

International evidence on fiscal levers to deliver reductions in greenhouse gas emissions

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1 Executive summary

In this study we review the use of fiscal levers to reduce greenhouse gas (GHG) emissions across the world. These levers include taxes, levies, duties or charges applied by governments on major sources of emissions.

We focus mainly on direct carbon taxes which are applied to specific goods – typically fuels – based on the amount or intensity of greenhouse gases they produce. We also consider indirect taxes, which place a price on other forms of pollution, such as air or water, but often target GHGs as well. Grants and subsidies are not in scope.

We examine whether these levers have been effective in decreasing GHG emissions, the revenue that has been raised, and how governments have used that revenue. We look at six international case studies in more detail. We also examine relevant fiscal levers currently applied in the UK and Scotland, and the possible implications for Scotland of adopting any new lever, based on the case studies. This study does not make policy recommendations, nor does it consider the costs and benefits if they were adopted.

1.1 Findings

We focus mainly on the use of direct carbon taxes both nationally and sub-nationally (in specific regions or provinces within a country) around the world. Key findings are:

- **The use of carbon taxes is increasingly common.** There are 37 direct carbon taxes in 27 jurisdictions globally, most of them in Europe. Several jurisdictions outside Europe have adopted taxes and more are considering them. About 6% of global GHG emissions are taxed by carbon taxes and this share has increased over the past 15 years. **Sub-national carbon taxes have also been applied** by Canada and Mexico.
- Taxes differ in terms of GHG coverage and carbon price: We identified three broad categories:

- i. 'High ambition' instruments with both a relatively high price and coverage of GHGs;
 - ii. A mixed level of ambition, with either high prices and low coverage; or a high share but low prices;
 - iii. Relatively low prices and coverage.
- **The balance of evidence suggests carbon taxes have reduced GHG emissions** where adopted, but the data is limited, uncertain and rarely quantifies carbon leakage – when businesses transfer production to other countries with laxer emission constraints. Other regulatory measures are likely to be required alongside them to meet wider climate policy goals. There is limited detailed evidence on how affected businesses and households adjust behaviour in response to taxes.
 - **Carbon taxes have generated government revenue;** between several billion dollars in Sweden to tens of million in Iceland. The potential for revenue generation depends on the prevailing carbon price and coverage of the tax, as well as the size of the economy, its carbon intensity and energy mix. They have been relatively straightforward and inexpensive to administer for governments. Some direct carbon taxes have been used to raise revenues for specific purposes. These have typically been channelled towards green technology and specific rebates or tax cuts for affected groups, including low-income households.
 - **Implementation has been politically challenging.** Carbon taxes have been repealed in Australia, delayed in New Zealand and a planned acceleration of the carbon price was suspended in France. A legal challenge was brought in Mexico over whether the regional government had legal authority to implement a proposed tax.

1.2 Current fiscal levers in the UK and Scotland

Fiscal levers that target or address GHG emissions focus on energy and energy intensive industries, transportation and resource use. Examples include Fuel Duty, the Climate Change Levy, the Renewable Energy Obligation and the UK Emission Trading System, as well as Air Passenger Duty and vehicle excise duty. A devolved tax, the Air Departure Tax (Scotland) Act 2017, is being progressed, but needs to address the Highland and Islands exemption and safeguard connectivity. The Scottish Landfill Tax applies to waste disposed to landfill.

The introduction of new national devolved taxes can only be delivered by agreement of the Scottish and UK Parliaments or through a change to the devolution settlement. Four of the six case studies have similarities to UK levies, which would need amending, but two would be entirely new. We consider how elements of the case studies could be applied in Scotland but make no recommendations on whether this would be advisable.

1.3 Principles for implementation

Any financial lever would be designed based on the six principles in Scotland's Framework for Tax: proportionality, efficiency, certainty, convenience, engagement and effectiveness. As such, the precise design of any lever would need to be subject to careful consideration and clear communication in terms of its scope, phase-in, price (including future price escalation), sectors and activities on which it is levied and any relevant exemptions.

Distributional effects would have to be carefully considered, including if and how revenue should be reallocated, to whom and under what conditions.

Successful fiscal levers have been based on transparent design, regular monitoring and communication of revenues, costs and benefits, with rapid adjustments if unexpected adverse effects occur. They have formed part of wider fiscal reforms, with a clear strategic objective. Any potential options would be required to undergo extensive further consultation and robust impact assessment to fully understand the costs and benefits.

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Glossary

1tCO₂e	One tonne CO ₂ equivalent. A metric that allows like for like comparison of carbon intensity
Abatement technologies	A technological mechanism or process that has the potential to reduce emissions or pollution
Bonus Malus	Latin for “good-bad”, used to describe an arrangement – or fiscal lever in this case – which alternatively rewards (bonus) and penalises (malus) specific purchasing behaviour.
Carbon leakage	A potential situation whereby carbon emissions were displaced, in whole or in part, from one jurisdiction to another, as a result of business production relocation in response to specific policies, for example.
CBAM	Carbon border adjustment mechanism. A fiscal lever which applies a carbon price to certain products imported into a jurisdiction
CCC	The Climate Change Committee. A statutory body established to advise the UK government and devolved administrations on emission targets, progress made in reducing GHG emissions and preparing for and adapting to the impacts of climate change.
Counterfactual scenario	Estimates or analysis of what would have occurred without the policy being adopted. It is widely used in public policy analysis.
Earmarking or hypothecation (of revenues)	Commitments – whether set out in legislation, policy documents or via political statements – on specific uses of revenue from taxation (for example on tax rebates for low-income groups, or investment in green technologies)
Ex-ante	Translates from Latin as “before the event”. It refers to evidence based on prediction or forecast.
Ex-post	Translates from Latin as “after the fact”. It refers to evidence based on what actually occurred.
ETS	Emission trading scheme or emission trading system
Fiscal levers	An intervention or policy used by governments to affect financial revenue generated via taxes, duties, levies, charges (or fees). In this study the scope of the term excludes grants and subsidies.

GHG	Greenhouse gases, i.e., gases present in the earth's atmosphere that trap heat. Examples include carbon dioxide (CO ₂), methane and industrial fluorinated gases hydro fluorocarbons (HFC, perfluorocarbons (PFC).
IPCC	Intergovernmental Panel on Climate Change. The United Nations expert body for assessing the science related to climate change.
Negative externalities	Where the social costs of a market transaction are greater than the private costs (for example air passengers may not pay the full costs of the damage from the carbon emission associated with their flight).
Price elasticity of demand and supply	An economic concept concerned with if, and to what extent, demand or supply of a good or service changes when its price does. It is calculated by observing changes in quantity of a good or service demanded (supplied), divided by the change in its price. Inelastic in this context means that demand (supply) does not change when prices do.
Progressive and regressive taxation	Terms which refer to the effects of specific taxes based on a person's or a household's income. Progressive refers to taxes which increase as a person's income increases, for example income tax. Regressive taxes are applied uniformly, irrespective of income. The tax would then take a larger share of income from lower earners than from higher. For example, VAT is applied uniformly.

2 Introduction

Scotland has a legally binding target to reach “net zero” by 2045, as well as annual climate targets. “Net zero” means reducing carbon emissions to almost zero, with any remaining emissions absorbed by nature (such as via forests) or by technologies (such as carbon capture and storage). Rapid transformation across Scotland’s economy and society is required to meet this goal and the Climate Change Plan sets out a pathway and policies to deliver the targets. The Scottish Government has also committed to a just transition, which endeavours to make rapid decarbonisation beneficial and positive for society. There is currently a gap in our evidence base on the potential role for fiscal levers to deliver reductions in greenhouse gas emissions. For the purposes of this study, we define fiscal levers as taxes, levies, duties, or charges. The use of subsidies, grants and loans are not in scope of this work.

We summarise the results of a targeted evidence review on the international use of fiscal levers seeking to reduce GHG emissions, which have either been considered or adopted by national or sub-national governments. We examine the evidence for how well certain fiscal levers have worked internationally, both in terms of reducing emissions of GHGs and in raising government revenue. We analyse six case studies in detail. After reviewing existing fiscal levers in Scotland, we also assess the potential implications for Scotland.

This report should not be interpreted to mean the Scottish Government intends to adopt the examples analysed in this report, nor any fiscal lever. The purpose is to provide an evidence base for the Scottish Government in their consideration of policy action as part of a strategic approach to climate change mitigation.

2.1 Overview of methodology

We conducted a targeted literature review of the global use of fiscal levers currently in place – or being considered – that seek to reduce GHG emissions, either directly or indirectly. We then selected six case study examples that were judged to be relevant to Scotland for further exploration. We conducted semi-structured interviews with academics and technical specialists and with experts in the case study jurisdictions to obtain greater insights. We also conducted a high-level review of existing environmental fiscal levers in the UK (including energy, transport and pollution or resources taxes), focusing the analysis on those that deliver reductions in GHG emissions. This was to help understand whether the six case study examples could be implemented by the Scottish Government under current devolved competencies, or whether their adoption would require joint action with the UK Government. More detail on the methodology we used is in Appendix A.

This approach has limitations. The project was undertaken over a short period, between July and October 2023. As such, the report presents selected results of a targeted search of a large secondary literature supplemented by the interviews referred to above, and it has not been possible to examine all issues in detail. No economic modelling has been undertaken on the potential scope or effects of the levers identified.

3 The use of fiscal levers for GHG emission reductions

Given the size of the literature and the complexity of the issues involved, we have simplified the review into a smaller number of lever typologies and identified lessons learned via successes and challenges encountered. The information in this chapter is drawn from secondary literature and a small number of targeted interviews with subject matter experts.

We have defined fiscal levers as a tax, duty, levy or charge. Typically enacted by a national or sub-national government, they seek to induce changes in behaviour of companies and consumers via changes in the prices of goods and services. This is sometimes referred to as ‘carbon pricing’, which means levers which apply a price to GHG emissions with the intention of reducing them. Carbon pricing can provide an effective and cost-efficient approach to reducing GHG emissions in multiple economic sectors. They do so by incentivising changes in behaviour, via changes in prices, on both the supply side (i.e., amongst the suppliers of goods and services to invest in new abatement technologies or more efficient processes or products) as well as the demand side (i.e., among consumers in their purchasing choices). They also have the potential to raise government revenue.

Economists often refer to GHGs (and other forms of pollution) as negative externalities. This is a type of market failure where the social costs (in this case the damages caused by climate change to current and future generations) are greater than the private costs from specific transactions (i.e., one only pays for the fuel, not the harm from emissions when filling a tank of petrol). A carbon price is a way of correcting the market failure by ensuring those wider costs are captured or ‘internalised’ in transactions (Coyle, 2020).

The scope of this study does not extend to any assessment of the use of grants and subsidies, including so called “environmentally harmful subsidies” (World Bank, 2023a). These have been considered in Scotland in separate work (Blackburn, 2022).

3.1 Typologies of fiscal levers

We developed a list of typologies of fiscal levers to enable their effectiveness to be assessed. We have taken a simple approach to aid clarity, and therefore define five broad types of fiscal lever for this study. These are broadly in line with the categories used by the World Bank (2023b). The types of lever are:

3.1.1 Direct taxation schemes

These are taxes which provide a direct price signal and have the explicit aim to reduce GHG emissions, often referred to in the literature as ‘carbon taxes’. They are levied on emissions, for example £ per tonne of CO₂ equivalent (tCO₂e), or on £ on emissions per litre of fuel. Costs incurred increase in direct proportion to emissions, but costs may be reduced or avoided by changes to production processes or purchasing decisions, where feasible. In practice all such direct taxes are applied only to certain sectors or economic activities, with various exemptions. Given that the focus of the work are levers to reduce GHG emissions, we have focused our research on direct taxes, where the link to GHG reduction is clearest.

3.1.2 Indirect taxation schemes

These are taxes which provide an indirect price signal and may have multiple aims, which include addressing GHGs as well as other forms of pollution, such as air or water pollution. The tax may be applied on a range of activities but are not directly proportionate to embodied GHGs. As such there is a much wider range of such taxes in operation. We summarise such schemes at a high-level.

3.1.3 Carbon credit schemes

These are systems where tradable carbon credits (again typically representing 1tCO₂e) can be generated via voluntary emission reduction activities. Such activities are varied and can include emission avoidance as well as removal, for example tree planting, or carbon capture and storage activities. These credits can be sold (either by businesses achieving the credits or the organisation that administers the scheme). Demand for such credits (and hence value) are generated via the requirements of other carbon pricing or climate change mitigation policies. These are discussed further below, but our research indicates they offer limited potential for revenue raising by a host government, so are not prioritised in this study.

3.1.4 Emission Trading Scheme (ETS)

A Government places a limit on the mass of GHG emissions from the affected entity (usually businesses within a defined economic sector, or undertaking specific economic activities, e.g. agriculture, or aviation) defined in the legislation. Emissions units or allowances, typically representing one tonne of CO₂ equivalent (1tCO₂e), are typically auctioned to businesses. These can be traded to enable them to emit GHGs, within a given period. The price from the auction and/or a traded second market represents the price of carbon. There are two main types of ETS:

- **Cap and trade ETS:** Governments set a cap on total GHG emissions from one or more economic sectors (or specific entities). They then sell allowances, typically in auctions, or distribute them for free (or a combination of both) up to the level of the cap. The cap (or the number of free allowances) may be progressively reduced. The European Union (EU) and UK ETSs are examples.
- **Rate based ETS:** Here the total emissions are not fixed, but entities are allocated a performance benchmark (typically based on the emission intensity of their output). This then serves as a limit on net emissions. Emission allowances can be earned where entities' emissions are lower than the benchmark and these can then be traded with those who exceed it. The China national ETS system is an example.

The UK ETS replaced the UK's participation in the EU ETS on 1 January 2021. The UK ETS applies in England, Scotland, Wales and Northern Ireland, whose governments comprise the UK ETS Authority. In Scotland, the Scottish Environment Protection Agency (SEPA) administer the scheme (UK Gov, 2023a). The UK ETS was originally based on the EU ETS but has since diverged in structure and operation. Given that Scotland currently has an ETS system, further research on such schemes have not been prioritised in the current research.

However, in some jurisdictions, national governments have applied domestic ETS to additional sectors not covered by, for the example, the EU scheme. We refer to these as 'national ETS'. These are included in the research as they could potentially be applied in Scotland.

3.1.5 Carbon border adjustment mechanism (CBAM)

These are policy mechanisms which impose a carbon price at the border on embodied emissions in specific goods imported from elsewhere. These seek to ensure a level playing field between the carbon price imposed via domestic legislation (such as via an ETS) and goods produced outside that jurisdiction as well as mitigate the risk of carbon leakage (i.e., displacement of carbon intensive activities outside of regulated jurisdiction) which may lead to a lower level of emission reduction overall.

The EU CBAM entered a transitional phase in October 2023. This is aligned with the phase-out of the allocation of free allowances under the EU ETS. The first reporting period ends on the 31st January 2024 (European Commission, 2023).

The UK Government is considering a range of further potential policy measures to mitigate the risk of carbon leakage in future. One such policy being considered is a UK CBAM. A consultation on these options was conducted jointly by HM Treasury and the Department of Energy Security and Net Zero between the 30th March and 22nd June 2023. The UK Government is currently considering these responses (UK Gov, 2023b). As such, this review does not focus on CBAM measures in other jurisdictions.

3.2 Direct taxation schemes

We used data from the World Bank carbon pricing dashboard (World Bank 2023c) to provide an overview of the characteristics of direct carbon pricing instruments as of March 2023. This dashboard identifies a total of 73 such instruments implemented in 39 national jurisdictions across the world. Together, these cover 11.6 gigatonnes CO₂e (GtCO₂e) of emissions (23% of global GHG emissions). Of these, 37 instruments are direct carbon tax instruments, the remainder are ETS instruments. These carbon taxes have been implemented in 27 national jurisdictions and they cover 2.7 GtCO₂e about 5.6% of global GHG emissions. Several trends are evident from these data.

The vast majority of direct carbon tax instruments in operation are in high-income countries, particularly Europe. In terms of timescales for adoption the earliest adopters of national carbon tax instruments in the 1990s are in Northern Europe (Finland, Sweden, Norway, Denmark) but also Poland. The 2000s saw modest further adoption, with only Estonia, Latvia, Switzerland, Ireland and Iceland adopting national carbon tax instruments by 2010. Thereafter, several further European and Non-European countries adopted instruments (the UK Carbon Price Support and carbon taxes in France, Portugal, Spain, Ukraine, Japan and Mexico). These were followed relatively quickly by carbon taxes in Argentina, Chile, Colombia, then Canada, Singapore and South Africa.

In several jurisdictions, **carbon taxes have been applied alongside national (or supranational) ETS instruments**. These include several in EU Member States (including the UK at the time), as well as Mexico and Canada.

There are only two jurisdictions where sub-national carbon taxes are in operation. There are a total of five in Canada: British Columbia (BC) which was the first subnational carbon tax anywhere in the world; Northwest Territories; Newfoundland and Labrador; New Brunswick and Prince Edward Island. Mexico has several such instruments, the Zacatecas carbon tax, and instruments in Queretaro and Yucatan, for example. In both cases, these are applied alongside a national carbon pricing mechanism; the Canadian federal fuel charge and the Mexican carbon tax, respectively. As would be the case in Scotland, they are also applied alongside an ETS instrument (the Canadian Federal Output based Pricing System (OBPS) and the Mexican pilot ETS, respectively).

Recently, several further jurisdictions are considering instruments. These include the New Zealand agricultural carbon tax, and taxes in Indonesia and three African states: Botswana, Senegal and Morocco. Manitoba in Canada, Mexico (Jalisco), Catalonia and Hawaii are considering new subnational instruments.

Figure 3.1 provides a visual overview of carbon taxes that are either implemented (in operation), scheduled for implementation (adopted in legislation with an official start date) or under consideration (the relevant government has announced its intention to work toward an initiative). Those that are implemented or scheduled are in blue; those under consideration – four subnational taxes and five national – are in yellow.

Figure 3.1: Carbon tax instruments as of March 2023 (World Bank 2023c)

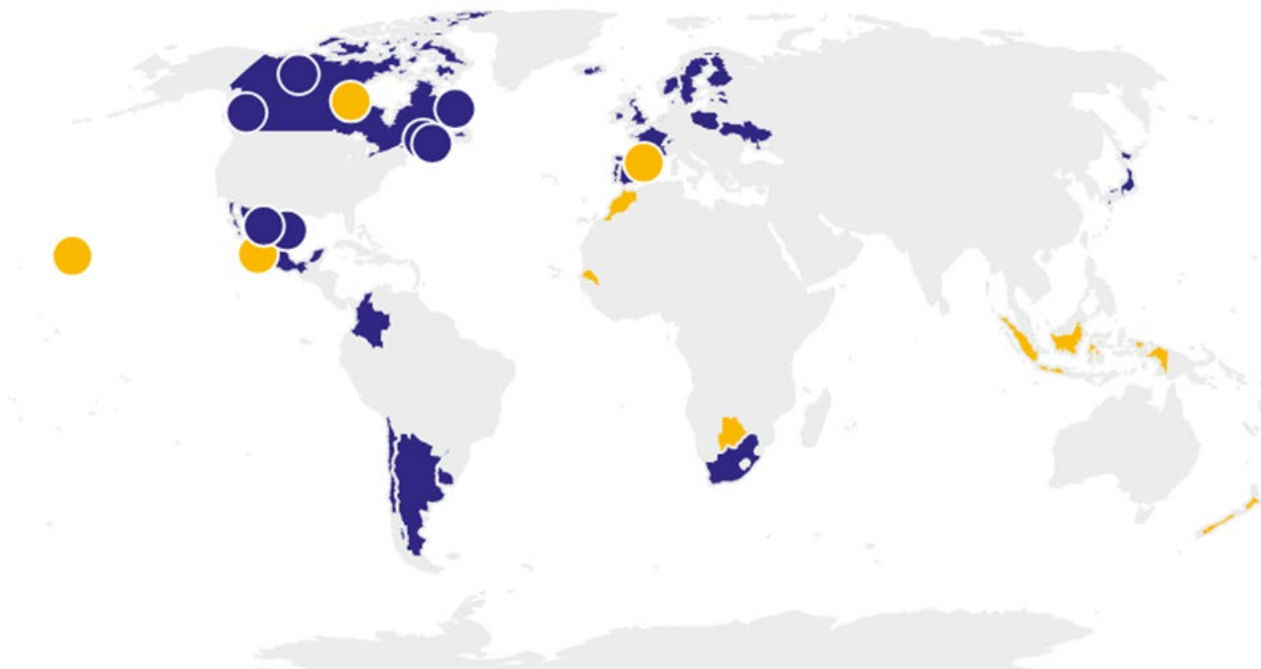


Figure 8.1 (Appendix C) provides time series data on the share of global GHGs covered in the various carbon tax instruments between 1990 and 2023. This provides an indication of the overall significance of their use globally. Note, due to data limitations the share of emissions

shown in the figure from 2015 onwards is based on 2015 global emissions data. Several trends are evident, based on these data:

- As of March 2023, **carbon tax instruments covered 5.4% of global GHG emissions**. This was slightly down from a peak in 2019 of 5.7%. This is likely to reflect reductions in GHG emissions associated with mandatory lockdowns during the Covid-19 pandemic, alongside some emission reductions in at least some jurisdictions.
- **Increases in coverage are evident in the last 15 years**, arising from the introduction of new instruments in 2011 (Ukraine), 2012 (Japan), 2014 (France and Mexico), and 2019 (South Africa).
- Over the same period however, **total global GHG emissions increased by around 50%**, from about 31 million kilotonnes of CO₂e (ktCO₂e) in 1990 to over 46 million in 2020 (latest data). Whilst there are some uncertainties in the data, the overall rate of increase in global GHG does appear to have slowed after 2013 (World Bank 2023d).¹

In terms of overall ambition for the carbon tax instrument, Figure 8.2 (Appendix C) presents data from March 2023 which compares the carbon price (in US Dollars per tCO₂e) with the share of GHG emissions that are covered by the relevant tax. The figure also shows ETs for comparison. These data highlight that existing instruments vary in both price and coverage. Overall, we can identify three broad groupings based on the overall level of ambition of existing instruments:

- **High ambition:** those with relatively high carbon prices and relatively broad coverage as a proportion of total GHG emissions in that jurisdiction. The carbon taxes in Liechtenstein, Sweden, Switzerland, Norway and Finland are such examples.
- **Mixed ambition:** this is a larger group with some trade-offs apparent between share or price. For example, Uruguay's carbon tax, levied on gasoline, provides the highest carbon price but only covers a small share (less than 20% of relevant GHGs). Conversely, Singapore and Japan have wider coverage but a lower price. Others have middling coverage and price, for example France, Canada's federal fuel charge, Iceland, Denmark and Portugal.
- **Low ambition:** a smaller group with relatively low prices and coverage. For example, Poland, Estonia, Argentina, Chile and Colombia.

