UNITED NATIONS

HANDBOOK ON CARBON TAXATION

FOR DEVELOPING COUNTRIES

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Foreword to the 2021 United Nations Handbook on Carbon Taxation for Developing Countries

The United Nations Handbook on Carbon Taxation for Developing Countries is a new publication developed through the work of the United Nations Committee of Experts on International Cooperation in Tax Matters ("the Committee") and its Subcommittee on Environmental Taxation Issues ("the Subcommittee").

Environmental taxes are an important part of the portfolio of economic instruments that countries have at their disposal to address climate change and environmental degradation. These instruments provide the dual benefit of expanding revenues needed for public investments towards a green transition, while incentivizing the reduction in emissions and pollution by giving economic actors a market signal. Evidence also shows that environmental taxation and expenditure have the potential to promote a range of macroeconomic benefits, such as increased employment, economic diversification and improved competitiveness of domestic industries.

For these reasons, well-designed and implemented environmental taxes can play an important role in building fairer, more resilient societies. Although tax is only part of the solution, there is significant scope to make better use of fiscal policy to reach climate and environmental goals and to contribute to sustainable development.

Environmental taxes are on the agenda of many developing countries, both for generating revenues and for meeting countries' commitments on climate change and sustainable development. These taxes figure prominently in the Addis Ababa Action Agenda[1] and have a key role to play in achieving the Sustainable Development Goals. Further, the 2015 Paris Agreement on climate change requires all parties under the UN Framework Convention on Climate Change to undertake efforts to curb greenhouse gas emissions in the years ahead.

The Covid-19 pandemic has renewed the urgency to shape more resilient societies and to accelerate the fight against climate change with the goal of building a more inclusive and sustainable future. To establish more equitable systems within and among countries, the United Nations Secretary-General António Guterres has repeatedly called for aligning all recovery efforts with the 2030 Agenda for Sustainable Development and the Paris Agreement.

1 The Addis Ababa Action Agenda is the outcome document of the Third International Conference on Financing for Development, and it provides a new global framework for financing sustainable development. It consists of a comprehensive set of policy actions by Member States, with a package of over 100 concrete measures to finance sustainable development, transform the global economy, and achieve the Sustainable Development Goals. The full text can be found at https://sustainabledevelopment.un.org/index.php?page=view&type=400&nr=2051&menu=35

To make progress towards achieving these commitments, the Secretary-General has also called for efforts to shift the tax burden from income to carbon, and from taxpayers to polluters. Some of the actions that countries can take to move in this direction are putting a price on carbon, eliminating fossil fuel subsidies, and fast-tracking renewable energy and green infrastructure projects. Such approaches will increase the ability of countries to raise the necessary revenues to respond to the climate and development crises and build more resilient societies.

Climate change is a global challenge that requires global efforts. This does not mean that individual countries remain powerless to make a significant change, but rather that the leap toward carbon neutrality demands action both at the country level and on a global scale. Developing countries play a fundamental role in this transition, while taking into account the principle of common but differentiated responsibilities and the necessity for action by the international community to support all countries in the adoption and the achievement of ambitious goals.

Countries in every region and at all levels of development can take action to reorient their domestic tax policies to raise revenues while fighting climate change. Multilateral solutions and international cooperation can amplify and support these individual endeavours.

To contribute to these international efforts, and to support developing countries aligning fiscal policies with the commitments of the 2030 Agenda and the Paris Agreement, the Committee initiated work on environmental taxation in 2017. During its 15th Session, the Committee established a Subcommittee (coordinated by Ms. Natalia Aristizabal Mora) with the following mandate:

> *The Subcommittee on Environmental Taxation Issues is mandated to consider, report on and propose guidance on environmental tax issues and opportunities for developing countries in particular, on the basis that it shall:*
>
> - *Identify and consider the most pressing issues where guidance from the Committee may most usefully assist developing countries in this area and initially report to the Committee on such issues at its sixteenth session in 2018;*
> - *Pay particular attention to the application of carbon taxes, and report on current country practices, policy considerations and administrative issues;*
> - *Provide draft guidance on such issues as are approved by the Committee at its sessions.*
>
> *In undertaking its work, the Subcommittee shall consult broadly and seek to engage with others active in the field. The Subcommittee shall report on its work at each session.*

Given the urgency and global nature of the climate crisis, within the broader environmental taxation area, the Subcommittee prioritized work on carbon taxation and developed this Handbook on Carbon Taxation for Developing Countries.

Carbon taxes are a policy option aimed at curbing carbon-based emissions responsible for climate change, in line with the commitments undertaken by countries under the Paris Agreement.

Greenhouse gas emissions, particularly carbon emissions resulting from the burning of fossil fuels, are the main drivers of climate change and have a range of other health and environmental consequences. For the most part, however, current energy prices do not reflect the societal cost of carbon emissions, i.e. the costs that societies will have to bear because of increases in global temperatures, extreme weather conditions, and other effects of climate change.

Carbon taxes put a price on the emission of greenhouse gases, thereby motivating companies to invest in cleaner technology or switch to more efficient practices. Likewise, consumers may be incentivized to invest in energy efficiency, change their lifestyle habits or, where options are available, switch to cleaner forms of energy. Moreover, additional revenues could be used to invest in sustainable development.

From a practical point of view, carbon taxation is an instrument that is relatively simple to administer, and it can take advantage of existing fiscal infrastructure present in most countries. For example, one way to introduce carbon taxes is to apply a tax on fossil fuels (e.g. gasoline, diesel etc.), which is proportionate to the carbon content of those fuels. Since most countries in the world apply some type of tax or levy to fuels, they most likely already have in place the necessary administrative structure to introduce a carbon tax.

This Handbook on Carbon Taxation for Developing Countries responds to country demands for clearer practical guidance on policy and administrative aspects of designing and implementing these taxes. The Handbook outlines some of the common reasons why countries might want to introduce a carbon tax and provides options for policy design and administration that might cater to the different needs and priorities of countries. It also provides a guide on how to increase the acceptability of carbon taxation and how to deal with potential interactions that a carbon tax may have with other existing laws and policy measures.

The Handbook is meant as a practical guide containing many real-world examples and practical tools, including checklists to assist policymakers and government officials. It seeks to address carbon taxation issues in a clear form, to raise awareness of potential challenges and opportunities as well as the pros and cons of possible options for countries and agencies, and ultimately to assist in making decisions on policy and administration that are informed and reflect country priorities as well as

local and global realities.

This Handbook has been the work of many authors, in particular the Members of the Subcommittee on Environmental Taxation Issues. The members of the Subcommittee[2] contributing to this Handbook at various times were: Natalia Aristizabal Mora (Coordinator); Susanne Åkerfeldt (Ministry of Finance, Sweden); Stefan Agne (European Commission); Robin Damberger (Institute for Austrian and International Tax Law, WU Vienna); Jorge Antonio Deher Rachid (Brazil); Álvaro de Juan Ledesma (Repsol); Tatiana Falcão (Coalition of Finance Ministers for Climate Action, The World Bank); Dang Ngoc Minh (Viet Nam); María Amparo Grau Ruiz (Universidad Complutense, Madrid, Spain; and Northwestern University, Chicago, USA); Sverker C. Jagers (University of Gothenburg, Sweden); Gregory Leshchuk (IATA); Eike Meyer (GIZ); Christopher Morgan (KPMG); Gabriela Mundaca (The World Bank); Marlene Patricia Nembhard-Parker (Jamaica); Rodrigo Pizarro (University of Santiago, Chile); Carlos E. Protto (Argentina); Aart Roelofsen (the Netherlands); Karl-Anders Stigzelius (Ministry of Finance, Sweden); Anna Theeuwes (Shell); Kurt Van Dender (OECD); and Ingela Willfors (Sweden).

Additional authors who significantly contributed to the drafting and review of the Handbook were: Niklas Harring (University of Gothenburg, Sweden); Simon Matti (Luleå University of Technology, Sweden); Daniel Waluszewski (Ministry of Finance, Sweden). Finally, Christian De Perthius (Université Paris Dauphine); Dhruv Sanghavi (Maastricht University) and Attiya Waris (University of Nairobi) also contributed to discussions that were instrumental to the drafting of this Handbook.

The Subcommittee wishes to gratefully acknowledge Rodrigo Pizarro for the technical editing of the publication, Pedro Scudeller and Charles Dakay for the graphic design and formatting of the final text. Substantive and editorial support to the Handbook was provided by the United Nations Secretariat, in particular Elena Belletti and Olivier Munyaneza (Financing for Sustainable Development Office). The contribution of Jiin Jeong in the editing phase is also gratefully acknowledged.

Capacity development activities based on this Handbook encouraged and contextualized feedback from developing countries, helped identify priority areas for improvement, and contributed to better targeting the messages and examples in the Handbook. The Subcommittee wishes to express gratitude to all the government officials that were involved in capacity development activities and provided their feedback and contributions.

2 The list reflects all persons that were, at one point, members of the Subcommittee – although some members have changed in the course of the 2017-2021 mandate. The Subcommittee is comprised of members with wide and varied experience, including in governments, academia, international organizations and the private sector. Members are listed in alphabetical order, with their countries (in the case of government officials) or current affiliations (in other cases). However, reference to countries and other affiliations is purely for informational purposes, as membership in the Subcommittee is assumed on a personal capacity.

The Subcommittee carried out discussions by virtual means, and also met productively on many occasions.[3] Short meetings were also held in the side-lines of some Committee sessions. The generosity of country and institutional hosts of Subcommittee meetings is warmly acknowledged, as is the valued support of the European Commission for some of these meetings, and of the Governments of India and Norway in supporting this and other Committee projects.

While consensus has been sought as far as possible, it was considered most in accord with a practical Handbook to include some elements where consensus could not be reached. As a consequence, the views expressed in the Handbook may not reflect the understanding of all authors, and specific views expressed in this publication should not be ascribed to any particular person involved in its drafting.

Finally, this Handbook is conceived as a living work that should be regularly revised and improved, including by the addition of new chapters and additional materials of special relevance to developing countries. This will continue to increase its relevance to users and its significance in the capacity building efforts of the United Nations and others.

3 Subcommittee meetings were held in Brussels (March 2018, hosted by the European Commission); Paris (January 2019, hosted by the International Chamber of Commerce); Brussels (August 2019, hosted by the European Economic and Social Committee); Paris (February 2020, held at UNESCO); and virtually (September 2020, January and February 2021).

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List of Acronyms

°C	Degree Celsius
ASAs	Air Services Agreements
Can$	Canadian dollars
CBAM	Carbon Border Adjustment Mechanisms
CBT	Consumption-based taxation
CCL	UK Climate Change Levy
CDM	Clean Development Mechanism
CEMS	Continuous Emissions Measurement Systems
CER	Certified Emission Reductions
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalents
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CPLC	Carbon Pricing Leadership Coalition
CPIs	Carbon Pricing Instruments
EEDI	Energy Efficiency Design Index
ETS	Emissions Trading System
EU	European Union
EU ETS	European Union Emissions Trading System
EUR	Euro
EVs	Electric vehicles
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GJ	Gigajoule
ICAO	International Civil Aviation Organization
IEA	International Energy Agency
IMF	International Monetary Fund
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
kg	Kilogram
LPG	Liquified petroleum gas
MARPOL	International Convention for the Prevention of Pollution from Ships
MB	Marginal Benefit
MPC	Marginal Private Cost

MRV	Monitoring, Reporting and Verification
MSC	Marginal Social Cost
MXN	Mexican peso
MW	Megawatt
NDCs	Nationally Determined Contributions
NCRE	Non-Conventional Renewable Energy
OECD	Organisation for Economic Co-operation and Development
PPA	Power Purchase Agreement
ppm	Parts per million
RGGI	Regional Greenhouse Gas Initiative
RPS	Renewable Portfolio Standards
R&D+i	Research, Development, and Innovation
SDGs	Sustainable Development Goals
SEK	Swedish krona
tCO_2e	Tonne of CO_2 equivalent
UN	United Nations
UNCLOS	UN Convention on the Law of the Seas
UNFCCC	United Nations Framework Convention on Climate Change
US$	United States dollars
WCI	Western Climate Initiative
WTO	World Trade Organization
VAT	Value-Added Tax

Chapter 1: Introduction to the Handbook on Carbon Taxation for Developing Countries

1. The United Nations Handbook on Carbon Taxation for Developing Countries is a response to the need, often expressed by developing countries, for clear and holistic guidance on the application of carbon taxes as a policy option that is geared towards (i) curbing carbon-based emissions that are responsible for climate change; and (ii) living up to the commitments undertaken by countries under the Paris Agreement.

2. Climate change is an existential threat. Countries are facing dramatic impacts because of global warming. Given the substantial costs associated with climate change, jurisdictions are increasingly adopting more ambitious and sophisticated policy instruments to support climate mitigation, especially market-based policy instruments such as carbon taxation.

3. This Handbook outlines some of the common reasons why countries might want to introduce a carbon tax and provides options for policy design and administration that might cater to the different needs and priorities of countries. It is meant as a practical guide, and it contains many real-world examples and practical tools, including checklists to guide on the design and administration of the tax.

4. This introduction is meant to provide an overview of the topics covered in each chapter of the Handbook.

5. The primary intention of **Chapter 2: An Introduction for Policymakers** is to give policymakers all the elements to make an informed decision when considering whether to introduce a carbon tax, and when weighting the benefits of a carbon tax over other carbon pricing instruments. It seeks to provide an introductory overview of key concepts and policy options further developed throughout the Handbook, as well as to discuss high-level concepts such as the goals of carbon taxation. Although Chapter 2 is intended primarily for policymakers, it was drafted having in mind the wide range of potential users of the Handbook, from politicians to practitioners.

6. Chapter 2 also briefly touches on the international framework that provides the backdrop for the introduction of carbon taxes; a more detailed discussion can be found in the **Appendix: Carbon Taxation in the Context of the United Nations**.

7. **Chapter 3: How to Generate Public Acceptability for Carbon Taxes** argues that, to introduce a feasible carbon tax, policymakers should consider not only how to achieve the best technical design, but also how to ensure public acceptability. Therefore, governments interested in the implementation of carbon taxes must consider strategies to achieve immediate acceptability and permanent acceptance.

The specific measures needed must be assessed considering the contextual factors of the jurisdiction that implements the tax. The chapter outlines the main factors affecting people's attitudes towards carbon taxes, and how these factors can be dealt with to increase acceptability – including adequate information and effective communication, as well as potential substantive changes in the tax design, such as implementing compensatory measure, focussed exceptions or revenue use, or even more complex policy-mixes.

8. **Chapter 4: General Issues in Designing a Carbon Tax** explores some of the main issues raised in designing a carbon tax, and examines the basic elements in carbon tax design, such as tax incidence, taxing power, tax base, and the point of regulation. The chapter conducts this analysis in light of two principal design approaches, the Fuel Approach - which uses fuels as the tax base and sets the tax rate based on carbon content, and the Direct Emissions Approach - which establishes the tax directly on emissions (the two approaches are then discussed in detail in Chapter 6).

9. **Chapter 5: Setting the Tax Rate** discusses why setting the tax rate can be an important design element and examines several practical approaches and their theoretical framework; however, an important conclusion of this chapter is that it is more important to get started and potentially set a sub-optimal tax rate, than delay the introduction of a carbon tax while trying to achieve the perfect rate.

10. **Chapter 6: Carbon Tax Design Approaches in Practice** discusses in detail the two main approaches that were introduced in Chapter 4, namely the Fuel Approach and the Direct Emissions Approach. The Fuel Approach is discussed based mainly on the example of Sweden, while the Direct Emissions Approach is outlined making frequent reference to the case of Chile.

11. **Chapter 7: Addressing Undesired Effects on Households and Firms** outlines the design features to keep in mind to counter potential undesired effects of the carbon tax. Potential adverse effects include distributional and equity impacts on households, competitiveness impacts on firms and carbon leakage. Chapter 7 also takes the reader through some methods to assess the actual risk of such negative effects, and finally policy options to counter them, including tax-reducing measures, support measures and trade-related measures.

12. **Chapter 8: From Design to Administration: Practical Application of a Carbon Tax** discusses the administrative issues raised by a carbon tax in light of different design approaches, and uses the cases of Sweden and Chile to explore some of the administrative decisions that authorities must make in this context. The chapter discusses general administrative issues, such as the role of tax authorities, inter-administrative cooperation, and the role of public consultations and information

campaigns to improve administration and public acceptance. The chapter also analyses, considering the different approaches, the detailed regulations of the core elements of good administration that promote compliance, and the administrative requirements for ex-post evaluation to ensure the necessary adjustments to both the design and administration of the tax.

13. **Chapter 9: Revenue Use** discusses the complexities of revenue use in the context of the political economy of carbon tax design and implementation. Although it is usually not considered their primary purpose, carbon taxes may raise significant revenues; the use of those revenues co-determines carbon taxes' net economic benefits (beyond the direct environmental benefit); it can affect distributional impacts, as well as strengthen support for their introduction or increase. The chapter identifies possible revenue uses, and discusses how countries can establish revenue commitments and communicate those choices. It also provides an overview of current and potential tax revenues around the world.

14. **Chapter 10: Interactions Between the Carbon Tax and Other Instruments** aims to support policymakers in identifying which existing policy instruments might interact with the carbon tax in relation to its intended goals and effectiveness, i.e., whether they are complementary (the various policies enhance each other's performance); overlapping (the various policies duplicate the same effect); or countervailing (the various policies have adverse effects on the behaviour of investors, consumers etc). Once the interactions are identified, the chapter provides guidance on how to address them by adjusting the carbon tax; the other instrument; creating a hybrid approach; or adding complementary policies. Instruments that are specifically analysed in this chapter are other carbon pricing mechanisms, fuel/energy taxation, incentives for clean technology and fossil fuel subsidies.

Chapter 2: An Introduction for Policymakers

1. Introduction

15. Climate change is an existential threat. Countries are facing dramatic impacts because of global warming. Given the substantial costs associated with climate change, jurisdictions are increasingly adopting more ambitious and sophisticated policy instruments to support climate mitigation, especially market-based policy instruments such as carbon pricing.

16. Carbon pricing is more cost-efficient than other policy instruments and has co-benefits that can support additional development objectives, such as resource mobilization. Carbon taxation is a common carbon pricing instrument (CPI). In this chapter, we examine the rationale for carbon taxation and compare it with other carbon pricing policy alternatives, such as Emission Trading Systems (ETS). We also touch on the theory and motivation behind carbon taxation.

2. The environmental problem: climate change and carbon emissions[4]

17. The long-term stability of the climate depends on the Earth's radiation balance. Radiation comes from the Sun and is reflected by the Earth by emitting outgoing longwave radiation. Greenhouse gases act as insulators to longwave radiation coming from the surface. This is known as the natural greenhouse effect and is the reason the Earth's surface is warm enough to sustain life.

18. Carbon dioxide (CO_2) is a naturally occurring greenhouse gas (GHG). Through the carbon cycle, the Earth keeps a balance of CO_2 in the atmosphere. Natural emissions are kept balanced because processes that generate emissions of CO_2 (such

4 This section is intended as a general overview on the link between carbon emissions and climate change. For a more detailed discussion, there are a wide range of scientific publications that can be consulted, mostly for free. For example, the National Aeronautics and Space Administration (NASA) website offers a comprehensive (but easily consultable) description of the causes and effects of climate change, as well as a discussion of why there is scientific consensus on global warming being caused by human activities. You can navigate the website from this tab: https://climate.nasa.gov/evidence/. The Intergovernmental Panel on Climate Change (IPCC) reports (https://www.ipcc.ch/reports/) offer a deeper assessment of climate change causes and impacts, based on the most advanced scientific knowledge available and drafted drawing on the expertise of a wide range of scientists and organizations. Academic texts used in college-level degrees in environmental science (or similar) provide exhaustive, rigorous discussions of the mechanisms behind climate change; the best approach might be to contact your local university and inquire about what text they are using to teach introductory courses on climate change or climatology; or alternatively, to check out the websites of major universities, which often include the syllabus for courses they offer and the text of reference (although these textbooks might be harder to find locally). Finally, for a "journalistic" approach, two very good, simple and informative sources are the BBC's "very simple guide" to climate change: https://www.bbc.com/news/science-environment-24021772 and the National Geographic Global Warming Overview: https://www.nationalgeographic.com/environment/global-warming/global-warming-overview/

as the respiration of humans and animals, and decomposition) are compensated by emission-capturing processes, including photosynthesis and emissions absorbed by the ocean.

19. Besides natural processes, CO_2 can also be produced by human activities, most notably the burning of fossil fuels.[5] These emissions are called "anthropogenic". Since the industrial revolution, human activities have caused a dramatic increase in carbon emissions in the atmosphere,[6] which has disrupted the Earth's natural balances. Carbon emissions concentrate in the Earth's atmosphere, exacerbating the natural greenhouse effect by trapping heat. This phenomenon, known as global warming, is causing the Earth to warm faster than normal.

20. The Earth has already experienced an increase in temperature of around 1 degree Celsius (°C) since the industrial revolution. This is caused directly by carbon emissions' higher-than-natural concentrations, which the Earth would take a long time to rebalance. Therefore, even if we stopped all emissions today, it would still take up to 200 years for the last artificially emitted CO_2 particle to leave the atmosphere.

21. As the planet warms, a series of reactions ("positive feedbacks") kick in and amplify the warming effects that cause climate change. For example, increasing temperatures cause ice to melt at the Poles; this results in a loss of white surface, which is crucial in reflecting part of the Sun rays. With lower reflective surface, more rays are absorbed, causing the Earth to warm further.

22. In a recent report of the Intergovernmental Panel on Climate Change (IPCC), scientists estimated that an increase of 1.5°C with respect to pre-industrial levels (0.5 more than today) would cause the climate to change with severe consequences to natural and human systems. With an increase of 2°C, the Earth may reach a tipping point, where it is no longer possible to reverse global warming.[7]

23. The effects of climate change are already visible and felt by many communities around the world, especially the most vulnerable. These effects include sea-level rise causing flooding, loss of coastal lands and the destruction of islands; heat waves, affecting human health and causing droughts; increased precipitation causing flooding and the destruction of economic infrastructure, and more extreme weather events such as hurricanes that generate significant economic losses. These impacts also cause the loss of biodiversity and migration of species (e.g., decline of marine fisheries).

24. Global warming will also likely have severe impacts on agriculture, and it

5 For simplicity, we refer to fossil fuels as the main source of anthropogenic carbon emissions. However, it should be noted that CO_2 emissions are also generated by biofuels, by cement production, and by a range of other activities. Other GHG emissions can be generated both by fossil fuel production, and by other sources: for example, methane can leak from oil wells, but is also a by-product of farming and of garbage disposal in landfills.

6 Concentration of CO_2 in the atmosphere rose from 280 parts per million (ppm) before the Industrial revolution, to almost 415 ppm in February 2020. Source: Lindsey, 2020.

7 IPCC, 2018.

could cause famines at the global level. The situation would be made worse by the fact that around 60 percent of people will live in cities by 2030, without direct access to food sources.[8]

3. Carbon emissions: a global policy problem

25. As mentioned, anthropogenic carbon emissions are mainly a consequence of the combustion of fossil fuels. They are generated in connection to a range of human activities, including the production of consumer goods, transportation, and electricity generation. High emissions are also generated by intensive and unsustainable agriculture and farming.[9]

26. Whenever fossil fuels are burnt, carbon emissions cannot be completely eliminated. Unlike other pollutants, CO_2 cannot be effectively "filtered" before being emitted into the atmosphere – at least not with current technologies.[10] Currently, the only way to generate zero emissions is by using non-fossil fuel sources (for example, renewable energy sources such as wind, solar, geothermal, etc.) or reducing activities that are energy intensive such as cement, steel, and pulp production.

27. Emissions can be reduced by using more efficient technologies that require low fuel use to generate the same amount of energy. By technological abatement, we mean the introduction of a new technology or practice that can reduce emissions without changing the fuel source; for example, a car with a more efficient engine that will do more mileage per litre or gallon of gasoline. More efficient technologies also have important co-benefits in reducing local pollution.

28. It is important to underscore that carbon emissions are a global problem, meaning that emissions in any part of the world contribute equally to warming the planet, and not just the location where they were generated. This is another characteristic that sets CO_2 apart from other pollutants, and it poses challenges but also offers opportunities.

29. An obvious opportunity is that, if carbon emissions are reduced anywhere in the world, this will have impacts on a global scale. As mentioned above, artificial carbon-capture technology is not yet scalable to the needs of the whole planet; however, emissions can be "absorbed" by supporting natural processes, for example, by increasing forested lands. Because of the global nature of carbon, a power plant in the city generating emissions and a forest outside the city absorbing emissions could theoretically balance (or "offset") each other, resulting in net zero emissions.

8 UN Habitat, 2020.

9 For a breakdown of emissions by sector and geographical location, the World Resources Institute's Climate Watch tool offers a range of tools to see historic and current data. Available at https://cait.wri.org/

10 Some technologies, such as carbon capture and storage, can intercept carbon emissions before they are released in the atmosphere, and safely store them in geological formations. However, such technologies do not prevent fossil fuels from being utilized; moreover, they are not yet commercially scalable.

The forest could even be in another country or continent.

30. Some countries, and even corporations, already use the concept of carbon offsets to counter their carbon emissions. For example, an airline can pay for planting a certain number of trees or sponsor renewable energy technology in a different part of the world, to balance the emissions generated by the fuel burnt in their planes. However, this approach has generated some criticism.[11]

31. The global nature of carbon also poses significant challenges, most notably due to the problem of collective action, since to be effective, all countries must act together to reduce carbon emissions and fight against climate change. Therefore, a global approach and agreement are necessary.

32. In 2015, United Nations Member States committed to three ground-breaking international agreements: the 2030 Agenda for Sustainable Development (2030 Agenda), the Addis Ababa Action Agenda (which contains the foundation for financing the 2030 Agenda) and the Paris Agreement. These form the basis of the international architecture on climate change and carbon pricing initiatives globally. See Box 1 for more details.

Box 1. International Agreements on Climate Change

The 2030 Agenda contains 17 Sustainable Development Goals (SDGs) and 169 targets to advance the three dimensions of sustainable development: economic, social, and environmental.[12] Nine of the 17 goals contain pledges related to environmental protection, based on the consideration that environmental protection is inextricably linked to sustainable and equitable development, and that countries should aim to decouple economic growth from environmental degradation (SDG 8.4).

The 2030 Agenda does not contain specific commitments related to the reduction of carbon emissions but acknowledges that the United Nations Framework Convention on Climate Change (UNFCCC) is the primary platform to address global actions to fight climate change.

The UNFCCC, signed in 1992, was the first international agreement on climate change. It is an umbrella convention that provides a framework for both market and non-market approaches to address climate change.

As follow-up agreements to the UNFCCC, the Kyoto Protocol (signed in 1997, entered into force in 2005) and the Paris Agreement (signed in 2015) emphasized different climate protection instruments, each at its own time. The Kyoto Protocol introduced a market-based approach for the reduction and control of GHGs. The Paris Agreement greatly broadened the set of tools to address carbon emissions and climate change, to include green financing and trading in green bonds, as well as regulatory and fiscal instruments.

The Paris Agreement also broadened the scope of the fight against climate change, as it requires countries at all levels of development to use their best efforts through Nationally Determined Contributions (NDCs)[13] to curb GHG emissions and to commit to the GHG reduction goals assigned under Article 2 of the agreement.

Source: T. Falcão, A Proposition for a Multilateral Carbon Tax Treaty, IBFD, 2019

11 Some experts point out that carbon offsets are an insufficient incentive (and sometimes, a perverse one or even disincentive) for companies and individuals to lower their carbon footprint; some also question the effectiveness of some forms of offsetting (for example, planting trees) in removing carbon dioxide from the atmosphere in the long-term. Another criticism relates to the efficiency and effectiveness of the implementation of these types of programmes since they are hard to monitor and can be more expensive than alternative approaches. For some discussion, see UNEP, 2019.

12 United Nations, 2015.

13 NDCs are the successors of binding targets for greenhouse gas emissions.

4. Carbon pricing

4.1 *Carbon emission reductions and Government policies*

33. CPIs are policy instruments that use prices to provide incentives for economic agents to support climate mitigation. Today, they are considered fundamental to support environmental policy and climate mitigation, and their use has increased across the world. See Box 2.

34. CPIs are based on the theory of externalities by Pigou (1920) and further developed by Coase (1960) and Baumol (1971). Externalities are a side effect of an economic activity, which may have positive or negative effects on other economic agents (household or firms). The argument is simple: an economic agent is generating an externality through the process of producing (e.g., fossil-fuel based energy) or consuming a good (e.g., fossil fuels) or service. Since the production of the externality has no price, the environmental costs, associated with the consumption or production activity, are not fully internalized by the economic agent responsible for the activity. As a result, the polluter passes the environmental cost of doing business on to society.

35. Economic agents, such as firms and households, do not usually have an incentive to adopt technologies that lower carbon emissions derived from their polluting activities; it is often cheaper to just continue emitting, regardless of the effect this has on the environment. Therefore, policy intervention is needed to reduce emissions and, in the case of climate policy, mitigate climate change and achieve the NDC pledges under the Paris Agreement.

36. In general, governments can take two policy approaches to reduce carbon emissions. First, regulatory approaches, often known as "command-and-control" policy instruments, that rely on the introduction of specific regulations to change practices. These approaches include emission standards, reporting requirements and emission licensing, among others. Second, carbon pricing. Both types of instruments are effective at reducing pollution, but there is considerable evidence that carbon pricing does so at a lower cost. Therefore, it is considered a more cost-efficient policy instrument.[14]

37. Carbon pricing tries to affect market solutions by imposing an explicit or implicit price on the externality. If the price is set correctly, the social cost of the externality will be internalized in the cost of producing the good or service, generating a market incentive to achieve the optimal production and reduce the pollution to the socially acceptable level.[15]

14 Baumol and Oates, 1988.
15 Baumol and Oates, 1988; Bovenberg and Goulder, 2002; and Goulder and Schein, 2013.

38. There are many types of CPIs. However, in the context of climate mitigation, it is generally understood that this refers to two principal instruments, carbon taxes and Emission Trading Systems (ETS) also known as cap-and-trade.[16]

Box 2. Carbon pricing initiatives around the world

Carbon pricing can be used by countries to lower their carbon emissions and meet their NDC pledges under the Paris Agreement. In fact, two-thirds of all submitted NDCs (around 100 countries) consider the use of carbon pricing to achieving their emission reduction targets. It is estimated that it could alone reduce the cost of climate change mitigation by 32 percent by 2030 and achieve full potential when coupled with coherent energy and environmental policies.

As of May 2021, 64 CPIs had been implemented, and three more scheduled for implementation; of these, 33 are carbon taxes, primarily applied on a national level. Although these instruments represent around 21.5 percent of global GHG emissions, less than 3.8 percent of emissions are priced at levels consistent with the Paris Agreement goals.

Private investors are also starting to take carbon pricing into account when making financial decisions even in jurisdictions where instruments have not been introduced yet.

Source: World Bank, 2016 and 2021

4.2 Carbon pricing instruments

39. Carbon taxation is a policy instrument where a government sets the price of carbon and lets the market determine the total emissions. An ETS is a pricing instrument where the government sets a maximum limit on emissions and lets the market determine the price of carbon emissions and emission abatement efforts through a mechanism that allocates and trades emission permits (or allowances) across firms. In effect, taxation and ETS consist of different instruments that achieve the same objective of pricing carbon emissions.

40. There are also hybrid systems that have design elements of both 'pure' instruments, for example, tax regimes that accept emission reduction projects to reduce the tax burden, or ETS with floor and ceiling prices. All these instruments have specific design features but are based on the same principle: to internalize environmental damage through carbon pricing as an incentive to reduce emissions.[17]

41. It is also important to note that there are several other instruments that a country may introduce, or already have in place, which in practice sets a price on carbon, for example, taxes on energy, excise taxes on fossil fuels, resource taxes, among others. The interaction between carbon taxes and those instruments will be explored in Chapter 10.

42. An ETS is generally considered to be more complex than a carbon tax because it requires a specialized institutional system to establish the rules for the transaction of emission allowances. This is difficult and costly and has only been implemented effectively in developed countries. The most well-known experiences are the European Union (EU) emissions' trading system that covers European

countries, the Western Climate Initiative that involves trading between California and Quebec, and the Regional Greenhouse Gas Initiative (RGGI) that regulates States in the Northeast of the United States.

43. There are many obvious advantages in implementing a carbon tax instead of an ETS. It is simple, it does not require a complex monitoring, reporting and verification (MRV) system, and it can be implemented through the existing tax instruments such as excise taxes and duties. See Table 1 for details.

44. An ETS, on the other hand, is often perceived as a market instrument that reduces emissions more cost-efficiently than a tax, because it creates an emission trading market that can access lower abatement costs across firms and can be linked across jurisdictions. However, the literature is clear that under similar conditions, taxes and ETS are equivalent and provide the same incentives for emissions reductions.

45. However, ETS do provide an advantage in real world situations, since firms and other economic agents can access a broader range of opportunities to lower the costs they would have to incur to reduce their emissions. In an ETS, a firm can trade with another firm and buy permits instead of lowering their own emissions – in case the latter is cheaper. For example, a tax combined with an offset market can replicate any cost-efficiency advantage associated with an ETS, but with potentially lower administrative cost. This can be a feature that is particularly attractive for developing countries. See Appendix 1 for a discussion.

Table 1. Advantages and disadvantages of different carbon pricing instruments

	Advantages	Disadvantages
Carbon tax	Generation of revenues. Certainty in costs for economic actors. Depending on the format, can require more or less administration. Cost-effective.	A priori uncertainty in quantity of emissions reduction (however, the tax rate can be adjusted over time to meet emission reduction goals; see Chapter 5 for more information on how to dynamically set the tax rate).
Command-and-control instruments	Often requires less administration. Easier to enforce.	Regulation is usually insufficient to achieve carbon reduction goals. Does not generate revenues. Costly (as in, not cost-effective).
ETS	Generation of revenues. Provides certainty in emission reduction goals. Cost-effective.	Uncertainty in costs does not necessarily incentivize investment in low-carbon technology. Can be administratively more complicated than other measures, e.g., carbon tax, due to the need to set up a carbon market, auctions, etc.

Offsets	Can be more cost-effective. Provide incentives to reduce emissions beyond the tax base.	Market not well developed and subject to manipulation. Risk of low additionality (due to manipulation and/or other uncertainties).

5. A Carbon Tax

46. A carbon tax, for the purposes of this Handbook, will be defined as a compulsory, unrequited payment to general government, levied on carbon emissions or its proxy that can confer a reduction in corresponding carbon-based (equivalent) emissions in the atmosphere and is thus characterized as having both environmental purpose and effect.[18]

47. This follows the general Organisation for Economic Co-operation and Development (OECD) definition of environmentally related taxes as "compulsory, unrequited payment to general government levied on tax-bases deemed to be of particular environmental relevance".[19] In this sense, carbon taxes can be seen as a specific type of environmental tax, as per the OECD definition of "[taxes] whose tax base is a physical unit (or a proxy of it) that ha[ve] a proven specific negative impact on the environment", namely CO_2.

48. The definition presented above suggests that a carbon tax can be set on emissions, as is the case of carbon taxes that have implemented what we refer to as the 'Direct Emissions Approach' or, alternatively, its proxy. Given the close relationship between carbon content and emissions in the case of fuels, taxes on fuels set at a rate consistent with carbon content can be considered as a proxy for carbon emissions and, therefore, should also be considered a carbon tax. In this Handbook, we will refer to these type of taxes as adopting the Fuel Approach.

49. Although the Handbook focusses on taxes from fuel sources, using either the Fuel or Direct Emissions Approaches, these should be considered examples of broader approaches. In effect, while the Direct Emission Approach can consider any type of emission, the Fuel Approach focuses on emissions from fossil fuels based on their carbon content. However, the Fuel Approach can be broadened to also include the emissions from the whole value chain, as, for example, in the case of the tax adopted in Finland on biofuels (see Chapter 6, for a discussion).

50. In theory, a carbon tax, as any other environmental tax, should be set at the marginal social cost of the damage generated (this is known as the social cost of carbon). In the case of climate change, the marginal social cost is global, and the

18 There is still a lot of debate around the definition of carbon tax, environmental tax and environmentally related tax, and those terms may have different meanings in different contexts. The definitions proposed here should be intended as working definitions for the purposes of this Handbook.

19 OECD, 2017.

cost of emissions reduction is local; as a result, the optimum tax set at the global level may be considerably higher than what a specific jurisdiction can effectively sustain economically.

51. Therefore, governments will have other considerations to determine the tax rate, such as emission reduction objectives or commitments (e.g., the NDCs), competitiveness, the distributive impact, coherence with other policy instruments and, above all, political viability. Therefore, in practice, carbon taxes are not set in terms of the socially optimum level, but rather in terms of the specific objectives of the jurisdictions that implement them. As a result, tax rates vary considerably across jurisdictions (see Chapter 5 for a discussion and for examples).

Box 3. Carbon taxes across the world

Many countries (among developing countries, Chile, Colombia, Argentina, Mexico, and South Africa) have already introduced carbon taxes at a domestic level. However, other countries have introduced taxes which may be called "carbon tax" but should not be considered carbon taxes from a technical perspective.

For example, some countries have taxes in place that are commonly referred to as a carbon tax but are in fact ad-valorem taxes on fuels, or taxes on motor vehicles. The distinction is relevant because those instruments, in practice, do not act like a carbon tax. They may be appropriate for raising revenue but will likely fail to produce the environmental effect that are usually associated with a true carbon tax (although they might reduce local pollution or bring other environmental benefits).

For example, an ad-valorem tax on gasoline might reduce car use, but not have any effect on the use of fuels for home heating, which also generate carbon emissions. Another example is that a carbon tax allows a different pricing between a traditional diesel and "cleaner" diesel (i.e., lower fossil content, achieved by blending with biofuels), while this would be more difficult with an ad-valorem tax. Since currently there is no single definition of what a carbon tax is, policymakers should be aware of possible methodologies in designing carbon taxes.

6. Motives for the introduction of a carbon tax

52. The primary purpose of a carbon tax is the reduction of carbon emissions (i.e., an environmental purpose). However, governments may also have additional or complementary goals while implementing these policies; for example, they may wish to also generate public revenues. Different policies provide different advantages and disadvantages. Depending on their priorities, governments may, therefore, prefer to implement one type over the other, or to combine elements of two or more policy objectives.

53. Below we provide a discussion of goals that governments may seek to address in their policies for emissions reduction. For each goal, we will discuss whether carbon taxes are the best-suited instrument, considering the advantages and disadvantages.

54. Although the primary focus of this Handbook is on carbon taxes, comparison

with other policy options to reduce carbon emissions is provided. The purpose of this comparison is to support policymakers in understanding whether carbon taxation is the best policy instrument for their country, depending on their desired policy objectives and institutional constraints.

6.1 Fighting climate change by reducing carbon emissions (the "green" dividend)

55. Carbon taxes are considered a cost-effective way to incentivise the reduction of GHG emissions by encouraging low-carbon emission behaviour, including the abatement of emissions through investment in technology. The reduction of carbon emissions is the primary tool to fight against climate change and complies with Sustainable Development Goal (SDG) 13 (Climate Action).

56. By implementing a tax, emitters are confronted with the environmental cost of their actions and forced to manage their carbon emissions. Carbon prices create incentives that spread up and down supply chains, delivering emissions reductions where they make sense, while simultaneously providing disincentives for new investments in carbon intensive technologies, as well as incentives for innovation. In addition, the reduction of emissions has other co-benefits to consider such as reducing pollution and, therefore, lowering health-related costs.

57. However, contrary to an ETS, a carbon tax does not offer the same degree of certainty on what will be the total emissions reduction in the economy (and therefore the contribution to the concentration of emissions in the atmosphere). The uncertainty derives from the fact that a carbon tax sets a price on emissions, and it is up to economic agents to decide how much to emit (based on the total amount they are willing to spend). Therefore, there is no assurance that any given tax level will result in the desired reduction in greenhouse gas emissions.

58. However, such a disadvantage can be reduced by adjusting the tax if the initial emissions reductions are considered not to meet the objectives. This will be discussed further in Chapter 4.

6.2 Generation of budgetary sources

59. Even though it is not their primary objective, carbon taxes can generate considerable revenues. Therefore, they can mobilize resources to support other development objectives. In this respect, an efficient redistribution of tax revenues may foster sustainable growth, creating new business and employment opportunities (often known as "green growth").

60. Furthermore, the design of the tax could include provisions to ensure that revenues compensate distributional concerns of particularly regressive effects, as

discussed in Chapters 7 and 9.

61. Moreover, where the tax rate is maintained, a reduction in emissions will reduce the tax base and affect revenue stability over time. To provide a growing incentive for emissions reduction, and to keep revenues stable, the tax rate should be revised periodically and possibly increased over time.

6.3 Promotion of investment in new technology

62. A major challenge for developing countries is to industrialise while reducing emissions. To reduce carbon emissions, many countries are shifting towards renewable energy. In the EU, for example, renewables are expected to reach at least 27 percent by 2030. Similarly, some oil producer and import countries have developed plans in the medium and long-term to reduce their dependence on oil and diversify their respective economies (e.g., Vision 2030 plan or China's National Climate Change Programme). However, other countries are still reliant on fossil fuels to develop their economy.

63. How to balance economic growth and reduction of emissions poses a crucial policy issue for both developing countries and industrialised countries introducing public policies to support decarbonization of their economy.

64. Carbon taxes provide an incentive for technological innovation to decarbonise, and, unlike emission standards (or command-and-control instruments), this incentive is permanent and is known as dynamic efficiency. Therefore, taxes encourage investment and innovation in alternative energy sources by making them cost-competitive with respect to fossil fuels.

65. Ideally, over time, continued investment in technologies for emissions' reduction will result in technological progress and reduce the cost of clean energy, therefore providing an accelerating mechanism for the reduction of carbon emissions. Moreover, this incentive will create new jobs while offering a competitive edge to industries.

7. Policy considerations in the introduction of a carbon tax

66. When introducing a carbon tax, policymakers will consider their goals and the advantages of a carbon tax over other instruments. They should also apply the four principles behind environmental policy discussed in Box 4.

67. Moreover, to facilitate the introduction and implementation of the tax, and to ensure that other overarching policy goals are not negatively impacted by the introduction of the tax, other considerations should be made. The sections below discuss issues such as instrument design, considering certainty and predictability

of the carbon tax; administrative burden; the prevention of distributional impacts; and the safeguarding of competitiveness. All these issues will be explored in more detail in subsequent chapters of this Handbook.

Box 4. Principles of environmental policy

When introducing carbon taxation, policymakers are (implicitly or explicitly) applying four core principles, even though they might not be stated in national legislation. These principles are (i) the polluter-pays principle; (ii) the principle of prevention; (iii) the precautionary principle; and (iv) the principle of common but differentiated responsibilities. The section provides an overview of these principles, and their theoretical underpinning.

(i) The polluter-pays-principle promotes the internalisation of environmental costs using economic instruments, considering the approach that the polluter should, in principle, bear the cost of pollution, rather than shift the cost of pollution to the community.

→ A carbon tax can internalize the environmental cost of pollution by making the polluter pay (and potentially, pass on to the consumer) a tax that is directly proportionate to the polluting content of the product consumed, produced, or extracted.

(ii) The principle of prevention provides that States have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States.

→ A carbon tax does not impede economic activity per se, although countries with high carbon tax rates (e.g., above US$40) may render carbon intensive investments less appealing. In essence, countries employing carbon taxes continue making use of their sovereign right to exploit their own resources pursuant to their own environmental and developmental policies. However, by attaching a price to pollution (i.e., by costing the environmental damage), countries employing carbon taxes at a high enough rate not only prevent the widespread use of carbon intensive fuels and technologies, but they also employ the required duty of care to make sure that the activities within the control of their jurisdiction do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction.

(iii) The precautionary principle is based on the concept that preventative measures should be put in place when there is a risk of future long-term harm to the environment that cannot be fully assessed at the time of the decision-making process.

→ By conceding to employ a tax instrument of environmental control, countries automatically acknowledge that there is a risk of future long-term harm to the environment if their emissions are not reduced or eliminated. Therefore, the introduction of a carbon tax is also the indirect embodiment and endorsement of the precautionary principle.

(iv) The principle of common but differentiated responsibilities assumes that all countries are to share the responsibility for avoiding environmental degradation, but with differentiated levels of engagement depending on their social and economic development.

→ The principle is implicitly included in every national carbon tax legislation in the form of the tax rate adopted by the country. Low- and middle-income countries employing carbon taxes are more prone to apply lower tax rates (particularly on first introduction) whereas high income countries are more likely to employ higher taxes, as further demonstrated in Chapter 5.

Source: Falcão, 2019

7.1 Certainty and predictability of the price of carbon

68. A carbon tax ensures cost certainty as the price is determined by the tax rate, and whatever the incidence of the tax (i.e., whether it can be passed on to consumers or not), the cost cannot rise above this price. An ETS, on the other hand, suffers from inherent cost uncertainty. While allowances may be initially distributed for free, businesses will eventually have to pay for them, and since the price is determined by the demand and supply of emission permits or allowances, businesses will face price uncertainty.

69. A carbon tax offers stable and predictable carbon prices. Economic agents are aware that they will have to pay a certain price when the triggering event occurs, i.e., when they emit above a certain level. This enables businesses to plan their investments on low-carbon technologies based on reliable decision-making elements. Therefore, a carbon tax provides certainty on the cost that the polluter will consider when making decisions. In addition, in situations of emissions' reductions (e.g., economic downturn), the tax will continue to provide a price signal.

70. To ensure the continued reduction of emissions, policymakers should review the tax rate periodically and check whether the rate is still suitable to achieve the desired emissions' target. However, revision of the tax rate might provide uncertainty. A way to lower uncertainty is to contemplate an explicit adjustment mechanism in the tax legislation and inform businesses that the tax rate might be increased over time.

7.2 Administration of the carbon tax

71. Compared to other pricing mechanisms, a carbon tax is often simple and quick to implement, as well as easy to administer and collect at low costs, particularly when adopting the Fuel Approach. Generally, monitoring, reporting and verifying emissions is not simple, something that is normally required for carbon trading systems. However, carbon tax systems tend to work with a proxy (i.e., an assumed amount of carbon released when burning certain types of fossil fuels). The proxy price generally avoids the complexities of carbon trading systems. While the Direct Emissions Approach may be more complex to implement, both approaches are based on the current tax administration system and, therefore, can take advantage of the current institutional system.

72. Nevertheless, in both cases, complexity will be increased with additional features such as exemptions, subsidies, or refund mechanisms applied to support or compensate certain industries affected by the tax (e.g., agriculture, fisheries, etc.). For this reason, it is important to consider the existing overall fiscal framework when introducing a carbon tax, and carefully consider administrative interactions.

