Handbook on Carbon Taxation – Chapters for discussion

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Chapter VII: Designing a Carbon Tax

Motives for introducing carbon dioxide taxation, commonly referred to as a carbon tax, has been discussed in chapter xxx. Once a decision has been made to consider such a tax, the policymaker is faced with a number of choices, see a brief overview in figure below.

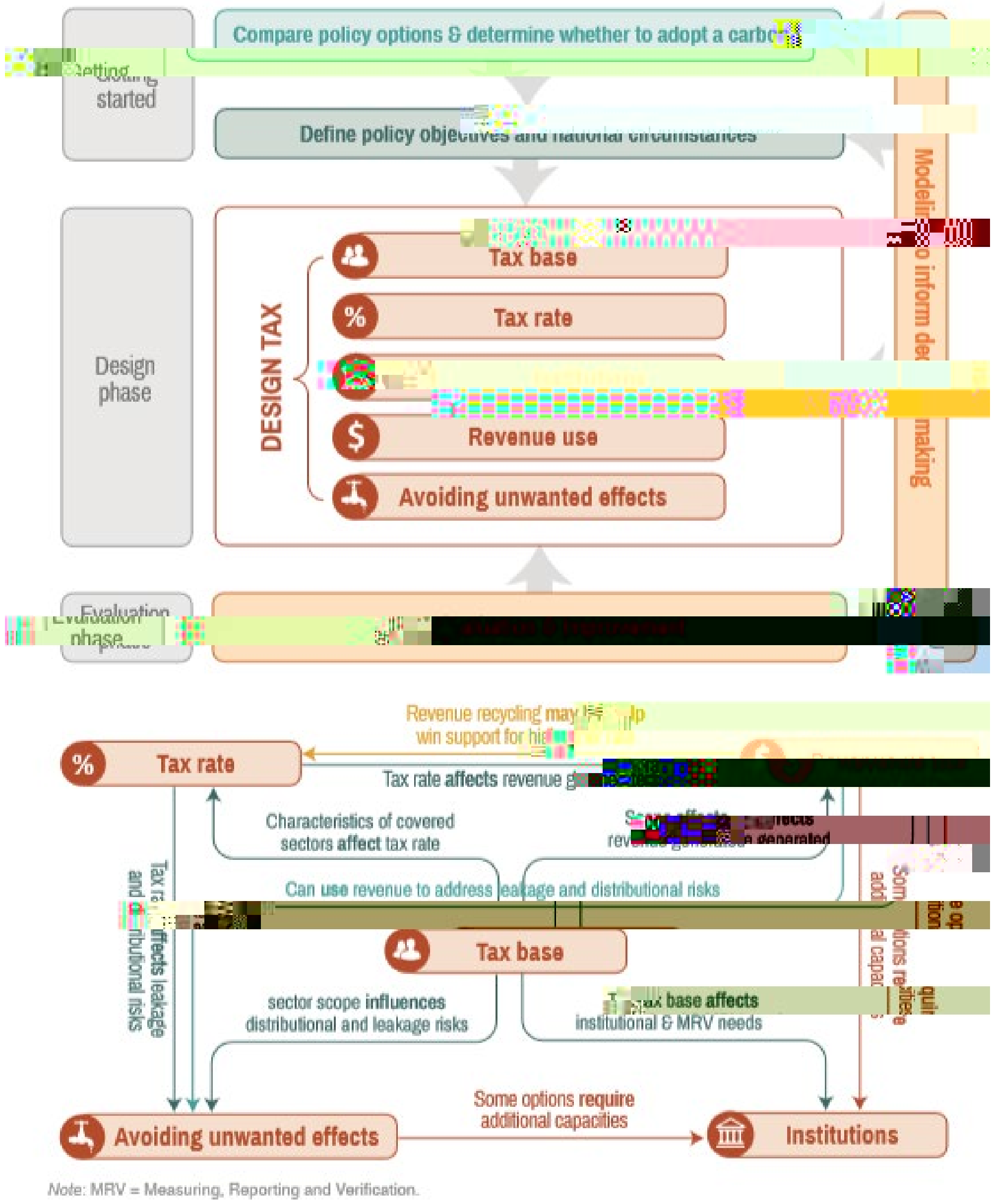

Figure: Stages of Carbon Tax Design and Interlinkages between Design Options
Source: Partnership for Market Readiness. 2017. Carbon Tax Guide: A Handbook for Policy Makers. World Bank, Washington, DC.

[Figure provisionally placed in this section; however, as it shows the whole process of designing a carbon tax, it might be moved to an earlier chapter (for example the conceptual framework) and referred to here.]

7.1 Taxing power *[Draft in progress]*

7.2 Scope of the carbon tax and defining the tax base *[Draft as of 28 March 2019]*

7.2.1. What are we going to tax?

The simple answer, to the question of what we are going to tax, is emissions of carbon dioxide. Carbon dioxide amounts to roughly 80 per cent of the total greenhouse gas emissions (GHG) emitted globally and already this fact speaks highly in favour of starting out by focusing taxation on these emissions. This limitation as to the type of emissions to be covered in this handbook has already been set in chapter II.

Figure Global Greenhouse Gas Emissions by Gas [to be updated with more recent graph and figure]

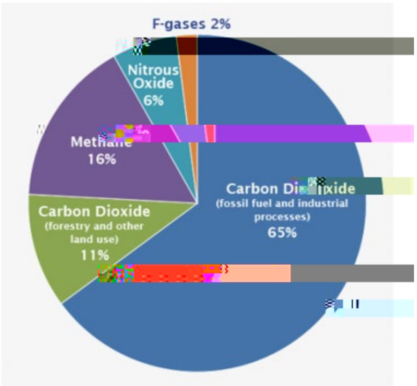

Figure: Global Greenhouse Gas Emissions by Gas
Source: IPCC 2010.