3.3 Indirect taxation schemes

The World Bank (2023) defines indirect carbon pricing as other policies which might change the price of products associated with GHG emissions, but they do so in ways not directly proportional to the emissions associated with those products. So these levers do not tax carbon or tax at a rate proportionate to carbon content. Rather, they tax carbon intensive

¹Official data indicate that between 2013 and 2020, the increase was less than 1%, but 2020 emissions were affected by the restrictions associated with the COVID-19 pandemic. A more accurate comparison of underlying trends may be between 2013 and 2018, where global GHG emission increased by just under 5%.

activities or services (or focus on other forms of pollution, such as air pollution, which also has the benefit of producing GHG reductions alongside), hence indirectly create a carbon price signal and encouraging the reduction of GHG emissions. Indirect taxation schemes are therefore very broad. As such, the World Bank (2023c) note that indirect carbon pricing policies are far more common and wide-ranging than direct pricing. This diversity and the weaker causal link with reductions in GHG emissions present a challenge for assessing their effectiveness in this study. As a result, we have given them a lower priority than direct taxation schemes for the purposes of the evidence review.

Examples of indirect taxes exist across many different sectors. They include landfill taxes, such as those in place in Bulgaria (EEA 2022a) and Austria (IEEP, 2016a) or ‘pay as you throw’, schemes for example in Lithuania (EEA 2022b). Pay as you throw schemes are designed to incentivise citizens to separate their waste at source and charge a fee for the collection of residual waste from households.

France has a ‘General Tax on polluting activities’ which applies to companies which are engaged in the storage, thermal treatment or transfer of non-hazardous and hazardous waste (French Ministry of Finance 2023). Latvia employs a National Resources Tax (Latvian Ministry of Finance, 2020), which applies to the extraction of natural resources, environmental pollution, disposal and use of hazardous goods as well as the packaging used in business activities.

In the field of air quality, levers include the Bonus Malus Scheme in France (see Section 8.9 for further detail), air pollution load charge in Hungary, which applies to emissions of nitrogen oxides, sulphur dioxides and non-toxic dust (IEEP 2016b) and a tax on emissions of SO₂ and NO₂ in Galicia, Spain (Xunta de Galicia, nd). Other levers include an incentive fee on volatile organic compounds as is in place in Switzerland, and a Pesticide Tax (Sweden and Denmark).

Finland also employs a tax on peat use for energy. However, this represents a unique situation as peat is in fact subsidised in comparison to the tax rates of other fuels, and peat makes up a significant part of Finland’s energy mix.

3.4 Carbon credit schemes

We have used data from the World Bank carbon pricing dashboard (World Bank 2023c) to provide an overview of carbon credit schemes, their use, prominence in global trading, and role in international climate agreements.

Carbon credits are units that represent emission reduction activities that include either avoiding the carbon being produced (e.g., capturing methane from landfills), or removing carbon from atmosphere (e.g., sequestering carbon through planting trees or directly capturing carbon from the air and storing it). One credit is typically equivalent to one metric tonne of a carbon dioxide equivalent (tCO₂e) reduced or removed.

Carbon credit schemes create opportunities for investors and corporations to trade carbon credits. The carbon credit market has grown significantly since the concept was establish

alongside the 1997 Kyoto Protocol. It experienced a further surge in interest following the Paris Agreement of 2015, more than doubling in size over five years (Dyck, 2022), though the sector grew less between 2021 and 2022, reflecting challenging economic conditions and criticism of the integrity of some schemes (World Bank 2023c). Carbon credits are supplied via regional, sub-national and national governments (such as the California Compliance Offset Program), at international scale through international treaties (such as the Kyoto Protocol and the Paris Agreement), and independently, via non-governmental entities (such as Gold Standard). The largest share of carbon credits is issued via independent non-governmental mechanisms, which had driven much of the overall growth seen between 2018 and 2021. Figure 8.3 in Appendix C provides more detail.

The biggest driver for demand on carbon credits is companies purchasing credits, usually from independent suppliers, to compensate for emissions-heavy activities, either voluntarily or in response to regulation. However, carbon credits can be controversial because it is not always clear that carbon has in fact been saved or stored, and there are concerns with the ways in which schemes are set up, managed and promoted. The carbon credit market is currently evolving to respond to these concerns (Donaho, 2023).

3.5 Effectiveness of fiscal levers

We interpret effectiveness as the extent to which the policy has achieved its desired objectives and reached the affected group(s) (Scot Gov, 2018), compared to the starting (or baseline) position (i.e. has the instrument led to decreases in GHG emissions in the sector or activities targeted). We have also considered the extent to which impacts can be attributed to the policy in question, compared to other factors. We focus on the available secondary evidence and on direct tax examples. We have sought evidence on policy objectives of interest to the Scottish Government; namely the extent to which the instruments have resulted in GHG emission reductions, preferably where these have been quantified and attributed to the tax, and the extent to which they have generated revenues for the host government. Where possible, we consider whether the policy has brought about behaviour change in response to the tax. We have also considered data on the revenues that the tax has created, as well as how that revenue has been used by the host government. Other unintended impacts are noted, where evidence allows.

Before we consider data from specific instruments, a key broader conclusion is that several sources do not consider that existing carbon tax instruments are sufficient to address climate change goals. The Intergovernmental Panel on Climate Change (IPCC) estimated that to meet global GHG reduction requirements the average G20 economy needs to reduce its GHG emissions by over 10% every year (Green, 2021). The sources above suggest that the price and scope of *existing* instruments are not sufficient to deliver this kind of reduction.

3.5.1 Evidence on effectiveness – GHG emissions and behaviour change

In analysing the literature, we looked for secondary evidence on the overall effectiveness of different fiscal levers. Our assessment was limited by two key factors. First, it is not always possible to attribute GHG reductions to one policy instrument, compared to the various

other factors influencing GHG emissions and all such estimates are subject to uncertainty. Possible other factors include rates of overall economic growth, growth within sectors, economic structure (i.e., size of emission intensive sectors and trends within these), imports and exports, as well as economic shocks such as recessions, the Covid-19 pandemic, and the Russian invasion of Ukraine. Similarly, there are several policies that may affect GHG emissions, so it can be difficult to ascribe GHG reduction to one climate-related policy over another. Second, there is a time lag between policy implementation and observed changes which, in this case, limits the available evidence.

Overall, the balance of evidence suggests that the fiscal levers reviewed have reduced GHG emissions in the relevant jurisdictions, but the precise reduction is unclear. A 2021 review (Green, 2021) collated available quantitative *ex post* evidence on GHG emissions reductions attributed to either ETs or carbon taxes.² Key findings are below (note further detail is provided in Table 8.1 in Appendix C, which contains discussion on the findings of several specific studies, including quantitative GHG emission reduction estimates).

- Although carbon pricing has dominated many political discussions of climate change, only 37 studies assess the actual effects of the policy on emission reductions. Of these, the vast majority are focused on European examples. In turn, most of these examples focus on ETs, rather than carbon taxes, *per se*. Similarly, there are few studies which compare either carbon taxes or ETs to other climate change mitigation policies to establish the relative effectiveness and efficiency of policy measure or packages.
- Most studies suggest that the aggregate reductions from carbon pricing (note this refers to both ETs and carbon taxes) on emissions are generally limited. The overall reductions observed were on average up to 2% per year (again this refers to both ETs and carbon taxes). However, there is considerable variation in the GHG reductions seen between sectors.
- In general, the review concluded that the existing evidence suggested carbon taxes may have performed better than ETs in producing emission reductions. Note this conclusion should be interpreted with caution; it may reflect the prevailing carbon price, rather than the mechanism itself and much of the evidence on emission reductions from ETs discussed in the review focussed on the EU ET. Some of the studies on which this conclusion is drawn are based on the pilot phase of the EU ET, which involved free allocations to several sectors, a higher emissions cap and a relatively low carbon price. Future evidence should be monitored to examine whether that conclusion remains valid.

² Note the evidence in this paper was drawn from peer reviewed academic research and grey literature published since 2000. The review focussed on emission reduction evidence, it did not consider the balance of costs and benefits, technological innovation or issues associated with equity, for example. It excluded national evaluation reports, reflecting the diversity in methodological approaches and a potential lack of independence in these sources. The latter critique is questionable, as third parties often conduct them. Our secondary review has also not identified such evaluations, which is an acknowledged limitation of the review.

- However, there is more evidence that other regulatory instruments beyond either ETSs or carbon pricing probably have a greater effect than either measure acting alone. A 2020 study concluded that “the real work of emission control is done through regulatory instruments” (Cullenward and Victor, cited in Green 2021). A 2018 review provides some evidence that nations which are part of the EU ETS and are without a carbon tax experienced emission reduction in those sectors not covered by the ETS at a slightly faster rate than those that applied a domestic carbon tax, alongside the EU ETS (Haites, 2018, cited in Green 2021). There are clearly several factors at play.
- Experience to date indicates that in comparison with ETSs, establishing and administering carbon taxes in the host government are comparatively straightforward and inexpensive.

We have identified limited evidence on the behavioural effects of the taxes. Two studies (Tvinneim and Mehling 2018, Rosenbloom et al 2020, cited in Green, 2021) consider this. They conclude that there is little evidence that the taxes directly result in wider decarbonisation. The studies suggest a more common response is to mitigate the flow of emissions, via fuel switching or efficiency improvements, rather than more significant changes in manufacturing process or technologies. This may be a product of the nature of the instrument, the activities on which the taxes are targeted or current relatively low prices. It may also reflect a lack of coordination of wider climate mitigation policy, which as we have seen above, is likely to be necessary to sustain wider emission reductions.

3.5.2 Evidence on effectiveness – Revenue generation and ‘hypothecation or earmarking’

We reviewed evidence on both the revenue generated by carbon taxes as well as how these revenues have been used. The available data reflects different time periods and there are some methodological inconsistencies. Two overall conclusions are apparent. First, that carbon taxes have generated substantial income for the host government. Second, that a key characteristic of carbon taxes in operation to date is that a substantial proportion of that revenue is often allocated (or ‘earmarked’ or ‘hypothecated’) for specific purposes. Occasionally this hypothecation is explicit in the legislation, hence legally binding, while in other cases this allocation is via a political commitment, hence potentially subject to change with associated changes in Government.

A 2016 review (Carl and Fedor, 2016) of 56 national or subnational instruments found revenues from carbon pricing (i.e., taxes and ETSs) amounted to \$28.3 billion in 2013. Of this, well over \$20 billion was raised from carbon taxes.³ Of this only a small proportion of this revenue overall (about 15% was allocated to ‘green spending’. The review concluded that it was much more common for carbon tax revenues to be reallocated in the form of tax cuts and rebates and this accounted for about 44% of revenues at the time. About 28% were not allocated for a specific purpose, referred to as ‘unconstrained’. The same review

³ Defined as levies applied downstream to the emission of carbon dioxide and other GHGs or upstream to the sale of carbon intensive fuels.

indicates indirect taxes are often not reallocated for specific purposes (Carl and Fedor, 2016). Analysis of specific carbon tax instruments were also included, with results shown in Table 8.2 in Appendix C. These data indicate that taxes accounted for revenues between \$30 million per year (Iceland) to \$1 billion or more (Denmark, British Columbia and Norway). Sweden's is by far the largest at \$3.5 billion and it also has the largest per capita cost and share of GDP. These data indicate – at the time – that the most ambitious schemes constitute well under 1% of GDP. Further quantitative data is set out in Table 8.2 in Appendix C.

More recent data show that by 2022 (World Bank 2023), revenues from carbon pricing had increased significantly to \$95 billion, of which carbon taxes generated 31% (just under \$30 billion).⁴ Although revenues from carbon taxes had increased, this had been driven by rising revenues from ETSs. The overall tax revenue is not just a by-product of prices, but of the share of GHG emission covered, exemptions, the carbon intensity of sectors, and carbon leakage. For example, South Africa's carbon tax covers nearly 10 times more emissions than Colombia's and at a higher rate but was delivering a similar amount of revenues (World Bank 2023).

For comparison, a more recent study based on 40 countries also examined the level and use of revenue (OECD, 2019). This source examines whether the revenue reallocations were legally binding (i.e., set out in the relevant legislative act) or based on a political commitment (i.e., via ministerial or policy statement). The review also provides further detail on precisely how the revenues have been used. These full data are produced in Table 8.3 in Appendix C.

Again, the data show that a consistent feature of carbon taxes is the extent to which the revenues are used for specific purposes; around two thirds of total revenues have some form of hypothecation or constraint. They have been particularly directed toward reducing the taxation burden in other spheres, such as associated with employment or in provision of direct financial relief or subsidy to specific groups. Moreover, the review found that introduction of carbon taxes has frequently been part of broader tax reforms and that it has been more common for carbon tax revenue to be allocated based on political, rather than legal commitments. The authors indicate that the tax reform potential of carbon taxes (i.e., reducing the tax liabilities from labour and capital) may form part of the motivation for adoption, alongside the climate mitigation potential in at least some jurisdictions (OECD, (2019).

3.6 Lessons learned

We reviewed evidence on where carbon taxes have been effective, as well as where setbacks have occurred and why. We highlight data gaps and conclude with

⁴ Note the two figures are not directly comparable, the 2016 review is based on a selection rather than an overall estimate of total revenues. Moreover, the two studies appear to use different definitions of "carbon taxes" and for example do not appear to treat e.g., fuel/excise taxes in the same way.

recommendations identified in the literature on how a hypothetical UK carbon tax might be applied.

3.6.1 Are carbon taxes regressive?

A small number of studies have explicitly reviewed the evidence on distributional effects from carbon taxes (i.e., to whom the costs are incurred, with a particular focus on different impacts based on income) and whether carbon pricing results in generally progressive or regressive effects. For example, Ohlendorf et al (2018) provide a meta-review, but the information identified has generally focussed on low and middle-income countries and shown different results. The review notes that literature reviews have shown mostly regressive impacts in developed countries, but that this is not necessarily the case in developing countries. More progressive outcomes were observed for reforms that remove fossil fuel subsidies as well as some transportation policy. Overall, the review is inconclusive and provides limited lessons for Scotland. The tax itself is likely to be regressive, where additional costs incurred via carbon taxes are passed through supply chains to end users or consumers. Without the revenue recycling/rebate measures described above this may disproportionately affect those on the lowest incomes (Ohlendorf et al 2018, LSE, 2019). The UK Government Net Zero Review examines household exposure to the costs associated with the net zero transition. The review concludes that forecasting household costs in detail is not possible, but costs may fall on households via a number of routes. These include via Government decisions on tax and expenditure, via businesses and reflected in prices, wages and consumer choices (HM Treasury, 2021).

3.6.2 What has worked in the application of carbon taxes?

Overall, we found several examples where carbon taxes have been applied, maintained, contributed to emission reduction and generated revenue for the host government, whilst maintaining popular support. However, in every case, the design of the tax has considered the unique context in each jurisdiction.

A significant element of revenue recycling is a characteristic of most instruments adopted to date. An OECD review notes it has been possible, “in most circumstances”, to strike a balance between using the revenue in ways that are socially useful and that contribute to public support for carbon pricing. Such revenue recycling should not be seen as a panacea for public support, however. Introducing carbon pricing instruments generally is seen as more challenging when general public confidence in government is low (note this is not defined and is clearly relative). Such lack of confidence further limits the options for revenue use, by reducing the space for more significant tax reforms and increasing the political appeal for lump sum transfers of revenue (OECD, 2019).

Others have seen the degree of hypothecation of revenues as a way of ensuring ‘lock in’ of the front-end prices and increasing the overall longevity and stability of the instrument. For instance, by ensuring the back-end uses of the proceeds are visible, it is harder to change prices or exempt certain sectors for reasons of political expediency (Carl and Fedor, 2016).

A further balance must be struck between rigid hypothecation of the revenues, which may constrain flexibility, and the benefits of clearly communicating what revenues are being generated and how they are to be used. This communication is considered to be key for creating public support and any policy should be developed in conjunction with stakeholders and be subject to a detailed cost-benefit analysis (OECD, 2019).

Sweden's carbon tax, for example, may be seen as an exception to this. Some analysis suggests that it has been subject to so many changes that the ultimate effect of the carbon tax is not clearly distinct from effects of other measures e.g., value added tax, excise duties, etc. (Carl and Fedor, 2016). However, what is clear from the Swedish example is that the tax was part of a wider reform which itself had a clear objective (Section 8.6). This may explain at least some of the public support, even with a relatively high carbon price.

The justification made at the time for the introduction of carbon taxes vary and are not confined to emission reduction objectives. For example, reducing taxation in other areas, such as on labour (British Columbia, Sweden) as well as using them for wider fiscal recovery after financial crisis (Ireland, Iceland). Other rationale includes the relative simplicity and stability relative to ETS instruments (Carl and Fedor, 2016).

In the past, carbon taxes have provided a degree of price predictability and of revenue certainty for the host government. For instance, the British Columbia government has been able to predict revenues at least a year ahead within a 5% margin for error (Carl and Fedor, 2016). This would seem to be a feature of the design of the tax (i.e., the sectors at which it is targeted and the overall share of GHG affected).

Gradual introduction of the tax was seen as a positive feature (for example British Columbia), avoiding a sudden increase in the cost base for affected sectors and mitigating unintended consequences. However, they are also seen as visible, tangible and “politically immediate” ways of demonstrating progress toward climate mitigation (Carl and Fedor, 2016, LSE, 2019).

3.6.3 What lessons have been observed in the application of carbon taxes?

It is equally important to draw lessons on where they have not worked or have encountered problems. Reflecting on implementation, we find that existing carbon taxes are generally not sufficient, either in price or scope, to meet existing climate policy goals.

Carbon taxes have also been politically difficult to implement. They have proved controversial in many jurisdictions, including several with similarities to Scotland. Green (2021) suggests this opposition comes from two sources. The first source is the emitting industries themselves. Second, some evidence is presented by Green (2022) that the public tend to prefer other policies to carbon pricing. Use of dividends (i.e., rebates) may mitigate this risk, but only as part of a wider climate change mitigation package of policy.

The review has identified several jurisdictions where significant setbacks have been observed. The clearest case is in Australia where an existing carbon tax policy was cancelled. The tax generated what were at the time the largest overall revenues and per capita costs in the world. This was despite having a carbon price (\$30 per tonne as of 2016) which was

comparable with other jurisdictions. The revenues were a product of the relative carbon intensity of the country's – largely coal fired – energy generation infrastructure. Repealing the tax became a key element of the opposition party's ultimately successful political campaign (Carl and Fedor, 2016).

Mexico is the first Latin American country which has introduced sub-national carbon taxes. Durango is the most recent State to enact one, in January 2023 and others are considering implementing them. Baja California (a Mexican State) introduced a carbon tax as of 2022 as a part of broader fiscal reforms. The tax was levied on emissions from gasoline and diesels. A legal challenge was subsequently brought in Baja California, by the Mexican Federal Government and a group of regulated entities. This argued that under the Mexican Constitution, only the federal government could implement a tax on fuels. The Mexican Supreme Court ruled in favour of the Federal Government (World Bank 2023c).

In France a planned acceleration of the carbon price increase was suspended in 2018. At that point the price was around \$50 per tonne. This was in response to a public backlash on the perceived unfairness of the tax, which was introduced at the same time as broader reforms which were perceived as benefiting the wealthy (IMF, 2019). The wider backlash was epitomised by the 'gilets jaunes' or 'yellow vests' protests about fuel prices.

There are other examples where the instruments have been adjusted, paused, amended or the price escalator has been delayed or otherwise changed. For example, British Columbia and particularly New Zealand, where a proposed 'fart tax' was cancelled and an agricultural tax has been delayed (see Section 3.7.4).

A specific challenge is that the UK – and by implication, Scotland – has one of the most complex tax systems in the world. Some experts have consistently criticised a lack of an overall coherent tax strategy for the UK, particularly considering the implications of demographic changes for future taxation targeted at the economically active working age population (Johnson, 2023).

