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Environmental Taxation

Co-Coordinators' Report: Interaction of carbon taxation with other national measures

Proposed Part B: Interaction between carbon taxes and other environmental measures (emissions trading and climate policy)

Summary

At its Twenty-fourth Session, the Committee considered note E/C.18/2022/CRP.9, which, among other things, set out the proposed workplan for the Subcommittee on Environmental Taxation under the current mandate.

Per the Report of the Twenty-fourth Session, the Committee approved the proposed workplan along four broad mainstreams, including the workstream on the interaction of carbon taxation with other national measures – Workstream 1.

At the Twenty-fifth Session, the Subcommittee presented the progress of all the workstreams under note E/C.18/2022/CRP20 the Committee's comment and guidance, including the additional workstream on other environmental taxes other than carbon taxes, which was already contemplated by the mandate.

This note is presented for the **Committee's first consideration and discussion** of Part B (Interaction between carbon taxes and other environmental measures (emissions trading and climate policy) of Workstream 1.

See E/C.18/2023/CRP15 for general details and update on the progress of the other workstreams.

Background

1. At its Twenty-fourth Session, the Committee approved the proposed workplan of the Subcommittee on Environmental Taxation as laid out in E/C.18/2022/CRP.9, which included the workstream on the interaction of carbon taxation with other national measures.

2. At the Twenty-fifth Session, the Subcommittee presented a detailed annotated outline of the proposed work under Workstream 1 organized into three parts, with the work on Part B then sufficiently developed:
   - Part A: How to assess and correct the interaction between carbon taxes and other taxes.
   - Part B: Interaction between carbon taxes and other environmental measures (emissions trading and climate policy).
   - Part C: Phasing out fossil fuel subsidies.

Status update and next steps

3. After the Twenty-fifth Session, the Subcommittee further developed the remaining sections of Part B. Accordingly, the Subcommittee presents the outline and text below for the Committee's consideration and discussion. Parts A and C are still being developed with the expectation to present draft texts for the Committee's guidance and comment at its Twenty-seventh Session.

4. The Subcommittee proposes to reorder the workstreams as follows:

   - Part A: Interaction between carbon taxes and other environmental measures (emissions trading and climate policy).
   - Part B: How to assess and correct the interaction between carbon taxes and other taxes.
   - Part C: Phasing out fossil fuel subsidies.

   The Subcommittee proposes this reordering of the parts on the basis that the first part of the paper should address the general issues and then narrow down to specific elements.

5. The Coordinators present this note outlining the progress of Part B [now proposed to be part A – see paragraph 4 above] of Workstream 1 for the Committee's first consideration and discussion with the hope to present that part for final approval at the Twenty-seventh Session.

Part B [now proposed to be Part A]: Interaction between carbon taxes and other environmental measures (emissions trading and climate policy)

Outline/structure

1. Introduction

Carbon taxes and other climate policy measures are not introduced in a policy vacuum, there are always existing policies and regulations with which they need to be in compliance and with which interactions will unfold. These interactions can enhance or obstruct the effectiveness of the chosen climate change measures. The 2021 UN Handbook on Carbon Taxation for Developing Countries ('the Handbook') has already discussed the different types of instruments and examined possible interactions between carbon taxes and other policy instruments. It emphasizes that clarity on the different interactions and challenges associated with interrelated policies and instruments is essential for effective policy implementation. The existing policy and regulatory framework should therefore be closely examined by policy makers when designing and implementing carbon taxes and other climate policy measures.

The current contribution seeks to offer other perspectives, for example, by taking incentives of market participants as a central theme. The underlying theoretical idea is that laws/rules set incentives for actors to behave in a desirable (social welfare enhancing) fashion. The theoretical grounding for this lies in 'Law & Economics', the economic analysis of law. Let us use a simple example to explain this point: people may be aware of a municipal rule that they have to put money in a parking meter when they park their cars. Yet individuals will often only be doing so if it is incentive compatible for them to do so, i.e., if they benefit from following the rules. If it is a cold and rainy day, risks of being detected and fined may be lower and hence many drivers might decide that adhering to rules may not be in their self-interest. The example shows that an incentive (Law & Economics) based approach can help to shape and design rules and their implementation in such a way as to make them both effective and efficient.

Section 2 of this contribution presents insights into instrument choice by providing a review of the advantages and disadvantages of carbon taxes, emissions trading systems and regulatory measures. All these instruments can be used to reduce greenhouse gas emissions but they have different strengths and weaknesses. In practice a combination of such instruments (instrument mixes) will be used to prevent climate change. Such instrument mix will help to address climate change and aid the realization of other policy objectives.

Section 3 identifies instruments that are employed in various jurisdictions to combat climate change. This contribution does not attempt to be exhaustive. Instead, it endeavors to take stock of the diversity of instruments used in various countries and examines how these instruments are designed.

Section 4 will build upon the discussion in Sections 2 and will outline the interactions between the various instruments, paying particular attention to the pitfalls to be avoided by policy makers.

2. Insights on Instrument choice

The climate change crisis needs to be addressed urgently. Greenhouse gas emissions must be reduced. There are various instruments that legislators can use to do this. They all have their strengths and weaknesses. This section examines the advantages and disadvantages of instruments that can be used to address the climate change crisis. These include command-and-control type of public law regulations and pricing instruments such as carbon taxation and emissions trading. Finally, some insights are provided for consideration by developing countries.

2.1 Instrument choice

Market actors are thought to be self-interested and that they react to costs and benefits when they take decisions. In line with basic assumptions on demand and supply of goods, we can predict that if prices of goods are low, more of them will be demanded and if prices are high, less of them will be demanded. This insight is especially relevant when the production of goods is associated with carbon emissions or other forms of environmental pollution. If producers are not held accountable for the pollution, they will only take their own production costs into account and hence offer the goods for a price that is too low, not taking into account the social cost of pollution. Consumers in turn enjoy a low price and consequently demand too much of the goods. As a consequence of not taking due account of the social costs of pollution, the market fails to deliver adequate information on the optimal quantity that is to be produced and consumed by society. Too much is being produced and consumed and as a consequence environmental pollution is too high.

Whenever social costs of producing exceed the private costs of production, economists speak of ‘externalities’. If the social costs of pollution are not taken into account carbon emissions constitute a ‘negative externality’ leading to overprovision. This 'market failure' can be corrected by ‘internalizing the negative effects’, i.e. bringing them into the market price mechanism by putting a price on carbon emissions. The price of the product should be inflated to adequately reflect social costs in order to create incentives to use less of the goods. Via pricing instruments, such as carbon taxation or emissions trading, the absolute loss to society that stems from the excessive use of scarce resources is reduced to a socially desirable level.

Putting a price on pollution will thus lead to higher product prices and to less consumption. Despite this, or rather precisely because of this, society is better off because excessive consumption and production is associated with detrimental levels of pollution.

The lack of flexibility and incentives is often considered a disadvantage of traditional command and control type of approaches. They are often too general (‘one hat fits all’ approaches do often not work well) to allow for a differentiation between polluting firms’ abatement cost structures and potentials. Fine-tuned regulations such as permit schemes are expensive and require a lot of administrative efforts. Carbon pricing is one of the ways that can be employed to achieve emission reductions. Following the economic insight that there is an interrelation between the price and the quantity, both price and quantity can be targeted to reduce emissions. Carbon taxation sets a price for emissions but how the market reacts to this price increase in reducing emissions is uncertain (i.e., price certainty vs environmental effectiveness uncertainty). A (cap-and-trade) emissions trading system sets a quantity of emission allowances but might present uncertainty about how prices would respond (i.e., environmental effectiveness certainty vs price uncertainty).

The idea to tax externalities and bring them within the framework of the market price mechanism goes back to the British economist Arthur C. Pigou who developed this idea in 1920. Under a Pigouvian tax a firm´s marginal private costs are increased to reflect in proportion the social marginal cost of pollution (hence reflecting all externalities) and as a consequence firms will maximize profits by reducing activity levels to the social optimum.[1] This has the effect that the production and pollution are reduced, government revenue is generated, and that both the benefits accruing to producers and consumers (consumer and producer surplus) are lowered. Overall, society is better off because of the reduced pollution.

