ANNEX E-1 to E/C.18/2024/CRP.7

Draft paper from the Subcommittee on Environmental Taxation for discussion and first consideration by the Tax Committee in March 2024

Other Environmental Measures other than Carbon Taxes

This paper on Workstream 5 comprises eight sections and an appendix. The appendix, titled "*Inventory of Select Environmental Taxes and other Measures*", is provided as ANNEX E-2 to E/C.18/2024/CRP7.

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1. Introduction

Using taxes to influence harmful behavior has long been at the center of many countries' environmental policies. The most prominent example of an environmental tax is the carbon tax. Putting a price on carbon emissions, such as through a carbon tax, has been identified as a key mechanism to combat global warming. One advantage of imposing a price on greenhouse gas (GHG) emissions, rather than regulating specific activities or relying on voluntary emissions reductions, is that it provides a market-based incentive for their reduction and tax revenue for the government. GHG emissions are however not the only environmental problems that countries face. Air pollution and littering, which primarily impact the local environment rather than the global one, pose additional challenges. Even these challenges can be addressed through the polluter-pays principle. Examples of environmental taxes beyond carbon taxes include taxes on sulfur, nitrogen oxides, plastics, and pesticides.

This paper aims to present practical guidance on how developing countries can employ environmental taxes to achieve national environmental and policy objectives. The paper looks at various types of measures and uses real-life examples that are of particular relevance for developing countries.

Section 2 of the paper provides some country examples of taxes successfully targeting air pollution. Air pollution is a growing concern in developing countries due to urbanization and industrialization, leading to premature deaths and health issues. The World Health Organization (WHO) recognizes air pollution as a leading environmental cause of premature death.[1] Many countries, including China, Chile, and Denmark, have implemented tax programs to reduce air pollution, targeting pollutants or polluting behaviors. These taxes vary in their approach, with China's Environmental Protection Tax focusing on pollutants, Chile's Green Tax addressing both pollutants and behaviors, and Denmark's Sulphur Tax offering options for levy. These taxes have shown positive effects in reducing air pollutants and protecting local air quality.

Section 3 looks at plastic taxes which can be aimed at addressing littering and resource challenges. They offer a market-oriented approach compared to bans on plastic bags. Case studies from Denmark, Ireland, South Africa, South Korea, and the United Kingdom (UK) showcase producer-focused and consumer-focused models. Producer-focused approaches, like those employed by South Korea and the UK, target manufacturers and importers, driving innovation and promoting the use of sustainable materials. Consumer-focused approaches, as seen in Ireland and South Africa, levy taxes on single-use plastics to directly impact consumers. The discussion in the section shows that these taxes have proven effective in reducing plastic waste and promoting recycling.

[1] Air Pollution Note – Data you need to know (unep.org)

Section 4 offers guidance to developing countries on designing energy taxation strategies, with a focus on electrification. It highlights the importance of excise duties (fuel taxes) in energy pricing and their potential as a policy tool. Practical examples from Finland, Indonesia, and the Netherlands demonstrate how taxation can support decarbonization efforts and the adoption of cleaner energy sources. In Finland, a harmonized approach integrates carbon taxation into the wider energy taxation framework, providing a model for countries with existing or planned carbon tax regimes. Finland's energy tax regime also benefits biofuels, which can help reduce import dependency and promote decarbonization. Indonesia's measures, including value-added tax (VAT) reductions for electric vehicles and exemptions for renewable energy projects, demonstrate how indirect taxation can support decarbonization efforts and foster the adoption of renewable energy sources. The Netherlands' approach includes reduced rates for electricity used by electric vehicles and lump-sum support for energy consumption, encouraging energy savings and investment in energy-efficient appliances. Overall, the section shows that energy taxation can play a dual role, generating revenue and promoting sustainability in energy consumption.

Section 5 discusses the energy transition from fossil-based energy to renewable sources, emphasizing its significance in addressing climate risks and opportunities. Developed countries have successfully adopted renewable energy as a cost-effective electricity source, while developing countries face challenges due to the prohibitive costs of transitioning. For some developing countries taxing the oil and gas sector remains a major revenue source for revenue. These face a particular challenge when they transition towards less emitting energy production as this may affect a country’s revenues.

Section 6 sheds light on pesticide taxes. Pesticides, essential for boosting agricultural productivity and food security, simultaneously pose significant environmental and health risks due to their pervasive use. Taxing pesticides can help by balance productivity with ecological and health concerns.

Section 7 explores water and sewerage taxes, vital for community well-being and sustainability. It illustrates the purposes, types, policy design considerations, and presents case studies. These taxes fund infrastructure and environmental protection, mainly at the local level. Challenges in tax design and administration highlight the need for strategic policy formulation. Through innovation and collaboration, governments can ensure equitable access to clean water, economic efficiency, and environmental sustainability.

Section 8 explores the role of petroleum taxes in advancing the global energy transition and fostering environmental consciousness within the petroleum industry. Traditionally revenue generators, these taxes can incentivize sustainable practices and clean energy investments, aligning fiscal objectives with environmental imperatives. Country examples from Nigeria, Norway, and Trinidad and Tobago illustrate diverse regulatory frameworks and practices for managing emissions and promoting sustainability. Continued collaboration, innovation, and adherence to international standards are essential for fostering sustainable petroleum activities globally.

Finally, the paper provides for an inventory of tax measures that can be used by developing countries for dealing with specific environmental problems. The aim of the inventory is to provide countries with initial insights into the implementation of other environmental taxes in other countries and to offer relevant information on such measures. The inventory can serve as a resource for countries to address the various environmental challenges they may be facing. The inventory takes a broad approach to different tax measures that could, in one way or the other, be of environmental relevance. The inventory is presented as an appendix to this paper and is provided in ANNEX E-2 to E/C.18/2024/CRP7.

2. Air pollution tax

2.1 Introduction

As urbanization and industrialization continue progressing in developing countries, air pollution become a critical threat to human health and quality of life. According to the estimation of the WHO, air pollution has become the leading environmental cause of premature deaths.

There are primary and secondary air pollutants. Primary pollutants are directly released into the atmosphere, including particulate matter (PM), sulphur dioxides (SO2), nitrogen oxides (NOX), ammonia (NH3), carbon monoxide (CO), and methane (CH4). On the other hand, secondary pollutants are generated in the atmosphere through chemical reactions and microphysical processes from precursor gases, including PM, ozone (O3), NO2 and several oxidised volatile organic compounds (VOCs). These pollutants can be from many anthropogenic activities, such as burning fossil fuels in electricity generation, transport, industry and households, industrial processes, agriculture and waste treatment.

Taxes have been adopted in many countries to reduce air pollution, often targeting either specific pollutants or polluting behaviors. Directly levying the tax on targeted pollutants is straightforward, where taxes are either applied to pollutants emitted to the atmosphere, such as the concentration of the SO2, or the polluting content, such as taxes on road fuel with different sulphur content of gasoline. Taxes on polluting behaviors can be indirect and sometimes need to reply on proxies or intermediate goods, such as taxes on coal use aiming for sulphur emissions reduction.

We select three countries' tax programs that help reduce air pollution, including China's Environmental Protection Tax, Chile's Green Tax, and Denmark' Sulphur Tax. These three case studies have relatively wider geographic representation, and the tax programs in China and Chile only target at pollutants, while Denmark's case focuses on both pollutants or polluting behaviors. While the Chilean green tax program covers carbon dioxide (CO2) emissions, this section will exclude CO2 and instead concentrate solely on other key air pollutants observed across the case studies, including PM, SO2 and NOx. Carbon taxes are discussed in other UN Tax Committee environmental work, including in the 2021 UN Handbook.

2.2 Country case studies

2.2.1 China’s environmental protection tax

China's environmental protection tax (EPT) law took effect on 1 January 2018, aiming at addressing environmental issues. Despite its relative infancy as at the time of writing, the EPT replaced the Pollutant Discharge Fee (PDF), which had been in place for about 40 years at the time of its repeal. The evolving progress of PDF and the final adoption of EPT reflect China's continuous efforts in prioritizing environmental protection in its strategic objectives. While the EPT retains the same four categories of pollutants – air and water pollutants, solid waste and noise pollution – it has a stronger legal, executive, and binding force, compared to the PDF. Notably, the EPT imposes taxes on 44 major air pollutants, including SO2, NOx, and PM2.5, contributing to environmental protection efforts.

EPT implements a dynamic tax adjustment mechanism that allows each province to set their own tax rates within the range between 1.2 and 12 yuan per unit of pollution equivalent under the guidance of the central government. In practice, provinces consider their tax rates by generally striking the balance between environmental impacts and budgetary capability to deal with the pollution. As of the time writing, three tiers of tax rates are observed among different provinces: the highest tax rate is between 4.8 and 12 yuan per pollution equivalent in six provinces such as Beijing; the middle level is between 1.8 and 3.9 yuan per pollution equivalent in 12 provinces such as Shanxi; and the lowest level is 1.2 yuan per pollution equivalent in 12 provinces such as Heilongjiang. The equivalent value of atmospheric pollutants in China’s environmental tax is determined both through a combination of direct measurement and estimation. The direct measurement usually requires either installing automatic monitoring devices or third-party monitory bodies. The estimation can be done by applying the pollutant-production ratio.

EPT also has a tax deduction scheme, which provides economic incentives for enterprises to change production patterns. For example, when the concentration of levied air pollutants is 30% or 50% lower than the standards, the tax credits are eligible for 75% or 50% deduction.

It is widely agreed that EPT has played an important role to help China progressively achieve pollutant reductions. In 2020, emissions of SO2 and NOx have decreased by 3.5% and 3.1% per year respectively, and pollution equivalents per 10,000 yuan of GDP output has declined from 1.16 equivalents in 2018 to 0.86 equivalents in 2020 with the decrease of 25.8%.