3.6.4 What are the data gaps?

Our review and the interviews have generated limited specific detail on impacts within affected sectors, as well as details on the behavioural response of those sectors. This reflects methodological challenges as well as time lags between policy action and observed effects. It has also identified limited quantitative information on carbon leakage. The emission reduction estimates are likely to be somewhat overstated, given that this has not been quantified.

3.6.5 Recommendations for the UK in the literature

A 2019 policy brief from the Grantham Institute reviewed the global evidence and provided a series of explicit recommendations for the UK if it were to implement a carbon tax (LSE, 2019). The recommendations were:

- The tax rate should be high enough to be consistent with net zero policy objectives. This implied a starting rate somewhere around £40 per tonne (as of 2020) (note this

also depends on the scope of the tax, which is not specified in detail in the paper, but would need to be applied “in most sectors”). It should complement and be carefully designed alongside other climate change mitigation policies.

- Credibility requires clear rules, a design that is not susceptible to political pressure and visibility on how the trajectory of prices or scope may change over time (i.e., annually, based on factors like investment cycles or emission performance).
- The price should start low and rise over time. This doesn’t only allow affected industries time to respond but allows evidence on effectiveness and any unintended effects to be observed in practice.
- The use of the proceeds should be carefully and regularly explained alongside information on the economic, social and environmental costs and benefits (via a published, independent cost-benefit analysis, for example).

3.7 Case studies

To gain further depth on specific international examples of fiscal levers, we assessed six case studies in further detail. Their selection was based on six predetermined criteria (see Section 8.1.2 in Appendix A on the methodology for the overall study for more detail). An overview of the selected case studies, and the accompanying rationale for their selection against these criteria is in Table 3.1, below. Each criterion has been assigned a red [R], amber [A] or green [G] (RAG) rating. This is based on a judgement of the researchers on the overall similarities between the case study jurisdiction and the Scottish context. For comparison, the Scottish population was some 5.4 million (in 2022), whilst GDP per capita was \$42,362 (in 2021).⁵ Given Scotland’s devolved powers to create taxes with consent of UK Parliament, we include examples where instruments have been applied sub-nationally (for example Canada, Wallonia). There are cases which include rural and island communities or significant renewable energy generation potential (for example New Zealand). Scotland’s ambition is for Net Zero by 2045 and 75% reduction in emission by 2030, so we have selected jurisdictions with similarly ambitious targets (for example Sweden and Austria).

We discuss key features and potential lessons for Scotland in Sections 3.7.1 to 3.7.4 below the table. Full details of the case studies are in Appendix D.

⁵ £30,793 in 2021, converted to US dollars for consistency in jurisdictions, using the average exchange rate for 2021 of 1.3757. Source: <https://www.exchangerates.org.uk/GBP-USD-spot-exchange-rates-history-2021.html>

Table 3.1: Overview of the case studies (RAG status indicating similarities with Scotland denoted by [R] red; [A] amber or [G] green)

	British Columbia	Sweden	Austria	New Zealand	France	Wallonia
Overview of instrument	Direct carbon tax, applied to fuels based on their CO ₂ content	Direct carbon tax, applied to fuels based on a CO ₂ price per tonne	National ETS scheme which augments the EU ETS and applies to sectors excluded from it	Agricultural tax, applying a farm-level levy on GHG emissions	Bonus Malus scheme with fees on purchase of new emission intensive vehicles and rebates for electric vehicles	Indirect tax on environmental impacts from farming, focussed on water resources
Population and GDP per capita	5 million (2021) and \$59,962 [G]	10.5 million (2022) and \$65,157 (2021) [A]	9 million (2022) and \$59,991 (2021) [A]	5.1 million (2022) and \$47,982 (2021) [G]	68 million (2022) \$55,064 (2022) [A]	3.6 million (2022) and €31,568 (2021) [A]
Administrative and legal arrangements/competencies	Sub-national tax, with separate federal tax system [G]	National level tax, alongside EU ETS [A]	National ETS designed around EU ETS [G]	A proposed national-level tax [A]	National level indirect tax [A]	Indirect tax at sub-national level [G]
Shared challenges	Significant renewable energy use (largely hydropower), rural communities [G]	Rapidly growing renewable energy potential, Rural and Island communities [G]	Rapidly growing renewable energy potential, rural communities [A]	Significant renewable energy potential, Peatland [G]	Increasing renewable energy potential, rural communities [G]	Increasing renewable energy use [G]
Climate ambition	Net Zero by 2050 [A]	Net Zero by 2045 [G]	Net Zero by 2040 [G]	Net Zero by 2050 [A]	Net Zero by 2050 [A]	80-95% reduction in emissions by 2050 [A]
Data and Evidence	Good level of evidence [G]	Good level of evidence [G]	No ex-post evidence, but detail on design/expected impacts [G]	Implementation lessons only [R]	Good level of evidence [G]	Good detail on lever design, limited evidence on effectiveness [A]
Diversity of Approaches	Sub-national direct carbon tax [G]	Longstanding and highest priced direct carbon tax [G]	National level ETS [G]	Novel concept [G]	Indirect tax, administered nationally [G]	Indirect tax, administered at sub-nationally [G]

3.7.1 Impact on GHG emissions

The available evidence linking each fiscal lever with GHG emission reduction varies significantly. The case studies include two direct taxes – both of which are applied to various fuels based on their CO₂ content – in Sweden and British Columbia (BC), Canada. These levers have been in place for a relatively long period, so have generally good *ex-post* evidence available. Bernard and Kichian (2019) have calculated that the British Columbia carbon tax, once reaching the rate of \$30/ton of CO₂, achieved an estimated 1.13-million-ton reduction in CO₂ emissions. This equates to an average annual reduction of 1.3% relative to British Columbia's 2008 diesel emissions and 0.2% relative to all BC CO₂ emissions in 2008. However, they do not think it is a viable strategy for achieving net zero goals in isolation. With regards to the Swedish carbon tax, a review of *ex-post* analyses of carbon taxes by Green (2021) reveals different results around Sweden's emission reductions. For example, research by Andersson (2019) found an average emission reduction of 6.3% per year between 1990 and 2005, Fernando (2019) found an annual average reduction of 17.2% and research by Shmelev and Speck (2018) found no effect on emissions. A study conducted by Jonsson, Ydstedt, & Asen (2022) state that GHG emissions have declined by 27% between 1990 and 2018. This highlights various methodological differences in conducting these *ex-post* analyses, and the difficulty in establishing the baseline of what emissions reductions would have occurred even in the absence of the lever.

The Austrian national ETS (nETS) – which extends the EU ETS, of which Austria is a part, to other sectors – is still in a phased implementation stage and will establish a set price which increases each year, reaching a market phase in 2026. *Ex-ante* modelling conducted by the Austrian government expects the scheme to reduce GHG emissions 800,000 tonnes by 2025. The proposed tax on agricultural emissions in New Zealand has not yet been finalised.

The evidence suggests the French Bonus Malus scheme – which incentivises uptake of low emission vehicles with a combination of fees and rebates – has been effective in shifting vehicle sales toward more environmentally friendly vehicles. Even though progress has slowed in recent years, average emissions have reduced significantly from 149 gCO₂/km in 2010 to 111 gCO₂/km in 2017. The relationship between the agricultural tax in Wallonia – which is applied at a farm level on the effects on water resources from livestock and land cultivation – and GHG emissions is much less clear.

3.7.2 Revenue generation and use

Data availability on revenue generated by these schemes varies. In all cases, a key element has been that revenues are either directly recycled back to citizens or are offset in other parts of the budget. This has occurred via direct payments/rebates to households or implementing other tax cuts alongside the lever.

The British Columbia carbon tax was designed to be revenue neutral and so was implemented alongside a wider scheme of tax cuts, and is now part of the Canadian Federal approach, which gives direct payments back to households. In 2019, SEK 22.2 billion was generated via the Swedish carbon tax, which is approximately 1% of Sweden's total tax revenue. The carbon tax revenue goes into the overall government budget, and is not

hypothecated, thus it is unclear where the revenue generated is distributed (Jonsson, Ydstedt, & Asen, 2022). The Austrian nETS was implemented as part of a wider policy package. Although revenue for the emissions allowances goes directly into the main budget and there is no hypothecation, 'climate bonus' payments are given directly back to households. Revenue in 2022 was approximately €800 million and the government have reallocated around €1 billion.

Since 2014, the Bonus Malus scheme has generated surplus revenue for the French general budget. For 2018, the malus was set at a level that covered the costs of the bonus payments (EUR 261 million) and the additional bonus for scrapped vehicles (EUR 127 million). The agricultural tax in Wallonia generates an annual revenue of around €1.2 million, however, it is unclear how this is subsequently used.

3.7.3 Behaviour change

There is some evidence on how the case study examples influence behaviour change. The carbon tax in British Columbia has been shown to have had a role in decreasing consumer demand for fossil fuels and natural gas (Pretis, 2022). Additional studies from Xiang and Lawley (2018) and Antweiler and Gulati (2016) also draw correlations between the implementation of the tax and a decrease in fuel demand.

The carbon tax in Sweden has shown to be effective in shifting market investment into low-carbon technology, specifically in renewable energy sources such as hydro and wind (Hildingsson and Knaggård, 2022). Levying the carbon tax at different rates on fuels has also resulted in behaviour changes in companies. Between 1993 and 1997, the higher tax rate on fuels used within domestic heating systems compared to fuels used within industry resulted in industries selling their by-products to domestic heating companies, while continuing to burn fossil fuels themselves (Johansson, 2000).

One interviewee suggested that the Austrian nETS, whilst in its fixed price stage, is not expected to generate a strong enough price signal to result in a clear and significant change in behaviour. However, other parts of the policy package have been designed to specifically change behaviour (such as subsidies for changing heating systems in households). The Bonus Malus scheme has had a clear impact on shifting vehicle sales in France towards less CO₂ intensive vehicles. However, the scheme may have a rebound effect, as the lower fuel expenditure for consumers due to more efficient vehicles may lead to an increase in vehicle use and thus in fuel consumed (and thus on emissions). There is no evidence regarding the behavioural effects of the agricultural tax in Wallonia.

3.7.4 Unexpected challenges

In British Columbia, the tax was initially designed without exemptions and applied universally. However, after competitiveness concerns were raised, the government introduced a one-time exemption worth \$7.6 million in 2012, followed by an ongoing exemption in 2013 to greenhouse growers and an exemption for gasoline and diesel used in agriculture in 2014.

When implementing their nETS, the Austrian government experienced challenges designing the scheme around the existing EU ETS. To ensure that emissions were not double counted, exemptions from the national ETS were given to installations already regulated under the EU ETS. This proved a challenging exercise for the Austrian government.

Challenges have been observed for the proposed agricultural tax in New Zealand. Whilst these are political in nature, they have presented challenges for the implementing government. The original proposal for a split-gas, farm-level levy was revoked after a consultation highlighted public concerns about the impact on the cost and potential implications on availability of produce. A series of media outlets reported tensions between the agricultural sector in New Zealand and the government. Farmers expressed concerns regarding both the profitability and competitiveness of their business, with some expecting to have to reduce their herd size (Pannett, 2023). After revoking the original planned tax, the NZ government are now implementing mandatory monitoring and reporting of emissions from agriculture, to eventually transition into pricing of emissions.

4 Overview of fiscal levers in the UK

We investigated existing UK environmental fiscal levers, including taxes in the energy intensive industries, the power generation, transport, and pollution and resource sectors in Appendix B. We focused analysis on those that deliver reductions in GHG emissions. These include:

1. Fiscal levers specifically targeted to reduce GHG emissions.
2. Fiscal levers specifically targeted to address environmental impacts and affecting GHG emissions.

These were classified using the typologies developed in Section 3.1. Fiscal levers that do not contribute to reducing GHG emissions have not been considered. A complete list of environmental taxes in the UK (at time of writing) is in Section 8.1.4.

Existing fiscal levers which target or address GHG emissions focus on energy and energy intensive industries, transportation (road and air transport) and resource use. Examples include Fuel Duty, the Climate Change Levy (CCL), the Renewables Obligation (RO), the UK ETS, the UK Air Passenger Duty (APD), and the Vehicle Excise Duty (VED).

Under the current devolution settlement, most tax powers remain reserved to the UK Government and Parliament. However, any existing national tax can potentially be devolved to the Scottish Parliament. New national taxes can be created through a mechanism allowing the UK Parliament, with the consent of the Scottish Parliament, to grant powers for new national devolved taxes to be created in Scotland (Scottish Parliament, 2021).

5 Overview of fiscal levers in Scotland and implications of the case studies

Devolution is the statutory delegation of powers from the central government of a sovereign state to govern at a subnational level. It is a form of administrative decentralisation. Devolved territories have the power to make legislation relevant to the area, thus granting them higher levels of autonomy. In the UK, devolution is the term used to describe the process of transferring power from the centre (Westminster) to the nations and regions of the United Kingdom (Torrance, 2022). Devolution provides Scotland, Wales and Northern Ireland with forms of self-government within the UK. In the case of Scotland, this includes the transfer of legislative powers to the Scottish Parliament and the granting of powers to the Scottish Government. While the UK Parliament still legislates for Scotland, it does not do so for devolved matters without the consent of the Scottish Parliament.

The devolution process has led to calls for the Scottish Parliament to be given more responsibility over revenue raised and spent in Scotland. There are existing devolved environmental taxes under the Scottish Government's remit that contribute to reducing GHG emissions. We have also considered implications of the case studies from a legal and regulatory perspective. No assessment is made of the potential costs and benefits of adoption nor of the practical challenges associated with them.

5.1 Legal and regulatory fiscal system in Scotland

The legislative framework for devolution to Scotland was originally set out in the **Scotland Act 1998**. The Scotland Act 1998 established the Scottish Parliament and set out the matters on which the Scottish Parliament cannot legislate and make laws, known as general and specific reservations. Everything not listed as a reserved matter is assumed to be devolved. Reserved taxation matters include VAT rates, Fuel Duty, and Corporation Tax. The Scottish Parliament currently has devolved responsibilities in relation to five taxes (Scottish Government (2021), as follows:

- Scottish Income Tax, which is partially devolved. It is collected and administered by HMRC on behalf of the Scottish Government.
- Land and Buildings Transaction Tax, a tax paid in relation to land and property transactions in Scotland, and Scottish Landfill Tax, a tax on the disposal of waste to landfill, are fully devolved national taxes and are managed and collected by Revenue Scotland.
- The Scottish Parliament also has powers over local taxes for local expenditure. Currently, the two main local taxes are Council Tax and Non-Domestic Rates (also known as business rates), which are collected by local authorities. Note that a review of local taxes is not covered in this study.

In addition, powers in relation to two further taxes have been devolved to the Scottish Parliament, but these have not yet been implemented and the relevant reserved taxes therefore continue to apply. These taxes are Air Departure Tax, a tax on all eligible

passengers flying from Scottish airports, which will replace Air Passenger Duty when introduced, and a devolved tax on the commercial exploitation of crushed rock, gravel, or sand, which will replace the Aggregates Levy when introduced.

The Scottish Parliament has the power to create new local taxes (i.e. local taxes to fund local authority expenditure). There is also a mechanism allowing the UK Parliament, with the consent of the Scottish Parliament, to devolve powers for new national devolved taxes to be created in Scotland. This is unlikely to be a swift process and would likely depend on the complexity of the new national tax and negotiation over devolution of the requisite powers.

The UK Internal Market Act 2020 (IMA) seeks to prevent internal trade barriers among the four countries of the United Kingdom. Schedule 1, paragraph 11 of the IMA specifically exempts taxes (Legislation.gov.uk, 2020a). However, new regulatory acts considered to create additional administrative burdens which may affect intra UK trade may be challenged under the IMA.

5.2 Devolved fiscal levers to deliver reductions in GHG emissions in Scotland

The **Commission on Scottish Devolution** (also referred to as the Calman Commission), established in 2007, identified some taxes (including the Landfill Tax and the Air Passenger Duty) where devolved powers could be applied. Following this, the **Scotland Act 2012** devolved powers for a Landfill Tax to the Scottish Parliament to cover landfills and transactions taking place in Scotland, which led to the **Landfill Tax (Scotland) Act 2014**. At the time of writing, this is the only fully devolved fiscal lever delivering reductions in GHG emissions that currently applies in Scotland.⁶ Although the **Scotland Act 2016** included the power to introduce a devolved tax on the carriage of passengers by air from airports in Scotland (i.e. to replace the present, UK-wide Air Passenger Duty). The **Air Departure Tax (Scotland) Act 2017** was passed by the Scottish Parliament 2017, however the introduction of the tax has been deferred due to state aid (and now subsidy control) issues. The Scotland Act 2016 Act also made provisions for the creation of a devolved tax on extraction of aggregates, which is currently being legislated for in the Scottish Parliament, although this does not specifically look to reduce greenhouse gas emissions.

5.2.1 Indirect Taxation Schemes

The **Scottish Landfill Tax (SLfT)** replaced the UK Landfill Tax in Scotland from 1 April 2015 under the Landfill Tax (Scotland) Act 2012. The SLfT is part of Scotland's Zero Waste Scheme and aims to encourage the prevention, reuse and recycling of waste in the country. It is administered by Revenue Scotland with support from the Scottish Environment Protection Agency (SEPA). SLfT is a tax on the disposal of waste to an authorised or non-authorised

6 i.e., it is managed, and revenues are collected by Revenue Scotland. In this context, partially devolved, is where instruments are managed and revenues collected by HMRC on behalf of the Scottish Government.

landfill in Scotland. The taxation of disposals to unauthorised sites (that is illegal dumping) is a key difference between SLfT and UK Landfill tax.

The Scottish Government is responsible for setting the rates of the tax as part of the annual Scottish Budget and determining which waste is subject to it. The tax is paid on the disposal or unauthorised disposal of waste to landfill and is calculated based on the weight and type of the waste material. A standard rate of £102.10 per tonne is applied, while a lower rate of £3.25 per tonne is paid on less polluting (referred to as 'inert')⁷ materials. Tax revenues have decreased from £149 million in 2015-2016 to £125 million in 2021-2022. The SLfT has been a major part of the success in driving change in Scotland's waste performance (Revenue Scotland, 2021).

Air Departure Tax (ADT). The Scotland Act 2016 included the power to introduce a devolved tax on the carriage of passengers by air from airports in Scotland. This allows Scotland to design a replacement for APD. The Air Departure Tax (Scotland) Act 2017 made provision for such a tax, which will be managed and collected by Revenue Scotland. However, the tax has not yet been introduced and UK APD continues to apply.

The Scottish ADT will tax flights departing from an airport in Scotland (this includes airports in the Highlands and Islands regions). As with the UK APD, the amount of tax payable depends on the destination of the passenger and the characteristics of the aircraft (take-off weight,⁸ flight distance seat pitch and seating capacity). Depending on the aircraft, the passenger will pay either the standard, premium or special rate.⁹ Certain flights and passengers are exempt from ADT. Exemptions apply to flights operated under a public service obligation, which may include many flights to/from small islands, although the Air Departure Tax (Scotland) Act 2017 making provision for such a tax does not mention any exemptions for passengers on flights leaving from airports in the Scottish Highlands and Islands. There are also exemptions for emergency medical service flights, military, training or research flights. Passenger exemptions apply to persons that are working during the flight, such as flight crew, cabin attendants, persons undertaking repair, maintenance, safety or security work, persons not carried for reward, such as Civil Aviation Authority flight operations inspectors, or children under the age of 16 (FCC Aviation, 2023).

ADT was originally expected to come into force on 1 April 2018. However, on April 2019 the Scottish Government deferred the introduction of ADT beyond April 2020 until issues have been resolved regarding the tax exemption for flights departing from airports in the Highlands and Islands regions. The devolution process is, thus, on hold. In the meantime, UK

⁷ Defined by the European Environment Agency as wastes that do not undergo any significant physical, chemical, or biological transformations when deposited in a landfill.

⁸ The maximum mass at which the aircraft is certified for take-off due to structural or other limits

⁹ The special rate applies to business jets with a take-off distance weight (MTOW) of more than 20 tons and a maximum seating capacity of less than 19 passengers. The Scottish standard rate applies if the aircraft does not qualify for the special rate and the seat pitch does not exceed 1,016 meters. Otherwise, passengers will be charged the premium rate.

APD (and the rates and bands that currently exist) and the current Highlands and Islands exemption continues to apply.

5.3 Implications of the case studies for Scotland

We assessed whether the six case study examples (Section 3.7) could hypothetically be implemented by the Scottish Government under current devolved competencies. We also provide a high-level explanation of practical issues (e.g., target of the lever and groups affected). No assessment is made of the costs and benefits of adoption.