To employ an optimal Pigouvian tax, the marginal production costs and marginal social costs (expressed in monetary terms) must be known, not only to producers but also to the government. Only then can a tax level be set for each level of output that is capable of internalizing the corresponding externality per unit of output. Since such information is difficult and expensive to obtain, American economists William J. Baumol and Wallace E. Oates proposed that governments could instead determine an acceptable (ideally optimal) level of pollution and set a tax that would give rise to this norm. The tax would then uniformly be applied to each unit of production. This has the effect that the pollution and production is reduced, substantial government revenue is generated (more than under a Pigouvian tax), and that the benefits from transactions accruing to producers and consumers (consumer and producer surplus) are lowered. Especially producers are losing to the government. Overall, society is better off

[1] Grossman, B., (1999), ‘2500 pollution tax’, in B. Bouckaert and G.. De Geest, Encyclopaedia of Law and Economics: Volume II, Civil Law and Economics, Cheltenham, UK and Northampton, MA., USA: Edward Elgar, 538-568.. See also Turner R. K., D. Pearce and L. Bateman (1994) Environmental Economics: An Elementary Introduction, New York, NY, USA: Harvester Wheatsheaf.

because of the reduced pollution. For a concise presentation of the Pigouvian tax and the Baumol and Oates tax, see Annex 1.
Carbon taxes in both the Pigouvian and the Baumol and Oates tradition set a price and leave the environmental effect to be determined by the market. Emissions trading systems by contrast set a quantity and leave the price to be determined by the market. So, in essence under carbon tax schemes the price is set in light of the externalities, while under a (cap-and-trade) emissions trading system the externalities inform the quantity setting but the market price is determined by the carbon abatement costs of companies. Emissions trading systems can be traced back to Dales' (1968) idea of marketable emission permits (often referred to as 'emission allowances') that are issued to polluters. Polluters are only allowed to pollute if they hold such an emission allowance. Since the number of allowances issued by the government is predetermined, the environmental effectiveness of the emissions trading system is guaranteed (provided of course that it is based on a cap-and-trade design). The market price and polluters' individual abatement costs determine which actors will pollute and which actors will abate. Government revenue can be raised if emission allowances are for example sold at auction, but in practice several emission trading schemes allocate substantial amounts of allowances for free.

Both taxation and emissions trading can be used to increase costs for producers. The legal incident of increasing costs or levying taxes is, however, logically separable from its economic incident. Who actually bears most of the costs of an environmental measure – producers or consumers – does not depend on who is legally charged with paying but is purely dependent upon demand and supply elasticity.

2.2 Command-and-control type of legislation
Traditionally environmental law largely consisted of 'command and control' type of public law regulation. Examples include production permits or licenses, but can also extend to actual production bans or bans on the use of particular technologies such as coal.

2.2.1 Advantages of command-and-control type of regulation
There are several advantages of command and control type of regulation that are implemented via public law provisions, including the following:

(1) *Public law provisions are mandatory*. Private parties must comply and do not have the discretion to decide for themselves how they would like to behave in a particular situation. Negotiations between involved parties that are generally allowed under private law are not allowed under public law.

(2) *Public law provisions can be very effective.* Because command and control type of regulation is mandatory, it can be very effective immediately - this may constitute a critical benefit when seeking to urgently address a well-defined environmental problem. Complete bans on harmful substances or production methods can be implemented. Chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs), for example, were banned in several jurisdictions, having a positive impact on the reduction of the Ozone hole.

(3) *Violations of public law provisions can be punished severely*. Even if many violations can result in administrative sanctions or fines for companies, criminal liabilities can also be imposed on company representatives.

(4) *Polluters that violate public law provisions can be identified by employing the full force of government authority*. The government can be expected to have better information about activities taking place within their jurisdiction than private parties. Thus, the government is better able to identify polluters. This benefit may be somewhat weaker in the case of climate change because carbon emissions are a global pollutant and differences in carbon concentrations are not easily attributable to a specific location or region or polluter.

(5) *Government authorities possess the power to enter production premises and take samples*. This power is not as readily available in the context of private enforcement contexts.

(6) *Pollution permits or standards can be used to reduce the generally high costs of public rules enforcement*. This is especially based on the understanding that public rules must be set, updated, controlled and violations must be punished.

2.2.2 Disadvantages of command-and-control type of regulation

Command and control type of regulation presents some challenges, including the following:

(1) *Production permits require polluters to observe specific emission standards but do not limit the actual quantity of pollution that results from high production activity levels*. The underlying criticism is that even if the environmental efficiency of production is enhanced, if more is produced, more absolute pollution is generated leading to serious degradation of environmental quality. In order to take due account of production activity levels command and control regulation could instead focus on laying down absolute emission targets or environmental quality standards.

(2) *Command and control regulation requires that standards are set optimally*. Standard setting involves high information costs. Reliance on industry information can help to reduce information costs, but it creates the clear risk that industry offers distorted information so as to impact standard setting and thus undermines the effectiveness of command-and-control regulation.

(3) *Setting standards can be administratively burdensome for a government and require significant technical capability, as it needs to evaluate different options, emissions levels, etc., in order to 'pick a winner'*. If new technology becomes available or new insights about climate change emerge, the government needs to quickly update its rules. Particularly in the area of climate change, it has been shown that in the recent decades environmental objectives have been updated every few years and new production technology has been developed rapidly.

(4) *Command and control regulation also requires optimal enforcement*. Enforcement costs can be high. The responsibility for enforcement rests with the government. Often governmental bodies do not have adequate capability (including sufficient human resources) to investigate and undertake on-site visits, and to identify the many different ways rules can be circumvented. If enforcement is less than optimal, profits can be earned from pollution. Although relying on industry information could reduce enforcement costs, there is the risk that this information is distorted.

(5) *Command and control regulation presents diminished incentive to reduce pollution after a certain point*. Public law standards or rules must be complied with. Once in compliance there are no further incentives for reducing pollution or to invest in more environmentally friendly technology. This is also exhibited in the fact that polluters bear the costs of complying with regulatory standards. Once they are in compliance, they can continue production and pollution. The costs of residual pollution are thus not borne by the polluter (polluter pays principle is not complied with) and the legal liability for pollution may also be absent or shifted to the government.

(6) *Command and control type of regulation cannot ensure the equalization of marginal abatement costs among polluters*. Every polluter must comply with the same rules independent of abatement costs, rendering this instrument inefficient and attaining an environmental standard

costly for society. Making rules more company specific is generally not feasible because of the prohibitively high information and regulatory costs.

2.3 Carbon taxation

Carbon taxation has a number of advantages and disadvantages that should be considered. This passage also pays due attention to the two generic tax designs, Pigouvian taxes and Baumol and Oates taxes.

2.3.1 Advantages of carbon taxation

Carbon taxes have various advantages, including the following:

(1) *Carbon taxes provide clear and continuous price signals incentivizing the reduction of pollution*. A clear price signal will reduce business uncertainty, help to avoid stranded assets[2] or technological lock-ins, and offer the possibility to innovate and invest in abatement opportunities. If tax rates are known beforehand (e.g. when Baumol and Oates type of taxes are set for a multitude of years), the price signals are less likely to suffer from volatility. Clear price information may incentivize investments in innovation and abatement technology.

(2) *Carbon taxes generate revenues*. These revenues address market failures and are thus welfare enhancing. If these revenues are used to reduce other market distorting taxes (such as income taxes), they can give rise to additional positive welfare effects for society (double dividend hypothesis). Baumol and Oates taxes generate higher tax revenues than Pigouvian taxes.

(3) *Carbon taxes can be fairly flexible*. For example, they can be adjusted if environmental targets need to be sharpened or reduced in case of economic strive.

(4) *Carbon taxes apply in a similar fashion to both incumbent firms and new entrants*. Domestically, they are thus not distorting competition on the merits between existing companies and new ones.

(5) *Carbon taxes are capable of setting a carbon price for both formal and informal sectors of the economy*. Setting a single price for the whole economy reduces the administrative complexity of the tax. This point may merit specific consideration in countries where a substantial share of the economy consists of informal sectors.

(6) *Carbon taxes can be designed without being administratively burdensome*. Carbon taxes can for example be employed in combination with other taxes levied on the extractive industries. In the alternative, carbon taxes can also be employed at the import level, creating synergies with customs duties.

The Handbook distinguishes between the Fuel Approach (used for example by Sweden) and the Direct Emissions Approach (used for example by Chile) when it comes to the practical design of a carbon tax. Both approaches could be designed to avoid having to put in place not only new legal infrastructures but also make use of existing technically well-equipped administrative machinery to do benchmarking, and measurement and monitoring of carbon emissions. Thus, a Fuel Approach can make use of existing systems for collecting excise duties on fuels and a Direct Emissions Approach would include measurement and monitoring that is already necessary to satisfy the reporting requirements of the UNFCCC. New administrative

[2] Stranded assets are investments (assets) that become obsolete prematurely as they are unable to earn enough economic return.

implications could otherwise present obstacles for countries or jurisdictions considering introducing a carbon tax, rather than facilitating the introducing of a tax design.

(7) *Carbon taxes can be paired with other policy measures*. Carbon taxes can be introduced in the form of a policy package designed to overcome social resistance against its implementation, by using revenues to relevant areas for households and business.