2.2.2 Chile’s green tax

Chile faces significant challenges arising from local environmental pollution, including health problems and early deaths caused by intensive economic activities, geographic and climatic conditions, and patterns of production and consumption. In its updated Nationally Determined Contributions (NDC),

Chile pledged to reduce GHG emissions to 95 MtCO2eq by 2030 and achieve net-zero emissions by 2050.

Consistent with its emission reduction ambitions, Chile introduced the first Latin-American green tax on air pollutants in 2017. It covers not only CO2 emissions, but also local air pollutants such as PM2.5, NOx, and SO2, which directly affect communities in areas where emitting industries are located. The tax targets both on stationary and mobile sources.

It specifically targets stationary sources, including power generation plants and boilers used in industries such as pulp and paper, fisheries, mining and other industrial sectors. The tax rates on PM2.5, NOx and SO2 are set by considering three variables: the social cost of pollutants, the population in the municipality where the emitter is located, as well as an air quality coefficient that depends on the level of local population on each municipality. Take the air quality coefficient as an example, a tonne of pollutant emitted in a saturated zone with a large population will cause greater damage than that being emitted in a zone with a smaller population and lower pollutant concentration. Therefore, the tax is weighted according to the respective air quality coefficients for each zone.

With regard to mobile sources, the tax only applies to light-duty vehicles, with exemptions in certain cases. The tax rates are applied based on the fuel efficiency, the NOx content level and market price of the vehicle.

2.2.3 Denmark's sulphur tax

To meet its international and unilateral environmental commitments, Demark introduced the sulphur tax in 1996. It applies to boilers burning coal and oil in household and industrial sectors, with the aim to encourage the use of low-sulphur-content fuels. The tax does not apply to fuels with a sulphur content less than 0.05%, which excludes petrol, kerosene, and light diesel.

Compared with the programs in China and Chile, the Danish sulphur tax program provides two options for boiler owners liable to the tax, namely being levied either on the sulphur content of the fuel (actual emissions of sulphur dioxide (SO2)), or on the behavior of using the fuel (similar to fuel tax). The intention of the Danish authorities providing options to the polluters is to motivate actions of removing the sulphur dioxide from the flue gas before injecting them into the atmosphere. However, direct-emission-based levy became less relevant in reality, as it requires installation of the equipment to measure emissions.

The tax rates have been revised from time to time since implementation of the tax. For example, in 1996, the rate was set to 20 DKK per kg sulphur in fuels or 10 DKK per kg SO2, and it increased to 24.2 DKK per kg sulphur in fuels or 12.1 DKK per kg SO2 in 2021.

2.3 Conclusion

Unlike carbon tax dealing with global pollution, air pollution tax aims to protect local air quality and revenues generated from its implementation are likely to go back to the local community. Hence, it is particularly important to align with local circumstances, which should be reflected in the tax program design. In this spirit, four specific lessons are worth highlighting:

- Applying the flexible tax rates: In China and Chile's cases, the central authorities allow the local tax rates to be determined to meet local needs.
- Returning the revenue to the locals: In these three cases, tax deductions of China, tax revenue recycling of Denmark, tax credits of Chile are applied to incentivize the local actions.
- Providing alternative tax base: Denmark provides options of levying tax on pollutants or polluting behavior, to encourage the use of emissions reduction technologies.
- Synergizing the reductions of carbon and air pollutants: the tax should prioritize its liable activities to maximize the climate and environmental benefits.

Table 1: The comparison of air pollution taxes in China, Chile and Denmark

Features	**China' environmental protection tax**	**Chile' Green Tax**	**Denmark' Sulphur Tax**
Applying the flexible tax rates	YES	YES	NO
Returning the revenue to the locals	YES	YES	YES
Providing alternative tax base	NO	NO	YES
Synergizing the reductions of carbon and air pollutants	NO	YES	YES

3. Plastic taxes

3.1 Introduction

Taxing plastics is a policy that is used by numerous countries at different stages of development. Plastic taxes represent a market-based instrument in the repertoire of tools available to policymakers aimed at addressing the ecological and resource-related challenges posed by plastic pollution. Plastic taxation can occur in two ways: at the level of consumption, or at the level of production.

Taxing the production of plastics provides incentives to reduce the overall use of these materials which are predominately based on fossil fuels.[2] Taxes at the producer level also tend to lead to technological innovation of sustainable materials and packaging, aiming to curtail plastic waste at its origin.[3]

At the level of consumption, the practice is for countries to impose a small charge on the final consumption of a plastic product (for example, a plastic bag), with the objective of instilling a change in consumer behaviour – most often aiming at combatting plastic pollution, i.e., littering. The small charge is not meant to act as a revenue raiser since, as further demonstrated, revenue proceeds from the administration of this tax are quite low. Instead, the small charge is meant to alert the consumer to the fact that he or she is purchasing a bag and with that, stimulate him or her to carry a reusable bag instead of making a novel, unnecessary purchase of a single use plastic. Over time, the policy is geared towards lowering the consumption of plastics. However, taxes on plastics are not the only way that countries can address the adverse environmental effects of plastic pollution. Some countries, among them Kenya and Rwanda have opted for banning plastic bags to solve environmental problems due to littering.

The section below presents a few country examples for taxing plastics. The examination of these models provides an overview of the varied strategies and effects of plastic taxation in tackling the pressing issue of plastic pollution. The examples include countries from different stages of development and taxes at the producer and consumer level. Denmark, South Korea, and the United Kingdom serve as examples of the producer-focused approach. Conversely, Ireland and South Africa have introduced taxes on consumers. The latter approach aims to influence consumer behavior directly with the goal of reducing the usage of use plastics bags with the goal of curbing littering.

3.2 Country examples

3.2.1 The United Kingdom's plastic packaging tax[4]

Effective from 1 April 2022, the UK government's Plastic Packaging Tax (PPT) is a producer-focused measure. The tax's primary goal is to give firms an incentive to use more recycled plastic packaging. This is aimed at increasing the recycling and collection of plastic garbage, preventing it from going to a landfill or being burned. It mandates that imported or domestically manufactured plastic packaging must comprise at least 30% recycled material. Failing this, a tax is levied at a current rate of £210.82[5]

[2] Another aspect to consider is that petroleum products are important input for making plastics. As such there is an argument to be made for including these inputs in a comprehensive carbon tax.

[3] There are a number of studies showing that environmental taxation has a positive impact on innovation and technology adoption. Among them are Jaffe et al (2002), Aghion et al (2016) and Brown et al (2022). Another aspect to consider is that petroleum products are important input for making plastics. As such there is an argument to be made for including these inputs in a comprehensive carbon tax. See also T. Falcao, A Climate Treaty for the Global Taxation of Carbon, International Centre for Tax and Development, March 2024 (forthcoming).

[4] https://www.gov.uk/government/collections/plastic-packaging-tax

[5] Google spot currency conversion rate on 23 November 2023 is adopted throughout this case summary to convert native currencies into Euro.

(around 242.52 Euro) per ton of plastic packaging. The PPT's expected effectiveness lies in incentivizing producers and importers to shift away from single-use plastics and stimulate the upstream industry of the supply chain to develop more cost-effective recycling technologies. Furthermore, the PPT is projected to yield an annual revenue of approximately £ 220 to 240 million (between 253 to 276 million Euro) for the UK Treasury (WTS Global, 2022). It also aligns with the EU's advocacy for extended producer responsibility (EPR), which strives to hold producers responsible for the environmental impacts of their products.

3.2.2 Republic of Korea's waste disposal charge system

Similar to the UK, manufacturers and importers of plastic products are held financially accountable for the environmental impact of their plastic products in the Republic of Korea. The system levies charges on the production and import of plastic products, especially those that are non-recyclable or environmentally damaging. This includes various forms of single-use plastics, certain packaging materials, and other plastic goods that pose recycling challenges. The charges collected are used to support initiatives for managing plastic waste. This includes funding for recycling facilities, research into new recycling technologies, and projects aimed at reducing plastic waste generation.

Under the Waste Disposal Charge System managed by the Korea Environment Corporation (KECO), specific charges are applied to plastics to encourage recycling and reduce waste. These charges vary based on the type and amount of plastic used. For instance, charges are levied on plastic containers of pesticides and toxic products, at varying rates depending on the size of the container. For plastic containers less than or equal to 500 ml, the charge is 24.9 KRW (appx. 0.018 EUR), and for those over 500 ml, the rate is 30.7 KRW (appx. 0.022 Euro). The charges for plastic products in general are calculated per kilogram of synthetic resin contained, with different rates for general use (150 KRW/kg, appx. 0.11 Euro/kg) and construction use (75 KRW/kg, appx. 0,053 Euro/kg).

Notably, the Korean system also offers reduced rates to businesses that deal with significant amounts of plastics, thus limiting the effectiveness of the policy for with respect to large businesses.[6] Manufacturers qualify for a charge reduction if they use at least 10 tons of plastic annually or if their plastic usage contributes to 1 billion KRW (appx. 705,512,30 Euro) of their total annual sales. The reduction is calculated by multiplying the amount of synthetic resins used by 1 billion KRW (appx. 705,512,30 Euro), divided by total annual sales. For importers, a reduction is available if they import at least 3 tons of plastic annually or if their plastic imports amount to 90,000 USD (appx. 82,516,95 Euro) at CIF price annually. This is calculated by multiplying the amount of synthetic resins used by 90,000 USD (82,516,95 Euro), divided by the annual import amount.

[6] See Martinsson et al (2024) for the effect of reduced rates on the limited effectiveness of environmental taxes.

3.2.3 Denmark's plastic tax

The practice in Denmark is also producer-focused and extends across the upstream supply chain of plastic packaging. By imposing a tax, it effectively discourages the utilization of single-use plastic bags, thereby reducing the amount of plastic waste that ends up in landfills and incineration facilities. Relevant EU data shows that the number of plastic bag consumption has halved from 800 million to 400 million since the introduction of plastic tax in Denmark (TaxEDU, 2019).