Table 5.1: Potential of case studies in Scotland

Case study	Description	Exists in the UK?	Exists in Scotland?	Can be devolved to or created in Scotland?
Direct Carbon Tax: British Columbia, Canada	Tax applied to fuels based on their CO ₂ content, covering all liquid transportation fuels such as gasoline and diesel, as well as natural gas or coal used to power electric plants.	Yes. Similar to Climate Change Levy (CCL)	No	Yes. Hypothetically the CCL could be devolved to Scotland. A new Scottish CCL, with additions/adjustments to incorporate the carbon tax could then replace the UK CCL in Scotland. This would be subject to UK Parliament consent and Scottish Parliament agreement. A Scotland Act including the power to introduce a devolved CCL in Scotland and a new specific CCL (Scotland) Act applying the legislation to Scotland would be required.
Direct Carbon Tax: Sweden	Tax applied on fossil fuels used for motor fuels and heating purposes including gas oil, heavy fuel oil, coal, natural gas, petrol, gas oil, heavy fuel oil, coal and natural gas.	Yes. Similar to Climate Change Levy	No	
National ETS: Austria	The national ETS was designed to complement and exist alongside the EU ETS. It covers CO ₂ emissions from fossil fuels including transport fuels (petrol and diesel), fuel and heating oil, natural gas/liquified gas, coal and kerosene used in sectors which are	Yes. Similar to UK ETS	No	Yes. A new Scottish ETS (with adjustments in scope to incorporate additional sectors, for example) could hypothetically replace the UK ETS in Scotland. This would be subject to UK Parliament, Welsh Parliament, Northern Ireland Assembly consent and Scottish Parliament agreement. A new specific ETS (Scotland) Act applying

Case study	Description	Exists in the UK?	Exists in Scotland?	Can be devolved to or created in Scotland?
	not regulated under the EU ETS.			the legislation to Scotland would be required.
Proposed tax on agricultural emissions: New Zealand	A proposed farm-level levy that would require farms to calculate and pay for their emissions through a central calculator. It was set to use a split-gas approach by applying unique levy rates to short-and long-lived gases.	No	No	Yes. Hypothetically a new national tax on agricultural emissions could be introduced in Scotland by the Scottish Government with the consent of the UK Government. A new specific Tax on Agricultural Emissions (Scotland) Act would be required.
Tax on environmental impacts from farming: Wallonia, Belgium	The tax is intended to address the environmental costs associated with the impact of agricultural activities on water resources, in particular livestock manure and the use of fertilisers and phytosanitary on crops.	No	No	
Bonus Malus Scheme: France	This system combines fees and rebates for the purchase of new vehicles: vehicles purchased or leased whose emissions exceed certain limits pay a fee, while vehicles that do not exceed these limits are entitled to a bonus or rebate.	Yes. Similar to Vehicle Excise Duty (VED)	No	Yes. Hypothetically, the VED could be devolved to Scotland; thus, a new Scottish VED (with adjustments as per the Bonus-Malus scheme) could replace the UK VED in Scotland. This would be subject to UK Parliament consent and Scotland Parliament agreement. A Scotland Act including the power to introduce a devolved VED in Scotland and a new specific VED (Scotland) Act applying the legislation to Scotland would be required.

While the balance of evidence suggests that similar taxes have reduced GHG emissions where they have been applied elsewhere, the net effect on GHG emissions in the host jurisdiction is uncertain. Challenges in implementation have also been observed and there is limited detailed evidence on behavioural effects. These issues will need to be further investigated before any such tax could be considered for Scotland. If the Scottish Government were to consider exploring any of the examples we have looked at, it would be necessary to undertake thorough policy scoping, analysis and consultation, in addition to the agreement of both the UK and Scottish Parliaments. The Scottish Government could also consider these points in the context of its wider discussions with the UK Government on the direction of climate and fiscal policies as part of a collaborative approach.

5.3.1 Direct Carbon Tax

The UK CCL (which is in practice similar to direct carbon taxes in place in several countries or regions, including Sweden and British Columbia) could be devolved to the Scottish Parliament through an agreement between the Scottish and UK governments and parliaments on the transfer of powers.

A new Scottish carbon tax could then in theory replace the UK CCL in Scotland. This could be broadly similar to the UK CCL, although the Scottish Government could also make its own decisions on issues such as scope and rates to better align it with Scotland's socioeconomic conditions and emissions reduction targets. Were the Scottish Government to consider such a measure, it would require significant exploration of options and detailed analysis to ensure it achieved these objectives, including consultation and engagement with stakeholders.

5.3.2 Emissions Trading System

The UK ETS is jointly operated by the Scottish Government, UK Government, Welsh Government and Northern Ireland Executive through the UK ETS Authority. It relies primarily on legislation that is devolved (the Climate Change Act), although parts of the ETS relating to auction processes are based on legislation that is more often considered reserved and, thus, relies on UK parliament.

A new 'Scotland ETS' could hypothetically replace the UK ETS. This would require prior consent of the UK Parliament, Welsh Parliament, and Northern Ireland Assembly to have effect, as well as the agreement of the Scottish Parliament. The agreement of the Scottish Parliament could be sought through new specific legislation (either primary or secondary). Thus, an Act of the Scottish Parliament to make provision about the functioning of the ETS in Scotland would be required. This could in theory cover additional sectors not covered by the UK ETS, similar to the Austrian nETS operating alongside the EU ETS. However, any such proposal would require comprehensive policy scoping and consultation, in addition to the need for agreement from each legislative body, as detailed above.

5.3.3 Bonus Malus Scheme for Vehicles

The UK VED (similar to the bonus malus scheme explained in Appendix D) paid by businesses and households could in theory be devolved to the Scottish Parliament. Thus the new Scotland VED would replace the UK VED through an agreement between the Scottish and UK governments and parliaments on the transfer of powers.

This could potentially allow for innovation, as differences are in principle permitted, as happened with landfill tax (the SLfT applies on the disposal of waste to both authorised and non-authorised landfills, whereas the UK landfill tax only applies to disposals to authorised sites). It could therefore be feasible to create bonuses to incentivise buyers to purchase low or zero emission vehicles (along the lines of the Bonus-Malus in France), which UK VED does not currently offer. However, this would require detailed policy scoping and consultation to ensure any potential measure operates fairly and effectively, as well as having the consent of both the UK and Scottish Parliaments.

5.3.4 Tax on agricultural emissions

Under Section 80B of the Scotland Act 1998 (as amended), a new tax on agricultural emissions similar to the tax on agricultural emissions proposed in New Zealand (for further details, see Appendix D) could in theory be created in Scotland as the UK Parliament can, with the consent of the Scottish Parliament, devolve powers for new national devolved taxes to be created in Scotland.

This tax might operate by putting a price on agricultural GHG emissions, for example, and could include farmers and growers who operate on Scottish territory, depending on their GHG emissions. The lessons learned from the example in New Zealand clearly demonstrate that consideration of any such measures would require rigorous policy design, consultation and close collaboration with stakeholders in the sector. Whilst new taxes can be effective in changing behaviours and reducing GHG emissions, there is an important and challenging balance to strike between protecting jobs and the viability of industries such as agriculture whilst also meeting net zero targets.

6 Conclusions

Of the various policies to mitigate the effects of climate change, the use of fiscal levers (taxes, levies, duties or charges) to reduce GHG emissions has gained increased attention and wider adoption by policymakers around the world. Different types of fiscal levers include emission trading schemes; carbon credit schemes; carbon border adjustment mechanisms; and carbon taxes. We focused on direct carbon taxes. Subsidies, grants and loans by the UK or Scottish Governments were not in scope.

6.1 International review of fiscal levers for GHG emissions

Use of carbon taxes is increasingly common. 37 direct carbon taxes are in operation in 27 jurisdictions globally. The majority are applied in high-income countries, particularly Europe. Scandinavian countries were among the earliest adopters. Many of these taxes have been applied alongside an ETS. There has been less use outside Europe to date. However, several jurisdictions are currently considering them.

Sub-national carbon taxes have been applied successfully: Of particular relevance to Scotland, two jurisdictions have applied carbon taxes sub-nationally: Canada, which has five, and Mexico, which currently has two with further instruments planned.

Existing instruments differ in terms of GHG coverage and carbon price: about 6% of global GHG emissions are taxed by carbon taxes. This share has increased significantly over the past 15 years. Existing instruments differ in scope, price and coverage. For example, Sweden has a 'high ambition' instrument and was one of the earliest adopters with the highest carbon tax globally. Other instruments have a mixed level of ambition e.g. high prices and low share (Uruguay) or high share but low prices (Singapore). Relatively low prices and shares include some Eastern European and South American states.

The balance of evidence suggests carbon taxes have reduced GHG emissions, with caveats. Despite the extensive literature on the merits of carbon taxation, actual data on their impact on GHG emissions is limited. Any assessment of impact is methodologically challenging, particularly in attributing GHG reductions to the specific tax. Effects of carbon leakage are rarely quantified, so estimates may overstate reductions in GHG emissions when taking a global view. Despite these challenges, the evidence indicates that carbon taxes have generally reduced GHG emissions in the relevant sector or jurisdiction. There is some limited evidence that carbon taxes perform better than ETSs in terms of GHG reduction, but both are likely to need additional regulatory measures to deliver the scale of decarbonisation necessary. The extent of reductions attributed to the taxes to date are not considered sufficient to meet broader climate goals.

Evidence on behavioural effects within affected sectors is more limited. The available evidence indicates that fuel switching or efficiency improvements may be more common responses than significant changes to manufacturing processes or technologies. Analysis of the Swedish carbon tax suggests some decreased demand for petrol was offset by increases for diesel but it was considered to have supported a shift in investment toward low-carbon

technologies. It is not clear if responses were a result of the design of the tax or a reflection of prevailing prices and/or coverage.

Carbon taxes have generated government revenue but their magnitude depends on the design of the tax. The data contain some methodological and reporting inconsistencies, but 2013 information suggested revenues differed between some \$3.5 billion (Sweden) and tens of million (Iceland). Data from 2019 show similar orders of magnitude, but the values for specific jurisdictions differ. The share of GDP represented by the taxes were all under 1% of national GDP at that time. By 2022 carbon tax revenues were upwards of \$30 billion globally. Overall, revenues reflect the carbon price, as well as factors including the size of the economy, the coverage of the tax, exemptions, the carbon intensity of the jurisdiction and energy mix. The available evidence suggests that direct carbon taxes are relatively straightforward and inexpensive to administer for the host government.

Direct carbon taxes have involved extensive allocations of revenues for specific purposes. Many of the instruments for which data are available contained extensive allocations, as a percentage of revenue. These were often legally binding or via political commitment. Specific allocations include for green spending and particularly on specific rebates or tax cuts to affected groups, including low-income households and some businesses. British Columbia's carbon tax was designed to be revenue neutral. In Sweden and Iceland, revenues are unconstrained and used to finance general government expenditure.

Implementation has been politically challenging. Australia is the only jurisdiction identified where an existing carbon tax was repealed. Repealing the tax became a central element of a successful opposition election campaign. Similarly, a planned acceleration of the carbon price was suspended in France as a result of widespread civil unrest, citing the perceived unfairness of the tax, having been introduced alongside tax cuts for the wealthy. A successful legal challenge was brought in Mexico over whether the regional government had legal authority to implement a subnational tax.

6.2 Potential implications for Scotland

Our high-level review of existing fiscal levers in the UK identified several existing taxes in the energy, transport and resource sectors which specifically target or address GHG emissions.

The Scotland Act 2012 (Section 80B) provides the Scottish Parliament with the power to devolve any existing national tax of any description to Scotland and create new national taxes such as on activities currently not taxed under the UK tax code. Any changes to existing taxes or the introduction of new taxes will require the agreement of the Scottish Parliament and the prior consent of the UK Parliament to have effect. Several of the case studies contain elements that are in practice similar to existing UK levies, but which would need amending if they were to be considered for Scotland.

Any new carbon tax could hypothetically be applied in Scotland, potentially as part of a devolved Scottish Climate Change levy. Similarly, a new 'Scotland ETS' could hypothetically replace the UK ETS, with adjustments in scope to incorporate additional sectors. This would require prior consent of the UK Parliament, Welsh Parliament and Northern Ireland

Assembly, as well as the agreement of the Scottish Parliament. A devolved VED could theoretically replace the UK VED in Scotland. New national taxes could also be created in Scotland, requiring consent of both the UK and Scottish Parliaments. In each case, new Scottish legislation would be required.

6.3 Principles for implementation

This review has highlighted several fiscal levers used in other countries to reduce GHG emissions. Should any of these be explored further, Scotland's Framework for Tax sets out the principles and strategic objectives that underpin the Scottish approach to taxation and any new measures (Scottish Government, 2021). These principles are:

- **Proportionality:** Taxes should be levied in proportion to taxpayers' ability to pay and a fair system should reflect relative income or wealth of the taxpayer.
- **Efficiency:** Prospects for revenue should be balanced against the potential for unintended behavioural responses.
- **Certainty:** So that businesses and individuals can plan and invest with confidence, taxpayers must know what is to be paid, by whom and when.
- **Convenience:** Taxes should be collected in a way that maximises convenience for taxpayers. Policy should be simple, clear and straightforward and opportunities to streamline the tax system taken.
- **Engagement:** To ensure accountability and maintain trust, governments should consult as widely as possible on tax design.
- **Effectiveness:** Taxes should raise the expected revenues and achieve their intended aims. Opportunities for tax avoidance should be minimised.

As such, the effectiveness of any fiscal lever depends on the precise design of the lever and should be subject to careful consideration and clear communication in terms of its scope, phase-in, price (including future price escalation), sectors and activities on which it is levied and any relevant exemptions. Distributional effects should be carefully considered, including if and how revenue should be reallocated, to whom and under what conditions. challenges in implementation have been observed. Successful fiscal lever examples have been based on transparent design, regular monitoring and communication of revenues, costs and benefits, with rapid adjustments if unexpected adverse effects occur. Successful examples have also formed part of wider fiscal reforms, with a clear strategic objective.

Any potential instrument should be subject to detailed economic modelling, including testing different price rates and trajectories, an assessment of the risk of carbon leakage (with or without a UK CBAM), economic competitiveness and innovation effects, distributional effects (and potential mitigation via revenue reallocation), and any impacts on small and medium sizes businesses. This should be published in a robust Regulatory Impact Assessment to provide a comprehensive evaluation of any prospective measures, and ensure they adhere to the principles of the Framework for Tax while achieving GHG reductions through behavioural change.

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8 Appendices

Appendix A Methodology

This section provides a more detailed overview of the methodology we used.

8.1.1 Literature review

First, we conducted a targeted literature review on fiscal levers used to reduce greenhouse gas emissions. We focussed on academic and grey literature sources using agreed search terms. These were: 'fiscal levers', 'tax', 'levy', 'duties', 'charges', 'carbon tax', 'environmental tax', 'carbon pricing', 'carbon credits', 'greenhouse gas emissions', 'Net Zero', 'climate change', 'fiscal measures', 'environmental behaviours', 'behaviour change', 'dis/incentive', 'rural' & 'island', 'revenues', and 'devolved'. We used Boolean operators e.g., AND/OR etc to create relevant search strings from these key words and to refine the search results. We used additional terms including 'effectiveness of', 'review of', 'evaluation of', 'impact assessment of' and 'meta-review of' to identify additional evidence for specific schemes once they had been identified.

We searched databases including PubMed, Web of Science All Databases and Scopus to identify relevant academic literature sources. We also looked for legislation as well as publications from national Governments, supranational organisations such as the European Commission or OECD as well as non-governmental organisations. The grey literature was identified via Google searches and searches of relevant government/organisation websites.

As we identified sources, we screened them using executive summaries or abstracts to ascertain their relevance and quality. If we decided the source was relevant and of sufficient quality, we logged them in a data source register, which was a live Excel document (stored on the project SharePoint site) that was available to all team members. We recorded the source details (title, author, year, source) and information on the contents of the publication, such as the type(s) of lever it discusses, geographical scope, relevance for GHG emissions as well as an indication of the methodological rigour, accuracy and robustness of the source. This ensured that we clearly documented the evidence, and that we could share resources efficiently across the project team. As part of this exercise, 36 sources were logged, informing the beginning of the more in-depth research undertaken for each individual case study.

As we logged the sources in the register, we undertook a secondary screening exercise of the lever examples – where specific examples were discussed - categorising them into an initial list of typologies. This also identified a 'longlist' of potential case studies of specific lever examples for more detailed analysis.

8.1.2 Case study selection

We shortlisted six case studies to be analysed in greater detail, from a long list of 12. The case study selection process was twofold. First, initial assessment during literature review stage of the project. While logging the data in the live excel sheet, we conducted a high-

level assessment of the relevance of the identified fiscal levers to the Scottish context. Each case study was assigned a RAG rating based on an assessment against six criteria agreed with CxC and the Scottish Government. These criteria were:

- **Population, economic structure and GDP:** Countries/regions that with comparable population, GDP/GDP per capita and economic structure (i.e., size of manufacturing sectors, predominance of service sectors) were prioritised. This may include certain EU Member States, for example.
- **Administrative and legal arrangements and competencies:** Countries/regions with similar administrative arrangements (i.e., devolved competencies or instruments applied sub-nationally) were prioritised. Examples may include U.S. States, Australian territories or Belgian Regions.
- **Shared challenges:** Countries/regions with similar characteristics to Scotland, such as extensive peatland, rural/island communities or extensive renewable energy resources may provide valuable insight. This may include Ireland, Canada, Estonia, Sweden, Finland and Germany, for example.
- **Climate ambition:** Countries/regions with similar levels of ambition in terms of climate change mitigation should be prioritised. For example, those with net zero targets set out in national legislation.
- **Diversity of approaches:** Different levers and typologies should be covered in the case studies to allow for a comprehensive analysis.
- **Data and evidence:** Sufficient data and evidence on the lever and its effectiveness must be available to support case study analysis.

We then used this RAG rating to select the most relevant case studies, which were presented to the project steering group for agreement. The project steering group selected the final six case studies for the project. These case studies are contained in Appendix C.

8.1.3 Semi-structured interviews

To supplement the literature review, we conducted 7 semi-structured interviews of c.45 minutes via MS teams. In two cases, the interviewees requested to respond in writing. Two rounds of interviews were conducted.

We conducted the first round of interviews with experts who could offer an international perspective on the use of fiscal levers for greenhouse gas emission reductions. The purpose of these interviews was to gain expert input on the global picture, to ensure that sound case study options had been selected and to ensure that the project team was aware of all available evidence. We held interviews with Stefano Carattini, an academic specialising in carbon taxation worldwide, Ian Parry an expert from the IMF and Professor Lorraine Whitmarsh, an academic specialising in behavioural change in the face of environmental legislation and carbon taxation.

The second round of interviews aimed to gain more targeted information about specific case studies in the relevant jurisdictions. We aimed to obtain evidence on the effectiveness of the fiscal levers and fill in any data gaps that had persisted after the literature review.

These interviews included civil servants working on the policy in the relevant governments where these could be identified, as well as academics with the required expertise working in the relevant countries. We were able to arrange interviews with experts from four out of the six case studies analysed in this study. Experts in British Columbia, Austria, Wallonia and Sweden were consulted. Difficulties related to recent elections, and the early nature of the implementation of the tax in New Zealand meant that no civil servants were available to contribute to our study in this jurisdiction. In France, the expert we contacted rejected our interview request, based on the time which had elapsed since the individual was involved with that instrument. We were satisfied with the amount of information publicly available regarding the Bonus Malus scheme, however.

We provided each interviewee with an interview guide in advance of the interview. The guide included a letter of introduction on the project and a short project briefing note, an interview consent form, detailing how the information would be used and stored (in accordance with GDPR). We requested that each interviewee signed and returned the form in advance of the interview. We recorded the interviews, subject to interviewee consent, and stored their data securely. The recordings were used to create meeting notes which were agreed by both the interviewee and the interviewer.

8.1.4 Fiscal levers in the UK and Scotland

We first identified existing environmental fiscal levers in the UK (including taxes in the energy, transport and pollution/resource sectors). The main source of information was the Office of National Statistics (ONS). The UK environmental taxes annual bulletin from the ONS shows the value and composition of UK environmental taxes, by type of tax and economic activity. These levers were:

- Environmental taxes in the energy sector include the following: Tax on Hydrocarbon oil; Climate Change Levy; Fossil Fuel Levy; Gas Levy; Hydro-Benefit; Renewable Energy Obligations; Contracts for Difference;) UK Emissions Trading Scheme; Carbon Reduction Commitment
- Environmental taxes in the transport sector include the following: Air Passenger Duty; Rail Franchise Premia; Vehicle Registration Tax; Northern Ireland Driver Vehicle Agency; Fuel Duty; Vehicle Excise Duty (VED) paid by businesses; VED paid by households; Boat Licenses; Air Travel Operators Tax; Dartford Toll
- Pollution Resources taxes include the following: Landfill Tax; Fishing Licenses; Aggregates Levy; Plastic Packaging Tax.

As the focus of our assignment is on fiscal levers to deliver reductions in GHG emissions, we focused our analysis on those that deliver reductions in GHG emissions. These include:

[1] Fiscal levers specifically targeted to address environmental impacts and affecting GHG emissions.

[2] Fiscal levers specifically targeted to reduce GHG emissions.

The Rail Franchise Premia (premium paid by train companies to UK government to provide specified train services), the Boat Licenses (annual charge required by owners of boats who

use or keep their boats on inland waterways in the UK), the Air Travel Operators Tax (an insurance scheme ran by the UK Civil Aviation Authority), the Dartford Toll (toll for motorists to use the Dartford Crossing), the Fishing Licenses (required to fish for certain species of fish in various locations across the UK), the Aggregates Levy (a tax on sand, gravel or rock that has been dug from the ground, dredged from the sea or imported into the UK), and the Plastic Packaging Tax (on finished plastic packaging components containing less than 30% recycled plastic) have not been considered in our analysis. These taxes do not contribute to reducing GHG emissions, either directly or indirectly. The Contracts for Difference and the Vehicle Registration Tax have not been considered either. The Contracts for Difference offers generators a contract with a known strike price for renewable electricity sold and, thus, it is considered a subsidy and not a tax. The Vehicle Registration Tax is a tax on vehicle registration in the UK.