73. Additional details on the administration of carbon taxes, and on which elements may simplify or complicate their implementation, can be found in Chapter 8 on the administration of a carbon tax.

7.3 *Potential distributional implications and corrective measures*

74. Introducing a carbon tax may have distributional effects that raise concerns, especially impacting low-income household and consumers (see Chapter 7 for more details). To mitigate these negative economic distributive effects, governments may need to consider other changes to the tax system to alleviate the tax burden of low-income citizens; a more detailed discussion on how to design a carbon tax with this purpose will be provided in Chapter 7.

7.4 *Safeguarding the competitiveness of domestic industries*

75. In the absence of a global agreement, some countries or regions have unilaterally adopted a carbon price. A carbon price, whether in the form of a carbon tax or another instrument, forces domestic producers to partially internalize the cost of environmental damage, and therefore can raise their cost of production.

76. When the carbon tax is not imposed on producers outside that country or region, this can reduce the competitiveness of domestic producers as compared to foreign companies. The result may be that a polluting activity is reduced in geographical areas where environmental standards are higher but increased or taken over by competitors in places with laxer regulatory regimes. This is known as "carbon leakage".[20]

77. Dealing with competitive disadvantage and potential carbon leakage is important for government to gain industry acceptance of climate policy, including carbon pricing (see Chapter 7 for more details). Moreover, some governments are exploring carbon border adjustments mechanisms (CBAM) as a tool to deal with carbon leakage and competitiveness.[21]

8. Conclusion

78. Carbon emissions generated by humans are the main drivers of climate change, which will have extremely negative consequences for humans and for the environment. Even a warming of 1.5°C will impact ecosystems and societies much more severely than previously thought. Considering that the Earth temperature has already increased by 1°C post-industrial revolution, it is imperative to act quickly.

20 Ex-post studies have found little evidence confirming the existence of carbon leakage. See, for example, World Bank, 2015.

21 For example, in 2021, the European Commission adopted a proposal for a new Carbon Border Adjustment Mechanism, with the aim to put a price on the carbon content of imported products. For more references, please see Chapter 4.

79. Carbon taxation is one of the instruments available to countries to reduce carbon emissions efficiently. It can be used in conjunction with other environmental taxes, as well as other forms of regulation, to promote environmental protection and mitigate climate change. However, practical design requires considering several issues from tax rates to distributional concerns and administrative simplicity. These are all explored in this Handbook.

80. This chapter provided an overview of CPIs. It outlined the advantages and disadvantages of such instruments as opposed to a carbon tax, to allow policymakers to identify which are their most pressing concerns and whether a carbon tax is the right instrument. Carbon taxation was defined and the motivations behind implementing it were also explored.

81. To be feasible, however, carbon tax needs public acceptability, and it must be well designed. The next chapters will explore how to improve public acceptance and design a carbon tax from a practical point of view to ensure this instrument is effective at achieving the goals set by policymakers.

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Appendix 1: Emission Trading Systems (ETS) vs taxes and cost-efficiency

A1. ETS and taxes

82. An ETS is a carbon pricing system in which emitters are provided with emission allowances or permits and allowed to trade between themselves. In its most basic form, an ETS establishes a maximum cap for total emissions within a specific jurisdiction and assigns permits to emissions' sources.[22] Emitters can choose to use their permits, or to sell them to other emitters that have fallen short. Emitters are usually allowed to trade directly among themselves, sometimes across sectors and even jurisdictions. This way, polluters for whom it is easier or cheaper to lower their emissions can do so and sell their permits to companies that are having a harder time in reducing their emissions.

83. If the market works and there is no incentive to accumulate permits or speculate due to uncertainty, an ETS can take advantage of the different marginal costs of abatement or reduction across emitters, in different sectors, and even across multiple jurisdictions; i.e. a specific emitter will find it more convenient to just buy extra permits from another firm to avoid exceeding their allocation; while for the other firm, it is cheaper to install technology that lowers their emissions, or to source their energy from renewable sources. However, the key design consideration for an ETS is allowing trade across firms and sectors. If this is not permitted, an ETS in practice is the same as a tax in its basic formulation, namely the tax rate is determined by the minimum auction price set by the government.

84. Carbon taxes do not establish a market for exchanging "permits to pollute" The lack of a carbon market means that facilities liable for paying a tax will produce up to the point that the marginal benefit of producing an additional unit of carbon emission is equal to the cost determined by the carbon tax. In theory, the optimal pollution will be the same for a tax as an ETS. In practice, entities that pay a tax may not face continuous marginal abatement costs. This means that they may face the choice of paying the tax or closing, with no intermediate choice in the middle.

85. In effect, tax-liable entities cannot take advantage of the potential for lower abatement costs by exchanging tax commitments with entities that have lower costs or more investment flexibility.

86. This limitation of the carbon tax (i.e., the lack of a carbon market that allows purchasing of permits, which can be cheaper than reducing emissions) can be overcome by using mechanisms such as offsets, i.e., allowing economic actors to pay for an equivalent amount of emissions to be reduced or "absorbed" elsewhere,

instead of paying the tax. An example could be that a power plant in Canada pays a farmer in Zambia to plant a quantity of trees sufficient to offset the power plant emissions. This might be cheaper than paying the tax or the significant investment required to switch fuels, and it can have substantial co-benefits (for example, on the livelihoods of people in developing countries).

87. With offsets, a carbon tax can take advantage of lower abatement costs across or between economic sectors. In fact, a carbon tax combined with an offset market is essentially equivalent to an ETS that allows for trading of permits across different sectors (and/or jurisdictions). The decision on the specific design features of a tax will ultimately depend on institutional and political context of the jurisdictions implementing the instrument.

88. What is relevant for our purposes is that a tax can have additional complementary features that allow for more cost efficiency, making it comparable to the advantages of an ETS, but with potentially lower administrative costs. For this reason, carbon taxes with offset mechanisms can be easier to implement, especially in developing countries, while providing much of the same benefits as an ETS that allows for a secondary cross-sector market.

A2. Carbon pricing and markets

89. Climate change is a global problem with multiple impacts. The social cost of carbon can be defined as the monetary value of the damage generated by the emission of an additional (marginal) unit of carbon. Significantly, since the problem is global, the social cost of carbon should (in theory) be the same anywhere - and a carbon tax should therefore be set at the same level everywhere. However, as is discussed in Chapters 3 and 4, establishing a tax rate is often a political decision that considers many factors, including political acceptance.

90. Determining the social cost of carbon is complex, and there are many estimates. According to the 'Report of the High-Level Commission on Carbon Prices', a price consistent with the objectives laid out in the Paris Agreement varies between US$ 40-80 per ton of CO_2 for 2020 and between US$ 50-100 for 2030.[23]

91. While the social cost of carbon should be the same everywhere, the costs of carbon emissions mitigation may vary considerably across different jurisdictions. For example, the cost of labour or installation of a new technology might be different depending on the country. The economic implication is that reducing emissions is more cost-efficient in jurisdictions where the cost of reduction is lower.

92. For example, if the global social cost of carbon emissions is US$ 50, but it

23 CPLC, 2017.

costs US$ 10 to reduce emissions in Chile and US$ 40 to reduce in Europe, it is socially optimal to reduce carbon emissions in Chile rather than Europe. This is the logic behind integrating global markets: in short, to reduce the costs of climate change mitigation, some form of carbon market exchange is necessary. In the case of carbon taxes, this can be achieved by introducing measures such as offsets and compensations schemes across sectors and jurisdictions, and/or by introducing a sufficient level of coordination among States so that the real value of carbon pricing is similar in different jurisdictions.

93. According to recent estimates, global mitigation costs can be reduced by implementing integrated markets, and by reducing emissions wherever it is cheapest to do so, to almost 56 percent in the unconditional NDC scenario and by 44 percent in the conditional NDC scenario.[24] Similarly, Fujimori (2016) found that global markets could reduce welfare losses up to 75 percent.[25] Therefore, global integrated markets are a way to reduce global mitigation costs.

94. However, as emission reduction targets become more ambitious globally, all countries will have to contribute. In the example above, if all of Europe turned to Chile to offset emissions, at some point, the marginal cost of emission reduction in Chile would start to increase and level with that of Europe (for example, cheaper technologies reach capacity and economic agents must start employing more and more expensive technologies; or the capacity for reforestation starts declining; etc.).

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24 Hof, et al., 2017.

25 In the UNFCCC and Paris Agreement nomenclature, NDCs are the Parties' (country) explicit commitments for climate mitigations. Conditional NDCs refer to those commitments that depend on additional financial support.

Chapter 3: How to Generate Public Acceptability for Carbon Taxes

1. Introduction

95. A key element in implementing carbon taxes is their feasibility. Feasible policy measures are those that can be implemented and achieve their objectives efficiently. This chapter discusses how the policy feasibility of carbon taxes can be increased by improving its acceptability, as well as the elements that policymakers might want to consider to increase successful policy implementation.

96. First, the chapter examines the concept of a feasible carbon tax and how this relates to acceptability. Then, it explores the main factors affecting people's attitudes towards carbon taxes. Finally, it discusses how these factors can be dealt with to increase acceptability.

2. Designing a feasible carbon tax

97. Assessing climate policy designs is complex and is based on several criteria. The most relevant are the direct and indirect impacts on climate mitigation (i.e., effectiveness), implementation costs, enforcement capacity, and the side-effects of implementation (i.e., cost-efficiency).

98. It is generally accepted that carbon taxation is a more efficient policy instrument than rights-based or regulatory measures.[27] However, the effectiveness and efficiency of a carbon tax is also connected to *acceptability*, that is, the extent to which the policy, once implemented, has the potential to be accepted by the public. Only when these three components (i.e. effectiveness, cost-efficiency, and acceptability) coincide can the policy measure be considered as feasible. Although the focus of this chapter is on public acceptability of carbon taxation, the last section discusses how policy-mixes can simultaneously address all three components presented in Figure 1, and may, therefore, increase the probability for feasible policy implementation.

Figure 1. Feasibility as a function of effectiveness, cost-efficiency, and acceptability

2.1 The importance of acceptability

99. Even though carbon taxation is both an effective and cost-efficient policy instrument for mitigating climate change, it has only been implemented in a small number of jurisdictions around the world.[28] This can be attributed to contextual factors such as the system of government and policymaking, path-dependence, economic conditions and development, quality of government, and political culture.[29] However, research also points towards the highly politicized nature of climate policies and carbon taxes, making them sensitive to public opinion for their successful implementation.[30] Specifically, the limited prevalence of carbon taxes around the world reflects a lack of public acceptability, therefore making them unfeasible.

100. Low acceptability has been an issue in failed attempts to implement carbon taxes, for example, in Washington State (United States of America), where a ballot initiative for a carbon tax was rejected in both 2016 and 2018. Similarly, in France, the *gilets jaunes* (yellow vests) protests in 2018 forced the government to suspend its proposal to escalate the existing carbon tax.[31] Other experiences illustrate how

28 See Chapter 2.
29 Harring et al., 2019.
30 Feldman and Hart, 2017.
31 Maestre-Andrés et al., 2019.

low public acceptability has restricted policymaking and limited implementation.[32]

101. The public's attitudes towards the tax are also important once the policy has been implemented. Sustaining public *acceptance* (i.e., attitudes formed once the policy is in place) over time may be crucial for effective implementation (see section 4.5 of this chapter, "Consider trial periods"). Research on the implementation of other similar policy instruments (e.g. congestion charges and taxes in major European cities, such as London and Stockholm) shows that the level of acceptability was relatively low before implementation, but gradually increased after the policy was put in place.[33] One reason is that people's acceptance is linked to their experience with the policy and its intended effect.[34]

102. In sum, it is crucial for governments to recognize the importance of policy acceptability, and to design carbon taxes to minimize public resistance and reduce subsequent political and economic costs. To do so, knowledge on the factors that explain acceptability is necessary. However, although some factors are known to generate positive attitudes towards environmental policy, how they influence carbon tax acceptability specifically is still an open question. Thus, it is also a question that has yet to be answered for countries aspiring to implement carbon taxes in the future.

3. Explaining attitudes towards carbon taxes

103. Research has consistently identified several factors that drive attitudes with respect to environmental policy. Although not all of these have been systematically studied in relation to carbon taxes, there are reasons to believe that they constitute important drivers for carbon tax acceptability.

104. Research on policy attitudes has had a limited geographical scope – in fact, there is little systematic research on carbon taxation acceptability conducted in developing countries. This limits the possibility to draw definitive conclusions for developing countries.

105. A major strand of research focuses on *individual-level factors*. A person's core values, beliefs (e.g., about the seriousness of climate change and general risk perceptions), and personal norms (i.e., a feeling of moral obligation to act in a specific way) are relevant for their attitudes towards carbon taxation. In addition, people who are more aware of or knowledgeable about climate change, tend to be more willing to accept climate policy measures. Finally, a person's ideology is also a factor in explaining different attitudes to taxation. A consistent finding is that

32 Drews and van den Bergh, 2016.
33 Schuitema et al., 2010.
34 Jagers, Matti and Nilsson, 2017.

conservatives are usually less accepting of government intervention than those inclined towards the left.[35] It should, however, be recognized that few studies have focussed on the relationship between ideology and climate policy attitudes *outside* developed countries.

106. *Inter-relational factors* also determine policy attitudes. Most notably, trust in people's voluntary compliance with policy initiatives (i.e., interpersonal trust) and in the political-administrative system responsible for implementing and enforcing policies (i.e., institutional trust) affect policy acceptability. While interpersonal trust influences both the perceived necessity and potential effectiveness of a carbon tax, institutional trust relates to ability of political institutions to monitor and enforce compliance, to create incentives for behavioural change, and to present viable alternatives to the public.

107. There are significant variations in acceptability across different types of policy measures and between different policy designs. This suggests that the perceived characteristics and consequences of the proposed policy, or *policy-specific beliefs*, should also be considered as factors determining policy attitudes.[36]

108. Four interrelated policy-specific beliefs have been suggested to affect policy attitudes:

(i) perceived distributional effects - the extent to which the consequences of a carbon tax are perceived as being fair;

(ii) perceived impact on freedom of choice - whether implementing a carbon tax requires a change in behaviour and whether behavioural substitutes are readily available;

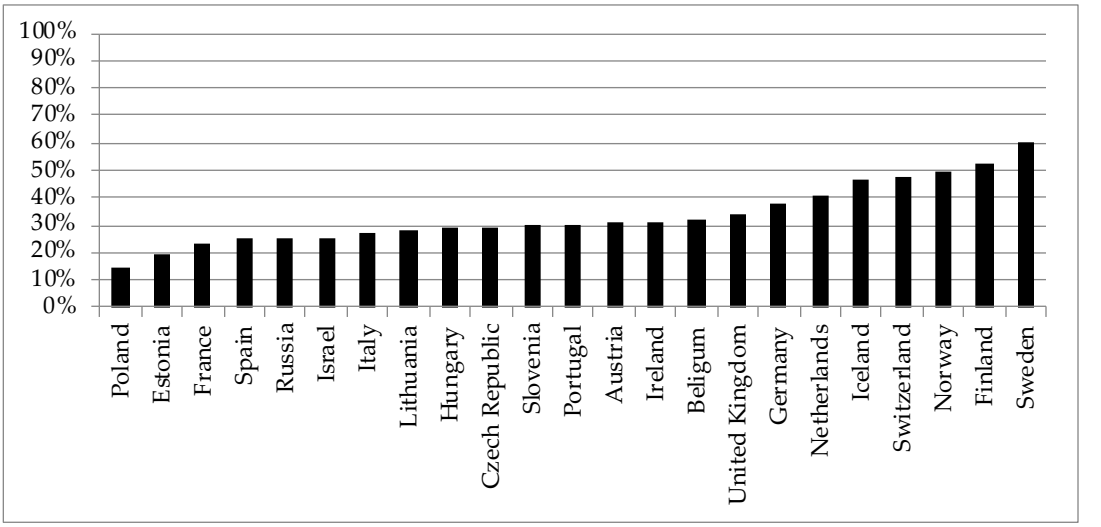
(iii) perceptions of policy *effectiveness* - the extent to which the proposed carbon tax is expected to achieve its aims, and;

(iv) personal outcome expectancy - the perceptions of how oneself will be positively or negatively affected by implementing a carbon tax.

109. It is worth noting that these policy-specific beliefs are the results of both individual-level factors and policy design.

35 See for example McCright et al. 2014; Harring & Sohlberg, 2017.
36 Samuelson & Messick, 1995.

Figure 2. Attitudes in favour of climate taxes across 23 countries



Note: The figure is previously published in Davidovic & Harring 2020 using the survey question 'To what extent are you in favour or against the following policies in [country] to reduce climate change?' and five response categories ranging from 'strongly in favour' (1) to 'strongly against' (5). The figure shows the proportion of respondents in percentages who are "somewhat in favour" or "strongly in favour" of climate taxes ("increasing taxes on fossil fuels, such as oil, gas and coal"), in 23 countries.
Source: European Social Survey 2016. Data available at https://www.europeansocialsurvey.org/data/download.html?r=8

110. Differences in policy acceptability are not only evident between individuals; there is also substantial cross-national variation (see Figure 2). Thus, it is important to consider how *contextual factors* might interact with the factors that determine policy attitudes. Cross-national variations have been attributed to various contextual features such as system of government and policymaking, path-dependency, economic dependencies, political culture, wealth and affluence, and social capital.

111. Recent studies also suggest that differences in political and institutional quality, or *Quality of Government* (QoG), can explain why policy attitudes differ significantly across countries. Higher levels of corruption correlate negatively with the acceptability of economic policy tools, such as taxes and subsidies, but positively with acceptability of command-and-control regulations.[37]

4. How to generate public acceptability

112. Attempting to implement an optimal, but unpopular, tax may not be feasible. However, a feasible carbon tax requiring public acceptability entails costs, such as designing a not fully efficient tax or setting the tax below the effective rate. On the other hand, even if combining all three objectives only results in the implementation of a second-best policy instrument in terms of effectiveness and cost-efficiency, one should keep in mind that this will nevertheless be significantly better than the

37 Davidovic and Harring, 2019.

risk of not implementing due to public protests.

113. In addition to the high indirect societal costs of attempting to forcefully implement an unpopular (yet optimal) tax, introducing policy measures that do not enjoy acceptability among the public should also be questioned from a perspective of democratic legitimacy. As such, striving for feasible approaches should be seen as a worthwhile route for most decision-makers. The specific factors that increase public acceptability are explored in Checklist 1 below. Additionally, examples of policy mixes are presented that can mitigate or overcome negative public attitudes towards carbon taxes.

Checklist 1. Achieving public acceptability

1. Ensure transparency in the decision process
2. Engage in dialogue with stakeholders
3. Consider revenue use for environmental objectives or affected groups
4. Ensure perceived fairness
5. Consider introducing carbon tax in broader tax reform
6. Establish trail periods
7. Consider policy mixes
8. Consider compensating disproportionately affected groups or stakeholders
9. Engage in public communication and information campaigns

4.1 The role of political and institutional trust

114. The characteristics and perceived quality of government are crucial for the acceptability of a proposed carbon tax. This is a challenge for most governments but will particularly be problematic in countries where overall trust in both the government and the administration are low.[38] Institutional trust is important since it is linked to people's general beliefs about the legitimacy of the political system, that is a belief that the existing political institutions and processes are the most appropriate. Without political legitimacy, most policies are difficult to implement and sustain.

115. Unfortunately, there are no known quick fixes or shortcuts to renewing institutional trust. Trust can, however, be generated for a specific issue, for example, a proposed carbon tax. Two key components are transparency in the decision-making process and stakeholder dialogue early in the process. A large body of social science research suggests that deliberative practices are crucial for generating

38 Davidovic and Harring, 2020

acceptability for policy decisions, particularly when they conflict with stakeholders' short-term self-interests.[39]

116. Furthermore, being transparent about the use of tax revenues can be a successful way to increase acceptability, especially among groups with low levels of political and institutional trust. Since earmarking is often not permitted in many countries, measures that clearly and transparently connect tax revenues with compensatory measures can be explored. Finally, it is important to note that many of the countries that have introduced carbon taxes suffer from relatively low corruption according to the Corruption Perceptions Index metrics.[40] In a situation where countries and governments experience low political trust, it is important to introduce the carbon tax in a way that would not further lower institutional trust.[41]

4.2 Focus on the revenues

117. A carbon tax is often a reliable source of revenue. This can contribute to increased levels of acceptability, especially if it can be convincingly demonstrated that welfare improvements will be achieved with the expected revenues.[42]

118. Since the costs for climate change adaptation are likely to increase in most countries, linking mitigation policies such as carbon taxation explicitly to the funding of adaptation efforts may increase acceptability. This emphasizes the local and national benefits from the tax, and instead of focussing exclusively on mitigation, it is also a way to build political alliances with domestic groups that benefit from adaptation. Policies where the benefits accrue to broader groups in society run a lower risk of being terminated when reviewed by Parliament.[43]

4.3 The importance of perceived fairness

119. Research has emphasized the importance of perceived fairness for policy acceptance.[44] Expectations that some groups will benefit more than others increase the perception of unfairness, resulting in negative opinions on a carbon tax across all stakeholders.[45]

120. However, people tend to have different perceptions on what fairness entails. On the one hand, multiple exceptions, such as tax reliefs for certain industries, increase perceptions of unfairness and, therefore, reduce acceptability across

39 See for example McLaverty and Halpin, 2008.
40 Transparency International, 2017.
41 Klenert et al., 2018.
42 Jagers and Hammar, 2009.
43 Klenert et al., 2018.
44 Maestre-Andrés et al., 2019; Drews and van den Bergh, 2019.
45 Evidence suggests negative opinions are not necessarily only among those who expect to be personally worse off than others, but also among morally righteous "winners" (Maestre-Andrés et al., 2019).

the public. On the other hand, allowing focussed exceptions for disadvantaged groups may increase the perception of fairness and, therefore, acceptability. These issues must be analysed considering the attitudes towards taxation in the specific jurisdiction.

4.4 Searching for windows of opportunity

121. Previous experiences in carbon tax implementation (e.g., in Sweden, Chile, Colombia, and Mexico) suggest that timing can be an important factor for increasing acceptability. Introducing carbon taxation as an isolated policy response will inevitably increase public attention, both positive and negative, compared to the case where the carbon tax is implemented as part of a broader tax-reform. This will also provide an opportunity for governments to signal more clearly the interlinkages between carbon taxation, other sources of governmental revenues, and potential plans for revenue-use.

4.5 Consider trial periods

122. Research on the acceptance of other economic policy measures, for example congestion taxes and charges, finds that there is stronger resistance before the policy is implemented. This suggests the importance of policy-specific beliefs, and that expected outcomes are a key driver for pre-implementation acceptability. Once implemented, people become familiar with the policy, and adjust their perceptions since their first-hand experience is less negative than what was initially expected.[46]

123. Therefore, trial-periods for implementation should be considered, so that groups who have negative perceptions can assess the policy impacts and change their opinion. However, although this has been shown to matter for policies where the local benefits are evident, for example, improved air quality and less congestion as discussed above, there is less evidence for policies where the positive outcomes are global. A related strategy, more relevant for carbon taxes, is to introduce a relatively low tax and then to gradually (and transparently) increase the tax rate along the way.

4.6 Examples of potential policy-mixes/packages

124. There are no simple solutions for some of the factors that drive the acceptance for carbon taxes. For example, the fact that people's core values affect their propensity to accept a carbon tax does not help policy design since (a) core values are difficult to change, and (b) it is difficult to design a tax that is sensitive to the great variation in people's core values.

46 See for example Schuitema et al., 2010.

125. On the other hand, *personal norms* are probably less challenging since such norms *can* be changed. Two important channels for such norm changes are education and the media. Thus, a long-term objective can be to educate students that those environmental policies are necessary for sustainable development. However, this is beyond the scope of this chapter, and we will instead concentrate on the factors more directly affecting policy-specific beliefs.

126. As mentioned in section 3, there are four policy-specific beliefs that have been identified as major drivers of (non)acceptance: (a) perceived distributional effects and consequences related to perceived fairness of the policy, (b) perceived impact on personal freedom, (c) perceived effectiveness, and (d) personal outcome expectancy.[47] Considering these beliefs, it is possible to increase acceptability by combining the tax with additional policy measures. Since there is little empirical evidence on this issue, the following exercise should be seen primarily as *food for thought* for policymakers when designing policy packages aimed at overcoming challenges constituted by the various policy-specific beliefs.

(Un)fairness in outcome

127. If studies in a jurisdiction show that unfairness in outcome is a reason why agents express disapproval of an intended carbon tax, reducing the potential resistance by combining the tax with compensatory measures should be considered.[48] This can be done in various ways. For example, a flat dividend (lump sum) will compensate for perceived "wallet"/income effects, especially among lower-income groups. If this compensation is connected to an annual income tax return, then a flat dividend can even have a redistribution effect, since many citizens with lower incomes may not have access to a car at all but will – in this example - still benefit from the dividend.

128. An alternative compensation scheme can be to connect the tax revenues to other policy goals, for example, compensation by improving healthcare, education or other policies aimed at increasing the general welfare.[49] Finally, avoiding exceptions is another approach that can lower resistance, since the tax will then "hit" individuals more equally.

47 It is true that all four aspects in a sense can be seen as different expressions of fairness, but here we disregard this and stick to the terminology in the literature. See Samuelson and Messick, 1995.

48 See further below under section 4.7, "Measuring acceptability in due time".

49 Such connections should not be conflated with earmarking, which is typically not compatible with many countries' constitutions.

Freedom

129. Introducing a carbon tax is often associated with reduced freedom (e.g., of movement). When the price increases, some people can only afford public transport or vehicles without combustion engines. For example, a common argument against the intended increase of the French carbon tax was that it would mainly affect people living in suburbs or in rural areas that had no alternative but to drive their car. To avoid such reactions, it is possible to combine the carbon tax with policies improving public transport or increasing access to the existing system, for example, through the provision of parking space nearby train or bus stations, or by subsidizing electric vehicles.

Effectiveness

130. A common argument against a carbon tax is whether it is necessary and will have the intended effect. These arguments cannot be overcome by complementing the tax with a compensation scheme. This challenge has to do with overcoming people's scepticism: i.e., lack of knowledge, conviction and eventually with experience.

131. To overcome scepticism, education and a communication strategy are important, as well as to explain to the public the benefits and the most likely outcomes of the implemented tax. The communication strategy can be built upon various lines of reasoning, for example, either by applying pure cost-efficiency arguments, or more ethical motivations, to argue that it is more *reasonable* that only polluters are paying, rather than all of society.

132. Policy measures are usually resisted *before* implementation. However, once the policy has been in place for a while, the level of acceptance tends to increase. Adopting a trial period (see above under section 4.5) can reduce resistance and reinforce public support gradually.

Personal outcome expectancy

133. Personal outcome expectancy resembles unfairness in outcomes but is specifically directed towards the consequences for the individual consumer or citizen. Nevertheless, the same logic can be applied to both, for example, the tax can either be complemented with direct compensation, such as a dividend or a deduction in the income tax return and/or in investments in more general welfare policies such as improved public transport, educational programmes, or improvements in the health sector.

4.7 *Measuring acceptability in due time*

134. Throughout this chapter, it has been emphasized that trying to predict if a prospective carbon tax will be considered acceptable is difficult and depends on specific circumstances. The reviewed literature suggests that the acceptability of carbon taxes is determined by several factors which vary across countries. Thus, there is not a universal "one-fit-all-solution". For these reasons, it is important to survey public opinion to understand and establish which are the main objections against the tax in each case and consider complementary policies that can help overcome these objections. The examples of how to develop policy mixes gives some insight. Furthermore, it is important to do this at an early stage of the decision-making process.

135. At least three approaches are possible. First, policymakers should be open to dialogue through consultation processes, which can provide important qualitative input into the designing of the tax. Second, it is important to determine and quantify objections to the tax. Third, (survey-)experimental approaches can be used to determine how specific policy packages will be received.[50]

5. Conclusion

136. Carbon taxes are effective and efficient instruments to support decarbonization, but to be implemented, they must be feasible. Feasibility requires acceptability, and taxes may generate considerable opposition. In many jurisdictions, such as Australia, France, Ontario in Canada, and Ecuador, carbon taxation, or the elimination of subsidies, has generated considerable opposition. In these cases, it has forced governments to change policy.

137. Therefore, governments interested in the implementation of carbon taxes must consider strategies to achieve immediate acceptability and permanent acceptance. Given the research in this area, and presented in this chapter, acceptability may involve simply providing adequate information and effective communication or may require implementing substantive changes in the tax design, such as implementing compensatory measures, focussed exceptions or revenue use, or even more complex policy-mixes.

138. The specific measures needed must be assessed considering the contextual factors of the jurisdiction that implements the tax. However, no government can afford to go ahead with a carbon tax without serious consideration of the conditions required to achieve acceptability; otherwise, the policy will simply not be feasible.

50 These have become frequent in the research literature and methodological guidance and can be collected from there (e.g., Fesenfelt et al., 2020; Hainmueller et al., 2014).

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Chapter 4: General Issues in Designing a Carbon Tax

1. Introduction

139. In this chapter, we will explore some of the main issues raised in designing a carbon tax. We examine the basic elements in carbon tax design, such as tax incidence, taxing power, tax base and the point of regulation.

140. We refer to the two principal design approaches, the Fuel Approach - which uses fuels as the tax base and sets the tax rate based on carbon content- and the Direct Emissions Approach - which establishes the tax directly on emissions. However, these will be discussed in detail in Chapter 6: Carbon Tax Design Approaches in Practice.

141. Finally, design mechanisms to deal with the undesired distributional effects on households and firms will be addressed in Chapter 7. As the choice of taxpayer and time of tax payment are also relevant for design, they are given some attention in this chapter, but are primarily dealt with in Chapter 8 on tax administration.

2. A carbon tax in context with other forms of taxation

142. A carbon tax is a tax on carbon emissions. However, in practice, the tax base is a product, a process, or a service; thus, it is typically considered a type of indirect taxation, and more specifically an excise tax. Therefore, a jurisdiction's experience with indirect taxation should be the starting point for considering the implementation of a carbon tax. See Box 5 for a definition of the types of taxes.

143. With indirect taxation, the producer or seller who pays the tax usually passes the cost on to the consumer as part of the purchase price of the goods or services. This means that a carbon tax, levied on fuels by weight or volume or on actual emissions, would be referred to as an indirect tax and more precisely an excise tax (or excise duty).

144. There are some issues that warrant special consideration when assessing how a carbon tax system may be implemented in a country with little or no experience in levying excise taxes. These will be further discussed below.

Box 5. Indirect and direct taxation

Taxes are generally divided into direct taxes and indirect taxes. Direct taxes are imposed on a person or property and are normally paid directly. Examples include personal and corporate income taxes and property taxes. An indirect tax, on the other hand, is levied on specific goods or the provision of services and is collected and paid to the tax authority by an entity in the supply chain (usually a producer or an intermediary such as a retailer).

There are basically two kinds of indirect taxes: sales taxes or value added taxes (VAT), and excise taxes on specific goods or services. The former is typically imposed in addition to a sales tax or value added tax.

An excise tax is usually expressed as a per unit tax established on a specific volume or unit of an item, whereas a sales tax or value added tax is an ad valorem tax and proportional to the price of the goods.[50]

Another difference is that an excise tax typically applies to a narrow range of products (such as alcohol or tobacco products or petroleum products) while a sales tax or value added tax is more generally applied to all sales occurring in a jurisdiction.

Examples of taxes

Direct taxes	Indirect Taxes
Income Tax Corporate Tax Property Tax Inheritance Tax Wealth Tax	Excise Duties, e.g., alcohol, tobacco, fuels, emissions Sales Tax Value Added Tax

3. Who faces the cost of a carbon tax?

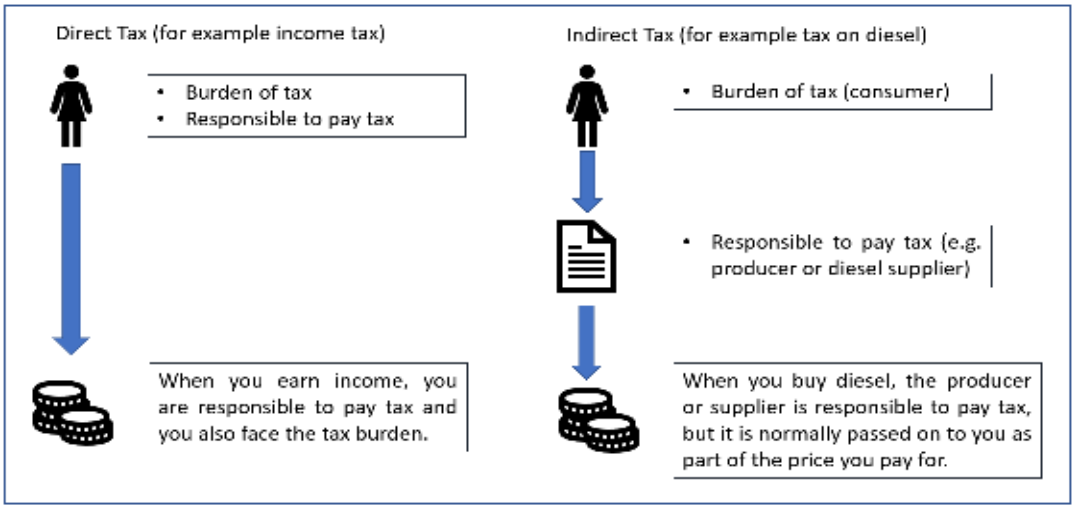
145. A carbon tax is aimed at giving consumers an incentive to change their behaviours and consume less carbon-intensive products. Carbon tax legislation determines which legal entity will be responsible for paying the tax, which is the taxpayer. The carbon tax incentive effect will depend on whether the taxpayer can pass the cost of the carbon tax on to the consumers, who are expected to change their behaviours. However, there may be a difference between who is targeted by the tax, who is legally responsible for payment, and who bears the tax burden.

146. The tax burden or tax incidence is the effect of a specific tax amount on the distribution of economic welfare in society. The introduction of a tax drives a wedge between the price consumers pay and the price producers receive, which typically imposes an economic burden on both producers and consumers. The tax incidence is said to "fall" upon those who ultimately bear the burden of the tax. The key issue is that the tax incidence or tax burden does not depend on where the revenue is collected (this is known as statutory incidence), but on the relative own-price elasticities of demand and supply which, in turn, determines the extent

50 There are also examples of ad valorem excise taxes, such as the carbon tax in Costa Rica which is calculated as a percentage of the price of certain fuels.

to which the taxpayer can pass the cost of the tax on to the consumers. Figure 3 presents this schematically.

Figure 3 Direct vs indirect tax – who pays the tax and who faces the tax burden



147. In the case of a carbon tax, the tax incidence depends on whether the entities obliged to pay the tax can pass it on to the consumers. If the entities can raise the product price to compensate for the full amount of the tax, the tax incidence falls completely on the consumers. It is important to emphasize that a change in consumer behaviour is needed for the tax to fulfil the purpose of reducing emissions. If the producer is neither able to abate emissions nor raise the product price, the producer will bear the full incidence of the tax, consumption will be unaffected, and carbon dioxide (CO_2) emissions will not be reduced.

148. There are several important issues to consider in this discussion. For instance, if a regulated price exists, it may not be possible to increase the price and pass the burden of the tax. In this case, the tax burden falls on the taxpaying entities, reducing their profits. Under these circumstances, a carbon tax will not reduce emissions and operate as a revenue raiser, at least in the short term.

149. However, most entities operate in markets where it is possible to pass on at least part of the increased cost to consumers. This means that, in most cases, the carbon tax incidence will be divided between the taxpayer entities and the consumers. There are, however, circumstances where the taxpayers are unable to transfer increasing costs to consumers, for instance when facing international competition. In these cases, it may be necessary to introduce exemptions and/or lower tax rates for certain sectors of the economy. Another option might be for jurisdictions to engage in regional cooperation on carbon taxation. These issues will be further discussed in Chapter 7.

4. Taxing power

4.1 Taxing power boundaries

150. The statutory power or authority to levy taxes varies across and within jurisdictions. It is established in rules that can take the form of constitutional arrangements, public law requirements, supra-national principles, or other legal obligations. These rules may influence specific design choices as well as identify potential gaps in regulation. Some countries, for example Indonesia, have adopted a fiscal decentralisation policy that gives provincial and local governments the authority to levy certain taxes and decide on the revenue use.

151. Considering taxing power arrangements early in the design process will help provide a clearer view on who should be involved in the design and implementation of the carbon tax and which resources policymakers have at their disposal to effectively implement the tax.

152. Cross jurisdictional value chains should also be considered. Implementing the tax at lower subnational level may involve more complexity due to the potential for double or multiple taxation of producers, retailers, and consumers. This may also require adjustments to deal with potential carbon leakage and competitiveness.

4.2 Existing institutional frameworks for setting and collecting taxes

153. In most countries, an institutional framework is already in place to implement taxes which involves a mandate and governance structure for setting and collecting taxes. Taxes are usually designed by Ministries of Finance and collected by Tax Agencies or Customs Authorities.

4.3 Distinct features of a carbon tax

154. Carbon taxes have some distinct features that make them different from other taxes. The primary purpose of a carbon tax is not to raise revenue but to change the behaviour of households and firms. An effective carbon tax should incentivise the reduction in carbon emissions.

155. Complementary or overlapping carbon emission reduction policies will affect the effectiveness of carbon pricing policy (see Chapter 10 for a discussion) and in some cases on how the tax is collected.[51] Given the policies and objectives of different government agencies, coordination across the government is important when considering the introduction of a carbon tax.

51 E.g., Singapore recently introduced a carbon tax that will not be collected through the Tax Authorities. The tax works through emission certificates. Although there is no carbon emission certificates market, the tax will be collected through the issuance of certificates, which will be done outside the Tax Authorities.

156. When designing a carbon tax, technical expertise on environmental and energy issues is crucial for setting the tax rate and the effective design and administration of the tax, particularly in the case of the Direct Emissions Approach (see Chapter 6). This expertise is usually found outside the Ministry of Finance and Tax Authorities. Therefore, cooperation between relevant government agencies is an essential part of the evaluation process leading up to the implementation of a carbon tax.

157. A carbon tax can also be designed using the existing excise tax administration system, particularly with the Fuel Approach (see Chapter 6). In this case, existing tax collection authorities can administer the tax effectively since implementation does not differ from other excise taxes and, therefore, cooperation between government agencies can be centred on broad carbon emissions' reduction policy strategies.

4.4 Constitutional rules regarding taxing power

158. National constitutions or similar documents often regulate taxing power. The constitutional requirements to introduce taxing powers or legislate tax rules may be more stringent than the constitutional requirements and checks to general legislation. This means that policymakers will need to consider constitutional requirements and the confines of the fiscal system in general, as they determine carbon tax design choices.

159. One example of a jurisdiction that has more stringent constitutional requirements for taxes is California (United States of America). Its constitution requires a two-thirds supermajority vote for tax measures, which heightens attention to what is a "tax". After the State of California created a cap-and-trade programme that auctioned emissions allowances, a court determined the system did not impose a "tax" and therefore did not require a supermajority for its approval.

160. Carbon tax design can be adjusted to accommodate such restrictions, but understanding constitutional requirements and boundaries upfront improves the effectiveness of implementation.

161. Some jurisdictions require that an independent legal body review the constitutionality of a tax bill before it is put in force. This is, for example, the case in France, where the original proposal of introducing a carbon tax in 2009 was blocked by the country's Constitutional Council. The Council expressed concerns that the tax included too many exemptions, among them certain industries, e.g. trucking, and agriculture, which would have made the tax unfair and inefficient. The carbon tax finally introduced in 2014 had addressed those concerns by broadening the scope of the tax and closing the loopholes in the prior proposal.

162. While many jurisdictions do not earmark tax revenues for specific purposes,

it is common for jurisdictions to specify in advance how environmental tax revenues will be used, particularly if they are assigned for additional environmental protection expenditures. Earmarking all or a portion of tax revenues can be a tool for a government to gain acceptability for the introduction of a carbon tax (see Chapter 9 on Revenue Use).

163. Some constitutional rules prohibit even this kind of informal earmarking by, for example, defining specific taxes that can be introduced in a limited way without mentioning a carbon tax. Exceptionally, this could mean that introducing a carbon tax could not be possible without constitutional changes. If this would apply, efforts can be made to change the Constitution, although that may be a long and difficult political process to undertake for the sake of a single tax.

164. However, even if policymakers need to address specific constitutional issues in their national jurisdictions, it is rare to find situations where constitutional requirements would significantly hinder the introduction of a carbon tax.[52]

4.5 *Special considerations for jurisdictions with subnational levels*

165. In case a jurisdiction has subnational levels, a country's constitution or public law arrangements will likely contain rules as to which levels of the state have taxing powers, e.g., municipal level, provincial level and/or federal level. These levels may vary depending on the types of taxes. Moreover, in the case of carbon taxes, both constitutional mandates that regulate environmental as well as taxes may be relevant.

166. In Canada, provinces and territories are required to have a carbon pricing instrument that meets a level of stringency determined by the federal government, otherwise a federal carbon pricing system applies; this is known as the federal backstop. The federal system is composed of a fee on fossil fuels, known as the fuel charge, and an output-based pricing system for large industrial facilities that applies either fully or partially depending on the circumstances in each province or territory.

167. Even if there is no conflict between subnational governments on mandates, it is helpful to stipulate which tax takes precedence. A subnational government may

52 When taxing power constitutional restrictions exist, they are often not applicable to other instruments. This means that alternative instruments could be considered, other than prices or regulations of carbon emissions. For example, the European Union (EU) initially explored the possibility of introducing a carbon tax framework for the Union. However, according to the EU Treaty rules, tax rules need to be approved by unanimity whereas an emission trading system could be introduced by qualified majority. The EU Emissions Trading Scheme (EU ETS) ended up being easier to introduce than an EU-wide carbon tax, mandatory in all the Member States, in large part for that reason. Discussions within the EU have continued to extend the current tax framework for energy products to also cover a mandatory carbon tax, as a complement to the EU ETS for sectors which are not covered by the EU ETS. It has, however, not proved possible to reach unanimous agreement on such a tax system so far. As the current EU legislation allows EU Member States to introduce a carbon tax unilaterally as part of their general excise duty regime, seven countries have chosen to do so up to date.

be inclined to introduce a carbon tax before action is agreed on at the national level. For example, in the USA, implementing a federal carbon tax is challenging, therefore many individual US states have implemented state or regional carbon pricing instruments.[53]

168. Clarity on the interaction of a carbon tax across levels of government could garner more support for introducing the tax at a subnational level, while calling for introduction of the same or a similar tax at a higher state level. The federal tax could become credible against the state tax once it is introduced. It could also be argued that the subnational tax should cease to apply once a federal tax has entered into force because of double taxation or compliance costs.[54]

169. Concerns over double taxation also occur at the supra-national level. For this reason, the European Union (EU) Commission proposed a carbon tax framework to be introduced for EU Member States. Such a wide mandatory framework has, however, not yet been decided within the EU. See Box 6 for discussion.

Box 6. Example of carbon taxes within the EU Energy Taxation Framework

In the EU. most fuels are subject to an excise duty. Eight Member States have also chosen to implement a carbon tax. These taxes are due at (i) production or extraction, or (ii) importation into the EU. However, a carbon tax in an EU country does not become chargeable until it is released for consumption to the Member State. This means that, in terms of administering and levying the carbon tax, the taxable event occurs as follows:

- The departure of taxable goods, including irregular departure, from a tax suspension arrangement.
- The holding of taxable goods outside a tax suspension arrangement where a carbon tax has not been levied pursuant to the applicable provisions of EU law and national legislation.
- The production of taxable goods, including irregular production, outside a tax suspension arrangement.
- The importation of taxable goods, including irregular importation, unless the goods are placed, immediately upon importation, under a tax suspension arrangement.

Each EU Member State has discretion as to where the tax is liable on the distribution chain, that is there is flexibility in determining the extent of the tax suspension regime.

Some EU countries are applying rules which result in a relatively few taxpayers. Such taxpayers are normally to be found early in the distributional chain, while operators further down the distributional chain will not be involved in the tax collection. Tax rebates are, in those cases, normally administered by the end users asking for a tax reimbursement. Another way could be to introduce approval procedures for businesses, which under tax control may receive the fuels tax exempted.

While some EU countries, for example of Sweden (see further in Chapter 6), allow large business consumers to be taxpayers, the EU legislation does not allow private individuals to register as taxpayers. This means, for example, that petrol stations selling motor fuels to households are not taxpayers but buy the fuels already taxed in a previous leg of the distributional chain.

53 California implemented the Western Climate Initiative, and the New England States in the northeast have implemented the Regional Greenhouse Gas Initiative (RGGI).

54 For example, in Spain, Autonomous Communities have the constitutional power to establish new taxes, subject to the condition that they do not overlap with taxes at the national level. Following the Constitution, several Autonomous Communities have created a wide array of regional environmental taxes (e.g., on CO2 emissions, thermonuclear electricity production, electricity, waste, etc.). The situation has given rise to compliance costs for firms operating with facilities subject to taxation in more than one Autonomous Community; in some instances, it has led to Constitutional Court cases as well.

Checklist 2. Taxing power

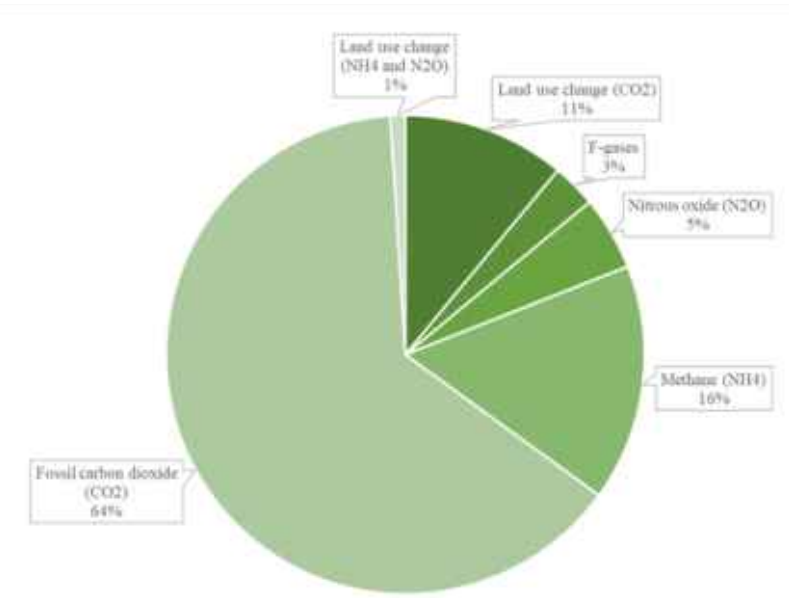
1. Consider taxing power arrangements
2. Assess issues of double or multiple taxation within and across jurisdictions
3. Consider the current institutional framework, particularly existing taxation system
4. Raise awareness of increased coordination efforts
5. Assess constitutional restrictions, for example, earmarking limitations

5. Scope of the carbon tax

5.1 *What to tax*?