As documented by WTS Global (2022), in Denmark, an excise duty is imposed on plastic carrier bags. This tax was first introduced on 1 January 1994, and was most recently increased on 1 January 2020. For the years 2021 to 2023, the rate is set at DKK 69.63/kg (appx. EUR 9.30/kg). From 2024 onwards, the rate will be DKK 73.46/kg (appx. EUR 9.80/kg). Businesses involved in the manufacturing or importing of plastic bags are responsible for paying this duty and must comply with specific registration and reporting obligations. They are required to register and report the taxable quantity of plastic bags on a monthly basis. Additionally, businesses involved in wholesaling of plastic carrier bags have the option to voluntarily conform to this duty.

3.2.4 Ireland's plastic bag levy[7]

According to the MARLISCO (n.d.) project, Ireland introduced a consumer-focused plastic bag levy in March 2002, initially set at 15 Euro cents per bag, later increased to 22 cents in 2007. Retailers are required to charge this levy for each plastic bag, with the proceeds going towards environmental protection initiatives. The levy led to a dramatic decrease in plastic bag consumption, with an estimated 94% drop in usage shortly after its implementation.

In the latest report by Institute for European Environmental Policy (2022), survey data from 2014 indicates that plastic bags constituted only 0.13% of litter pollution, a substantial decrease from the estimated 5% prior to the levy's implementation. This represents a 40-fold reduction in plastic bag litter since the year 2002. Furthermore, a study by Newman et al. (2013) found that the presence of plastic bags in marine litter also decreased markedly, from 5% in 2001 to just 0.25% in 2010. These figures demonstrate the effectiveness of the levy in drastically reducing the environmental impact of plastic bags in Ireland, both on land and in marine environments. According to Convey et al (2007) it turned out that the plastic bag tax turned out to be a very popular tax that was universally supported in Ireland.

3.2.5 South Africa's plastic bag levy[8]

Contrary to the stringent prohibitions on plastic production and usage implemented by other African nations like Kenya and Rwanda, South Africa has adopted a multifaceted approach to plastic management. This strategy encompasses measures such as the standardization of plastic bag sizes,

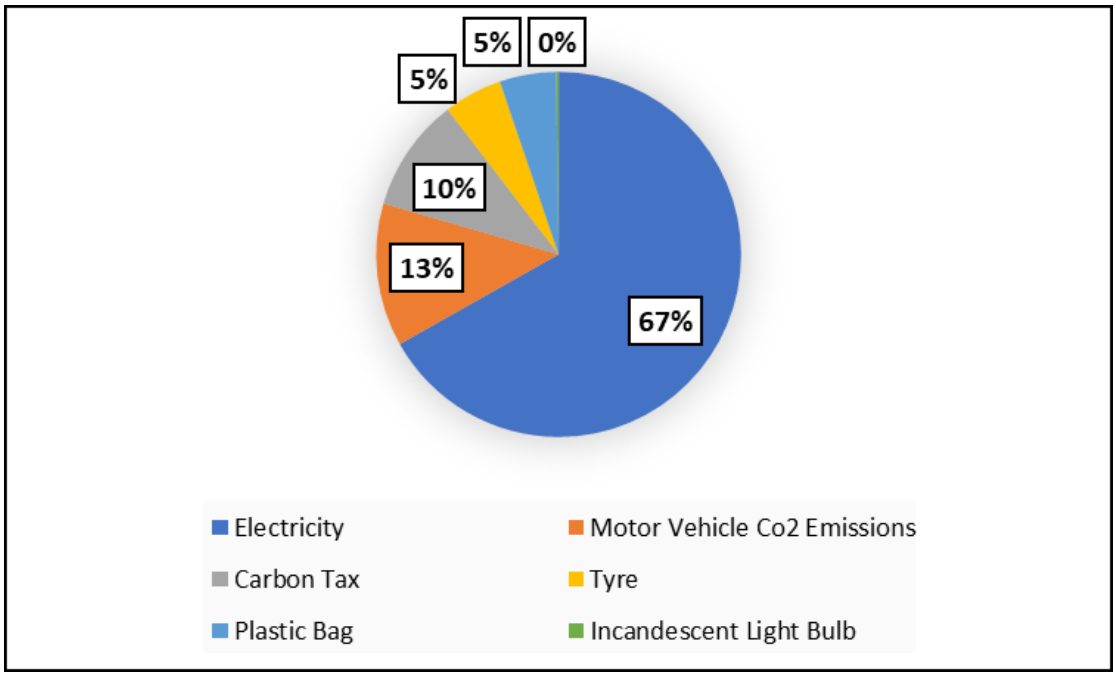
[7] https://www.revenue.ie/en/companies-and-charities/plastic-bag-environmental-levy/index.aspx
[8] https://www.sars.gov.za/customs-and-excise/excise/environmental-levy-products/plastic-bags/

regulation of the inks utilized on these bags, and the implementation of a levy on plastic bags to mitigate the environmental issues associated with white pollution.

Analogous to the Irish tax design (section 3.2.4 above), the South African plastic bag levy was introduced in 2003 and initially set at 46 Rand cents (appx. 0.022 Euro) but was later reduced to 32 Rand cents (appx. 0.016 Euro) due to the pressure and lobbying from plastic manufacturers. The charge also varies across retailers. Initially, there was a significant reduction in plastic bag manufacturing, up to 80%. However, after the reduction in the levy, plastic bag consumption began to rise again, indicating that a part of the initial effect was temporary. Overall, Dikgang et al. (2012) found that the fall in the consumption of plastic bags per real 1000 Rand of shopping was approximately 44%.

Figure 1 shows the revenue from the plastic tax and from other environmental taxes for South Africa. It shows that the revenue generated from it is not very significant, compared to other environmental taxes. For instance, in 2021, out of the six environmental taxes, plastic bag levy was the second least contributor, contributing R579.7 million for the year which is equivalent to only 5 percent of the total environmental revenue.

Figure 1 Annual Environmental Levies in South Africa for 2021



Source: South African Revenue Services

3.3 Conclusion

By introducing plastic tax countries can internalize some of the externalities associated with the use of plastic. As is typical for Pigouvian taxes it is necessary to adjust the level of taxation to induce or keep up the changes in changes in behavior. While some countries have opted for producer taxes others have

chosen to levy a tax on consumers. The effects of the taxes differ. A country that is concerned with littering may want to choose to tax consumption of plastic bags as this reduces the number of plastic bags used. The examples for consumer taxes shown above suggest that there are considerable behavioral effects of these taxes and that taxes may help countries to reduce the use of plastic bags and thereby decrease the number of plastic bags that can end up in the sea or nature. A tax on producers provides incentives for product innovation. It also incentivizes more efficient production processes or the use of recycled materials.

4. Energy taxes

4.1 Energy taxation as an accelerator of sustainable development

This chapter aims at providing guidance to developing countries on designing their energy taxation in the context of fast evolving energy technologies and markets. The guidance pays special attention to electrification. Electrification, a key driver of any country's energy transition, is progressing in developing countries: China is the world's largest electric vehicle (EV) market, EV sales in Indonesia, India and Thailand tripled in the last two years.[9]

Energy taxation consists of excise duties (fuel taxes) and Value Added Tax (General Sales Tax in some legislations). Energy excise duties are consumption taxes imposed on fuels used for transport and heating. Electricity and other energy products are also often but not always subject to excise duties. Energy taxation covers the energy consumption of industries, households, transport and agriculture. It varies from country to country to what extent energy taxation is used as a tool of industrial and social policy. In recent years energy taxation emerged in an additional role: as a tool of environmental and climate policy.

Energy taxation can be a potent policy tool. This is due to the fact that excise duties account for a sizeable share of total energy prices as of 2023. In India, excise duties make up about 26% of petrol and 21% gas oil prices respectively. In Turkey, the excise duty on petrol recently[10] almost tripled, reaching 19% of the price at the pump. In the United States, federal and state taxes make up on average 12% of petrol and 15% of gas oil prices. In the European Union the share of excise duties is even higher. Typically, over 20% of the total price both for petrol and gasoline. Electricity and natural gas excise

[9] International Energy Agency, Global EV Outlook 2023 (2023), Retrieved on: 29.07.2023. Retrieved from: https://iea.blob.core.windows.net/assets/dacf14d2-eabc-498a-8263-9f97fd5dc327/GEVO2023.pdf
[10] As of August 2023.

duties typically range between 8% to 12% in the European Union, depending on the consumer type and their volume of annual consumption.[11]

Excise duties also represent a sizeable share of revenue for governments around the world. Currently, fossil fuels used for road transport12 are taxed much higher in most legislations. A shift in these revenues is expected as electrification progresses. Consequently, the budgetary importance of electricity excise duties is expected to grow, alongside the taxation of fuels of non- biological origin. Such fuels, including hydrogen, are the cornerstones of complementing the role of electricity in the clean energy transition and sector coupling of countries around the world.

4.2 Practical country examples

This section provides guidance by introducing three country examples. It does not aim at fully describing the energy taxation of these countries. Instead, it focuses on highlighting the features that can help other countries to design successful energy taxation regimes.

4.2.1 Finland

Finland's energy taxation is subject to the European Union's Energy Taxation Directive[13]. The directive itself remained unchanged for two decades. The national energy taxation of several EU Member States, including Finland has evolved in the meantime. In the course of this evolution, Finland became one of the first countries in the world to shape its energy taxation into an environmental policy tool. A tool that supports the uptake of green technologies that replace the use of polluting fossil fuels.

Finland determines its final energy tax rates based on two components: carbon component and energy component. The carbon component is set according to Finland's carbon tax regime, which has been in place since 1990. In this sense, excise and carbon taxation are aligned. In other words, carbon taxation is integrated in the wider energy taxation framework. This alignment can serve as guidance for developing countries that already have in place a carbon tax regime or plan to introduce one. Energy component rates are expressed in harmonized energy units instead of physical units. In practical terms, it means that rates are expressed in EUR/Gigajoule (GJ) instead of different units such as EUR/litre or EUR/cubic meter.