For taxes covered in our assessment (Tax on Hydrocarbon oil (Fuel Duty); Climate Change Levy¹⁰; Gas Levy; Hydro-Benefit; Renewable Energy Obligations; UK Emissions Trading Scheme¹¹; Carbon Reduction Commitment; Air Passenger Duty; VED paid by businesses; VED paid by households and the Landfill Tax), we conducted a literature review of several academic and grey literature sources that reported information. This related to the following issues: objective of the tax, revenue generated, year of introduction, what is taxed and how tax is collected. This provided a good background overview.

Within the UK, the devolution process has led to calls for the Scottish Parliament to be given more responsibility over revenue raised and spent in Scotland. Following the review of existing UK taxes, the next step has been to look at the environmental taxes under the Scottish Government's remit that contribute to reducing GHG emissions.

The devolution process was examined. This includes Section 80B of the Scotland Act 1998 (as amended), which devolves powers to add new national taxes in Scotland with the agreement of the Scottish Parliament. It also includes the Calman Commission, which supported the principle of devolution and identified some taxes (Stamp Duty Land Tax, Landfill Tax, the Aggregates Levy and Air Passenger Duty, and elements of Income Tax) where devolved powers could be applied. We reviewed the current legal framework and identified existing environmental fiscal levers in Scotland with an impact on GHG emissions where this devolution process has been applied. This only includes the Scottish Landfill Tax, which was devolved to the Scottish Parliament following the Scotland Act 2012 and replaced Landfill Tax on transactions taking place in Scotland. The Air Departure Tax (Scotland) has also been reviewed following the Scotland Act 2016. According to this Act, Air Passenger Duty is due to be fully devolved to Scotland and to be replaced by Air Departure Tax.

¹⁰ Prior to the introduction of the Climate Change Levy, a Fossil Fuel Levy introduced in 1990 existed. The tax was paid by suppliers of electricity from non-renewable energy sources and ended following the introduction of the Climate Change Levy.

¹¹ The United Kingdom Emissions Trading Scheme replaced the European Union Emissions Trading Scheme in 2021 following the UK's exit from the EU.

However, this devolution process is currently on hold until a solution can be identified that protects Highland and Island connectivity and complies with UK subsidy controls.

For the devolved taxes (this includes the Scottish Landfill Tax and the (Scottish) Air Departure Tax, even though the latter is still on hold) we conducted a literature review of academic and grey literature sources that reported information related to the following issues: objective of the tax, revenue generated, year of introduction, what is taxed and how tax is collected. A brief description of the levy/tax is presented, including, depending on the availability of official data, the rates applied, the taxable event, the taxable person and other additional considerations.

Finally, we examined whether the six case study examples could be implemented by the Scottish Government under current devolved competencies, or whether their adoption would require joint action by the UK Government. This was carried out with reference to two key legislative acts. First, the **Scotland Act 1998** that established the Scottish Parliament and gave it the power to legislate on certain matters, including certain elements of taxation. Second, **Scotland Act 2012** (which amends the Scotland Act 1998) and gives the Scottish Parliament the power to (a) **create new taxes** in Scotland (such as on activities currently not taxed under the UK tax code) and (b) **devolve any tax** of any description with the prior consent of the UK Parliament (in addition to fully devolve the power to raise taxes on waste disposal to landfill).

Appendix B Fiscal levers to deliver reductions in GHG in the UK

8.2 Direct taxation schemes

8.2.1 Tax on Hydrocarbon oil (or Fuel Duty)

Fuel Duty is charged on the purchase of petrol, diesel and a variety of other fuels. It is levied per unit of fuel purchased and is included in the price paid for petrol, diesel and other fuels used in vehicles or for heating. The rate depends on the type of fuel, as follows (Office for Budget Responsibility, 2023):

- The headline rate on standard petrol, diesel, biodiesel and bioethanol is 52.95 pence per litre.
- The rate on liquefied petroleum gas is 28.88 pence per kilogram.
- The rate on natural gas used as fuel in vehicles is 22.57 pence per kilogram.
- The rate on fuel oil burned in a furnace or used for heating is 9.78 pence per litre.

In 2022, Fuel Duty revenue was £24.8 billion. It is the largest environmental tax, comprising 52.5% of environmental taxes and 70.2% of energy taxes in 2022 (Office for National Statistics 2023). Data for Scotland is not reported.

8.2.2 Climate Change Levy (CCL)

This levy was introduced by the UK Government in April 2001. It is an environmental tax charged on the energy used by businesses to encourage them to become more energy efficient, while helping to reduce their overall emissions. By 2022, the tax generated revenues of more than £2 billion in the UK (Office for National Statistics, 2023). Data for Scotland indicates that the share collected in Scotland was between 8 and 9% from 2001 to 2019. Revenues collected in Scotland reached £158 million in 2018-2019.

Specifically, the tax applies to four groups of energy products: electricity; coal and lignite products; liquid petroleum (LPG); and natural gas when supplied by a gas utility. The CCL is paid via two rates: the main levy rate (for energy suppliers) and the carbon price support rate (for electricity producers). The CCL must be declared (via submission of a Climate Change Levy return to HMRC) and paid every three months, although small businesses can apply to make annual returns instead of quarterly returns.

Main levy rate

The main levy rate is applied to companies in the industrial, public services, commercial and agricultural sectors, and according to their consumption of electricity, gas and solid fuels (e.g., coal, coke, lignite or petroleum coke). Energy suppliers are responsible for charging the correct levy to their customers (SEFE Energy, 2023).

The levy rate varies for each category of taxable commodity, according to energy content: kilowatt-hours (kWh) for gas and electricity; and kilograms for all other taxable commodities. The rates do not apply to domestic consumers and charities for non-business use. There are also reduced rates for energy consumers that hold a climate change agreement (United Nations, 2012). Climate change agreements (CCA) are voluntary

agreements made between UK industry and the relevant Environment Agency to reduce energy use and CO₂ emissions. CCAs are available for a wide range of industry sectors from major energy-intensive processes such as chemicals and paper to supermarkets and agricultural businesses such as intensive pig and poultry farming.

Carbon price support rate

Carbon price support rates apply to owners of electricity generating stations and operators of combined heat and power stations. They become liable for the carbon price support rate when (a) gas passes through the meter at the registration station and or (b) LPG, coal and other solid fossil fuels are delivered through the entrance gate at the generation station. Electricity generators are responsible for measuring, declaring and paying the correct carbon price support rate.

8.2.3 Renewable Energy Obligations

The Renewables Obligations (RO) were introduced in April 2002 in Great Britain, and in 2005 in Northern Ireland, with the aim of increasing the use of renewable energy to help reduce GHG emissions. Revenue from the tax has increased since its introduction, reaching £6.6 billion in 2022 (Office for National Statistics, 2023). Disaggregated data for Scotland is not reported.

This scheme requires electricity suppliers to generate a certain proportion of electricity from renewable sources. It imposes an annual obligation to present to the Office of Gas and Electricity Markets (OFGEM) a specified number of Renewables Obligation Certificates (ROCs) per megawatt hour (MWh) of electricity supplied to their customers during each obligation period. Suppliers can therefore comply with their obligation in two ways: buying and then redeeming ROCs or paying a buy-out price to OFGEM. The energy must be generated in the UK to qualify for ROCs and the eligible renewable sources include landfill gas, sewage gas, hydro (20MW or less), onshore wind, offshore wind, biomass (agricultural and forestry residues), energy crops, wave power and photovoltaics.

The government sets the RO obligation each year based on predictions of the amount of electricity that will be generated in the UK and the number of ROCs that OFGEM will issue to eligible renewable generators. This obligation level is published at least six months before the start of each obligation period, which runs from April 1 through March 31 (Office of Gas and Electricity Markets, 2023).

8.2.4 Carbon Reduction Commitment (CRC)

The CRC was introduced in 2010 to improve energy efficiency and reduce carbon dioxide emissions in private and public sector organisations that are high energy users, although it was closed in 2019. In the years that the tax was in force, the revenue collected ranged from £0.2 billion to £0.7 billion (Office for National Statistics, 2023).

Organisations that met the qualification criteria were required to participate and purchase allowances for every tonne of carbon emitted. For example, the scheme included supermarkets, water companies, banks, local authorities and all central government

departments. Participating organisations were required to monitor their energy use and report annually on their energy supply. The Environment Agency's reporting system then applied emission factors to calculate participants' CO₂ emissions based on this information. Participants were then required to purchase and surrender allowances for their emissions (UK Government, 2023d).

8.3 Emission trading schemes

8.3.1 UK ETS

The UK ETS was established on 1 January 2021. It replaced the EU ETS following the UK's exit from the EU. The scheme revenue was £4.3 billion in 2022 (Office for National Statistics, 2023).

The UK ETS covers energy-intensive industries, power generation and aviation. For aviation, the routes covered by this scheme include UK domestic flights, flights between UK and Gibraltar, flights between Great Britain and Switzerland, and flights departing the UK to European Economic Area states, conducted by all aircraft operators, regardless of nationality. For installations, the UK ETS applies to regulated activities that result in GHG emissions (except installations whose primary purpose is the incineration of hazardous or municipal waste). Activities in scope are listed in Schedule One (aviation) and Schedule Two (installations) of the in the Greenhouse Gas Emissions Trading Scheme Order 2020 (Legislation.gov.uk, 2020). The scope of the scheme is set to expand to include more high-emitting areas. It will be applicable to large maritime vessels of 5,000 gross tonnage and above from 2026. From 2028, it will also include waste incineration and energy generated from waste.

Installations with combustion activity below 35MW rated thermal capacity (small emitters), installations with emissions of less than 2.500t CO₂e per year (ultra-small emitters) and operators that provide services to hospitals can opt out of the UK ETS. Instead of having to obtain allowances and thus having allowance surrender obligations, these installations will be subject to emissions targets. However, they will be required to monitor their emissions and notify the regulator if they exceed the threshold.

Free allocation of allowances to eligible installation operators and aircraft operators is maintained to reduce the risk of carbon leakage for UK businesses (UK Government, 2023c). The maximum number of free allowances was set at around 58 million in 2021 (approximately 37% of the 2021 cap) and will decline by 1.6 million allowances per year (ICAP, 2022). Eligible installations must submit a verified Activity Level Report. If the data in the Activity Level Report shows an increase or decrease in activity of 15% or more from historical activity levels, their free allocation will be recalculated. Specific data for Scotland has not been reported.

Free allocations will be made available for operators of eligible installations who applied for a free allocation of allowances for the 2021 to 2025 allocation period and for new entrants to the UK ETS. The free allocation will also apply to the allocation period 2026 to 2030,

although free allocations are intended to reduce over time. From 2026, flight operators and aviation businesses will need to buy allowances for every tonne of carbon they emit.

8.4 Indirect taxation schemes

8.4.1 Air Passenger Duty (APD)

UK APD is a tax levied on airlines based on the number of passengers carried when departing from a UK airport. It was introduced in 1994 to raise funds for the government and to regulate larger aircraft, but over the years it has become an important environmental tax. The amount of APD is based on the distance travelled and the class of service. There are four different pricing bands. Pricing as of April 2023¹² is:

- For domestic flights (only within England, Scotland, Wales and Northern Ireland), the APD is £6.50 in economy, and £13 in a premium cabin.
- For international flights of up to 2,000 miles (short haul), the APD is £13 in economy, and £26 in a premium cabin.
- For international flights of 2,001 to 5,500 miles (long haul), the APD is £87 in economy, and £191 in a premium cabin.
- For international flights of more than 5,500 miles (ultra long haul), the APD is £91 in economy, and £200 in a premium cabin.

This tax does not apply to flights to the UK, as it is a departure tax only, nor to children under the age of 16 (OMAAAT, 2023). Passengers carried on flights leaving from airports in the Scottish Highlands and Islands region are exempt, but passengers on flights from other areas of the UK to airports in Scotland are not. As with other environmental taxes, the government's revenue from the APD has increased over time. Although it declined between 2020 and 2021 due to restrictions placed on air travel during the COVID-19 pandemic, it reached £2.9 billion in 2022 (Office for National Statistics, 2023). According to HM Revenue & Customs, UK APD collections from Scotland have been over 9% since 1999 and over 10% since 2018, amounting to over £380 million in 2022.

8.4.2 Vehicle Excise Duty (VED)

This is paid by businesses and households as a tax levied on vehicles using public roads in the UK. It is payable annually by owners of most types of vehicles, collected by the Driver and Vehicle Licensing Agency. The amount of VED depends on the year of registration of the vehicle: before or after 1 April 2017, or before 1 March 2001. Further changes will come into effect in April 2025, affecting new and existing electric vehicles.

For cars **registered before 1 March 2001** the excise duty is based on engine size. Vehicles with an engine size < 1549 cc pay £180 (single annual payment), while vehicles with an engine size > 1549 cc pay £295 (single annual payment). For vehicles registered **between 1 March 2001 and 31 March 2017** a standard rate between £0 (up to 100 g/CO₂/km, which includes hybrid vehicles) and £630 (Over 255 g/CO₂/km) is charged based on theoretical CO₂

¹² Up to 31 March 2023, there were 2 destination rate bands

emission rates per kilometre. The standard rate is only paid in the year the vehicle is first registered.

For vehicles registered **from April 2017 onwards**, VED are paid every year. First-year VED payments are based on theoretical CO₂ emission rates per kilometre and are in the range between £0 (up to 0 g/CO₂/km, which does not include hybrid vehicles) and £2000 (Over 255 g/CO₂/km). Drivers of Ultra Low Emission Vehicles (ULEVs) are particularly incentivised as they pay zero VED. Drivers of relatively fuel-efficient petrol or diesel cars (up to 10g/km CO₂) pay up to £10 for the year of initial registration (depending on the car's official CO₂ emissions), while drivers of less fuel-efficient cars pay up to a maximum of £2,000. For the second year and beyond, most drivers pay a fixed flat rate of £140 regardless of their vehicle's CO₂ emissions (except for zero-emission cars which pay zero). Apart from the payment period, the biggest changes from April 2017 are that hybrid vehicles are no longer rated at £0 and that cars with a retail price above £40,000 will pay a £310 supplement for years 2 to 6. The reformed VED system retains and strengthens the CO₂-based first year rates to incentivise uptake of the very cleanest cars whilst moving to a flat standard rate.

Electric vehicles (EVs) are currently exempt and drivers of EVs pay no VED. However, from 2025 EVs first registered on or after 1 April 2017 will be liable to pay the lower rate in the first year and the standard rate from the second year of registration onwards. This also applies to zero emission vans and motorcycles (Office for Budget Responsibility, 2023).

8.4.3 Landfill tax

The landfill tax was introduced in the UK in October 1996 to encourage recycling and increase the use of reusable materials. Since its introduction, the amount of waste sent to landfill has fallen by 60%. The tax applies to all waste disposed at a licensed landfill site unless the waste is exempt. It is charged by weight and there are two charge rates: a lower rate for 'inactive waste', such as rocks or soil, currently £3.25 per tonne, and a standard rate for all other waste, currently £102.10 per tonne. Rates are updated by the UK Government annually and come into effect on 1 April each year.

The landfill tax is paid by the operators or owners of landfill sites, who often pass on the costs to waste producers such as companies or local authority. Households are not required to pay landfill tax directly as local councils and authorities are responsible for the disposal of household waste. However, the cost may be further passed on to households that end up paying it indirectly via their council tax bill.

In 2022, the UK government raised £0.8 billion from the landfill tax (Office for National Statistics, 2023). The revenue is used for a variety of purposes, including supporting environmental projects and programs (Business Waste, 2023). According to HM Revenue & Customs, Scotland's share of the total collected by the UK Landfill Tax was 13% in 2014-2015 (the tax was devolved to Scotland in 2015), amounting to a collection of £0.15 billion.

Appendix C Supplementary data

Figure 8.1: Share of GHG emissions covered, as of March 2023 (World Bank 2023c)

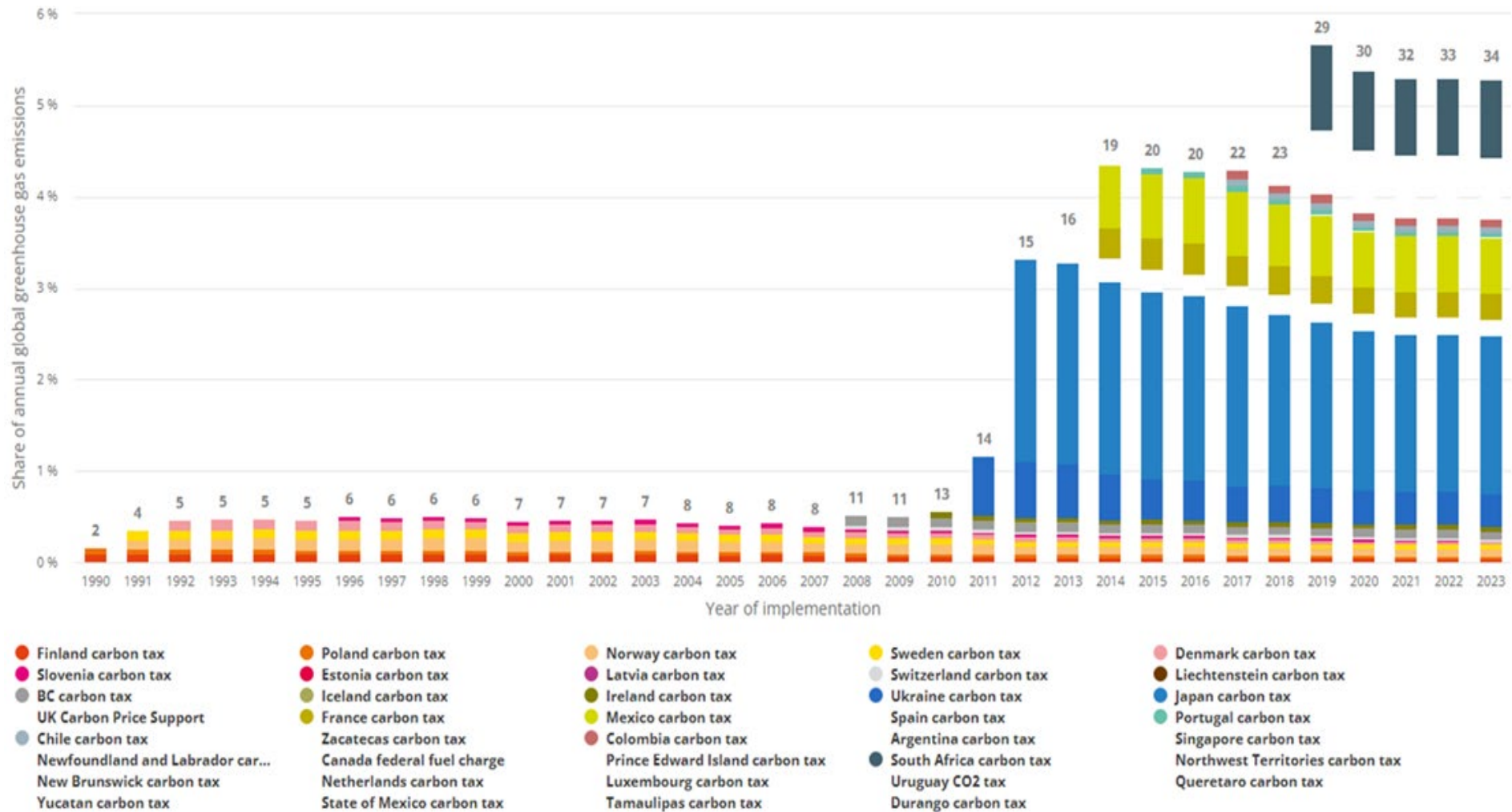


Figure 8.2: Comparing coverage and prices (CTs and ETS instruments, 2023 (World Bank 2023c))