Carbon dioxide enters the atmosphere mainly through burning of fossil fuels (such as coal, natural gas, and oil), solid waste, trees and wood products. Carbon dioxide is removed from the atmosphere when it is absorbed by plants or in ocean waters as part of the biological carbon cycle or artificially in a framework of carbon capture and storage. Taking these facts into account, there are two basic approaches when considering what to tax. One is focusing on a tax by volume or weight units of the fuels giving rise to emissions when combusted ("the Fuel Approach"), where the tax rate is based on standardized amounts of carbon content in those fuels. The other includes measuring the emissions directly as they occur from the burning of such fuels ("the Direct Emissions Approach"). There are pros and cons with both approaches and the design choice depends on the national prerequisites in a specific jurisdiction. A discussion will follow below, where also examples will be given from tax systems currently in force in different jurisdictions.

While carbon dioxide by far accounts for the vast part of greenhouse gases emitted from combustion of fuels and thus merits the focus of this handbook, also smaller amounts of nitrous oxide and methane are emitted during the combustion, depending on the type of fuel and method of combustion. Emissions of other greenhouse gases than carbon dioxide can be converted into carbon dioxide equivalents (CO_2e) to enable a comparison between the emissions and some jurisdictions using the Direct Emissions Approach in their carbon tax

7.2.2.2 What fuels can be taxed with the Fuel Approach?

Box: Examples of fuels subject to a Fuel Approach carbon tax in different jurisdictions

Seven states in the European Union have introduced national carbon taxes covering all motor fuels, coal and the bulk of commercially available liquid and gaseous fuels used for heating purposes. The carbon tax has been added to an already existing general excise duty scheme, either as part of the general excise duty or as a separate tax.

For various reasons, countries may choose to only tax certain fuels. Iceland only taxes petrol, diesel and heating gas oil. In India and the Philippines only coal is taxed, while Mexico taxes coal and petroleum products (not natural gas) and Costa Rica all fossil hydrocarbons. On the other hand, natural gas as motor fuel and coal are exempted from the carbon tax coverage in Colombia. The carbon tax in Argentina covers all major fossil fuels used in motor fuels or for heating purposes with the exemption of natural gas and liquified petroleum gas used for heating purposes.

Basing carbon taxation on fuels has the administrative advantage of being able to use the general system of fuel taxation. Such systems already exist in some form in many jurisdictions. The naming of this instrument may vary between jurisdictions – tax, excise duty, levy being the most common ones.

For the Member States of the European Union, there is a harmonized tax framework for taxation of fuels,[2] which the EU Member States are obliged to follow in their national tax implementation. This means that the seven EU Member States which have chosen to introduce a specific carbon tax are 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. The current EU framework does not oblige the Member States to levy a carbon tax, but if a Member State decides to introduce such as tax it is considered as a duty covered by the harmonized EU tax framework.[3]

The EU Member States which have introduced a carbon tax have generally added it to an already existing general excise duty (sometimes referred to as an energy tax), either as part of the general excise duty (e.g. in France) or as a separate tax (e.g. in the Nordic countries[4]). The same situation can apply in non-EU jurisdictions, as taxing energy to some extent has over the years become a common source of revenue raising across the world. There are different

[2] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework foter /T.1 ( )-12.1 (f)13.427 O-4 (l)-

Another approach is to structure a carbon tax to target carbon dioxide emissions regardless of

used to design an administratively simple tax system, which serves the policy purpose of being a cost-effective instrument to reduce emissions.

Most jurisdictions having introduced a carbon tax have relied on emission factors expressed in terms of average carbon content of fuels to calculate the tax. What makes this simple, is that there is a sufficiently close relation between carbon content and carbon dioxide emissions. This major simplification does not imply any large errors in providing incentive to switch fuels to reduce carbon dioxide emissions. Calculations made by Government officials based on the average carbon content of the fuels can determine the tax rates laid down in the tax legislation. No measurements of actual emissions are necessary. A jurisdiction introducing a carbon tax can could thus choose to express their carbon tax rates by volume or weight units (such as litre of petrol or tonne of coal) based on calculations of the average carbon content of the relevant fuel. These are standard trade units and such an approach facilitates tax administration. The method also broadly corresponds to the guidelines countries follow when reporting carbon dioxide emissions to the UNFCCC (IPPC National Greenhouse Gas Inventories).

Hands-on – how to do calculate the tax

It is often relatively straight forward for a jurisdiction to select the appropriate emission factors to be used for the tax calculations (see further box xx below[6]). This is the case if the number of fuel qualities available on the market are limited and it could thus make sense to use an average emission factor for several different heating gas oil products. In general, jurisdictions are taxing the fuels only when they are used as motor fuels or for heating purposes, not when the fuel product is used for non-combustion purposes – such as coal or natural gas being a necessary component in certain industrial reduction processes or coal used in purification filters. However, the calculation method as such does not prevent taxing also the fuel products when used for such purposes.

To facilitate the understanding of implementing a carbon tax, an example is given in the box below of how to calculate a tax rate per litre of petrol, by way of the prevailing method used by jurisdictions having introduced a carbon tax.

[6] Carbon dioxide (CO_2) emissions can be expressed in kg/MJ since it is assumed that all the carbon content is transformed to carbon dioxide after combustion (complete combustion in dry air). The carbon content of the fuel is known. The emission factor is calculated by dividing the carbon content of the fuel (e.g. per m^3) with the percentage of carbon in carbon dioxide. The percentage of carbon in CO_2 is 27 per cent and is calculated by dividing the molecular weight of carbon with the molecular weight of CO_2. Since all carbon content in the fuel is assumed to be converted to CO_2, the same amount of carbon is present in CO_2 after combustion as in the fuel before combustion.