2.3.2 Disadvantages of carbon taxation

There are also disadvantages associated with carbon taxation, including the following:

(1) *Ensuring the exact environmental impact to be achieved through carbon taxes is not easy.* Carbon taxes operate by putting a price on carbon emissions. The carbon tax burden is either determined by reference to the actual externality that is created for each unit of output (Pigouvian tax) or based on a set emission standard (Baumol and Oates tax) that is capable to internalize the externality. The tax is generally known to polluters so that they are incentivized to produce less and to pollute less. Since most of the time there is insufficient information to introduce Pigouvian taxes, or the costs of doing so are prohibitively high, environmental taxes are often set in the Baumol and Oates tradition. Here the price is known but the exact environmental impact is uncertain. To ensure that the environmental steering effect that we are after actually materializes, carbon taxes must be evaluated and adapted (often raised).

(2) *Setting optimal carbon tax rates is challenging*. In order to internalize all externalities, a tax should be set in such a way that marginal benefits and marginal costs of pollution equal each other. If that is not achieved, it would undermine the effectiveness of the tax. To set an optimal tax rate, governments require optimal information, which is not always likely to be available.[3] The problem of information availability is more grave under a Pigouvian tax than under a Baumol and Oates tax as the latter is only based on a uniform tax. This theoretical insight should, however, not be taken as a justification for inaction. The 'perfect is the enemy of the good'[4] and a carbon price is better than no carbon price even if the environmental steering effect is not optimal.

(3) *Other intervening factors affect the effectiveness of carbon taxes*. The environmental steering effect of taxes depends on the responsiveness of the demand and supply functions to the tax burden. Only if the functions are flat (elastic) will the introduction of a carbon price lead to a significant change in the consumption or supply patterns and render an environmental tax 'effective'. In case a carbon tax is levied upon an inelastic product or behavior, the environmental steering effect will be limited and the tax is primarily revenue raising. Over time elasticities can change due to adaptation or technology changes.

(4) *A uniform rate will not give optimal incentives for emission reductions*. A uniform rate tax in the Baumol and Oates tradition is inconsistent with the idea of the Pigouvian tax since different actors have different marginal cost functions and therefore a uniform rate will not give optimal incentives for emission reductions. Given the climate change crisis any action is better than no action at all.

(5) *Producers lose more producer surplus and can resist carbon taxes*. Under Baumol and Oates taxes producer surplus is smaller than under a Pigouvian tax. This is because producers pay a

[3] See Fullerton, D., A. Leicester and S. Smith (2010), 'Environmental taxes' in Institute for Fiscal Studies (ed), Dimensions of Tax Design, Oxford: Oxford University Press, 423-547 for an elaborate criticism.
[4] Different philosophers have expressed such ideas. Voltaire, in La Bégueule, writes 'Dans ses écrits, un sage Italien, Dit que le mieux est l'ennemi du bien' (In his writings, a wise Italian says that the best is the enemy of the good). Confucius states 'Better a diamond with a flaw than a pebble without'.

higher amount of tax to the government. Producers might therefore prefer a Pigouvian tax provided that administrative tasks for them are not too burdensome and costly.

(6) *Incentivizing the implementation of new environmentally friendly technology can be difficult.* Baumol and Oates taxes are not as good as Pigouvian taxes in incentivizing the implementation of new environmentally friendly technology. The underlying intuition is that under a Pigouvian tax polluters pay for all the externality they generate and any technology reducing emissions will also reduce their tax burden. Under a Baumol and Oates uniform tax, polluters have to pay the uniform tax based on the amount of their activity or use of the tax base. Technology that reduces emissions but does not reduce the tax burden will not be implemented as it does not reduce the tax burden. Careful selection of the tax base is therefore critical.

(7) *Although carbon taxes can offer administrative simplicity, other technical operational issues abound*. The point of regulation of carbon taxes is a critical element for implementing carbon taxes because the administrative burden for both the Government and business rises with the number of taxpayers to be controlled. Also complexity in terms of monitoring, reporting and verification systems needs to be more refined if the heterogeneity of regulated entities increases.

Further, the relative ease of introducing a unit carbon tax across society, for example through a carbon tax on fuels, may make it administratively complicated to set detailed incentives for particular downstream sectors, as this may need to be achieved by reimbursement schemes. One alternative would be to set different general carbon tax levels to different sectors of society which may involve control problems. The key for the environmental effectiveness of a carbon tax is of course the environmental steering effect, thus the responsiveness of companies and individuals to take carbon reducing decisions (see item (3) above).

(8) *Carbon taxes might present some socially undesirable effects*. A carbon tax leads to social welfare increases by raising production costs and product prices, incentivizing people to consume less, by bringing negative externalities down to socially desirable levels. This restriction in consumption, albeit welfare enhancing, may give rise to socially undesirable effects in the sense that it hits low-income groups of society harder by for example rising energy prices (regressive effects). Distributive effects should be carefully considered because they can undermine the political acceptability of carbon taxes. Here the use of carbon tax revenues can be of relevance to mitigate regressive effects (see Chapter 9 of the Handbook).

2.4 Carbon Emissions trading systems

Emissions trading systems (ETS) can be designed in different ways. There is a substantial amount of literature discussing the various design features. This section takes a cap-and-trade ETS as a basis to discuss the advantages and disadvantages of an ETS.

2.4.1 Advantages of emissions trading systems

Below are some advantages of ETS:

(1) *Regulators' control of the system informs its effectiveness*. Under a cap-and-trade system, the regulator determines directly the quantity of emission allowances that will be circulated. Since each polluter covered by the scheme must surrender allowances equivalent to the amount of pollution, the environmental effectiveness of a cap and trade ETS is directly determined by the regulator.

(2) *ETS can present significant cost advantages for operators*. Actual abatement costs of entities are generally not known to the regulator. They can better be determined by the regulatees themselves that possess better information about production processes. An emissions trading system creates tradable property rights (emission allowances) that can be traded among polluters. Polluters can thereby determine themselves who will abate pollution and sell emission allowances to those market operators that find it too expensive to abate to reduce

emissions. Allowing for trade between operators that enjoy different abatement costs leads to significant cost advantages while ensuring the realization of the environmental target.

(3) ETS allows market forces to rule. Emissions trading systems allow market prices to be determined by demand and supply. Prices thereby automatically adjust for inflation.

(4) *Potential for more acceptability*. Emission allowances are tradable permits. Such allowances may gain more political acceptance because regulators are already familiar with permits and other instruments such as (carbon) taxation is often disliked by regulatees and citizens.

(5) *ETS functions as an automatic stabilizer*. Automatic stabilizers reduce the fluctuations in economic activity, dampening the economy when it is overheating, and alleviating burden on citizens when it is in recession. The burden created by emissions trading systems is determined by the allowance prices, which are subject to the forces of demand and supply. When the economy is growing and a lot of pollution is created, emission allowances are in high demand, increasing the costs of pollution.

2.4.2 Disadvantages of emissions trading systems

Emissions trading systems also have some disadvantages that should be considered, including the following:

(1) *Although ETS allows market forces to rule and function as automatic stabilizers, they might not attain certain long-term objectives*. Emission allowance prices are subject to the forces of demand and supply and hence function as automatic stabilizers. This 'strength', however, turns into a weakness if emission allowance trading systems are intended to attain other policy objectives such as incentivizing investments into abatement technology or incentivizing the economy to transition towards carbon neutrality. The price volatility that is inherent in the emissions trading system undermines a long-term price signal that could incentivize long term investments. A good example of this problem can be seen in the price development of EU ETS allowances in the aftermath of the 2008 financial crisis. Due to a contraction of economic activity, there was an oversupply of allowances and prices were low for several years. A reform of the EU ETS was necessary to avoid more than a decade of low allowance prices due to this oversupply situation.

(2) *ETS need frequent reviewing and updating.* For the operation of a cap-and-trade emissions trading system, the setting of an emissions level is necessary. Setting an optimal level is, however, non-trivial. Greenhouse gas concentrations in the atmosphere are increasing ever more quickly. Countries have been responding by frequently updating their emissions targets. Several jurisdictions including the EU, Japan and Korea, have now committed themselves to attain carbon neutrality by 2050 or by 2060 in the case of China.

(3) *ETS can give rise to carbon leakage*. Putting a price on emissions increases production costs can lead to a displacement of pollution to other jurisdictions that are not subject to similar environmental cost burdens. This is conventionally referred to as ´carbon leakage´ and is a problem that can exist also under tax schemes.