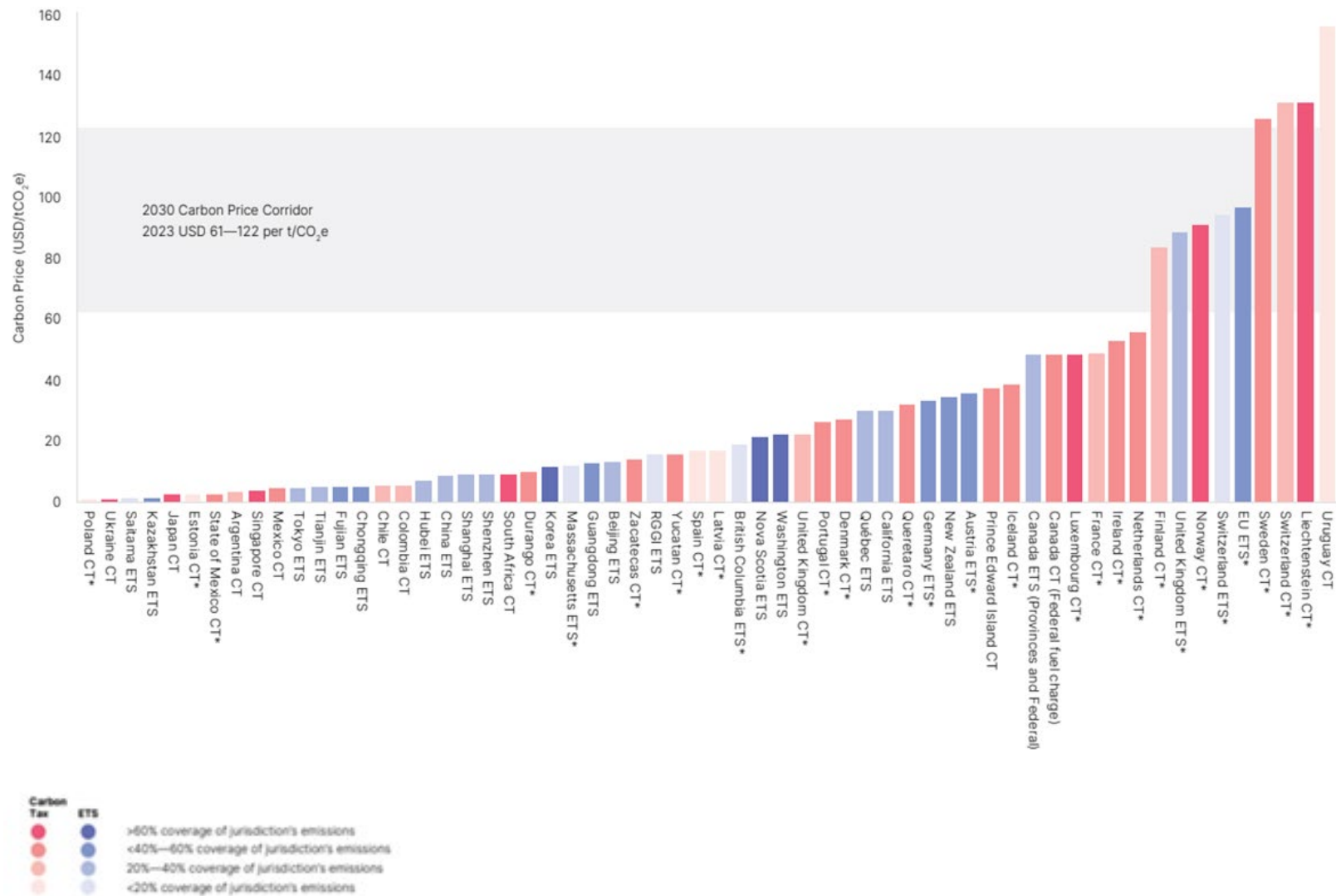


Figure 8.3: An overview of global carbon credit issuance (World Bank 2023c)

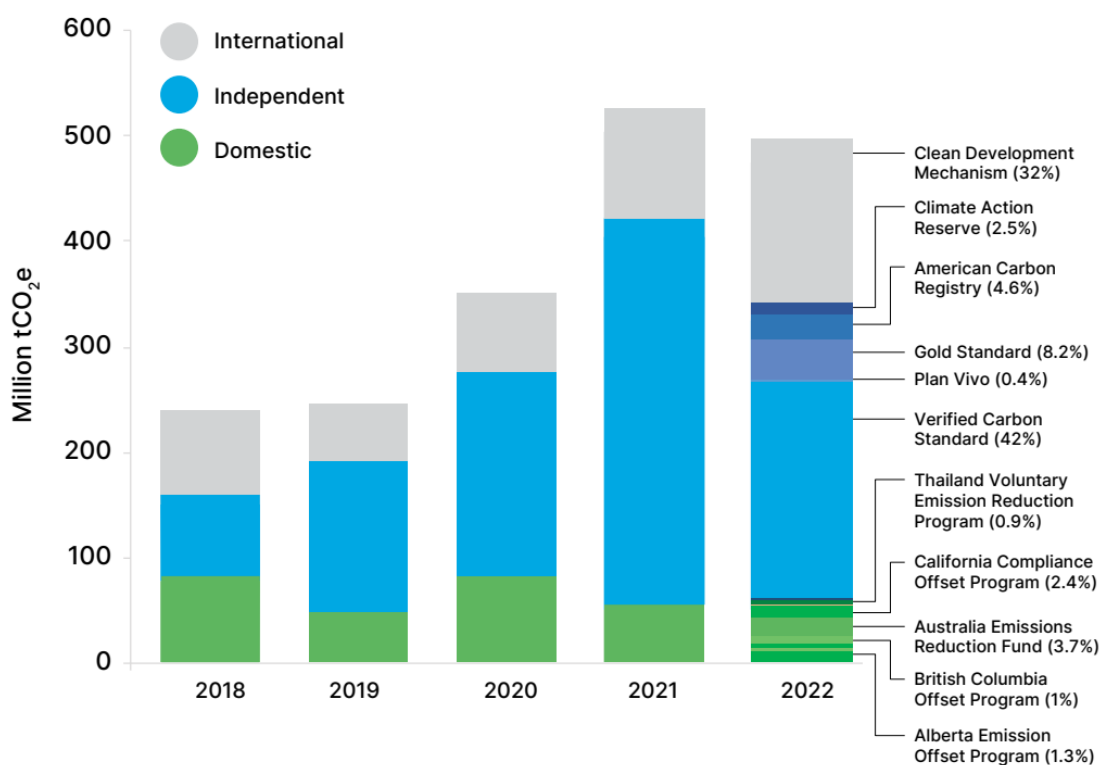


Table 8.1: Quantitative impacts from selected instruments

Instrument	Quantified GHG emission reductions	Notes
"Carbon taxes in European nations"	Reduction in GHG emissions "by up to 6.5% over several years".	Evidence taken from a 2018 review, drawing on data up to the end of 2015 from 35 carbon taxes (cited in Green 2021). The instruments and period are not specified further.
Carbon tax in British Columbia	Reductions over 2008 - 2014 (with some variation in dates among studies) range between 5% and 15% below a counterfactual reference level, or around 2% per year. Note it is not clear in the source if this figure relates to total emissions in the jurisdiction or in affected sectors; it is assumed to be the latter. A 2015 study noted it reduced CO₂ emissions from gasoline consumption by more than 2.4 million tonnes in the first four	Evidence based on a meta-review of various (number not given) of studies on the BC tax. Note this estimate does not include a quantitative estimate of carbon leakage associated with the tax to other jurisdictions. The net reduction is therefore highly likely to be less (cited in Green, 2021).

Instrument	Quantified GHG emission reductions	Notes
	years of operation. And a 2020 study over the period 1990-2014 noted the tax had reduced transport sector emissions by 5%.	
UK carbon price support (UKCPS)	A 2019 study concludes the UKCPS reduced emissions in the power sector between 41% and 49% over 4 years (2013–17). Another that it reduced emissions “overall” by 6.2% (2013-2016(2.1% per year)), based on a price of €18 per ton.	All three studies are cited in Green, 2021. It is not always clear if these studies referred to reductions within the sectors affected by the instrument or overall aggregate reduction. Again, it is assumed to be the former. As above, the treatment of carbon leakage is not specified, hence the emission reduction estimates may be overstated.
UK Climate Change Levy (CCL)	A third study noted the CCL reduced emissions amongst power plants paying the full levy rate by “between 8.4% and 22.6% compared to plants paying the reduced rate”. The study refers to between 2000 and 2004.	
Sweden Carbon Tax	Overall, the findings differ. A 2019 study estimated emission reductions of 6.3% in an average year, between 1990 and 2005. Other studies identify emission reductions only in certain sectors (district heating emissions, in a 1998 study and emissions from petrol in a 2018 study).	The review notes “Nordic taxes tend to do better on emission reductions, although the wide variation in fundings make it hard to conclude this definitively”. The source is not clear on the precise period in question for each statistic, but the overall period assessed was 1960-2010. Other studies suggest the tax had “little or no effect on emissions”. This is an important finding, given the relatively high carbon price in Sweden as well as the length it has been in operation. Note: No estimates have been identified for Liechtenstein and Switzerland, the other jurisdictions with the highest carbon prices.
Finland, Netherlands, Norway, Sweden.	A 2011 study identified no effect on per capita growth rate of emissions between 1990 and 2008 in any jurisdiction, except Finland (which saw a reduction of 1.7%).	The study applied a “difference in difference” analysis (a type of economic modelling approach). The time period this refers to is not clear.

Instrument	Quantified GHG emission reductions	Notes
Sweden, Norway, Denmark, and Finland.	A 2019 study identifies annual reductions in Sweden of 17.2% and 19.4% in Norway, but “no statistically significant effects in Denmark or Finland, over the period 1990-2004.	Based on a synthetic control study (a statistical approach which compares effects based on case studies). Results considered “an outlier” in the Green 2021 review.
Norway	A 1997 study identifies a reduction of between 3% to 4% between 1991 and 1993 (1-1.3% per year).	Based on a hypothetical counterfactual scenario.
Denmark, Ireland, Finland, Sweden and Slovenia	An increase in price of €1 per ton in CO ₂ tax results in an annual 11.58 kg per capita decrease in emissions.	Based on panel data.
France	Carbon tax reduced emissions in manufacturing sectors by between 1% and 5% between 2014 and 2018.	A 2019 study, using a counterfactual based on historical data.
“Tipping points”	A 2018 study, based on analysis between 1995 and 2013 suggests that CO ₂ taxes reduce emission if they surpass 2.2% of GDP.	Based on economic modelling based on panel data.
Germany, Denmark, Netherlands, UK, Slovenia, Finland and Sweden.	Average reduction of 3.1% compared to a historical baseline (for 6 of the 7 countries).	Based on historical data for the baseline and a counterfactual using country specific data. The “7 th country” is not specified.

Table 8.2: Carbon tax revenue characteristics (based on 2013 data, unless specified) Carl and Fedor, 2016

Instrument	Annual revenue (million)	Per capita revenue	Share of GDP	Earmarking/hypothecation
Sweden carbon dioxide tax	\$3,680	\$381	0.67%	General funds (50%) and revenue recycling (50%)
Norway carbon dioxide tax	\$1,580	\$307	0.31%	Green spending (30%); general funding (40%) revenue recycling (30%)

Instrument	Annual revenue (million)	Per capita revenue	Share of GDP	Earmarking/hypothecation
British Columbia carbon tax shift	\$1,100	\$239	0.49%	Revenue recycling (102%)
Denmark carbon tax act (2010)	\$1,000	\$177	0.29%	Green spending (8%); general funding (47%) revenue recycling (45%)
Switzerland carbon dioxide levy	\$875	\$107	0.13%	Green spending (33%); revenue recycling (67%)
Mexico special tax on production and services (2014)	\$870	\$7	0.06%	General funding (100%)
Finland carbon dioxide tax	\$800	\$146	0.29%	General funding (50%); revenue recycling (50%)
Ireland [1]	\$510	\$111	0.03%	Green spending (13%); general funds (88%)
Japan tax for climate mitigation (2012)	\$490	\$4	0.01%	Green spending (100%)
France [2]	\$452	\$7	0.02%	Green spending (100%)
Iceland [3]	\$30	\$92	0.22%	General funds (100%)

Notes:

- [3] natural gas carbon tax, mineral oil tax and solid fuel carbon tax, data from 2012
- [4] domestic consumption tax on energy products (carbon dioxide), data for 2014 and reflects a partial year
- [5] Carbon tax on carbon of fossil fuel origin

Table 8.3: Revenues and allocations, based on 2016 data (OECD 2019)

Instrument	Annual revenue (EUR Million)	Earmarking/hypothecation commitment	Notes on revenue use
Canada (Alberta and BC)	1,520	Legally binding	Overall spending measures exceed revenues, via tax cuts, rebates and direct compensation. Revenues are distributed to households – targeted to low-income households – as well as business (including small businesses). Since 2018 a “clean growth incentive programme has been supported which

Instrument	Annual revenue (EUR Million)	Earmarking/hypothecation commitment	Notes on revenue use
			focuses on research on fugitive emissions in the oil and gas sector and on slash burning.
Chile	233 (2018)	None	Unconstrained (used for general funds). Tax introduced in 2014 as part of a broader reform, to help fund educational reform policy.
Denmark	480	Political commitment	No data.
Finland	1,402		All revenues distributed as tax cuts or rebates.
France	3,800	79% legally binding, remainder unconstrained	The legally hypothecated 79% is distributed via tax cuts and rebates. Up to 2016 this funded a tax credit for business. Since 2017 revenues are allocated to a dedicated “energy transition account” which compensates affected industries of a proportion of the costs associated with use of renewable energy sources.
Iceland	26	None	Revenues are unconstrained.
Ireland	434	12% legally binding, reminder via political commitment	The majority of revenues are distributed via tax cuts and rebates, including reductions in payroll taxes. A small proportion is allocated to energy efficiency measures, particularly household retrofits to help households at risk of fuel poverty and to provide support for rural public transport.
Japan	No data	100% legally binding.	Revenue data is not publicly available but used for energy efficiency and renewable energy support programmes.
Norway	1,246	44% legally binding, reminder via political commitment	Revenues are distributed via tax cuts and rebates. A proportion of the revenue flows to the Government Pension fund, the returns from which (expected to equate to the real rate of return (3%)) are then allocated to general government funds.

Instrument	Annual revenue (EUR Million)	Earmarking/hypothecation commitment	Notes on revenue use
Portugal	134	11% legally binding	Reallocated to tax cuts and rebates particularly income tax reductions for households with larger families. A proportion of the revenue are allocated to green and environmental spending, including infrastructure for electric vehicles, public transport, conservation and climate change mitigation policy.
Slovenia	132	All revenues are unconstrained	From 2005 to 2008 some revenues were used to finance carbon reduction projects and environmental subsidies for industries.
Sweden	2,549		Introduced in the early 1990s as part of a broader fiscal reform package. The revenues were used to finance labour tax reductions as well as fund Sweden's 1996 application to the EU. Revenues from 2016 flow directly to central government budget.
Switzerland	985	100% of revenues legally binding	One third of revenues fund energy efficiency in buildings, including geothermal heating as well as a technology fund. The remainder fund social security contributions for businesses as well as subsidies on health care premiums.

Appendix D Case studies

For all case studies, RAG rating for similarities to Scotland denoted red [R], amber [A] and green [G].

8.5 Case study 1

		Lever type: Direct Carbon Tax Jurisdiction: British Columbia, Canada
Context		
Population and GDP	[G]	Like Scotland, Canada is a high-income country, it comprises ten provinces and three territories. The British Columbia (BC) economy is similar in size to Scotland's. For comparison, BC's GDP was \$265.8 billion (around £154 billion) ¹³ in 2020; Scotland's was £148 billion. GDP per Capita in BC is \$59,962 (Government of Canada, 2023a); in Scotland it was \$42,632 in 2021 (Scottish Government, 2023a) ¹⁴ BC's population is also comparable; BC's population was 5 million in 2021 (Government of Canada, 2023b), compared to 5.4 million in Scotland in 2022 (Scottish Government, 2023c).
Administrative and legal arrangement/competencies	[G]	The carbon tax in BC was designed, applied, enforced, and administered at province level. This makes it of particular interest to Scotland, given devolution. Since its implementation however, it was frozen and then re-introduced when the Federal carbon tax was implemented at national scale by the Canadian Government. This tax is administered by the Canadian Ministry of Finance. The Ministry of Environment and Climate Change is responsible for the inventory and allocating funding.
Shared challenges	[A]	Canada relies heavily on fossil fuel consumption for both domestic use and net exports of carbon-intensive manufactured goods and fossil fuels. It is also among some of the most intensive emitters of CO ₂ in the OECD, with per capita emissions for 2010 being recording at 15.5 tonnes per capita of CO ₂ . This compares to 9.6 tonnes per capita of CO ₂ the OECD

¹³ Based on the 2020 annual average exchange rate of CAD 1.7202 to 1 GBP.

<https://www.exchangerates.org.uk/GBP-CAD-spot-exchange-rates-history-2020.html>

¹⁴ £30,793 in 2021, converted to US dollars for consistency in jurisdictions, using the average exchange rate for 2021 of 1.3757. Source: <https://www.exchangerates.org.uk/GBP-USD-spot-exchange-rates-history-2021.html>

		average and 7.6 tonnes per capita in the UK in the same year (OECD, 2023). ¹⁵ BC sources a very high proportion (93% of its electricity in 2008) from renewable energy, specifically hydropower (Harrison, 2013).
Climate ambition	[A]	Canada is committed to achieving Net Zero by 2050. Scotland has committed to reducing emissions by 75% by 2030 and achieving Net Zero by 2045.
Data and evidence	[G]	There is significant information available.
Diversity of approaches	[G]	The approach taken in BC is a direct carbon tax that is administered at sub-national level. It is the only sub-national direct carbon tax selected as a case study.
Lever design		
The BC Government introduced the first carbon tax in North America in 2008 (Pretis, 2022). It was introduced at a time when other North American governments were embracing cap and trade over taxation (Harrison, 2013). It is a direct carbon tax applied to fuels based on their CO₂ content, covering all liquid transportation fuels such as gasoline and diesel, as well as natural gas or coal used to power electric plants. The tax is applicable to 70-75% of the province's GHG emissions, with the remainder of GHG emissions coming from non-combustion CO₂ in industrial processes, methane emissions, from natural gas extraction and transmission, nitrous oxide emissions from agriculture and CO₂ emissions from forestry (Murray and Rivers, 2015, p.676). The rate of the tax at implementation was \$10 CAD per tonne emitted. Initially, this was set to rise by \$5 CAD per year until it reached \$30 CAD per tonne in 2012. The tax increase was frozen however in 2012 by the British Columbia Government. In 2018, a change in government and the implementation of a federal carbon tax in Canada resulted in the BC carbon tax being unfrozen and the price increased. However, the legislation surrounding the tax was altered to no longer require revenue neutrality. We understand, following a stakeholder interview, that the British Columbian Government have mirrored the rates set by the federal government at national scale by following the federal government's schedule for carbon tax increases¹⁶. The British Columbian government initially committed to the tax being revenue neutral. It operated as a tax shift wherein carbon tax revenues were countered by cuts in other taxes (such as business taxes, personal income tax, low-income tax credits and direct grants to rural households) or direct transfers to households. Between the tax's implementation in 2008 and 2015, the tax generated C\$6.1 billion (Murray and Rivers, 2015). Since 2018, the revenue generated is now allocated centrally by the federal government. The revenues are		

¹⁵ [Air and climate - Air and GHG emissions - OECD Data](#)

¹⁶ Information obtained during the case study expert interview phase of the stakeholder consultation

then redistributed through dedicated tax rebates for low-income households or for public purposes, including climate action.¹⁷ The administration of the tax is via the Ministry of Finance. The Ministry of Environment and Climate Change is responsible for the inventory and fund allocation.¹⁸

When introduced, the tax did not include exemptions for particular sectors, it was applied universally. Concerns were raised, however, by greenhouse plant/vegetable growers (Seed your future, 2023)¹⁹ regarding the competitiveness of their operations in comparison with California and Mexico. This led the Government in BC to introduce a one-time exemption (worth \$7.6 million) from the Carbon tax in 2012, an ongoing 80% exemption from the carbon tax for greenhouse growers from 2013, and an exemption for gasoline and diesel used in agriculture from 2014.

Lever effectiveness

Public perception of the carbon tax in BC, almost 15 years on from its implementation, is seen as generally positive. The tax is considered a success in terms of its role in promoting behavioural change and decreasing consumer demand for fossil fuels and natural gas (Pretis, 2022). The Pretis paper outlines a series of studies, including Xiang and Lawley (2018) and Antweiler and Gulati (2016) that drew correlations between the implementation of the tax and a decrease in fuel demand. Furthermore, evidence shows that the tax has had a low per capita cost, aiding further public acceptance.

Bernard and Kichian (2019) assess the extent to which the tax reduces British Columbia's CO₂ emissions. They state that once reaching the rate of \$30/ton of CO₂, it achieved an estimated 1.13-million-ton reduction in CO₂ emissions, amounting to an average annual reduction of 1.3% relative to BC 2008 diesel emissions and to 0.2% relative to all BC CO₂ emissions in 2008. Bernard and Kichian (2019) argue however, that whilst the tax can be considered politically successful, the reductions seen are not significant enough for it to be considered a viable strategy, in isolation, for the Canadian government to meet its carbon-related commitments.

Pretis (2022) conducted a study on the effectiveness of the tax at reducing aggregate CO₂ emissions in order to determine economy-wide CO₂ emission reductions. It was concluded that there is a lack of statistically significant proof of economy-wide effectiveness. The carbon tax was considered too low to result in rapid cross-sectoral changes. Pretis (2022) did outline that the tax has had significant impact on emissions from transport as BC relies heavily on individual motor vehicles due to the long driving distances and limited public transport. It also showed little impact on emissions from electricity production. This is explained by the high reliance on hydropower for electricity generation.

¹⁷ Information obtained during the case study expert interview phase of the stakeholder consultation

¹⁸ Information obtained during the case study expert interview phase of the stakeholder consultation

¹⁹<https://www.seedyourfuture.org/greenhousegrower#:~:text=A%20greenhouse%20grower%20specializes%20in%20growing%20plants%20in%20a%20greenhouse%20environment>

The revenue-neutral commitment made by the government upon implementation of the carbon tax has been criticised by some analysts for not fully compensating low-income households for the additional burden due to higher energy prices (Beck et al., 2014). Beck et al. (2014) argues however, that criticisms such as that are unfounded, stating that the government have made every effort to ensure that the policy is equitable. It is important to note however, that this study was published before the revenue-neutrality element of the tax was changed, no later assessments of the equitability of the tax were found.