170. The simple answer to the question of what we are going to tax is carbon emissions. Carbon is the primary element that may give rise to the release of CO_2, if submitted to a combustion or other processes (See Chapter 2). Emissions of CO_2 from fossil fuels and industrial processes amounts to roughly two thirds of the global greenhouse gas (GHG) emissions, as illustrated in Figure 4 below. Of these, the combustion of fossil fuels account for more than 80 percent.[55] In this Handbook, we will principally focus on CO_2 emissions from fuel combustion, although one of the approaches to carbon taxation discussed below can also accommodate taxation of other processes that generate carbon emissions as well.

Figure 4. Global GHG Emissions per gas, 2019



CO2 equivalents calculated with Global Warming Potentials (GWP-100) of the Fourth IPCC Assessment report (2017) (AR4).
Source: United Nations Environment Programme, 2020

55 Olivier and Peters, 2020.

171. There are two basic approaches when considering what to tax. One is a tax on the volume or weight units of the fuels giving rise to emissions when combusted; this will be referred to as the Fuel Approach, where the tax rate is based on standardized amounts of carbon content in fossil fuels. The other is a tax on emissions directly at source; this is known as the Direct Emissions Approach.

172. There are advantages and disadvantages with both approaches. The design choice will depend on the national conditions, since both can, in principle, result in well-designed carbon taxes.[56] A discussion will follow below using examples of tax systems currently in force in different jurisdictions.[57] The two different approaches will be discussed in more detail in Chapter 6.

173. The design must determine which are the sectors, subsectors, or economic activities to target. This is a broader question than the types of fuels, emissions, or facilities covered. Circumstances will differ across jurisdictions, and having tax coverage that is consistent with the policy objectives will depend on the emissions profile of the jurisdiction, relevant tax policies, the structure of key sectors, and government capacity to administer the tax. In general, for jurisdictions without any carbon pricing system in place, a broader carbon tax will usually be more efficient.

174. To achieve the expected emissions' reductions, it is important to assess what is technically and economically possible in the targeted sectors. As a result, governments must consider potential adverse impacts on firm competitiveness and distributional effects from the implementation of the tax. This is further discussed in Chapter 8.

Box 7. GHG emissions targeted

CO_2 is the principal GHG emitted from the combustion of fuels and thus merits the focus of this Handbook, however smaller amounts of other gases such as nitrous oxide and methane are also emitted during combustion, depending on the type of fuel and method of combustion[58]. Emissions of greenhouse gases other than carbon dioxide can be converted into carbon dioxide equivalents (CO_2e). Jurisdictions that use the Direct Emissions Approach can apply CO_2e to compare between different gases, and include other GHG in their tax scheme.

There are also examples of jurisdictions that have introduced taxation of fluorinated greenhouse gases, so-called f-gases, the most common ones being hydrofluorocarbons (HFC) and perfluorocarbons (PFC)[59]. However, f-gases are generally used for refrigeration systems.

This means that such taxation would not relate to the burning of fuels and the tax design would need to be found outside of a system of taxing fuel products or actual emissions from the combustion of the fuels and therefore merit different considerations that are beyond the scope of this document.

56 Many jurisdictions across the globe – such as most countries in the EU, Sri Lanka, South Africa, and Zimbabwe – have introduced an element into their taxation of the acquisition of ownership of passenger cars which accounts for emissions of CO_2 from the propulsion of the vehicle. However, these kinds of taxes are not within the scope of this Handbook.

57 Most carbon taxes currently in existence follow either the Fuel Approach or the Direct Emissions Approach. However, in literature, consumption-based carbon taxes are also discussed as an alternative approach to existing carbon taxes. Consumption-based carbon taxes price carbon further to the point of final consumption. In theory, pricing carbon consumption, rather than just production, can help to avoid the risk of carbon leakage. However, consumption-based carbon taxes only really exist in theory as they are complex to administer and will not be covered in this Handbook. See for further reading: CPLC, 2018.

58 There are seven GHG covered by the United Nation's Framework Convention on Climate Change (UNFCCC), including apart from CO_2, six others, namely methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride.

59 Denmark and Norway, for instance, tax emissions of carbon dioxide as well as f-gases, while Spain is an example of a jurisdiction with a tax solely on f-gases at the national level.

5.2 *Who will pay the tax?*

175. Choosing the taxpayer and liable sectors will depend on the objective of the tax, the tax approach, and the administrative conditions in the implementing jurisdiction. In the case of the Fuel Approach, discussed in more detail in Chapter 6, the taxpayer will depend on the fuel distribution chain which typically involves a range of agents operating at different points.

176. The actual payment of the tax – when and by whom – should be regulated in the carbon tax legislation. These issues are of interest to authorities set to administer the carbon tax and, consequently, to legislators considering how to design their tax legislation. The legislator's choice depends on the possibilities for the taxpayer to transfer the cost of the tax down to the fuel supply chain or the consumer.

177. The jurisdiction's current administrative structure and its expected development will be important in identifying who pays the tax. It should also be highlighted that many developing countries are adopting digital tax declarations systems, which can significantly facilitate the tax administration while resources can concentrate on ex-post tax control in the form of tax audits and spot-checks (see also Chapter 8 on administration).

5.3 *How to tax?*

178. The point of regulation, or when to charge the tax, will depend on the tax approach taken. A distinction between upstream, midstream, and downstream points of regulation is sometimes used in economic literature to identify the point at which the tax is controlled or collected.

179. It is crucial to analyse which agents will bear the burden of the tax and if they are responsive to the price signal. To ensure efficiency and environmental integrity, households and firms should respond by changing their behaviour. Whether the price is passed on to the final consumer will depend on price elasticities, trade exposure and, in the case of regulated contracts, the nature of the trade agreements between sellers and buyers of the fuel. This should be considered in the design but cannot be regulated by the tax legislation.

180. Another important aspect is the challenge associated with administering the tax, including difficulties in monitoring, reporting and verification (MRV). Due to administrative complexities and the number of taxpayers, it would not make sense to let each individual consumer, for example, private persons using petrol-consuming cars, be responsible for paying the tax to the Government or some other public body.

Box 8. Summary of principal elements in carbon tax design

The **tax base** defines what is to be taxed and determines the different approaches to carbon taxation discussed in this Handbook. This is a design choice, but it also has relevance for the administrative burden and tax rate. In the case of the Direct Emission Approach, the tax base is emissions, usually CO_2, but it can be broadened to other GHG emissions. In the case of the Fuel Approach, the tax base is fuels that give rise to CO_2 emissions when combusted.

The **taxable event** refers to the occurrence of the event that makes the tax due. In the case of the Fuel Approach, the taxable event can be the importation, sale, or consumption of the fuel volume. In the case of the Direct Emission Approach, the taxable event is when emissions occur. In the first case, the point of regulation may vary, but in the second, the point of regulation must be now of the emissions. The **point of regulation** refers to the moment when the tax authorities regulate the taxable event.

The **tax rate** refers to the rate or price carbon emissions costs will be set at. This is usually determined in the legislation. In the case of the Direct Emissions Approach, the rate is fixed by the legislation; in the case of the Fuel Approach, the carbon emission rate is translated into the carbon content of fuels, so the tax rate will vary by fuel type and volume depending on the pre-established amount of CO_2 emissions released to the atmosphere when a specific fuel type is being combusted.

The **taxpayer** is the economic agent that pays for the tax. Note that this is not necessarily who bears the burden of the tax (see above, for a discussion). The taxpayer must be clearly identified and regulated. In the case of Direct Emissions Approach, the taxpayer is the facility that generates the emission. In the case of the Fuel Approach, there may be some flexibility as to whom the taxpayer can be. For example, as is further discussed in the next chapter, Sweden has limited the administrative burden of charging multiple taxpayers by registering tax warehouses who should pay the tax to the authorities.

The **tax administration authority** is the public body charged with administering the tax or overseeing its administration. Usually this is the tax authority, but in the case of the Direct Emissions Approach, the role of environmental agencies will be especially important in verifying and controlling the emissions data submitted by the tax liable facilities. Although the Fuel Approach does not require additional expertise, there may be exemptions or reimbursement schemes, e.g., for businesses performing a certain environmentally friendly activity, carbon capture and storage. The policymaker must acquire relevant data (such as average emission factors, type of fuels and, in some cases, production processes) to determine carbon content, set the formula for calculating the tax and transform it into the weight or volume units used to lay down the tax rates in the legal text. This is done through the tax declaration form. Once that is made, it is straightforward to apply the carbon tax and calculate future tax rates changes.

Checklist 3. Core elements of Carbon Tax Design

Consider taxing power arrangements

1. What to tax?
   - (i) Tax base – emissions or fuels?
     - (a) Which emissions? GHG or CO2
     - (b) Which fuels? All fuels, the most relevant in the jurisdiction
   - (ii) Tax base - which sectors?
   - (iii) Consider technical viability
   - (iv) Consider economic feasibility

2. Who to Tax?
   - (i) Who is the taxpayer?
   - (ii) Who is liable?

3. How to Tax?
   - (i) When is the tax payment – what is the taxable event and/or point of regulation?

6. Conclusion

181. In this chapter, we explored some of the general issues raised in designing a carbon tax. We examined basic elements such as tax incidence, taxing power and issues raised by taxations at sub and supra national levels. We also briefly discussed the tax base and referred broadly to two design approaches, the Fuel Approach -which uses fuels as the tax base and sets the tax rate based on carbon content - and the Direct Emissions Approach - which establishes the tax rate directly on emissions, as practical approaches for carbon tax design.

182. The final section explored the specific questions of carbon tax design, namely, what, who, and how to tax. In Chapter 6, we explore these questions in more detail, drawing specifically on two country cases that have adopted the Fuel and Direct Emissions Approach respectively, and discuss design elements associated with these different approaches. Further, in Chapter 8, the different elements of the tax design are dealt with from an administrative perspective, considering the actual procedures needed development to make the tax scheme operational for the body or bodies in charge of those tasks.

183. Before going into detail, we examine, in the next chapter, different criteria or considerations to set the tax rate, a key design issue.

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Chapter 5: Setting the Tax Rate

1. Introduction

184. Setting the tax rate is an essential element in the policy design of a carbon tax since it has direct consequences in achieving the environmental objective and impacting the economy. There are various economic theories and approaches that could be used to help policymakers determine the tax rate.[60]

185. In this chapter, we examine practical approaches to determining the tax rate, complemented by country examples.[61] These are the Standards and Price Approach, the Revenue Target Approach, and the Benchmarking Approach. These methodologies should not be considered independently since they support an integrated decision-making process. This is because each one provides insights that can help find a tax rate in line with a desired climate policy objective.

2. Basic considerations for setting the tax rate

186. Since the impacts of the tax can be difficult to predict in advance, implementing a carbon tax should be viewed as a learning-by-doing process. To meet the objectives of the Paris Agreement, jurisdictions should strive to implement a carbon tax as soon as possible. If the desired policy goal is not reached after a certain period (to be analysed according to the jurisdiction's specific economic and social circumstances), a tax adjustment should follow. A dynamic tax rate trajectory could help to increase the effectiveness of the tax. Hence, it is advisable for jurisdictions to start applying a carbon tax, irrespective of the starting rate.[62]

187. The range of carbon tax rates currently implemented across the world varies from less than US$ 1 per tonne of carbon dioxide equivalent (tCO_2e) to over US$ 100.[63] It is worth noting that the jurisdictions that have the highest rates in place did not start their carbon tax programmes at a high level. Most jurisdictions (for example, Sweden) initiated their carbon tax programmes with relatively low tax rates, increasing them over an extended period.[64] Nevertheless, most initiatives currently implement relatively low carbon tax rates, generally below US$ 30 / tCO_2e.[65]

188. To achieve the 1.5 degrees Celsius temperature increase limit target agreed upon by the Paris Agreement, the High-Level Commission on Carbon Prices

60 Kettner-Marx and Kletzan-Slamanig, 2018.
61 PMR, 2017. (p. 89).
62 PMR, 2017. (p. 95).
63 For an overview, see World Bank Group, 2021.
64 Hammar & Åkerfeldt, 2011.
65 OECD, 2021.

proposed a carbon price ranging from US$ 50 – 100 / tCO_2e by 2030.[66] These rates are high compared to the current state of the art of carbon taxation. However, even low initial tax rates can serve as price signals since the tax rate can later be adjusted to a level consistent with environmental targets.

189. Ideally, the introduction of a carbon tax should include a political commitment to increase rates over time to reach a specific emission reduction target. The implementation of hard commitments to raise carbon prices is difficult, but some design features may help. Examples include politically committing to higher rates when carbon prices rise in neighbouring countries or with trading partners, ensuring that changes to the tax rate do not require changing primary legislation, and ensuring that the revenue generation and use is integrated in the fiscal policy.[67]

190. Applying a uniform carbon tax rate to all emission sources is considered more efficient.[68] However, in practice, some jurisdictions apply different effective carbon tax rates[69] according to fuel use (e.g., heating, transport) or sectors (e.g., households, industries). Different tax rates within an economy may be necessary to achieve policy acceptance. See Chapters 3 and 7 for a discussion.

3. The theoretical framework

3.1 *Theory of externalities*

191. The theoretical framework that supports carbon taxation is based on the theory of externalities developed by Pigou.[70] The idea is that carbon emitters generate an externality by imposing costs and disservices on others, without paying the full cost of the resulting damage that occurs. Therefore, since private and social costs do not coincide, there is a market failure and the market solution is not efficient, generating environmental damage.

192. However, it is possible to internalize external costs and achieve a socially efficient outcome, through a tax on the externality, in this case carbon emissions, at a rate consistent with the marginal external costs. The tax should equalize the private costs of an economic agent (marginal private costs) to the costs to society (marginal social costs). As a result, polluters bear the costs of their economic actions[71] and produce or consume at the socially optimal level.

66 CPLC, 2017; IPCC, 2018.
67 PMR, 2017. (p. 95).
68 Kettner-Marx and Kletzan-Slamanig, 2018.
69 See for an overview Carbon Pricing Dashboard, The World Bank available at https://carbonpricingdashboard.worldbank.org/map_data
70 Pigou, 1920.
71 Pearce, 2003. Pigou, 1920.

Box 9. Carbon taxes and the Nobel Prize

William D. Nordhaus was one of the first economists who combined economic and climate-related models. He created an Integrated Assessment Model, which describes the interplay between the economy and climate. Nordhaus supports the idea of implementing carbon taxes. His research showed that carbon pricing through emission trading schemes or carbon taxes is an efficient way of lowering carbon emissions.

In 2018, Nordhaus received the Nobel Prize in Economics. The Nobel committee recognized with the award the economics of climate change, which underlines the relevance of a carbon tax.[72]

Nordhaus' model is often used to simulate how the economy responds to climate change. Moreover, his Integrated Assessment Model can also be used to calculate the cost of climate change. This data can help to define the tax rate of a carbon tax.

In addition, the model provides a methodological framework to examine the consequences of various climate change policies, like carbon taxes. The practical relevance of the model was demonstrated through the application by the Intergovernmental Panel on Climate Change (IPCC), who referred to the work of Nordhaus when calculating the costs of climate change.[73]

3.2 *Pigouvian taxation – internalising external costs*

193. According to economic theory, the tax rate of a Pigouvian tax should be set equal to the marginal social cost of the pollution, thus increasing the price for the activity causing the pollution and reducing its demand. See Box 10 for an analytical presentation.[74]

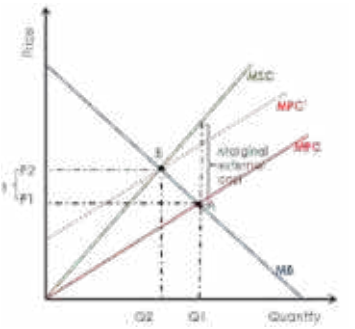
194. Determining the optimum Pigouvian tax is difficult since it requires considerable information, including an assessment of environmental damage, as well as, in the case of climate change, intergenerational assumptions on preferences.[75] Furthermore, assumptions on adaptation and technological change and the choice of the discount rate[76] are also necessary. Thus, even the most complex model is subject to a degree of uncertainty.

195. Therefore, although the theory of externalities and Pigouvian taxation are the conceptual frameworks behind determining effective carbon tax rate, in practice, there are several approaches to set the rate.

72 For further reading on the contribution of William Nordhaus, see http://www.nobelprize.org/uploads/2018/10/advanced-economicsciencesprize2018.pdf.
73 IPCC, 2018.
74 See Chapter 2.
75 Hope, 2006; Nordhaus, et al., 2000; Nordhaus and Yang, 1996; Isaacs, et al., 2016.
76 The discount rate refers to the rate that future costs and benefits are discounted relative to current costs.

Box 10. Technical Note: Pigouvian Taxation

Figure 5. Pigouvian Taxation



The graph illustrates how a Pigouvian tax works. The horizontal axis represents the amount of output produced by the good/product that generates pollution. The vertical axis represents the market price. The marginal benefit (MB) curve measures the MB (benefit from the production of each additional unit of the good) which arises for society at different levels of production. The marginal private cost (MPC) represents the marginal costs (costs of each additional unit of the good) which can be attributed to the producer. Finally, the marginal social cost (MSC) measures the marginal costs (costs of each additional unit of the good) to the society. The MSC is composed of the MPC and the costs of the externality. Point A represents the market equilibrium with the quantity Q1 and the price P1 which arises without any intervention. However, point A is not optimal for society as its costs are not covered completely at the level of the producer. As a result, the costs exceed the social benefit. To correct the market failure, a tax (t) at the level of the marginal external cost could be introduced. Thereby, the MPC will be shifted to the MSC at point B, which represents the social optimum. At this level, production is reduced to Q2 at the new price P2. At point B, the MSC equals the value of the MB.[77]

Source: Kettner-Marx and Kletzan-Slamanig, 2018

4. Practical approaches to set the carbon tax rate

4.1 Standards and Price Approach – to reach a specific carbon reduction target

196. In practice, several approaches can be used to set a carbon tax rate. One approach is to set the tax rate corresponding to a specific carbon reduction target; this is known as the Standards and Price Approach (also known in literature as *Baumol-Oates* approach).[78] The focus of the Standards and Price Approach is not the determination of the correct social cost of carbon, but the tax rate required to achieve a specific emission reduction target.

197. The approach involves initially setting an emission reduction target (standard), for example, the commitments under the Nationally Determined Contributions (NDC), then estimating the tax rate (price) consistent with this goal. Given the high level of uncertainty, the initial tax rate can be adjusted by "trial and error" to reach the set standard. Following the iterative approach suggested by the Standards and Price Approach helps to reach the specific emission reduction targets by adjusting the price

77 Kettner-Marx and Kletzan-Slamanig, 2018.
78 Baumol and Oates, 1971; Walker and Storey, 1977.

signal so it becomes more accurate.

198. The main advantage of this method is that it is not necessary to find the economic optimal tax rate since the emission reduction goal will be reached following a dynamic tax rate trajectory. However, the disadvantage of the Standards and Price Approach is that there needs to be strong political commitment to follow this strategy over several years, because regular tax rate adjustments are crucial. Those adjustments must be solely based on environmental objectives, rather than on political considerations.

199. This approach is feasible if the primary purpose of the carbon tax is to meet a specific emission reduction target. Emission targets could be set in a national law or as a political commitment. Moreover, an emission reduction target can be based on the NDC under the Paris Agreement and the United Nations Framework Convention on Climate Change (UNFCCC).

Box 11. Standards and Price Approach in practice

A Standards and Price Approach was used to determine the tax on waste in Denmark and helped to achieve a solid waste reduction of 26 percent between 1987 and 1998. The tax was levied per ton of solid waste, which was produced by industry and construction activities.

The purpose of the tax was to affect behaviour and support a national plan to increase the recycling rate to 54 percent in 1996. The Danish authorities did not attempt to evaluate the externalities associated with waste treatment. This means that no economic model served as a basis for the tax rate. Tax rate adjustments helped to reach the targeted standard. The tax rate gradually increased from DKr (Danish Krone) 40 / ton to DKr 375 / ton in 2000. Therefore, the tax can be seen as following the principles of the Standards and Price Approach.[79]

Source: Andersen and Dengsøe , 2002

4.2 Revenue Target Approach

200. Different policy objectives may encourage jurisdictions to implement carbon taxes. Aside from environmental considerations, one of the main reasons for implementing carbon taxes is raising revenue.[80] Although carbon taxes are primarily intended for climate mitigation policy, they can generate a considerable amount of tax revenue. In 2020, the total value of all carbon taxes and emission trading systems in force was US$ 53 billion.[81] Therefore, carbon taxes can contribute to the general budget or to reduce unwanted distributional effects of the carbon tax itself (see Chapter 9 on Revenue Use).

201. Jurisdictions may set the tax rate in a way that maximises tax revenue or that generates a specific level of revenue. To determine the expected tax revenue, the approach needs data on price-elasticities to determine the specific revenue target

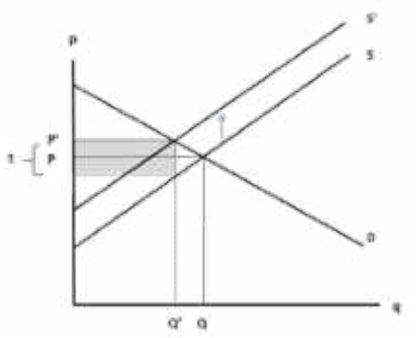
79 Andersen and Dengsøe, 2002.
80 PMR, 2017. (p.93).
81 World Bank, 2021.

(see Box 12, Price Elasticities).[82] This is because the tax revenue generated from a specific tax rate depends on the markets and price-elasticities of carbon-intensive products.

Box 12. Revenue Target Approach – economic theory

The Revenue Target Approach is based on microeconomic theory. The graph below illustrates the supply (S) and demand (D) curves. In the initial scenario, market equilibrium emerges at the intersection of both curves. At this point, the market produces the quantity Q at a price of P. However, the market equilibrium changes after the implementation of a tax (t). The S curve is shifting because of the increasing cost of production. As a result, a new equilibrium will be reached at the intersection of S' and Q'. The tax revenue is calculated by multiplying the new quantity Q' by the tax rate t. In practice, setting the carbon tax rate through the revenue target approach is a tricky task, as the tax revenue depends on many factors which need to be considered. Examples are price elasticity, market power and economic situation.

Figure 6. Graphical representation of the Revenue Target Approach



Source: PMR, 2017

202. For example, one of the motivations behind Chile's carbon tax was raising revenues for the increased spending expected for a significant education reform. The fiscal reform implemented in 2014 modified the tax system considerably, including the implementation of a carbon tax. The fiscal reform was estimated to collect US$ 8.3 billion in total and the carbon tax around US$ 168 million. However, the government did not define in advance a specific revenue target, which had to be met with the carbon tax.[83]

203. Carbon taxation can be a stable source of revenue over short-term fiscal planning horizon.[84] However, as carbon emissions decrease over time, the tax base will erode, reducing expected revenues.

The Revenue Target Approach has generated criticism from an environmental point of view. It is argued that the primary aim of carbon taxes is to internalise

82 Abenezer Zeleke, 2016.
83 Pizarro, Pinto, Ainzúa, 2017).
84 PMR, 2017. (p. 120).

external costs and not to raise the tax revenue for the government. Hence, there is concern that revenue targets as an objective may affect long-term environmental integrity objectives.

Box 13. Price elasticities

To follow the Revenue Target Approach, it is crucial for policymakers to know the price elasticity for products that are subject to the carbon tax. In economics, the own-price elasticity measures the responsiveness of the demand for a good or service after a change in its price.

Studies have shown that the price elasticity of fuels is relatively inelastic in the short-term. This means that the demand response is disproportionately low compared to changes in the price. This is partly because emitters cannot change their habits in the short term. However, in the long term, studies have shown that the fuel price elasticity is higher, which means that the demand responds to price changes.[85]

4.3 Benchmarking Approach

204. Another approach to determining tax rates is known as the Benchmarking Approach. Two methodologies have been proposed for benchmarking existing carbon tax rates or other market instruments. These are explored in turn.

Benchmarking comparison with carbon tax rates

205. As of 2021, more than 30 jurisdictions had adopted a carbon tax. The Organisation for Economic Co-operation and Development (OECD) and the World Bank publish updates on new and existing carbon tax rates and carbon pricing instruments on a regular basis.[86] Jurisdictions can use the tax rate implemented in other countries as a 'benchmark' for setting their own.

206. Table 2 presents a selection of current carbon tax rates, ranging from US$ 2.61/ tCO_2e (Japan) to around US$ 137.24 / tCO_2e (Sweden). The wide spectrum of tax rates is an indicator that carbon taxes follow different policy strategies.[87]

Table 2. Carbon tax rate around the world in April 2021

Jurisdiction Covered	Nominal tax rate in April 2021 (US$ / tCO_2)
Argentina	5.54 (most liquid fuels)
British Columbia	35.81
Chile	5
Colombia	5
Denmark	28.14 (fossil fuel)

85 Abenezer Zeleke, 2016; World Bank, 2021.
86 World Bank, 2021; OECD, 2021.
87 See Chapter 2.

Finland	72.83 (transport fuel)
France	52.39
Japan	2.61
Mexico	3.18 (upper limit of the tax)
Norway	69.33 (upper limit of the tax)
Singapore	3.71
South Africa	9.15
Sweden	137.24
Switzerland	101.47

Source: Data based on Carbon Pricing Dashboard; The World Bank.

207. The Benchmarking Approach relies on an analysis of the tax rates as well as the tax design of other jurisdictions. It is important to underscore that headline tax rates may differ from effective rates due to different design options. For example, they may be levied on different levels of the production chain, include exemptions for certain industries, have different coverage, or include revenue-recycling, among other design options.

208. As jurisdictions have different framework conditions, policymakers should consider which is comparable to their own when choosing their tax rates. Regarding the selection of comparable jurisdictions, factors to consider include:[88] (i) policy objective; (ii) similar economies/politics; (iii) demographic factors; (iv) energy production; (v) geographic distribution; (vi) potential for coordination, and (vii) tax system.

209. The list only presents the most relevant factors. It is also important to consider current trends and the international development of carbon taxes in a benchmarking analysis. This could help policymakers to approach the discussion at the national level.

210. An especially relevant factor to consider is the carbon tax level of key trading partners and competing jurisdictions. Policymakers may be concerned with introducing high carbon taxes compared to taxes applied by key trading partners. The Benchmark Approach also considers the tax rate level of competing jurisdictions to reduce the risk of carbon leakage. Political concerns regarding carbon leakage and competitiveness are, in practice, key factors for setting the tax rate (see Chapter 7).

211. While it can be useful for policymakers to be informed about existing carbon tax rates in other jurisdictions, it should be noted that, in most cases, carbon tax rates are significantly lower than the tax rates necessary to achieve the Paris Agreement emission reduction targets. For instance, the High-Level-Commission on

88 PMR, 2017. (p. 95).

Carbon Prices proposed a carbon price of US$ 50–100 / tCO_2 by 2030.[89] Currently, only seven countries (Finland, France, Liechtenstein, Luxembourg, Norway, Sweden, and Switzerland) have tax rates higher than US$ 40 / tCO_2.[90] Therefore, given current tax rates, it is questionable from an environmental perspective whether a benchmarking analysis rate is appropriate to set carbon tax rates.

212. At the same time, studies from the OECD have shown that taxes on fossil fuel products have been rising steadily in many jurisdictions. For example, Alberta (Canada), British Columbia (Canada), Finland, France, Latvia and South Africa have increased – some of them significantly – their carbon tax rates since 2018. This recent development could encourage the implementation of a more ambitious carbon tax rate.

Box 14. Examples of carbon tax rate changes made between 2019 and 2021

- Iceland's carbon tax rate increased from ISK 3850 / tCO_2e (US$ 27 / tCO_2e) to ISK 4235 / tCO_2e (US$ 30 / tCO_2e) on January 1, 2020
- South Africa's carbon tax increased from R 120 / tCO_2e (US$ 7 / tCO_2e) to R 127 / tCO_2e (US$ 7 / tCO_2e) on January 1, 2020.
- Ireland's carbon tax increased by EUR 6 / tCO_2e (US$7 / tCO_2e) to EUR 26 / tCO_2e (US$ 28 / tCO_2e) for liquid transport fuels on October 9, 2019, and other fuels from May 1, 2020.
- Latvia's carbon tax increased from EUR 4.50 / tCO_2e (US$ 5 / tCO_2e) in 2019 to EUR 12 / tCO_2e (US$ 14 / tCO_2e) in 2021.

Source: The World Bank, State and Trends of Carbon Pricing 2019 - 2021

Benchmarking comparison with other market-based instruments

213. The benchmarking analysis does not have to be exclusively limited to the comparison of carbon tax rates. Considering other market instruments in the analysis can contribute to the aggregated price signal on carbon emissions in each jurisdiction and therefore provide a broader context. In this respect, specific taxes on fuel (excise taxes) can also be relevant to consider in a benchmarking analysis, as well as prices observed in emissions trading systems.[91]

214. Although they do not explicitly price carbon, excise taxes on fuels mirror carbon taxes and can support the benchmark analysis. However, since taxes may differ across fuel types, it is not always clear which specific tax rate should be used for benchmarking, for example, the tax rate for diesel, petrol, or coal. Another issue to consider is carbon prices observed in emission trading schemes. For example, Portugal and Iceland use the allowance prices within the EU Emission Trading Scheme to set their carbon tax rate.[92]

89 CPLC, 2017.
90 See for an overview: Carbon Pricing Dashboard; The World Bank.
91 OECD, 2018.
92 PMR, 2017. (p. 95).

215. It is also possible to use a measure of the aggregate effective carbon price signal in the benchmark analysis. So called *effective carbon rates* – consisting of carbon taxes, excise taxes on fuels and prices of tradable emission permits – these are calculated by the OECD for many countries.[93] See Box 15.

Box 15. OECD effective carbon rate

The OECD publishes the effective carbon rates for 44 OECD and Group of Twenty (G20) countries, on a regular basis.[94] In its report, the OECD measures the carbon pricing gap, which represents the difference between actual effective carbon rates and a benchmark rate.

The first benchmark, EUR 30 / tCO_2, is an historic low-end price benchmark of carbon costs and a minimum price level to start triggering meaningful abatement efforts. The second benchmark, EUR 60 / tCO_2, is a forward looking 2030 low-end and mid-range 2020 benchmark. The third benchmark, EUR 120 / tCO_2, is a central estimate of the carbon costs in 2030.

The 44 OECD and G20 countries together have not even reached a fifth of the goal to price all emissions at least at EUR 60 / tCO_2 in 2018. Therefore, most jurisdictions do not reach even the lowest estimated costs of society. However, the top ten performing countries in 2018 progressed by around 6 percent points towards the EUR 60 benchmark. But 60 percent of the emissions from energy use are still not taxed at all. The OECD concluded that more needs to be done to steer economies along a decarbonized growth path. It is important to notice that in the OECD report, emissions from biomass are also included when effective carbon rates are calculated. For countries with large shares of energy from biomass, the effective carbon rates for fossil energy may be higher than what the OECD estimates indicate.

Source: OECD, 2021

Checklist 4. Approaches for setting the tax rate

1. Standards and Price Approach: Set the tax rate to achieve a specific carbon reduction target
2. Revenue Target Approach: Set the tax rate to achieve a specific carbon revenue target or goal
3. Benchmarking Approach: Set the tax rate compared to other comparable jurisdictions (neighbours, trading partners, jurisdictions with similar levels of development)
   (i) Comparing Tax Rates: Carbon Tax Rates
   (ii) Comparing other market-based instruments: Carbon prices

5. Dynamic Tax Rates

5.1 *The role of politics*

216. In this chapter, various approaches for setting a carbon tax rate were discussed. They can help jurisdictions to create a policy strategy; however, to prevent the tax rate level from becoming subject to short-term political considerations, achieving the broadest political consensus is also important.

93 OECD, 2018.
94 OECD, 2021.

5.2 *Tax rate trajectory*

217. Policymakers should consider different strategies for imposing the optimum tax rate, which may also involve considering the tax rate trajectory. One strategy is to introduce an initial tax rate that remains at the same level for the initial period ("static carbon tax rate"). Another strategy is to adjust the tax rate over time to soften the impacts of the tax. In practice, dynamic tax rate strategies have been used by several jurisdictions.[95]

218. To ensure compliance and limit opposition, policymakers can implement a low tax rate in its initial year and then increase the rate later ("ramp-up introduction").[96] If a jurisdiction has decided to apply a slow ramp-up strategy, the tax rate would be increased gradually until the tax rate reaches the desired level. Under the ramp-up strategy, it is easier to adjust and anticipate carbon taxes. The economy would have more time to invest in alternative environmentally friendly technologies and would not face major economic shocks.

219. For example, the Canadian State of British Columbia and Federal Canadian Government implemented a ramp-up strategy. British Columbia introduced a carbon tax at a rate of Can$ 10 / tCO_2 in July 2008. The province then gradually increased the tax rate in the next four years by Can$ 5 each year, reaching its target level at Can$ 30 in 2012. Meanwhile, the carbon tax rate increased to Can$ 45 on April 1, 2021, and a further increase is planned for April 1, 2022.[97]

220. A similar approach was taken by France, which introduced a carbon tax in 2015. Legislation set a rising tax rate for each year up to 2021 when it is planned to reach EUR 56 / tCO_2. The French legislators also laid down the goal for the tax rate to reach EUR 100 in 2030 without defining the actual tax rates between 2021 and 2029 from the outset. However, following nation-wide protests, the tax rate was frozen at EUR 44.6 / tCO_2 for 2019 and remains at this level.

221. Singapore has also implemented a carbon tax with an initial tax rate of S$ 5 / tCO_2 in 2019. The intention of Singapore is to increase the tax rate gradually to S$ 10 to 15 / tCO_2 in 2030.[98]

222. It is not necessary to define the exact trajectory for a specific tax level. However, to achieve the environmental objective, it is important to define the future targeted tax level when introducing a carbon tax. This provides a clear price signal, and emitters will respond to the expected carbon price from the beginning of the implementation of the tax.

95 PMR, 2017. (p. 95).
96 IEEP, 2013 (p. 58)
97 World Bank Group, 2019.
98 World Bank Group, 2019. (p. 41).

223. A gradual increase of the carbon tax rate seems politically desirable, as it is easier to gain political support for gradual implementation. Moreover, it also gives investors and businesses time to phase-out carbon-intensive facilities. Nevertheless, the ramp-up strategy also has risks. First, the environmental effect is limited in its initial phase, due to relatively low tax rates. Second, low initial tax rates may remain because of political considerations.[99]

224. An alternative strategy is to implement a static carbon tax rate, which means that the carbon tax rate stays the same after its introduction. Such an approach has the advantages of giving the market a stable and predictable price signal. However, to be effective from an environmental point of view, the tax rate will need to be set at a sufficiently high level that achieves the environmental objective and moves towards a greener growth path.[100] Also, a static carbon tax rate at a high level is likely to face more political opposition than a ramp-up strategy by those who are affected by the tax. If a static approach with a high tax rate is chosen upon implementation, it would need be to be part of a comprehensive reform package including certain compensatory measures for vulnerable groups of society.[101]

5.3 *Regular adjustments of the tax rate*

225. Setting the carbon tax rate is not a one-time task. It is an ongoing process requiring constant adjustments. This is because the optimum tax rate is always subject to uncertainties since the exact impact of the tax is not predictable in advance. Therefore, it is important to evaluate and adjust carbon tax rates over time.

226. Moreover, as economic circumstances change, or as new information is available and economic models perfected, the assessment of the optimum tax-rate could be revaluated (see Box 16). Furthermore, changes in a jurisdiction's climate mitigation target or a change in public support may occur.[102]

Box 16. Tax rate and inflation

Even if the tax rates remain constant, jurisdictions may decide to index the carbon tax rate to inflation to ensure a stable environmental effect. This is because, with inflation, a constant tax rate dampens the incentive effect. Therefore, Colombia, Denmark, the Netherlands and Sweden, have indexed their carbon and energy taxes to inflation to maintain the price signal of their tax rates.

The effect of not indexing the tax rate is illustrated by Argentina. Argentina currently applies a carbon tax that is valued at US$ 65.54 t/CO_2e in 2021. Worthy to note is the fact that the Argentinian carbon tax was originally priced at US$ 10 t/CO_2e in 2018. However, due to a massive currency devaluation of the Argentinian peso against the American dollar through the fiscal year of 2018, the effective carbon price was reduced to US$ 6.25 t/ CO_2e in 2018. It is still the highest price for the region, but it has the potential to be devalued even further considering the law does not foresee annual carbon price adjustments according to inflation.[103]

99 World Bank Group, 2019. (p. 97).
100 OECD, 2021.
101 PMR, 2017. (p. 95).
102 See Chapter 2.
103 World Bank Group, 2019. (p. 29).

227. To deal with economic change, policymakers may decide to implement predetermined adjustment formulas in the legislation.[104] The law can include specific criteria or scenarios that trigger changes in the tax rate. One example could be that the tax rate automatically increases if specific reduction targets are not met.

228. Moreover, economic factors like Gross Domestic Product (GDP) growth or changes in exchange rates could be used as triggering factors. Switzerland has implemented reduction target in its national carbon tax. The tax rate is raised by a predetermined formula in advance,[105] thus avoiding a new legislative process in Parliament. In the case of Portugal, the national carbon tax has incorporated an annual adjustment, which is dependent on economic criteria. However, predetermined adjustment formulas may raise constitutional and political concerns in some jurisdictions.

229. Another approach is to periodically review the carbon tax rate, for example, via a special committee. Experts can assess the impacts of the carbon tax. Past experiences and available information about future developments allow those expert committees to draft concrete proposals for tax rate changes. The composition of the panels may differ in each jurisdiction. To avoid political interests, these committees can be composed of experts or stakeholders.

230. Reviewing the carbon tax rate can also be part of the general political considerations. For example, Norway reviews its carbon tax rate on a yearly basis, as the Norwegian tax law requires it to be presented as part of the annual national budget. During this process, the Norwegian carbon tax rate have increased.[106] Also, Ireland reviews the status of their national carbon tax rate on a yearly basis considering international trends of carbon pricing.[107] One advantage of the reviewing processes is that it provides more flexibility compared to a strict adjustment formula. However, any review of tax rates involves a political decision-making process and the amount of input from external experts and stakeholders in that process will undoubtedly vary across jurisdictions.

6. Setting tax rates under challenging circumstances

231. Special consideration may be necessary for a country in an extraordinary condition, as compared to other countries. For example, countries may face an external unexpected event affecting economic performance that may require adjustments - the COVID-19 crisis is a case in point. Choosing a tax design which is

104 See Chapter 2.
105 See Article 10 *Verordnung über die Reduktion der CO_2-Emissionen (CO_2-Verordnung)* vom 30.12.2012 (Stand 19.02.2019), AS 2012 7005.
106 PMR, 2017. (p. 97).
107 Report of the Joint Committee on Climate Action, 2019.

easy to administer is a key issue for countries under such circumstances. Economic growth and development are essential in fighting widespread poverty. Therefore, concerns might exist that high carbon taxes could slow down future economic development that may hamper access to basic services and infrastructure.

232. However, it can also be argued that tax revenues help countries to mobilize resources to strengthen their social and educational systems, that could help to reach a higher growth path. Additionally, resource-rich countries may feel dependent on carbon-intensive industries such as coal, oil, cement, steel, and aluminium. Therefore, they may be concerned that climate protection counters their economic growth and development. Nevertheless, in practice, all countries have special economic and demographic characteristics that need to be considered when setting a tax carbon tax rate.

233. Colombia provides an example of connecting carbon taxes with broader development objectives and predefining tax rate trajectories. In 2017, Colombia implemented a tax to support a lower-carbon development path. Colombia also used the tax revenue of the carbon tax to finance investments in low carbon projects, adaptation, and technological innovation. The initial tax rate was set at US$ 5 but included annual increases of 1 point plus inflation until the tax rate reaches US$ 10. In its initial year, the Colombian carbon tax generated tax revenue of nearly US$ 250 million, which was more than initially expected. The Colombian Government assessments have shown that the carbon tax was not regressive, which means that households with higher income are more affected by the tax.

234. Trade-offs between economic development and emission reduction may exist in some countries. Examples are countries that are strongly dependent on carbon-based energy resources and on energy imports.[108] In these cases, the imperative of development and poverty reduction may justify lower carbon tax rates in the short term.

235. Lower tax rates could help to support a smooth transition from a carbon-based economy to a low-carbon economy. Moreover, lower carbon tax rates may also be justified in countries with lower purchasing power. A lower purchasing power can lead to the situation that a given tax rate, which is derived from the tax rate of a rich country, would be more burdensome for least developed countries. Therefore, carbon tax rates, which are applied in countries with strong economic performance, may not be suitable or overshooting for countries with challenging economic performance. In developing countries, lower carbon tax rates may be justified due to specific economic situations where the impact of a price change in fuel prices is higher.

108 CPLC, 2017. (p. 19).

236. Although there may be justifications to have lower carbon tax rates in some countries due to specific and extraordinary circumstances, this does not mean that these countries should not implement carbon taxes. Well-designed carbon taxes can play a major role in a sustainable development in all countries. Carbon taxes are promising tools in achieving the UN Sustainable Developments Goals (SDGs) by 2030.

Checklist 5. Strategies to determine the tax rate trajectories

1. Fixed Tax rate
2. Dynamic Tax Rate
   - (i) Predetermined Adjustment
     - (a) Ramp-up strategy
     - (b) Based on national conditions e.g. Inflation indexed
     - (c) Based on external conditions e.g., trading partners
   - (ii) Flexible
     - (a) Based on revaluation and assessment of policy objectives, such as emission targets
     - (b) Based on technical committed evaluation
3. Tax Rate considering economic conditions
   - (i) Adjustments based on economic strategy e.g. green growth strategy
   - (ii) Adjustment considering economic crisis e.g. COVID-19 emergency

7. Conclusion

237. The tax rate is a key element in the policy design of a carbon tax. It has direct consequences in achieving the environmental objective and may have considerable impacts in the economy. In theory, the tax rate should be set at the marginal social costs of the environmental damage generated by the emission of an additional unit of carbon. However, in practice, setting the tax rates follows an integrated decision-making process.

238. This chapter has discussed various practical approaches to determine the tax rate and drawn from several country examples. Nevertheless, regardless of these approaches and the final tax rate chosen, implementing a carbon tax, even at low rates, will be important. In the next chapter, we discuss the practical design of a carbon tax considering the two principal approaches.

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Chapter 6: Carbon Tax Design Approaches in Practice[109]

1. Introduction

239. This chapter examines the two principal carbon tax design approaches, the Fuel Approach (which uses fuels as the tax base and sets the tax rate based on the carbon content of the fuels) and the Emissions Approach (which establishes the tax directly on emissions).

240. To illustrate, we draw on two specific examples. The first is the Swedish carbon tax, based on the Fuel Approach, which has had over thirty years' experience and could be considered a benchmark of carbon tax design and implementation. The second is the relatively recent experience in Chile with a tax on carbon emissions, one of the few examples of a middle-income country implementing this approach. The examples serve to address some of the specific questions raised by carbon tax design considering the two different approaches.

2. The Fuel Approach

2.1 Basic concept

241. The Fuel Approach is the predominant method of carbon taxation around the world. It involves taxing fossil fuels, primarily oil, gas, coal, and their derivative products, and setting the tax rate based on the carbon content of the fuel. The key to this approach is that carbon emissions are closely related to the carbon content of a specific fuel; therefore, emissions from fuel combustion can be determined accurately by standardized carbon emission factors.

242. Therefore, once the carbon tax rate has been determined, carbon content is used to establish the specific tax rates on fuels based on average emission factors. The advantage of this approach is that measurement of actual emissions is not necessary. A jurisdiction introducing a carbon tax could thus choose to express their carbon tax rates by volume or weight units (such as litre of petrol or tonne of

109 Unless otherwise stated, the source for facts on the Chilean carbon tax is Rodrigo Pizarro, Universidad de Santiago de Chile (expert in the Subcommittee) and for facts on the Swedish carbon tax Karl-Anders Stigzelius and Susanne Åkerfeldt, both Swedish Ministry of Finance (experts in the Subcommittee).

coal) based on the average carbon content of each fuel type.

2.2 Carbon tax rates applied to different fuels in practice

243. When completely combusted in dry air, any given fuel type will provide an exact relation between the carbon content and emitted carbon dioxide (CO_2). The relationship between the energy content or physical units of fuel (mass or volume) on the one hand, and the resulting emissions from combustion on the other, can be expressed in so called emission factors. In real world situations, other aspects of fuel quality and, to a lesser extent, combustion technology, will also affect total emissions. For CO_2, however, emission factors mainly depend on the carbon content, and emissions can thus be estimated accurately based on the amount of fuel combusted and the average carbon content of the fuel.[110]

244. Therefore, in the case of the Fuel Approach, carbon tax rates on fuels, based on carbon content, can be applied by operators and authorities using volume or weight units; these are standard trade units facilitating tax administration enormously. The advantage is that the calculation of the tax revenue can be carried out by the Ministry drafting the carbon tax legislation and not left to the agencies responsible for administering and collecting the tax.

245. For administrative reasons, most jurisdictions have chosen to group similar fuels in categories with the same tax rate per litre. This is normally the case with diesel fuels of different qualities, which may have marginally different carbon content. However, the emission factor is still deemed sufficiently close for the tax to be set on the fuels, and the carbon tax would still be effective and provide an incentive to reduce CO_2 emissions.

246. The table below presents examples of emission factors and heating values for common fuel types from the Intergovernmental Panel on Climate Change (IPCC) Emission Factor Database and the International Energy Agency (IEA) Energy Statistics Manual. The carbon content here expressed in terms of emission factors (kilogram (kg) CO_2 per Gigajoule (GJ)), as well as the heating values (GJ per m^3 or tonne), varies for fuels depending on their composition. Hence, specific values should be used where available to reflect national or facility-specific circumstances. See Table 3 below.