[11] European Commission, Evaluation of Council Directive 2003/96/EC of 27 October 2003 (2019), retrieved on: 05.08.2019, retrieved from: https://taxation-customs.ec.europa.eu/document/download/fc5110b6-6fd0-4e7c-b116-e2eae1b851c6_en?filename=energy-tax-report-2019.pdf

[12] Energy products and electricity used for air and sea navigation are mostly untaxed.

[13] Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity. Retrieved on: 01.05.2019. Retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0096

Finland introduced energy unit-based taxation in 2011, as feature its energy taxation reform [14]. Prior to the reform in Finland, and still today in most countries around the world, biofuels are disadvantaged by physical unit-based taxation. This is due to the fact that biofuels typically have a lower energy content per litre, than the fossil fuel they replace. This means that a litre of biofuel would take the same car over a shorter distance than a fossil fuel. Yet, the same tax applies per liter to both fuels. Finland's energy tax regime eliminates the disadvantageous tax treatment of biofuels.

Eliminating such disadvantages is important, as biofuels can play an important role in decreasing the import dependency of developing countries. Import dependency means lower security of supply and higher vulnerability to volatile external fuel prices. While some developing countries are oil exporters, others are dependent on imported fuels. Thailand, Pakistan, Vietnam are among the countries most impacted by recent increases in global oil prices.[15] Domestic biofuel production can decrease this dependency and mitigate vulnerability to volatile international prices. Brazil for example, initially driven by the goal to reduce its dependency on imported fuels, became one of the largest markets and leading producers of biofuels in the world. This was achieved through a long -standing biofuel support policy, that includes lower taxes on biofuels compared to fossil alternatives.

Biofuels can drive decarbonization of the transport sector fueled by a domestically available energy sources and create employment opportunities in rural areas. It however remains important that biofuels are produced in a sustainable way and do not increase food insecurity in developing countries.[16]

Finland's energy tax regime also contains several provisions that accelerate electrification. Heating (space and water heating) is a hard to decarbonize sector around the world. While Finland applies relatively high rates on general electricity consumption, electricity used by certain heat pumps is tax exempted.[17] An exemption also applies to electricity used in rail transport, and reductions apply to the electricity consumption of energy intensive industries.[18] A reduced electricity rate applies to a restricted list of industrial uses, such as mining, data centers and agriculture.[19] As renewable electricity

[14] Finnish Ministry of Finance, Report of the working group on energy taxation reform: A proposal for implementing the intentions and goals of the Government Programme and for further development of energy taxation (2021). Retrieved on 20.11.2023, retrieved from: http://urn.fi/URN:ISBN:978-952-367-508-7
[15] https://www.bloomberg.com/news/articles/2022-03-17/energy-shock-hitting-poorer-nations-reliant-on-imports-hardest?embedded-checkout=true#xj4y7vzkg
[16] See also section 5 of "Workstream 2: The Role of Carbon Taxes and other Measures to Support Energy Transition in paper presented at the Twenty-eighth Session of the UN Tax Committee in March 2024 (as Annex B to E/C.18/2024/CRP7).
[17] Council Implementing Decision (EU) 2022/1004 of 17 June 2022 authorising Finland to apply a reduced rate of taxation to electricity supplied to certain heat pumps, electric boilers and recirculating water pumps, in accordance with Article 19 of Directive 2003/96/EC, retrieved on 10.07.2023, retrieved from https://eur-lex.europa.eu/legalcontent/EN/TXT/?uri=CELEX%3A32022D1004,
[18] Tax expenditure for energy intensive industries is set to be gradually abolished by 2025.
[19] Further ongoing measures in the Finnish energy tax system include: Moving electricity used by certain heat pumps (currently exempted by an Article 19 Council decision), certain data centers and recycling industry to the lower electricity class and introduction of a tax on biogas in transport use (-20 MEUR).

technologies, such as wind and solar become cheaper, the share of green electricity continues to grow. Consequently, such tax measures accelerate electrification, sector coupling and the overall decarbonization of the economy.

Energy storage is another cornerstone of the clean energy transition and sector coupling. Large scale energy storage allows the storage of renewable electricity surplus when there is abundant sunshine or wind. Beyond commercial energy storage, even single electric vehicles could also play a role in balancing energy systems in the future. As we will see in the next section, electromobility is rapidly expanding around the world. Given equipped electricity distribution systems, electric vehicles could feed back electricity stored in their batteries into the system. Therefore, be it large or small scale storage, it is important to avoid the double taxation of stored energy. The Finnish system does so by defining storage as part of the distribution system. Whereas the taxable event is "release for consumption, thereby excluding the distribution system

Exemptions and reductions are prevalent for all energy products in all countries. Well- designed tax reliefs can allow a country to tax most of its energy consumption at a higher rate, while protecting selected consumers or industries. Finland's applies a rate of 527 EUR/litre to gas oil (diesel) consumption of cars. The rate for gas oil consumption in agriculture is lower, 268 EUR/MWh. Given the agricultural sector's widespread reliance on gas oil globally, it is crucial to support the electrification of this sector. This is particularly relevant when considering the impact of energy prices on food costs and food security. It is important to note that unjustified tax reliefs, such as preferential treatment for fossil fuels in agriculture, can constitute harmful fossil fuel subsidies. Therefore, careful consideration ought to be given to ensuring that tax policies align with broader sustainability goals and do not inadvertently perpetuate reliance on environmentally damaging energy sources.

4.2.2 Indonesia

In Indonesia CO2 emissions of the transport sector account for 30% of all CO2 emissions.[20] Beyond global CO2 emissions, local air pollutants also pose an increasing problem. In growing cities around the world, air pollution is a matter of life or death. Health complications from poor air quality result in globally 8 million deaths each year, over 230 thousand deaths in Indonesia[21]. The transport sector plays

[20] World Bank, CO2 emissions from transport (% of total fuel combustion), retrieved on: 10.08.2023, retrieved from: https://data.worldbank.org/indicator/EN.CO2.TRAN.ZS?locations=ID
[21] The Jakarta Post, Pollution kills more than 230,000 Indonesians per year: Report, retrieved on 25.02.2024, retrieved from: https://www.thejakartapost.com/news/2019/12/30/pollution-kills-more-than-230000-indonesians-per-year-report.html.

an important part in this global crisis, as many local air pollutants, especially in congested urban areas, stem from vehicles.[22]

Indonesia established an ambitious electrification plan with a target of 600K[23] four- wheel battery electric vehicles and 2.45 million electric two-wheelers by 2030. Indonesia has traditionally been a strong automotive market in the region. In 2023, 1 million units were sold in the country, marking it as the largest market in the Association of Southeast Asian Nations (ASEAN). Indonesia also produced 1.5 million vehicles (the second highest number after Thailand).[24] This target would however mean increasing the sale of electric vehicles 100- fold compared to 2023.

To achieve this target Indonesia put in place excise duty and VAT measures. Most of them aim at reducing the price premium of electric vehicles compared to internal combustion engine vehicles driven by fossil fuels. In this sense, the Indonesian regime does not apply excise duty reductions to energy consumption itself. Yet, these are a useful example to demonstrate the role indirect taxation can play in decarbonizing the transport sector.

In 2023, the Ministry of Finance enabled a Value Added Tax (VAT) reduction on battery electric vehicles until the end of the fiscal year. The VAT reduction includes a 10% cut for electric cars and buses with a minimum 40% of local content as well as a 5% tax reduction for cars and buses with less than 40% and minimum of 20% local content.[25] Another regulation provides adjustments for the exemption of Luxury-Goods Sales Tax (LGST).[26] It is to be noted that this regulation also contains tax reductions for certain internal combustion engine vehicles.

Beyond electromobility, Indonesia also uses indirect taxation as a tool to foster the uptake of renewable energy sources. Value Added Tax (VAT) exemptions apply to taxable goods imported to develop renewable energy projects, as long as no substitutes are manufactured in Indonesia. Exemptions are valid for 2 years with optional extension depending on applicability and feasibility. The VAT exemption applies to machinery (both constructed and dismantled); while tax may still be raised on spare parts that companies need to use renewable energy for end-product manufacturing. A VAT reduction specifically

[22] World Bank Blogs, Ricardo Puliti, In developing countries, the e-mobility revolution is closer than you might think (2022), retrieved on 15.07.2023, retrieved from https://blogs.worldbank.org/voices/developing-countries-e-mobility-revolution-closer-you-might-think

[23] The Economic Times, Bad news for India? Indonesia and Thailand up their EV strategy to attract electric vehicle makers, retrieved on 25.02,2024, retrieved from: https://economictimes.indiatimes.com/industry/renewables/bad-news-for-india-indonesia-and-thailand-up-their-ev-strategy-to-attract-electric-vehicle-makers/articleshow/107921201.cms?from=mdr

[24] AdLittle, Unleashing Indonesia's Electric Mobility Potentia, retrieved on 01.08.20230, retrieved from: https://www.adlittle.com/id-en/insights/report/unleashing-indonesias-electric-mobility-potential

[25] Minister of Finance Regulation (PMK) Number 38 of 2023 on Value-added Tax of Certain Four-Wheeled Battery-Based Electric Motorized Vehicles and Certain Bus Battery-Based Electric Motorized Vehicles Borne by the Government for the 2023 Fiscal Year.

[26] Regulation No. 42/PMK.010/2022 concerning the Determination of Types of Motorized Vehicles Subject to Sales Tax on Luxury Goods.

for geothermal energy ended in 2011. The regulation stipulated that goods imported for the purpose of upstream oil and gas activities or geothermal exploration will be exempted from Value-added Tax for the budget year 2011. No local content provision applied. The policy ended in 2011.[27]

4.2.3 The Netherlands

The Netherland's energy taxation is also subject to the European Union's Energy Taxation Directive[28]. The directive itself remained unchanged for two decades. The national energy taxation of several EU Member States, including the Netherlands, has evolved in the meantime.