Key lessons learned

Pretis (2022) argues that the BC carbon tax is a good example for the introduction of carbon taxes in comparable jurisdictions. It confirms that carbon tax policies with high public support and acceptance are possible. It is also a positive example for how a carbon tax, with targeted sectoral exemptions, can reduce aggregate emissions. Pretis (2022) notes however, that the predominant role that hydropower plays in BC electricity generation potentially limits its applicability where reliance on fossil fuels is higher.

Moreover, Harrison (2013) argued that the introduction of a carbon tax in BC resulted from a “perfect storm” of factors that enabled its implementation. These factors included the prominence of the hydropower, an increase in public concern for climate change, a government with the trust of the business community and a political leader (at province level) with the ability and determination to implement his ambitions. It is important to consider therefore, that whilst it worked in the context of BC, other nations considering the implementation of a carbon tax with a similar ethos, will still need a combination of factors related to political, economic and social context which ultimately determine its success.

But several elements of the BC context are applicable to Scotland. First, there are lessons to be learnt from the progression of the tax, transitioning from sub-national instrument to later alignment with federal standards. It is an example of how sub-national taxation can be successful at reducing GHG emissions at sectoral level. It also shows that subnational carbon taxation can generate significant revenue for Governments to spend as they deem fit. As in Scotland there is high reliance on private vehicle use in BC, given low population density, extent of rural areas and low reliability of public transport connections in rural areas. Bernard and Kichian (2019) also noted that whilst the carbon tax in BC is generally publicly accepted, it has not been shown to have influenced significant reductions in overall emissions of CO₂. They conclude therefore that it should not be considered a viable sole strategy for the Canadian government to meet its carbon-related commitments.

8.6 Case study 2

	Lever type: Direct Carbon Tax Jurisdiction: Sweden	
Context		
Population and GDP	[A]	Like Scotland, Sweden is a high-income country. Sweden has a larger economy and double the population. For example, GDP per Capita in Sweden was \$65,157 in 2021 and in Scotland was \$42,362 (Scottish Government, 2023a). ²⁰ Sweden’s GDP was \$683 billion in 2021 compared to Scotland’s £148 billion. Sweden has a population of 10.5 million (2022), approximately double that of Scotland (5.4 million in the same year (Scottish Government, 2023c)).
Administrative and legal arrangement/competencies	[A]	Sweden provides an example of a nationally administered carbon tax. The carbon tax is levied on transport fuels and is designed to work alongside Sweden’s energy tax and the EU ETS. Sweden’s energy tax is levied on diesel, coal, oil, and electricity used for heating purposes. This could give valuable lessons for Scotland in terms of designing a similar carbon tax to function alongside the UK ETS and the UK climate change levy.
Shared challenges	[G]	Both Sweden and Scotland are increasing their renewable energy potential, in 2021 around 60% of Sweden’s energy production came from renewable sources compared to Scotland at around 57% (Swedish Institute, 2022) (BBC, 2021). In addition, both Sweden and Scotland have rural and rural-island communities which create a unique set of challenges and opportunities in delivering equitable national climate action.
Climate ambition	[G]	Sweden is legally bound to achieving Net Zero by 2045. They are on track with this target and have managed to meet one of their renewable energy targets already. Scotland has similarly committed to achieving Net Zero by 2045 and reducing emissions by 75% by 2030.
Data and evidence	[G]	There is significant information available for this case study as the carbon tax was implemented in the early 1990s, however there are contesting views on the effectiveness of the tax in reducing greenhouse gas.

²⁰ £30,793 in 2021, converted to US dollars for consistency in jurisdictions, using the average exchange rate for 2021 of 1.3757. Source: <https://www.exchangerates.org.uk/GBP-USD-spot-exchange-rates-history-2021.html>

Diversity of approaches	[G]	This is an example of a direct carbon tax, administered at national level. The tax is one of the oldest and currently the highest priced carbon tax in the world.
Lever Design		
Due to growing environmental concerns and building on Sweden's history of levying taxes on energy products, the government introduced their first carbon tax in 1991 (Andersson, 2019). The carbon tax was levied on gas oil, heavy fuel oil, coal, natural gas, petrol, gas oil, heavy fuel oil, coal and natural gas (Johansson, 2000). To ensure Sweden's existing energy tax - levied on diesel, coal, oil, and electricity for heating purposes - would work alongside the newly introduced carbon tax, fuels used for power generation were exempt from the carbon tax (Johansson, 2000). As such the fuels targeted by the carbon tax were mainly used within the transport sector, which in the early 1990s was Sweden's largest emitting sector. In 1991, the carbon tax was introduced at a price of US\$30 per tonne of CO₂ however tax rates were lowered by 50% for the agricultural and industrial sector to avoid carbon leakage and ensure international competitiveness. Furthermore, full exemptions were made for fuels used within electricity production as these were covered by Sweden's energy tax (Jonsson, Ydstedt, & Asen, 2022). The Carbon tax introduction in 1991, was part of a wider tax reform by the Swedish Government, referred to as the "green tax switch". Here, environmental taxes were increased while taxes such as marginal income tax, corporate tax and the capital income tax were lowered. The revenue generated by the carbon tax was 26 billion SEK in 2004 (Government Offices of Sweden, 2021). More recently, the carbon tax covers the direct (Scope 1) CO₂ emissions from all fossil fuels except peat, with 90% of the tax revenue coming from gasoline and motor diesel alone (Andersson, 2019) (World Bank, 2023b). As there are still numerous fuel exemptions from the tax, for example those used for commercial aviation and maritime, only around 40% of Sweden's greenhouse gas emissions are covered by the tax. Some of the exempted industries are covered by the EU ETS (European Union Emission Trading Scheme) however levies within this scheme currently price carbon lower than the carbon tax (Jonsson, Ydstedt, & Asen, 2022). Note limited data was identified regarding the administration and enforcement of the tax.		
Lever effectiveness		
Public perception of the tax is generally positive, and Sweden is acknowledged as a pioneer in environmental governance at an international level (Hildingsson and Knaggård, 2022). The tax is considered to be a success as Sweden has been able to reduce its greenhouse gas emissions while maintaining a growing GDP (Government Offices of Sweden, 2021). Published research has attempted to quantify the effectiveness of the tax in reducing greenhouse gas emissions. Research by Sumner, Bird & Smith (2009) evaluates the carbon tax by comparing its implementation period to national greenhouse gas reduction trends. The results state that emissions were reduced by approximately 15% from 1990 to 1996, by 9% from 1990 to 2006 and decreased by 40% from the mid-1970s to 2008. There is some		

methodological disagreement on what reduction can be attributed to the carbon tax, in isolation. A review of ex-post analyses of carbon taxes by Green (2021) reveals contesting results around Sweden's emission reductions. For example, research by Andersson (2019) found an average emission reduction of 6.3% per year between 1990 and 2005, Fernando (2019) found an annual average reduction of 17.2% and research by Shmelev and Speck (2018) found no effect on emissions. A study conducted by Jonsson, Ydstedt, & Asen (2022) state that GHG emissions have declined by 27% between 1990 and 2018.

In terms of revenue generated by the tax, by 1994 the carbon tax generated 7 billion SEK. From 1994 revenue rapidly increased to 26 billion SEK in 2004 (Government Offices of Sweden, 2021). During this time the carbon tax rate increased from 23 EUR/tonne CO₂ to 84 EUR/tonne CO₂. Fluctuations in revenue generated by the tax have been caused by an increasing tax rate and decreasing tax base (greenhouse gas emissions overall are declining).

From 2004, the revenue generated stabilised until 2010 and since then it has gradually declined over the last decade (Jonsson, Ydstedt, & Asen, 2022). In 2019, SEK 22.2 billion was generated which is approximately 1% of Sweden's total tax revenue. The carbon tax revenue goes into the overall government budget, and is not hypothecated, thus it is unclear where revenue generated is distributed (Jonsson, Ydstedt, & Asen, 2022).

The carbon tax has shown to be effective in shifting market investment into low-carbon technology, specifically in renewable energy sources such as hydro and wind (Hildingsson and Knaggård, 2022). In 2019, 59% of Sweden's energy mix was generated by renewable energy sources (Hildingsson and Knaggård, 2022). Levying the carbon tax at different rates on fuels has also resulted in behaviour changes in companies. Between 1993 and 1997, the higher tax rate on fuels used within domestic heating systems compared to fuels used within industry resulted in industries selling their byproducts to domestic heating companies, while continuing to burn fossil fuels themselves (Johansson, 2000). Our understanding, following a stakeholder interview, is that the carbon tax increased the price of gasoline and diesel for consumers at the fuel pump and in response there was a substitution away from gasoline toward diesel. This interviewee referred to data showing road sector fuel consumption of gasoline decreasing while diesel consumption increased after the carbon tax was implemented.

Key lessons learned

Sweden's experience with the world's longest standing carbon tax makes it a valuable case study for Scotland. Sweden's carbon tax is described as a 'resilient success' by the policy assessment called the "PPPE framework" (programmatic, process, political and endurance) and the tax has formed the backbone of environmental policy in Sweden to date (Hildingsson and Knaggård, 2022).

The tax has been continuously redesigned over the past 30 years by the Swedish Government to reflect Sweden's political, social, and economic situation. For example, the tax rate has incrementally increased over the last 30 years and the tax rate has been lowered by 50% on fossil fuels used by industry. These measures have ensured Sweden's international

competitiveness in energy exports have not been negatively impacted by the tax (Hildingsson and Knaggård, 2022).

Sweden's carbon tax was introduced at a time in which the country was undergoing a wider fiscal reform referred to as the 'green tax shift' where energy and CO₂ taxes were introduced while labour taxes were reduced. Research by Shmelev and Speck (2018) suggests that in isolation the carbon tax would have been insufficient at reducing emissions and emission reductions were only achieved by a collective effort of the carbon tax, energy tax and investment into low carbon technology such as nuclear and hydro power. As evidence suggests, a carbon tax alone may not be effective enough in reducing Scotland's emissions.

Research by Carattini, Carvalho and Fankhauser (2018) reveals that the public's support in increasing the Swedish carbon tax was strengthened by findings which demonstrated the effectiveness of the tax in reducing national emissions. Therefore, Scotland would need to consider the benefits of public awareness and information sources in incentivising support around any potential future carbon tax, should it be considered. Tax revenue recycling can be implemented to reduce potential distributional effects of carbon taxes. Thus, Scotland could explore revenue recycling options if it were to consider implementing a carbon tax to reduce any distributional effects such as income inequality.

8.7 Case study 3

	Lever type: National ETS (nETS) Jurisdiction: Austria	
Context		
Population and GDP	[A]	Austria is a high-income country, however, there are differences in GDP. Austria's was 537 billion USD in 2021, whereas Scotland was 181 billion in 2021). In per capita terms, this equates to \$59,991 per capita for Austria in 2021 in comparison to Scotland's \$42,361 in the same year. ²¹ .Austria also has almost double the population of Scotland – 9 million vs 5.4 million in 2022 (OECD, 2023a; OECD 2023b; Scottish Government, 2023a).
Administrative and legal arrangement/competencies	[G]	The Austrian nETS is administered at national level. However, it has been specifically designed to fit around and complement the EU ETS, a supranational cap and trade system. This could give valuable lessons for Scotland in terms of designing a similar scheme around the UK ETS.
Shared challenges	[A]	Both Austria and Scotland are rapidly growing their renewable energy potential, although their situations are not necessarily comparable – Scotland had a target of 100% renewable electricity generation by 2020, however, the equivalent of 85% of gross energy consumption was from renewable sources in 2021. (Scottish Government, 2023b). Austria aims to reach 100% renewable electricity generation by 2030, and in 2021 Austria's electricity mix was 71% renewable energy (Eurostat, 2023). Austria's renewable energy is largely supplied by hydropower as a result of the many rivers and high rainfall, whereas Scotland's is largely driven by onshore and offshore wind (Scottish Renewables, 2023). Austria has no island communities but does contain large rural population which could provide useful insights and comparators, in particular for the transport sector covered by the nETS.
Climate ambition	[G]	The Austrian government has pledged to achieve Net Zero by 2040, however this has not been enshrined into national legislation and the IEA state that achieving this would require Austria to substantially enhance decarbonisation efforts across all energy sectors (IEA, 2023). Despite this, they have demonstrated climate ambition by implementing a novel fiscal

²¹ £30,793 in 2021, converted to US dollars for consistency in jurisdictions, using the average exchange rate for 2021 of 1.3757. Source: <https://www.exchangerates.org.uk/GBP-USD-spot-exchange-rates-history-2021.html>

		lever to reduce GHG emissions in non-EU ETS sectors. Although Germany also has a nETS in place, neither have been in place long enough to generate significant evidence on effectiveness.
Data and evidence	[G]	A lot of information is available on the lever design; however, the scheme is still in its initial implementation phase. An overall cap on emissions and trading of allowances, which will create a “market” price, will be initiated in 2026. Therefore, no ex-post evidence is available on effectiveness of the lever in practice as it has not yet reached the final stage of implementation.
Diversity of approaches	[G]	This is the only national level ETS considered as a case study. Germany also operates a similar national level ETS but these are novel approaches.
Lever design		
Austria launched its nETS as part of the Ecological Tax Reform Act on 1 October 2022 (Parliament Österreich, 2022). The reforms included many other pricing instruments, so was implemented as part of a wider policy package. The scheme was initially intended to be in place from 1 July 2022, but was postponed as part of an energy relief package intended to relieve cost of living pressures from increased energy prices resulting from the war in Ukraine. The nETS was designed to complement and exist alongside the EU ETS. It covers CO₂ emissions from fossil fuels including transport fuels (petrol and diesel), fuel and heating oil, natural gas/liquified gas, coal and kerosene used in sectors which are not regulated under the EU ETS. The sectors in scope are small, non-EU ETS industry, transport, buildings, waste and agriculture. No data has been identified which set out the differences between the EU ETS and nETS in terms of GHG coverage. Designing the nETS to fit around the EU ETS, namely ensuring that EU ETS installations are not exposed to double counting, was one of the biggest challenges the Austrian government experienced when implementing this lever.²² The ETS has a fixed price, which is designed to steadily increase from 2022-2025, before transitioning to a market price after that, which will operate as a standard cap and trade scheme. The scheme was designed to increase as a fixed price in this way to ensure there is security for market participants to plan ahead. The pricing scheme is as follows, for allowance which covers one tonne of CO₂e: • 2022 – 30 EUR • 2023 – 35 EUR • 2024 – 45 EUR • 2025 – 55 EUR For comparison, the price under the EU ETS in September 2023 was ~85 EUR per tonne. Therefore, the price under the nETS is much lower than under the EU ETS, however, at the end of the transitional phase it will be closer. However, by nature of the market phase it is uncertain what the price will be after the fixed allowance prices cease.		

²² Information obtained during the case study expert interview phase of the stakeholder consultation

Phased implementation

In the early phase of the scheme (2022-2023), there is a fixed price and a simplified procedure for registration and reporting – registered entities (the company/person liable for paying the tax) are not required to conduct monitoring and reporting at this stage, and the National Emissions Trading Information System is being established. Emission allowances do not need to be formally purchased or surrendered, so the scheme is more like a tax, although companies are preparing for full implementation.

In the transitional phase (2024-2025), allowances will start being issued and surrendered and obligatory monitoring and reporting will be phased in. This will include independent verification of emission allowances. In 2026, an overall cap on emissions will be in place and allowances will shift to a market price. The scheme will eventually align with the EU ETS 2, which from 2027 will eventually price emissions in the same sectors at European level.

Compliance, MRV and Enforcement (ICAP, 2023)

The Austrian Federal Ministry for Finance (BMF) and its excess duty administration is responsible for the implementation of the scheme in Austria, which has eased administration burdens for implementing the scheme due to similarities with existing excise duties, although the process of surrendering allowances is new and has been a learning process (other departments handle this for EU ETS).²³

The compliance period runs per calendar year, and registered entities must submit an emissions report at the end of June for the previous year's emissions, and then have until the end of July in the following year to surrender allowances to cover the reported emissions. Emissions reporting must be independently verified and be based on a pre-approved monitoring plan. Exemptions are in place for installations subject to the EU ETS to avoid double burdens, negligible cases (emitting less than one tonne CO₂e) or exemptions under energy taxes.

Entities must pay an increased certificate price (at two times the fixed emissions price) for each tonne of CO₂e for which no allowance has been surrendered. Once the market phase has been reached, entities must pay an increased certificate price of EUR 125 per tonne CO₂e. Fines can be issued for other instances of non-compliance, apart from those exempted outlined above.

The Austrian Federal Ministry for Finance (BMF) is the authority responsible for establishing the regulatory framework of the nETS, and the Office for National Emissions Allowance

²³ Information obtained during the case study expert interview phase of the stakeholder consultation

Trading at the Austria Customs Office is the implementing authority, responsible for receiving emissions reports.

Revenue

The nETS was implemented as part of a wider policy package. Although revenue for the emissions allowances goes directly into the main budget and there is no hypothecation, 'climate bonus' payments are given directly back to households. This is paid as a set price per person, which means that relatively poorer households (who typically live a less carbon intensive lifestyle, hence pay less of the costs) gain relatively more back than richer households. Currently, in the fixed price phase, more money is given back to households and companies in 'climate bonus' payments than is received by the Austrian government in revenue. Revenue in 2022 was approximately €800 million and the government have provided rebates of around €1 billion.²⁴

Lever effectiveness

There are no ex-post studies or evaluations available as the lever has not yet reached its full implementation stage. Emissions data for 2022 (although implementation only started in October 2022) will be available in due course. However, 2022 was an unusual year as energy prices were very high, affecting behaviour. The CO₂ price was still relatively low in 2022 – a carbon price of €30 leads to no more than €0.08 per litre of diesel or gasoline). Therefore, the Austrian government do not think that this will be representative of a typical year.

Ex ante modelling studies conducted by the Austrian government showed that the scheme was expected to reduce CO₂ emissions from the sectors affected of around 800,000 tonnes by 2025.²⁵ During the fixed price scheme the price signal is not expected to result in a clear and significant change in behaviour, however, other parts of the policy package are designed to specifically change behaviour (such as subsidies for changing heating systems in households).

Key lessons learned

The case of the nETS in Austria could yield important lessons for any potential similar system in Scotland. The Austrian scheme is specifically designed to be complementary to the existing EU ETS and covers emissions from non-EU ETS sectors. A similar scheme in Scotland could be designed to complement and exist alongside the UK ETS, which currently has the same coverage as the EU ETS. This would be crucial to ensure there is no double counting, and this was a key area highlighted by interviewees. The sectors covered by the Austrian nETS are small industry, transport, agriculture and buildings, which are not covered by the EU ETS.

Many effects of the scheme are yet to be realised as the scheme is still under phased implementation. This phased implementation has been crucial to give businesses certainty about the future. However, from experience, the Austrian government suggest that a period of mandatory monitoring and reporting, without implementing a carbon charge, would be a useful place to start.²⁶

²⁴ Information obtained during the case study expert interview phase of the stakeholder consultation

²⁵ Information obtained during the case study expert interview phase of the stakeholder consultation

²⁶ Information obtained during the case study expert interview phase of the stakeholder consultation

8.8 Case study 4

	Lever type: Proposed tax on agricultural emissions Jurisdiction: New Zealand	
Context		
Population and GDP	[G]	Like Scotland, New Zealand is a high-income country. New Zealand’s economy is larger than Scotland (\$231.7 billion in 2020, compared to £148 billion and GDP per capita is slightly higher (\$47,982 in NZ and \$42,362 in Scotland in 2021 (Scottish Government, 2023a)) ²⁷ . New Zealand is of comparable size to Scotland in terms of population (NZ 5.1 million in 2022 (OECD, 2023b) compared to 5.4 million in Scotland (Scottish Government, 2023c)).
Administrative and legal arrangement/competencies	[A]	The proposed tax on agricultural emissions in New Zealand would apply at a national level.
Shared challenges	[G]	The agricultural sector plays a key role in New Zealand’s economy, being a net exporter of farm commodities. In 2020, the crop and livestock exported was worth \$25 billion (Ministry for Primary Industries, New Zealand Government, 2022). Similarly, approximately 80% of Scotland’s land mass is currently being under agricultural production (National Farmers Union Scotland, 2023). Like Scotland, New Zealand has a high potential for transitioning its energy sector towards renewable sources. This is due to the high potential of its wind, solar and hydro energy sectors (Anon, 2021).
Climate ambition	[A]	New Zealand is committed to achieving Net Zero by 2050. Scotland has committed to more ambitious targets of achieving a 75% reduction in its CO ₂ emissions by 2030 and Net Zero by 2045.
Data and evidence	[R]	There is limited evidence available on the tax and its exact design is still uncertain as the original design was revoked and is yet to be applied. However, it is the first tax which explicitly focusses on agricultural emissions.

