tCO_2e (Hintermann and Zarkovic, 2020[265]). The last increase of the Swiss carbon tax was in 2020 when the tax rate increased from CHF 96 to CHF 120 per ton of CO_2e (section 3.1), the maximum tax level. In 2021, Swiss voters rejected a proposal to increase the maximum tax level from CHF 120 to CHF 210 (section 4.2).

In contrast to carbon taxes, ETS provide certainty on meeting a given emissions reduction target because the cap is set exogenously by policy makers. However, the price is uncertain, and thus exposes investors and consumers to price volatility. In well-functioning markets, permit prices would automatically adjust depending on the emissions cap and the interplay between supply and demand, not needing further intervention by policy makers in theory. Yet, prices could become too low during recessions when demand for permits drop, failing to send a consistent price signal for low-carbon investments. This has been the case, e.g., in the EU ETS during and after the GFC. However, ETS permit prices have been relatively stable during the first 20 months of COVID-19 (section 3.2) thanks to price or supply adjustment mechanisms that limit volatility and/or prevent persistent low prices.[39]

5.2. Instruments related to carbon pricing

A number of other instruments related to carbon pricing are available to governments and may be less politically challenging and require less time to implement. These include, among others, internal carbon prices (i.e. carbon prices used in public or private project appraisal and investment), carbon contract for differences (CCfD, i.e. the guarantee of a pre-determined carbon price for investments in abatement), product taxes or feebates (i.e. product taxes or subsidies for durables depending on expected lifecycle emissions), and taxes or levies on fossil fuel supply. These instruments would help steer private and public decisions towards low-carbon alternatives in the recovery and all have been implemented or are under discussion in at least one of the 47 OECD/G20 countries between January 2020 and August 2021.

Governments and companies could use **internal carbon prices** for cost-benefit analysis in project appraisal (e.g. investments in transport or energy infrastructure) or long-term investments (OECD, 2018[270]). An internal carbon price would put a monetary value on future emissions, rendering low-carbon alternatives relatively more attractive than high-carbon alternatives in the project evaluation. As of 2020, some governments as well as almost half of the largest 500 companies in the world by market value reported using internal carbon prices or are planning to use internal carbon prices until the year 2022 (World Bank, 2021[29]). In addition, as of 2020, almost 2000 companies reported to make use of internal carbon prices or are planning to do so in the next two years. Jointly, these companies represent a market value of USD 27 trillion (EUR 24 trillion), 4 times the amount of the 2017 level (World Bank, 2021[29]). While it is difficult to draw conclusions on companies' internal carbon prices due to transparency issues, the reported internal prices range from USD 6 (EUR 5.15) to USD 918 (EUR 788) per tCO_2. Most internal carbon price across all industries are, however, below the USD 40-80 (EUR 34.3-68.7) benchmark deemed to be necessary to limit warming to 'well-below' 2°C (World Bank, 2021[29]).

Governments' internal carbon prices can effectively guide public investment decisions in the recovery. Governments base their internal carbon prices on different methodologies, including the social cost of carbon[40] (as in the US) or carbon prices that are consistent with governments' mitigation targets (e.g. UK). The UK moved away from carbon values based on the social cost of carbon towards values that align with the UK carbon budget and long-term mitigation targets (OECD, 2020, green budgeting). In 2020, the internal carbon price was GBP 76 (EUR 90) in the non-traded sector and GBP 22 (EUR 26) in the traded sector (BEIS, 2021[271]).[41] After applying a new methodology to calculate carbon values, internal carbon prices range from GBP 120 (EUR 142) to GBP 361 (EUR 426) per tCO_2e in 2021 (BEIS, 2021[272]). During the first 20 months of COVID-19, the US raised its internal carbon price from USD 1 (EUR 0.86) to USD 51 (EUR 43.8) and is expected to further increase this value after the completion of a reassessment on the social cost of carbon. An internal carbon price of USD 51 (EUR 43.8) mirrors the price level that the US had in place during the Obama presidency.

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[39] Price or supply adjustment mechanisms include price floors (e.g. Chinese ETS), price corridors (e.g. Hubei), minimum auction reserve prices (e.g. California, Korea, New Zealand), and market stability reserves (e.g. EU, RGGI) (World Bank, 2021[29]).