The Netherlands also uses energy taxation as a tool to drive the electrification and consequently decarbonization of the transport sector. As of December 2023, the Netherlands is the only country in the world that applies a reduced rate to electricity used by electric vehicles.[29] The reduced rate applies only to electricity used at public charging stations. As the price of batteries that drive electric vehicles continues to fall, the relatively high purchase price of electric vehicles also falls. This means that the price of the fuel that drives the vehicle is likely to gain importance. The Dutch example can serve as guidance how to maintain general electricity tax rates at relatively high levels while applying a reduction to electromobility.

The Netherlands uses energy taxation to foster energy savings. Doing so by granting a lump sum support for energy consumption. It applies jointly to electricity and natural gas. The lump sum, granted per connection, increased from EUR 300 to EUR 1300 in 2022.[30] The measure increases energy savings and investment in energy efficient appliances. In practical terms the measure reduces the effective energy tax rates up to a certain energy consumption. A relatively high excise duty on electricity and natural gas consumption, is compensated by the lump sum up to a certain level of consumption. The lump sum can also serve as a social policy, by mitigating the negative impacts of rising energy prices. While the lump sum is available to all households, low- income households typically spend a higher share of their disposable income on energy but overall consume less energy. Therefore, the impact of the lump sum is higher for low- income households.

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[27] International Energy Agency, Policy Data Base, retrieved on 25.02.24, retrieved from https://www.iea.org/policies?q=indonesia&type%5B0%5D=Payments%2C%20finance%20and%20taxation

[28] European Union, Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity, retrieved on 25.02.2024, retrieved from: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32003L0096

[29] Council Implementing Decision authorising the Netherlands to apply a reduced rate of taxation to electricity supplied to [charging stations for] electric vehicles in accordance with Article 19 of Directive 2003/96/EC, retrieved on 25.02.2024, retrieved from: https://eur-lex.europa.eu/legal content/EN/TXT/HTML/?uri=CELEX:52021PC0023&from=EN

[30] Government of The Netherlands, How do I apply for the energy allowance in 2022? Retrieved on 25.02.224, retrieved from: https://www.government.nl/topics/energy-crisis/how-do-i-apply-for-the-energy-allowance-in-nl#:~:text=You%20can%20apply%20for%20the,(cohabiting%20couple)%20per%20month.

4.3 Conclusions

Energy taxation can play an important dual role. On one hand, it is a significant budgetary revenue in many countries. As energy consumption shifts from fossil fuels to electricity, taxation should follow this shift to fulfil its budgetary role. Therefore, this report also aims to serve as a guide on introducing future proof energy taxation for developing countries that currently do not tax electricity but plan to do so. On the other hand, energy taxation can play an important role in steering production and consumption of energy towards a more sustainable path. Energy taxation can support the uptake of low carbon energy products and uses, thereby accelerating the green energy transition in developing countries. Energy taxation can also contribute to preventing death and sickness resulting from air pollution as well as easing congestion in large cities. The cost of renewable electricity production continues to fall and emerging technologies, such as renewable hydrogen and other fuels of non-biological origin and energy storage enter markets. Energy tax design can accelerate the uptake of these technologies, thereby abating both global carbon dioxide emissions and local air pollutants.

5. Waste landfill and incineration taxes

5.1 Introduction

The world keeps generating more and more waste, which in turn generates an increasingly serious global problem. There are more than 2 billion tonnes of waste created each year. This already alarming number is projected to grow by 70% by 2050.[31] This chapter aims to display different avenues which developing countries may choose when introducing waste taxation, whereas taxation is considered also as a tool of waste reduction and facilitator of recycling.

Waste policies around the world typically adhere to the same hierarchy: Waste production should be minimized or avoided wherever possible. When waste reduction is not possible, the produced waste should be recycled. Waste that cannot be recycled, at times can be incinerated to produce electrical energy or heat. Waste should be incinerated with adequate environmental protections to avoid harmful air pollution. Lastly, only waste that can't be avoided, recycled or incinerated should go to landfill sites. Landfill sites should also operate with adequate environmental protections to avoid soil, groundwater and air pollution. Overall, environmental taxes can help to decrease waste incineration and landfill while increasing waste reduction and recycling.

Landfill means the disposal of waste at dump sites, often as a method of filling in and reclaiming excavated pits, such as abandoned mines. Waste is also disposed at unexcavated overground sites. This is called land raising. Illegal or not properly designed and maintained landfill sites have serious negative

[31] World Economic Forum, The World Has a Waste Problem, retrieved on 10.08.2023, retrieved from: https://www.weforum.org/videos/the-world-has-a-waste-problem

environmental consequences. These include the pollution of soil, air and water. Hazardous chemicals from waste can leak into the soil and from there into food. One of the most prevalent sources of pollution in landfills is the leachate generated by the decomposition of waste. Leachate can penetrate into the soil and water resources, including ground water. Landfills are also major contributors to climate change by releasing the greenhouse gas methane into the atmosphere. It is estimated that landfill sites will generate about 10% of all greenhouse gases in just a few years. The United States Environmental Agency for example, estimates that US landfills emitted as much methane as 23 million gasoline vehicles driven for a whole year would emit [32]. Modern landfill sites are designed to contain these negative effects. Such capacities are however limited and much of the word's landfill waste is not disposed in sites equipped with adequate environmental protection.

Landfill taxes can contribute to easing the word's garbage problem in a dual way: they can reduce the overall production of waste by making it more expensive and they can also increase recycling rates of the waste that was already produced. When waste is recycled, it does not end up in landfill sites. Numerous countries around the world introduced landfill taxes to make use of this dual power.

Incineration means the combustion of waste, essentially burning it. While incineration can reduce the volume of waste for disposal and generate energy, it also carries significant negative environmental impacts, particularly air pollution. When waste is burned in incineration facilities it produces hazardous air pollutants including particulate matters PM2.5 and PM10, carbon monoxide, acid gases, nitrogen oxides and cancer-causing dioxins. Nonetheless, municipal solid waste keeps being incinerated in countries around the world. The OECD estimates that in Japan 75% of all municipal waste is burned with energy recovery, followed by Switzerland (47%) and the United Kingdom (42%).

In Scandinavia as a region, it is estimated that over three-quarters of all municipal waste is incinerated with energy recovery.[33] Separated municipal solid waste (MSW) is considered to be a renewable resource in the United States and the European Union as well, where the separation criteria is expected to become tighter with the update of the union's regime for renewable energies, called Renewable Energy Directive. In 2022 the European Parliament strengthened the sustainability criteria regarding the use of mixed wastes for renewable energy production. It now requires that in case the mixed wastes are used for 'renewable energy', the operators must sort the waste to remove fossil materials for recycling. Moreover, waste incineration of biogenic waste (biowaste, paper, etc.) can only be supported

[32] United States Environmental Protection Agency, Basic Information about Landfill Gas, retrieved on 05.08.2023, retrieved from: https://www.epa.gov/lmop/basic-information-about-landfill-gas
[33] USA Energy Information Administration Biomass explained, Waste-to-energy (Municipal Solid Waste), retrieved on 10.08.2023, retrieved from: https://www.eia.gov/energyexplained/biomass/waste-to-energy.php

if separate collection obligations are fully met.[34] Elsewhere, in 2021 the Government of Brazil approved the country's first urban solid waste tender for energy production.[35]

Waste incineration taxes are imposed to internalize the above listed environmental costs and to improve waste management practices. In other words, waste incineration taxes can also increase recycling rates. Most notably industrial plastic waste, much of which is being burned instead of being recycled. According to the European Environmental agency, 10 EU Member States applied waste incineration taxes. Amongst them, Belgium applied the highest rate of 70 EUR/ tonne of waste, followed by Portugal with a tax rate of 22 EUR/tonne of waste.[36] Waste incineration taxes play an especially important role in countries where landfill is banned or is almost zero. For example, Austria first introduced a landfill tax, later a landfill ban and an incineration tax. On the other hand, Sweden had introduced a waste incineration tax in 2006, but abolished it in 2023. An evaluation has shown that the tax was not in line with a cost-effective policy to reach an overall reduction of GHG emissions in the country.

5.2 Practical country examples for landfill waste taxes

This section considers three practical examples. It does not aim at fully describing the waste landfill taxation of these countries. Instead, it focuses on highlighting the features that can help other countries to design their energy tax regimes.

5.2.1 Spain: Catalonia

Catalonia, an autonomous community of Spain, is globally at the forefront of developing both incineration and landfill taxation as well as supporting recycling. Barcelona City Council has produced the Barcelona Zero Waste Plan 2021-2027 as an instrument for tackling the strategic challenges and goals relating to waste prevention and management over the coming years. It takes over from the previous Barcelona Waste Prevention Plan 2012-2020 and also incorporates the Zero Waste Strategy. The Zero Waste Plan is based on the zero-waste philosophy, which follows the circular economy model where waste is understood as a resource, and it promotes tools to facilitate the reuse and recycling of waste materials.[37]

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[34] Zero Waste Europe, Zero Waste Europe approves Parliament resolutions on RED III, retrieved on 09.08.2023, retrieved from: https://zerowasteeurope.eu/press-release/zero-waste-europe-approves-parliament-resolutions-on-red-iii/

[35] Brazilian Association of Energy Recovery of Waste, Brazil opens path for Waste-to-Energy projects (BNamericas), retrieved on: 09.08.2023, retrieved from: https://abren.org.br/en/2021/01/14/brazil-opens-path-for-waste-to-energy-projects-bnamericas/

[36] European Environmental Agency, Overview of taxes on the incineration of municipal waste used in EU Member States, 2023, retrieved on: 08.08.2023, retrieved from: https://www.eea.europa.eu/data-and-maps/figures/overview-of-taxes-on-the

[37] Adjuntament Barcelona, Barcelona Zero Waste Plan 2021-2027, retrieved on 25.02.2024, retrieved from https://ajuntament.barcelona.cat/neteja-i-residus/en/presentation/waste/zero-waste-plan#:~:text=The%20Zero%20Waste%20Plan%20is,and%20recycling%20of%20waste%20materials.