110 IPCC, 2006.

Table 3. Examples of emission factors and heating values for common fossil fuels

	Emission factor* (kg CO_2 per GJ)	Heating value**	Emissions from combustion***
Petrol	73	33 GJ per m^3	2409 kg per m^3
Diesel oil	74	37 GJ per m^3	2738 kg per m^3
Liquified petroleum gas (LPG)	63	24 GJ per m^3	1512 kg per m^3
Fuel oil	77	40 GJ per m^3	3080 kg per m^3
Coal (anthracite)	98	30 GJ per tonne	2940 kg per tonne
Natural gas	56	38 MJ per m^3	2128 kg per 1000 m^3

** IPCC default values: https://www.ipcc-nggip.iges.or.jp/EFDB*
*** Estimates based on typical net calorific values and densities (for liquid fuels): EIA, 2017.*
**** Emission factor multiplied by heating value.*

247. Fuel quality may change over time due to new technologies or practices. For example, when the Swedish carbon tax was introduced in 1991, an average emission factor for diesel, as well as light and heavy fuel oils for heating purposes, was used to calculate a single tax rate per litre for all these fuels. At the time, the quality of these liquid fuels was reasonably close, and applying the same carbon tax rate for all these fuels was a simplification that lowered administrative costs for business and tax authorities considerably.[111] However, Sweden recently updated the emission factor used for diesel to better reflect diesel qualities available today.[112]

248. The need for precise emission factors will also depend on fuel use. For example, since coal is not a fuel commonly used in Sweden, an average emission factor for different coal types (such as hard coal, lignite, and coke) is sufficient with a single tax rate for all coal types. However, a country with large coal consumption may need more precise emission factors for different coal fuel types to strengthen the emission reduction incentive. The important thing to consider is that the carbon content of each single consignment of a fuel is not measured, but rather authorities rely on calculations based on average emissions. Establishing tax rates in this manner will still create an effective carbon tax.

249. In general, jurisdictions mostly tax fuels when they are used as motor fuels or for heating purposes, and not when the fuel product is used for non-combustion purposes – such as coal or natural gas used as a component in certain industrial reduction processes or in purification filters. However, the calculation method as

111 Emission factor for light heating fuel and diesel was 2.74 kg CO_2/litre, for heavy fuel oil 2.97 kg CO_2/litre, which gave an average emission factor used of 2.86 kg CO_2/litre.

112 This meant that from 1 July 2018, the carbon tax rate for the fossil part of diesel is calculated on the emission factor of 2.54 CO_2/litre.

such does not prevent taxing fuel products when used for such purposes.

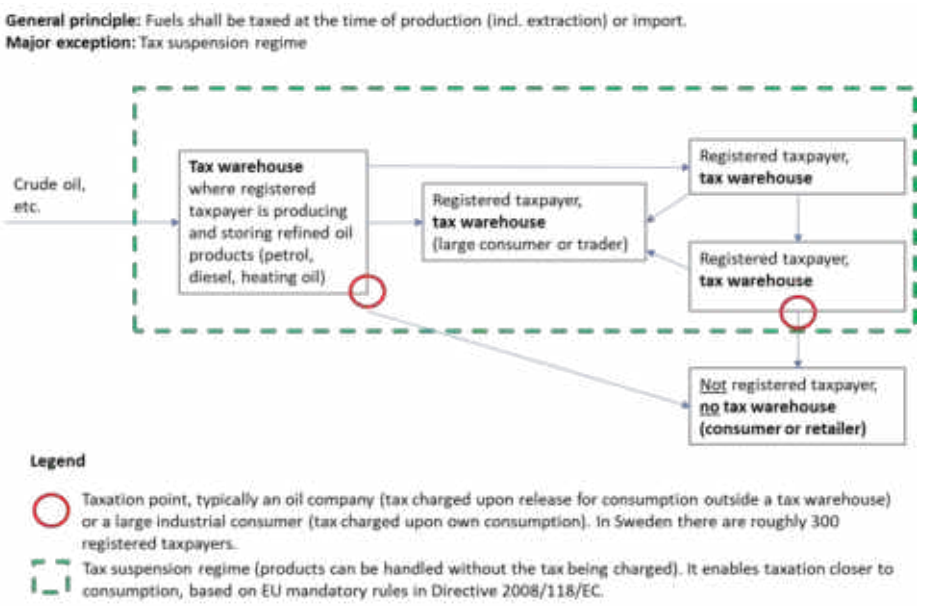
2.3 Point of regulation and tax payment

250. The point of regulation refers to when the tax is charged in the value chain. In the case of the Fuel Approach, the tax can be levied at any point in the value chain from the extraction (in a mine or crude oil extraction site) or importation into the jurisdiction, down the value chain until consumption, depending on the institutional framework.

251. In many cases, the tax is paid further down the value chain since most tax schemes allow the tax payment to be deferred during part of the distributional chain. Thus, the tax is paid after some form of the suspension arrangement. An example is the one applied to excise taxes (including carbon taxes) within the European Union (EU). EU Member States have a choice of who to register as taxpayers within the regime, but the basic principle is the same for all countries (see the illustration of the Swedish scheme in Figure 7). Administrative issues will be discussed in more detail in Chapter 8.

252. Jurisdictions choosing to design a carbon tax levied on fuels are likely to explore existing excise duties on the relevant fuels and who is responsible for the collection of such taxes. Choosing the same taxpayer for the new carbon tax will mean low additional administrative costs for both the taxpayers and the tax authorities.

Figure 7. Example taxation points for the carbon tax in Sweden



2.3.1 *Carbon tax due early in the distributional chain*

253. Administrative simplicity and effective tax control are key issues to consider. Keeping the number of taxpayers to a minimum is another way to keep costs low. One option would be to establish a tax collection point early in the fuel distribution chain, that is the point of extraction (such as coal mine, oil drill, natural gas pipeline) or importation. See illustration in Figure 7.

254. Coordinating tax collection with other taxes or duties can facilitate tax administration. For a country choosing to collect a carbon tax upon importation, tax collection can be coordinated with import duties on the taxable fuels. Zimbabwe is an example of this. Although the country does not have an explicit carbon tax, it collects a Petroleum Importers Levy on petrol and diesel (a tax on energy products) and combines it with other import duties. Firms or individuals holding a procurement license to import petroleum products in bulk into Zimbabwe are liable to pay this levy, which amounts to US$ 0.03 per litre.

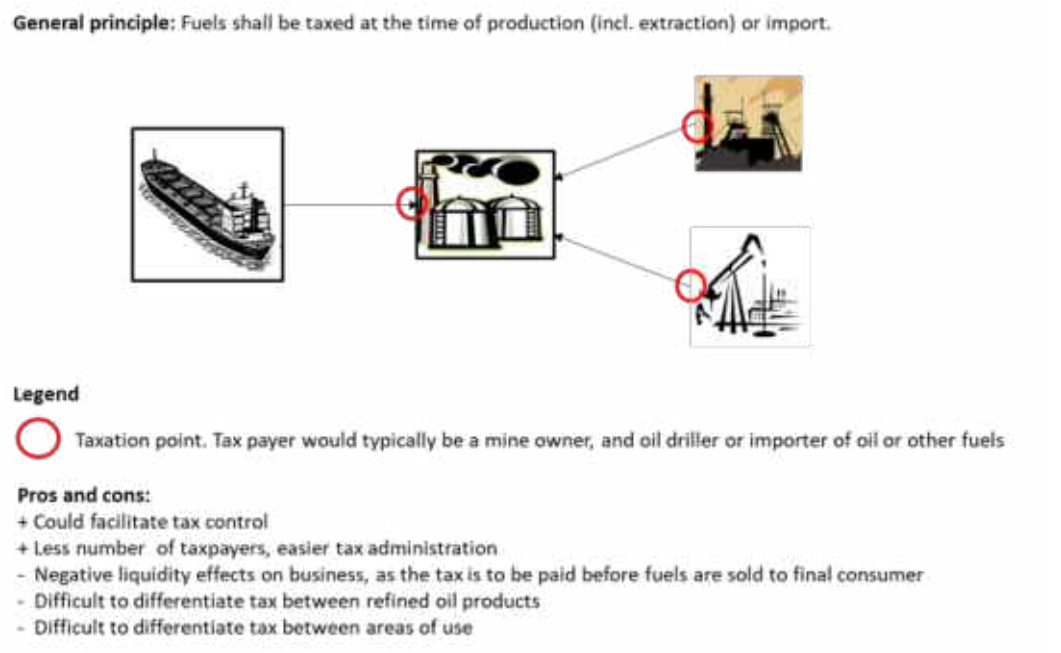
255. However, while choosing a tax point early in the distributional chain (as illustrated in Figure 8) could offer administrative advantages in terms of relatively few taxpayers and better opportunities to conduct an effective tax control, there are other issues to consider. Crude oil and natural gas largely dominate the imports of fuels in most countries, and choosing a taxation point at importation can make it difficult to differentiate the carbon tax between different qualities of refined petroleum products (such as petrol, diesel, heavy fuel oil etc.). Colombia offers an interesting example.

256. Colombia introduced a carbon tax in 2017.[113] The tax base consists of different refined petroleum products, namely natural gas (for certain industrial processes), LPG, petrol, kerosene, diesel and fuel oil. The importer or producer of such products is the body responsible for paying the carbon tax to the Government. In certain cases, the tax law gives the final consumer the right to ask for a tax reimbursement.

257. Choosing the same taxpayer for the carbon tax as the taxpayer of an existing excise duty on fuels, will mean low additional administrative costs. The carbon tax can be implemented as a new, separate tax or be incorporated as part of an already existing excise duty levied on fuels. A separate tax can be administrated in the same way as the existing excise duty and would not give rise to much additional administration. Since a carbon tax designed using the Fuel Approach is levied on weight or volume units, which is the same approach normally used for other excise taxes, this makes administration simpler. Introducing a separate carbon tax will also allow the government to more clearly advocate to the public that the tax has climate policy objectives.

113 For more information on Colombia's carbon tax please refer to the carbon tax legislation (Law 1819 of 2016 and the Decree 926 of 2017 (Congreso de la República, 2016; Ministerio de Hacienda y Crédito Público, 2017, and Gutierrez, 2017.

Figure 8. Example of a fuel tax design – tax payment early in the distributional chain



Note. Not applicable within the EU, as a major part of taxable events occur within a tax suspension regime system with authorized traders under Directive 2008/118/EC.

2.3.2 *Carbon tax due later in the distributional chain*

258. Many jurisdictions have taken the approach to levy taxes further down the value chain. One reason is the desire to be able to differentiate the tax depending on final fuel use or sectors.[114] Another is to avoid cash-flow problems by allowing trading of fuels between operators before reaching the final consumer, and therefore deferring tax payment.

259. In Norway, the carbon tax is due when the goods are imported or produced. However, in practice, this is not always the case. First, the production or import of taxable products must carried out by an entity which has been approved by the tax authorities, known as an approved tax warehouse. Tax liability occurs when the goods leave the tax warehouse. An importer can register as a tax warehouse and store the fuels without paying tax until the product leaves. The Norwegian tax system includes exemptions and reduced rates. These are either implemented as direct exemptions, which means that the registered importer or producer sells the product without paying tax or at a lower tax rate. In other cases, a situation like the

114 For example, for several years (1991-2017), Sweden applied different carbon tax rates for heating fuels used by industry compared to households and service sector firms; see Chapter 7 for further information.

Colombian case, it is accounted for as an end-user can ask for reimbursement of the tax.

260. Another example is the tax in British Columbia (Canada). In this case, the tax becomes liable for payment down in the distributional chain by enlisting the fuel distributors as tax collectors. First-time manufacturers or importers of a fuel must be appointed as a "refiner collector" for each fuel type they sell. They generally remit a security to the provincial government and are reimbursed as fuel is sold through the supply chain, until the tax is borne by end purchasers. The British Columbia scheme allows for exemptions from security requirements in some cases, for example, for direct fuel sales between refiner collectors, and for reporting exemptions in the case of natural gas sales.[115]

2.4 Using an existing fuel taxation administrative system

261. Basing carbon taxation on fuels has the administrative advantage of allowing a policymaker to make use of an existing fuel taxation administrative system. Since most jurisdictions already collect some form of fuel tax, excise duty or levy, they likely already have the necessary administrative infrastructure in place. For example, the EU Member States that have introduced a carbon tax have generally added it to an already existing general excise tax, either as part of the general excise duty (e.g., in France) or as a separate tax (e.g., in Denmark, Finland, Norway and Sweden[116]).[117] In some cases, the introduction of a carbon tax was combined with a reduction in the pre-existing excise tax covering the same fuels.

262. Excise taxes reduce energy use and hence carbon emissions. However, they do not usually do so in a cost-effective way, because they are not aligned with the carbon content or the broader pollution profile of the taxed fuels. If an excise tax, on the other hand, is designed in proportion to carbon content, it generates an incentive for a low-carbon energy mix.

263. Since energy taxes are a common source of revenue, non-EU jurisdictions can draw from the EU experience to treat the interaction between energy and carbon taxes. Sweden, for instance, has chosen to increase its carbon tax significantly, as a share of the total tax on energy products. Other EU countries have, however,

115 For more information about the carbon tax in British Columbia, please refer to http://www.bclaws.ca/civix/document/id/lc/statreg/08040_01 and https://www2.gov.bc.ca/gov/content/environment/climate-change/clean-economy/carbon-tax

116 The legal provisions for the separate taxes are laid down in the same legal act in some Nordic countries and in separate legal acts in others.

117 EU Member States must follow the EU harmonized framework for taxation of fuels. This framework does not require Member States to levy a carbon tax, but it is covered under the harmonized EU tax framework. Seven EU Member States have chosen to introduce specific carbon tax by using the fuel tax base of this EU directive. It consists of all motor fuels, coal and the bulk part of all commercially available liquid and gaseous fuels used for heating purposes (See Article 4.2 of Directive 2003/96/EC).

added a smaller – but in most cases increasing – carbon taxes on top of the existing taxation of energy products. Liechtenstein, Norway, and Switzerland, which are European countries outside the EU membership, provide similar examples. Carbon taxes in Liechtenstein and Switzerland are not levied on road fuels; however, they are subject to an excise duty not based on the carbon content of fuels.

2.5 *Coverage of fuels by the Fuel Approach*

264. Different jurisdictions have chosen to tax different fuel sources depending on their specific conditions. For example, in Iceland, the carbon tax base is petrol, diesel, and heating gas oil, as these are the only fossil fuels available in that country. Outside Europe, some countries (for instance India, Mexico, the Philippines, and Zimbabwe) have chosen to tax a limited number of fuels. In the case of India and the Philippines, only coal is taxed, while Mexico taxes coal and petroleum products.

265. The Colombian carbon tax base consists of natural gas and other petroleum products. Although not specifically designed as a carbon tax, Zimbabwe only taxes petrol and diesel. The carbon tax in Argentina covers all major fossil fuels used as motor fuels or for heating purposes with the exemption of natural gas and LPG used for heating purposes.

266. Costa Rica is the Latin American pioneer, with a carbon tax in place since 1997. The Costa Rican tax base is fossil hydrocarbons, which means an application of the Fuel Approach. However, the carbon tax rate is not related to the fossil carbon content of the hydrocarbons nor based on the measurement of emissions, but rather by a percentage (currently 3.5) of the market price of the hydrocarbons.

267. The reasons behind these different approaches are often due to national contexts, such as existing administration systems, targeting fuels that represent the bulk of carbon emissions, or due to other public policy concerns. In Latin America, many of the countries currently applying a carbon tax exempt natural gas from the carbon tax base.

268. In Mexico and Argentina, natural gas is considered as a transitional fossil fuel. The policies in those countries aim to substitute carbon intensive fossil fuels such as coal, diesel, and petrol, for natural gas, which is less carbon intensive.

269. Competitive concerns for certain business sectors and social concerns for households or for specific geographical areas can also play a role, as measures to meet such concerns could ease the introduction of a carbon tax. Such measures can later be phased out during continued policy design (see Chapter 7).

2.6 Methodology to calculate a carbon tax by the Fuel Approach

270. If policymakers use the Fuel Approach to design a carbon tax, the essential element in the design phase is to calculate tax rates to be proposed in the tax legislation based on average carbon content for specific fuel types. To understand how tax rates are determined, consider the case of Sweden in Box 17 to calculate a carbon tax rate per litre of petrol.

Box 17. How to calculate the actual carbon tax rate for a fuel with the Fuel Approach

With the Fuel Approach, the rationale is that the carbon tax is applied to fuels, and the tax rate presented in the tax legislation is calculated based on the amount of CO_2 emitted when the fuel is combusted, expressed in volume or weight units of the fuel in question. The amount of carbon emissions from combustion can be calculated from specific emission factors and heating values for different fuels (see examples in Table 3 above). The tax rate is then obtained by simply multiplying the emissions with the general carbon tax level.

Emission of fossil CO_2 for specific fuel [kg CO_2/unit] * General carbon tax rate [currency/kg CO_2] = Carbon tax rate on specific fuel [currency/unit]

Example: calculation of carbon tax rate on petrol in Sweden 2018 (in Swedish Krona (SEK)/litre).

Heating value of fossil petrol: 31.39 GJ/m^3

Emission factor of fossil petrol: 74 kg CO_2/GJ

Emissions of fossil CO_2: 31.39 GJ/m^3 * 74 kg CO_2/GJ = 2323 kg CO_2/m^3

Volumetric conversion factor (standard): 1 m^3 = 1000 litre, therefore 2323 kg CO_2/m^3 = 2.323 kg CO_2/litre

General carbon tax rate: 1.15 SEK/kg fossil CO_2

Carbon tax rate on fossil petrol: 2.323 kg CO_2/litre * 1.15 SEK kg/fossil CO_2 = 2.67 SEK/litre

Source: Swedish Ministry of Finance

2.7 Tax rates are presented in the tax law in weight or volume units

271. Legislation on carbon tax provisions need not present the method of calculation of tax rates. However, to increase transparency, the tax rate per kg of fossil carbon, which is the basis of the tax calculation (referred to as "general carbon tax rate" in Box 17), can be established in the tax law or in other official regulations. Decisions on this matter will also depend on legislative tradition in specific jurisdictions. For example, Sweden keeps statutes as short and simple as possible and provides additional explanations in the preparatory documentation (Government Bills).

272. When the carbon tax was first introduced in Sweden in 1991, the Government Bill presented to Parliament contained a detailed description of the method and emission values used by the Government when calculating the actual tax rates. The description included a list of emission values used for the different fossil fuels. However, the actual legal text proposed to Parliament only consisted of the carbon tax rates expressed in weight or volume units, which has since been the transparent

and established method in Sweden.[118]

2.8 Differentiation based on fuel quality

273. Different fuel qualities may have significant differences in carbon content. If such fuels are major energy sources in a country, different tax rates based on the carbon content should be set for the various qualities. The same design approach laid down above can be used.

274. The use of fossil and biomass fuel mixtures can be a challenge when determining the carbon content of the fuel and therefore the tax rate. The administrative complexity will depend on the choice of the taxable event. If a finished product is not established until it leaves a fuel depot and is due to be taxed, regular bookkeeping will enable the taxpayer to pay the correct tax. Such a system has been applied in Sweden for many years.

2.9 Some aspects relating to carbon content in fuels of biomass origin

275. Another decision facing a policymaker is whether the tax base should relate to the fossil carbon content of fuels, or to carbon emissions generated in general, which may include biomass-based fuels, for instance ethanol and biodiesel (commonly referred to as biofuels). Most jurisdictions that have introduced carbon taxation have primarily sought to deal with emissions from fossil fuels, since these fuels are predominant on the global fuel market and contribute by far to most greenhouse gas (GHG) emissions.[119] However, the global debate is increasingly focussing on indirect emissions in land use changes which may be triggered by biomass for fuel production.

276. Some jurisdictions consider biomass-based fuels (also referred to as "bioenergy") to be carbon neutral and therefore part of the solution towards a low-carbon economy, while other jurisdictions focus solely on a transition to other renewable energy sources such as wind and solar. Motives for the latter approach may include, for instance, that bioenergy can place pressure on land use, and canaffect biodiversity.[120] An in-depth discussion on this issue is outside the scope of this Handbook.

277. Sweden is an example of a country rich in forest resources, where sustainable forestry management is a key component of the country's agricultural and forestry policy. The general principle of not subjecting fuels of biomass origin to a carbon tax

118 The units used for the Swedish carbon tax are litre for petrol, m^3 (1 000 litres) for gas oil, kerosene and heavy fuel oil, 1,000 kg for LPG, 1,000 m^3 for natural gas and 1,000 kg for coal and coke.

119 The IPCC has stated that 75 percent of the changes in the temperature in the atmosphere during the past 25 years relates to the combustion of fossil fuels. The remaining 25 percent is due to changes in land use, primarily deforestation. (IPCC, 2014).

120 See for example OECD, 2020.

has prevailed since the introduction of such a tax in 1991. A restriction to applying this principle only to biofuels fulfilling certain established sustainability criteria has since been introduced, following mandatory EU legislation. An increased use of non-fossil fuels has played a key role for Sweden's road towards a low-carbon economy. The reasoning behind the Swedish approach is that combustion of sustainable biofuels would not result in a net increase of carbon in the atmosphere and therefore those fuels should not be subject to carbon taxation.

2.10 Low blends of ethanol and biodiesel into petrol and diesel

278. When there are fuel blends, carbon taxation may require simplification for administrative efficiency. When using the Fuel Approach method, many countries tax fossil fuels mixed with biomass components, such as ethanol or biodiesel, at per litre tax as if the fuel were 100 percent of fossil origin. Although most EU countries have introduced biofuel quotas for fuel blending in petrol and diesel, carbon tax rates have remained the same, regardless of the content of biomass fuels in those motor fuels. EU state aid provisions put legal constraints on EU Member States' possibilities to combine a quota obligation scheme with tax exemptions.

279. Depending on where the carbon tax is levied on the distribution chain, jurisdictions may encounter administrative problems in implementing tax exemptions, for example, adding ethanol in petrol fuel blends. However, this can be resolved with extensive bookkeeping and verifications for the different components or legal definitions of the level of a low blend to be eligible for a tax refund.

2.11 Taking account of the biomass part of petrol and diesel when calculating the carbon tax rate

280. Some countries, such as Sweden and France, consider the biomass component of fuel blends to determine the per litre of petrol and diesel carbon tax rate121. The use of pure or high blended liquid fuels of biomass origin, which amounts to low volumes in most countries, is often exempted from applied carbon taxes. Another example is British Columbia. In the Canadian province, the carbon tax is applied to ethanol at the same rate as petrol and biodiesel, and to renewable diesel at the same rate as diesel or light fuel oil.

281. British Columbia approached the issue more broadly when the renewable fuel

121 Prior to the introduction of the quota obligation in Sweden, the carbon tax rate for petrol and diesel only applied to fossil fuels, whereas now the tax rate is calculated for the fuel blend. Compared to the example in Box 18 above, when calculating the Swedish carbon tax rate for petrol for 2020, the heating value of fossil petrol was 32.76 GJ/m^3 and the emission factor 72 kg CO_2/GJ (both values revised to better reflect current quality of fossil petrol in Sweden). Furthermore, assuming zero fossil emissions from sustainable biofuels and with a quota resulting in a 7.7 percent share of biofuels in petrol, the emissions of fossil CO_2 from blended petrol amounted to 32.76 GJ/m^3 * 72 kg CO_2/GJ * (10.077) = 2177 kg CO_2/m^3, or 2.177 kg CO_2/litre. Multiplying this with the 2020 general carbon tax level of 1.19 SEK/kg fossil CO_2, the carbon tax rate for petrol is obtained at 2.57 SEK/litre.

standard was introduced in 2010, requiring an average annual blend of respectively five and four percent renewable content for petrol and light fuel. Carbon tax rates on these fuels were reduced by five percent to reflect the expected emission's reductions.

Box 18. Finland – An example of a jurisdiction with an innovative view of future carbon taxation

Finland was the first country in the world to introduce a carbon tax in the early 1990s. It is a key component in the country's pathway to a low-carbon and eventually carbon-neutral society. Since 2011, taxation of motor and heating fuels has been based on energy content, a CO_2 emission component and local emissions of fuels.

The CO_2 emissions of each fuel source are based on the carbon content using a life-cycle perspective. Biofuels are subject to a carbon tax rate that is reduced from 50 to 100 percent according to performance, giving a carbon tax exemption for the biofuels that are considered best from an environmental point of view (sometimes referred to as second generation or advanced biofuels), and applying different levels of carbon taxation for other biofuels based on parameters laid down in EU legislation[122].

The Finnish system taxes fuels based on carbon content; however, biofuels are classified in three levels based on the emissions reduction achieved, relative to equivalent fossil fuels considering the life-cycle carbon emissions[123]. Biofuels that fail to meet sustainability criteria are subject to the same carbon tax (per energy content) as the equivalent fossil fuel, as they are not considered to be emissions-reducing. Biofuels that meet the sustainability criteria (e.g., agriculture origin/first generation biofuels) and where emission savings exceed 50 percent, are subject to a carbon tax rate corresponding to 50 percent of the carbon tax applicable to the equivalent fossil fuel.

Finally, carbon taxes are not levied on second generation biofuels made of waste, residues, lignocellulose, etc., as these fuels are considered to, on average, have CO_2 emissions savings of over 80 percent. Since the Finnish carbon tax design is based on life-cycle emissions, emission factors will differ from other jurisdictions. For example, the value of the emission factors used will be different with respect to Sweden (and other countries that base their tax on the actual carbon content of fuels). However, the carbon tax is still expressed in volume or weight units in the tax law, and the general method for calculating the tax rate is the same.

In sum, with the Fuel Approach, even the more complex system implemented by Finland does not require environmental knowledge from the tax authority. What the tax administration basically needs is to determine how to calculate and audit the number of litres fuel sold by the taxpayer. This is a task which tax authorities are normally familiar with.

Source: Authors and Finland's Fifth Progress Report, 24 January 2020

2.12 *Summing up*

282. The Fuel Approach is a way of implementing carbon taxation by recognizing that over 75 percent of global CO_2 emissions come from the combustion of fossil fuels. Since the carbon content of fuels is relatively stable and consistent, setting the tax rate of fuels based on the carbon content, in effect, performs as a tax on carbon emissions. There are many advantages with this approach: it is administratively simple, it does not require a sophisticated system to monitor emissions, and, above

122 Directive of the European Parliament, 2009.

123 A life-cycle analysis (LCA) of the production of fuels is a technique to assess environmental impacts associated with all the stages of a product's life from raw material extraction through materials processing, manufacture, distribution, use, repair and maintenance, and disposal or recycling. There have been studies made in recent years comparing energy and carbon balances for production and use of different fuels.

all, it can be developed using the current excise tax institutional framework.

Checklist 6 Fuel Approach

1.	Tax Base	→	Fuels
2.	Tax Rate	→	Applied to different fuels
3.	Taxable event/point of regulation	→	Anywhere in the value chain
4.	Administration	→	Typically, existing excise tax administration
5.	Coverage	→	Usually, main fuel sources
6.	How to calculate tax rate		Depends on carbon content, some jurisdictions use carbon content and others the value chain
7.	How tax rates are presented	→	By volume or weight units
8.	Calculating total tax liability	→	Based on total fuel use/combusted
9.	Special considerations	→	Different fuel qualities and biofuel mixtures

3. The Direct Emissions Approach

3.1 Basic concept

283. An alternative to the Fuel Approach is a carbon tax on measured emissions. With this approach, known as the 'Direct Emissions Approach', the carbon tax targets CO_2 emissions at source regardless of fuel or processes. Although the tax is usually focussed on fuel combustion, it can be applied to emissions from any source. This is an obvious advantage since the tax can extend to non-fuel emission sources and other GHG and pollution emissions. The disadvantage is that it requires a more sophisticated administrative structure to measure emissions at source and, therefore, it can only generally be applied to large facilities.

284. This approach relies on direct reporting of emissions from stationary installations/facilities, such as large factories, power plants, and oil refineries. This is the case in Chile and, most recently, in Singapore and South Africa. These facilities are often already subject to legal requirements to measure emissions. Therefore, jurisdictions that have applied this approach have usually used existing reporting structures or legal mandates, such as in the United Nations Framework Convention on Climate Change (UNFCCC) national reporting guidelines.

285. However, although measurement at source may seem to be a more accurate approach to assess carbon emissions, measurement systems are often not precise; therefore, the Direct Emissions Approach is not necessarily more accurate than the Fuel Approach. Furthermore, it may involve uncertainty and higher administrative costs. Regardless of existing reporting structures, jurisdictions will most certainly

need to establish new administrative and regulatory systems for monitoring, reporting, and verification (MRV), particularly for smaller facilities.

286. With this approach, jurisdictions may be able to ensure broader coverage of emissions, especially where a large part of their emissions is not fuel-based. However due to the requirements for measurement at source, the approach would work best focussing primarily on emissions from large stationary installations. It is thus not a system well suited to cater for incentives to reduce emissions from small facilities, due to the major administrative costs likely to occur. For the same reason, it is not a foreseeable alternative for emissions from the propulsion of vehicles. Therefore, a variation of this approach is to focus only on certain processes and types of emissions.

287. A policymaker considering the Direct Emissions Approach is likely to need more assistance with technical expertise on environmental and energy related matters in the tax design than the Fuel Approach. As will be further outlined in Chapter 8, a carbon tax based on a Direct Emissions Approach will also be administered in a way that differs from the tasks normally assigned to tax authorities. On the other hand, a Direct Emissions Approach can strengthen already existing environmental reporting systems – and this has many additional advantages and benefits.

3.2 Coverage of emissions by the Direct Emissions Approach

288. Although not as common as taxation of fuels, there are jurisdictions that have chosen to tax direct emissions. For example, in a 2017 tax reform, Chile introduced two new green taxes, a carbon tax and a local pollution tax targeting emissions from large facilities comprised of boilers or turbines.[124] The tax targets emissions of CO_2 - covering over 40 percent national emissions - and the local pollution tax covers PM (particulate matters from dust or smoke), NO_X (oxides of nitrogen) and SO_2 (sulphur dioxide).[125]

289. Other examples include the San Francisco Bay Area carbon tax in the USA (in force since 2008) and Singapore that introduced its first carbon tax in 2019. Both these jurisdictions calculate the tax on measured emissions arising from combustion of fuels in large stationary facilities. By converting emissions from other greenhouse into CO_2 equivalents (CO_2e), other GHGs are also included.

290. The San Francisco Bay Area's tax is levied on emissions from facilities that are subject to local environmental regulations (permits), while Singapore's carbon tax requires any industrial facility that emits 25,000 tCO_2e or above a year, to register as a taxable facility and pay the tax.

124 The tax exempts biomass.
125 Pizarro and Pinto, 2019.

291. A similar approach is taken by South Africa where a carbon tax came into force in 2019. The South African carbon tax[126] targets CO_2e emissions above a certain threshold from fuel combustion, electricity generation and industrial processes, as well as estimated fugitive emissions.[127] While South Africa is, in principle, using a Direct Emissions Approach, the emissions taxed are calculated based on pre-determined emission factors, according to a methodology approved by the relevant authority. The tax law also lays down standard values, in case such a methodology does not exist for a specific activity.

292. The facilities targeted by a tax based on the emissions are, in many cases, already required to measure and report their emissions due to national or international regulations. However, a MRV system will still be necessary. This requires cooperation between the national tax administration and agencies with environmental and technical capacities, to be able to control and monitor emissions and ensure tax control.

293. Starting in 2024, all parties to the Paris Agreement will be required to report their emissions using the guidelines of the Paris Rulebook. Although developing countries with limited capacity may initially report with some flexibility, parties will, over time, need to increase the accuracy of their national emissions inventory, increasing the capacity to implement a carbon tax based on emissions. Therefore, one of the principal advantages of the Direct Emissions Approach is that, although more difficult to implement initially, it forces countries to develop their MRV capabilities that will support a range of international commitments and local policies.

294. Further, while the Direct Emissions Approach places the tax on actual emissions, it is not necessary to have direct measurement of emissions at all sources. In effect, countries use a range of mechanisms to measure emissions that include continuous emissions measurement systems (CEMS), direct measurement, or estimations based on fuel use. The only effective requirement to monitor emissions is to ensure reporting at the facility level. This feature of the approach is relevant for developing more sophisticated policy instruments, or introducing other complementary environmental policies such as local pollution controls.

3.3 *Taxpayer*

295. If a Direct Emissions Approach is chosen for the design of a new carbon tax, it would be natural to choose the taxpayer as the entity that physically generates the emissions. Administrative advantages can be expected by coordinating the tax collection and payment with already existing obligations to report emissions based

126 For further information about the South African carbon tax, see Republic of South Africa Carbon Tax Bill B-46-2018.
127 Fugitive emissions are emissions of gases or vapours from pressurized equipment due to leaks and other unintended or irregular releases of gases, mostly from industrial activities.

on environmental regulations. Still, such a tax system would most likely require new administrative practices for the tax authorities, including necessary cooperation with – and the technical expertise of – environmental authorities to be able to carry out tax control.

3.4 Methodology to calculate the tax payment by the Direct Emissions Approach

296. For the Direct Emissions Approach, jurisdictions need to determine where the emissions are coming from. Therefore, defining the facility affected by the tax, or what the boundaries of the tax liability are, is crucial: Is it a spatially contained area, or does it involve broader processes that span a larger area? Is it one chimney stack or many? This not only limits coverage but also establishes the criteria of who pays the tax.

297. Determining the boundaries of a facility is not obvious in all cases. For example, in the case of Chile, a facility was defined as "*the set of structures and installations where one or more boilers or turbines are located, which are close to each other and that for technical reasons are under a single or coordinated operational control, that together have a thermal power capacity of* 50MW." Although the definition does not limit coverage to a sector, it does establish a boundary based on technological criteria of heat production. In effect, in the case of Chile, the tax affects sectors such as food processing, refining and electricity generation.

298. Moreover, jurisdictions often limit tax liability to an emission threshold for regulatory efficiency. In the case of Singapore, stationary facilities are liable if they surpass the emission threshold of 25,000 tons of CO_2e a year. While this limits coverage to those facilities that generate the most emissions, it may be problematic since applying the threshold requires the development or existence of an MRV system prior to identifying who is liable to pay the tax. Therefore, countries who do not have a sophisticated emissions reporting system will need to develop one before implementing these thresholds to identify potential taxpayers.

299. Through a strict definition of liable facility-based or an observable technology, namely the existence of boilers and turbines with 50 megawatt (MW) potential capacity (regardless of a specific emissions threshold), Chile avoided the above problem. Therefore, the regulator could, without recourse to an MRV system, identify liable facilities, and, therefore, place the burden on the facility to develop its own MRV system and report its own emissions.

3.5 *Measuring, Reporting and Verification Systems (MRV)*

300. Both the Fuel Approach and the Direct Emissions Approach will requireMRV. However, in the case of the Fuel Approach, the MRV system is, in effect, the current excise tax institutional system. The Direct Emissions Approach, on the other hand, will require a new MRV system.

301. The general structure of the MRV system is composed of, at least, four components:

- the registry of the facility and sources subject to the tax
- the measurement, monitoring (M) or quantification of emissions
- the reporting (R) mechanisms of emissions at the facility level, and
- the verification (V) of those emissions.

These are examined in turn.

Registry

302. A key component of the MRV is the system for registering facilities that are potentially liable for the tax. In general, all facilities should be registered to determine who meets a predetermined threshold and is therefore liable to pay the tax. Most countries will have some form of registry of polluting firms, which are already reporting emissions or are subject to some form of control. In the case of Chile, for example, the Pollution Release Transfer Registry (PRTR) was used. However, if no such registry exists, one must be developed.

Measurement of emissions

303. As mentioned above, despite the name of the Approach, it is not necessary for facilities to measure their own emissions. It is sufficient for them to keep track of the use of fuels, and estimate emissions based on their carbon content. What is required, however, is to report emissions at the facility level. This is the main advantage of using emissions as the tax base, since it forces facilities to make explicit, transparent, and certifiable declarations of emissions. It is the basis of the development of an institutional infrastructure to support MRV systems at the facility level. More accurate reporting systems will be essential for international reporting, as well as for expanding carbon pricing policies across jurisdictions and sectors. See Box 19 for the types of measurement available to facilities.

Reporting

304. After measurement, the facility must report its emissions to the relevant government agency. These must be verified (see below) and consolidated to report

to the authority in charge of the tax administration (Tax Authority). The emission reporting process should be based on specific guidelines that establish the conditions and standards that must be met, both to register the affected facilities and to report the taxable emissions. This will be further outlined in Chapter 8.

Verification

305. Verification systems refer to the institutional structures to validate, confirm or verify the emissions reported. Since this is a tax, the amount to be paid will be based on the reported emissions which need to be verified by the environmental authorities. However, if the objective is for the tax to evolve to other, more sophisticated systems (such as offsets or compensation schemes), some form of independent verification system could be conceptualized from the beginning and then later developed. Figure 9 summarizes the issues raised by the MRV system associated with the Direct Emissions Approach.

Box 19. Emission measurement alternatives

Facilities subject to the tax apply different methodologies or techniques for quantifying emissions for the purposes of paying the tax. These will vary across sectors and institutional capacities. There are four possible measurement approaches.

Direct measurement: It consists of the direct quantification of the output concentrations emitted, through a measuring device installed on site. Quantification can be carried out by continuous sampling or measurement systems.

Point or sampling: Collection of a sample with specialized equipment, for subsequent laboratory analysis or on-site measurement. The analysis delivers the output concentration and the representative flow at the moment of measurement.

Continuous: Real-time collection and analysis of emissions, through a CEMS. It can determine average emission schedules, generally during an annual period.

Estimate: This method consists of the indirect quantification of emissions, through emission factors (associated with the specific production process), and the annual activity level (hours of operation and fuel consumption, among others). For local pollutants, the emission factors provided by the United States Environmental Protection Agency (EPA) can be used,128 while for carbon emissions, the factors proposed by the Intergovernmental Panel on Climate Change (IPCC, 2006) can be considered.

128 These factors are regularly updated and can be found on the EPA website, at https://www.epa.gov/climateleadership/ghg-emission-factors-hub.

Figure 9. Different issues raised by an MRV system

Registry	Measurement	Report	Verification	Trade/offset
• Registry of potentially affected facilities • Establish reporting requirements • Determine necessary information • Responsibilities • Penalties • Technological platform • Training users • Regulatory agency	• Measurement methodologies protocols (e.g., CEMS, emission factors) • Base lines (in the case of reductions) • • Quality control • Responsibilities • • Penalties • • Enforcement agency	• Structure of report (e.g., required information, dates) • Responsibilities • Penalties • Quality control • Technological platform • Training users • Enforcement agency	• Verification system • Standards required for verifiers • Standards and criteria for verification • Responsibilities • Penalties • Quality control • • Training users • • Enforcement agency	• System of trades • Emissions registry • Allowance registry • Reduction registry • Establish reporting requirements • Determine necessary information • Responsibilities • Penalties • • Technological platform • Training users • Regulatory agency

3.6 Point of regulation

306. A carbon tax based on the Direct Emissions Approach is a downstream tax based on actual emissions released by facilities subject to taxation. Therefore, while the Fuel Approach can, depending on the tax design, use either an upstream or a downstream point of regulation, a carbon tax on emissions must be regulated downstream.

307. As outlined earlier in this Handbook, many jurisdictions around the world have introduced carbon taxation with somewhat different designs. However, Chile is the only Latin American country to have opted for a downstream tax, while Colombia and Mexico have chosen to institute upstream taxation based on carbon content of fuels.

308. A carbon tax based on a Direct Emissions Approach requires the measurement or estimation of actual emissions at the source. Therefore, the taxpayers are likely to be those who control the production process that generates the emission. These can either be the owner/renter of the installation where the emissions occur, or the business carrying out its activity in the facility and requiring the process which generates the emissions.

3.7 *Institutions involved*

309. The Fuel Approach requires technical or institutional support from environmental agencies when defining the methodology for calculating the carbon tax rate for specific fuels. In the case of a carbon tax on emissions, the role of technical and environmental agencies is permanent, as these are the key institutions that determine the tax base and consolidate the calculations of emissions for the final tax to be paid.

310. A central aspect in the implementation of the carbon tax is the coordination among various ministries and government departments for the construction of reliable methodologies and information systems on emissions, issuers, technologies, tax payments and fines.

311. Generally, the Ministry of Environment or an equivalent Environmental Agency would be responsible for coordinating the process through the regulation of emission MRV systems that constitute the information base for the calculation of the tax. After each facility declares its final emissions, the Environmental Agency should verify and consolidate them, while the Tax Authority will calculate the tax burden of the specific facility.

312. Thus, one of the problems (or advantages) of the Direct Emissions Approach is that it requires (or strengthens) the coordination between the Environmental Authorities, the Ministry of Finance and the Tax Authority.

3.8 *Summing up the Emissions Approach*

313. Conceptually, the Direct Emissions Approach targets emissions directly. However, there are both advantages and disadvantages to this approach. The most obvious advantage is that the tax on emissions is explicit, which can facilitate the introduction of a carbon tax in a country where new taxes are not easy to implement.

314. On the other hand, it can lead to increased institutional complexity and conflict in the shared responsibility for tax administration and tax control between Tax and Environmental Authorities. Another problem (which can also be an advantage) is that it will require the development of an MRV system. This is more expensive and may generate conflict, but will eventually be useful for additional purposes, such as developing inventories, enhancing domestic and international comparability, facilitating management within companies, and even generating conditions to move towards other policy instruments such as compensation mechanisms, offsets, and/or an emissions trading system.

Checklist 7. Direct Emissions Approach

1.	Tax Base	→	Emissions
2.	Tax Rate	→	Applied to emissions
3.	Taxable event/point of regulation	→	At the emission source, definition of facility required
4.	Administration	→	Require new MRV administration
5.	Coverage	→	Usually, large facilities
6.	How to calculate tax rate	→	No correction is required
7.	Calculating total tax liability	→	Based on total emissions
8.	Special considerations	→	MRV system required

4. Considering the different carbon tax approaches

315. The choice between the different tax approaches will depend on various factors: institutional capacity and legal restrictions. The general political economy of carbon tax implementation may also be relevant. Ultimately, the choice is not only technical but also political, and should be defined in terms of broader objectives.

316. Table 4 summarises the advantages and disadvantages of the different tax design approaches. Although the table compares the different approaches as alternatives, a better way of evaluating them is to consider them as complementary, since they have different advantages and disadvantages and achieve different goals in different sectors. In effect, jurisdictions may decide to implement a combination of both approaches.

5. Conclusion

317. This chapter has examined the issues raised by carbon tax design based on two alternative approaches, the Fuel Approach - which uses fuels as the tax base and sets the tax rate based on carbon content of the fuels - and the Direct Emissions Approach -which establishes the tax directly on emissions.

318. To illustrate, we drew on the examples of the taxes implemented in Sweden and Chile. Both approaches have different advantages and disadvantages, and potential challenges. However, the principal challenge, which affects them equally, is the potential conflict associated with implementing the tax, or the political economy of carbon tax design. In the next chapter, we explore the sectors affected and the available mechanisms to compensate or ameliorate impacts on households and firms. Although these issues go beyond the design of the tax, they should also be considered in the design phase.

Table 4. Some pros and cons of different carbon tax approaches

	Pros	Cons
Fuel Approach	• Incentive is clear – Polluter Pays (as tax is normally included in fuel price). • Administratively simple, can be added to an existing excise tax system. • Scope can include large part of CO2 emissions in small as well as big stationary facilities, as well as transport.	• If incentive to choose higher quality fuels within the same tax group is desirable, system may be more complicated as more tax rates are needed. • GHG emissions other than CO2 are out of scope. • Does not develop MRV systems.
Direct Emissions Approach	• Incentive is clear – Polluter Pays. • Making use of existing MRV and incentive to further develop MRV. • Possibility of developing other more complex instruments and of eventually converting to an emissions trading system. • Possible to include non-fuel combustion emission in scopes	• Costly to measure. • Difficult to apply to small facilities. • Cannot be applied to transport fuels. • Administratively complex.

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Appendix 2: Taxation of air and maritime transport

A1. *Introduction*

319. Extending the scope of carbon taxation to activities or processes that go beyond the borders of a jurisdiction can be problematic because it may to lead to double or multiple taxation, depending on how the tax is structured. Furthermore, international treaties and agreements enacted/ratified by a country may apply, and, under customary international law, a State may not use the provisions in its domestic law as a rationale for failing to adhere to the provisions of a treaty (Article 27 of the Vienna Convention).

320. This Handbook aims to give an overview of how a general carbon tax can be implemented within the borders of a jurisdiction. However, taxing fuels used in commercial air transport and maritime transport (including fishing) present specific challenges. Although this will not be dealt with in detail, this Appendix considers the principal issues with the purpose of offering interesting approaches worth exploring further, future considerations, and an overview of discussions ongoing in different international fora.

A2. *Commercial air transport*

321. There is widespread perception that fuels used in international aviation are exempt from taxation; this perception is based on the view that the Chicago Convention prohibits the taxation of these fuels.

322. The 1944 Chicago Convention establishes the rules regarding international civil aviation. The Treaty forms the basis for the International Civil Aviation Organization (ICAO), a specialized agency of the UN. The contracting States agreed not to tax fuel on board an aircraft of a contracting State, on arrival in the territory of another contracting State and retained on board on leaving the territory of that State. This only applies to fuel on board an aircraft when arriving in another State and for international flights. Therefore, since the Convention imposes no limitation on a State's right to tax fuel taken on board and consumed during a domestic flight, jurisdictions can impose carbon taxes on national commercial flights.

323. ICAO Policies in the Field of International Air Transport (and ICAO Council Resolutions) state that fuel taken on board an international flight should be exempt from all customs and other duties; however, these policies only have standing as non-binding soft law, and several States stated (in an appendix to the policies) that they don't agree with the resolutions. Further specific agreements, known as Air Services Agreements (ASAs), akin to an international treaty, can provide for

the exemption from customs duties, excise taxes and other duties and charges on aircraft, fuel, lubricating oils, technical supplies and spare parts used by an airline of the counterparty State in the provision of international air transport services.

324. Consequently, it is advisable that the scope of any local, regional, or national carbon tax regime examine and consider any existing international agreements prior to implementation.

325. Nevertheless, EU Member States have argued that without global instruments in place, a tax on kerosene, an air passenger tax, or a tax per flight is necessary. Furthermore, this position is sustained by the understanding that taxing fuel for international aviation is legally possible. For example, countries could, on a bilateral basis, tax fuel on flights between themselves while still following international law. At the time of the publication of this handbook, discussions are still ongoing on this topic.

326. To deal with international emissions, in 2016, ICAO adopted the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). This is a market-based measure applied to CO_2 emissions from international flights, stating that CO_2 emissions from international aviation should be stabilized to 2020 levels. The proposal is that CO_2 emissions above this level should be compensated through an offsetting scheme. The new system will start by a voluntary phase and will be compulsory from 2027.

A3. *International maritime transport*

327. Currently, there are no international agreements establishing a country's right to tax carbon emissions (or fuel consumption) deriving from international maritime transport, nor restrictions prohibiting or limiting a State's right to tax fuels used on cross-border maritime transport of goods and in high-sea fishing exploration.