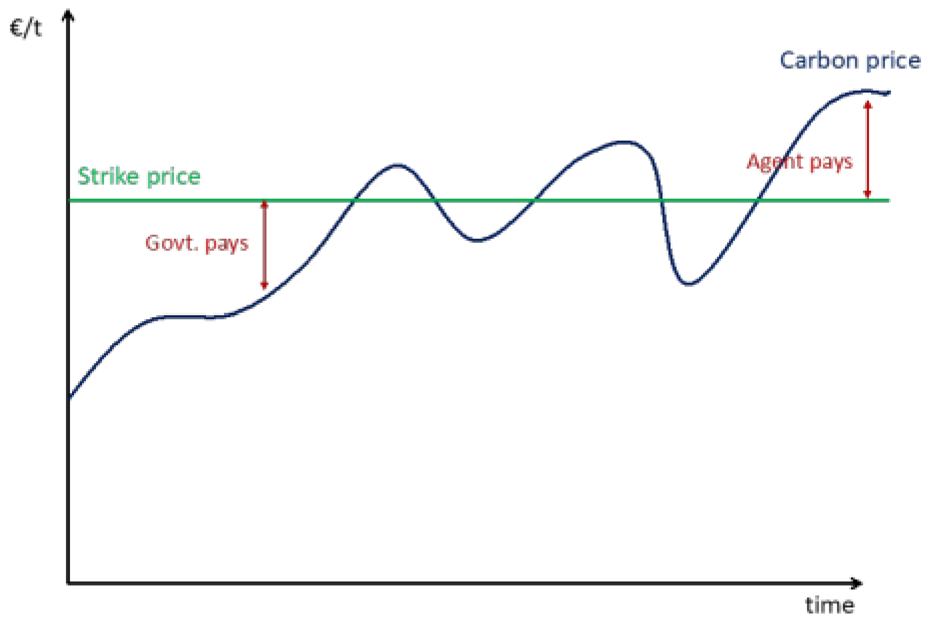
[40] The social cost of carbon is the expected discounted future damage of one ton of CO_2e emitted today.

[41] The UK provides a carbon price trajectory from 2010-2100 and distinguishes between carbon traded for projects that were covered by the former EU ETS (and now UK ETS) and non-traded carbon for the remaining sectors. Carbon values in both sectors differ because the targets in both sectors are different.

Governments can use **CCfD** to spur investments into specific early stage abatement technologies by guaranteeing investors a fixed carbon price (usually higher than the current carbon price) over a specific time period. The investor can sell any carbon emission reductions at that given price. In addition to creating price certainty, which reduces investors' risk and financing costs, a sufficiently high CCfD carbon price would promote the deployment of low-carbon technologies (e.g. low-carbon hydrogen for steel production), which face higher investment and operating costs than traditional technologies (e.g. coal use for steel production) under current carbon prices (Gerres and Linares, 2020[273]). Deployment of low-carbon technologies would bring down the investment and operational costs, and help mainstream those technologies by creating a market for them (Sartor and Bataille, 2019[274]).

Germany announced in its National Recovery and Resilience plan to use CCfDs to support the deployment of low-carbon technologies in energy-intensive sectors, including cement, chemicals, and steel (BMF, 2021[275]). Under the planned German scheme, firms would sign contracts with the government, determining the contract duration and the carbon price for each emission abated. The German government would cover the difference between the current carbon price in the EU ETS and the contracted price. If the EU ETS price exceeded the guaranteed price, the firm would be obliged to pay back the difference to the government (Figure 5.2). As the government tops up the difference of the current carbon price, the fiscal commitment is expected to be much lower than feed-in tariffs or feed-in premiums used in the renewable energy sector (BMF, 2021[275]).

Figure 5.2. Carbon contract for differences



Source: (Gerres and Linares, 2020[273]).

Product taxes or feebates decrease the relative costs of low-emission products, providing incentives for uptake of those, reducing carbon lock-in. Feebates impose a sliding scale of fees on products with above-average emissions and a sliding scale of rebates for products with below-average emissions. Evidence from France suggests that feebates increased the uptake of low-emissions vehicles (D'Haultfœuille, Givord and Boutin, 2014[276]). Feebates are usually designed to be revenue-neutral as the revenues from the fees would finance the rebates for the low-carbon alternatives. However, by increasing the fees on products with above-average emissions, feebates could potentially generate revenues, making it a promising instrument for cash-strapped governments during the pandemic. When the public budget allows, governments could also increase the rebates to provide further incentives for uptake of low-carbon alternatives (OECD, 2020[248]).