Catalonian municipalities are charged for landfilling (and also for incinerating) waste. This in turn incentivizes them to put in place better waste management systems, including separation and waste prevention aiming to reduce the amount of waste that goes to landfill and thereby reducing the taxes they have to pay. The Catalonian tax was first introduced in 2004. Its introduction was preceded by careful stakeholder involvement (the implementation of the tax took almost 10 years). Since then, the tax has been gradually increasing to reach 47.1 €/t by 2020. The gradual increase fostered the social acceptance of the tax.

Tax revenues are earmarked for a specific fund which finances waste separation. In 2021, municipalities were refunded 34 EUR/tonne of biowaste treated separately. The predictability of rebates helps the planning of tax budgets. The municipalities pass on the cost to households and businesses in the form of a fee. As monitoring the waste production of each household and business is impossible, water consumption serves as a proxy for determining the fee. Barcelona implements a system in which individual taxpayers can also benefit from reductions: Reductions of up to 14% on the fee payable for people who use a Green Point cards at the city's Green Points. This ranges from 1% for two uses of green points a year to 14% for 15 or more uses per year.[38]

As a result of Catalonia's waste policy, from 2004 to 2021, separate collection of waste increased from 25% to 45% and the volume of landfilled waste decreased by two thirds over the same period.[39]

5.2.2 Australia: Australian Capital Territory

Several Australian jurisdictions apply waste taxes[40]. The Australian Capital Territory (ACT), which includes Canberra, the country's capital, applies the highest waste taxes among its counterparts. These taxes, known locally as waste levies, constitute a financial contribution whereby licensed waste facilities are required to pay for each tonne of waste received at the facility. Waste levies are intended to encourage the diversion of waste from landfill to recycling. A study by the Australian government found that well designed waste levies provide an incentive for waste collectors to find the most economic method to dispose of waste material. As waste levies increase the price of landfill, recycling becomes increasingly viable.

A notable feature of the ACT waste tax is that it applies different rates to different types of waste. Municipal solid waste (MSW) costs AUD 90.55/ tonne to dispose of at landfill. As of 22 January 2024, this value equals approximately USD 60 or EUR 55. Construction and industrial waste (C&I) costs $146.20/tonne to dispose of at landfill. The disposal of non- recyclable construction waste is even more

[38] Ajuntament Barcelona, Green Point Network, retrieved on 25.02.24, retrieved from: https://ajuntament.barcelona.cat/neteja-i-residus/en/household-waste-collection/green-point-network
[39] European Commission, Ensuring that Polluters Pay – Spain, retrieved on 25.02.2024, retrieved from https://environment.ec.europa.eu/system/files/2021-10/Spain.pdf
[40] Such are called levies in Australia. In the context of this report waste taxes and waste levies are interchangeable terms. Waste fees are to be distinguished from both.

costly. Mixed C&I waste with less than 50 per cent recyclable material costs $199.20 per tonne to dispose of at landfill.[41]

As urbanization accelerates in many developing countries, so does the frequency of construction and demolition (C&D) activities, resulting in a corresponding increase in construction and demolition waste. C&D activities typically generate high volumes of waste, much of which is hard or costly to recycle. For example, concrete can be recycled, but its collection and transport come at a significant cost due to its weight.

Many countries around the world face significant challenges in C&D waste management. These include open dumping practices, inadequate regulation and limited infrastructure. For many developing countries, legal disposal of C&D waste is expensive. For instance, in Brazil (in the city of Rio de Janeiro), a 5 cubic meter container costs on average BRL 380 (approximately USD 77 or EUR 70). In México, a notable portion of C&D waste is disposed in unregulated dumpsites, while regulated disposal sites often lack sufficient engineering measures. A differentiated (higher) tax for C&D waste can play an important role in improving C&D waste management. It should however be accompanied by measures to combat illegal dumping.

In the ACT, part of the revenue earned from waste disposal is used to improve enforcement and compliance as well as the development of sound policies. They also fund actions and strategies that contribute to waste minimization.

5.2.3 Belgium: Wallonia

The Belgian region of Wallonia introduced a decree in 2007 that establishes nine (9) distinct taxes for waste, including a landfill tax.[42] The landfill tax specifically targets non-household waste and aims to reduce waste production while encouraging the adoption of more environmentally friendly processing methods. This tax applies a sliding scales of taxation rates that vary based on the environmental impacts of the waste-processing methods. This in turn provides incentives for sustainable practices.
Wallonia applies different rates to different type of waste non- household waste: EUR 120.52 /tonne for general waste (approximately USD 130), EUR 66.89 / tonne for non-combustible waste and EUR

[41] Parliament of Australia, Senate Standing Committees on Environment and Communications, Waste and Recycling industry in Australia, Report, Chapter 4, retrieved on 28.02.2024, retrieved from: https://www.aph.gov.au/Parliamentary_Business/Committees/Senate/Environment_and_Communications/WasteandRecycling/Report/c04

[42] 1. Tax on the disposal of waste at a technical landfill centre 2. Tax on waste incineration 3. Tax on waste co-incineration 4. Subsidiary tax on waste collection and management 5. Tax encouraging the selective collection of household waste 6. Tax on waste that is subject to mandatory reclamation 7. Tax on holding waste 8. Tax on abandoning waste 9. Tax on organisations that perform mandatory reclamations.

267.55 / tonne of a mix of hazardous and non-hazardous waste. The tax revenue is allocated exclusively to a waste management fund.[43]

Different policies apply to waste produced by households, which are required to dispose of waste in dedicated disposal bags available for purchase in stores. The price of these bags is higher than the price of common plastic bags. The bags are differentiated by colour. For example, households are obliged to dispose plastic waste in blue, and paper in yellow bags. Different colour bags are collected by the city on different days.

Overall, the Wallonia regime can serve as an example how to differentiate policies for household and non-household waste as well as how to impose a cost on households exactly proportionate to their waste production. In practice, the system is complicated and requires high compliance from citizens. To increase compliance, the city fines buildings that fail to comply with household waste disposal rules.

5.2.4 Conclusions on landfill waste taxes

A few commonly observed features of landfill waste taxes can guide developing countries considering implementing such policies. Typically, the introduction of such taxes is gradual, with rates increasing over time. Stakeholders (waste collectors and site managers) are carefully involved, and communication campaigns are organized to inform citizens, as waste separation by citizens is essential to increase recycling rates. A unique feature to be observed is the use, often outright earmarking of the revenues for dedicated funds that aim to improve waste management policies. Such fiscal practices are typically rare. However, they are more common for waste taxes, depending on constitutional and other national conditions in the jurisdictions. Jurisdictions can set separate policies for household (municipal) and other types of waste to effectively improve their management according to the specific characteristics of the jurisdiction. C&D waste is a waste type often subject to higher rates. When coupled with measures to avoid illegal dumping, such differentiated taxes can increase the sustainability of practices of the construction industry. One that is rapidly growing with urbanization in developing countries.

5.3 Practical country examples for waste incineration taxes

This section considers three country examples. It does not aim at fully describing the waste incineration taxation of these countries. Instead, it focuses on highlighting the features that can help other countries to design their energy tax regimes.

[43] Wallonia, Paying tax on waste in the Walloon region, retrieved on 28.02.2024, retrieved from https://www.wallonie.be/en/demarches/paying-tax-waste-walloon-region

5.3.1 Norway

The Norwegian case can provide an example for developing countries that already have in place, or plan to introduce CO2 taxation and aim at including or adding waste incineration to their CO2 taxation scheme. [44]

In Norway, about 50% of municipal solid waste is incinerated. The current rate is 238 NOK/tonne of CO2 (approximately USD 22 or EUR 20). The tax payable is calculated by multiplying the amount of waste delivered to the incineration facility measured in tonnes by a factor of 0.5498 tonne fossil CO2 per tonne of waste. This is a uniform value. Individual facilities, however, may apply to the Norwegian Environment Agency for assessment of a facility-specific factor to be used when calculating the duty, instead of using the factor of 0.5498.

The tax is aligned to Norway's carbon tax regime and to the EU- Emission Trading System. For 2023, two rates were set: one rate for emissions subject to quotas, and one rate for emissions not subject to quotas. The rate for emissions subject to quotas has been reduced by 50 percent compared to 2022, while the rate for emissions not subject to quotas has increased by 141 percent, to NOK 95 and NOK 476 respectively per tonne of CO2.

The tax regime also contains a feature that aims to support Carbon Capture, Utilization and Storage: An exemption is granted from the tax in certain cases, such as when burning dangerous waste and when CO2 is captured and stored.

5.3.2 Spain (whole country)

Since 1 January 2023, Spain applies a new tax regime that covers both landfill and incineration waste. The tax is implemented as an excise duty, set out by Law 7/2022 of 8 April 2022 on "Waste and Contaminated Soils for a Circular Economy".

The new law introduced a tax on the deposit of waste in landfills, incineration, and co-incineration of waste, which is levied at rates of up to EUR 40 /tonne (approximately USD 43), depending on the type of waste, with certain exemptions.

Secondly, a new plastics tax in the form of a special tax on non-reusable (single-use) plastic containers, which is levied at a rate of EUR 0.45 per kilogram of non-recycled plastic contained in products within the scope of the tax.

[44] Norwegian Tax Administration https://www.skatteetaten.no/en/business-and-organisation/vat-and-duties/excise-duties/about-the-excise-duties/avfallsforbrenning/#:~:text=2023%20rate,CO2%20per%20tonne%20of%20waste.

The tax incineration is devolved to the autonomous community governments. This means the granting of certain legislative, management, collection and auditing powers. The federal scheme, which is a result of long- standing efforts since 1998, replaces existing autonomous community taxes. The autonomous community governments may increase these rates for the waste landfilled, incinerated or co-incinerated in their respective areas.