328. There are, however, two relevant international regulations: (i) the regulations issued by the International Maritime Organization (IMO), and (ii) the UN Convention on the Law of the Seas (UNCLOS). Neither specifically deals with economic instruments relating to carbon emissions, but nothing prevents countries from implementing policies such as carbon taxes to reduce carbon emissions.

329. The IMO was created in 1948 as a specialized UN agency, [129] with the purpose of developing, administrating, and legally implementing international

129 The IMO, initially named Inter-Governmental Maritime Consultative Organization (IMCO), has issued mandatory energy efficiency standards for new ships (the Energy Efficiency Design Index (EEDI)) and mandatory operational measures to reduce emissions from all ships which have entered into force in 2013, as amendments to MARPOL Annex VI. By 2025, based on the EEDI phased approach, all new ships are expected, based on that legislation, to be 30 percent more energy efficient than those built before 2014.

regulations and practices to be followed with the cooperation of Governments, to achieve the highest standards in matters concerning maritime safety, efficiency of navigation, and prevention and control of marine pollution from ships. The Marine Environmental Protection Committee was created to address environmental issues under IMO's remit.

330. UNCLOS, which was ratified by 166 parties (including the EU, but not the USA),[130] is a general convention and, as such, is compatible and may be subject to the provisions of other more specific conventions, provided that these do not contravene the basic principles embodied in the Convention. Therefore, UNCLOS may interact with the Paris Agreement and the Kyoto Protocol, for example, when it comes to setting specific and higher standards for environmental protection for shipping operations.

331. In 2018, the IMO adopted the Initial IMO Strategy on Reduction of GHG Emissions from Ships (Resolution MEPC.304(72)), aimed at reducing total GHG emissions from international shipping at least by 50 percent by 2050. To that purpose, the Strategy lists several candidate measures to reduce GHG emissions from international shipping. They do not, however, include carbon taxation.

332. IMO's policies so far have only addressed mitigation techniques and efficiency improvements, rather than carbon taxation or market-based initiatives (such as emissions trading). Since the EEDI only applies to new ships, and a ship's operational life ranges between twenty and twenty-five years on average, it is unlikely that energy efficiency standards would be sufficient to reduce CO_2 in the short- and medium-run. Even in the long-run, Smith et al. (2016) indicate that with the current designed EEDI, shipping's cumulative CO_2 emissions will be reduced by only 3 percent between 2010 and 2050. Smith et al. (2015, 2016), in a study commissioned by IMO, predict that the EEDI regulation alone will not change the increasing trends of CO_2 and GHG emissions.

333. The international maritime transport sector is not currently subject to the payment of any carbon tax (or environmental charge or other implicit price through market-based instruments). This has at least three adverse consequences. The *first* is a higher than optimal activity in international shipping (types of vessels, the routes they take, and the types of goods they transport), as this sector does not face the true global costs of international trade. The *second* is high fuel consumption

130 Established in 1982, UNCLOS is responsible for codifying the rules applicable to activities on the high seas, by: 1) establishing an international legal order for the economic and scientific exploration of seas and oceans; (2) facilitating international communication; and (3) promoting the peaceful uses of the seas and oceans, equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection, and preservation of the marine environment.

(and too much use of polluting fuels) and consequently high carbon emissions[131] (see Smith et al. (2015)). The *third* is the lost opportunity of raising fiscal revenues raised from international shipping transport for countries participating in international trade. This issue is especially critical for many low-income countries with low tax revenues.

334. Absent an international environmental agreement to source and tax carbon emissions from international shipping, taxation of those emissions becomes a topic of exclusive competence of national States.

335. The attribution of indirect taxing rights over activities occurring on the high seas is not a topic covered under international tax treaties or the UNCLOS. Regulatory environmental standards are within the competence of the flag State, but as carbon taxation is a specialized topic within the general field of environmental law, it would be up to policymakers to define how taxing rights derived from global emissions could be allocated between States.

336. Taxing carbon emissions would be consistent with the principle, consolidated in the UNCLOS, that the responsibility for the emissions released on the high seas should be shared by the larger international community, and with IMO's guiding principle of non-discriminatory treatment of all ships regardless of the flag State. Extensive cooperation between all countries on this matter would represent a recognition of such responsibility and would be the first step in allowing countries to reach an agreement on a global carbon tax scheme for the international shipping sector. The international community (including IMO) acknowledges that low-income countries and small island developing States could be affected. Addressing potential negative effects of implementing a carbon tax in the maritime sector may, for example, require designing a scheme to compensate the countries that are most affected.

131 Bunker fuel consists primarily of residual and distillate fuel oil (see EIA (2015)). Starting January 1, 2020, IMO requires that all fuels used in ships contain no more than 0.5 percent sulfur. The cap is a significant reduction from the existing sulfur limit of 3.5 percent.

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Chapter 7: Addressing Undesired Effects on Households and Firms

1. Introduction

337. A carbon tax provides a price signal that generates an incentive to reduce emissions. However, concerns over the undesired effects on firm competitiveness and carbon leakage, together with fear of unwanted distributional impacts, can constitute political obstacles for its implementation. The concerns can be addressed both in the design of the tax and the introduction of additional mitigating measures.

338. This chapter discusses the possible negative side-effects of carbon taxes and explores measures to address undesired impacts. It also provides examples of how jurisdictions have introduced a carbon tax using two-level tax system and liability thresholds or exemptions.

2. Possible adverse effects from carbon taxation

339. Like any policy intervention, carbon taxation may have undesired effects or impacts. Carbon taxes may lead to price increases in goods and services, which can have negative impacts on households' disposable income and firms' competitiveness. Policymakers may want to avoid or mitigate these impacts. Addressing concerns over distributional effects, social equity, fairness, employment, and firm competitiveness, among others, is also important for achieving public acceptance. In addition, paying attention to possible adverse side effects can help safeguard the environmental integrity of the carbon tax as some of the measures available for policymakers to protect domestic firm competitiveness may help to avoid carbon leakage.

2.1 Negative impacts on households

340. The impact of a carbon tax on households is often at the centre of the public debate; this can provide valuable input to the design of the tax, or give insights to the need for policies complementing the tax and the possible design of such measures.

341. Concerns over distributional impacts, social justice, and equity implications are not only legitimate, but require the attention of policymakers to ensure the success of the tax. The wider policy context of those affected is also relevant; therefore, it is advisable to consider the implementation of the tax in the context of other economic policies. For example, the French nation-wide demonstrations organized by the "*Gilets Jaunes*" movement was sparked in late 2018 by, among other things, concerns over the effect of increasing carbon taxation on fuel prices and

how this would affect households.

342. The most common way to measure distributional effects is to study the impact on different income groups. While the empirical literature has predominately researched distributional effects from general excise duties on energy sources, these studies can nevertheless provide insights into the potential impacts of carbon taxation.[132]

343. Conventional wisdom regarding the distributional effects of taxation of energy sources has been that it is regressive, i.e., that these taxes increase the burden on low-income groups relatively more than those with higher income. However, more recent research suggests that taxes on energy can no longer be viewed as universally regressive; instead, the tax incidence (or the final distribution of the burden of taxation), depends on a variety of factors. These include, among others, the type of energy commodity being taxed, the social, physical, and climate characteristics of the jurisdiction, and how household income is measured.[133]

344. For instance, due to the profile of vehicle ownership in middle- and lower-income countries, taxation of motor vehicle fuels has been found to be neutral or even progressive.[134] However, households may be affected by a carbon tax not only from direct consumption (e.g., from the burning of fuels for transport or heating), but also from the increased price of carbon-intensive goods and services or inflationary impacts. These indirect costs to households are sometimes less tangible and hence more difficult to measure. Nevertheless, when examining the social effects of a carbon tax, it is important to consider both the direct and indirect effects.

345. In addition to the distributional effects of carbon taxation, other dimensions of the social impacts of the tax include the perception of fairness, equity, and social justice in the design and implementation of the tax.

2.2 Negative effects on firms

346. For firms, a carbon tax will increase the cost of carbon-intensive inputs. If the additional cost cannot be passed on to the consumers, the tax may affect competitiveness. Apart from the increased direct cost of emissions, or carbon-intensive inputs, the firm may also face increased costs from its own abatement measures. In the short run, measures to decrease emissions can entail fuel switching or other energy-efficiency improvements. There is also the possibility that some firms may choose to avoid the tax by reducing production, since, in the short run, it is likely that mitigation options are limited by capital constraints, current

132 Flues and Thomas, 2015; Pizer and Sexton, 2019.
133 Ibid.
134 Sterner, 2012. see e.g., Flues and Thomas, 2015.

technologies, and production processes.

347. In the long run, other types of mitigation efforts will be available, as firms have more time to raise capital, invest in Research and Development (R&D), and adopt new technologies. Firms' long-term investments can focus on reducing emissions within the existing production technologies and processes, or be aimed at changing entire production processes. Either way, the more significant mitigation measures a firm undertakes, the more resources are likely to have been invested, and hence the larger the direct cost is for the firm.

348. In addition to the direct cost of mitigation measures, firms may also face an indirect cost, measured as the loss in profits that follows from the fact that investment in abatement crowds out productive investments in capital and innovation that the firm would otherwise have undertaken. While the opportunity cost of capital does not increase expenditure for firms like the direct costs discussed above, it can have a long-term negative effect on, for example, competitiveness.[135]

349. Firms that produce a homogeneous product for an international market are normally price-takers, and they will not be able to pass the additional costs from taxation on to customers. Under these circumstances, an increase in production costs risks reducing domestic firms' market share. The competitiveness of such firms is likely to be more affected by a carbon tax than firms with a lower energy intensity and trade exposure. In jurisdictions where exporting firms constitute an important part of the economy, there may also be concerns over impacts on aggregated economic indicators such as total factor productivity, investments, employment, and output.[136]

350. Firms that can transfer a significant portion of their costs through prices without losing market shares (price-setters) are, in general, more likely to be less exposed to competitive effects. Knowing ex-ante which firms and sectors are more vulnerable requires a careful assessment, since it depends on the circumstances in each specific jurisdiction. There is no straightforward way to determine the vulnerability of a given firm or sector, but various measures of trade exposure and emission intensity are often used to identify which are likely to be negatively affected.[137]

351. It could be noted here that having to invest in less polluting technologies sometimes is considered to have a positive effect on, for example, firm productivity, profits, and competitiveness, as these investments will lead to enhanced resource

135 Ibid..
136 Ibid
137 As an example of how sectors at risk of carbon leakage can be identified, see the impact assessment supporting the preparation of the so-called carbon leakage list under the EU Emissions Trading System for the period 2021-2030, SWD(2019) 22 final.

efficiency, spur innovation and open new markets. Although there is considerable research on the empirical evidence to support the existence of the so-called Porter hypothesis (which stipulates that environmental regulations can enhance innovation and competitiveness), it is not conclusive. While regulation indeed seems to spur innovation, it is less clear to what extent stricter regulation also enhances business performance.[138]

352. There is considerable research on the possible interaction between environmental taxes (such as carbon taxes), energy prices and trade, and their impact on competitiveness.[139] These studies suggest that the effects of carbon taxes can be large, depending on which sectors are being investigated and what method is used for the analysis.[140] However, in ex-post evaluations, there is less evidence to support significant adverse effects from environmental taxes on firm competitiveness in general. As expected, studies confirm that negative impacts are more likely to occur in energy-intensive, trade-exposed sectors, but observed impacts have been found to be relatively small and short-term.

353. This is not to say that carbon taxes cannot have negative impacts on firm competitiveness, nor that concerns over such impacts do not need to be considered when designing and implementing the tax. But, to date, the evidence suggests that impacts are limited. There are several possible explanations for this, including that carbon taxation is only one of many factors that affect firms' choices.[141] Careful policy design may also have prevented or mitigated possible negative impacts.

2.3 Concerns over carbon leakage

354. The notion of carbon leakage is closely related to the question of adverse competitive impacts. Carbon leakage occurs when the carbon pricing in one jurisdiction results in increased emissions in another. If this happens, in practice, the carbon pricing policy would just displace carbon emissions from one area to another. While the effects of carbon taxes discussed above are manifested as increased costs for economic agents, carbon leakage reflects the effectiveness of the tax as an instrument to reduce global carbon emissions. There are several channels through which such leakage can arise; however, the discussion below will focus mainly on competitiveness-driven carbon leakage.

355. As a carbon tax increases the cost of domestic production, foreign goods gain a competitive advantage, and, as a result, consumption may switch towards

138 Se e.g., Ambec et al., 2011.
139 See e.g., discussion in Coste et al, in Pigato, 2019. Again, the literature referred to here is on environmental taxation in general rather than on carbon taxes, but, as noted earlier, the conclusions are in essence valid for carbon taxes as well.
140 Coste et al, in Pigato, 2019.
141 Ibid.

imported goods. As production and emissions decrease domestically, carbon leakage suggests that production of carbon-intensive goods will increase abroad. Since the effect on climate change from carbon dioxide (CO_2) emitted into the atmosphere is the same regardless of where the emissions occur, the overall effect of climate change mitigation cannot solely be measured by the domestic emission reductions.

356. If domestic production is less polluting than foreign production, the reduction in domestic emissions will be more than counterweighted by increased emissions abroad, and the total emissions at global level will be higher. The opposite can, of course, also be true, that is, when foreign production is cleaner, total emissions at the global level would be lower than if production had remained domestic. However, this latter scenario is less likely to happen, as it is reasonable to assume that production will move to jurisdictions with less stringent climate policy.

357. Carbon leakage can also occur as domestic firms choose to reduce production volumes in existing factories as a result of the tax, and that market share is taken over by foreign companies with higher carbon emissions. In the longer run, the situation can become permanent as investments, in anticipation of reduced profits or lower rates of return, shift away from the domestic industry, affecting future production capacity. In both cases, there is a risk that overall emissions will increase. Hence, addressing concerns over potential adverse effects of a carbon tax on competitiveness may also strengthen the environmental integrity of the carbon tax.

358. Besides the competitiveness channel, carbon leakage may also arise through energy markets, as reduced demand for fossil energy in countries with more stringent climate policies may cause a decline in global energy prices, which in turn can trigger higher energy demand and carbon emissions elsewhere.[142]

359. The empirical literature on carbon leakage – and especially through the competitiveness channel – coincides with the literature on trade, competitive effects, and environmental taxation. The evidence for carbon leakage to date is weak. While ex-ante studies (impact assessments conducted prior the policy change) show leakage rates varying from negligible to close to 100 percent, there is less support to be found for significant carbon leakage in ex-post evaluations (studies relying on actual data after the policy has been implemented).[143]

360. One explanation is that general excise duty taxation on energy or carbon taxation is just one of many factors that influence the decisions of firms and investors. Design features that aim at protecting firm competitiveness and carbon leakage, in existing carbon taxes and other pricing mechanisms, may have contributed as well.

142 For an overview of the forms and channels of carbon leakage, see Görlach and Zelljadt, 2018.
143 Coste et al. in Pigato, 2019.

Furthermore, carbon leakage has likely also been limited by the fact that carbon taxes to date have been set at rather modest rates.

Checklist 8. Possible adverse effects from carbon taxation

1. Impacts on households' disposable income

   Measure distributional effects by studying the impact of the tax on different income groups

   (i) The energy price channel
      (a) Consider general electricity costs
      (b) Consider heating costs

   (ii) The transport price channel
      (a) Consider car ownership
      (b) Public transport use

   (iii) The general price channel.

2. Impacts on firms

3. Consider direct and indirect costs borne by different types of firms:

   (i) Price-takers
      (a) Consider direct cost of the tax (tax burden)
      (b) Consider competitive issues
      (c) Consider carbon leakage

   (ii) Price-setters
      (a) Consider tax burden

4. Environmental integrity

   (i) Carbon leakage

3. Assessing the risk of negative effects

361. Understanding the unique challenges and specific context where the carbon tax is introduced will enable policymakers to design appropriate measures to avoid or counter unwanted negative effects such as carbon leakage, competitive effects, and distributional risks. It will also help to ensure that economic agents are not given unnecessary compensations. Accurately assessing and communicating how the proposed carbon tax will affect stakeholders are also helpful in gaining public acceptance (see Chapter 3).

362. There are many ways to analyse the impacts of a carbon tax. Assessments by experts and broad public consultations can be valuable sources of information for effective tax design and help policymakers identify the need for complementary

measures (see Chapter 10 for a discussion). However, economic and/or energy system modelling are often crucial in exploring the effects of alternative tax designs and complementary measures in more detail.[144]

363. There are a wide range of modelling approaches. Economic partial equilibrium models, for example, can help explain how a carbon tax affects a specific industry or sector, while a computable general equilibrium model can be particularly useful for estimating economy-wide effects such as the level and distribution of costs. On the other hand, the overall techno-economic potential, and possible paths to reach emission targets, can be explored using energy systems modelling.[145]

364. As different analytical tools provide insights from different perspectives, adopting a set of multiple approaches can be valuable. At the same time, modelling is costly and the lack of funding, availability of data and limited capacity may limit the number of alternatives. Regardless of the means available for the assessment, careful planning will provide policymakers with useful information for the design of complementary measures. International organizations may also aid in the analysis of domestic mitigation policies.[146]

4. Policy options to address concerns over unwanted adverse effects

365. Economic theory suggests that a uniform carbon tax with wide coverage will be the most cost-efficient design.[147] At the same time, stakeholders commonly raise concerns that the additional tax burden can lead to adverse effects on the competitiveness of domestic firms – especially in energy-intensive and trade-exposed sectors – causing carbon taxes to deviate from a theoretically ideal carbon tax. Many jurisdictions have strived for a balance between environmental objectives, risks of carbon leakage, and competitiveness of sectors subject to international competition.

366. The risk of undesired effects from a carbon tax can constitute significant political obstacles for its implementation and therefore needs to be considered in the process of designing the tax. The impact of a carbon tax in different income groups and geographical regions, and how such impacts are alleviated, are other factors determining the acceptability of the tax. Consequently, each carbon tax system needs to have a unique design to address such concerns. Box 20 presents examples of how different jurisdictions have designed their carbon taxes to minimize adverse impacts.

144 For a general overview of different modelling approaches, their strengths and weaknesses, see e.g., Pigato, 2019. and PMR, 2017.
145 Ibid.
146 E.g., the IMF has developed a spreadsheet tool to help countries evaluate progress towards their Paris Agreement mitigation pledges. See IMF, 2019.
147 Baumol and Oates, 1988.

Box 20. Country examples of carbon tax designs with various degrees of exemptions[148]

- The carbon tax in Argentina was adopted in 2017 as part of a comprehensive tax reform and entered into force in 2019. The tax partially replaced an already existing fuel tax. The carbon tax applies to CO_2 emissions from all sectors and covers almost all liquid fuels and coal, in total, 20 percent of all the Argentinian greenhouse gas (GHG) emissions. The use of fossil fuels in certain sectors and/or for certain purposes is partially exempt from the carbon tax, including international aviation and international shipping, export of the fuels covered, the share of biofuels in mineral oils and raw materials in petro-chemical processes. To offset the fuel price increase by the carbon tax, the existing tax on liquid fossil fuels was adjusted. For mineral coal, petroleum, and fuel oil, the tax rate started in 2019 at 10 percent of the full tax rate, increasing annually by 10 percent to reach 100 percent in 2028.
- The Colombian carbon tax was adopted as part of a structural tax reform and was launched in 2017. The tax applies to GHG emissions from all sectors with some minor exemptions. It covers all liquid and gaseous fossil fuels used for combustion, accounting for 24 percent of all GHG emissions in Colombia. Tax exemptions apply to natural gas consumers that are not in the petrochemical and refinery sectors, and fossil fuel consumers that are certified to be carbon neutral.
- In Mexico, the carbon tax is an excise tax under the special tax on production and services. It is not a tax on the full carbon content of fuels, but on the additional CO_2 emission content compared to natural gas. 46 percent of all GHG emissions in Mexico are covered. The tax is capped at 3 percent of the fuel sales price. Since 2017, companies liable for paying the carbon tax may choose to pay with credits from Clean Development Mechanism (CDM) projects developed in Mexico, equivalent to the market value of the credits at the time of paying the tax.
- The South African carbon tax came into force in 2019 and applies to GHG emissions from the industry, power, buildings, and transport sectors irrespective of the fossil fuel used. 80 percent of the South African GHG emissions are covered. For many sectors, tax exemptions starting from 60 percent up to 95 percent will apply. The level of tax exemption depends on the presence of fugitive emissions, level of trade exposure, emission performance, offset use, and participation in the carbon budget program. Also, residential transport is exempt from the carbon tax. Companies may be eligible for either a 5 or 10 percent offset allowance to reduce their carbon tax liability.

Source: World Bank, 2021

367. The most popular measures to deal with adverse effects are tax-reducing measures, lowering the effective carbon tax via exemptions, thresholds, or reduced rates. Another set of policies include support measures to affected households, firms, or sectors: output-based rebates or targeted support for resource efficiency and cleaner consumption and production. Also, reductions of taxes other than carbon tax (such as labour or income taxes) can be included in this group of measures. A third category of policies consists of trade-related measures, such as border carbon adjustments, consumption-based taxation, and international cooperation.149

368. These measures can contribute to the implementation of a carbon tax by increasing its public acceptance. The political economy aspects of carbon taxation must be acknowledged and the question of how to gain public acceptance for a carbon tax is examined in Chapter 3. A carbon tax will undoubtedly raise tax revenues, but, at the same time, measures to counter or mitigate unwanted effects from the tax often require public funding. Considerations regarding how and to what extent carbon tax revenues can be used to finance various other policy measures is further discussed in Chapter 9.

148 More information about these, and other carbon tax schemes around the world can be found in World Bank, 2021.
149 Pigato, 2019; PMR, 2017.

4.1 Tax-reducing measures

369. Most jurisdictions that have implemented a carbon tax have chosen to lower the carbon tax rate for some fuels and/or sectors or exempt them altogether. Measures such as exemptions, thresholds, reduced rates, or tax payment refunds, can be implemented temporarily, phased out stepwise, or be part of a long-term policy design. These kinds of measures are straightforward to implement and can target specific sectors or groups. In addition, they are easy to communicate and popular with groups benefitting from the measure. See Box 21, for examples.

370. An immediate result of reduced carbon tax rates and exemptions is the loss of revenues, which can be rather substantial. Another disadvantage is the dampening of the price signal, and therefore the weakened incentive for decarbonisation. As the price signal differs across sectors, the adoption of abatement measures will be more costly in those sectors not benefitting from the reduced rates, and thereby the overall economic cost of reaching the jurisdiction's abatement targets is likely to increase. If sustained, such measures may also prove counterproductive, as sectors benefitting in the short-term face the risk of being less adapted to compete in a low-carbon economy in the long-term.

371. As it may be difficult for policymakers to determine the appropriate scope, level, and duration of the reduced rates, careful ex-ante analysis can provide valuable input to the decision process. Measures to reduce the carbon tax payment nevertheless risk being questioned by those excluded from the tax reductions which may, in turn, contribute to negative perceptions on the fairness of the tax. Excessive tax exemptions can also lead to domestic legal challenges. For instance, the first attempt of a carbon tax in France was rejected by the National Constitutional Council in 2009, since the body deemed that multiple tax exemptions and thus differences in treatment were not consistent with the legislator's intentions.

372. It is crucial for policymakers to consider alternatives to exemptions and to balance the negative effects with the need to protect certain sectors of special importance to the economy. If exemptions are part of the tax design, policymakers may want to attempt to minimize their environmental and economic costs. This can be achieved by making exemptions targeted and, if possible, timebound with regular reviews.

373. In some carbon taxing schemes, offset allowances enable liable entities to reduce their tax payments by investing in carbon mitigating activities outside the scope of the tax. This can also be viewed as broadening of the tax base. An example of this can be found in Colombia, and Chile has recently approved a law in this direction.

Box 21. What sectors to exempt – some examples

To address adverse effects of a carbon tax, it is important to analyse how and to what extent such effects are likely to occur. Each jurisdiction faces different circumstances that need to be considered.

A common distinction is to exempt installations in sectors included in an emission trading system (ETS), as consumption of fuels in such installations is already covered by another economic instrument aimed to incentivize less emissions of CO_2. This line of action has been chosen by, for example, Denmark, France, Ireland, and Portugal, regarding emissions covered by the European Union Emissions Trading System (EU ETS).

In other jurisdictions, fuels or sectors considered important to the economy have been exempted from the carbon tax. One example is Switzerland, where only fuels used for heating purposes (not propellants) are taxed. The UK Climate Change Levy (CCL), which can be considered as a climate tax although it is calculated on the energy content of fuels rather than the content of carbon, has chosen a somewhat different approach by only levying the CCL on business consumption, thus exempting households from the levy altogether.

4.2 Support measures

374. In addition to tax exemptions and rebates, various types of support measures can be used to reduce the financial burden of entities or households affected by the tax. Such measures can be targeted to specific sectors or have even broader coverage. For example, it might be possible to reduce other taxes, lower employer contributions to labour costs, or implement government grants or programmes to maintain the competitiveness of especially vulnerable sectors, such as public support for clean technology investments. Reallocating carbon tax revenues collected from a sector to the firms within the same sector based on their share of domestic production – so-called output-based rebates – is another way to protect firms while still providing incentives for emission reductions.[150]

375. The durability of measures may differ depending on their objective. There may be, for instance, a need to combine short-term relief and long-term incentives for firms to adapt by adopting cleaner and more efficient technologies. As support schemes are often easier to implement than to withdraw, policymakers may want to announce upfront for how long, or under what circumstances, a particular measure will be in force.[151]

376. Support measures can also target households with tax reductions or flat payments. In certain jurisdictions (for instance in Canada), revenues from the Federal Carbon Pollution Pricing System are redistributed to households and individuals through an income tax and benefit return.[152] The British Columbian Climate Action Tax Credit is another example of a support measure that seeks to offset the impact of the carbon taxes paid by low-income individuals and families. The amounts received depend on family size and adjusted family net income. Yet

150 Pigato, 2019.
151 Ibid.
152 Government of British Columbia, 2021.

another scheme for allocating carbon tax revenues to households can be found in Switzerland, where part of the revenue from the Swiss carbon tax is redistributed uniformly to all residents, through an annual discount in the compulsory health insurance premium.[153]

377. Other support schemes for households can involve direct or indirect subsidies to reduce emissions through, for example, support for improved energy efficiency in housing or subsidies for public transport.[154] These measures will contribute to incentivising households to shift towards less polluting consumption patterns and help them lower their carbon tax expenditures. At the same time, care should be taken to ensure that support is given where it is needed most. For example, subsidising high-end electric vehicles will likely benefit households in higher income groups, and may prove to be both cost-ineffective and counter-productive from a public acceptance perspective.

378. Support measures imply a cost. Yet, cost for targeted support to a certain group (e.g., low-income households or disproportionately affected workers, or communities such as coal-mining areas) may not necessarily be high in relation to the overall carbon tax revenue.[155] It is important that these measures are designed with care, preferably supported by ex-ante analysis of the need for, and effects of, possible support policies.

379. Jurisdictions may choose to implement a carbon tax as part of a wider tax reform. This may provide the opportunity to support affected households and firms through adjustments of existing taxes. For instance, the Swedish carbon tax was introduced in the early 1990s in a major reform including reductions of already existing taxes on energy, as well as taxes on labour, capital, and income. Subsequent changes (increases) to the Swedish carbon tax rate have also often taken place in the context of broader tax reforms, which have helped package the implementation of the new rates.[156] More recently, Chile, Argentina and Colombia have introduced carbon taxes in the context of broader tax reforms.

380. Introducing or increasing a carbon tax as a part of a general tax reform not only gives policymakers the chance to present the carbon tax in a wider context, but it also provides an opportunity to implement complementary measures to address distributional (income and/or geographical) concerns related to the impact of the carbon tax. Similarly, reductions in broad-based, non-carbon taxes can also be designed to benefit firms or specific sectors. Revenues from the carbon tax can of course also be used to address distributional concerns or reduce inefficiencies in

153 Swiss Federal Office for the Environment, 2021.
154 PMR, 2017.
155 Pigato, 2019.
156 Hammar et al, 2013.

other parts of the tax system, the latter possibly resulting in the so-called double dividend (society gaining from the carbon tax through both its impact on the climate as well as from the improved functioning of the tax system and the economy).

4.3 *Trade-related measures*

381. Trade-related measures that address carbon leakage and competitiveness concerns arising from carbon taxation are rare in practice. In the EU ETS, the risk of carbon leakage has been addressed by allocating free emission permits to installations in the most exposed sectors.[157] A measure that has been discussed as a tool specifically for addressing the risks of carbon leakage is a Carbon Border Adjustment Mechanisms (CBAM). A CBAM aims to put domestic firms facing a carbon price on an even footing with importers that operate under a lower or no carbon price, and can serve as an alternative to other measures in force to prevent the risk of carbon leakage, such as the allocation of allowances free of charge under an ETS. Charging a levy on imports corresponding to the difference in carbon price between the jurisdictions would be an example of such measure.

382. If and how a CBAM can be used in practice as a tool against carbon leakage is still an open question. At present, no country has implemented this measure; administrative burden, technical feasibility, the availability of data, the risk of retaliation from other countries, and perhaps most importantly, the compatibility with the World Trade Organization (WTO) rules, are a few of the challenges often mentioned in relation to CBAM.[158] Nevertheless, in 2019, the instrument has gained renewed attention as the European Commission announced that it would draft a proposal for a CBAM covering the import of certain products to the EU to reduce the risk of carbon leakage.[159] The proposal was presented and adopted in July 2021.[160]

383. The EU CBAM will apply from 2023, starting with a transitional phase until 2026, which will only include reporting of embedded emissions in imported goods (without paying a financial adjustment). From 2026, financial obligations, consisting of surrendering CBAM certificates covering the embedded emissions, will come into force.

384. Another possible mechanism is consumption-based taxation (CBT). This means that a carbon tax is levied on domestic consumers, and products are taxed on their carbon-intensity regardless of where they are produced. While common in tobacco and alcohol taxation, CBT applied to climate concerns has yet to be

157 C (2019) 930 final.
158 For an overview of the economic and legal challenges see e.g., Cosbey et al., 2019.
159 Communication of the European Green Deal, EU Commission Document presented on 11 December 2019, see https://ec.europa.eu/info/publications/communication-european-green-deal_en.
160 For more information, please visit https://ec.europa.eu/taxation_customs/green-taxation-0/carbon-border-adjustment-mechanism_en.

introduced. As with CBAM, there are many uncertainties surrounding the practical feasibility of consumption-based carbon taxation.

385. Climate change is a global challenge that requires international cooperation. A global price on carbon is the most cost-effective policy instrument to reduce carbon emissions in line with the Paris Agreement.[161] Although there is no experience with global carbon prices, there is experience with coordination across international ETS programmes such as the Western Climate Initiative, and the EU ETS. However, as there is no experience in the case of carbon taxes, bilateral or multilateral agreements would be necessary to move forward. These could take the form of common minimum carbon tax levels agreed upon between jurisdictions, such as the Federal Carbon Pollution Pricing System in Canada, or within a larger group of trade partners.

386. A summary of the three main categories of policy instruments that can be used to address unwanted adverse effects of carbon taxes can be found in Table 5 below.

161 World Bank, 2017.

Table 5. Overview of measures to address unwanted adverse effects of carbon taxes

Tax-reducing measures		
Measure	**Advantages**	**Drawbacks**
Exemptions Reduced rates Tax payment refund	• Target and effectively protect vulnerable industries (at least in the short term). • Relatively simple to implement (but only for downstream tax). • Popular with industry groups; easy to communicate.	• Undermine tax price signals and environmental effectiveness. • Difficult to determine appropriate level and extent ex-ante. • Risk of rent-seeking and challenge from/ extension to nonexempted industries. • Increase abatement costs for other sectors. • Costly option in terms of tax revenue. • Risk of long-term competitiveness loss.
Offsets	• Incentive for emission reductions in uncovered sectors. • Incentive for private investment in emission reductions.	• Undermine price signals for the taxed industry. • Administratively complex to ensure environmental effectiveness. • Reduced tax revenues. • Effectiveness at improving competitiveness depends on offset prices.

Support measures		
Measure	**Advantages**	**Drawbacks**
Support for resource efficiency and cleaner production	• Retain price signal and additional abatement incentives. • Promote green innovation. • Popular with industry groups. • Possibility to leverage commercial finance. • Flexible in design.	• Scope for gains varies depending on country, sector, firm type, etc. • May not provide immediate or full relief to industries. • Depending on scheme, widely varying cost and can be difficult to scale up at industry level.
Output-based rebates	• Retain tax price signals and abatement incentives for producers. • Strong leakage protection. • Divides industry opposition: Up to half of industry enjoys net gain (if sufficient revenue is used to finance rebates).	• High cost to public budget (although less than exemptions). • Reduce incentives for producers to adopt cleaner inputs and for consumers to shift to cleaner products relative to CBAM and CBT (but better than exemp tions).
Flat payments	• Retain price signal. • Simple for citizens to claim. • Popular with the public. • Potential for net positive social and economic benefits.	• Cost to public budget.
Reducing broad-based (non-carbon) taxes	• Reduce distortions from the tax system, for example, by reducing corporate income taxes or electricity taxes • Potential "double dividend" (creating net gains to output/welfare/ employment)	• Tax revenue reduced by using environmental tax to finance reductions in other taxes • Benefitting the economy rather than individual sectors with industry-specific competitiveness problems

Trade-related measures

Measure	Advantages	Drawbacks
Carbon border adjustment mechanisms (CBAM)	• Effectively prevent competitiveness losses and leakage, while maintaining tax price signal. • Prevent free riding by non-taxing jurisdictions. • Do not put pressure on public budgets.	• Administratively challenging. • Uncertainty regarding WTO compatibility (though well-designed measures could likely be defended) • Risk retaliations by partners and damaging trade/climate negotiations. • Limited experience to date.
Consumption-based taxation (CBT)	• Effectively address competitiveness and leakage risks. • Extend pricing to non-domestic emissions. • Lower legal/political risks than CBAM.	• Limited experience to date with application to climate (although standard for taxation of other "bads" like tobacco and alcohol). • Administratively complex for design options with best environmental effectiveness.
International cooperation	• Retain price signal and protect against leakage. • Leverage domestic tax to encourage equivalent effort in partner jurisdictions. • No administrative cost or legal risk.	• Not controlled by domestic policymakers only. • Difficult to negotiate across many countries and in sectors with many competitors. • Only regional examples to date, no global ones.

Source: Adapted from Pigato, 2019. and PMR, 2017.

Checklist 9. Compensatory measures

1. Tax exemptions
   - (i) Consider thresholds
   - (ii) Reduced rates for sectors or groups

2. Support Measures
   - (i) Lower other taxes
   - (ii) Support for technology investments for firms
   - (iii) Tax rebate or income support for households
   - (iv) Support for energy efficiency investments

3. Trade-related Measures
   - (i) Carbon border adjustment mechanisms
   - (ii) Consumption-based taxation

5. Administrative simplicity, environmental integrity, and fairness

387. Fear of adverse impacts from a carbon tax may justify measures that seek to avoid or alleviate these negative effects. At the same time, these measures often come with unwanted side effects of their own.

388. Although concerns over firm competitiveness and distributional effects must be addressed when they arise, the indiscriminate exemptions and tax reductions can lead to increased complexity and inefficiency in the administration and collection of the tax. Countries without experience in excise duties on energy may, therefore, want to strive to grant the least exemptions/price differentiations possible to avoid complexity and thereby reduce implementation costs. A key to a simple administrative system is to consult widely with the different actors within society, and get their input prior to introducing the tax, to avoid a web of exemptions.

389. Carbon taxes aim to equalize private costs and social costs. Exemptions undermine this aim, thereby limiting the efficiency and effectiveness of the tax. If emissions are taxed at different rates or exempt, policymakers should be aware of unintended, environmentally harmful responses which could in some cases defeat the initial purpose of the tax and increase the country's carbon footprint.

390. Nevertheless, governments may need to resort to tax exemptions and rebates to gain public acceptance, particularly while discussing the introduction and implementation of the tax. As carbon taxes become more popular and widely

used, calls for tax fairness and equity also gain traction.[162] In fact, the notion of fairness is strongly associated with use of revenues (see Chapter 9).

391. Stakeholders tend to support carbon taxation when revenues are used in projects that are high in the public agenda, are returned to the public according to the ability to pay through targeted exemptions, rebates, or corresponding reduction of other taxes, or are employed towards projects that will derive a positive environmental result and are consistent with the sustainable development goals.[163] What is considered high on the agenda depends on the jurisdictions' level of understanding of climate change, civic engagement, level of inequality, and economic development (See Chapter 3). Therefore, these issues are tailored depending on the country context. The question of how to gain public acceptance for a carbon tax was discussed in detail in Chapter 3.

6. Examples of carbon tax introduction: Two-level tax systems and thresholds

392. To date, over 30 national or subnational jurisdictions have implemented a carbon tax, all with different measures to protect competitiveness and address distributional risks. A two-level tax system and/or the adoption of thresholds are examples of exemptions that can be found in some of these jurisdictions.

393. In a *two-level carbon tax system*, different carbon tax rates apply to different parts of the economy; this system is easier to administer than lowering the tax rates for individual sectors and companies. A two-level tax system may be a feasible design, possibly leading to better environmental results overall, as the politically acceptable alternative could be a general carbon tax for all operators, set at a much lower level to protect the domestic industry subject to international competition.

394. A *threshold* is a minimum level of activity (or emissions, or technologies) that will trigger tax liability or responsibility for paying the tax. The purpose of a threshold is often to reduce the costs of reporting and administration.

395. To examine the need of a threshold, several characteristics can be analysed. One is the proportion of emissions derived from small emitters. If there are many small sources of emissions in sectors covered by the carbon tax, a relatively low threshold may be needed to ensure that a significant proportion of emissions is covered by the tax. The cost of reporting in relation to the tax amount, the capabilities among firms to administer a carbon tax, and the risk for intersectoral leakage are other important aspects to consider. A threshold could also result in

162 Falcão and Cottrell, 2018.
163 Baranzini, Caliskan and Carattini, 2014.

small firms deciding not to grow, to avoid the tax and counteract the establishment of large-scale operators.

396. In the case of carbon taxes, thresholds applied directly to emissions are common.[164] By contrast, jurisdictions that apply their carbon tax to fuels at the level of distribution, typically do not apply thresholds. Applying a tax to fuels normally does not require direct measurement of emissions, and is often built upon existing excise taxes, thereby making thresholds unnecessary. Applying thresholds in these cases could also create market distortions by encouraging consumers to purchase from smaller wholesalers.

397. An example of thresholds is the later abolished Australian Carbon Pricing Scheme, where emissions were taxed when they were released into the atmosphere. The threshold was set to 25,000 tCO_2e in order to not burden smaller facilities with reporting obligations. Another example is Chile, where the carbon tax was initially only applied to emissions from boilers and turbines in facilities of a certain capacity (above 50 MW). Such a technical condition is easily observable, whereas an emissions threshold requires that reporting be already in place.

Box 22. Country example of a two-level carbon tax

When designing the Swedish carbon taxation system, to avoid negative effects on domestic industry and carbon leakage, two carbon tax levels were introduced. The lower carbon tax level was applied to fuels used for heating purposes by the industry. The lower tax level has, since the introduction of the tax in 1991, been phased out in Sweden and was fully abolished in 2018. Such a lower tax level has been the prerequisite for a high tax level for other sectors, and one important cause of the emission reductions achieved in the high taxed sectors.[165]

Figure 10. Development of the Swedish Carbon Tax.

Note: General level and industry level. Industry level outside the EU ETS since 2008.

Source: Government Offices of Sweden

164 Most jurisdiction establish a 25,000 tonne CO_2 annual emission threshold for tax liability.
165 Hammar and Åkerfeldt, 2011.

7. Conclusion

398. A carbon tax provides a price signal that generates an incentive to reduce emissions. However, there may be undesired effects on firms or households. This chapter discussed the possible negative side effects of carbon taxes and explored potential measures to address them.

399. To ensure the feasibility and effectiveness of the tax, policymakers should carefully assess the risks of competitive effects and carbon leakage, as well as undesired distributional effects. Energy-intensive and trade-exposed firms are more likely to suffer from adverse competitiveness effects than others. Such firms also face the greatest risk of carbon leakage. Distributional effects often depend on household income, but there can be considerable heterogeneity within income groups which may also need to be considered.

400. Policymakers can implement measures to mitigate undesired impacts, for instance, measures that reduce carbon tax payments (e.g. exemptions, reduced rates, tiered systems, thresholds), support measures to alleviate negative effects (e.g. support programs, flat payments, reductions of taxes other than the carbon tax, wider economic policy reforms) and/or international coordination and cooperation. A two-level carbon tax system and liability thresholds were discussed as possible mechanisms to deal with these issues.

401. Policymakers should seek to avoid undue administrative complexity, preserve the environmental integrity of the tax and be attentive to the perception of fairness of the tax among both different social groups as well as sectors. Moreover, both the tax and the implemented measures should be assessed regularly to ensure that they remain relevant and appropriate, and above all that the carbon tax environmental objective is fulfilled.

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Chapter 8: From Design to Administration: Practical Application of a Carbon Tax

1. Introduction

402. A functional administration is required to ensure that the carbon tax legislation is effective and serves as an operational instrument to reach a country's intended goals. The administration of the tax refers to the role of different agencies and how to make the system operate smoothly.[166] These administrative provisions may involve several institutional levels depending on the jurisdiction, and they are likely to be decided on during various steps in the implementation process. In this chapter, we will discuss some of the issues raised by the administration of the tax and especially focus on those aspects where the administration of a carbon tax may significantly differ from the application of other kinds of taxes.

2. General issues in tax administration

403. The principal role of the administration of a carbon tax, as well as any other tax, is to guarantee that the revenue is collected in line with the provisions laid down by the legislation. A carbon tax raises revenue, but also contributes to achieving climate objectives by pricing carbon emissions. The task of the administration is usually given to tax authorities; however, there are specific challenges and expectations when administering a carbon tax compared to other kinds of taxes.

404. The administration of a carbon tax is mainly affected by the design choice of whether to tax direct emissions or fuels (see Chapters 4 and 6 for a discussion). The differences between these approaches will be highlighted in this chapter as they relate to administrative issues.[167]

405. The major elements of how to administer a carbon tax should be laid down by the legislation. Most jurisdictions use an act (law or statute) passed by a national parliament or similar body. However, the decision-making levels that regulate the details of administration may vary across jurisdictions. Once the legislation establishing the tax has been enacted, secondary legal acts, sectoral regulations, newsletters, or other administrative provisions are often used to facilitate day-to-day management. When setting these rules, attention should be paid to generating the necessary information for enabling their continuous improvement.

406. To overcome challenges in the administration of the tax, it is important to think about how to use existing institutions and tools to ensure low administrative costs and generate possible co-benefits. The priorities in the administrative cycle

can be reviewed to recalibrate or improve them considering the problems found and the responses given during the implementation phase.

407. In sum, the effectiveness of the tax in terms of its environmental objectives will depend both on the design and its administrative implementation. Furthermore, if adequate data is collected in the process, its effectiveness can be assessed by ex-post analyses and later perfected.

3. General issues in carbon tax administration

3.1 *Institutions and their responsibilities*

408. At an early stage in the design process, policymakers should decide on the public agency responsible for administering the carbon tax and subsequently allocating the necessary funds to cover the administrative costs (e.g., sufficient human resources and adequate technologies). This choice will often depend on the way the tax is designed and how tax administration in general is organised in the jurisdiction. The tax authorities administering the carbon tax may seek the involvement of relevant stakeholders, such as tax accountant's association, to ensure that administrative provisions are clear and well-functioning, both during the administrative design process and once the tax is in place.

Administration agencies/ administrative authorities

409. A carbon tax based on the Fuel Approach can be implemented through the existing fuel tax administration structure. This approach is relatively simple and there are a few new administrative issues. The main difference lies in the way the tax rate is calculated before it is included in the tax legislation. Since each fuel has a different carbon content, to estimate emissions correctly, the legislator must ensure that the relevant emission factors are used when establishing the tax rate in the tax law for each fuel.[168] This will likely involve cooperation with other relevant government agencies or public authorities.

410. Although the organisation of tax administration agencies may vary across jurisdictions (tax authorities may be independent bodies or part of the Ministry of Finance), the most common strategy for a carbon tax, under the Fuel Approach, is to assign the administration to the tax authorities. Another common approach is for taxes to be administered by the Customs Offices. This choice may be of particular interest if a country's fuel mix consists principally of imported fuels.

411. If the authorities adopt the Direct Emissions Approach, the best choice for an

168 See description in Chapter 5.

administrative body to handle tax collection is still likely to be the tax authority.[169] However, it will probably need to rely on emissions data from the facilities. This data can be submitted by taxpayers as part of their declarations or be collected and communicated to the tax authority from an environmental authority. The tax authority normally does not have the expertise to monitor or assess this data. It will, therefore, require some form of verification and control performed by a government or independent technical agency.

412. In many cases, the environmental authorities are already in charge of gathering relevant data and have developed reporting and monitoring systems. The existing infrastructure can be used for collecting emissions data. In Chile, for example, the environmental agency used the Pollution Release and Transfer Registry (PRTR) system to register facilities and monitor emissions related data.[170]

413. As with the tax authority, the technical agency required to assess emissions data may be independent or part of another government office (such as the Ministry of the Environment). On the one hand, this agency must ensure that the measurement of the emissions level is accurate, secure, and verified. Trust is vital since, under this system, emissions are tax liable. Using information initially collected for environmental reporting in accordance with the Intergovernmental Panel on Climate Change (IPCC) regulations could also result in strengthening capacity to fulfil these international obligations.

414. Therefore, devising a sound administrative strategy may require cooperation across different agencies of the national and sub-national levels of the government. This includes gathering the necessary information to effectively administer the tax. A basic aspect to consider, regardless of the design approach chosen, is to what extent existing organisational structures can be used, as this can keep administration costs low.

169 The administrative issues may differ from the drafting. Depending on national conditions, a jurisdiction may leave the Ministry of Finance in charge of drafting the carbon tax law and its officials would thus need to seek environmental technical assistance. Alternatively, a jurisdiction can ask the Ministry of the Environment to take the lead in the drafting, as the environmental knowledge is fundamental for the design of the carbon tax, and its officials should seek technical assistance in tax matters.

170 Pizarro and Pinto, 2020.

Box 23. Agencies responsible for administering the carbon tax in Singapore, the Netherlands and Australia

In Singapore, the carbon tax is collected by the National Environment Agency (NEA), not the Inland Revenue Authority of Singapore, and is paid into Singapore's Consolidated Fund. Under the Carbon Pricing Act 2018, registered persons with operational control of taxable facilities in Singapore would need to purchase fixed-price carbon credits and surrender them at the end of each reporting period in payment of their assessed carbon tax.