(4) *ETS design and implementation may present wider policy issues*. When emissions trading systems are introduced, political acceptability for stakeholders is often times increased by allocating allowances based on historic emissions for free to them (also referred to as 'grandfathering'). When covered entities face inelastic demand (steep demand curves), they are able to pass on a larger share of the cost burden of an ETS on to consumers. Such companies will then increase prices to consumers even though they have received emission allowances for free. They are thus enjoying 'windfall profits'. While such transfers do not raise problems from

an economic perspective, they are politically undesirable since they constitute a wealth transfer to polluters.

(5) *Emissions trading systems often only raise limited amounts of revenues for the government.* They can be based on full auctioning of allowances, but in practice large parts of allowances are allocated for free, via grandfathering or based on benchmarks (see item (4) above). Such practices are particularly used for Energy Intensive Trade Exposed industries (such as iron, steel, fertilizers and cement).

(6) *The market price for emission allowances can be inelastic*. Covered entities may not be able to reduce their emissions quickly when allowance prices increase. In such situations small changes in the quantity can have substantial impacts on the allowance price. Allowance prices may be volatile. Volatility may lead to business uncertainty and prevent covered entities from undertaking the necessary investments in abatement technology.

(7) *Emissions trading systems are costly to operate and set up.* They require detailed information about emissions and covered entities incur high transaction costs when buying and selling emissions allowances. All transactions and emissions must be monitored. Especially for emissions trading systems that not only cover fuel inputs but also process emissions (emissions created in the production process through chemical processes), the monitoring and verification processes can be expensive. Given the high transaction and monitoring costs, emissions trading is best used for large emitters that stand to gain most from trading emission allowances. Monitoring and administrative costs can be reduced by limiting the scope of the trading system by, for example, focusing on input emissions rather than process emissions.

(8) *ETS instruments may be particularly susceptible to congruent and overlapping policies that seek to achieve similar objectives*. Policies such as phasing out coal or efficiency measures in the building stock, can have repercussions on allowance demand. Falling demand will lead to reduced prices but not to a reduction in pollution under a cap-and-trade emissions trading system. This is commonly described as a ‘waterbed effect’ when emission reductions realized in one sector or jurisdiction simply enable higher emissions elsewhere among the covered entities.

(9) *ETS may distort competition between incumbents and new entrants*. Emissions trading systems based on historic allocation (grandfathering) may set new market entrants at a comparative disadvantage if new entrants are not able to be allocated for free (e.g. via a new entrants reserve).

(10) *ETS might present some socially undesirable effects*. As with carbon taxation (discussed above) also when designing emissions trading systems distributional effects are important. Emissions trading leads to social welfare increases by raising production costs and product prices, incentivizing people to consume less, and thus by bringing negative externalities down to socially desirable levels. This restriction in consumption, albeit welfare enhancing, gives rise to socially undesirable effects in the sense that it hits low income groups of society harder by e.g. rising energy prices (regressive effects). Distributive effects should be carefully considered because they can undermine the political acceptability of ETS.

2.5 Insights for developing countries

The subsections above presented the advantages and disadvantages of the main carbon policy instruments used to address climate change based on a Law and Economics approach. What should be clear from the above is that no system is perfect. Each has its own strengths and weaknesses.

It should also be equally clear that these instruments are employed in a country specific context and that all countries are different. They have their specific legal and policy framework, industry structure, their particular resource endowments, their own energy mix and abilities to generate renewable energy. They also have their own culture and preferences. Any choice of instruments must take all such considerations into account. Special attention must be paid to what is actually feasible, both in terms of administrative capacity, as well as economically and socially. A solution to address climate change must therefore always be country specific.

There are, however, some common themes. Addressing climate issues requires clear regulatory frameworks and long-term policy ambition that are able to garner long term policy support. Policy makers need to balance different societal interests and clearly determine their policy objectives in order to be able to select an instrument and to determine its precise design features. Long term visions and plans help to offer better investment outlooks that are capable of incentivizing climate friendly investments. Once the objective and its constraints are clarified, the appropriate instrument can be selected and its features designed.

In all likelihood it will not be a single instrument, a ‘one hat fits all’ solution, but a combination of different instruments that will be employed to create a harmonious and ‘smart mix of instruments’. Such smart mixes may combine pricing instruments such as carbon taxes and emissions trading with regulatory command and control type of measures, but could also extend to other public law fields (procurement rules, criminal law and procedural rules relating to access to information and justice) and suasive instruments such as corporate cods of conducts or labeling and certification.

3. Inventorying instruments employed for climate policy

3.1 Overview

The Handbook complements the discussion on carbon taxes with practical examples from various jurisdictions. This section identifies instruments employed in various jurisdictions to combat climate change, including carbon taxation and other instruments. It does not attempt to be exhaustive but rather strives to take stock of the diversity of instruments used in various countries. The aim is to present examples of different generic approaches that offer inspiration and a starting point for countries considering similar approaches. The selected examples are summarized in the table below.

Table 1: Summary of instruments across different jurisdictions

Instrument	**Description**	**Country/Region**
Carbon taxation	Fuel Approach to carbon taxation in sectors not covered by the EU ETS	Sweden
Emissions trading	Cap-and-trade system with Business As Usual allocation	Korea
	Cap-and-trade system on input and process emissions	European Union
	Fuel excise taxes, subsidy reductions and energy trading system	India

3.2 Swedish carbon taxation regime

Sweden was among the first countries to introduce a carbon tax in the 1990s. It already had a long history of taxing fuels by an excise duty (in Sweden called energy tax) for fiscal purposes. However, from 1990’s and onwards environmental issues were given higher priority by Government as well as by households and business; thus a carbon tax was introduced in 1991 to complement the existing energy tax.

The energy tax and the carbon tax are administered under the same excise duty system. Starting out at low levels, the carbon tax levels have over the 30 years the carbon tax has been in force been increased step-by-step and nowadays the carbon tax is substantially higher than the energy tax and in 2022 amounts to SEK 1200 (USD 115) per tonne fossil carbon emitted[5].
The Swedish carbon tax is in the legislation expressed in normal trade units (weight or volume, such as litres or kilograms). These tax rates have been calculated by the Government when drafting the carbon tax legislation and are not left to the agencies responsible for administering and collecting the tax. This removes the need to measure emissions at point of emissions to air. The calculations have been made based on average internationally acknowledged heating values carbon emission factors[6] for different fuels, which gives an accurate estimation of actual emissions. The last producer or supplier in the value chain is responsible for paying the tax, but the tax is usually passed on to the consumer as a part of the price the consumer pays.

Public acceptability of the carbon tax is facilitated by general environmental concerns of the need to fight climate change, both from households and businesses

- Broad political consensus
- Availability of feasible options (bio fuels, district heating, public transport, housing insulation etc.)
- Gradual introduction: a step-by-step approach combined with limited tax exemptions or reductions for certain areas of the economy
- Revenue use: mainly to provide options and to aid schemes

As result the fossil heating fuel use has dropped by 85% since 1990 and now represents only 2% of Sweden's total greenhouse gas emissions. Fossil heating fuels have been nearly phased out. Fossil fuel has been replaced by district heating (large heating installations interconnected in city grids, supplying heating and cooling to households and business, fuelled by mainly household waste and wood scraps), wood pellets burners and heat pumps. The transition to district heating was instrumental to this success: district heating covers now around 92% of all Swedish flats. But there have also been temporary aid schemes to support the conversion to renewable energy heating sources (e.g. for solar cells).

Upon the introduction of the carbon tax, lower tax rates were applied for industry. Those initially lower carbon tax rates for industry have gradually been reduced and from 2018 there is no longer a reduction available. The service sector (e.g. offices, shops) has had no tax reductions.

In Sweden a large part of heavy industry (such as steel, cement, paper and pulp, chemicals) as well as district heating plants (see description above) is covered by the EU ETS, which applies in Sweden. Fuels used in the EU ETS installations are exempted from the carbon tax (which helps avoid double taxation). This means that carbon tax since the introduction of the EU ETS has been focused on motor fuels and heating fuels used in sectors not covered by the emissions trading (households, service sectors and small manufacturing industries in for example metal working an textile sectors). Approximately 95% of Swedish fossil carbon emissions are covered by either the carbon tax or the EU ETS.

3.3 Korean ETS

As early as the 2009 Copenhagen Accord, South Korea used a business-as-usual approach for setting its climate reduction targets. It pledged a 30% reduction below 2020 levels, equivalent to a 4% emission reduction in absolute terms below 2005 levels. This business-as-usual target setting approach was

[5] As an example, expressed in 1 000 liters, the tax rates for heating gas oil were in 2022 SEK 3490 (USD 334) carbon tax and SEK 921 (USD 88) energy tax, which means a total carbon and energy taxation of SEK 4411 (422 USD).
[6] See IPCC default values: https://www.ipcc-nggip.iges.or.jp/EFDB Intergovernmental Panel on Climate Change (IPCC) Emission Factor Database and the International Energy Agency (IEA) Energy Statistics Manual and Table 3 of Chapter 6.2 of the Handbook.

pursued under 'The Low Carbon and Green Growth Framework Act' (2010) which tried to balance carbon reduction and economic prosperity. Over time the carbon reduction target was strengthened to -37%, consisting of a domestic target of -30% (later reduced to -25.7%) and a reduction target of -11.3% to be achieved abroad. In 2021 South Korea legislated the 'Framework Act on Carbon Neutrality and Green Growth for Climate Crisis Response' which abandoned the business-as-usual approach for an absolute emission reduction target. The South Korean updated 2021 NDC target is set at -40% below 2018 levels by 2030. Carbon neutrality is to be achieved by 2050.