Unlike Norway where the tax base is emission- unit based, Spain applies volumetric unit tax base. The taxable amount is calculated by reference to the weight, measured in metric tons (Tm) expressed in figures with up to three decimal places.

5.3.3 Austria

Austria has a long history of evolving waste management policies. It was one of the first countries to ban landfill. Therefore, incineration and incineration taxes pay an important role. Austria considers cooperation among involved public bodies a factor that contributed to the success of its waste policies. The Federal Ministry of Finance works in close cooperation with the management authority in the Federal Ministry of Climate, which in turn works in close cooperation with the chamber of commerce. The Austrian Chamber of Commerce also plays an important role in stakeholder engagement, as it unites the approximately one thousand stakeholders, all of whom are members of the chamber.

Trainings for customs officers responsible for waste management, are organized in cooperation between the Ministry of Finance and the management authority. The management authority operates a special software for waste management policies.

The Austrian incineration tax is accompanied by regular controls. The controls are mandated by law.[45] Austria was also the first country to earmark the revenue of waste incineration (as well as landfill taxes) for environmental purposes, namely the restauration of landfill sites.

The tax base is similar to that of Spain, namely volumetric. The rate is currently 8 EUR/tonne (approximately USD 8.7) for incineration of waste, production of combustible material from waste, and use of waste in blast furnaces.

5.3.4 Conclusions on incineration taxes

The main feature of waste incineration taxes that can be useful for developing countries that are considering such policies, is that they are always part of an integrated tax regime. Such regimes cover both waste landfill and waste incineration. This ties in with the hierarchy (mentioned in section 5.1 above) of waste management policies that taxation can foster. However, contrary to landfill, waste

[45] Bundesgesetz vom 7. Juni 1989 zur Finanzierung und Durchführung der Altlastensanierung (Altlastensanierungsgesetz) StF: BGBl. Nr. 299/1989 (NR: GP XVII RV 898 AB 979 S. 106. BR: AB 3691 S. 517.)

incineration taxes can be applied based on different tax bases. Such are CO2 emissions of the incinerated waste or the volume (in volumetric tonnes) of the incinerated waste. This can provide an opportunity to developing countries that wish to include waste incineration in their CO2 tax regime, thereby imposing in indirect CO2 price on waste incineration.

Another common feature is the importance of institutional cooperation. Meaning cooperation among public bodies, such as the Ministry of Finance and the Ministry of Climate or Environment as well as the continuous stakeholder involvement of waste collection operators and waste management facilities.

6. Pesticides taxes

6.1 Introduction

Pesticides provide a crucial solution for improving agricultural productivity. However, they also pose a growing concern particularly with regard to their environmental impact. While essential for enhancing crop yields and ensuring food security, their unchecked application raises environmental and health worries. Pesticides, a diverse category designed for pest control, have revolutionized agriculture but led to unintended consequences like soil degradation and water contamination. Effective pesticide taxes can be utilized to address this complexity, offering a balance between agricultural productivity and ecological preservation.

The need for regulation to discourage excessive pesticide use while promoting sustainable practices is evident. Pesticide taxes have the potential to act as an economic tool with broad environmental implications. By discouraging conventional pesticide use through financial disincentives, governments can encourage responsible practices, aligning with global efforts for sustainable agriculture, emphasizing ecosystem health, biodiversity, and climate change mitigation. Implementing pesticide taxes is motivated by diverse reasons such as soil conservation, crop diversity promotion, and pollution mitigation. Countries worldwide are driven by concerns over health and environmental risks, reflected in reduction commitments addressing pesticide-related hazards and usage volume.

6.2 Impact of pesticides

Pesticides, especially broad-spectrum formulations, exert significant antimicrobial effects, disrupting soil microorganism diversity and abundance. This disturbance compromises vital soil functions like nutrient cycling, organic matter decomposition, and disease suppression, potentially causing lasting changes in soil ecology. Persistent pesticide residues in soil pose environmental concerns due to extended half-lives, increasing the risk of cumulative impacts and complicating remediation efforts. Residue accumulation persists across multiple cropping seasons, posing enduring threats to soil health.

Pesticides can interfere with nutrient cycling processes, disrupting soil fertility and affecting plant health. Simultaneously, hazardous substances in pesticides and fertilizers contribute to adverse

externalities, including soil and water contamination. Illicit pesticide use introduces risks from unapproved impurities, impacting agricultural yield, farmer health, and the environment (TRACIT 2019). Fertilizer application poses threats to aquatic ecosystems, with energy-intensive production raising environmental concerns. Economic costs, such as healthcare expenses related to pesticide-induced poisonings, highlight the broader impact on farmers' well-being and the environment.

Recognizing the significant risks posed by pesticides, the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) have defined highly hazardous pesticides (HHPs) as chemicals acknowledged to pose particularly high levels of acute or chronic hazards. The intricate link between HHPs and genetically modified (GM) seeds has created a challenging cycle for farmers, marked by dependence on these pesticides due to GM crops engineered to withstand them.

Integrated seed-pesticide packages reinforce this dependency, driven by economic pressures and the desire for high yields. The fiscal year 2022 witnessed a substantial surge in pesticide sales, with the top 20 industry players collectively reaching US$85.762 billion, a notable 18.18% year-on-year increase. Major agricultural giants, including Syngenta, Bayer, BASF, and Corteva, accounted for over half (55%) of total sales.

In 2021, 65% of Nigeria's pesticide use comprised HHPs, with India and Vietnam following closely at 59% and 44%, respectively.[46] The adoption of GM crops has led to resistance among pests, escalating pesticide use. Alarming statistics underscore the urgent need for a paradigm shift towards sustainable farming practices. Efforts to break free from this detrimental cycle require diversification of cropping systems, education on sustainable practices, supportive policies, and investments in research for resilient crop varieties and eco-friendly pest management solutions. Only through concerted efforts can we ensure a more sustainable and resilient future for global agriculture.

6.3 The potential role of a pesticide tax

Pesticide taxes are a strategic response to environmental and health concerns associated with extensive pesticide use in agriculture. Governments aim to alleviate the detrimental effects on ecosystems, soil, water, and human health by incentivizing sustainable agricultural practices through these taxes.

The diverse goals of pesticide taxes, including soil conservation and pollution reduction, reflect a global commitment to environmentally friendly farming methods. The financial disincentive created encourages farmers to adopt alternative pest management strategies, contributing to the adoption of integrated pest management practices.

[46] See: Statista. “Global Share of Highly Hazardous Pesticides in Use 2018-2021, by Selected Country,” May 15, 2023. https://www.statista.com/statistics/1382198/global-share-of-highly-hazardous-pesticides-in-use-by-selected-country/

Revenue generated from pesticide taxes supports environmental conservation, funds research for safer agricultural technologies, and promotes sustainable farming. Fiscal incentives for organic farming, such as reduced tax rates and exemptions, provide additional support for environmentally responsible practices.

Implementing pesticide taxes can help mitigate the adverse effects, driving a transformative shift towards responsible and sustainable agricultural practices. This strategic approach plays a vital role in raising awareness and fostering a global commitment to environmental and public health stewardship.

Assessing the impact of pesticide taxes is challenging due to recent implementation in only a few countries. Factors such as tax design, including incentive structures, rates, demand elasticity, and precision in targeting, influence the effects. The utilization of tax revenues, impact on public awareness, and the signaling role of taxes are crucial channels through which impacts unfold. Political economy considerations, addressing concerns about competitiveness and distributional impacts, are critical for effectiveness.

6.4 Practical country examples of pesticide taxes

This section provides guidance by introducing three country examples. It does not aim at fully describing the pesticide taxation regime of these countries. Instead, it focuses on highlighting the features that can help other countries to design successful pesticide taxation regimes. Notable examples of countries that have successfully implemented pesticide taxes include Norway, Sweden, and France. Short case studies on their systems are presented in following sections.

6.4.1 Norway

The Norwegian pesticide tax, first adopted in 1988 and updated in 1999, is aligned with the polluter pays principle. The tax is area-based and differentiates between 7 bands of pesticides, based on their health and environmental risks. The human health criteria are based on the intrinsic properties of the pesticide and the exposure during mixing, while the environmental criteria consider toxicity of the pesticide in aquatic and terrestrial ecosystems and the leaching potential amongst others. The base tax rate is fixed and uniform for all products; it started at NOK 20 and then increased to NOK 25.

The base rate Is then multiplied by a factor that varies by band—the factor increases proportionally to the risk the product poses. This tax design reflects the objective of reducing the use of pesticides that represent the greatest risk to human health and the environment (Institute for European Environmental Policy 2014). However, the environmental impact and the effectiveness of Norway's pesticide tax have been challenging to measure as many variables influence the amount of pesticide sales. For example, both stockpiling (after announcement of a tax) and exceptions to sowing patterns obscured the effects of the tax on pesticide sales. Nevertheless, health and environmental risks were also assessed based on

the trade of pesticides and are estimated to have reduced by approximately 35% compared to the 1996-1997 baseline period (Rorstad 2005 as cited in IEEP 2014).

Moreover, the annual income from the pesticide tax was around NOK 20 million and has increased to about NOK 60 million (EUR 7.2 million) a year (PAN Europe 2005 as cited in IIEP 2014). Overall, the banded tax system is considered effective as it not only encourages the more conservative use of pesticides but also provides an incentive to use less harmful products (OECD, 2010).

6.4.2 Sweden

In Sweden, the pesticide tax is payable by manufacturers, wholesalers and importers. The tax was increased from 30 SEK /kg active substance to 34 SEK/kg active substance in 2015 (Böcker and Finger 2016). Total revenue generated in 2021 was about SEK 150 million (around EUR 13 million[47]). There is a registration fee and an annual charge based on sales for companies seeking approval of placing plant protection products on the market (Plepys, Heiskanen and Mont 2015). The tax revenues are directly allocated to the state's budget.