The carbon tax is levied on the direct emissions of six types of greenhouse gases. The Carbon Pricing Act 2018 also imposes annual reporting obligations for them (under the United Nations Framework Convention on Climate Change, Singapore must report these data in its greenhouse gas inventory). This Act distinguishes between facilities that are required to report and those that are liable for the tax, depending on their emissions levels. Different measurement, reporting and verification requirements apply to the different facilities. Verification of emission reports is carried out by NEA-accredited independent third parties.[171]

As shown in this example, different jurisdictions may allocate different tasks related to the administration of a carbon tax to different authorities. In this sense, any authority could be appointed to collect the tax (e.g., the standard tax authorities or other specific agencies not attached to the Ministry of Finance). In such a situation, the environmental agency might be also broadly considered as the tax authority, because it in fact administers the tax.

The Dutch Government provides another example. Effective in 2021, the Netherlands introduced a new national carbon tax, applied to emitters already covered by the European Union Emissions Trading System (EU ETS) plus industrial production and waste incineration. This tax was introduced alongside the existing EU ETS and is administered by the Dutch Emissions Authority (NEa), and not the Tax and Customs Administration.

When considering the tax design of the carbon tax in Australia (which was later revoked), collection through other parties in the value chain was also discussed.

Administration in a regional context

415. Effective carbon tax administration must also consider both the subnational and supranational levels.[172] Carbon taxes applied where fiscal federalism exists may generate additional challenges, as in the case of Spain and Canada where carbon taxes are applied at subnational levels. Another type of administrative restrictions may occur within the framework of supranational associations or cooperation, for instance, the framework of taxation of energy products in the European Union (EU).

416. In subnational jurisdictions, policymakers may need to pay attention to specific conditions and restrictions. For example, several Autonomous Communities in Spain have implemented taxes on emissions, adopting different administrative requirements, such as payment periods and amounts. This may complicate compliance for companies that operate facilities in different regions within the same

171 See https://sso.agc.gov.sg/

172 The regional context (different provinces or other sub-national levels within one country, or even neighbouring countries) may influence decisions on the level of the carbon tax rate or measures to alleviate undesired distributional or competitive effects. These aspects have been dealt with in Chapter 5.

country.[173] Implementing carbon taxes with different designs and administrations in the same country may cause inefficiencies and a considerable administrative burden for taxpayers. Administrative channels should be developed to ensure fluent communication between tax authorities of different levels of government (both vertically and horizontally) and avoid problems in implementation.

417. At the international level, a regional association of countries may agree on legally binding rules to establish a common framework to administer certain taxes. This may generate considerable restrictions for carbon tax administration. One example is EU Member States. Proposals for a mandatory carbon tax in the EU have been discussed, but not yet implemented.[174] Nevertheless, some EU countries have moved ahead with national carbon taxes but are restricted by the Energy Taxation Directive framework.[175] See Box 24 for more details.

418. When regulating administration issues in a regional context (within or outside the national State borders), legislative coordination to enact a carbon tax among jurisdictions is desirable, as it facilitates coherent implementation. If a tax is levied on fuels, a cooperative administrative system needs to be established to avoid risks, such as double taxation, for example, one jurisdiction taxing production and another consumption of the same fuel.

419. Cooperation between tax administrations is needed to check the actual application of the tax and avoid fraud. This situation can arise within and across jurisdictions. However, when the taxpayer is the owner or operator of a liable stationary facility, it seems unlikely that specific regulations are needed in neighbouring jurisdictions to avoid this problem.

420. Specific administrative design challenges may emerge when attempting to ensure a stream of revenues for local governments or to facilitate public acceptance by committing revenue use for local projects. Such discussions are currently emerging in African countries. This issue may arise in countries like Indonesia where, although a carbon tax has yet to be introduced, local districts and provincial governments are playing a greater role in administering their territorial areas.

173 Galicia, Andalucía, Aragón, Castilla-La Mancha, Comunidad Valenciana and Cataluña. The Committee of Experts for the Regional Finance proposed the establishment of a permanent normative Commission where previous communication may take place between tax administrations in cases of new projects regarding environmental taxes to be introduced in the system (Adame Martínez, 2019). In the future, by reaching an agreement, a State framework Law could harmonize the core elements including the tax base and leave the Autonomous Communities the choice of the tax rate and tax reductions. The report presented in 2017 by this Committee can be found here (see proposal in p.59) https://www.hacienda.gob.es/CDI/sist%20financiacion%20y%20deuda/informaciónccaa/informe_final_comisión_reforma_sfa.pdf For Andalusia's Act 18/2003, 29 of December. Aragon's Act 13/2005, 30 of December (Legislative Decree 1/2007, 18 September). Castile's Act 16/2005, 29 of December, Catalonia's Act 12/2014, 10 of October. See Secretaría General de Financiación Autonómica y Local Subdirección General de Relaciones Tributarias con las Comunidades Autónomas

174 See https://ec.europa.eu/taxation_customs/business/excise-duties-alcohol-tobacco-energy/excise-duties-energy/excise-duties-energy-tax-proposal_en.

175 Council Directive 2003/96/EC.

Box 24. The Energy Taxation Directive framework (Council Directive 2003/96/EC)

The Energy Taxation Directive framework (Council Directive 2003/96/EC) does not refer specifically to carbon taxes; however, it covers indirect taxes, except value added tax, calculated directly or indirectly on the quantity of energy fuel products.

The EU law lays down provisions for the administration of those indirect taxes and allows production, storage, and movements of energy products under a tax suspension regime between tax warehouses within the EU.[176]

Energy products subject to excise duties can be produced and stored without requiring the tax payment (suspension regime) in authorised tax warehouses. The tax warehouses and warehouse keepers are authorised by national authorities according to conditions meant to prevent any possible tax evasion or tax abuse.

Once these goods are released for consumption, i.e., removed from the tax suspension regime, the excise duties must be paid. An authorised warehouse keeper can move excise products – under tax suspension – from a tax warehouse (or the place of importation into the EU) to another tax warehouse without occurring the liability of paying excise duty.

All movements of excise goods under tax suspension between Member States are entered into a computerised system (Excise Movement Control System) and must be accompanied by a reference to the relevant entry into the system to enable a proper tax control.[177] Any national carbon tax applied in an EU Member State is thus subject to the constraints of these administrative procedures.[178]

However, a regional approach could lead to an eventual scaling problem where the system was not well designed or implemented, because it would adversely affect a whole region, and not just one country. This could relate to the interaction between carbon tax and emission trading systems.[179] Greater attention should be paid to it.

3.2 *Stakeholders and public engagement*

421. Cooperation with the private sector may help to ensure the effectiveness of the carbon tax and its administrative efficiency. Incorporating stakeholders' views early on will help administrative design and public acceptance.

Administering consultations prior to enactment

422. Stakeholder involvement in the tax design process will vary across jurisdictions. Many tax administration systems have a formal organisational structure for consultations (e.g., by the tax revenue service or other Government bodies). In general, extensive consultation will inform a more efficient administrative design and help promote positive behavioural changes.

176 Council Directive 2008/118/EC., concerning the general arrangements for excise duty and repealing Directive 92/12/EEC. A recast has been decided of Directive 2008/118/EC, see Council Directive (EU) 2020/262 of 19 December 2019 laying down the general arrangements for excise duty, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=uriserv:OJ.L_.2020.058.01.0004.01.ENG. The amendments will apply from 13 February 2023.

177 For further information, see information on the EU Commission website https://ec.europa.eu/taxation_customs/business/excise-duties-alcohol-tobacco-energy/general-overview/common-provisions_en.

178 This system has also been briefly mentioned in section 2.3 of Chapter 6, where a figure illustrating the taxable points within the tax suspension regime is included.

179 The functioning of any other market-based instrument regarded when introducing the carbon tax should be monitored to adjust its administration accordingly. This could happen with an emissions trading system. For example, Friends of the Earth (Europe) pointed out in 2010 that failure of the EU ETS was leaving Europe in its failure to meet its share of the climate challenge. By 2010, twenty-one member states were seeking 2012 emission caps higher than 2005 emissions when the EU ETS was launched. It has also been pointed out that the EU ETS has been characterized by policy uncertainty. Sources: Friends of the Earth Europe, 2010; Andrei Marcu et al., 2018.

423. A consultation process prior to introducing a new tax, or major changes of an existing tax, will provide policymakers with relevant information to facilitate the administration, as well as support public acceptance. Such an approach is also in line with the principle of openness in providing public information prevailing in many jurisdictions. Public acceptability is important and essential for feasibility (see Chapter 3).

424. Given the nature of carbon taxation, public consultations should engage a broad group of stakeholders. These should range from potential agencies given the task of administering the tax, tax authorities, other relevant agencies, as well as business organizations, trade and consumer organisations representing their members who are likely to face the tax burden, and tax advisors or accountants. Environmental and technical experts may also be relevant. They should be consulted to provide information for both tax design and administration.

425. For example, in Sweden and France, the introduction of a carbon tax was the result of proposals from committees of inquiry that included various experts and business representatives. The tax proposals were sent out for public consultation, enabling more stakeholders to express their views.[180] In many jurisdictions, it is customary to make the draft proposals available for public consultation. Prior to the carbon tax introduction, the South African Ministry of Finance revised its proposal after a first round of consultations and sent it out for a second review by stakeholders. This process proved to be instrumental for social acceptance of the tax after several years of deliberation.

426. Public consultation may underscore the undesired distributional effects of taxes, which may make policymakers consider compensatory measures.[181] However, they may also refer to more direct administrative issues, such as the length of declaration periods, how tax exemptions should be administered, how the tax collection should be designed to prevent tax fraud, and how to lower compliance costs, among other issues. This sort of communication helps support an efficient administration and increases legitimacy.

Information campaigns and post-enactment administration

427. Public consultations are important to support public acceptance and compliance when administering. This will help to support the administration of the

180 Sometimes, a public consultation may not be particularly useful. In France, the proposal to implement carbon tax received strong public support in 2007 and a negative public reaction in 2009, and the Government shelved its plans to introduce a carbon emissions tax in 2010 (although another attempt was made in 2014). Butler, 2009. Rocamora, 2017.

181 See Chapter 7. To seek public acceptance, depending on national conditions, compensatory measures may take various forms. They are likely to be directed at consumers who would be affected by the distributional effects of the tax in a way that would not be politically desirable. The public acceptance of a carbon tax is an important matter for policymakers to consider and it is discussed in more detail in Chapter 3.

tax by reducing enforcement costs. Consultations can be combined with information campaigns, explaining the reasons for the adoption of a carbon tax, who will be affected, how the system will work, what the new reporting and filing obligations for taxpayers will be, and what outcomes are expected (e.g., environmental benefits and revenue use). These efforts aimed at transparency are needed to support any reform and later show accountability and good administrative performance, as well as avoid the risk of corruption.

428. A carbon tax aims to give households and firms incentives to change their behaviour. The effectiveness of a carbon tax is likely to increase if the objective of the tax is clearly presented and managed accordingly. Information campaigns, however, are normally not the task of the tax authority, but that of other public bodies. Nevertheless, the tax authority should be involved when developing online guides and leaflets to facilitate compliance by educating the affected parties.

429. Since the government may implement a carbon tax as part of a package with other measures, making it easier for households and firms to adopt green choices, the correlation between them should be clearly specified, as there are often linked administrative checks that may interact. Making affordable alternatives to fossil fuel use available may often be a key factor for an effective carbon tax. Such measures can include time-limited grants for households to invest in non-fossil heating or cooling equipment, more frequent local public transport options encouraging citizens to leave their car at home when commuting to work, and government aid to Research, Development, and Innovation (R&D+i) for environmentally friendly equipment.

3.3 *Transition period considerations*

430. Policymakers must allow a reasonable time period between the enactment of a new carbon tax and the date when the legislation will come into force. For example, Chile chose three years. The public authority in charge of the tax collection will need time to register taxpayers and establish relevant forms for filing returns or declarations; the taxpayers will need time to develop proper business routines in their book-keeping, internal systems, and procedures to ensure the declarations are accurately completed and payments of the tax amounts are made on time. Taxpayers may also need to consider the effects of the tax on the price of their products to pass the cost of the tax on to consumers.

431. Moreover, announcing the introduction of the tax well in advance helps the public acceptance of the tax and gives time for adjustments. A step-by-step approach could also ease the transition. Some jurisdictions have laid down a clear trajectory of the trend for the tax rate during a specific time, and it has been well

communicated.[182] The tax rate may be adjusted to account for specific conditions in each sector while the carbon tax is implemented. Feedback from the operation of the administration is of paramount importance in this respect.

432. The adaptation of behaviours and procedures should occur both in the administration agencies and the private sector. An early announcement by the tax administration on how the carbon tax will be applied will also give businesses the incentive to kick-start measures that will reduce the use of carbon dioxide emissions, in line with the existing technologies and their associated costs. For example, Sweden's tax on the sulphur content in fuels was approved by Parliament in 1990 and came into effect in 1993. By then, fuel producers had already lowered the sulphur content below the taxable level in most of the volumes of fuels sold.

433. The length of this transition will depend on the national conditions, the complexity of the tax system introduced, and the way taxes are currently administered.[183] But even a relatively simple tax will need time to become fully operational. The official announcement of the planned implementation of a carbon tax may encourage authorities and taxpayers to start preparing for the tax, but the final administrative adjustments will not be made until the Tax Act is passed by the national Parliament or similar regional body.

434. Moreover, the time between the enactment of the carbon tax law and its actual implementation may also need to be longer if administrative issues are still left to be decided by lower jurisdiction levels. If the Fuel Approach is chosen, there should not be significant time constraints as the carbon tax declaration and payment can be linked to the already existing fuel taxation. However, in the case of the Direct Emissions Approach, the tax authorities will need time to coordinate with environmental authorities, although reporting may be linked with systems in place.

435. Furthermore, a longer period may be necessary if public consultations were not conducted before passing the national carbon tax law. Even with enough advanced notification in relation to the implementation of a new carbon tax, taxpayers may still face significant challenges related to their compliance capacity. Depending on the circumstances, it may be appropriate for the tax authority to have a defined transition period, under which taxpayers that "demonstrate best efforts" in complying with the new carbon tax are not given fines and penalties associated with non-compliance.

182 This was discussed in Chapter 5 regarding the tax rate and its possible annual increases by the budgetary law.

183 The choice between the Fuel or the Direct Emissions Approaches does not necessarily imply a longer transition period, as the direct measurement in the latter is not always required and estimation methods can be used. The decisions on the reporting level and the contents of the report may have an influence in timing.

3.4 Coordination with overlapping policy instruments

436. Overlapping policy instruments such as fuel taxes, energy contracts and Emission Trading Systems (ETS) are discussed in more detail in Chapter 10. These must be considered when dealing with the administration of a carbon tax. The most common concern with respect to overlapping economic instruments relates to fuel taxation and ETS. Fuels used in facilities or covered by an ETS could be totally or partially exempted from the carbon tax, and consequently provisions on how to administer the tax exemption must be laid down. See Box 25 for an example from the EU.

437. Some jurisdictions have addressed overlaps when granting fiscal benefits to the taxpayers regarding other, already existing taxes and schemes. For example, in South Africa, the 2019 budget recognised that emission reduction credits could be used to reduce a taxpayer's carbon tax liabilities. Consequently, the tax exemption for income generated from the sale of certified emission reduction credits was repealed. This was to prevent a situation where a taxpayer benefits from that exemption and has a reduced carbon tax liability.[184] In other cases, when introducing a carbon tax under the Fuel or the Direct Emissions Approaches, the possible connections between related taxes should be clarified.

Box 25. EU Emissions Trading System

The EU ETS set up the trade of emission allowances for large facilities in Europe and is also linked to systems in Iceland, Liechtenstein, Norway, and Switzerland.

The Member States that have introduced national carbon taxes on fuels have taken different approaches on how to deal with the overlapping regimes. Denmark, France, Ireland, Norway, Portugal, and Switzerland grant an exemption from their national carbon taxes to fuels used in installations covered by the EU ETS.

Sweden, on the other hand, has in recent years reintroduced parts of the carbon tax on fuels used in some of the Swedish installations that participate in the EU ETS. Coordination must exist between the tax administration and the registry of installations covered by the EU ETS.

Exactly how the coordination is handled varies across countries. For example, following requirements in the Swedish Act of Excise Duties on Energy, to be granted the tax reduction, it is sufficient to carry out activities according to the EU ETS in an installation under that scheme and use the fuel in such installation. It is not a task for the tax authority to check whether the EU ETS obligations are fulfilled. Such controls are part of the regulations governing the EU ETS.

4. Core features of the carbon tax

438. The core features of a carbon tax were discussed in Chapters 4, 5 and 6; a list can also be found below. These must be appraised in the tax law or in secondary regulations depending on the legal sources of each jurisdiction:

- Taxable event (occurrence of what chargeable events should make the tax due,

184 KPMG, 2019.

e.g., extraction, sale or consumption of fuel volumes or actual emissions).

- Taxpayer (who should pay the tax to the public authorities?).[185]
- Tax base and tax rate(s) (what is to be taxed and by which amount?).
- Public body to administer the tax or oversee its administration.
- Tax declaration period (timeframe to provide data or file the return).
- Information to be given in the tax declaration (concerning the taxpayer or other third parties).
- Administration of possible tax exemptions or other reductions (fiscal benefits) that the taxpayer may apply in the carbon tax declaration.
- Administration of reducing the facility's tax burden if other market features such as crediting, or emission offsetting schemes are applied. Such features reduce the facilitý s tax burden by reducing emissions in third party facilities. Typically, these schemes are based on some form of compensation or payment to both tax and/or non-tax liable entities and require some emissions' reduction verification system by the authority.[186]
- Control mechanisms and tax enforcement regime (penalties in carbon taxation do not present any speciality and usually can be referred to the general applicable regime).

439. Some of these features need to be dealt with in the initial phase of the tax design, as they relate to the very essence of the tax and determine how well it will meet its declared objectives. This is the case with the taxpayer and the taxable event, the tax base and tax rate,[187] or the interactions with other instruments and management of various tax exemptions laid down in the primary legislative act.[188] However, there are many design elements relating to the details and these will inevitably be resolved at a later stage during the implementation phase. These elements are further discussed below.

440. Different jurisdictions have adopted different practical solutions when addressing these core elements. Chile and Sweden are taken into consideration here as examples because they have, respectively, chosen the Direct Emissions Approach and the Fuel Approach. Irrespective of the approach chosen, administrative issues are always key to the success of a carbon tax.

185 Additionally, some legislators may indicate other person liable as a warrant for the tax debt, and administrative procedures should be applied accordingly (jointly and severally, or in a subsidiary manner). E.g., if the designated taxpayer is who emits the taxed pollutant substance and does not pay the tax due, then the owner of the facilities or activities that are sources of emissions could be also declared liable (as a sort of personal guarantee) to be able to recover the carbon tax.

186 In the administration of the offset, for instance, when the mechanism may be triggered by the reinvestments in clean energy processes, they must be verified. If they were implemented badly, the tax base would be eroded, and no environmental benefit would be produced. This type of experiences can be found in Colombia and Costa Rica.

187 All of them have already been discussed in Chapters 4, 5 and 6.

188 More details on the possible interactions can be found in Chapter 10 (i.e., ETS, subsidies, etc.).

441. In the table below, a comparison is made of the main design features of the carbon taxes with implications on the administration in Sweden (the Fuel Approach) and in Chile (the Direct Emissions Approach).

Table 6. Comparison of approaches to administration of carbon taxes: Sweden and Chile

	Sweden – Fuel Approach	Chile – Direct Emissions Approach
Taxable event	When fuel leaves tax warehouse, operated by an authorised warehouse keeper (either consumed by the warehouse keeper in their own business or sold to someone who is not an authorised warehouse keeper)	The emissions at the facility level
Taxpayer	Authorised warehouse keepers* (fuel distributors or undertakings consuming large amounts of fuel)	Operator of facility with boiler and turbine with an energy potential of 50MW or more **
Tax base	Fossil fuels	Carbon emissions
Tax rate	In volume or weight units (litres, tons), calculated based on average CO2 emissions from each fuel type	US$ 5 /CO2 tons
Public body in charge of administration	Tax authority	Tax authority and Ministry of the Environment
Declaration period	Monthly	Facilities are required to report their respective emissions quarterly to the environmental authority, but submit a tax declaration annually based on the reported emissions.
Information given in tax declaration	Amount of fuels (litres, tons) that left the tax warehouse during the declaration period or were consumed by the warehouse keeper themselves	Emissions, provided by the Environmental Authority. The emissions report to the environmental authority requires additional information to verify that it is accurate
Administration of tax exemptions (e.g. for a special activity, special sector)	Deductions in declaration, if relating to warehouse keeper's own consumption; reimbursement application to tax authority in other situations (fuels are bought taxed)	No exemptions; however, power energy facilities which are regulated under formal contracts in the electric energy system have rebates associated with their electric generation tariff law
Additional market mechanisms or other forms of crediting through offsetting mechanisms	None	None exist at present; however, a recent tax reform (Tax Law 21.210, February 2020) contemplates crediting through an offsetting mechanism by third party emitters. The Ministry of the Environment has yet to publish the secondary legislation to make this innovation operational. It is important to point out that these schemes require an additional administrative burden since the Technical Agency must verify emission reductions. Moreover, if non-tax liable entities are recognized, in practice, the tax base is broadened, and the average tax-rate reduced.
Control mechanisms	Check volumes declared by taxpayer (and related transactions) according to general tax auditing procedures.	Both the environmental agency and the tax authority can inspect emissions, but at present there is no independent verification system

** While normally the taxpayer is an authorized warehouse keeper, the system also, more rarely, allows for other operators to pay tax on a single consignment of fuels.*
*** As of February 2020, the tax Law 21.210 reformed the taxpayer based on an emissions threshold. However, the new system will be implemented once secondary legislation is adopted (probably in 2021-2022).*

Checklist 10. General administration issues

1. Determine who will administer the tax – usually tax or custom agency
2. Consider sub-national and supranational coordination
3. Consider stakeholder consultation before enactment
4. Consider public and targeted information campaign
5. Consider transition periods for effective administration
6. Assess coordination with overlapping policy instruments

5. Considerations regarding detailed administrative regulations to manage the carbon tax

442. Once the basic carbon tax legislation is in place, in most cases, additional detailed administrative regulations are needed. The power to decide such regulations is often based on delegating provisions in the tax law (delegated acts) or may follow directly from the national Constitution.[189] Their nature will depend on the body that enacts them, and their effects will vary depending on whether they are published or not.

443. To provide the additional administrative clarity and certainty required by taxpayers, administrative regulations and guidelines, or information newsletters, should be prepared as close to the finalization of the underlying legislation as possible.

444. To ensure that the administration of a new carbon tax will work smoothly, taxpayers need accurate information on their responsibilities and ways to perform those tasks in detail. While there are variations across jurisdictions, usually tax authorities are responsible for publishing this information.

445. Information can be shared with taxpayers through direct contacts, which may be feasible if the taxpayers are a small number of companies or are already well defined, e.g., registered facilities to be covered by a Direct Emissions Tax. If the Fuel Approach is adopted, information can be shared with the same group of taxpayers that already are responsible for handling other excise duty, levied on the same fuels covered by a carbon tax. A common approach is to communicate general information via websites and other public communication tools, which may be complemented by individual company-by-company basis at later stages of tax collection and auditing.

446. Administrative agencies should be aware of the management effort demanded to administer any tax, both for the Administration Authority (whose efficiency is often mandated by constitutional law) and the taxpayers themselves. Thus, making proportionate requirements (limiting to what is strictly necessary

in terms of amount of data, frequency of filing, etc.) for the good administration of a carbon tax will lead to increased acceptability by the taxpayers, and it will also help the tax administration to render a better service. It is important to avoid unnecessary workload for taxpayers as well as for tax officials (by taking advantage of digitalisation, when possible, to avoid waste of time and resources).

447. Administrative regulations required include the following:

- Criteria for registering taxpayers and the associated timeframe for registration. (section 5.1)
- Various forms, such as tax returns (declarations) and book-keeping (section 5.2).
- Information that taxpayers need to include in each declaration (section 5.2)
- Tax exemptions and reimbursements (section 5.3)
- Period to file the tax return (section 5.4)
- Securing the payment of the tax due (section 5.5)
- Liability thresholds (section 5.6)
- Control mechanisms and emissions reporting (section 5.7)
- Compliance and enforcement mechanisms (section 5.8)

5.1 *Registering taxpayers*

448. The tax legislation should establish the criteria to determine which individuals and legal bodies are liable for the carbon tax. Further, it should give authority to a specific agency to identify and register the liable facilities or taxpayers. The agency responsible for registration may vary with the carbon tax approach. In the case of the Fuel Approach, this is usually done by the tax authority. In the case of the Emissions Approach, this will require support from the Ministry of the Environment, but it will probably depend on the role of different agencies in the specific jurisdiction implementing the carbon tax.

449. Depending on which entities are required to pay the tax, the authorities will implement a system to register them. Detailed regulations will include the specific steps or system necessary to ensure that liable facilities/entities register, as well as the sanctions for not registering or giving false or insufficient information. The information asked for will vary, depending on the type of design approach as well as specific requirements laid down by the relevant authority, but could include data on the types of fuels handled, facility, owner, or operator and the financial liability of the taxpayer to ensure the fulfilment of their tax obligations. In the case of the

Direct Emissions Approach, information on the technology and processes, to verify that the emissions data is consistent with the fuel consumption or load capacity, may also be necessary.

450. In some cases, once the entity has registered, the tax agency must decide whether the entity is liable. This may involve certain thresholds for total fuel-use, annual emissions or uses of certain technologies (see further below). However, this is only for enforcement purposes; facilities are ultimately responsible for determining whether they are subject to the tax, thus, as with other taxes, placing the burden of tax declaration on the liable entity/facility.

Box 26. Swedish tax warehouses

A key component of the Swedish carbon tax system is the authorisation of companies handling energy products as taxpayers. These are referred to as tax warehouse keepers. This system reduces the administrative burden by allowing the authorities to control a small number of liable taxpayers.

Out of 900,000 registered business companies in Sweden, only around 300 companies are registered taxpayers for the carbon tax, mainly fuel distributors selling taxed fuel to end-consumers.

The warehouse keepers are obliged to store fuels in specific premises, which need to be approved as storing facilities (tax warehouses) by the tax administration. The tax authorities decide if a company may be granted a warehouse keeper status, depending on several criteria, the principal of which is economic situation, and being able to put forward a sound and reliable business idea.

The possibility to register as taxpayers in Sweden has also been extended to large consumers, normally engaged in industrial activities. They can store fuels under the tax suspension regime and declare the tax once the actual consumption has occurred, thus avoiding negative liquidity effects.

Box 27. Definition of liable facilities in Chile

Under the Direct Emissions Approach, many jurisdictions establish emission thresholds, to determine from what emissions level a facility is liable to pay tax on its emissions. The problem with this approach is that it requires information of current emissions to determine liable facilities. Chile took a different approach. It established technological criterion to determine which facilities were liable, rather than a threshold of liable emissions.

In the Chilean example, liable facilities are defined as those that have boilers and turbines with 50 MW or above potential capacity. This identifies only large installations, which have the greatest expected emissions, as tax liable. The authorities requested information on the facility, owner and operator among others, but above all the technology and processes to verify that the emissions data is consistent with the fuel consumption or load capacity.

Once the liable facilities have been identified and are formally registered, they are liable for all their emissions regardless of the amount. The advantage of this approach is that the liable facilities can be clearly identified without recourse to emissions monitoring. Furthermore, the burden of the reporting is placed on the facilities that are liable. They are interested in developing the most accurate reporting system to reduce their tax burden. Finally, the tax can be operational immediately without waiting for a long period of establishing a reporting system.

Once the entity has registered, the Environmental Agency set up a reporting structure to ensure the monitoring of emissions (MRV system).

5.2 *Tax returns (declaration) and book-keeping*

451. Tax returns and book-keeping are essential for administrative issues. While both carbon tax approaches will need to determine how to handle this administrative aspect, the advantage of the Fuel Approach is that a carbon tax can often be handled

as an additional part of an already existent excise tax declaration. See Box 28 for an example from Sweden. In the Direct Emissions Approach, the tax return is associated with emissions reporting at the facility level. See below for a discussion for emission monitoring.

452. In the case of both approaches, book-keeping regulations are needed to enable efficient tax controls. However, in the case of the Direct Emissions Approach, tax returns and book-keeping are associated with emissions reporting. Once the methodology to calculate emissions is established (see below), the tax or environmental authorities must regulate how facilities report their emissions.

453. The emissions reporting process should be based on pre-established guidelines that fix the conditions and standards to be met. The tax-liable facility must therefore submit an emissions monitoring or estimation report, in accordance with those general guidelines stipulated by the relevant authority (what, when, where, how to report, etc.).

454. The authority must decide when to require this reporting (which may be every year, or other time periods). The moment will depend, in turn, on when the taxpayer is liable. Reporting can be carried out through various platforms (from paper reporting to digital reporting) and security is important, since emissions are causally related to the liable entities tax burden.

455. Furthermore, often independent verification is necessary. This requires setting up the institutional framework that includes third-party verification. These verification or certification agencies must be registered with the competent authorities and must follow the appropriate guidelines and protocols established by the Government. Once emissions are reported, the environmental or technical agencies in charge of overseeing the emissions verify and consolidate this information. Therefore, the tax authority places the responsibility for determining emissions on the liable entities, and their verification on the Environmental Agency.

Box 28. Swedish carbon tax return (declaration) periods

The Swedish carbon tax base covers the same fuel as the general excise duty on fuels (named as energy tax in Sweden). The two taxes are handled in the same tax declaration forms by the same taxpayers under basically the same administrative rules. This strategic option greatly facilitates the tax administration and makes administrative costs low. The administration costs for the Swedish Tax Agency amount to 0.1 percent of the total revenues from energy and carbon taxes.[190]

The Swedish energy tax and carbon tax return (declaration) is filed once a month and the warehouse keeper supplies lump-sum information of the amount of fuels that left the tax suspension regime (by own consumption or deliveries to a company or individual who is not a taxpayer), for which tax has become chargeable during that month. The required data is typically found in the taxpayer's ordinary book-keeping, but the Swedish legislation also lays down specific requirements for stock records to be kept by the warehouse keeper. The Tax Agency issues regulations on how these requirements are to be followed in more detail. Taxpayers are further required to keep proper records of all individual transactions, enabling the Tax Agency to do more in-depth checks of the book-keeping at a later stage.

5.3 *Tax exemptions and reimbursements*

456. The carbon tax design may establish specific tax exemptions. For example, in the case of the Swedish tax, there are full or partial exemptions to non-fuel use of energy products, as well as in parts of the manufacturing, agricultural and railway sectors and the mining industry. There are different ways to administer these exemptions.

457. Examples of how to deal with tax exemptions include deductions in tax declarations if the fuels have been consumed for a tax-exempt purpose. This system ensures that the taxpayer will not face liquidity constraints, which would be the case if the tax was paid and later reimbursed. However, in most cases, if a company operating within a tax exempted sector is not an approved taxpayer, the company would need to pay the tax included in the price of the fuel, and later request for a tax reimbursement from the tax authority. In some specific cases where the risk of fraud is deemed to be minor, it is possible, however, for a taxpayer to deliver non-taxed fuels to a company not being an approved taxpayer.[191] Such a delivery requires that the recipient holds a special approval by the tax authority.

458. In the case of the Swedish carbon tax, a gross declaration is required. This means that deductions are made for deliveries or own use for certain tax-exempted areas. As mentioned above, such deliveries need to be to a recipient who has received a special approval by the tax authority, to be able to receive the fuels without tax being charged. If the end-consumer buys the fuels fully taxed, they need to ask for a tax reimbursement at a later stage from the tax authority, upon showing that the fuels have been consumed for a tax-exempted area.

459. In the case of the Direct Emissions Approach, tax reimbursement or

190 Hammar and Åkerfeldt, 2011.

191 The fuels are in this situation delivered outside the tax suspension regime. The handling of fuels within a tax suspension has been further described in Chapter 6 as well as above in this chapter.

crediting may be associated with offsetting or compensation schemes. Colombia has introduced such an approach, where a tax-liable entity can be exempted if it can show reduced emissions elsewhere.

5.4 *Period to file the tax return*

460. The period to file the tax return refers to the regular dates for its presentation, and determination in case the activity starts later or finishes earlier. Also, it is necessary to identify possible payment plans (e.g., by instalments fractioning the amount to pay in each period) and acceptable payment methods. Deadlines may vary depending on the traditions in the jurisdiction (declarations may be required after a month, a quarter of a year, or even yearly). Other administrative aspects that the authority needs to define are specific book-keeping obligations, records that need to be maintained, and the length of time they need to be maintained by the taxpayer (commensurate with the statute of limitations) to make them available if a more in-depth audit takes place.[192]

5.5 *Securing the payment of the tax due*

461. The tax administration system seeks a balance between flexibility and tax compliance. Some jurisdictions consider time periods for tax payments, but this may require guarantees. For example, in Sweden, the registered taxpayers (authorised warehouse keepers) are obliged to provide a guarantee, following mandatory EU regulations. This provides a secure and tested system for ensuring that tax obligations are met. The fuels must be stored in specially approved tax warehouses, and the warehouse keeper must leave security to cover potential losses in storage or transport between tax warehouses.

462. A financial guarantee (e.g., a bank guarantee to ensure proper tax collection) for movement of fuels as well as for 10 percent of the fuels stored on average for one year is required in Sweden. The purpose of the guarantee is to enable the tax authority to claim it in case of non-payment of a tax debt.

463. In the case of the Direct Emissions Approach, the tax is due usually at the end of the fiscal year, after emissions have been reported and certified. However, some systems establish crediting mechanism for complementary market mechanisms such as emission offsets.

192 Fiscal control is an essential part of any tax system. The way control mechanisms are administered differs between jurisdictions. However, it is more likely that the variation in control is linked to fiscal traditions in the jurisdictions, rather than to any special characteristic of a carbon tax. Also, some jurisdictions tend to rely on book-keeping checks to a large extent, while the fiscal control in other jurisdictions more generally includes checks of the premises where the tax liability occurs. The degree of digitalization of tax reporting also varies across jurisdictions. Many developing countries are adopting digital tax declarations systems, which can significantly facilitate the tax administration if extended to also cover a carbon tax. Labour resources can thus be concentrated on tax control in the forms of tax audits and spot-checks.

5.6 *Liability thresholds*

464. There is a need to strike a balance between the administrative burden and fairness, including by treating small and big operators in a similar way. In terms of administrative control, it would be preferable if the tax collection system could be designed in a way that limits the number of taxpayers.

465. Therefore, to reduce the administrative burden on the tax authority, many jurisdictions have adopted thresholds regarding procedural aspects either in the Direct Emissions Approach or the Fuel approach (e.g., for registration or reimbursement). These can limit the number of liable facilities that register as taxpayers. Eventually, it could be decided that only the tax paid above a certain amount would be reimbursed (even if the fuel is used in an exempted area).

466. Under the Direct Emissions Approach, many jurisdictions establish emission thresholds to determine from what emissions level a facility is liable to pay tax on its emissions. Typical thresholds are 10 or 25 thousand tons of CO_2 emissions a year. Another approach is to pay the tax regardless of the emission amount and limit the number of liable facilities; this was the approach taken by Chile.

5.7 *Control mechanisms and emissions reporting*

467. Control mechanisms are necessary to ensure accurate reporting and determining the tax burden. In the case of the Fuel Approach, it is necessary to control the use of fuels and, in the case of the Direct Emissions Approach, to monitor emissions. In the latter, emissions control systems are often referred to as Monitoring, Reporting and Verification (MRV) systems.

468. The MRV system is made up of at least four components: the registry of liable entities/taxpayers, which necessarily requires a broader survey of facilities that may be subject to the tax discussed above; the measurement or quantification (M) of emissions regulated under government guidelines; reporting (R), which stipulates guidelines for emissions reporting; and verification (V), covered under regulatory verification guidelines in the case of third party verification, or enforcement in the case of government verification.[193]

469. In the case of the Fuel Approach, the tax authority does not require specific emissions data reported from a facility, since monitoring involves control of fuel volumes. The tax administration only needs to calculate and audit the taxpayer's amount of fuel used or sold. This is a task which tax authorities are normally familiar with, and generally involves regulations on book-keeping records. In the case of

193 Pizarro et al, 2017.

the Direct Emissions Approach, despite its name, the measurement of emissions at the facility level is not actually required, and emissions data can also be based on average carbon content from fuel volumes. What is essential, however, is facility level reporting.

470. That is, for the Direct Emissions Approach to work, an administration system must be set up to receive information from each tax-liable facility on their emissions. This will require a new agency or, at least, a new reporting system to ensure the capacity to receive and assess emissions data at the facility level.

471. Nevertheless, when possible, measurement is recommended. Facilities can monitor their emissions through various measurement strategies, monitoring emissions through end of pipe technology, such as Continuous Emissions Monitoring Systems (CEMS), or estimating emissions through emission factors and using energy inputs.

472. Thus, a MRV system will need to be developed at a facility level before implementing the carbon tax. The complexity and costs will depend on the infrastructure already in place in the jurisdiction following national or international emissions reporting obligations. More accurate reporting systems will be essential when a system used for international reporting is to be expanded to fill the needs of a well-functioning carbon tax administration.

473. The process of introducing a carbon tax will, in the case of the Direct Emissions Approach, necessarily entail expanding and strengthening administrative capacity, particularly of environmental agencies, establishing protocols for determining procedural responsibilities, creating more robust information systems, and improving inter-ministerial coordination. In this regard, the Chilean experience provides a clear example that an emissions-based taxation strategy can be implemented in way that is coherent, administratively feasible, and at a low cost.[194]

474. A jurisdiction choosing a Direct Emissions Approach will still, in most cases, leave the administration of the carbon tax to the tax authority in charge of administering other kinds of taxes in its territory. However, the environmental agency will oversee the actual monitoring and verification of emissions from the facility, and report this information to the tax authority. This establishes a different institutional relationship between agencies. It requires agencies such as the tax authority, Ministry of Finance and Ministry of the Environment, among others, to establish a permanent dialogue.[195]

194 Pizarro and Pinto 2020.

195 It is most likely to be the general tax authority that administers the tax, but nothing would prevent a jurisdiction from deciding that the environmental agency also oversee the tax collection. In such a situation, someone, as a matter of terminology, could call the environmental body a tax authority too.

475. Although this may be initially difficult and many conflicts may arise, particularly in the initial phase, ultimately it will benefit all institutions since there will be a better understanding of the objectives and of the carbon tax design. Furthermore, the different agencies will understand the restrictions and commitments of the other institutions involved.

476. The tax law can be designed so that the taxpayer pays the tax based on the amount of emissions given by a certificate of emissions, issued by a competent supervising environmental authority. This would mean that the tax authority does not need to enter an area where their officials have no technical competence. The policymaker could also choose to focus all the administration relating to the liable facilities to the environmental body, making it in charge of administering the tax as well as all the MRV. And, quite obviously, there are a variety of alternatives on how to distribute the responsibilities to different agencies in a way that the policymaker decides is most appropriate in the relevant jurisdiction; however they are structured, it is important to ensure clear channels for information flows . Even as their roles are being set out, there is need to ensure that the mandates of all the agencies are clearly defined to avoid a situation where there are overlapping functions, as these could give rise to confusion and conflicts.

Box 29. MRV system in Chile

In the case of the Direct Emissions Approach, liable facilities must implement the emissions quantification methodologies determined by the protocols of the regulating agencies. These may be difficult, and capacity building may be necessary. In general, there are three types of measurement approaches that may vary in different sectors or technologies.

(a) *Sampling and measurement*: This comprises the direct quantification of emissions concentrations, using measurement equipment installed at the facility. Both sampling and continuous measurement are among quantification options, including CEMS. CEMS provides hour-by-hour emissions averages over the course of the tax period (e.g., a year).

(b) *Discrete sampling*: Monitoring equipment is used to take a sample, which is then analysed in a laboratory or on site. This method is used to determine output concentration and representative flow rate at the time the measurement is taken.

(c) *Estimation*: This method comprises the indirect quantification of emissions using emission-factors (for the specific production process in question) and annual activity records (such as operating hours and fuel consumption).

In Chile, once liable entities/taxpayers are registered, each facility is required to report emissions. The authority established different reporting and measurement protocols for the liable entities, depending on the sector, capacity, and type of technology. Large energy installations were required to use CEMS. These monitoring devices can capture CO_2 data and they can report through the same system. However, these systems are expensive and, if not adequately managed, may be imprecise. Other facilities may prefer to report fuel data and estimate emissions through emission factors. In any of these ways, facilities are making a legally binding declaration of their emissions, which has a direct impact on their tax lability. For example, in the case of Chile, eleven methodologies for emissions quantification were initially proposed to the facilities to choose how to report their emissions.

5.8 Compliance and enforcement mechanisms

477. In the Fuel Approach and the Direct Emissions Approach, enforcement is dependent on the role of the different authorities. For all kinds of taxes, including the carbon tax, authorities rely on checking relevant book-keeping rather than extended physical checks of the taxpayer's premises. This has enabled low administrative costs for both the tax authority and the taxpayers, while maintaining fiscal control.

478. To avoid fraud, some penalties may reinforce the sanctioning of violations under the different approaches. In the Fuel Approach, the volumes are subject to controls. Here, anti-fraud and control measures might also need the legislation to allow for checks with other entities than taxpayers (such as the companies who have bought goods including tax from a taxpayer). This is not different from other kinds of taxes such as value-added tax (VAT), with which controls could be coordinated.

479. In the case of the Fuel Approach, taxpayers provide lump sum data in their monthly declarations, and individual transactions need to be recorded in the taxpayer's books to be available if in-depth auditing is eventually performed. In Sweden, the tax authority performs basic computer-based control of the tax declarations, and further audits are handled on a risk analysis-based selection.

480. Basic audits include, for example, comprehensive checks of tax declaration data and annual financial reports. In-depth audits may include visits to the taxpayer's premises and checks of book-keeping, including individual transaction checks with customers, and checks of anti-fraud systems at warehouses. Often such in-depth audits include checking other taxes, such as corporate tax and VAT. For example, computer support is used as much as possible in the Swedish fiscal controls.

481. In the case of the Direct Emissions Approach, enforcement is more difficult because emissions must be monitored and certified. However, some jurisdictions have facilitated this process through independent verification. This may also be important in developing future carbon markets.

482. Facility level reporting may require a more detailed enforcement or verification system, and this requires setting up the institutional framework to both register liable facilities or installations and establish a periodic reporting system. This may be carried out by government agencies through usual enforcement and compliance practices, or by third-party verification.

483. These verification or certification agencies must be registered with the competent authorities and must follow the appropriate guidelines and protocols (established by the Government). Once emissions are reported, the environmental or technical agencies in charge of overseeing the emissions verify and consolidate this information. After verification or certification, they are sent to the tax authority.

Likewise, the tax authority places the responsibility for determining emissions on the liable entities, and their verification on the Environmental Agency.

Checklist 11. Core administration issues

1. Establish criteria for registering taxpayers and the associated timeframe for registration
2. Develop necessary forms, such as tax returns (declarations) and book-keeping rules
3. Determine the necessary information that taxpayers must provide
4. Determine criteria and requirements for tax exemptions and reimbursement
5. Establish periods to file the tax return
6. Determine administration and control to secure tax payment
7. Establish liability thresholds
8. Establish control mechanisms and emissions reporting guidelines
9. Determine compliance and enforcement mechanisms

6. Ex-post evaluation of a carbon tax

484. While the pure administrative design is a pre-condition to be able to implement a carbon tax, it is also advisable to identify the criteria to evaluate how well the carbon tax is performing, considering the need for further development and the opportunity to make necessary changes to improve its design. Ensuring an efficiently administrated and well-functioning carbon tax system is an ongoing process. If the carbon tax introduction has not been preceded by a comprehensive public consultation, the need for ex-post evaluations may be even more necessary to avoid criticism on the goals and risk of institutional mistrust by civil society.

485. For example, the Swedish carbon tax has been in force for 30 years and legal changes – minor or major – have been made nearly every year since its introduction. These changes have included measures such as changing the tax rate, areas covered, the full or partial exemptions and the administrative procedures (e.g., conditions for approval to act as a taxpayer or level of thresholds for tax reimbursements). Aspects such as guaranteeing that tax is properly collected with no major tax evasion, and making sure that the legislation is followed, are core elements to consider when doing ex-post evaluations of the effectiveness of a carbon tax. This ensures a well-functioning tax, ready to meet its revenue objectives and consequently the environmental goals. Similarly, after two years of implementation, Chile introduced important reforms to its tax, including improving the accuracy of definitions and other procedural aspects.

486. Jurisdictions will decide on different types of evaluation method (environmental, revenues, administrative effectiveness and simplicity, anti-fraud design, etc.) based on specific objectives and the legal traditions and constitutional

obligations. Certain permanent bodies may be assigned the task to evaluate a tax regularly, at predefined times or upon a special mandate from the Government.

487. A special commission for evaluation may also be appointed. In some jurisdictions, this may be a task for the tax authorities, while in others, it is considered vital that such evaluations are performed by external, independent bodies. For example, where they exist, a Court of Auditors may help with the control of efficiency of the administrative actions, when reviewing the tax incentives granted for environmental purposes. In Spain, the Court of Auditors has published periodical special reports on the control carried out by the tax administration, with respect to environmental deductions in the national corporate income tax.

488. The reasons for decisions in favour of changes in a carbon tax design and administration may depend on the feedback received from different stakeholders. Issues typically raised include the desire to increase the environmental impact of the tax, the lobbies arguing for special treatment for specific sectors, the necessary coordination with other measures to foster a transition to a low-carbon economy, as well as changes required by the tax authority.

489. A frequent dialogue with the relevant stakeholders may be beneficial to understand the needs and the improvements required in each sector. Ultimately, it can result in a modification of the administrative practices or rules to make them more suitable in accordance with business life.

490. Existing international mutual assistance frameworks for administrative cooperation (either at bilateral or multilateral level) could quite easily cover carbon taxes (just by expanding their scope). This would allow the State parties to these agreements to realise how these environmental regulations are applied in practice by other jurisdictions (by making use of the possibilities to exchange information relevant to determining the tax debts or collecting them).

491. Further, the discussions carried out to assess carbon taxes in different global fora (such as the United Nations (UN), the World Bank, or the International Monetary Fund (IMF)) in line with their joint efforts towards the achievement of the Sustainable Development Goals (SDGs), would be useful.

7. Conclusion

492. This chapter has discussed the administrative issues raised by a carbon tax, considering the specific issues raised by the different tax design approaches. Drawing heavily from the cases of Sweden and Chile, it explored some of the more relevant administrative decisions that authorities must make.