The choice for a business-as-usual approach can also strongly impact the efficacy of climate change instruments. Markets operate best under conditions of scarcity and business-as-usual targets may be less stringent in absolute terms.

The Korea ETS (K-ETS) started in 2015. It was the first nationwide ETS in East Asia. The K-ETS covers 684 of the country's largest emitters from six sectors (69 sub-sectors) (heat and power, industry, buildings, transportation, waste, and the public sector), accounting for ~73.5% (during the 2021-2025 phase 3) of national greenhouse gas emissions. It covers direct emissions of six greenhouse gases (CO2, CH4, N2O, PFCs, HFCs, SF6) as well as indirect emissions from electricity consumption. It is implemented in phases. Phases 1 and 2 were 3 years long (2015-2017, 2018-2020) and as of phase 3 they are 5 years long (2021-2025).

The K-ETS is designed as a cap-and-trade system, but the allocation cap was set in a bottom-up fashion in consultation with energy intensive trade exposed industries.
Getting the allocation right and ensuring scarcity can be challenging and the business-as-usual emphasis adds a layer of complexity. Market data, however, shows that the K-ETS demonstrates both steadily increasing allowance prices and transaction volumes, implying that the market is working. The K-ETS has also contributed to improving the carbon intensity in the manufacturing and building sectors but not in the power sector.

The K-ETS has also an elaborate market stability instrument. In case of substantial price increases satisfying particular thresholds, the Government may take measures for stabilizing the markets, by for example releasing additional allowances, setting a temporary price floor or ceiling, alter the offset quota, alter the borrowing rules or requiring compliance entities to hold a maximum or minimum number of allowances.[7] The ultimate decision whether or not market stabilization measures are implemented is subject to political decisions by the Government and the Emission Permits Allocation Committee, and hence neither entirely rule-based, nor discretionary.[8]

3.4 EU ETS

The EU ETS is an example of a cap-and-trade system setting a carbon price on input and process emissions. It was introduced in 2005 and extends to many sectors and gasses, covering currently around 5000 operators and 11000 installations from energy, ferrous metals, minerals, pulp and paper, accounting for around 45% of EU's total greenhouse gas emissions. The system thus requires a lot of detailed information to function properly, information that is not always available to decision makers. The 'learning by doing' phase (2005-2007) of the EU ETS was therefore really needed to bring the amount of allowances and emissions into equilibrium (as elaborated below, this was not enough and a market stability mechanism had to be introduced).

In 2012 the ETS scope was extended to aviation emissions, and additional sectors (aluminium, carbon capture and storage, petrochemicals and chemicals) were added during the third trading phase (2013-2020). The EU ETS does not only cover energy-using power stations and combustion installations with a thermal rated input exceeding 20 MW in the EU but also those in Lichtenstein, Iceland and Norway.

[7] Tiche, F. (2017). Linking emissions trading systems: A law and economics analysis, Dissertation, University of Groningen, p. 82.
[8] Ibid.

In terms of gases it covers carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), sulphur hexafluoride (SF6), Perfluorocarbons (PFCs), hydrofluorocarbons (HFCs) and input as well as process emissions. It is designed as a cap and trade system, initially without any type of price support system. The allocation was based on historic emissions (grandfathering) and to a very limited degree on auctioning. A new entrance reserve secured the allocation of allowances to new companies so as to maintain a level playing field between them and incumbent companies. During the 3rd trading phase (2013-2020) the allocation decisions that were formerly undertaken by Member States on the basis of predetermined criteria were centralized, putting the European Commission into the driving seat, and henceforth were based on benchmarking and auctioning for the electricity sector.

In preparation of the 4th trading phase (2021-2030) a new legislative package was prepared in 2018 to strengthen the emission reduction target to 43% below 2005 levels and to address the excess supply situation that depressed emission allowance prices. The carbon leakage list for energy intensive and trade exposed industry was revised and additional funding was made available to support low carbon innovation and energy sector modernization.

Yet even before the fourth trading phase (2021-2030) began the European Parliament declared a climate emergency and requested the European Commission to present proposals to reduce emissions by 55% below 1990 levels and to ensure that all relevant legislative and budget proposals be designed to limit global warming to 1.5 °C Celsius.

The proposed 'Fit for 55' legislative package encompasses several policy initiatives, which aim to set the EU on the path to a green transition, to reduce emissions by 2030 by at least 55% and with the ultimate goal of reaching climate neutrality by 2050.

Also the EU ETS is changed to do justice to the increased climate ambition of the EU. It is extended to include maritime transport, and carbon leakage is addressed via a carbon boarder adjustment mechanism. In addition in December 2022 the Council of the EU[9]reached a provisional deal with the European Parliament to strengthen the emission reduction of sectors covered by the EU ETS to 62% below 2005 levels by 2030.

Moreover, a new self-standing emissions trading system for buildings and road transport will be established to help EU Member States to attain their national targets.

3.5 India's fuel excise taxes, subsidy reductions and energy trading system

At present India does not have a cap-and-trade system nor an explicit carbon price. Instead India has introduced several schemes which impose an implicit price on carbon. The example of India demonstrates the use of fuel excise taxes and subsidy reductions and an energy trading system as an indirect approach to carbon pricing.

In 2010 India introduced 'the Clean Energy Cess on Coal' in an amendment to the Finance Act. This cess sets an implied carbon price and is levied on items specified in the Tenth Schedule of the Finance Act of 2010 (including Coal, briquettes Lignite and Peat). The cess was initially applied at a rate of 50 INR (USD 0.73) per tonne and rising to 400 INR (USD 4.83) in 2016. The Clean Energy Cess on Coal was abolished by the Taxation Laws Amendment Act of 2017. The Goods and Services Tax (GST) Compensation Cess was introduced in 2017 as a consumption-based tax with a broad tax base. It also extends to Coal, ovoids, briquettes, and similar solid fuels manufactured from lignite, coal, whether or not agglomerated, excluding jet, peat (including peat litter), whether or not agglomerated, levying 400 INR (USD 4.83) per tonne. The GST Compensation Cess was envisaged to raise revenues to reimburse states for revenue losses brought on by the new indirect tax system.

[9] The ordinary legislative procedure in the EU is a co-decision procedure involving the Council of the EU, representing the interests of the national government of the Member States) and the European Parliament.

India has likewise changed its carbon subsidy system into one that resembles carbon taxation by reducing subsidies and raising excise taxes on fossil fuels (petroleum and diesel). In India, a positive Net Effective Carbon Rate (ECR) applies to 54.7% of GHG emissions as of 2021, while fossil fuel subsidies only apply to 2.5% of emissions. In essence, an effective carbon rate refers to the sum of tradable emission permit prices, carbon taxes and fuel excise taxes which result in a price on carbon emissions. Average fuel excise taxes amounted to 1155.76 INR (USD 14) in the same year, a rise of 305.67 INR (USD 3.70) from 2018. Since 2018, subsidies have been reduced by 89.5%, to an average of 14.93 INR (USD 0.18) per tonne of CO2.

While the above shows that India does not have an explicit carbon pricing system, India has pursued an alternative approach. The Bureau of Energy Efficiency (BEE) of India provided a draft plan for the phase-wise implementation of a nationwide trading system called ‘Perform, Achieve and Trade’ (PAT). The rationale of this trading system is to incentivize organizations to voluntarily contribute to fulfilling the Nationally Determined Contribution commitments under the Paris agreement.

The PAT trading scheme establishes precise energy reduction targets to cut emissions from energy intensive industrial sectors by issuing Energy Saving Certificates to industries that surpass the targets. Energy Saving Certificates are each worth one metric tonne of oil equivalent. However, the certificates must be purchased through a centralized trading system run by the Indian Energy Exchange by industries that are unable to reach these targets. Industries that do not purchase the certificates or meet the targets by their own actions are liable to financial penalty under the Energy Conservation Act, 2001. The PAT scheme has been implemented in six cycles, the most recent of which was cycle 6 that began in April 2020 and covered 1073 industries as well as 13 industrial and service sectors, accounting for 50% of India's primary consumption. These sectors are: aluminium, cement, fertilizer, pulp and paper, thermal power plant, chlor-alkali, iron and steel, textile, railways, petroleum refinery, petrochemicals, DISCOMs and hotels (under commercial buildings). The PAT program's execution is broken down into three phases, the last of which is the shift toward a cap and trade system. It is regarded as the foundation over which a voluntary carbon market (VCM) can be established.