In 2021, New Zealand announced to implement a feebate scheme, in which taxes on highly emitting cars would finance rebates for clean cars such as electric vehicles, to be effective from 2022 (Ministry of Transport, 2021[277]). The standard will be set at 105g CO_2 per km. Cars with lower CO_2 rating (based on the international testing protocols and calculated using the World Harmonized Light-duty Vehicles Test Procedure) will be eligible for a rebate whereas cars with higher emissions will face a fee that increases with the car's CO_2 rating. New Zealand expects the programme to reduce up to 9.2 million tCO_2e by reducing the upfront cost of switching to an electric or low emission vehicle (Ministry of Transport, 2021[277]). Ireland updated its vehicle registration tax to better reflect CO_2 emissions (VRT, 2021[278]). Ireland increased the vehicle registration tax for high emitting vehicles (i.e. those that emit >191gCO_2e/km) from 36% to 37%. Ireland also reduced the registration tax for the cleanest vehicle group (i.e. <50gCO_2e/km) from 14% to 7% to provide further incentives for buying electric vehicles.

Effective taxes on fossil fuel *supply* can discourage fossil fuel production and generate revenue, strengthening the sustainable recovery from COVID-19. Putting a price on fossil fuel extraction reduces the incentives of companies to explore and/or extract fossil fuel resources. Countries use a variety of approaches to tax fossil fuel production, including corporate profit taxes, rent taxes, income from resource-extracting state-owned enterprises or royalties (Elgouacem, 2020[279]). The multitude of instruments makes it challenging to compare effective fossil fuel supply tax rates across countries. The revenue potential of supply taxes is, nevertheless, substantial. For example, revenues from royalties in the US amounted to USD 10 billion in 2019, accounting for 0.2% of the total federal government budget (Department of the Interior, 2021[280]). Furthermore, in 2021, the US is planning to increase the royalty rate by more than 50% from 12% to 18.75% (Reuters, 2021[281]). More empirical work and careful impact assessments will be needed to ensure that fossil fuel supply taxes have no unintended consequences while contributing to an overall transition towards cleaner energy sources.

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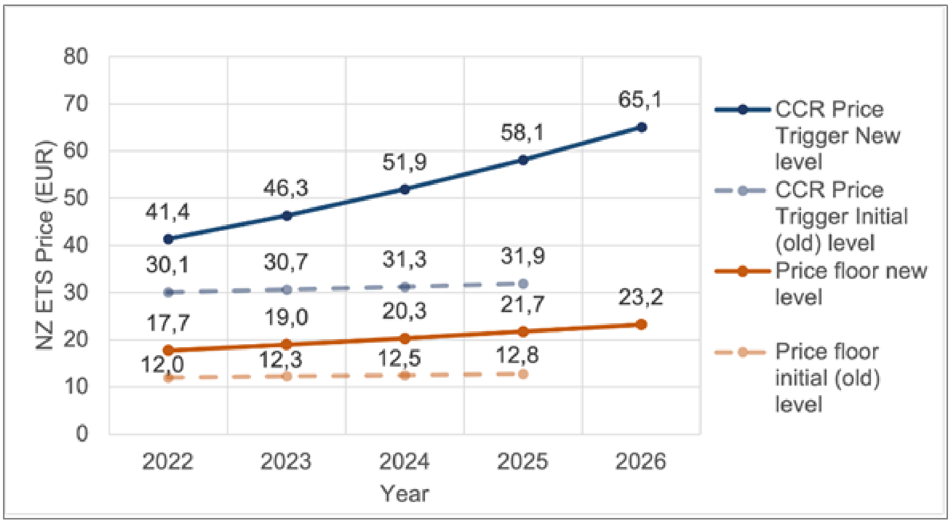
Annex A. Overview of New Zealand's 2022 price adjustments

Figure A A.1. Overview of New Zealand's 2022 price adjustment



Note: The initial (old) new auction price floor, and the new (old) Cost Containment Reserve (CCR) trigger price which collectively forms a price corridor.
Source: Authors (based on NZ Government numbers (New Zealand Government, 2021[282]) (New Zealand Government, 2021[100])).