493. The chapter dealt with general administrative issues and specifically the

role of tax authorities. In this context, the relevance of clearly stating the role of the involved competent authorities has been underscored. Furthermore, special attention should be paid to inter-administrative cooperation relations (particularly in cases of fiscal federalism or regional groupings). It also discussed the importance of public consultations and information campaigns, and how they may be beneficial in improving administration and public acceptance.

494. The chapter also analysed, considering the different approaches, the detailed regulations of the core elements of good administration that promote compliance, such as how to ensure greater certainty in the measurement of the tax base, or how to deal with filing and reporting obligations.

495. Nevertheless, it is impossible to deal with all administrative issues effectively. Carbon tax design and implementation are dynamic and, therefore, we argued that administrative requirements should facilitate ex-post evaluation to ensure the necessary adjustments to both the design and administration of the tax.

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Chapter 9: Revenue Use

1. Introduction

496. Carbon taxes may raise significant revenues. Therefore, governments, particularly in developing countries with low tax-to-Gross Domestic Product (GDP) ratios[196], may want to consider carbon taxes as a source for domestic resource mobilization in addition to their role as an environmental policy instrument.

497. Broadly, revenue use co-determines carbon taxes' net economic benefits (beyond the direct environmental benefit); it can affect distributional impacts, as well as strengthen support for their introduction or increase. This chapter explores revenue use in the context of the political economy of carbon tax design and implementation. Section 2 identifies possible revenue uses. Section 3 discusses how to establish revenue commitments, and Section 4 how to communicate those choices. Finally, the appendix presents information on estimates of potential revenues of carbon taxes and similar instruments.

2. Options for revenue use

2.1 *Compensation for vulnerable industries*

498. Carbon taxes increase costs, particularly in energy-intensive industries; this can trigger carbon leakage (production moving to places with lower carbon costs) and reduce the ability of firms to compete internationally. These effects may need to be dampened, which can be done by using part of the revenues to compensate trade-exposed industries after the introduction of the tax.

499. Two mechanisms can be used to address competitiveness concerns. First, revenue-recycling measures. This implies direct financial transfers to companies based on output, or financial support for efficiency improvements. Second, measures that reduce tax rates and/or targeted tax exemptions; however, they may result in the loss of revenues and reduced environmental effectiveness.

500. So as not to compromise the environmental objective of the carbon tax, two design principles should be considered. First, compensations should only benefit companies (or facilities) that are highly exposed to international trade and face significant cost increases because of the carbon tax. Second, compensations should be designed in a way that maintains the incentive to reduce carbon emissions.

501. To satisfy the second principle, having companies pay the full tax rate and

196 World Bank data, Tax Revenue (% GDP) https://data.worldbank.org/indicator/GC.TAX.TOTL.GD.ZS

recycling part of the revenues to those same companies (based on their output), or for supporting efficiency improvements, are better options than tax rate reductions or exemptions. If such revenue-recycling is not feasible, tax reductions or exemptions can be an alternative, but these should be limited and eventually phased out. Additionally, these measures should be granted conditional on efficiency improvements.

502. When designing compensation schemes for affected industries, governments will inevitably be confronted with significant lobbying for more generous compensation or for broader exemptions. While it is important, in principle, to limit beneficiaries (i.e., to those facilities exposed to international trade) and to maintain the incentive for reducing emissions, in practice, it may also be necessary to strike a balance between these principles and the political feasibility of the carbon tax considering industry pushback.

503. Instead of using tax exemptions or transfers, governments can also address the leakage and competitiveness concerns with measures such as tariffs on imports of highly traded emission-intensive commodities, which are known as Carbon Border Adjustment Mechanisms (CBAM).[197]

2.2 Compensation for households

504. Carbon taxes can result in different relative burdens on households depending on their income.[198] A disproportionate burden on low-income households, or reduced energy affordability (irrespective of how the burden differs by income), may not be possible politically and reduce the public acceptability of the tax.

505. To mitigate unwanted negative effects of carbon taxes on households, governments may choose to use parts of the revenue for compensating some (usually low-income) households for the price increase. Country experience with compensation mechanisms in the context of a carbon tax is scarce, but there is considerable experience in the context of reforming energy subsidies and energy taxes, which can be built upon.[199]

506. As is the case of vulnerable industries, mechanisms for compensating households should be limited to those that need support without compromising the incentive of the tax to change consumption. Also, households can be shielded from rising energy prices either through targeted transfers (revenue-recycling) or through reduced rates or exemptions (forgone revenues).

507. Designing compensation mechanisms that reach targeted households may

197 See Chapter 7.
198 Potential distributive implications of carbon taxes are discussed in Chapter 7.
199 Coady et al., 2015.

be more difficult than compensating vulnerable industries. This is due to two factors. First, it might be difficult to identify the households most affected by higher energy prices. Second, administratively simple compensation measures, such as tax deductions or tax credits, might not target low-income households, since they are not paying taxes. This problem is exacerbated where there is a large informal economy.[200]

508. To avoid the second problem identified above, governments can choose to implement targeted transfers as a redistributive mechanism. Targeted transfers can take the form of cash transfers or near-cash transfers.[201] If a cash transfer system already exists, where beneficiaries are known and coincide with households that should receive compensation for increased energy prices, transfers from carbon tax revenues can be distributed by piggybacking on these systems. Targeted transfers can also be handed out conditional on specific household behaviour (e.g., children going to school), hence pursuing other policy objectives in addition to redistribution.

509. Cash transfers or near-cash transfers can compensate households without reducing the incentive for changing behaviour. Cash transfers are more effective when provided at regular intervals, for example, as monthly dividends, to truly offset impacts on household income.[202]

510. Sometimes, broad or universal cash transfers are used to compensate households after the introduction of a carbon tax (this was the case, for example, in Switzerland and British Columbia), or after the removal of fuel subsidies (for example, Iran in 2010).[203] In the case of a carbon tax, this mechanism is known as a carbon dividend. The benefits of such a compensation mechanism are its salience and universality; these can help increase the acceptability of the tax.[204] This is especially true if the dividend is disbursed before the tax is introduced. The downside of using carbon tax revenue for universal cash transfers is that this mechanism may not improve distributional outcomes.[205]

511. An alternative to cash-transfers can be expanding existing programs

200 Falcão and Cottrell, 2018.

201 An example is the National Fuel Allowance Scheme, a weekly cash payment to low- and fixed-income households which recycles carbon tax revenues in Ireland.

202 For a comprehensive discussion of the evidence on cash and near-cash transfers in a general context, see Bastagli et al, 2016.

203 In 2013 and 2015, the government of India also introduced a reform of liquified petroleum gas (LPG) subsidies. LPG cylinders were sold at market price, and a consumption-linked subsidy was directed to households.. The scheme aimed to reduce leakages (and avoid a black market of LPG cylinders) by achieving a common market price for LPG and by channelling the consumption-linked subsidy directly to domestic consumers (MoPNG, 2013). Under the scheme, households would buy LPG at the market price (instead of the subsidised price) and receive the subsidy directly into their bank accounts (following the purchase, for a maximum of 12 cylinders of 14.2 kilograms each per household per year). This scheme was first launched on 1 June 2013 and subsequently expanded to 291 districts in six phases covering 17 million people (Nag, 2014).

204 Klenert et al., 2018.

205 Vogt-Shilb et al, 2019.

targeting low-income households (e.g., school meals, public works, reductions in education and health user fees, subsidized mass urban transport, subsidies for water and electricity connection costs).[206] Further, if transfers are not possible, other policy choices include granting life-line tariffs, reduced rates for low-income households, or providing vouchers.

512. Finally, reinvestment of additional revenue in vulnerable communities can be an alternative, albeit not focalized on compensating the directly affected low-income households.

2.3 *Environmental spending*

513. Carbon taxes are simultaneously a revenue-raising and environmental policy instrument. While the environmental objective of the carbon tax is achieved primarily by changing the relative price of goods that generate carbon emissions, governments may choose to use part of the revenues to further additional environmental objectives. This can strengthen support where the demand for more ambitious environment policy is high and can be justified if environmental spending needs are not currently met.

514. There are examples of governments using revenues to finance environment-related programmes and projects, including promoting or subsidising the use of renewable energies and low-carbon technologies, the conservation and protection of biodiversity, waste and water management, and other green programmes. Carbon tax revenues can also be used to fund energy efficiency and savings measures.[207]

515. Directing part of revenues towards the promotion of low-carbon technologies and Research, Development and Innovation (R&D+i) can help address the issue of hard-to-eliminate emissions.

516. To reduce emissions, countries should aim at "filling-the-gap" policies that use revenues to address emissions that the tax would miss, while avoiding reinforcing behaviours that are incentivised by the tax anyway. For example, carbon tax revenues used to incentivise businesses to install solar panels are often redundant, since many of those businesses would have likely installed the panels because of the tax anyway. "Filling-the-gap" policies, on the other hand, aim at targeting only those entities for which the tax would not be a sufficient incentive to change behaviour. With this approach, more revenues would potentially be available to spend to reduce emissions that would otherwise have been missed, in our example small businesses that might not have the necessary capital to install solar panels.

206 For example, British Columbia uses part of the carbon tax revenue to grant non-energy related tax credits to low-income households, including a "children's fitness and arts" tax credit.

207 Some examples include the carbon dioxide tax in Denmark, which uses part of revenues to fund business energy efficiency subsidies; and the Slovenia emissions tax, where a third of revenues are used for emissions mitigation.

517. For developing countries, investing in R&D might not be a priority. To further environmental protection, they might choose measures that directly impact citizens instead, such as expanding low-carbon public transport infrastructure or the public electrical grid with renewable energy. These direct measures would also contribute to increasing the acceptance of the carbon tax, as citizens can see the visible results of the policy.

2.4 *Tax shifts*

518. Revenues from carbon taxes can also be used to finance changes in the overall tax policy, by lowering other taxes simultaneously with the introduction of carbon taxes. Typical examples include the reduction of taxes on personal or corporate income (including social security contributions), or taxes on capital. The use of revenues from carbon or other environmental taxes to reduce other taxes is often referred to as a green tax shift or an environmental fiscal reform.[208]

519. The rationale for such tax shifts can be to improve the overall efficiency of the tax system. A more efficient tax system is one that raises the same amount of revenue at lower economic cost (i.e., with smaller economic distortions). In general, only lump-sum taxes do not distort economic behaviour and therefore are considered efficient. Carbon taxes can also reduce distortions since they internalize the social cost of externalities. Hence, in tax regimes where personal or corporate income taxes are high, using revenues from carbon taxes to lower income taxes can improve the overall efficiency of the tax system. While such tax shifts may be appropriate for high income countries with high levels of income tax, they may be less relevant – and less advisable – for developing countries with comparatively low overall tax-to-GDP ratios and low levels of income taxation. However, carbon taxes apply to consumption in the informal economy, which helps to reduce the – inefficient – differential treatment between formal and informal sectors.

Checklist 12. Possible revenue use

1. Compensation of vulnerable industries
2. Compensation for households
3. Environmental spending
4. Double-dividend tax changes (tax shifts)

3. Administrative systems to commit tax revenues

520. In practice, allocating carbon tax revenues to specific, pre-determined expenditures may involve earmarking or establishing explicit political commitments.

521. Earmarking entails legal prescriptions assigning revenues to specific spending purposes. These provisions, depending on the country, can be included in primary or secondary legislation. While earmarking is standard practice in some jurisdictions, it is constitutionally prohibited in others.[209] Where earmarking is prohibited, the creation of special trust funds – with an environmental purpose, or other – may be an option for ring-fencing revenues to specific purposes, in cases where this is considered important for political reasons (see Box 30).

522. Politically committing revenue to specific spending purposes is an option that can have the same effect as earmarking, but with more flexibility and the possibility to change the allocation of funds as environmental or social priorities change. Political commitments can, therefore, be useful both in jurisdictions that allow earmarking and in those that do not. Political commitments for specific revenues use can be made by public statements (e.g., as part of policy packages) but may not necessarily involve legal prescriptions. However, such flexibility might also result in lower political thresholds when shifting revenue use, because of changing political priorities of different governments, and therefore in increased uncertainty.[210]

209 For example, in Chile, earmarking revenues from any tax is prohibited by the Constitution, while British Columbia earmarked some revenues from their carbon tax to lower the energy costs of low-income households, and Denmark partially earmarked revenues for green spending, specifically for energy efficiency.

210 For example, in the case where revenues from a carbon tax are politically committed to supporting renewable energy power plants, a change in political priorities that reallocate such revenues to lowering energy costs for low-income households would create uncertainty for power producers; they might therefore have less of an incentive to invest in the first place.

Box 30. The potential role of trust funds in linking revenue sources to spending items

When earmarking revenues is not an option, and depending on the country's legal framework, a trust fund can still help to ensure that some funding is set aside for a specific purpose (environmental or other) in the case that this should be a policy objective. Independent government agencies could play a similar role.

In general, environmental funds are mechanisms that help mobilize, combine, and oversee the collection and allocation of financial resources for environmental purposes. The money allocated to the fund is usually tied to the specified purposes of its mission and kept separate from other funding sources such as a country's general budget. This can help to ring-fence the allocation of resources from the possible influence of political cycles, but also limits the flexibility of the budgetary process.

Revenues from carbon taxes and other environmental taxes can be sources of funding for environmental funds, while allowing these independent structures to be long-lasting, to the extent that they receive a steady flow of revenue resources. This feature may be constrained by legal impediments within a country's budgetary legislation and may require some form of oversight to operate independently.

Many environmental funds (e.g., the National Fund for Environment and Climate Change (FONERWA) in Rwanda and the Environmental Investment Fund in Namibia) have their own internal governance structures that regulate how they operate and how the funds get to be employed. An internal governance structure can be an important step in keeping the revenues or general resources attributed to the fund separate from the country's general budget, and even allowing contributions from private sources in addition to the revenues from environmental taxes. The more transparent the fund, the more likely it will be successful in harnessing private investors and international attention to sponsor promoted activities.

Examples of successful environmental funds

As shown by these country examples, environmental funds can allow the employment of carbon tax revenues for environmental purposes.

- Colombia: 30 percent of the revenues accumulated via the carbon tax are geared towards a national environmental fund for coastal preservation (activities include protecting the erosion of coastal areas, fighting deforestation, monitoring forested areas, preserving water sources as well as other strategic ecosystems, and fighting climate change).
- Costa Rica: the main source of funding for the Forestry Environmental Services Program (FESP), which is the revenue accumulated via a dedicated tax on the sale of fossil fuels. Over one third of the revenues accumulated via the tax, i.e., 5 percent of fuel sales, is earmarked to invest into forest reforestation, sustainable management of forests, and forest preservation.[211]

For more information about environmental funds, see UNDP, 2017.

4. Transparency and communication

523. When carbon taxes are introduced as part of a policy package, and revenues are used to compensate vulnerable industries, or households, or for environmental purposes, the perception of fairness and effectiveness of revenue use becomes an important factor for the public acceptability. While the effects of the tax on the price of fuel products are usually felt directly by businesses and consumers as a price increase, the (positive) effects of compensating measures addressing businesses or households, or of environmental measures, are often indirect and less salient.

524. In this situation, deliberate efforts by governments to communicate and explain the design and purpose of the policy package, including the use of revenue,

211 Chomitz, et al., 1999.

become an important factor for the acceptance of the tax. Revenue-recycling mechanisms may not be self-evident. Governments should communicate clearly what purpose revenues are used for, and how these purposes are meant to address negative competitiveness or fairness concerns, or further environmental objectives.

525. Trust in the government is relevant for choosing and communicating revenue use. When the policy objective of using revenues for compensating affected households is to increase public acceptability, compensation measures become even more important where trust in government is low. In countries with high distrust, very salient options for revenue use like uniform lump-sum or other cash transfers generate more public support for a carbon tax.[212]

526. The labelling of a carbon tax can also be an important part of the communication strategy. A 'fee-and-dividend' renaming (with lump-sum payments) has been found to be an effective labelling strategy when the credibility of revenue-recycling for households and firms is chosen to increase political acceptance[213].

5. Conclusion

527. While the principal objective of carbon taxes is to provide incentives for emissions' reductions, they also raise revenue. This chapter discussed several potential ways for using the revenues that are typically associated with the introduction of a carbon taxes, namely to: (1) provide compensations for affected vulnerable industries; (2) provide compensation for households; (3) increase environmental spending purposes, and (4) finance tax shifts. Tax revenue can also be used for financing additional spending or paying off debt, issues that are not discussed in this Handbook.

528. The rationale for specific forms of revenue use, as opposed to contributing to general revenue raising, often lies in seeking public support for the carbon tax. The use of revenues also co-determines their net economic benefits, affects their distributional impact, and can strengthen support for their introduction or increase.

529. There is no one-size-fits-all solution or recommendation for carbon tax policy packages including revenue use. The right choice of revenue use depends on country circumstances including the pre-existing tax system, income distribution and consumption patterns, industrial structure and competitiveness, trust in government, understanding, as well as acceptance of environmental taxes and environmental policy, to name the main ones.

530. In the policy deliberation and design process leading up to a carbon tax,

212 Klenert et al., 2018.
213 Ibid.

governments should be mindful of potential sources of political opposition towards the tax, as well as key economic and social impact variables. They should also assess the likely impact of different options of revenue use and try to strike a balance between strengthening support and optimizing economic and distributional gains, by choosing an appropriate form of revenue use (or a combination of several).

531. In practice, using carbon tax revenue for specific purposes can take the form of earmarking or explicit political commitments. Since earmarking may not always be possible (and is prohibited in some jurisdictions), political commitments or other concurrent measures, such as environmental funds, can be used to direct revenues towards a specific priority. Where it is possible and where constraints on revenue are conducive to strengthening public support for carbon taxes (e.g., because of low trust in government), earmarking can be advisable. Generally, significant political support can be achieved by clearly communicating explicit commitments in the use of revenues and making sure that the chosen form of revenue use is adapted to local circumstances.

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Appendix 3: Carbon tax revenue in perspective

532. This appendix discusses actual and potential revenue from carbon taxes, and compares these figures to the revenues from excise taxes on energy use and emissions trading systems (ETS).

A1. Current carbon tax revenue

533. The World Bank's annual State and Trends of Carbon Pricing Reports tracks the adoption and continued application of carbon taxes and ETS across the world. In addition to key statistics on the price level and the base covered, the reports provide estimates of the total annual revenue and the total annual value of carbon pricing. See Table 7.

Table 7. Revenue from and value of carbon pricing. Carbon taxes and ETS[214]

Billion US$	2015	2016	2017	2018	2019	2020
Revenue (carbon tax and ETS)	26	22	33	45	45	53
Share of revenues from carbon tax[215]	64%	74%	66%	53%	53%	51%
Value (carbon tax and ETS)	48	49	52	82	98	120
Share of value from carbon tax[216]	34%	34%	42%	29%	24%	22%

Source: World Bank State and Trends of Carbon Pricing Reports 2016 – 2021

534. The table presents revenue in US$ billions from carbon pricing, including both carbon taxes and ETS. As can be observed in Table 7, the value of carbon pricing is around twice as large as the revenue that it generates. This is due to the fact that the value of an ETS includes the total value of allowances in the economy, while the revenue generated will likely be lower, with the difference attributable to the allocation of free allowances and of permits below the auction price.[217] [218]

535. It can be observed that both revenues and values have increased considerably, from 26 to 53 billion US$ between 2015 and 2020. The increase between 2017 and 2018 is mostly attributable to rising allowance prices in the EU ETS, but rising carbon taxes, notably in France and Alberta (Canada), also contributed to the increase. The EU ETS allowance prices stabilised in 2019 and then increased again in 2020,

214 2019 and 2020 figures for value are calculated based on the Carbon Pricing Dashboard data - https://carbonpricingdashboard.worldbank.org/.

215 Calculations based on Carbon Pricing Dashboard data - https://carbonpricingdashboard.worldbank.org/.

216 Calculations based on Carbon Pricing Dashboard data - https://carbonpricingdashboard.worldbank.org/.

217 The table reports the revenues collected, and value of, carbon taxes and ETS worldwide. The value of an ETS is estimated by multiplying the number of allowances by the allowance price, whereas the revenue from the carbon tax is obtained from government budget documents.

218 It can be noted from the table that revenue proportions are opposite the value proportions (i.e. carbon taxes represent a larger share of revenues but a lower share of value), indicating the widespread practice in ETS of allocating allowances for free. Flues and Van Dender, 2017, reach a similar conclusion in a study based on Organisation for Economic Co-operation and Development (OECD) and G20 countries.

contributing to the total increase in revenues and values, as well as the increase in the revenues generated by the ETS as a share of total carbon pricing revenues.[219]

536. To put the revenues from carbon taxes and ETS in perspective, the revenue from excise taxes on energy use, across OECD and G20 countries, is an estimated EUR 420 billion in 2016 (approximately US$ 466 billion).[220] This was twenty times larger than the revenue from carbon taxes and ETS combined. In other words, if the sum of excise taxes, carbon taxes, and emission permit prices is taken to be an effective price on carbon (an "effective carbon rate" in OECD terminology), then the revenue from effective carbon rates consists of 95.2 percent of excise tax revenue, 3.2 percent of carbon tax revenue, and 1.6 percent of revenues from emission allowances.[221] [222]

A2. Potential carbon tax revenue

537. Carbon pricing presently raises less revenue than it would if the instrument were deployed more in line with its climate policy potential. Low revenues from carbon taxes are mainly attributable to low tax rates and narrow tax bases. Estimates of the potential revenues, not considering behavioural change, conclude that a minimum carbon price of EUR 30/tCO2, (where pre-existing excise taxes, carbon taxes and emission permit prices are considered to calculate the required tax increase) can raise additional revenues worth of 1.32 percent of GDP across the 40 OECD and G20 countries analysed (0.72 percent for OECD only).[223]

538. Other estimates, considering behavioural responses (sector-elasticities) to carbon price increases, suggest carbon tax revenues will still be high. Table 8 summarizes the estimated impact on revenues of introducing a carbon tax of US$ 25, 50 or 75/tCO2 for a selection of countries and across the G20 from one study. The same study suggests that a carbon tax of US$ 75/tCO2 would reduce emissions by 35 percent in 2030 compared to 1990, which is sufficient to be on track for the Paris Agreement targets. For the G20, this tax would raise revenues worth 0.4 percent of GDP. Countries where current taxes are lower would collect proportionally more revenue.[224]

219 World Bank, 2020.
220 See Marten and K. van Dender, 2019 for a discussion.
221 This also means that revenues from carbon taxes are twice as high as those from emissions trading, compared to the near equal split estimated in the Global Carbon Accounts 2020 in the OECD estimate for 2016. As noted, the share of carbon tax revenues is lower in 2019 than in earlier years because of rising emission permit prices in the EU ETS. Differences in country coverage may also matter. According to the Carbon Pricing Dashboard data, the revenue from ETS systems is one quarter of revenues from taxes and trading systems combined in 2016.
222 See World Bank Carbon Pricing Dashboard for country data: https://carbonpricingdashboard.worldbank.org/
223 See Marten and Van Dender, 2019 for a discussion.
224 IMF, 2019.

Table 8. Estimated revenue from carbon taxes, % of GDP, 2030

	Revenue from carbon tax of $25/tCO2	Extra-revenue from carbon tax of $50/tCO2	Extra-revenue from carbon tax of $75/tCO2
G20 weighted average	0.7	0.5	0.4
Russian Federation (largest increase)	1.7	1.4	1.3
France, UK (smallest increase)	0.3	0.2	0.2
India	1.1	0.7	0.6
Indonesia	0.7	0.6	0.5

Source: International Monetary Fund (IMF), 2019

539. The IMF and the OECD studies suggest that there is potential for a considerable revenue increase over the next decades, particularly where carbon prices and energy taxes are currently low, and the base is narrow. However, they also indicate that higher carbon tax rates would likely not result in a structural impact on the composition of overall tax revenues of countries. Also, ultimately revenues should decline as carbon-based fuel use declines. However, in the near to medium run, this should not prevent countries from integrating carbon tax revenue considerations into their broader tax, climate, and spending policy frameworks.

540. Recent OECD estimates of the carbon pricing revenue potential of a carbon tax (set to a minimum rate of EUR 30/tCO2) for a selection of developing countries show considerable variation.[225] For Egypt, the combined effect of removing fossil fuel subsidies and raising the carbon tax could generate extra revenue worth 4.5 percent of GDP. In Ecuador, the potential is around 3.7 percent, in Morocco close to 2 percent, and in Nigeria, Sri Lanka and the Philippines around 1 percent. Jamaica, Côte d'Ivoire, Guatemala, Dominican Republic, and Ghana could raise around 0.5 percent of GDP. Uruguay and Kenya might raise around 0.25 percent of GDP. In Uganda and Costa Rica, the revenue potential of a carbon tax set at EUR 30/tCO2 is limited and almost negligible.

541. The revenue potential differs among countries for two main reasons. First, there are substantial differences in pre-existing carbon prices. In Uganda, for example, where most fossil fuel use occurs in the road sector, prevailing tax rates are already above the low-end carbon benchmark. Second, the carbon intensity of energy use varies across countries. In countries that do not use coal, tax and

225 OECD, 2021.

subsidy reform will provide incentives for skipping the coal phase in electricity generation and industry. According to the OECD analysis, candidate countries include Costa Rica and to a lesser extent Uruguay and Kenya. These estimates suggest that while rising carbon taxes can help some countries mobilize some revenue, the revenue potential is modest if compared to the total budget of most countries, and it is unlikely that they will be able to adopt fundamentally different domestic revenue mobilization strategies following the introduction of a carbon tax.

Box 31. Price elasticity of demand

The size of the change in energy consumption following a change in energy prices (whether induced by a carbon tax or other causes) is described by the price elasticity of demand. The own-price elasticity measures the percentage change in the demand for a good or service following a percentage change in its price. A high (absolute) value indicates that the behavioural response to a given price change will be large; a small value indicates that it will be small. For example, an own-price elasticity of the demand for gasoline of -0.2 means that a 10 percent increase in the price of gasoline triggers a reduction of the demand for gasoline of 2 percent.

Price elasticities are determined by various factors, including the untapped potential for using fuels more efficiently and the cost of tapping it, the availability and price of substitutes, and consumer knowledge. Hence, the price elasticity of demand can vary over time and geography, as well as by income level or even with the price of the good itself. For example, in section 2.1 of Chapter 7, we discussed about how motor fuel taxation can be neutral or even progressive in developing countries, due to vehicle ownership profile. These conclusions are based on empirical studies that show that demand of fuels in developing countries reacts more strongly to price changes, or in other words that price elasticity of fuel products is higher in poor countries than in rich countries.

The price elasticity of demand of the fuels covered by a carbon tax partly determines the environmental effectiveness of the tax and the amount of tax revenue that it raises. By way of example, suppose that a household's demand for gasoline is 100 litre per month at a price of US$ 1 per litre, and that its price elasticity of demand in the short run (e.g., a year) is -0.2. If a carbon tax were introduced which leads to a 10 percent increase in the gasoline price, the price is now USD 1.1 per litre. The demand for gasoline drops by 2 percent to 98 litre per month. The carbon tax revenue is 10 cent per litre, i.e., US$ 9.8.

Demand is usually more price elastic in the long run than in the short run because more options for changing behaviour become available. Suppose in the previous example that the long price elasticity is -0.4. In that case, over the long run, the 10 percent price increase leads to a 4 percent drop in demand, to 96 litres, and tax revenues are US$ 9.6. Hence, over the long run, the abatement impact of a tax rises, whereas the revenue generated declines (even if it is still greater than in the situation where there was no carbon tax).

Consequently, to the extent that the price incentive created by the tax leads to stronger behavioural responses of households and firms over time, consumption of the taxed fuels will be reduced and along with it the tax revenue, unless the tax rate is simultaneously increased. In practice, if carbon taxes were to be introduced and gradually increased, it can be expected that revenues would first increase and then start to decline over the span of one or two decades.

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Chapter 10: Interactions Between the Carbon Tax and Other Instruments

1. Introduction

542. A carbon tax is not introduced in a policy vacuum. Policies and regulations already in place may have relevant interactions with the tax and can enhance or inhibit its effectiveness, or even prompt additional administrative requirements for implementation.

543. This chapter seeks to support policymakers in understanding potential interactions between policies and instruments that affect carbon pricing, and discuss options on how the interactions can be addressed when designing and implementing carbon taxes.

2. Carbon Tax to be considered in context

544. The effectiveness of a carbon tax will not only depend on its design and implementation, but also on how the proposed carbon tax interacts with other related policies and instruments. Policy interactions refer to how policies, that may or may not have been conceived as a package, achieve their objectives in the context of other relevant policies or instruments.

545. It is, therefore, necessary to consider how policy instruments in place, or considered for introduction, can influence the effectiveness and goals of a carbon tax. Examples of such instruments include energy or fuel taxes, emission trading systems (ETS) and fossil fuel subsidies, as well as regulatory measures, such as renewable portfolio standards (RPS). Combining various instruments that are implemented with different policies and approaches, in order to reduce carbon emissions, may be a process that requires systematic adjustments. Moreover, defining upfront the timeline and scope for any needed adjustment can reduce the uncertainty.

3. Assessing the interaction

546. Environmental and carbon-related policies are often designed and implemented by different government entities, and at various levels of government. Policy consistency across different authorities will be important for both the effectiveness and efficiency of the carbon tax.

547. On the other hand, no single instrument may achieve all policy objectives. In practice, policymakers often resort to a combination of different policy approaches, or policy mixes, to achieve decarbonisation objectives, in combination with other

linked policy objectives such as air pollution reduction, energy security, revenue raising, economic development, and job creation. For instance, a carbon tax can be the cornerstone of a jurisdiction's climate policy, while other instruments may be complementary and deal with unintended consequences. Policy interactions may have intended direct and indirect effects, as well as unintended effects. For example, considering available resources and technologies, economic agents may make choices that are not cost-effective, thus driving up the total costs of implementation.

548. An effective and coordinated policy will vary across countries. Different jurisdictions have different needs depending on local circumstances, such as their development priorities, types of economy, domestic energy resources, ability to invest and national energy policies. Different needs will be balanced in different ways; hence, a multitude of combinations can exist.

549. To provide policymakers with a meaningful framework of how to assess interactions, this chapter will focus on the main types of interactions; for this, the terminology and conceptual framework developed by the World Bank is considered[226], where relevant types of policies are defined as:

- Complementary, in the sense that the various policies enhance each other's performance.
- Overlapping, in that they run parallel to each other, with similar objectives.
- Countervailing, in which case they give rise to adverse or contradictory effects.

3.1 *Complementary policies*

550. Complementary policies are those that can be introduced and applied together, with one policy improving the performance of the other. Complementary policies may have different objectives and generate different consequences. However, their combined effect is considered superior to the effect of one single policy.

551. Policies complementary to a carbon emission reduction policy may be less focussed on reinforcing the carbon price signal, but rather address potential barriers that prevent companies and individuals from responding to the carbon price signal given by the tax. See, for example, the case of Chile presented in Box 32. Complementary policies ensure that both producers and consumers are responding to the compliance costs of their actions, including climate impacts.

552. Complementary policies may help make revenue raising more sustainable.

226 See methodology and further examples further elaborated in World Bank, 2016

Since the main objective of a carbon tax is emissions reductions, significant decarbonisation will reduce the tax base and, therefore, revenues. Therefore, taxes on energy consumption can be developed as a complementary instrument, to retain at least part of the taxable base.

553. Depending on the features of the carbon tax, as well as of the other policies and instruments, this combination can also be overlapping or even countervailing. Often, a switch to low carbon fuels will require more energy for the same process (because fossil fuels are very energy-dense). If the energy tax increases the price of fuels by volume, but obtaining the same amount of energy from renewables is more expensive, decarbonisation may not occur.

Box 32. Complementary energy policies in Chile

Key policies in the energy sector in Chile that complemented the carbon tax and incentivised an energy transition include:

- **The Renewable Energy Law (Law No. 20.257):** The first important reform of the renewable energy sector was the approval of a Renewable Energy Law, which included a RPS. This is a quota system that encourages renewable energy generation by setting the proportion of electricity supply that must be produced from eligible renewable energy sources. The law aims to support the generation of electricity by renewable sources such as biomass, small hydraulic energy (capacity of less than 20 MW), geothermal, solar, wind power and marine energy. This law was amended in 2013 (Law 20,698, better known as "Law 20/25") stating that by 2025, 20 percent of the energy matrix in Chile must be composed of renewable energy.
- **Restructuring Public Auctions:** Another important reform in Chile was to improve renewable energy generators' ability to compete in energy auctions. Renewable energy projects without a power purchase agreement (PPA) used to face significant obstacles in obtaining funding from commercial banks. In Chile, PPAs can be achieved by bilateral negotiations or through participation in "power auctions"—carried out by the National Energy Commission (CNE)—for regulated consumers served by the distribution grid. Since 2005, Law 20.018 requires electricity distribution companies to contract their energy requirements by means of competitive non-discriminatory auctions (thus including renewables). A submitted bid with the lowest price is awarded a long-term contract (typically, a PPA) for the project. In 2014, three-time blocks were established in the bidding process, one block covering from 11 pm to 8 am, a second from 8 am to 6 pm, and a third at the time of peak demand between 6 pm and 11 pm. This change in the structure of the auction scheme has favoured renewable generators since they can supply during the times of the day when they are producing energy.
- **Energy Transmission:** Law 20,936, on electricity transmission, aims to create a robust interconnected transmission system allowing the unification of Chile's power grid connecting the Northern Interconnected System (SING) with the Central Interconnected System (SIC). The interconnection of the northern and central grid systems merges two medium-sized markets, not only forming a more competitive marketplace, but also allowing the energy generated from large solar potentials in the north to be distributed to the central and southern part of the country.
- **Distributed Energy:** The key regulatory instruments are Laws 19.940 and 20.571. The first grants rights to connect distribution projects, creating the small energy generators market (bigger than residential, but have facilities with an installed capacity of up to 9MW).[227] The second is a system of net billing of residential generators. Essentially, the law regulates energy self-generation from non-conventional renewable energy (NCRE) sources, and efficient cogeneration. The law gives users the right to sell their surplus directly to the electricity distributor at a regulated price, through net-billing.

227 Regulated by D.S. N° 244 of Ministry of Economy D.S. N°101 of the Ministry of Energy.

3.2 *Overlapping policies*

554. While complementary policies may have different objectives but reinforce each other, overlapping policies will, in practice, try to achieve the same goals while creating inefficiencies, such as higher costs. Overlapping policies that pre-exist or are considered together with the introduction of a carbon tax, might therefore create parallel carbon pricing. Tax design should consider policy interactions to avoid overlap across policy instruments. Cooperation with the policymakers responsible for other instruments, as well as expected taxpayers, can help identify the potential overlap across policies early on.

555. In the context of a carbon tax, an overlapping policy can be described as any policy which has similar objectives to the carbon tax, but unnecessarily raises the total social costs of achieving emissions reduction, thus creating cost-inefficiencies. For example, cost inefficiencies can arise in the case of additional renewables targets, mandates or subsidies which support high-cost renewable energy, because these duplicate the price signal provided by the carbon tax and lead to less cost-effective abatement measures.

556. There might be cases where having partially overlapping policies are useful, for example, to ensure decarbonisation in a certain sector; however, in general, policymakers should manage overlapping policies to avoid an excessive economic burden on economic agents, or an administrative burden on governments, while the same decarbonisation result could have been achieved with the carbon tax alone.

557. When a carbon tax is introduced, existing taxation per unit of production, distribution, and consumption of energy needs to be considered, generated through a pre-existing (and/or overlapping) ETS, energy-related tax or other implicit pricing instrument. For example, Argentina reformed its fuel taxes and adopted a carbon tax that maintained the same revenue. While the full mitigation effect is yet to be determined, the relevance of the policy is that it gave an important price signal, and changed the relative prices of fuels consistently with their carbon content.[228]

558. Introducing a carbon tax where overlapping policies exist should be managed carefully. However, a carbon price from a single instrument may not be sufficient or broad enough to stimulate investment in low-carbon technologies. For carbon pricing to be effective in stimulating the uptake of low-carbon energy options and technologies, the price needs to be appropriately strong and stable.

559. In countries and situations where the carbon price needed to drive the necessary changes is not politically achievable, a carbon tax may be strengthened by instruments such as technology mandates, emission performance standards and

228 OECD, 2019b.

energy efficiency measures, creating an implicit, higher CO_2 price, which may not be as transparent and evident as the carbon tax rate. If overlap from such measures on a carbon tax is not considered, these policies have the potential to undermine an explicit carbon price through the tax.

Box 33. Introducing carbon taxation in Mexico

In Mexico, the 2012 General Climate Change Law paved the way for a reform of fuel taxes, and for the introduction of the carbon tax. In 2013, as part of a comprehensive tax reform, Mexico became the first Latin American country to impose a carbon tax. The tax was implemented through a reform of the Law on Special Tax on Production and Services (LIEPS, 1980).

The initial tax was set at Mexican Peso (MXN$) 39.80 (approximately US$ 3.2) per tCO2. It is an upstream tax on fuels, with a rate based on their carbon content. It provides exemptions for gas production and imports, and it establishes a price cap on some high carbon intensity fuels. Since its implementation, the tax has been adjusted annually for inflation, but it is still low, approximately US$ 3 per tCO2. In addition, the tax rate was limited to 3 percent of the sale price of the fuel.

The Mexican carbon pricing policy is interesting because it was conceived from the beginning as a strategy to develop an ETS and link with the Western Climate Initiative (WCI). Although the tax is relatively simple, there are a series of additional features that have been implemented with the ETS and the WCI in mind. To this effect, memoranda of understanding were signed with the State of California in United States of America, and the provinces of Ontario and Quebec, in Canada.

Among the most important aspects of the carbon pricing policy, the Law on the Special Tax on Production and Services permits tax-crediting by using carbon credits from Certified Emission Reductions of Mexican projects approved by the United Nations Framework Convention on Climate Change (UNFCCC). The new legislation also included provisions for entities subject to the tax to deliver certified emission reductions (CER) from Mexican projects in lieu of the tax (CDC, EDF and IETA 2015; IEPS Law 2013). In December 2017, the CER regulations were published, allowing for credits of up to 20 percent of the carbon tax obligation.

Furthermore, in November 2013, a voluntary carbon exchange, MEXICO2, was established to trade carbon credits as a potential means of complying with the carbon tax. In August 2016, the Ministry of Environment (SEMARNAT) and the Mexican Stock Exchange agreed to implement a simulation exercise for an ETS, to develop capacities and generate more information.

In parallel, the authorities have been developing the National Emissions Registry (RENE). The 2015 RENE requires companies or facilities that emit more than 25,000 tCO2e / year to report their greenhouse gas (GHG) emissions from the previous year. The registry includes nearly 3,000 companies from various sectors, and will be the basis for the reporting system under the linked ETS. Although the system has experienced delays, the ETS started its three-year trial period in January 2020.[229]

3.3 *Countervailing policies*

560. Countervailing policies have contradictory objectives with respect to the carbon tax, or adverse effects on decarbonisation, hence undermining the effectiveness of the carbon tax. These kinds of policies are not necessarily bad per se, and in fact may have important goals. For example, policies aimed at supporting lower income groups, geographic regions, or strategic economic sectors, might be very effective in reaching their objectives, but end up increasing carbon emissions.

561. When considering introducing a carbon tax, it is crucial to determine the policies or instruments that subsidize and encourage carbon emissions, both at the

229 ICAP, 2020. See also the background information by the Mexican Secretariat of Environment and Natural Resources (SEMARNAT): https://www.gob.mx/semarnat/acciones-y-programas/programa-de-prueba-del-sistema-de-comercio-de-emisiones-179414

consumption and production levels. The co-existence of such subsidies or incentives, together with carbon pricing, needs to be evaluated by the country's policymakers to avoid undermining the effectiveness of the carbon pricing policy, as well as its public acceptability.

4. Policies and instruments interacting with a carbon tax

562. Given how deeply economies currently rely on processes that generate carbon emissions, jurisdictions have many policies and instruments that deal with energy, environment, or income support, that potentially interact with carbon pricing. A carbon tax will, therefore, be embedded in a complex policy landscape. Table 9 presents examples of policies and instruments that can interact with carbon taxes.

Table 9. Examples of policies that may interact with a carbon tax

Complementary	Overlapping	Countervailing
• Electric energy reform • Energy efficiency packages, allowing for fuel switching • Facilitating energy trade and daily contracts • Regulate and incentivize smart grids • Flexible demand side response • Encourage electricity storage • Policies that support the quality and availability of weather forecasting to make renewable generation more predictable • Regulating methane emissions in the oil and gas sector • Phasing out coal-based energy production • Incentives for electric vehicles (EVs) • Vehicle emission standards • Subsidies/investment in the charging stations and other infrastructure needed to support wide-scale adoption of transformative zero-emission options. • Standards for energy efficient buildings • Regulations or incentives on land management practices • Offset markets for GHG reductions from waste sites	• Emission trading systems • Fuel and energy taxes • Renewable energy support measures • Vehicle fuel efficiency standards • Feed-in tariffs or green certificates • Environmental emissions regulations and standards • Social carbon price in investment projects • Internal carbon price in businesses • Taxes on high emission cars • Payments for ecosystem goods and services (e.g., paying farmers to retire marginal agricultural land)	• Fossil fuel subsidies • Fuel taxes that create a price wedge across fuels which is not proportional to their carbon content • Land use change (forest clearing) subsidies • Private car and transport subsidies • Tax rebates on high emission cars (e.g. diesel) • Public transport taxes

4.1 *Carbon tax as one of the carbon pricing mechanisms*

563. For the effective assessment of policy interactions, it is necessary to understand the policies or instruments that are often considered in combination with the carbon tax.

564. A carbon price[230] is a powerful mechanism to reduce carbon emissions. There are several instruments that can put an explicit or implicit price on carbon emissions. Explicit carbon pricing includes carbon taxation, emissions trading, carbon crediting, and, under certain conditions, results-based climate financing. On the other hand, implicit carbon pricing influences the price of carbon in a more indirect way, through policies such as fuel taxation, energy efficiency standards, fossil fuel subsidy removal and incentives for low carbon technologies. [231]

4.2 Fuel and energy taxation

565. Carbon taxation may be introduced within an existing tax framework that includes taxes on the production or consumption of fuels or energy,[232] with diverse scope and rates.[233] When introducing a carbon tax, the interaction with these taxes should be considered. Other forms of taxation could be relevant when they impose an additional burden on energy and carbon throughout the value chain of production and distribution of energy and energy products.

566. Some countries have a long history of taxing energy products.[234] In several countries, it is the main or only tax specifically covering energy use.[235] These types of taxes were generally not introduced for environmental reasons, but to raise tax revenue or limit dependency on energy imports. For example, in the European Union (EU) countries, energy taxation on fossil fuels constitutes, on average, around 5 percent of their total tax revenue.[236] Estimates for Organisation for Economic Co-operation and Development (OECD) countries are similar.[237]

230 The World Bank features considerable information on carbon pricing. Its website on the subject, https://carbonpricingdashboard.worldbank.org/what-carbon-pricing, explains concisely what carbon pricing is, the main types of carbon pricing, international aspects of carbon pricing, as well as national and regional initiatives. It also covers forms of internal carbon pricing, as well as how various organisations and economic participants internalise the price of carbon in their economic decision-making.

231 The World Bank's State and Trends of Carbon Pricing report presents the distinction between explicit and implicit carbon pricing. See World Bank, 2016.

232 Further elaborated in Chapter 4

233 The OECD monitors the use of energy taxation on a regular basis and often in a context of assessing carbon pricing. See OECD, 2019a.

234 E.g., Sweden has taxed petrol since 1924, diesel since 1937, and coal, oil and electricity for heating purposes since the 1950s.

235 The OECD overview on Taxation of Energy Use 2019 considers countries like Australia, China, Indonesia, Israel, Republic of Korea, New Zealand, Russian Federation, and the United States as only having fuel excise duties burdening the use of energy.

236 The European Commission publishes a biennial report on energy prices, available at: https://ec.europa.eu/energy/data-analysis/energy-prices-and-costs_en?redir=1

237 The OECD Policy Instrument Database provides a comprehensive dataset on energy and environmental taxation: http://www.oecd.org/environment/indicators-modelling-outlooks/policy-instrument-database/

567. Once energy taxation attains a certain level, it tends to affect consumer behaviour. For example, building on the Mineral Oils Directive from the 1990s, the introduction of the EU 2003 Energy Taxation Directive has influenced a reduction in overall energy consumption by incentivising more energy efficient cars in EU Member States, rather than by encouraging Europeans to drive less. Therefore, the effect on consumer behaviour from taxes may not materialise the way that it is expected.

568. The institutional infrastructure for taxing energy products will generally provide an appropriate framework for implementing carbon taxation, especially in the case of the Fuel Approach. Potential gains from the interaction on the choice of carbon tax approach or the collection of carbon taxes will not be covered in this chapter.[238]

569. Introducing a carbon tax without consideration of pre-existing energy taxation will increase the cost of energy and energy products. Where a carbon tax intends to focus on stimulating the reduction of carbon emissions, an energy tax affects volume rather than emissions. In the total absence of coordination between different types of related taxation, the effect of both instruments will not necessarily reinforce the incentive for carbon emissions reductions. As discussed, low-carbon fuels tend to have a lower energy content than more conventional fossil fuel alternatives. Switching to a lower carbon fuel alternative may require the use of a higher volume of energy for the same effect. For example, running a car on biodiesel for 100 km will require a higher volume of biodiesel than the volume of diesel required to run a car for 100 km.

4.3 *Investment incentives*

570. A well-designed carbon tax should generate incentives for businesses and households to move towards lower-carbon products and services. It should support innovation and investment in low carbon options. However, depending on how the carbon tax is set up and the options available, the introduction of a carbon tax may not be sufficient. Targeted [tax] subsidies or incentives,[239] using tax revenues, may be needed to support investment in low carbon technology and innovation.

238 Relevant interactions in this respect included in Chapter 6.

239 In the framework of energy transition, subsidies and tax incentives seem most sustainable if they meet several conditions:

- They should be targeted to support investments that seek to reduce carbon emissions whilst being technology neutral (i.e. carbon reduction standards are set by the regulator, but firms are free to adopt the most cost-effective or otherwise appropriate technology that can meet those standards);
- Besides being focussed on a specific objective, they are limited in time and gradually expire under a predictable time schedule;
- They support the discovery, development, demonstration, and deployment of carbon reducing investments and innovations. They are not intended to subsidise end-users, certainly not in the long run (i.e., the new technologies must have a horizon to be self-sustainable).

4.4 *Fossil fuel subsidies*

571. Fossil fuel subsidies are policy instruments that target fuels directly, or electricity and heat generated from fossil fuels through monetary transfers, lowering the cost of fossil fuels and/or energy. These have many effects that impact carbon emission reduction objectives.[240]

572. Fossil fuel subsidies can have significant effects on overall economic choices and a country's financial position. By incentivising the use of fossil energy sources, they contribute to global warming, environmental pollution, and other environmental problems, all of which can have significant economic consequences.[241] See Box 34 for more details.