On 29 July 2022 an amendment bill to the 2001 Energy Conservation Act was adopted by the Lok Sabha, the lower house of Parliament, and it created the framework for the creation of a voluntary carbon credit trading system. This might be considered the beginning of the 2021 draft blueprint's first phase. The blueprint document discusses approaches for removing barriers in trading and issuing Energy Saving Certificates, thereby suggesting methods for establishing a voluntary carbon market in India, and offers recommendations to remove market obstacles. In accordance with Section 14 of the Bill, registered entities may get certificates for the reduction of carbon emissions from the central government of India or any approved agency. The targets may be stated in emission intensity reduction rather than energy intensity for the next PAT cycles scheduled after 3 to 5 years. By dividing the factory's total emissions by total production, one can calculate the emission intensity.

4. Interactions between instruments

4.1 Introduction

Building upon the preceding section, this section will outline the interactions between the various instruments, paying particular attention to the pitfalls to be avoided by policy makers. It will examine the problem of windfall profits, economic downturns, the waterbed effect, interactions between energy taxes and emissions trading systems, and between carbon tax design of biofuels and land use changes and competition concerns. Examples will be taken from experiences in the European Union.

4.2 Windfall profits

A ‘windfall profit’ commonly refers to a sudden and unexpected gain. Such benefits can also arise in the context of climate change policies, more specifically in the context of allocating allowances under an emissions trading system. Several emissions trading systems employ free allocation mechanisms in respect of emission allowances, frequently based on historical emissions ('Grandfathering'). Such allocation choices have given rise to both challenges and opportunities. While grandfathering is often more acceptable for covered entities, it may be difficult to explain to the general public why nevertheless product and energy prices increase. On the other hand, windfall profits can be transferred to the government or used to further climate change objectives. The latter point thus makes windfall profits relevant from an instrument interactions perspective because windfall profits can create opportunities for more ambitious climate policies.

The most prominent challenge perhaps has to do with considerations around public acceptability of any instruments. This can best be explained by means of an example. In the EU ETS power generators who received allowances for free on the basis of grandfathering still increased their prices to consumers. Both industrial customers and households found this 'unfair' and politicians found it difficult to explain to the general public why prices increased even though energy companies received the allowances for free. These profits were described as 'windfall' profits.

Power generators face steeply sloped demand curves (economists say they face inelastic demand) entailing that even when electricity prices increase, consumers will only be able to reduce their consumption very little and hence pay higher energy bills. This is the reason why energy companies were able to swiftly pass-on the increase in production costs on to consumers, even though they had received allowances for free.[10]

Windfall profits also give rise to opportunities. Firstly, such profits can for example be transferred to the government. This is what happened in the European Union context. Here the problem of 'windfall profits' was addressed in the third trading phase of the EU ETS (2013-2020) by obliging energy generators to purchase their allowances at auction. This intervention turned the windfall profits into government revenue. However, due to the indirect effects on electricity prices for heavy industry consumers, the EU later introduced specific rules enabling Member States to grant such companies an indirect cost compensation in the form of state aid.

Secondly, windfall profits can also create opportunities for more investments in climate friendly technology. Windfall profits could be used by covered entities for this purpose. The experience of the European Union has, however, shown that energy generators were happy to invest in coal fired power plants because the break-even point on such investments was reasonably short. Needless to point out that there are better alternatives from a climate perspective. Even if emissions trading creates windfall profits that could have been used for climate friendly investments, it would appear that additional instruments should be used to offer adequate incentives for covered entities to channel such windfall profits towards climate friendly alternatives. Command and control type of regulation[11] could be used, for example, to prevent the building of new coal fire power plants. The requirement for attaining a building and operation permit for a coal fired power plant could be made conditional upon phasing out less efficient power plants, or the required efficiency level of new plants could be increased.

4.3 Economic downturns

Economic downturns occur occasionally. An economic downturn puts businesses and consumers under financial constraints and often reduces public acceptance of climate policy measures. In addition, an economic downturn may also directly impact the short- or long-term effectiveness of the climate policy instrument. If an instrument mix is used to attain a climate target and one of the instruments relied upon performs less well, other instruments need to be sharpened to mitigate risks that all aspects of climate policy targets will not be reached.

[10] Production costs increased because tradable allowances represent a production input and have a market value.
[11] See section 2.2.

Command and control type of regulation and carbon tax rates do not change with the (macro) economic situation. This is different, however, for ETS. Demand for emission allowances declines when economic activity contracts and thus the price for such allowances declines as well. This means that allowances are cheaper, and it is easier for companies in economically difficult times to meet their compliance obligations. This is generally deemed to be desirable. Under a cap-and-trade emissions trading system the environmental effectiveness is safeguarded. The depleted allowance price, however, reduces the investment incentives for green technology and thus impedes the climate transition of the economy, thus impacting the long-term effectives of the climate change policy. Here other instruments can be used in addition to reinforce the attainment of all climate policy targets. An example from the EU experience will show this point.

The European climate policy consists of three pillars: energy efficiency, emissions trading and renewable energy.[12] The flagship of the policy instrument mix is the EU ETS. Its allowance prices should in effect drive investments in renewable energy and energy efficiency. The EU ETS started with a learning by doing phase. Since the allowance price is determined by demand and supply, forecasting allowance prices was at that stage inherently difficult but the European Commission suggested that it would be around 30 Euros per ton of CO2 equivalent. Market actors were also convinced that the market was short, i.e. that supply of emission allowances was limited, and market prices quickly approached 27 Euros per ton of CO2. Following the first words of caution of the European Commission that the market was long, the allowance prices halved by May 2006 and by October of the same year were at around 10 Euro cents. There was thus an over allocation of emission allowances that some national governments have been affording covered entities.[13] Since the first trading phase was presented from the beginning as a 'learning by doing' phase, and actual emissions data was available to re-calibrate the emissions trading system, trust in the EU ETS persisted and allowance prices for the second trading phase increased initially towards 30 Euros.

By end of 2007 the global economic downturn of the Great Depression (2007-2009) had taken hold of the European Union and economic activity declined. By the time the economic crisis unfolded its full impact, the rules for the 2009 reform preparing the third trading phase (2012-2020) had already been drafted. This effectively obstructed the taking of swift responses to the excess supply situation that emerged as a result of the declining economic activity. Naturally allowance prices fell again (to 3.5 Euros in 2013) as it became apparent that there were too many allowances available for purchase, rendering the market long until 2023-2024. Given that the EU ETS was designed as a cap and trade system, it did not impair the realization of the Union's short term EU ETS climate emissions targets. These were realized, at lower costs. The transition of the economy did, however, not take place and the transition in flanking policy fields of energy efficiency and renewable energy did not materialize as it was hoped. Covered industries did not decarbonize and renewable energy transition and energy efficiency policies were lagging behind.

In order to support the effectiveness of the flanking policy fields, other instruments are needed. These could take many different forms including inter alia subsidies, feed-in-tariffs, production quotas, etc. This example underlines the important insight that at times of economic downturn other instruments in an instrument mix need to take over in case an emissions trading system does not set an adequate price to incentivize investments in green technology.

In the alternative, the emissions trading system could be designed to avoid long term depression of the allowance price. Also, here the EU ETS can serve as an example. Under the EU ETS the excess supply problem was addressed by several complex steps: the use of offsets was severely restricted, by back-

[12] See also Stefan Weishaar, Kateryna Holzer and Bingyu Liu, Incentivizing carbon transition – a comparison of carbon trading in the EU and China (2022) in Reins, L., and Verschuuren J. (eds.) Researach Handbook on Climate Change Mitigation Law, Edward Elgar.

[13] Entailing that the non-covered sectors of the economy had to sholder a higher burden of the emission reductions to realize national climate targets.

loading (postponing) the auctioning of allowances to the end of the third trading phase, by increasing the annual carbon emission reduction factor and by introducing the market stability reserve (MSR) that was later strengthened. It took several years until the excess supply situation was effectively addressed. More simple measures, such as reserve price auctioning that could have been quicker in addressing such a situation, were deemed to be politically undesirable.

The examples above underscore the need for a pragmatic approach to the instrument design and the policy objectives and that it is important to have an environmental policy in place that is capable of dealing with economic downturn situations.