Table. Some pros and cons of different methodologies to calculate the tax

the carbon tax legislation. These issues are of interest to authorities set to administer the carbon

However, we are refraining from using this terminology as it risks adding to confusion, especially as these terms may have different meanings when used in different contexts.

A general principle for carbon tax systems levying a certain tax amount on fuels by weight or volume unit, is that the fuels shall be taxed at the time of when the fuels enters the economy. This normally coincides with production or importation. A strict application of such a system is illustrated in figure xx below and it may be a good starting point for a country which already administers some other kind of excise duty on the taxable fuels or has no prior experience of administering excise duties.

Administrative simplicity along with good possibilities for tax control are key issues to consider. Keeping the number of tax payers to a minimum is another aspect to keep administrative costs low, which often is desirable to the authorities as well as to the tax payers. One option would be to establish a tax collection point very early in the fuel distribution chain, that is the point of extraction (such as coal mine, oil drill, natural gas pipeline) or importation. Choosing a taxation point at importation would also have administrative advantages, as the tax collection can be combined with the collection of applicable customs duties to be paid upon importation. Further, a resource-rich country can choose to let the tax, at least from the start, be levied at the point of extraction, while a resource-poor country may feel it appropriate to start with only taxing fuels at the point of importation.

However, while choosing a tax point as illustrated in figure xx could offer administrative advantages in terms of a relatively few tax payers and better opportunities to conduct an effective tax control, there are also some other aspects to consider. Crude oil and natural gas largely dominate the imports of fuels to 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.). Although, here Colombia offers an interesting example.

Example Colombia's Carbon Tax[9] *[May be put in a box]*

Colombia introduced a carbon tax in 2017.

Coordinating tax collection with other tax objectives, such as import duties, could facilitate tax administration. For a country choosing to collect a carbon tax upon importation, to coordinate the collection with the collection of import duties due on the taxable fuels. Although not being

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consumption involves a tax exempted area of activity this means that the tax payer declares zero tax, thus avoiding negative liquidity effects for the company which would have arisen if the company would have had to buy the fuels at a price including the tax and ask for a tax reimbursement after the consumption has taken place. A non-tax payer would have bought the fuel at a price including the tax but can, if being eligible for a tax rebate, ask for a reimbursement of the tax paid.

The Swedish carbon tax is collected in the same way as the energy tax applicable to fuels. This means that the administrative costs can be kept low, both for the tax authority and for businesses. The administration costs for the tax Authority amounts to 0,1 per cent of the total for charging the tax to purchasers upon sale. Like the EU rules, the British Colombia scheme allows for sales between registered dealers or vendors without tax becoming chargeable.

When a carbon tax is based on the Direct Emissions Approach

A carbon tax based on a Direct Emissions Approach requires the measurement or estimation of actual emissions at the source. Therefore, the tax payers are likely to be th

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

In the case of a carbon tax, the tax incidence depends on whether the entities obligated to pay the carbon tax can pass it on to consumers or not. If the entities can raise the product price to compensate for the full amount of the tax, the whole tax incidence can be considered to fall on the consumers. In this discussion, it is important to emphasize that changed consumer behaviour is needed for the tax to fulfil the purpose of reducing emissions. If the product price is not raised the producer will bear the full incidence of the tax, the consumption will remain unaffected and the emissions of carbon dioxide will not be reduced.

There are several important issues to consider in this discussion. For instance, if a price regulation exists, the entities might not have the possibility to increase the price to pass on the burden of the tax. In this case the tax burden falls on the entities, reducing their profits. A carbon tax under these circumstances will not reduce emissions in the short term, but f8eh(e)4 (1e)4 (uT 1 a broader carbon tax will typically provide more opportunities and thus a more efficient emission reduction. Circumstances will differ between jurisdictions and the most suitable coverage of the carbon tax will depend on a range of factors, including e.g. the emissions profile of the jurisdiction; other relevant tax policies; the structure of key sectors; and government capacities for administering the tax. To attain emission reductions, it is important to analyse what reductions are possible to achieve in the targeted sectors, and to what costs.[14] *[This section will be expanded in a later version of the draft]*

7.2.4.1 Theory and practice

Although economic theory suggests a uniform carbon tax with wider base in terms of its coverage would be the most efficient design, concerns commonly raised among stakeholders that additional tax burden would lead to adverse effects on the competitiveness of domestic industries –

Table Carbon pricing mechanisms in selected countries

Country

		compared to natural gas			
South Africa	2019	The South Africa carbon tax is scheduled to come into effect by June 1, 2019.	80 %	The South Africa carbon tax applies to GHG emissions from the industry, power, buildings and transport sectors irrespective of the fossil fuel used, with partial exemptions for all these sectors.	For many sectors tax exemptions starting from 60 per cent up to 95 per cent 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 per cent offset allowance to reduce their carbon tax liability.
Further examples…					

Source: The World Bank *Carbon Pricing Dashboard*

7.2.4.2 Policy options to address concerns over competitiveness, carbon leakage and distributional effects

There are several policy options that seek to address concerns related to the potentially adverse effects of a carbon tax, see table below. The most popular set of policies focus on different types of *carbon tax payment reductions* lowering the effective carbon tax via exemptions, thresholds and reduced rates. Another set of policies in use include different *support measures* to affected firms or sectors: output-based rebates or targeted support for resource efficiency and cleaner production. Also, non-carbon tax reductions can be included in this group of measures. A third category of policies consists of *trade-related measures*, such as border trade adjustments, consumption-based taxation and international cooperation. International experiences from this latter category is however limited, and it is in this discussion vital to review the relationship between potential border tax adjustment measures and WTO requirements.