Annex B. Carbon pricing development in selected sub-national pricing schemes

In British Columbia, the **carbon tax** was planned to increase from CAD 40/tCO_2 (EUR 27.1/tCO_2) to 50/tCO_2 (EUR 33.5/tCO_2) on April 1st, 2020, however, due to COVID-19 the increase was postponed, and the original rate (CAD 40/tCO_2) was frozen throughout 2020. On April 1st 2021 the carbon tax increased to CAD 45/tCO_2 (EUR 30.2/tCO_2). Originally, British Columbia would have reached their target rate of 50/tCO_2 (EUR 33.5/tCO_2) in 2021, which will instead be reached by April 2022 (World Bank, 2021[91]). In Mexico, changes were initiated for two sub-national carbon tax schemes. The Tamaulipas carbon tax legislation was passed in July 2020 which resulted in the carbon tax being launched by January 2021. The carbon tax applies to CO_2e emissions from fixed sources and facilities emitting more than 25 tCO_2e, and is approximately MXN 250/tCO_2e (EUR 11/tCO_2e) (World Bank, 2021[91]). The carbon tax of Baja California was launched on May 1st, 2020, at a rate of MXN 170/tCO_2 (EUR 7.1/tCO_2) and is applicable to gasoline, diesel, natural gas, and liquefied petroleum gas (World Bank, 2021[91]).

The following policy changes during the first 20 months of COVID-19 for sub-national **ETS** were climate-positive and permanent.

- In Québec, Canada, climate-positive policy change within the ETS took place as a new bill was passed in October 2020. The modifications include a name change of the current fund from *Green Fund* to *Electrification and Climate Change Fund* and the fund is now fully managed by the Ministry of Environment. Furthermore, the total amount of revenue from the ETS is now attributed to climate action, as opposed to before. Allowances which were previously allocated for free to industrial emitters, have also been included in auctions. The revenue from these is, nevertheless, reserved for those emitters who previously benefitted from the free allocation, on the condition that the revenue is used to finance climate mitigation (ICAP, 2021[40]).
- For California's ETS, climate-positive changes were implemented on January 1st, 2021, and included a reduction of the emission cap by 13.4MtCO_2e each year from 2021 to 2023, equivalent to a 4% average per year. It also included the transition from three price tiers (three price levels at which additional allowances are released) to two price tiers at USD 41.4 (EUR 35.5) and USD 53.2 (EUR 45.7) and the implementation of a hard price ceiling at USD 65 (EUR 55.8) (State of California, 2021[283]) (EDF & IETA, 2018[284]). With its existing price floor, the system now has a price corridor. Changes, furthermore, include a reduction in the number of offset participants can use from 8% to 4% from 2021 to 2025 (World Bank, 2021[91]) (ICAP, 2021[40]).
- Another interesting ETS is the Transportation and Climate Initiative Program (TCI-P) which is the combination of regional sub-systems targeting CO_2 emissions in the transport sector in several US states. During COVID-19 a final Memorandum of Understanding and a document outlining the systems design were released in December 2020 and signed by Connecticut, Massachusetts, Rhode Island, and Washington D.C. in February 2021 (TCI-P, 2020[285]). The program operates with an emissions cap that declines 30% from 2023 (program start) until 2032, and auctions almost all of its allowances with revenue recycling back to each participating state (TCI-P, 2020[286]).
- A roadmap for an ETS pilot in the Sakhalin Region in Russia was approved in January 2021, which will help Sakhalin reach carbon neutrality in 2025. The Sakhalin ETS pilot is viewed as a testing phase for regional GHG regulation policy changes which can be extended later on (ICAP, 2021[40]).

- In Japan the Tokyo ETS started its third phase (2020-24) in April 2020, permanently increasing the emissions target from 15% or 17% (industry dependent) to 25% or 27% below base-year emissions (the average emissions of any three consecutive years between FY2002 and FY2007, as chosen by each entity) by 2024. The Tokyo ETS was the only assessed sub-national ETS which experienced a COVID-19 related delay in regard to the submission deadline for annual reports which was pushed by two months (ICAP, 2021[133]).

Regarding **aviation taxes**, British Columbia and Québec, Canada both waived long-term parking fees for aircrafts, while British Columbia also deferred aviation fees by three months. In California, the policy changes were similar as they also deferred rent and landing payments (IATA, 2021[120]).

All policy changes related to **FFS** took place in British Columbia and Québec in Canada, which both had multiple climate-negative FFS policy changes. In British Columbia the natural gas levy was decreased and the Orphan Liability Levy (covers oil well clean-up costs) was postponed. In Québec, support was given for natural gas projects (OECD, 2021[72]).