4.4 Waterbed effect

The waterbed effect encapsulates the idea that a push-down in one policy area leads to an increase somewhere else. Emissions are thus mainly displaced and not actually reduced. A waterbed effect can arise in conjunction with a carbon tax or a command-and-control measure. These two situations will be presented below.

Firstly, when carbon taxes and emissions trading systems operate side by side, highly relevant interactions for both covered entities and the environment arise. The example of a 'waterbed effect' presented below stems from the experience of the EU ETS, where the ETS is broader in its jurisdictional scope than national carbon tax schemes.

The EU ETS constitutes a policy field that is governed by harmonized EU legislation, leaving Member States little sovereignty to adopt their own measures. National measures are only permitted in so far as they do not interfere with the EU ETS. Since for Member States the route of altering the EU ETS is effectively foreclosed, many have opted to introduce their own carbon taxes instead. These tax schemes can also apply to aspects that already fall under the EU ETS, entailing that there might be an additional administrative and economic burden on those entities. Importantly, however, there is an additional implication of this interaction. Carbon emission reductions undertaken by individual EU Member States and that have the effect of reducing the emissions of companies that are covered by the EU ETS have very little impact on overall European emissions because the emission allowances that are 'saved' in one jurisdiction are available for use by companies in other jurisdictions (a displacement effect). Moreover, the overall emission allowance prices are depleted as overall demand is reduced, entailing that relevant investments in climate transition may not take place, and that also fewer investments in energy efficiency and renewable energy may be incentivized by the EU ETS. The overall environmental effect of domestic carbon tax schemes is thus diluted through the EU ETS.

Secondly, a waterbed effect can also arise in conjunction with a command-and-control measure. For example when a coal phaseout policy is to be augmented by a carbon pricing instrument to reinforce carbon mitigation efforts across several sectors. If the carbon pricing instrument also extends to energy and heat generation, instrument choice is critical. Generally there is a choice between a carbon tax or an ETS. A carbon tax levied across several sectors will reinforce climate efforts. By contrast an ETS will give rise to a waterbed effect that reduces the instrument's effectiveness. The price of emissions trading allowances, even if based on a cap and trade scheme, will decrease with the coal phase out. This reduces the carbon emission price and the measure's effectiveness. In such contexts a carbon tax may offer a stronger and more reliable price signal and incentive for industry to invest in carbon efficient technology.

4.5 Excise duties on electricity and ETS

The EU ETS was introduced in 2005 to cover greenhouse gas emissions. Before then, the EU Energy Tax Directive (ETD) (excise duty on energy products) was introduced in 2003 to widen the scope of the minimum tax rate system of 50 Eurocents per Mwh on electricity out-put to all energy products, including coal, coke, natural gas and electricity so as to set incentives to enhance energy efficiency, to introduce some harmonization in the market and to reduce emissions. Prior to the ETD, mineral oils such as gas oil and gasoline, were already covered by harmonized EU legislation since 1993. The EU ETS thus puts a price on carbon emissions at the point of electricity generation while by contrast the ETD puts an excise duty on electricity output independent of the fuel inputs. Both instruments have the effect of increasing energy prices and are therefore to a certain degree overlapping in scope.

A comparison of the cost burden created by the ETD and the EU ETS during the years 2008-2013, where the EU ETS allowance prices per ton of CO2-equivalent were around 13 Euros, shows that the ETD is an important complement to the ETS in setting an implicit carbon price for electricity by way of an excise duty on the consumed electricity.[14] Often the cost burden created by the ETD is that of the EU ETS. It has, however, also been shown that the cost burden of energy taxes is lower for countries with more carbon intensive electricity generation, especially in the case of large enterprises, thus failing to make polluters pay more. Here the EU ETS was clearly more successful. This example shows that even though combining two systems, an ETS on greenhouse gas emissions and an energy tax levied at consumption level, can have important synergy effects, even though of course it does lead to overall higher costs.

4.6 Biofuels and sustainability, land use changes and competition concerns

Replacing fossil fuels with biofuels can, especially for countries with rich biofuel raw material resources, be part of the road towards reaching set climate goals by reducing carbon emissions. On the other side, production chains of these biofuels, from feedstock production to end use, need to be sustainable to not be in conflict with other goals set to help achieve sustainable development. One example is the sustainability criteria laid down in EU legislation, ensuring that biofuels which may be used to fulfill set climate targets or receive subsidies must fulfill certain detailed criteria, for example relating to land-use changes for different crop groups and respecting limits for quantity of crop-based biofuels. Exempting biofuels from a carbon tax may in some jurisdictions, as in the EU, be considered as a state aid (subsidy) which can only be granted under certain conditions.

Laying down not only detailed provisions relating to reduced carbon emissions but also setting quantitative limits for certain biofuels may be considered as an unnecessary administrative burden with little value added in the case of a country endowed with forest resources and already applying strict agricultural and forestry policies and thus likely to be using these resources for biofuel production as one way of reaching climate targets. Such a quantitative restriction would be readily apparent and easily applicable for jurisdictions where the forestry sector is smaller or less sustainable and more biofuel would derive from land use changes. A policy maker assessing the fuels to be covered by a carbon tax thus may need to consider restrictions that may occur from other parts of the country's legislation, such as sustainability criteria, ways to fulfill national climate targets and competition law. In particular this may give rise to interaction and conflict if the same rules should apply to multiple jurisdictions. Moreover, concerns relating to the distortion of competition can give rise to derogations and thus place additional burden on administration and companies alike. At the same time it may undermine the environmental effectiveness of the tax measure.

5. Conclusion

This text presented the advantages and disadvantages of the main policy instruments that can be used to fight climate change from an interdisciplinary Law & Economics perspective. Each instrument has its particular strengths and weaknesses, and is employed in country specific contexts. Several examples of different instruments used in different jurisdictions have been described to show different approaches that are followed in practice.

Any choice of instruments must take diverse considerations into account. Special attention should therefore be paid to what is actually feasible, both in terms of administrative capacity, as well as

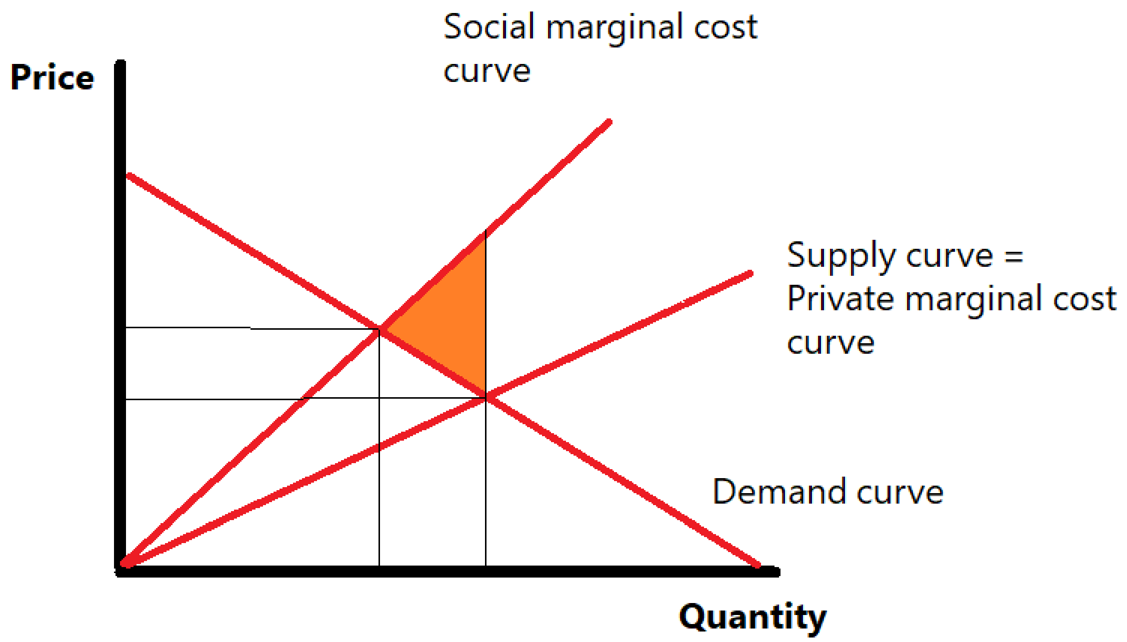
[14] This passage is based on Weishaar, S.E. (2017), 'Energy taxes, energy prices and competitiveness' in Villar Ezcurra, M. (ed.). State Aids, Taxation and the Energy Sector. Thomson-Reuters-Aranzadi, Madrid.

economically and socially. Policy makers need to balance different societal interests and clearly determine their policy objectives in order to be able to select an instrument and to determine its precise design features so as to realize the long-term climate policy ambition and to set adequate investment incentives to foster climate transition.