Whereas the first two categories consist of measures that address both leakage and distributional risks, measures in the third category focus primarily on leakage risks only.

Table Overview of Measures to Address Leakage and Distributional Effects

Category

(Non-carbon) tax reductions	Retain price signal Potential for net

International cooperation	Retains domestic price signal Leverages domestic carbon price to encourage carbon pricing in partner jurisdictions No domestic administration needs	Difficult to negotiate

Box: Country examples of carbon taxes being introduced and developed as part of a larger tax reform

Examples to be added: E.g. Sweden and examples from Latin America (Argentina, Chile, Columbia, Mexico), others?

7.2.4.4 Introducing a carbon tax: Two-level tax systems and setting of thresholds

To date, a carbon tax has been implemented in close to 30 national or subnational jurisdictions with different tax approaches to protect competitiveness and address distributional risks. A two-level tax system, and/or the adoption of thresholds are two examples of exemptions that can be found in many jurisdictions.

In a *two-level carbon 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 in the economy. A two-level tax system can be a feasible design leading to over-all better environmental results, as the politically acceptable alternative could be a general carbon tax for all operators set at low level to protect the domestic industry, which is subject to international competition.

Box: Country examples of a two-level carbon tax

When designing the Swedish carbon taxation system, two carbon tax levels were introduced. This was to avoid negative effects to the domestic industry and carbon leakage. 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

7.2.5.1 IPCC Climate Change Emission Reporting

The current IPCC Intergovernmental Panel on Climate Change emission reporting[16] is done based on emissions from combustion of fossil fuels and the IPCC has stated that 75 per cent of the changes in the temperature in the atmosphere during the past 25 years relates to the combustion of fossil fuels. The remaining 25 per cent is due to changes in land use, primarily deforestation. Using biomass energy is not contributing to an increased atmospheric temperature, when biomass is continuously being rebuilt to an extent that in the long run corresponds to the emissions occurring at the combustion of biomass. By calculating a carbon tax on the content of fossil carbon in the fuels, the Polluter Pays Principle (PPP) is fully integrated in the design of the tax. It would not make sense to levy it generally on the carbon content of fuels, as this would not be an instrument targeted to reduce fossil carbon dioxide emissions. As only fossil fuels result in net increases of carbon to the atmosphere, such a tax helps to reduce the use of fossil fuels and thus reach set global climate targets.

Sweden is among those countries where the principle of not subjecting biofuels to a carbon tax has been prevailing since the introduction of such a tax back in 1991. A restriction to applying this principle only to biofuels fulfilling certain established sustainability criteria has since been introduced, following mandatory EU legislation. The reasoning behind the Swedish approach is – in line with the theory just outlined – that combustion of sustainable biofuels does not result in a net increase of carbon in the atmosphere and hence are not subject to carbon taxation. However, applying a carbon tax only on fossil emissions is not a Swedish invention. The EU has set climate targets and work is globally carried out based on the 2015 Paris Climate Agreement. Only consumption of fossil fuels increases the net emissions of carbon and therefore, there is a need to strive towards reducing the global use of fossil fuels.

7.2.5.2 Low blends of ethanol and biodiesel into petrol and diesel

While the general principle of only taxing emissions from fossil fuels seems to be prevailing in jurisdictions having introduced a carbon tax, some simplifications have been made for administrative reasons. This means that low blends of ethanol into petrol and FAME (biodiesel) into fossil diesel in many countries are taxed by the same rate per litre fuel, as if the fuel mixture would have been of 100 per cent fossil origin. This is particularly true if countries have introduced another economic instrument, such as a quota obligation scheme, to ensure certain amounts of biofuels on the market. Almost all EU countries have now introduced national quota systems for biofuel blending into petrol and diesel and this has normally meant that the excise duties on petrol and diesel are the same, regardless of the content of biomass fuels in the

7.3 Tax Rates *[Draft as of 1 April 2019]*

7.3.1 Introduction

Implementing a carbon tax is a learning by doing process because the impacts of the tax are difficult to predict in advance. Hence, it is better to start a carbon tax at any level before waiting any longer, because it is not necessary to find an accurate tax rate right from the beginning. However, if the desired goal will not be reached after a certain period it is crucial to adjust the tax rate. Therefore, the tax rate needs an adjustment, if a specific reduction goal was not achieved during the past period. This trial-and-error approach could help to increase the accuracy of the tax rate. There are also economic theories and approaches that could be used in determining the tax rate.

Setting the rate of a carbon tax is an essential decision when designing this tax. The level of the tax rate has direct implications for both its effectiveness the economy as it influences market prices. As a consequence, setting the tax rate merits careful consideration and this chapter will point out key aspects to consider when making this decision.

Figure XX: Prices in implemented carbon pricing initiative
Source: World Bank, Ecofys (2018). *State and Trends of Carbon Pricing 2018.* © World Bank. https://openknowledge.worldbank.org/handle/10986/29687 License: CC BY 3.0 IGO.