²⁷ £30,793 in 2021, converted to US dollars for consistency in jurisdictions, using the average exchange rate for 2021 of 1.3757. Source: <https://www.exchangerates.org.uk/GBP-USD-spot-exchange-rates-history-2021.html>

		Lessons may be learned in terms of design, political acceptance and implementation.
Diversity of approaches	[G]	Despite the exact format of the tax remaining uncertain, it is a novel concept that could provide valuable insight for Scotland.
Lever design		
A government announcement in December 2020 declared a climate emergency that “demands a sufficiently ambitious, urgent, and coordinated response across government to meet the scale and complexity of the challenge”. Following this, an emissions reduction plan for the Agricultural sector was announced in May 2022. The aim was to meet emissions reduction targets set in New Zealand’s Nationally Determined Contribution under the Paris Agreement, and the domestic emission reduction targets laid out in the Climate Change Response Act 2002 (CCRA). Targets were set at both national and at sectoral scale. Particular attention was paid to the agricultural sector given it accounts for half of New Zealand’s total greenhouse gas emissions (New Zealand Government, 2023). Almost 20 years ago, the New Zealand government announced a ‘fart tax’, which taxed GHG emissions deriving from livestock and agricultural sources. The announcement resulted in protest amongst the farming community. The Government then retracted the proposal, demonstrating the strong political influence the agricultural industry holds (Pannett, 2023). More recently, in 2022, the government founded a partnership with the Māori government and primary industry. The partnership was known as the He Waka Eke Noa - the Primary Sector Climate Action Partnership. It proposed a ‘farm-level levy’ that would require farms to calculate their emissions and pay for them. The emissions pricing was set to use a split-gas approach by applying unique levy rates to long-lived gases, i.e., carbon dioxide and nitrous oxide. Note this would be alongside an ETS also introduced in New Zealand. In response to the proposal for a farm-level levy, the Government launched a consultation to gain feedback from a series of stakeholders on options to price agricultural emissions (New Zealand Government, 2022b). The results of the consultation highlighted public concerns for the impact of the levy on the cost and availability of agricultural produce to consumers as farmers, growers and the wider agricultural sector adjust to internalising the new cost on emissions (Ministry for the Environment and Ministry for Primary Industries, 2022). A series of media outlets, including the Washington Post, have reported on tensions between the agricultural sector in New Zealand and the government. Farmers expressed concerns regarding both the profitability and competitiveness of their business, with some expecting to have to reduce their herd size (Pannett, 2023). The concerns of the agricultural sector have been attributed to the government altering their proposal. A new, temporarily less-stringent proposal was made that shifted the Government’s focus from farm-level taxation towards tightening monitoring and permitting requirements. Instead of outlining farm-level emission pricing, this shifted the focus – at least in the short term - toward a phased approach to mandatory monitoring and reporting requirements, to be implemented by 2025. The proposal delays the implementation of a farm-level levy therefore,		

until 2027. This new proposed legislation has been better received by the agricultural sector, although some have suggested the involvement of farming lobby groups in the development process (Corlett, 2022).

The first stage of the revised proposal outlines a standardised approach to measuring and reporting of on-farm emissions which would eventually transition into the mandatory reporting of all farm-related emissions. The second area involved the recognition and reward of scientifically valid forms of on-farm sequestration (New Zealand Government, 2023). The policy would require that all producers in the agricultural sector collate emission reports by the end of 2022 and develop a farm plan to be implemented by 2025 (New Zealand Government, 2022a). These requirements seek to ensure farmers are aware of their own on-farm emissions and can provide the government with detail on their practices and technologies, providing it with further detail into how best to reduce emissions borne from agricultural sources and how emission levels vary between farms (New Zealand Government, 2023). It is proposed that the mandatory requirements for reporting and monitoring would apply to Inland Revenue registered farms.

The proposal also outlines financial incentives for farmers to use technologies recommended by the Government that reduce sheep and cow burps. It also commits to reinvest the revenue generated from the tax into the sector (Craymer, 2022).

Lever effectiveness

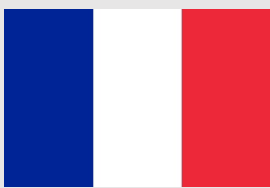
The lever is yet to be implemented; therefore, assessments of effectiveness or behavioural impacts are not available. The tax is thought to offer potential to reduce New Zealand's emissions due to the contribution of the agriculture sector to New Zealand's total GHG emissions (Craymer, 2022). The agricultural sector accounts for nearly half of New Zealand's total GHG emissions, the majority of which are emissions of methane. These emissions are not covered in New Zealand's ETS (Craymer, 2022).

Key lessons learned

The New Zealand Government's transition from a policy which placed direct pricing on emissions at farm-level towards one that implemented monitoring and reporting requirements demonstrates the importance of introducing change in a staggered, cooperative manner. Whilst the initial proposal from 2002 was widely contested, the involvement of farming groups in the development of the policy has enabled the Government to implement measures that are a step towards the pricing mechanism they have committed to in 2027 (Corlett, 2022).

The New Zealand case has demonstrated the importance of stakeholder engagement in the successful implementation of contentious policies. One of our interviewees Professor Lorraine Whitmarsh who specialises in behavioural change and public policy acceptance, highlighted the importance of stakeholder engagement in policy development to gain public acceptance more generally. She noted the Scottish Government had made progress in implementing these methods in its policymaking process.

8.9 Case study 5

	Lever type: Indirect tax (Bonus Malus scheme) Jurisdiction: France	
Context		
Population and GDP	[A]	France is a high-income country . According to World Bank estimates, it is the world’s seventh largest economy by nominal GDP. If this is calculated per inhabitant, France is 19 th . GDP per capita was 55,064 US dollars in 2022, ²⁸ higher than Scotland (42,362 US dollars in 2021 (Scottish Government, 2023a)) ²⁹ . The 2022 population of France was 68 million, based on OECD data. This is much larger than Scotland (5.4 million (Scottish Government, 2023c)).
Administrative and legal arrangement/competencies	[A]	The scheme is administered at national level.
Shared challenges	[G]	To achieve its 2050 carbon neutrality objective, France has committed to reducing the use of fossil fuels in energy production (almost two-thirds of the French heating and cooling systems are powered by fossil fuels) while increasing the use of renewable energy. In addition to accelerated phase-out of coal, the government will ban the sale of petrol and diesel vehicles from 2040 onwards. French diesel taxes are also increasing to further incentivise diesel drivers to switch to petrol, hybrid, or electric cars (Monschauer et al. 2018). Note, a carbon tax is also in place in France (not the focus of the current case study). The country’s carbon tax is among the highest in the world and was scheduled to increase steeply in the coming years. It covers the transport, industry and buildings sectors.
Climate ambition	[A]	In 2019, France passed the Law on Energy and Climate to introduce the objective of carbon neutrality by 2050 as part of its commitment to the 2015 Paris Agreement. The National Low-Carbon Strategy was updated in 2020 to reflect this objective.

²⁸ Provisional data

²⁹ £30,793 in 2021, converted to US dollars for consistency in jurisdictions, using the average exchange rate for 2021 of 1.3757. Source: <https://www.exchangerates.org.uk/GBP-USD-spot-exchange-rates-history-2021.html>

Data and evidence	[G]	A significant amount of information is available for the case study.
Diversity of approaches	[A]	An “indirect” taxation instrument, administered at national level.
Lever design		
The Bonus Malus system is one of the main instruments of climate policy in the French transport sector. It was introduced on January 1, 2008, by the Finance Law as amended for 2007 and Decree No. 2007-1873. This system combines fees and rebates for the purchase of new vehicles: vehicles purchased or leased whose emissions exceed certain limits pay a fee, whilst vehicles that do not exceed these limits are entitled to a bonus or rebate. Revenues from emission-intensive vehicle fees are used to finance these bonus payments for low-emission vehicles to incentivise car purchasing decisions. Since its inception in 2008, the French government has adjusted the system several times. Since 2017, only electric and hybrid vehicles have been eligible for bonuses. Since 2018, the fee must be paid for vehicles with CO₂ emissions equal to or greater than 120 g/km. For that threshold, the fee started at €50, but the fee function increases considerably (EUR 1,050 for 140 g/km and EUR 4050 for 160 g/km). For vehicles with CO₂ emissions equal to or above 185 g/km, car buyers must pay EUR 10,500. In parallel, vehicles specially equipped to run on E85 super ethanol can benefit from a 40% reduction in carbon dioxide emission levels if their CO₂ emissions are less than 250 g/km. In addition to the existing tax (‘malus’), a ‘super malus’ targeting luxury cars was introduced in January 2018. Car buyers must pay EUR 500 per “fiscal horsepower” for powerful vehicles with more than 35 fiscal horsepower and the tax is capped at EUR 8,000³⁰. On the ‘bonus’ side, since January 2018, the bonus of up to EUR 6,000 (27% of the acquisition cost) is only granted for electric vehicles emitting less than 20 gCO₂/km. Vehicles with emissions between 20 and 120 gCO₂/km are not affected by the Bonus Malus System, i.e. hybrid vehicles with emissions between 20 and 60 gCO₂/km are no longer eligible for a EUR 1,000 bonus payment. The bonus is granted directly to the buyer by means of an application form or is deducted from the price of the vehicle, when agreements are in place with dealers. At the same time, an additional bonus of EUR 1,000 (EUR 2,000 for non-taxable households) is granted when an old diesel or gasoline vehicle is scrapped and a used electric vehicle or a vehicle with a more efficient internal combustion engine is purchased (CEDEF, 2018). In the case of new electric and plug-in hybrid vehicles, the bonus is EUR 2,500. Two and three-wheeled vehicles, as well as electric quads, are eligible for a 20% or 27% subsidy of their acquisition cost (EUR 100 or EUR 900 maximum), depending on their power. In addition, non-		

³⁰ Fiscal horsepower is a unit indicating the tax burden on a vehicle. In the past it was related to engine power, hence this measure is also referred to as “fiscal power”. In Spain, for example, it is usually obtained from the engine capacity. In France, the calculation is different: since July 1998 (Article 62 of Law n°98-546 of 2 July 1998), the fiscal power depends on the standardised CO₂ emission value in g/km and the maximum engine power in kW.

taxable households can receive a subsidy of 20% of the cost when purchasing electrically assisted bicycles.

Lever effectiveness

In terms of **GHG emissions effectiveness**, the scheme has successfully contributed to reducing average passenger car emissions since its implementation. The scheme has been very effective in shifting vehicle sales towards more environmentally friendly vehicles, thereby removing old vehicles from French roads (according to plans, the scrappage bonus is likely to remove around 100,000 old vehicles) and lowering average emissions. Though progress has slowed in recent years, average emissions have reduced significantly from 149 gCO₂/km in 2010 to 111 gCO₂/km in 2017. The current European target for emissions levels of new cars sold is set at 95 gCO₂/km by 2024. For 2025 onwards, the EU fleet-wide CO₂ emission targets are defined as a percentage reduction from a 2021 starting point.

By promoting electric vehicles, the Bonus Malus scheme also contributes to improve local air quality in urban areas.

Although it seems clear that the scheme has proven to be effective in reducing GHG emissions in France and local air conditions, the impact of this measure on GHG emissions is difficult to isolate. The scheme may have a rebound effect, as the lower fuel expenditure for consumers due to more efficient vehicles may lead to an increase in vehicle use and thus in petrol/diesel consumed (and thus on emissions).

Based on projections of average annual vehicle kilometres and the number of new registrations, the French Ministry of Ecology estimates that measures to improve the performance of new passenger vehicles, including for example a CO₂ label for passenger cars, could lead to GHG emission savings of 5.4 million tonnes CO₂e (MtCO₂e) in 2020, 8.0 MtCO₂e in 2025 and 9.8 MtCO₂e in 2030. Compared to emissions from private cars, which in 2015 were around 66 MtCO₂e, the impact of the scheme could be substantial considering that the Bonus Malus system is likely to be the dominant driver of reductions. However, these figures also imply that additional measures would be necessary to significantly reduce emissions from the transport sector in the future.

In terms of revenues generated, since 2014 the Bonus Malus scheme has generated surplus revenue for the French general budget. For 2018, the malus was set at a level that cover the costs of the bonus payments (EUR 261 million) and the additional bonus for scrapped vehicles (EUR 127 million).

Note all data in this section taken from Monschauer, Y & Kotin-Förster, S 2018.

Key lessons learned

An important lesson was that incentives for new registrations were initially underestimated, leading to an overall increase in car sales and high costs for the bonuses paid at the beginning of the scheme. For example, during the first three years of implementation, the French state lost EUR 300 million (on average) per year because car manufacturers took advantage of the

large steps between bonus payment categories in previous years. The instrument has been continuously adapted to meet efficiency and effectiveness criteria.

It is also difficult to forecast the evolution of supply and demand. However, the establishment of a modelling function as a basis for malus rates has made it easier to predict the market reaction as a function of vehicle purchase cost elasticity. Consumers do not always understand how the system works and how it relates to air quality measures for passenger cars. Combining the Bonus Malus system with air quality criteria also remains a challenge, as the system is designed to be technologically neutral and it does not explicitly differentiate between petrol and diesel vehicles. Although diesel cars benefit slightly more from the system due to their lower average GHG emissions, they cause more particulate emissions than petrol cars. One success factor is the support of the French car industry, which has welcomed the bonus payments and acknowledges that they are financed by the malus charges.

8.10 Case study 6

		Lever type: Indirect tax (Environmental impacts of farming) Jurisdiction: Wallonia, Belgium
Context		
Population and GDP	[A]	Wallonia is a high-income region. According to the National Bank of Belgium, in 2021, the region’s GDP per capita was EUR 31,568, somewhat lower than Scotland (42,362 US dollars (Scottish Government, 2023a)). ³¹ The 2022 population of Wallonia was 3.6 million, based on Iweps (Institute Walloon of L'évaluation, De La Prospective Et De La Statistique) data. This is slightly lower than in Scotland (5.4 million in 2022 (Scottish Government, 2023c)).
Administrative and legal arrangement/competencies	[G]	Administered at sub-national level
Shared challenges	[G]	Wallonia is committed to transitioning towards a low carbon and environmentally friendly economy. It is also committed to increasing the use of renewable energy. For example, the region has decided to use Sustainable Capital Markets as a means of financing green projects and has created a Sustainability Bond Framework. One aim of the Bond is to help the region achieve its objectives in energy efficiency and low carbon buildings, sustainable mobility, resources/land use, and affordable housing. For the period 2019-2024, Wallonia has established an investment plan (in French PWI - Plan Wallon d'Investissement), which involves an investment budget of more than €5 billion to channel investments in social and environmental assets in several pillar sectors. The region has also established low emission zones to limit the most polluting vehicles and improve air quality. However, Wallonia must respond to several energy-related challenges, such as the planned closure of nuclear power plants and an ageing and energy inefficient residential building stock (Coppens et al.,

³¹ £30,793 in 2021, converted to US dollars for consistency in jurisdictions, using the average exchange rate for 2021 of 1.3757. Source: <https://www.exchangerates.org.uk/GBP-USD-spot-exchange-rates-history-2021.html>

		2022). About 80% of Scotland's total land area is under agricultural production, it is useful to focus a case study on this sector.
Climate ambition	[A]	The Walloon Region has made an ambitious commitment to reduce its GHG emissions by up to 55% by 2030 and by 80% to 95% by 2050 (compared to 1990). Moreover, on 4 February 2021, Wallonia adopted its first strategy for the Circular Economy, which shows ambitions for 2025, such as: (i) 50% of relevant public procurement contracts will integrate circular economy principles or circular criteria; (ii) 75% of public information and communications technology (ICT) contracts will be circular and ethical; (iii) All public demolition/deconstruction contracts and subsidised contracts will include a materials inventory and selective deconstruction; and (iv) Reuse materials will be used in all public works contracts and progressively in works subsidised by the Walloon Region (European Commission, 2022).
Data and evidence	[R]	There is limited data beyond the number of people affected and the annual revenue. However, there is detailed information on the coefficients applied by type of animal and crop.
Diversity of approaches	[G]	Indirect tax, administered at sub-national level
Lever design		
In Wallonia, agriculture represents about 40% of the total surface water abstractions. The main pressures on water resources are non-point source pollutions by nutrients and pesticides. Key pollutants from the agricultural sector are nutrients and pesticides as well as sediments from erosion. With the decrees of 12 December 2014 and 23 June 2016, the regional Parliament adopted measures aimed at financing water policy by optimising mechanisms for recovering the costs of services linked to water use, including costs for the environment and water resources, in application of Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Thus, the tax on environmental impacts from farming, in force since 2015, is intended to address the environmental costs associated with the impact of agricultural activities on water resources, in particular livestock manure and the use of fertilizers and phytosanitary on crops. In particular, the tax is based on the environmental charge, a tax base that considers not only the retained livestock, the "livestock" environmental charge, but also cultivation activities, the "land" environmental charge. Through the spreading of nitrogenous fertilisers and the use of plant protection products, these activities have a significant impact on water resources.		

The tax on environmental charges generated by farms in the Walloon Region is one of the key incentives in Wallonia's environmental policy. The aim of the tax is to meet the requirements of the Water Framework Directive 2000/60 of 23 October 2000, the ultimate objective of which is to achieve good ecological and chemical status of all Community waters. As such, it is not directly related with GHG although it is useful as it encourages farmers to use water more efficiently.

Principles: This system is based on the environmental load generated by the farm and it takes into account: (i) retained livestock or environmental loads generated by run-off from livestock manure storage infrastructures on the farm reaching groundwater or surface water, as well as pollution due to effluent storage infrastructures that do not allow storage for at least 6 months; and (ii) cultivation activities that generate, through the application of nitrogen fertilisers and the use of plant protection products, damage to aquatic resources.

Farmers concerned: Farmers who meet at least one of the following three conditions are subject to the tax: (1) Keep live more than three head of livestock stock with an environmental load of more than three units (this unit is not defined in the literature identified, but is assumed to relate to/the same as head of cattle); (2) Have an area of crops, other than grassland, of at least half hectare; and (3) Hold an area of grassland of at least 30 hectares.

Calculation of environmental load (taxation formula): $N = 2 + N1 + N2$ where N is the number of environmental load units, N1 is the "livestock" environmental charge. The load is determined by summing the products resulting from multiplying the number of animals in each category by its nitrogen coefficient (shown in the table below). This coefficient reflects the value of annual nitrogen production per type of animal.

N2 is the "land" environmental load. The charge is determined by summing the products resulting from multiplying the areas under crops and grassland by the following coefficients:

- 1) crop coefficient: 0.3
- 2) organic farming coefficient: 0.15
- 3) "Grassland" coefficient: 0.06
- 4) "Organic grassland" coefficient: 0.03

These coefficients reflect the average nitrogen residue in the soil, the average use of pesticides and the erosive potential of crops and meadows.

The Government may assimilate certain agricultural practices that preserve the quality and condition of groundwater and surface water to organic crops within the meaning of the coefficients.

$N2 = \text{area per category} \times \text{coefficient for the corresponding category}.$

Cattle	Dairy cow	0.5538
	Suckler cow	0.4062
	Cull cow	0.4062
	Other cattle over 2 years old	0.4062
	Cattle less than 6 months old	0.0615
	Heifer 6 to 12 months old	0.1723
	Heifer 1 to 2 years old	0.2954
	Bull from 6 to 12 months	0.1538
	Bull from 1 to 2 years old	0.2462

Sheep and goats	Sheep and goats under 1 year old	0.0203
	Sheep and goats over 1 year old	0.0406
Equines	Equine	0.3446
Pigs	Sow	0.0923
	Boar	0.0923
	Fattening pigs and gilts	0.0480
	Fattening pigs and gilts on biolitter	0.0277
	Piglets (4 to 10 weeks old)	0.0117
Rabbits	Mother rabbits	0.0222
	Fattening rabbits	0.0020
Poultry	Broilers (40 days)	0.0017
	Laying or breeding hens (343 days)	0.0037
	Pullets (127 days)	0.0017
	Breeding cocks	0.0026
	Ducks (75 days)	0.0026
	Geese (150 days)	0.0026
	Turkeys (85 days)	0.0050
	Guinea fowl (79 days)	0.0017
	Quails	0.0002
	Ostriches and emus	0.0185

Tax exemptions or reductions: The tax includes two exemptions: (1) "Livestock" environmental charge (N1): is zero when the farm holds a certificate of compliance for livestock effluent storage facilities or when this certificate is in the process of being used; and (2) "Land" environmental charge (N2): the first thirty hectares of a farm are exempt from the tax. This exemption is calculated by multiplying the farm's average "land" environmental load unit by 30. The average "land" environmental charge unit for the farm is obtained by dividing the "land" environmental charge (N2) by the total surface area of the farm.

Applicable rate: The basic rate of the tax per environmental load unit linked to the farm is set at €10 from 1 January 2015. This basic rate will be indexed based on the consumer price index in force six weeks before the indexation date.

Taxation data: The data integrated into SIGEC (detailed agricultural data filled by each farmer for the purpose of compliance with EU Common Agricultural Policy) as part of the Wallonia Agriculture Code are used to establish the tax on environmental charges.

Source for information in this section: Portail de wallonne, 2023; Interview.

Lever effectiveness

The tax concerns some 13,500 taxpayers and generates annual revenue of around €1.2 million. The view from an interviewee indicates the tax may not be as effective as it could be, as the rate of taxation is low and the polluting nature of certain types of crops is not considered in the tax calculation formula. Only the state of cultivation or grassland and whether it is organic are currently considered in the formula for determining the amount of tax.

Key lessons learned

This instrument is simple to apply and generate revenues. It sends a signal to the market that an increasingly scarce resource such as water needs to be better managed, otherwise a tax will have to be paid. This tax is applied in what is a key sector for Scotland and covers a large part of its territory, so it could feasibly have a significant effect. Moreover, it could potentially be applied without major legal/administrative complications.

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