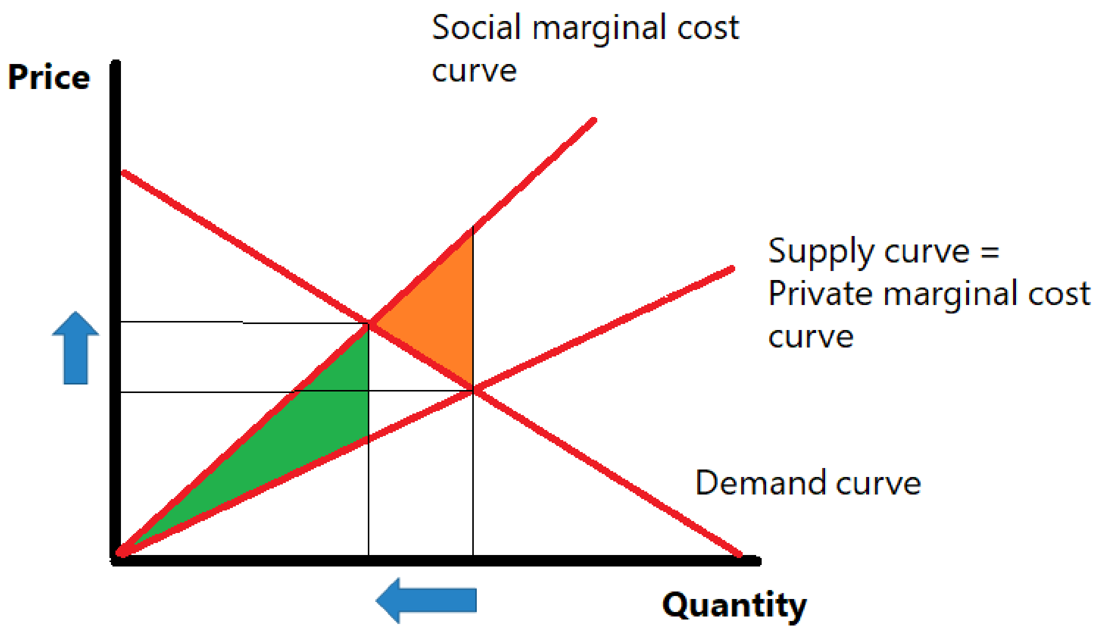
Oftentimes not a single instrument but a combination of various carbon policy instruments will be employed. These should ideally work in harmony with each other. These are commonly described as 'smart mixes'. Instrument mixes may combine pricing instruments such as carbon taxes and emissions trading with regulatory command and control type of measures, but could also extend to other public law fields (procurement rules, criminal law and procedural rules relating to access to information and justice) and specific regulatory instruments such as corporate codes of conducts or labeling and certification. When several instruments are combined, they will often impact each other. They can be reinforcing, they can be neutral or they can be countervailing. This text has highlighted several pitfalls for consideration by policy makers. These pitfalls relate to windfall profits, economic downturns, the waterbed effect, interactions between energy taxes and emissions trading systems, and between carbon tax design of biofuels and land use changes discussed in section 4.

Annex: Technical note on carbon taxation

The idea of using taxation to address pollution dates back to Arthur Cecil Pigou's seminal work on 'The Economics of Welfare' (1920). The basic idea is that pollution creates a detriment to society that is not taken into account by the private decision makers, the polluters. When pollution is costless for polluters, it is external to their decision making process. We thus describe pollution as an 'externality', as something that is not considered by decision makers. Externalities are thus detriments caused to society by production that are not taken into account by producers since they do not form part of their production costs. At the market equilibrium, the intersection between the private marginal costs and the demand curve, externalities are generated that are not compensated by societal benefits. This is represented by the orange triangle in the graph.



Society would be better off if we were able to produce at the intersection of the social marginal cost curve and the demand curve. At this new equilibrium prices are higher and the quantity lower, but society is better off because pollution is avoided. According to Arthur Cecil Pigou one can achieve this by simply introducing a tax covering the vertical distance between the private and social costs for each level of output. Economists describe this process as 'internalizing the externalities', as bringing the social costs into the market price mechanism of private actors. Graphically this is shown by the green area.



For each unit of production polluters will take full note of the societal costs. The externalities have been internalized, brought into the market price mechanism and are thus part of the decision-making process of producers.

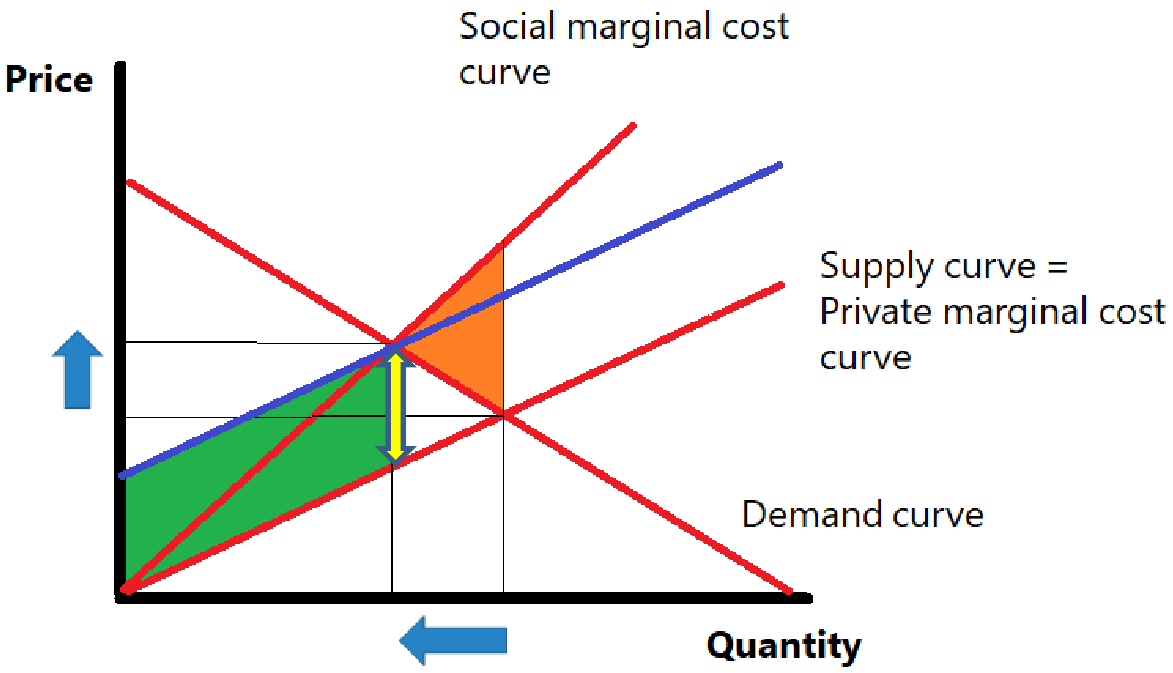
The Pigouvian tax is a beautiful theoretical idea! But setting an optimal Pigouvian tax is very difficult – to say the least. There are many practical information problems.

To set an optimal Pigouvian tax for climate change one needs to have at least adequate information on at least the following issues:

- assessment of the environmental damage for each level of production
- information on the marginal production costs for each level of production
- intergenerational assumptions on preferences
- assumptions on adaptation and technological change
- information on the discount rate.

Although the theory of externalities and Pigouvian taxation are the conceptual frameworks behind determining carbon tax rates, in practice there are more realistic approaches such as the 'Standard and Price Approach', which was proposed by Baumol and Oates in 1971. They proposed that the government should set an acceptable pollution level and set a tax in such a way that the desired pollution level would be reached.

This approach bears tribute to the information problems which are troubling Pigouvian taxes. A tax in the Baumol and Oates tradition can also lead to the full internalization of externalities. Full internalization will be achieved if the social optimal level of production is taken as a starting point. The tax rate to be levied simply needs to be equivalent to the difference of the social and private marginal cost at this socially optimal quantity. This is indicated by the yellow arrow. The tax rate is applied uniformly to each level of output. The amount of tax revenue raised by the government is larger than that of a tax in the Pigouvian tradition.



In case determining the optimal standard is challenging, the Standards and Price Approach can be further simplified by setting an emission reduction target (the pollution standard) and a tax rate (a carbon price) consistent with a country's already existing climate change goals.

This approach avoids the complexity of having to identify the social optimum level of output or the optimal tax rate. Commitments under the Nationally Determined Contributions (NDC) can for example serve as the standard. Given the high level of uncertainty in setting the effective carbon tax rate, an initial carbon price can be set and adjusted by trial and error over time so as to reach the target.

It does require, however, strong and continued political commitment because the tax rate must be adjusted regularly solely on the basis of environmental objectives. For more information on practical approaches to carbon taxes see the UN Handbook on Carbon Taxation chapter 5.