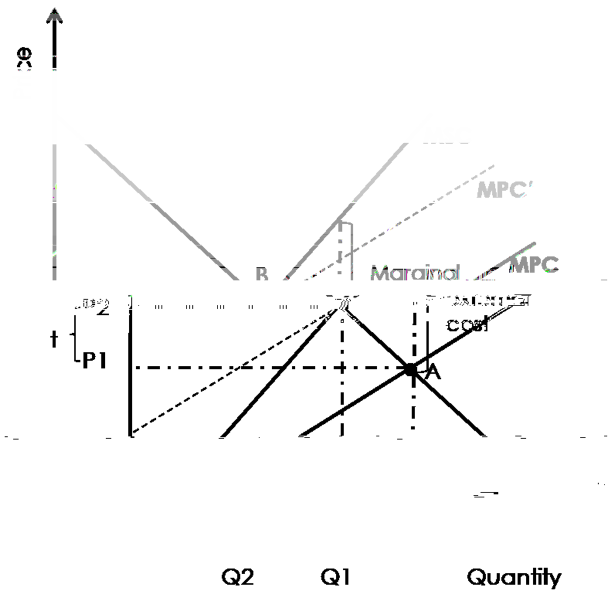
The figure above shows carbon tax rates in force in 2018. Thus, examples of various policy strategies followed by different jurisdictions can be seen from the figure. The variety of tax rates in force ranges from less than one US $ / tCO2e to over one hundred dollars. It is worth remembering that the higher tax rates currently applicable in some jurisdictions were not set at once, but rather achieved in a step-

However, in order to reach the temperature target agreed upon by the Paris Agreement, the High-Level Commission on Carbon Prices proposed a carbon price of at least US $ 40 – 80 / tCO2 by 2020 and US $ 50 – 100 / tCO2 by 2030. A brief comparison with the current state of the art of carbon taxation will show that these are quite high prices to achieve in a relative short time period, which is why it is important to start right away. However, even low initial tax rates can serve as a starting signal, since the tax rate can be adjusted to a level, which is in line with environmental targets after its implementation. Therefore, getting the system started with a low initial carbon tax rate could create the basis for a – from an environmental perspective – successful carbon tax.

action. Thereby, the tax equalizes the costs of an economic actor (private costs) to the costs of society (social costs). As a result, the polluters finally bear all costs occurring as a result of economic actions.

According to economic theory, the tax rate of a Pigouvian Tax should be set equal to the marginal social cost of the pollution. This marginal social cost of pollution represents the damage that occurs by producing an extra unit of a specific good (e.g. one-ton CO2). In consequence, the price for the activity causing the pollution which is responsible for the external effects will rise. This results in a situation where the demand for the underlying activity decreases as a result of higher prices.

Box XX: Technical Note: Pigouvian Approach



Source: Kettner-Marx/Kletzan-Slamanig 2018

The graph illustrates the working of a Pigouvian Tax. The horizontal axes represent the amount of output produced by the polluting factor. The vertical axis represents the market price. The marginal benefit curve (MB) measures the marginal benefit (benefit from the production of each additional unit) which arises for society for each level of production. The marginal private cost (MPC) represents the marginal costs (costs of each additional unit) which can be attributed to the producer. Finally, the marginal social costs (MSC) measures the marginal costs (costs of each additional unit) for the society. The MSC are 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 market intervention. However, point A is not optimal for society as its costs are not considered completely at the level of the producer. As a result, the costs exceed the social benefit. In order to correct 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

Nordhaus' model is

Source: Andersen, M. & Dengsøe, N. J Mater Cycles Waste Manag (2002) 4: 23.

Thus, implementing a carbon tax is a learning by doing process because the impacts of the tax are difficult to predict in advance. However, adjustments are crucial, if a specific reduction goal was not achieved during the past period. Therefore, a trial-and-error approach could help to increase the ecological effectiveness of the tax. This policy could overcome economic modelling limitations, by following a trial-and-error policy. Although the Standard Price Approach helps to overcome economic limitations, the approach seems to be difficult to implement in practice. As politicians must follow this approach over several periods.

7.2.2.3 Revenue Target Approach

Different policy objectives may encourage jurisdictions to implement carbon taxes. Besides environmental considerations, the main motive for some jurisdictions to implement carbon taxes is to generate considerable tax revenues. In 2018, the total value of all carbon taxes and ETSs which are worldwide in force was US $ 82 billion, which represent a 56 % increase compared to the 2017 value of US $ 52 billion. In British Columbia, the carbon tax amount to 3 % of the province`s budget. Therefore, carbon taxes could serve as a substantial source of government revenue, which could be spend in different ways. One example would be to spend the revenue on social programmes for poor households (bon t) B -2.16 T rj-o(on, w)2 &o-8 (i)- ($)-14 0 T

Box XX: Price Elasticities

In order 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 price elasticity measures the responsiveness of the demand after a change in the price. Studies have shown that the price elasticity of fuels is relatively inelastic in the short-term. This means that the demand responds disproportionately low to changes in the price. This is partly due to the fact that emitters can hardly change their habits in the short term. However, in the long-term, studies have shown that the elasticity is higher, which means that the demand responds to price changes (Abenezer Zeleke, A., 2016).

Economists need this data to calculate and estimate a tax rate, which generates a targeted level of revenue. However, it is unrealistic to predict the tax revenue of a specific tax in advance. This is one of the biggest downfalls as the revenue target approach is quite complex. Therefore, it is arguable that the revenue target approach is not appropriate for jurisdictions with a lack of resources, which are planning to introduce a carbon tax, because of its high degree of complexitypl g the ofZria2 (yp(e)4 (tg)10E)-2 ieheiat. (h i)-t(t)-12 (ypl)-(i)-.48 bo Tentrcqua2.01 Tc -24.0w

Finland	70.64
France	50.81
Japan	2.56
Mexico	2.73

level of competing jurisdictions in order to reduce the risk of carbon leakage. Political concerns regarding carbon leakage and competitiveness are in practice key factors for setting the tax rate. Thus, setting a carbon tax rate is finally a political decision. For example, the initial tax rate for the Norwegian carbon tax rate was entirely based on political negotiations. Furthermore, the political landscape in a jurisdiction is crucial in the decision-making process. Policymakers should accompany the political decision-making process by providing economic input and data. This input could be based on the benchmark approach as well as on the other approaches covered in this report. However, the choice of methodology is not important as long as the carbon tax policy is developed and deployed over time until it gets to a level that is sufficient to meet the Paris Agreement commitments is depeement (P)-4 a/ d. p6MD 1 ⊁(t to)M1 (at)--6 (c)4

The economy would have more time to invest in alternative and environmentally friendly technologies and would not face major economic shocks.