Box 34. The principal impacts from fossil fuel subsidies

The principal impacts associated with fossil fuel subsidies include:

1. Encourage energy intensive economic activities leading to increases in carbon dioxide (CO2) emissions.
2. Encourage excessive, wasteful, and inefficient fossil fuel consumption.
3. Generate deficits in fiscal budgets, and public debt.
4. Generate adverse effects in the balance-of-payments of oil-importing countries; and lost opportunity of raising revenues in oil-exporting countries, especially when international oil prices are high.
5. Divert resources away from productive public investment.
6. Lead to major distortions in the production structure.
7. Foster inefficient allocation of resources in economic activities that are more capital-intensive (i.e. fossil fuel production), but do not spur growth of productive employment. This challenge is exacerbated in countries endowed with relative abundant labour force.
8. Potentially benefit mostly high-income households who constitute a small proportion of the population.
9. Discourage investment in renewable energy.
10. Create incentives for smuggling.

Source: Mundaca, 2017 a,b

5. Addressing interactions

573. Carbon taxing policy will be more effective if it is aligned with the broader policy landscape. Once there is an overview of which policies interact with the carbon tax, consideration should be given to how to address them, especially overlapping and countervailing interactions. Cooperation with policymakers responsible for other instruments, as well as expected taxpayers, can help to identify potential overlap in the design phase.

574. To ensure effectiveness and efficiency, the interaction should be considered

240 Kojima and Koplow, 2015.
241 Mundaca, 2017 a,b.

both in the design and implementation phases. When considering the interaction in design, it can be addressed by:

- Adjusting the design of the carbon tax before introduction. For example, the scope, taxable base, or rate of the carbon tax can be adjusted to avoid overlapping policies.
- Adjusting the design and/or implementation of the other policies. For example, fossil fuel subsidies can be reduced in scope or phased out to avoid the countervailing interactions.
- Introducing complementary policies to address aspects of a carbon tax that might make it less sustainable, e.g. introducing social measures that address the potentially regressive nature of a carbon tax.
- Incorporating the carbon tax into other policies, by creating a hybrid tax or other pricing system.

5.1 *Adjusting the carbon tax*

575. To avoid overlapping with a pre-existing system, the carbon tax can be designed to focus on sectors that are not affected by other carbon pricing instruments (CPI). Certain types of CPIs may be more difficult to introduce for certain types of activities, for example: an instrument based on measuring specific emissions would be more complex to apply for carbon emissions resulting from private transport; and an ETS, while it works well for stationary facilities, is more problematic to introduce in the transport sector.

576. Also, carbon abatement costs are not the same for all kinds of carbon generating activities. It may be more effective to look at the abatement opportunities and associated costs for different activities, and tailor the policies to elicit the desired response. This could be done by introducing overlapping instruments. By focussing the carbon tax through a reduction in scope, a negative effect of the overlap can be reduced.[242] For example, the Fuel Approach taxes the carbon content of fuel; however, if a certain type of fuel is only used for a certain type of sector, an additional carbon tax on that specific fuel could enhance the decarbonisation signal in that sector, by moving the total burden on the fuel closer to the carbon abatement cost for that sector (i.e. it would become more convenient for producers to make the investment to stop using the fuel or improve their technological efficiency, rather than paying the carbon tax).

577. On the other hand, in case the same fuel is used in different sectors, the new carbon tax would need to include specific features to avoid double taxation in one

242 Andersen and Mainguy, 2010.

sector, whilst working effectively in the other. However, imposing two different tax rates on the same fuel may incentivise fraud; therefore, managing these overlapping instruments would be more challenging.

5.2 *Adjusting pre-existing policies*

578. To avoid undesirable types of interaction, pre-existing policies can be reviewed, rather than adjusting the carbon tax.

579. For example, fossil fuel subsidies are a countervailing policy. Ideally, they should be removed before carbon taxes are introduced to avoid confusion, uncertainty, and potential rejection from the public.

580. The gradual removal of fossil fuel subsidies and the implementation of carbon taxes should both have the same goals, namely, to reduce carbon emissions and price environmental externalities caused by excessive fossil fuel consumption.

581. Nevertheless, even when fossil fuel subsidies have not been completely phased-out, governments can introduce carbon taxation. To improve public acceptance of this reform, it is crucial to inform the public that a carbon tax will be gradually introduced and that this will imply a reduction in fossil fuel subsidies, that over time the subsidies will be removed, and a positive carbon tax will be in place.[243]

582. Institutional development facilitates the design of effective carbon tax policies and plans, to phase-out fossil fuel subsidies and achieve critical and necessary economic, social, and environmental objectives (i.e., meaningful carbon emission reductions). This is especially true in resource-rich countries where fossil fuel subsidies have been an instrument for sharing the revenues from local fossil fuel production.

583. Policymakers must be aware of the trade-off between the long-term climate change effects of maintaining fossil fuel subsidies, and the short-term expediency of retaining political acceptance by keeping fossil fuel subsidies. Fossil fuel price reforms will be more likely to be successful and effective if there is extensive consultation, as informed citizens are more likely to accept carbon tax policies (see Chapter 3).

584. Clarity on the scale and scope of fossil fuel subsidies informs policymakers and relevant stakeholders. Tools for fossil fuel subsidy assessment and review have been developed by several international organisations.[244] Governments and other stakeholders can use this information to evaluate the environmental and economic effects, and design effective fossil fuel subsidy reforms (See Appendix 4).

243 See Chapter 3.
244 See for example UNEP, 2019.

585. However, fossil fuel subsidy reform and carbon pricing will increase energy prices; therefore, targeted compensation for low-income households may be necessary. Cash transfers, investment in public services or environmental investments may be considered.[245]

586. Interactions with potentially overlapping policies, for example, through a pre-existing energy taxation, could also be managed by adjusting the energy taxation.

5.3 *Ensuring policies are complementary*

587. Adjusting existing energy taxation can become complementary to carbon taxation policies, for example, by substituting energy taxation with a carbon tax for specific products.

588. Carbon taxation can support innovation and investment in low-carbon technologies. Volume-based energy taxation may not be a sufficient price signal to reduce carbon emissions, since installations may generate the same result with less volume. When high carbon content fuels, such as coal, are covered by a carbon tax, complementary to an energy tax, there is a stronger incentive for innovation towards lower carbon emission fuel alternatives.

589. Policymakers should consider whether a higher carbon tax can increase the incentive to reduce carbon and if it is economically sustainable. In case the carbon cost from the overlapping instruments is considered excessive, mitigating instruments are available and can be included in the carbon tax when it is introduced.

590. However, introducing multiple instruments may duplicate efforts. The cost and resources that industries require to comply with overlapping policies can be broadly grouped into two areas: administrative costs that include the regulatory compliance costs, and the carbon price.

591. An example of an overlapping approach, that ends up working as a complementary policy, is a carbon tax set at the minimum price for a pre-existing ETS. Abatement options will be determined by carbon price signal through the ETS; however, the carbon tax will reinforce or stabilise the price signal and ensure a price floor. Moreover, the tax can positively influence excessive price volatility which can be a problem with an ETS.[246] The United Kingdom has taken this approach with the introduction of its carbon tax.[247]

245 See Chapters 7 and 9 for a discussion.
246 Fluesand van Dender, 2020.
247 Smith, 2008.

6. Hybrids

592. Interacting policies can also be combined into one instrument, creating a hybrid instrument. Hybrids can be created by combining various instruments and different aspects of carbon taxation. For example, a hybrid option can introduce a carbon tax system linked to emission allowances or credits through a linked fee, which is a tax linked to the carbon price in an ETS in the same economy[248]. It is also possible to introduce a carbon tax with features of an ETS with offsets, for example.

593. One of the first hybrid systems to be set up was the Australian carbon tax. This explicit carbon pricing instrument was introduced as an ETS, with certificates and allowances set up, but trading of the certificates was unavailable for the first 5 years. In absence of a market, the carbon price per tonne was pre-set by the issuing authorities in the first 5 years. However, once the market is established, trading sets the price. As carbon emissions are priced in the market, the expectation was to link the ETS to the EU ETS market. The system came into effect in 2012 but was repealed in 2014, having never reached the stage where the market was established and the link became effective.

594. In case there is a pre-existing energy tax framework, a carbon tax can be integrated in the energy tax framework and can become a carbon tax component of the overall taxation of energy products. Carbon taxes in several countries are integrated with the excise tax system for energy products. For example, this is the case in the Nordic countries, France and Mexico as is further discussed in Chapter 4.

595. The main advantage of using a hybrid system is that rather than adding an additional instrument to a pre-existing policy, the existing system can be adapted with features from the carbon tax. A hybrid system can be a more effective use of resources, as it does not require a duplication of implementation and administration. However, adding features of other instruments may complicate an existing instrument unnecessarily, therefore it can be easier just to introduce the second instrument.

7. Conclusion

596. A carbon tax is implemented in the context of a sophisticated and interrelated policy landscape. Policies and regulations already in place may, therefore, have considerable interactions with the tax and enhance or inhibit its effectiveness, or even prompt additional administrative requirements for effective implementation.

248 The linked fee covers targeted entities that lie outside the ETS, and the fee is determined by a historical value of the carbon price under the ETS, adjusted on a periodic basis. A linked fee might occur because of a compromise between regulators who wish to put a sector under the ETS, and the regulated party who advocates for a straight tax.

597. This chapter discussed the different types of instruments and examined possible interactions between the carbon tax and other policies and instruments. It also explored different approaches and challenges to deal with these interactions. Clarity on the different interactions and challenges associated with other interrelated policies and instruments is essential for effective policy implementation and should be one of the central issues assessed by policymakers in the design and implementation of a carbon tax.

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Appendix 4: Fossil fuel subsidies

598. Various definitions of fossil fuel subsidies have been elaborated by the World Trade Organization (WTO), the OECD and the International Energy Agency (IEA). These definitions depend on the form of policy intervention by governments (WTO, OECD), or the effect of some of these measures on costs and prices.[249]

599. There are several methodologies to measure fossil fuel subsidies, the most used are: 1) The Price Gap; 2) The Inventory of Support to Fossil Fuels; and 3) The Indicator. With any of these, it is possible to estimate negative externalities from energy consumption.[250] See Box 35.

600. The IEA finds that, in 42 countries, subsidy reform has saved US$ 120 billion in 2019, largely due to lower global fossil fuel market prices.[251] However, the OECD finds that, because of tax breaks and spending programs linked to the production and use of coal, oil, gas, and other petroleum products in 44 OECD and G20 economies, total fossil fuel support rose by 10 percent to US$ 178 billion in 2019, ending a five-year downward trend.[252]

601. Important reductions in fuel consumption, and consequently carbon emissions, can be achieved by reducing fossil fuel subsidies. Assuming a scenario with an increase in the price of diesel and gasoline by 20 US$ cents per litre, the reductions in the consumption and carbon emissions can be between 10 and 50 percent, depending on the country and type of fuel.[253] Coady et al. (2015) find that the Middle East/North Africa (MENA) region could reduce average CO_2 emissions by 36 percent.

249 UNEP, 2019.
250 See Parry and Small, 2005 and Clements et al., 2013 for further details.
251 See IEA key findings on energy consumption subsidies: https://www.iea.org/topics/energy-subsidies
252 The analysis builds on the OECD Inventory of Support Measures for Fossil Fuels. See http://www.oecd.org/fossil-fuels
253 Mundaca, 2017b.

Box 35. Methodologies to define and measure fossil fuel subsidies

We will analyse below three common methodologies to measure fossil fuel subsidies. These methodologies all face a common challenge: the gathering of credible and reliable information to calculate the actual subsidies. Cooperation, transparency, and diffusion of information is crucial to all countries to phase out all types of fossil fuel subsidies, to minimize efficiency losses, and to implement more equitable distributional solutions among the countries' citizens.

1. The price-gap approach. This is a widely used methodology for estimating consumption subsidies[254]. It compares average end-user prices paid by consumers (the local price) with the reference price of a fossil fuel that sold in a deregulated competitive market (an international price adjusted for miscellaneous costs and quality).

Subsidy per unit of fossil fuel consumed = (*Reference fossil fuel price – End-user fossil fuel price*)

This price gap can be positive or negative. It is negative when the producer in a net exporter country is subsidized.

In the estimation of the price gap, countries need to consider among other things:

- Whether their foreign exchange markets are free-floating. If they are not, it becomes difficult to convert import- or export-parity prices and consequently the estimation of the price gap.
- That the reference prices are calculated based on international fuel prices, and need to take into consideration costs of transportation (both international and domestic), quality, insurance, storage, distribution, and retailing. Fossil oil and petroleum products are traded internationally, and their sales prices are usually based on international benchmark prices. In contrast, coal and natural gas are traded much less frequently across national borders, and electricity even less – therefore, it might be difficult to use a relevant international benchmark price in the price gap calculation.
- For net exporters of fossil fuels, the domestic subsidies are implicit, and do not have direct budgetary impact if the price covers the cost of production. For net importers, subsidies are explicit, representing budget expenditures arising from the domestic sale of imported energy at subsidized prices.
- Some net exporting countries might consider basing the reference price in their markets on their cost of production, rather than prices in international markets. Even in this case, however, such countries miss the opportunity of collecting public revenues, curbing inefficient demand and production of fossil fuels, and reducing CO2 emissions.

The price gap methodology is useful because it measures the size of the net tax or subsidy, even in the presence of i) government policies that affect fossil fuels at different points in the supply chain: taxing or subsidizing the extraction, import, refining, or transportation of fuel, in ways that ultimately affect the retail price; ii) direct changes in the retail price by governments that are not necessarily taxes. The price gap measure renders an estimate of the aggregated effects of these policies).

2. Inventory of Support Measures for Fossil Fuels (Inventory methodology)[255]. The OECD has been leading and producing this inventory and maintains it online systematically. This project identifies, documents, and estimates tax expenditures, and how public resources are transferred to benefit or give preference to fossil fuel production and consumption relative to alternatives. The aims are to encourage transparency about governments' budgetary policies related to fossil fuel subsidies, which can be utilized for learning and sharing best practices. The 2017 Inventory includes more than 1,000 individual policies identified as supporting the production and consumption of fossil fuels in OECD countries and eight country partners: Argentina, Brazil, Colombia, China, India, Indonesia, Russian Federation, and South Africa. The OECD announced that data for the EU Eastern Partnership countries (Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova, and Ukraine) are forthcoming.

3. Indicator of Fossil Fuel Subsidies in the Context of the Sustainable Development Goals (SDGs)[256]. This indicator measures the amount of fossil fuel subsidies per unit of Gross Domestic Product (GDP). It requires the following data: 1) amount of direct transfer of government funds; 2) amount of induced transfers (price support); and 3) (optional) tax expenditure, other revenue foregone, and under-pricing of goods and services. To design this indicator, this methodology suggests collecting national data and supplementing it with two international datasets: i) the fossil fuel subsidies from the IEA; and ii) the data on fossil fuel producer and consumer subsidies collected by the OECD.

254 See for example Kosmo, 1987; Larsen and Shah, 1992; Coady et al., 2010; Kojima and Koplow, 2015; Mundaca, 2017 a,b; OECD, 2018.

255 The OECD Inventory and a detailed explanation of the methodology can be found at http://www.oecd.org/fossil-fuels

256 UNEP, 2019.

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Annex: Carbon Taxation in the Context of the United Nations

602. The United Nations has produced three key climate change agreements foreseeing targets for the reduction of greenhouse gas (GHG) emissions. In chronological order, the agreements are the United Nations Framework Agreement on Climate Change (UNFCCC)[257] (United Nations 1992); the Kyoto Protocol (United Nations 1997) and, more recently; the Paris Agreement (United Nations 2015).[258]

A1. The United Nations Framework Convention on Climate Change (UNFCCC)

603. The UNFCCC, the first international agreement on climate change, is an umbrella convention that provides a framework for both market and non-market approaches to address climate change. It was approved in 1994 and contains an open pledge "to achieve ... [the] stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."

604. While the UNFCCC targeted all signatory countries — both developed and developing — only developed countries, listed in Annex I, committed to adopting national policies and taking corresponding actions to mitigate climate change by, among other actions, limiting their emissions of GHG. Annex II countries, a more restricted group, had the supplementary obligation to provide financial resources to meet the costs incurred by developing country parties in complying with UNFCCC obligations.

605. Thus, the UNFCCC established different rights and obligations between developed and developing countries. However, it did not propose a specific mechanism for countries to meet those limited rights and obligations.

606. The UNFCCC brought into the body of the Convention the principles of

257 United Nations, 1992.

258 The UNFCCC, Kyoto Protocol, and the Paris Agreement deal with seven GHGs: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), perfluorocarbons (PFCs), hydrofluorocarbons (HFCs), Sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). The UNFCCC mentions broadly the term "greenhouse gases" without specifying the exact name of the gases it refers to. The Kyoto Protocol mentions the first six gases as GHGs covered under the agreement, not including Nitrogen Trifluoride (NF_3). The Paris Agreement covers all seven gases. CO_2 equivalent emissions is a measure of the total greenhouse effect created from all GHG emissions over a given timeframe, by means of which the non-CO_2 emission levels may be compared to a CO_2-equivalent basis. According to the Intergovernmental Panel on Climate Change (IPCC), CO_2-equivalent emission is the amount of CO_2 emission that would cause the same change the global mean equilibrium temperature, over a given time horizon, as an emitted amount of a long-lived GHG or a mixture of GHGs. The equivalent CO_2 emission is obtained by multiplying the emission of a GHG by its Global Warming Potential (GWP) for the given time horizon. GWP is therefore basically an index of how much a GHG may contribute to global warming over a period of time, typically 100 years. Therefore, under a carbon tax system, the use of carbon as a proxy for pollution, would allow countries to also target other GHGs through the tax, if emissions of these other gases are measures in CO_2 equivalent emissions (CO_2e).

environmental protection discussed in Chapter 2, namely: the polluter pays principle, the prevention principle, the precautionary principle, and the principle of common but differentiated responsibilities.[259]

607. These four principles have formed the basis of international environmental agreements negotiated since and even before the admission of the UNFCCC. They may therefore be considered the core principles of international environmental law and are references for international environmental taxation.[260]

A2. The Kyoto Protocol and ETS

608. The Kyoto Protocol was adopted only five years after the UNFCCC entered into force. It was clear in introducing a market-based approach for the reduction and control of GHG emissions. The close proximity between the adoption of the UNFCCC (1992) and the Kyoto Protocol (1997) made it appear as if the carbon markets contemplated through the three mechanisms of the protocol (emissions trading, clean development mechanisms and joint implementation) was the politically preferred instrument under the umbrella of the Convention.[261]

609. In this context, several developed countries and regions introduced ETS. The largest ETS implemented at the time was in the EU, launched in January 2005, and herein referred to as the EU ETS.[262]

610. The Kyoto Protocol recognizes that developed countries are principally responsible for the high levels of GHG emissions in the atmosphere because of more than 150 years of industrial activity. Therefore, the protocol only places an obligation to reduce GHG on certain developed economies (listed Annex I countries), applying the principle of common but differentiated responsibilities as a justification for that approach.[263]

611. For a complete discussion on ETS, and on the advantages/disadvantages with respect to a carbon tax and other measures, please see Chapter 2.

A3. The Paris Agreement

612. Introduced in 2015, the Paris Agreement broadened the scope of tools available for Member States to address carbon emissions specifically and climate

259 Although the principles in themselves already existed prior to the ratification of the UNFCCC, the Convention arguably had the effect of making them into general principles of international law. The polluter pays principle, for example, was developed by the OECD in the 1970s. See OECD, 1972 and OECD, 1974.

260 N. Sadeleer, 2008.

261 Falcão, 2017.

262 In the EU, the decision to go with an ETS was also premised on the fact that a new tax requires unanimous approval from all Member States within the EU to be accepted (European Union, 2003). However, some countries employ a mixed policy approach to carbon pricing, through the introduction of carbon taxes (i.e., Sweden, Denmark, Norway, Finland, and the United Kingdom) and other types of environmental taxes (i.e., Spain, the Netherlands, and others).

263 CISDL, 2002.

change more generally — tools that include green financing, trading in green bonds, and regulatory and fiscal instruments. It also broadened the scope of application of these instruments, by inviting all UN Member countries, at all levels of economic development, to adopt the Agreement and to commit to the GHG reduction goals assigned under Article 2. The Paris Agreement is thus the first international environmental agreement delving on climate change of true global application, and that feat was achieved by eliminating the different obligations originally bestowed on Annex I and Annex II countries.

613. The Paris Agreement requires all parties (developed and developing) to use their best efforts through Nationally Determined Contributions (NDCs) to curb GHG emissions and to continue to strengthen those efforts in the years ahead. The agreement is thus a return to the original objective of the UNFCCC, to the extent it formally acknowledges a broader array of instruments to fight climate change and reduce GHG emissions.[264]

614. The Paris Agreement does not deliver a binding commitment for GHG emissions reduction; however, it has put forward a broader set of tools to address carbon emissions (as opposed to supporting only emissions trading) specifically and climate change more generally. These tools include green financing, green bonds, and environmental taxes that include carbon taxes, the most popular behaviour-influencing instrument aimed at setting a price on carbon.

615. Although targets for the reduction of GHG emissions under the agreement are voluntarily determined and reported, national pledges are often conditional, and there is no enforcement mechanism and verifiability of implementation of pledges. Therefore, the agreement has no built-in mechanism to ensure delivery on commitments. Furthermore, intended contributions fall short of required emissions cuts and are unlikely to be able to contain global warming to the required threshold, without an intense carbon pricing campaign that is geared towards the effective reduction of emissions.

A4. The Broader UN Agenda: The SDGs

616. The Addis Ababa Action Agenda (Addis Agenda) was also adopted in 2015, providing the foundation to support the implementation of the UN 2030 Agenda for Sustainable Development (2030 Agenda). The Addis Agenda foresees a global framework for financing sustainable development by aligning all financing flows and policies with economic, social, and environmental priorities.

617. The 2030 Agenda is a plan of action for people, planet, and prosperity, that

264 Falcão, 2019.

furthers 17 SDGs and 169 targets to build on the achievements of the Millennium Development Goals. They seek to achieve human rights and gender equality for all. They are integrated and indivisible and balance the three dimensions of sustainable development: economic, social, and environmental.[265]

618. The 17 SDGs are currently the basis against which all UN Actions Plans are reported. The environment is such an important dimension of sustainable development that it features in nine of the seventeen goals,[266] with a dedicated action plan specifically referencing it – SDG 13- on Climate Action.

619. The Addis Agenda and the 2030 Agenda have emphasized the need for countries to mobilise resources to enhance development and meet the required goal. Several agencies have been set to monitor countries' progress in this field, and the UN itself produces frequent reports on countries' initiatives for resource mobilization.[267]

620. In the wake of the adoption of the 2030 Agenda, other parallel initiatives promoted by smaller country groupings, donor agencies, and regional associations have emerged, also with the objective of fostering the SDGs. The Addis Tax Initiative (ATI), for example, is one such approach. It was initiated by the Netherlands, Germany, United Kingdom, and the United States to enhance the mobilisation and effective use of domestic revenues and to improve the fairness, transparency, efficiency, and effectiveness of countries' tax systems. It is therefore an important tool to stimulate capacity building and policy development, particularly in developing countries.

621. It is clear from the above description of historic documents that domestic revenue mobilisation, as well as better and more comprehensive taxation systems, are becoming increasingly important in terms of financing development and are seen as important tools with which countries can achieve the SDGs.

265 United Nations, 2015.

266 Goals: (i) 3: Good Health and Well-being; (ii) 6: Clean Water and Sanitation; (iii) 7: Affordable and Clean Energy; (iv) 9: Industry, Innovation, and Infrastructure (v) 10: Reduced Inequality; (vi) 11: Sustainable Cities and Communities; (vii) 12: Responsible Consumption and Production; (viii) 14: Life Below Water; (ix) 15: Life on Land. That is not to mention the potential for new conflict and mass migration if climate change is not addressed. Environmental issues could therefore come to affect peace and security (SDG 16) and increase poverty (SDG 1) if not addressed in a timely manner.

267 United Nations, 2019

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Glossary

This glossary provides a summary of the definitions discussed in this Handbook. As such, all terms in this glossary should be read in the context of this publication, and they are not necessarily intended as general definitions.

Term	*Definition*
2030 Agenda for Sustainable Development (2030 Agenda)	The 2030 Agenda is an international agreement signed in 2015 by the Member States of the United Nations. It contains 17 Sustainable Development Goals (SDGs) and 169 targets to advance the three dimensions of sustainable development: economic, social, and environmental. Nine of the 17 goals contain pledges related to environmental protection, based on the consideration that environmental protection is inextricably linked to sustainable and equitable development, and that countries should aim to decouple economic growth from environmental degradation.
Abatement	See "technological abatement".
Abatement costs	Abatement costs refer to the expenditures incurred to abate emissions. See "technological abatement".
Acceptability (of a carbon tax)	The extent to which a policy (in our case, a carbon tax), once implemented, has the potential to be accepted by the public.
Addis Ababa Action Agenda (Addis Agenda)	The Addis Ababa Action Agenda was the outcome of the Third International Conference on Financing for Development, held in Addis Ababa, Ethiopia. It was adopted by United Nations Member States in 2015. It provides a roadmap for the financing of the Sustainable Development Goals (SDGs).
Allowance price	In Emissions Trading System (ETS), allowance prices refers to the price of the permit that has to be purchased to buy the right to emit a certain quantity of carbon dioxide (CO2). Usually, one allowance refers to a ton of CO2; therefore, an allowance price would generally refer to the price per ton of CO2 emission rights. In ETS, permits can be used or traded. See also "Emissions Trading System".
Autonomous communities	Sub-national governments with some degree of fiscal autonomy.
Bioenergy	Bioenergy is a renewable source of energy made from biomass or biofuels. These include, for example, wood, crops, seaweed, animal waste.
Cap-and-trade	See "Emissions Trading System".
Carbon Border Adjustment Mechanisms (CBAM)	Mechanisms to deal with competitiveness and carbon leakage concerns. Trade-related measures that address carbon leakage and competitiveness concerns. A CBAM aims to put domestic firms facing a carbon price on an even footing with importers that operate under a lower or no carbon price, and can serve as an alternative to other measures in force to prevent the risk of carbon leakage, such as the allocation of allowances free of charge under an ETS. Charging a levy on imports corresponding to the difference in carbon prices between jurisdictions would be an example of such a measure.
Carbon Dioxide (CO_2)	A naturally occurring gas, also a by-product of burning fossil fuels and biomass, as well as from land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas (GHG) that affects the Earth's radiative balance. It is the reference gas against which other GHGs are measured and therefore has a Global Warming Potential (GWP) of 1.

Carbon dioxide equivalents (CO2e)	A measure used to compare the emissions from various GHGs based upon their GWP. For example, the GWP potential for methane over 100 years is 21. This means that emissions of one million metric tons of methane is equivalent to emissions of 21 million metric tons of CO2.
Carbon emissions	The release of CO2 (or, more in general, greenhouse gases) into the atmosphere as a result, for example, of combustion.
Carbon leakage	Carbon leakage occurs when the carbon pricing in one jurisdiction results in increased emissions in another. If this happens, in practice, the carbon pricing policy would just displace carbon emissions from one area to another. Carbon leakage reflects the effectiveness of the tax as an instrument to reduce global carbon emissions. There are several channels through which such leakage can arise; however, the discussion in the Handbook focuses mainly on competitiveness-driven carbon leakage.
Carbon market	Trading system through which countries may buy or sell units of GHG emissions. See also "Emission Trading System".
Carbon neutral (or zero-carbon)	A country, project, facility, etc. is said to be carbon-neutral when the balance of carbon they release in the atmosphere is zero (or is compensated by other means). Carbon neutrality can be achieved through a multitude of measures, including by directly reducing emissions (for example, by using renewable energy sources), by compensating emissions (for example, by planting trees), or by buying credits for an equivalent emissions reduction (for example, Renewable Energy Credits).
Carbon offset	A unit of carbon emissions is offset when it is compensated by removing an equivalent unit of carbon from the atmosphere (or avoiding or sequestering it). This compensation can be done anywhere in the world, regardless of where the emissions actually occurred. In the context of carbon pricing, a carbon offset allows economic actors to pay for an equivalent amount of emissions to be reduced or "absorbed" elsewhere, instead of paying the tax. This might be cheaper than paying the tax or the significant investment required to switch fuels, and it can have substantial co-benefits (for example, on the livelihoods of people in developing countries).
Carbon pricing instruments (CPIs)	CPIs are policy instruments that use prices to provide incentives for economic agents to support climate mitigation. Today, they are considered fundamental to support environmental policy and climate mitigation, and their use has increased across the world. There are many types of CPIs. However, in the context of climate mitigation, it is generally understood that these refer to two principal instruments, carbon taxes and ETS also known as cap-and-trade.
Carbon tax	A carbon tax, for the purposes of this Handbook, will be defined as a compulsory, unrequited payment to general government, levied on carbon emissions or its proxy that can confer a reduction in corresponding carbon-based (equivalent) emissions in the atmosphere and is thus characterized as having both environmental purpose and effect.
Climate change mitigation	Action to reduce the net amount of GHGs released into the atmosphere, and thus help to slow down the process of climate change resulting from human activities.
Co-benefits	The positive effects that a policy or measure aimed at one objective might have on other objectives. For example, the direct benefit of a carbon tax is the reduction of carbon emissions, and its co-benefit include a reduction in urban pollution, and therefore a lower incidence of respiratory issues among the population.
Command and Control policy instruments	Regulatory approaches that rely on the introduction of specific regulations to change practices. These approaches include emission standards, reporting requirements and emission licensing, among others.

Complementary policies (with respect to a carbon tax)	Complementary policies are those that can be introduced and/or applied together, with one policy improving the performance of the other. Complementary policies may have different objectives and generate different consequences; their combined effect is considered superior to the effect of one single policy. Policies complementary to a carbon emission reduction policy may be less focussed on reinforcing the carbon price signal, but rather on addressing potential barriers for companies and individuals to respond to the carbon price signal of the tax. Complementary policies ensure that both producers and consumers are responding to the compliance costs of their actions, including climate impacts.
Consumption-based taxation (CBT)	CBT is a tax levied on the consumption (or purchase) of a good or service. CBT would be levied on domestic consumers, and products are taxed on their carbon-intensity regardless of where they are produced. While common in tobacco and alcohol taxation, CBT applied to climate concerns has yet to be introduced, due to the many uncertainties surrounding its practical feasibility.
Continuous emissions measurement systems (CEMS)	Technological systems that measure or monitor emissions at source continuously.
Cost-effectiveness (or cost-efficiency)	A policy is said to be cost-effective (or cost-efficient) when it achieves a given goal at a lower cost than other comparable policies. A more cost-efficient tax system is one that raises the same amount of revenue at lower economic cost (i.e., with smaller economic distortions). In general, only lump-sum taxes do not distort economic behaviour and therefore are considered efficient. Carbon taxes can also reduce distortions since they internalize the social cost of externalities. Hence, in tax regimes where personal or corporate income taxes are high, using revenues from carbon taxes to lower income taxes can improve the overall efficiency of the tax system.
Countervailing policies (with respect to a carbon tax)	Countervailing policies contradict or have a negative influence or impact on the objectives of another. In the case of a carbon tax, countervailing policies would have a contradictory objective with respect to the carbon tax, or adverse effects on decarbonization, hence undermining the effectiveness of the carbon tax. These kinds of policies are not necessarily bad per se, and in fact may have important goals. For example, policies aimed at supporting lower income groups, geographic regions, or strategic economic sectors, might be very effective in reaching their objectives, but end up increasing carbon emissions.
Decarbonization (Decarbonize)	The process by which countries or other entities aim to achieve a low-carbon economy, or by which individuals aim to reduce their consumption of carbon.
Direct Emissions Approach (or Emissions Approach) to carbon taxation	An approach to carbon taxation where the tax is levied directly on the amount of carbon emissions, calculated at the source (rather than through a proxy or estimation).
Direct tax	Direct taxes are imposed on a person or property and are normally paid directly. Examples include personal and corporate income taxes and property taxes.
Double dividend or green dividend (from a carbon tax)	A double dividend is considered to be achieved when society gains from the carbon tax through both its impact on the climate, as well as from the improved functioning of the tax system and the economy.
Downstream point of regulation	Regulation at the end of the production process.

Earmarking	The practice of committing a revenue stream for a specific purpose, object, or activity, such as environmental activities, or conservation funds, or climate adaptation.
Emissions Approach	See "Direct Emissions Approach".
Emissions Trading System (ETS) or cap-and-trade	An ETS is a carbon pricing system in which emitters are provided with emission allowances or permits and allowed to trade between themselves. In its most basic form, ETS establishes a maximum cap for total emissions within a specific jurisdiction and assigns permits to emissions' sources. Permits can be assigned to emitters through a range of mechanisms, including auctions, free allowances, or an allocation of the two. Emitters can choose to use their permits, or to sell them to other emitters that have fallen short. Emitters are usually allowed to trade directly among themselves, sometimes across sectors and even jurisdictions. This way, polluters for whom it is easier or cheaper to lower their emissions can do so and sell their permits to companies that are having a harder time in reducing their emissions.
Energy taxes	Taxes on energy products for transport (the most important being petrol and diesel) and for stationary use (fuel oils, natural gas, coal, and electricity). Energy taxes include, for example, mineral oil and motor oil tax, petrol (lead and non-lead) taxes, diesel, fuel oils, petroleum, kerosene tax, natural gas tax and electricity consumption tax.
Environmental fiscal reform (or green tax shift)	The use of revenues from carbon or other environmental taxes to reduce other taxes is often referred to as a green tax shift or an environmental fiscal reform. Revenues from carbon taxes can also be used to finance changes in the overall tax policy, by lowering other taxes simultaneously with the introduction of carbon taxes. Typical examples include the reduction of taxes on personal or corporate income (including social security contributions), or taxes on capital.
Environmental taxes	Taxes whose tax base is a physical unit (or a proxy of it) that have a proven specific negative impact on the environment.
Environmentally related taxes	A compulsory, unrequited payment to general government levied on tax-bases deemed to be of particular environmental relevance
Excise tax	An excise tax is usually expressed as a per unit tax established on a specific volume or unit of an item, which is typically applied to a narrow range of products (such as alcohol or tobacco products or petroleum products).
Externality	Externalities are a side effect of an economic activity, which may have positive or negative effects on other economic agents (household or firms). The argument is simple: an economic agent is generating an externality through the process of producing (e.g., fossil-fuel based energy) or consuming a good (e.g., fossil fuels) or service. Since the production of the externality has no price, the environmental costs, associated with the consumption or production activity, are not fully internalized by the economic agent responsible for the activity. As a result, the polluter passes the environmental cost of doing business on to society.
Fossil fuel subsidies	Fossil fuel subsidies are policy instruments that target fuels directly, or electricity and heat generated from fossil fuels through monetary transfers, lowering the cost of fossil fuels and/or energy. These have many effects that impact carbon emission reduction objectives. Fossil fuel subsidies can have significant effects on overall economic choices and a country's financial position. By incentivising the use of fossil energy sources, they contribute to global warming, environmental pollution, and other environmental problems, all of which can have significant economic consequences. Various definitions of fossil fuel subsidies have been elaborated by the World Trade Organization (WTO), the Organisation for Economic Co-operation and Development (OECD) and the International Energy Agency (IEA). These definitions depend on the form of policy intervention by governments (WTO, OECD), or the effect of some of these measures on costs and prices (IEA).

Fossil fuels	Carbon-based fuels from fossil hydrocarbon deposits, including coal, peat, oil, and natural gas
Fuel Approach (to carbon taxation)	The Fuel Approach is the predominant method of carbon taxation around the world. It involves taxing fossil fuels, primarily oil, gas, coal, and their derivative products, and setting the tax rate based on the carbon content of the fuel. The key to this approach is that carbon emissions are closely related to the carbon content of a specific fuel, therefore emissions from fuel combustion can be determined accurately by standardized carbon emission factors.
Green tax shift	See "Environmental fiscal reform".
Greenhouse gases (GHG)	GHGs refer to CO2, nitrous oxide, methane, ozone and chlorofluorocarbons occurring naturally and resulting from human (production and consumption) activities and contributing to the greenhouse effect (global warming).
Indirect Tax	An indirect tax is levied on specific goods or the provision of services and is collected and paid to the tax authority by an entity in the supply chain (usually a producer or an intermediary such as a retailer). There are basically two kinds of indirect taxes: sales taxes or value added taxes and excise taxes on specific goods or services. The former is typically imposed in addition to a sales tax or value added tax.
Installation	A structure intended for use in the manufacture or processing of products involving systematic labour or habitual employment, and where products are habitually or customarily processed or stored.
Marginal social cost of pollution	The additional (marginal) cost imposed on society from the externality produced by the production of an additional unit of output.
Market-Based Policy Instruments	Policy instruments that use markets, prices and/or other economic variables to provide incentives for economic agents to reduce or eliminate environmental externalities.
Measurement, reporting and verification system (MRV)	For the purpose of this Handbook, MRV refers to an integrated and comprehensive system of assessment and report of emissions.
Nationally Determined Contributions (NDCs)	See "Paris Agreement".
Offsets	See "Carbon offset".
Offset allowances	In some carbon taxing schemes, offset allowances enable liable entities to reduce their tax payments by investing in carbon mitigating activities outside the scope of the tax. See also "carbon offset".
Output-based rebates	Output-based rebates are the reallocation of carbon tax revenues collected from a sector to the firms within the same sector, based on their share of domestic production. This is another way to protect firms while still providing incentives for emission reductions.
Overlapping policies (with respect to a carbon tax)	In the context of a carbon tax, an overlapping policy can be described as any policy which has similar objectives to the carbon tax, but unnecessarily raises the total social costs of achieving emissions reduction, thus creating cost-inefficiencies and, potentially, parallel carbon pricing.

Own-price elasticity of demand	The own-price elasticity measures the percentage change in the demand for a good or service following a percentage change in its price. A high (absolute) value indicates that the behavioural response to a given price change will be large, a small value indicates that it will be small. See also "price elasticity".
Paris Agreement	The Paris Agreement on climate change was adopted by United Nations Member States at the 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) held in Paris, France, in December 2015. The Paris Agreement brings, for the first time, all nations together to undertake ambitious efforts to combat climate change and adapt to its effects. Its central aim is to "strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius." Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change, and all parties to put forward their best efforts through Nationally Determined Contributions (NDCs). The Paris Agreement broadened the scope of tools available for Member States to address carbon emissions specifically and climate change more generally — tools that include green financing, trading in green bonds, and regulatory and fiscal instruments.
Period to file the tax return	The period to file the tax return refers to the regular dates for its presentation, and determination in case the activity starts later or finish earlier.
Pigouvian tax	A Pigouvian tax is a tax levied on an agent causing an environmental externality (environmental damage) as an incentive to avert or mitigate such damage. The tax rate of a Pigouvian tax should be set equal to the marginal social cost of the pollution, thus increasing the price for the activity causing the pollution and reducing its demand.
Point of regulation (in the context of carbon taxation)	The point of regulation refers to the moment when the tax authorities regulate the taxable event.
Policy interactions	Policy interactions refer to how policies, that may or may not have been conceived as a package, achieve their objectives in the context of other relevant policies or instruments.
Polluter-pays-principle	The polluter-pays-principle is a core principle of environmental policy discussed in this Handbook. It promotes the internalisation of environmental costs using economic instruments, considering the approach that the polluter should, in principle, bear the cost of pollution, rather than shift the cost of pollution to the community.
Price elasticity of demand	Price elasticity of demand measures the percentage change in the demand of a good or service, following a percentage change in in its price (own-price elasticity) or in the price of a different good or service (cross-price elasticity). See also the definition of "own-price elasticity of demand". Price elasticities are determined by various factors, including the untapped potential for using fuels more efficiently and the cost of tapping it, the availability and price of substitutes, and consumer knowledge. Hence, the price elasticity of demand can vary over time and geography, as well as by income level or even with the price of the good itself.

Price takers/ price setters	Firms that produce a homogeneous product for an international market are normally price-takers, and they will not be able to pass the additional costs from taxation on to customers. Under these circumstances, an increase in production costs risks reducing domestic firms' market share. The competitiveness of such firms is likely to be more affected by a carbon tax than firms with a lower energy intensity and trade exposure. In jurisdictions where exporting firms constitute an important part of the economy, there may also be concerns over impacts on aggregated economic indicators such as total factor productivity, investments, employment, and output. Firms that can transfer a significant portion of their costs through prices without losing market shares are known as price-setters. They are, in general, more likely to be less exposed to competitive effects. Knowing ex-ante which firms and sectors are more vulnerable requires a careful assessment, since it depends on the circumstances in each specific jurisdiction. There is no straightforward way to determine the vulnerability of a given firm or sector, but various measures of trade exposure and emission intensity are often used to identify which are likely to be negatively affected.
Principle of prevention	The principle of prevention is a core principle of environmental policy discussed in this Handbook. The principle of prevention provides that States have the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States.
Principle of common but differentiated responsibilities	The principle of common but differentiated responsibilities is a core principle of environmental policy discussed in this Handbook. It assumes that all countries are to share the responsibility for avoiding environmental degradation, but with differentiated levels of engagement depending on their social and economic development.
Principles of environmental policy applied to carbon taxation	When introducing carbon taxation, policymakers are (implicitly or explicitly) applying four core principles of environmental policy, even though they might not be stated in national legislation. These principles are (i) the polluter-pays principle; (ii) the preventive principle; (iii) the precautionary principle; and (iv) the principle of common but differentiated responsibilities.
Refiner collector (carbon tax in British Columbia, Canada)	In British Columbia (Canada), the tax becomes liable for payment down in the distributional chain, by enlisting the fuel distributors as tax collectors. First-time manufacturers or importers of a fuel must be appointed as a "refiner collector" for each fuel type they sell. They generally remit a security to the provincial government, and are reimbursed as fuel is sold through the supply chain until the tax is borne by end purchasers. The British Columbia scheme allows for fuel sales between refiner collectors and natural gas sales to be exempt from security.
Regressivity (regressive tax)	A regressive tax increases the burden on low-income groups relatively more than those with higher income. Its opposite would be a progressive tax, which increases the tax burden on high-income groups more than on low-income groups.
Sales Tax	A sales tax or value added tax is an ad valorem tax that is proportional to the price of the good, generally applied to all sales occurring in a jurisdiction.
Secondary legal acts	Depending on the jurisdictions, refer to rules, regulations, standards, information, or other legal precisions that derive from executive bodies to comprehend, interpret and/or operate laws passed by legislative bodies.
Social Cost of Carbon (SCC)	An estimate of the monetary value of the damage environmental, economic, health-related, and social—generated by the emission of an additional (marginal) carbon, and borne by society.
Subnational levels	Refers to government bodies at the local, regional, or state level.

Tax administration authority (in the context of carbon taxation)	The tax administration authority is the public body charged with administering the tax or overseeing its administration. Usually this is the tax authority, but in the case of the Direct Emissions Approach, the role of environmental agencies will be especially important in verifying and controlling the emissions data submitted by the tax liable facilities.
Tax base (in the context of carbon taxation)	The tax base defines what is to be taxed and determines the different approaches to carbon taxation discussed in this Handbook. This is a design choice, but it also has relevance for the administrative burden and tax rate. In the case of the Direct Emission Approach, the tax base is emissions, usually CO2, but it can be broadened to other GHG emissions. In the case of the Fuel Approach, the tax base is fuels that give rise to CO2 emissions when combusted.
Taxable event (in the context of carbon taxation)	The taxable event refers to the occurrence of the event that makes the tax due. In the case of the Fuel Approach, the taxable event can be the import, sale, or consumption of the fuel volume. In the case of the Direct Emission Approach, the taxable event is when emissions occur. In the first case, the point of regulation may vary, but in the second, the point of regulation must be now of the emissions.
Tax rate (in the context of carbon taxation)	The tax rate refers to the rate or price carbon emissions costs will be set at. This is usually determined in the legislation. In the case of the Direct Emissions Approach, the rate is fixed by the legislation; in the case of the Fuel Approach, the carbon emission rate is translated into the carbon content of fuels, so the tax rate will vary by fuel type and volume depending on the pre-established amount of CO2 emissions released to the atmosphere when a specific fuel type is being combusted.
Tax shifts	Changes in the structure or rate of taxes. See “environmental tax reform”.
Tax warehouse	In some countries (e.g. Sweden and Norway), the production or import of taxable products must be carried out by an entity which has been approved by the tax authorities, known as an approved tax warehouse. Tax liability occurs when the goods leave the tax warehouse. An importer can register as a tax warehouse and store the fuels without paying tax until the product leaves. The warehouse keepers are obliged to store fuels in specific premises, which need to be approved as storing facilities (tax warehouses) by the tax administration. The tax authorities decide if a company may be granted a warehouse keeper status, depending on several criteria, the principal of which is economic situation, and being able to put forward a sound and reliable business idea. This system reduces the administrative burden by allowing the authorities to control a small number of liable taxpayers. The possibility to register as taxpayers in Sweden has also been extended to large consumers, normally engaged in industrial activities. They can store fuels under the tax suspension regime and declare the tax once the actual consumption has occurred, thus avoiding negative liquidity effects.
Taxpayer (in the context of carbon taxation)	The taxpayer is the economic agent that pays for the tax. Note that this is not necessarily who bears the burden of the tax. The taxpayer must be clearly identified and regulated. In the case of Direct Emissions Approach, the taxpayer is the facility that generates the emission. In the case of the Fuel Approach, there may be some flexibility as to whom the taxpayer can be. For example, Sweden has limited the administrative burden of charging multiple taxpayers by registering tax warehouses who should pay the tax to the authorities.
Technological abatement	The introduction of a new technology or practice that can reduce emissions without changing the fuel source; for example, a car with a more efficient engine with more mileage per litre or gallon of gasoline.
Trade exposure	Trade exposure refers to the ability of a firm or sector to pass on costs to the consumer without significant loss of market share, and hence their exposure to carbon prices. Trade, or the potential to trade, allows competition between producers in different jurisdictions and therefore exposes firms subject to the carbon tax to competition from firms not subject to a carbon price (or subject to a lower price), thereby limiting their ability to pass through costs.

Two-level tax system	Different carbon tax rates apply to different parts of the economy, and such a system is easier to administer than lowering the tax rates for individual sectors and companies in the economy.
Upstream point of regulation	Regulation at the beginning of the production process.
Value Added Tax (VAT)	See "sales tax".
Vulnerable industries	Industries that are especially affected by carbon taxes or other regulatory measures.

UN Tax Committee

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