For example, British Colombia followed a ramp up strategy. British Colombia introduced a carbon tax at a rate of CAD $ 10 / tCO2 in July 2008. The province then gradually increased the tax rate within the next four years per CAD $ 5 each year, reaching its target level at CAD $ 30 in 2012. Another approach is taken by France, which introduced a carbon tax in 2015. Thereby the legislator determined the rising tax rate for each year up to 2021 when it will reach € 56 / t CO2. The French legislator also defined the tax rate for 2030 at € 100. The tax rates between 2021 and 2029 are not defined yet, which leaves the legislator room to respond to economic developments. Singapore has also implemented a carbon tax with an initial tax rate of S $ 5 / tCO2 in 2019. The intention of Singapore is to increase the tax rate gradually to S $ 5 - 10 / tCO2 in 2030. It is not necessary to define the exact trajectory to a specific tax level. However, it is from an environmental point of view important to define the future targeted tax level when introducing a carbon tax. Only then, emitters will respond to the future carbon price from the beginning of the implementation of the carbon tax. A gradual increase of the carbon tax rate seems politically desirable, as it is easier to gain political support for a gradual implementation. Nevertheless, the ramp up strategy has also notable risks. First, the environmental effect is limited in its initial phase, due to relatively low tax rates. Second, low initial tax rates may stick due to political considerations.

Therefore, jurisdictions may decide to follow strategy static carbon tax rate, which means that the carbon tax rate stays the same after its introduction. The biggest advantage of a static carbon tax rate is that it maximizes the anticipation effect of the carbon tax: If the carbon tax would be implemented without a ramp up strategy, emitters will start to adjust their behaviour immediately. Moreover, a static carbon tax rate gives the market a stable and predictable price signal, which facilitates investments. The price stability of carbon taxes is one of the advantages of a carbon tax compared to an ETS in which the price depends on market forces. Consequently, the carbon tax triggers its full impact earlier in time. Therefore, a static carbon tax rate is more effective from an environmental point of view. However, the environmental effectiveness depends mostly on the amount of the tax rate. A low tax rate is not effective from an environmental point of view independent from the policy strategy after its implementation.

However, one argument opposing a static carbon tax rate is that the implementation of a carbon tax can trigger an economic shock in carbon-intense industries or among poor households (see chapter XX). Sudden increases in prices after the implementation of a carbon tax would be the consequence. Emitters would not have time to adjust their behaviour in advance in order to avoid negative consequences for their business. Another argument against a static carbon tax rate is that it may face more political opposition than a ramp up strategy by those who are

past periods on an annual basis. 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. Those committees may only be composed of experts or of various stakeholders, which are involved. For example, Norway is reviewing its carbon tax rate on a yearly basis. During this process, the Norwegian carbon tax rate has been increased over the last years. Also, Ireland reviews the status of their national carbon tax rate on a yearly basis.

Thereby, Ireland reviews the performance of the tax and takes into account international trends of carbon pricing. One advantage of reviewing processes is that it provides for more flexibility compared to a strict adjustment formula. However, annual reviews require also a political process. Therefore, a broad political commitment to the reviewing process could help to shield tax rate adjustments from political interventions. Hence, tax rate changes for carbon taxes should rather be based on environmental than on political considerations in order to realise the full potential of carbon taxes. Furthermore, overall stable political conditions are crucial for a favourable investment climate in green technologies.

7.3.4 Tax Rates and Country Specific Considerations

Special consideration may occur when setting a carbon tax rate for a specific country because it may not be in a comparable situation with other countries that have implemented a carbon establish an innovative energy infrastructure in a cost efficient and environmentally friendly way. Therefore, carbon taxes can also stimulate innovation, which could create economic opportunities for countries with a variety of different backgrounds. For example, Singapore mentioned the stimulation of low-carbon innovation as an additional objective of its carbon tax. Building a low-carbon infrastructure could help to avoid negative side effects of fossil-based development, such as air pollution, which is a severe problem in some countries.

However, trade-offs between economic development and emission reduction (nd e)4 (m)-2 (i)-2ie(s)-1 (e. (due should not be seen in isolation. Policymakers should balance the different approaches in order to reflect country-specific considerations.

- It does not really matter at an initial stage, whether the price is set at a low or a high level as compared to other countries, or to the international targets. In fact, most countries will start at a low price and increase it over time. What is important is for countries to have well defined carbon pricing policies that they can rely on for the next 10 to 50 years.
- Countries will price carbon according to their historic commitment to pricing carbon. Therefore, being prepared to adopt and commit to a carbon price now may be determinant to the country's furtherance of a higher and more significant carbon tax rate in the middle to long-term.
- However, at the end, setting the tax rate is a political decision. From an environmental point of view, instead of waiting any longer to find the most appropriate tax rate, which will be enormously challenging in practice, a rate

then cooperation with other countries can be pursued and adequately fitted in the existing international system (e.g. exchanging relevant information for tax purposes).

9.2.1 Domestic issues

Tax administrations have a central role in the design of a carbon tax (see chapter 7 for a discussion on design). It surpasses traditional tax schemes focused mainly on discovering/auditing, determining and collecting/recovering the tax debt by including environmental considerations. The adoption of a more extensive approach is now critical. The administrations when exercising their competences should consider, to the extent possible the environmental impacts (i.e. negative or positive externalities) caused by economic activities. The amount of revenue collected should somehow reflect the environmental costs or savings produced.

To achieve this broader objective the existing tax structure can be adapted progressively, considering the administrative capabilities in each organization/agency. National circumstances are influenced by historical evolution. Notwithstanding this, some paths for further administrative development are discussed below.

It may be useful to centre initial efforts on administrative collaboration: from the more technical, through the sector oriented, to the intra-territorial one.

Administrative collaboration may be built up stepwise:
1. Technical
2. Sectoral
3. Intra-territorial

Internally, the collaboration of the tax administration/agency with other financial authorities[23] would be advisable. These responsibilities may be organised differently. In some jurisdictions the tax collection and auditing may be handled by independent tax authorities, while in other jurisdictions those tasks are handled by special sections within the Ministry of Finance. Working hand in hand with the national authority in charge of budgetary administration is of interest in the case of environmental taxes, or other taxes with an environmental incentive (e.g. encouraging certain environment-friendly behaviours in income taxes). It clearly affects two main issues: the determination and assessment of the environmental tax expenditures, and the effect of any implemented earmarking policies.

In addition, it is may be necessary to explore the opportunities to strengthen and develop effective the relations with other administrations with relevant competence. This is especially important if the tax design chosen is the Direct Emissions Approach, where the tax base depends on measured emissions. The strategic partners are those authorities experienced in the sector where the tax is meant to have an impact. This may entail joint work with environmental experts, or even with more detailed areas of specialization: energy, transport, agricultural, timber, housing, waste or health, among others. The interconnectedness of carbon taxation with the goals outlined in the 2030 Agenda is clear, and tax policies are considered supportive of the SDGs if they help realize one or more SDGs without jeopardizing others.

> Example: If the tax is targeting transport fuels, avenues for cooperation can be found in the interaction with port and airport authorities, e.g. Landing and Take-off (LTO manoeuvres) in commercial aviation and possible reductions in case of using winglets (or sharklets).

9.2.1.3 Capacity building

The investment in the continuous qualification of human resources enrolled in the Administration is necessary, promoting new broad views and relational abilities among tax officials. Moreover, the different needs of countries at different levels of development and in diffe isre bbili(l a)-4 (b)2mrer (n)2 e is (r)2.4.1 (l,)2 ((r)2.9 (e)4(bl)2.9 v)-8 (r)5 l(n)2 (a)-4 8 Twilip0.04 a

Here the participation in several specialized fora with a global perspective may facilitate the interaction with other entities (administrations, chambers of commerce, inter-governmental meetings, conferences, academia, etc.). In this sense, regional organizations in the Network of Tax Organisations to enhance the efficiency and effectiveness of tax administrations worldwide and could be useful[24].

It is necessary to identify the existing domestic administrative structures familiarised with taxation and environmental issues, maintaining simultaneously a connection with the

9.3.1 Before implementation

One initial guideline for the development of environmental taxation is simplicity. This value should be defended at every level, being adapted to the different capabilities of Small and Medium Enterprises, or Multinational Enterprises. Keeping in mind the proportionality in the requirements KeisKen measure in place[28]. The convenience of offering an adaptation period cannot be denied (not only for companies, but also for the public administrations involved). Once the determination of the Government to make a move towards the sustainability through green taxation is shown, a sensible calendar for implementation helps in the transition. The changes in the private organizations to fit a new scenario can even be made with the sole official announcement of the implementation of an environmental tax in the following years at the end of the legislature term.

9.3.2 During implementation

The clarity in the designation of the competent authorities, and spreading information about any eventual change affecting them is decisive. The public perception of proximity and transparency may be as important as the content of the regulation itself. A frequent dialogue with the agents may be beneficial to better understand the needs and the improvements made in each specialized sector. Ultimately it can result in a modification to make rules more suitable in accordance with actual business life.

Along the implementation phase, the possible combination with other economic instruments operating in the same field should be considered (e.g. replace or add CO_2 instruments).

9.3.2.1 Tax audit and collection

Another realistic question is how to collect the environmental tax. Thinking about the tax payment is also relevant when implementing the polluter pays principle. Additionally, the compensation for environmentally-friendly behaviours can be anticipated through justified tax expenditures. To make political decisions to that end, gathering precise information is necessary. The tax expenditures may help the introduction of the tax in a soft mode. Later, by reducing them, it can be elevated. Additionally, the tax expenditures may reflect certain valuable contributions made to protect the environment as provided by the legislator, and should be taken into account accordingly by the tax administration when managing the collection process, checking that the justified reduction is applied in a proportionate manner in the tax debt.

A balance should be made with the pros and cons for the administrations and the taxpayers involved in the design phase. Depending on the point of regulation and the tax approach (fuel or emissions) they will face different obligations. If needed, a reporting period can be decided in the tax law or in other relevant regulation issued by the competent authority. It may vary depending on the country's tax traditions (a month, quarter of a year, or even yearly can be considered). Probably, from an administrative perspective and due to some common taxpayers' practice with other indirect taxes (such as value added tax), a periodic tax can be easier to manage through quarterly returns. It allows adjustment to the real circumstances of the activity carried out. I.e. in case of starting the polluting activity after or ending before the calendar year

[28] See also discussion about the proper timing for implementation in chapter 2 (to be written).

a proportional adjustment can be made in the payment finally required. Alternatively, the Government gets revenues more often if it is set monthly, as well as cash flow.

Taxpayers care that the collection system is fair and that evasion is effectively dealt with, as well as whether revenues are used in areas that they value. For example, in Chile, the process has also entailed expanding and strengthening the capacity of environmental agencies, establishing protocols for determining procedural responsibilities, creating more robust information systems, and improving inter-ministerial coordination. The new institutional infrastructure implements the tax in an effective manner and brings with it an institutional shift, allowing the development of new capacities, knowledge, and tools to improve the quality and efficiency of environmental management, which may be used in the future to pursue more sophisticated environmental protection mechanisms.

9.3.3 After implementation

The tax measure applied by the Administration must be subject to a process of monitoring. There might already be suitable systems in place that can be utilised for this, or a review mechanism for evaluation can be established. The authorities in charge to do so and the effects of the review must be stated. This review could even originate an adjustment of the tax rate.

In a process of sustained improvement, not only the auditing of correct data given in tax declarations, but also the checks done by the administrations to deliver better environmental results are monitored by different institutions (such as statistical bodies or departments within the ministries). Therefore, it is important to clarify to whom the tax administration will report on this topic.

For example, where it exists, the Court of Auditors may help with the control of efficiencher16 (he)4 (r16 (h

5. Overall economic efficiency 6. Feasibility

In Chile the new taxes have resulted in the design and construction of a new institutional structure, which includes the implementation of a registration system for sources subject to taxation and a system to measure, report, and verify emission levels. Once the new measures are in place, the government expects continued discussion over future tax increases or other possibilities such as sophisticated carbon pricing instruments like offsets and/or tradable emission permits.

Other delicate issue for administrative consideration is the possibility to enforce the regulation, in economy-sensitive sectors (e.g. mining in certain developing countries). Political considerations may influence the design of the rules, but the technical application must follow the administrative procedures, unless a carve-out clause is inserted. In addition, the regulatory consistency regarding regulations applicable to different sectors is a virtue. See chapter 7 for a discussion on exclusions or phase-ins.

Another topic that deserves a brief mention is the need to open administrative windows for the revision of claims (prior to judicial review), to avoid conflicts that are time and resources consuming.

9.4 Operational hints

9.4.1 Optimize the process of digitalization

efficiencies and save cohe3.9 (s)-5.1 (t)-6 (s)-5 (i)-5.9 (n)-4 (p)-4 (u)-4 (b)-4 (l)-6 (i)-6 (c f)-1 (i)-6 (n)-4 (an)
inequality, once greater traceability becomes feasible in many sectors (regarding consumption

or emissions). To achieve the Sustainable Development Goals, a legitimate and smart use of tax data will be possible.

The role of an integrated digital international tax administration could be devised, exploiting pilot experiences that some regional organizations are currently providing.

At the national level, administrations would need to ensure sufficient investments not only in their own capacities to take advantage of digitalization, but also in ensuring access and inclusiveness of all individuals and businesses.

9.4.2 Enhance Corporate Social Responsibility in the private sector

It is true that the administrative schemes should be proactively adapted and re-characterized to better contribute to sustainability. However, social responsibility is not only a matter of concern for public administrations. Joint efforts are needed and a greater involvement of the private

- Use regional cooperation as basis for joint tax introduction and save on administrative cost and competitiveness concerns.

9.5 Solutions found in a comparative analysis

9.5.1 The Swedish fuel approach

While an assumption could be that a carbon tax needs to include measuring emissions, this is not the case if a carbon tax is designed based on a fuel tax approach (See

9.6 Conclusion

The above-mentioned administrative issues are key to successful implementation of a carbon tax, either following a Fuel or an Emissions Approach. Therefore, policy makers should pay careful attention to the adaptation of the existing organizational structure and invest in improving the capacity of the personnel. This will allow tax authorities to work more efficiently with the other stakeholders in this process towards sustainability.

Carbon taxation promotes positive behavioural changes. An approach involving the whole

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Annex 1 – Economic theory background

A1.1 Pigouvian Approach: Theory versus reality

Although the Pigouvian Approach makes sense from an economic perspective, attention should be paid to several difficulties associated with its implementation. First of all, it is important to define which types of externalities it should be covered (Chapter Tax Base). Therefore, it is important to determine the tax base carefully, as it has a considerable impact on the tax rate. However, the more difficult part is to determine the marginal value of pollution. Assuming that the tax tackling all externalities deriving from CO2, following the Pigouvian Approach means that the rate should exactly represent the MSC of one ton CO2, which occurs at any point in future.

The valuation of externalities will be the most difficult task if policymakers follow the Pigouvian Approach. The MSC of CO2 are usually calculated with Integrated Assessment Models (IAM). Those models combine economic models with climate/environmental related system models. IAM simulates the expected costs along various emission pathways, due to increases in CO2 emissions. The most important IAM are PAGE (Hope 2011), DICE (Nordhaus and Boyer 2013), FUND (Tol, the cumulative predicted emissions abatement at or below any specific abatement costs at a specific point in time. Policymakers may rely on MACC which are published by economists, research organizations or consultancies (Nauclér, T., Enkvist, P. A., 2009). In 2013, the World Bank published a MACC for the power sector of Nigeria, which could serve as a reference MACC for countries with a comparable economic background (Cervigni, Raffaello, Rogers J. A., Henrion M., eds. 2013). However, jurisdictions may also develop own MACC for certain sectors/industries of their economy by estimating the abatement costs of GHG in their jurisdiction.

Figure XX: Hypothetical MACC
Source: Partnership for Market Readiness. 2017. Carbon Tax Guide

Graph 2 shows a hypothetical MACC pathway for a specific point in time. Each bar represents a technology, in which the width is dependent on the annual emissions reduction potential which results from the use of each technology. The bars are sorted from the lowest to the highest marginal

Market forces will make sure that economic actors reduce their emissions as long as their abatement