Absolute sales of active substance reduced more than 50% since the introduction of the tax in 1984. The Swedish pesticide risk indicator (indexed to the year 1998) shows a sharp decrease in risk to human health (now relatively constant at 20-40% as compared to 1988 levels) and to the environment (50-80% as compared to 1998 levels). Though the outcome coincides with the introduction of the tax, it is linked to a range of policy instruments (Böcker and Finger 2016).[48]

6.4.3 France

France has two tier tax schemes to foster a change in the use of pesticides. Firstly, synthetic pesticides are taxed with the regular VAT rate. Pesticides utilized in organic agriculture are charged with the reduced VAT, giving a comparative advantage to organic farming. Secondly, a three-category differentiated scheme applies. On the one hand, pesticides that are mutagenic, carcinogenic, or hazardous to reproduction are taxed relatively high in this scheme. On the other hand, pesticides that are utilized in organic farming and those that are less hazardous are taxed at a lower rate. It appears that this scheme gives incentives for a reduction of products that are levied at the high rate. However, the overall tax that has to be paid by a farmer also depends on the dose per ha of a product.

Pesticides of the high tax categories often need a relatively small dose and, therefore, the tax burden per hectare might be low. In contrast, less hazardous, low-levied pesticides get relatively cheaper at a first glance, but these products often have to be applied at a higher dose. Thus, in some cases this policy

[47] Taxation and Customs Union. "TEDB - 'Taxes in Europe' Database," n.d. https://taxation-customs.ec.europa.eu/online-services/online-services-and-databases-taxation/tedb-taxes-europe-database_en
[48] https://one.oecd.org/document/ENV/WKP(2020)2/En/pdf

gives incentives to switch to low-dose pesticides. For this reason, the French policy objective of reducing the overall pesticide use is consistent with the French tax but not fully consistent with the targets of a differentiated scheme, which is to reduce the load caused by pesticides. The high reduction effects induced by a relatively low tax was confirmed in a simulation study by Jacquet et al.[49], in which a 20% reduction is reached by a 16% ad valorem tax.

6.5 Conclusion

The case studies in the earlier section highlight the diverse strategies adopted by countries to incentivize environmentally responsible farming practices through taxation. The success of these measures, evident in reduced pesticide usage and reduction of environmental impact, showcases the potential of pesticide taxes as effective tools for promoting sustainability in agriculture. The nuanced approaches and continuous adjustments made by these countries emphasize the importance of tailor-made policies that consider local contexts and engage stakeholders in achieving long-term success.

7. Water and sewerage taxes

7.1 Introduction

Clean water and efficient drainage are vital for thriving communities. Beyond their foundational role in public health, providing preventative measures against waterborne diseases, clean water supports agricultural irrigation and safeguards livestock. In industries, a consistent water supply is crucial for operations and economic growth. Additionally, proper drainage prevents pollution, preserves ecosystems, and becomes pivotal in mitigating climate change-induced events. Access to clean water and efficient drainage systems is essential for sustainable communities, influencing public health, agriculture, economic development, environmental preservation, and resilience to climate change. Prioritizing these infrastructures is essential for ensuring global community well-being and sustainability.

7.2 Purpose of water and sanitation taxes

Taxes related to water and sanitation are often implemented at local government/municipality levels in most jurisdictions. Such taxes are crucial for funding essential infrastructure. Cities often combine water and sanitation taxes for operational efficiency, streamlining administrative processes and improving coordination in infrastructure development. A unified tax system simplifies the consumer experience and enables efficient resource allocation. However, challenges in developing countries, like a lack of metered water connections, may hinder this approach, requiring innovative solutions.

[49] Jacquet, F.; Butault, J.P.; Guichard, L. An economic analysis of the possibility of reducing pesticides in French field crops. Ecol. Econ. 2011, 70, 1638–1648.

Sewerage taxes, when levied as a proportion of water usage, aim for environmental effectiveness. Challenges in practice, such as deficiencies in tax design, difficulties in administration, and political influence, may compromise these objectives. To maximize environmental effectiveness, taxes should target pollutants accurately, but practical limitations and corruption can pose obstacles.

These objectives align with four sustainability dimensions:

- Financial sustainability: Ensuring the enduring functionality of physical assets over the long term.
- Economic efficiency: Directing water resources towards the most advantageous purposes for the community while preventing unnecessary wastage of economic resources.
- Environmental sustainability: Discouraging the depletion of vital natural resources that are crucial for the environment's stability.
- Social equity: Guaranteeing adequate and affordable access to water under fair and just conditions for all individuals.

7.3 Common types of water and sewerage taxes

In different countries, municipal governments often impose various taxes and fees related to water and sewerage services to cover the costs of maintaining, upgrading, and expanding infrastructure. It is seen that developing countries use ‘tax’ and ‘fees’ interchangeably for many kinds of charges imposed by the municipality. Conceptually, a tax is a compulsory charge levied to fund common goods; the benefit from such a charge is collective and does not directly benefit the persons charged. On the other hand, fees are voluntary charges for specific services or facilities, in exchange for a direct benefit for the payer. Often, charges imposed for sewerage but referred to as fees are compulsory levies by municipalities and are used for developing collective sewage infrastructure. Hence, a strict differentiation is not made between taxes and fees in this section.

Below are some of the common taxation practices followed by the governments around the world:

a) **Water Usage tax:** These are charges based on the amount of water consumed by a household or business. They can be a fixed rate per gallon or a tiered structure where higher consumption incurs higher rates.
b) **Sewer Service Charges:** Fees for the collection and treatment of wastewater. They are often calculated based on water usage since the assumption is that what goes in as water comes out as wastewater.
c) **Stormwater Fees:** Charged to manage rainwater runoff. These fees contribute to maintaining stormwater systems, preventing flooding, and managing water quality.

d) **Connection Fees or Tap Fees:** One-time charges for connecting a property to the municipal water and sewer system. They cover the initial setup costs.
e) **Infrastructure or Capital Improvement Fees:** Levied for infrastructure upgrades or expansions, ensuring that the systems can meet growing demand or comply with regulations.
f) **Property Tax Assessments:** Some municipalities incorporate water and sewer costs into property tax assessments to fund these services collectively.
g) **Impact Fees:** These fees are charged for new developments to offset the impact of increased water and sewer usage resulting from population growth or new construction.

These taxes and charges vary significantly depending on the location, local governance, infrastructure needs, and the specific way a municipality chooses to finance its water and sewer systems.

7.4 Considerations for sewerage tax policy design

The feasibility of sewerage and water taxes depends on economic capacity, infrastructure readiness, public acceptance, and robust enforcement mechanisms. Balancing revenue generation with affordability is crucial, emphasizing tangible benefits for taxpayers. Public education campaigns can enhance public awareness and support. Strong enforcement systems are imperative to tackle tax evasion. Clear policy frameworks and transparent fund allocation build public trust. Assessing environmental and health impacts is vital, highlighting positive societal benefits. A comprehensive evaluation considering economic, social, environmental, and infrastructural facets is essential for determining feasibility and viability.

Implementing water and sewerage taxes in developing countries presents challenges related to affordability, equity, and limited infrastructure. Low-income groups often bear the burden, and insufficient funds impact service quality. Compliance and revenue collection hurdles, coupled with limited resources, constrain critical infrastructure projects.

Dissimilarities between developed and developing countries in water and sewerage systems arise from factors like infrastructure, resources, economic capacities, and governance. Developed countries have extensive infrastructure and higher per capita income, mobilizing resources for modernization. In contrast, developing countries face challenges with insufficient infrastructure, leading to restricted access and reliance on inadequate water sources.

Disparities in investment and access exist between developed and developing countries. Developed countries allocate more resources, supported by dedicated budgets and regulatory oversight, while financial constraints in developing countries result in aging or inefficient systems. Lack of access in developing countries significantly impacts health, education, and economic opportunities, with disparities persisting even in developed countries.

Resolving these disparities requires collaborative efforts, focusing on investing in infrastructure, enhancing governance, promoting sustainability, and ensuring equal access to clean water and sanitation facilities globally.

7.5 Case studies

This section examines examples from various jurisdictions that have implemented water and sewerage taxes or related charges. While not exhaustive, it serves as a guide for countries considering the implementation of such taxes.

7.5.1 Dumaguete, Philippines[50]

In 2012, the Philippines initiated activities related to Fecal Sludge Management (FSM) under the National Sewerage and Septage Management Plan. This plan provided up to 40% financial assistance for sewerage or septage management programs in local cities and municipalities.

Dumaguete, a small city with a population of 134 000, adopted a collaborative approach to desludging services, with city water districts investing in truck capital and operational costs, while local governments manage treatment plants. The desludging service follows a 5-year cycle, and households pay desludging charges through their monthly water bill at a tariff of PHP 2.00 (US$0.05) per cubic meter of water consumed. Dumaguete's local ordinance serves as a model, establishing explicit septage management policies, including standards for septic tanks, desludging frequency, treatment, user fees, penalties, and monitoring mechanisms.

Dumaguete further established a City Septage Management Authority, ensuring program operation and fostering inter-agency coordination. In Metro Manila, a private sector provider manages fecal sludge management services in areas without sewerage coverage through a Public-Private Partnership (PPP), charging an environmental fee of 20 percent of the water bill.

One of the key lessons from the experience of Dumaguete is inter-agency coordination in sewerage tax administration. Imposition of water tax in general, and sewerage tax particularly, can involve engagement of multiple public agencies and private sector participants. A high level of cooperation is beneficial to improving environmental effectiveness in sewerage tax administration.

[50] Source: Robbins, D., Strande, L., and Doczi, J. (2012). Opportunities in Faecal Sludge Management for Cities in Developing. Countries: Experiences from Philippines. Chapel hill, NC: RTI International.

7.5.2 Saitama, Japan[51]

Saitama, a neighboring city of Tokyo with a population of 1.27 million, employs a combination of offsite and onsite sanitation systems. Approximately 92% of the population is connected to the sewerage system, while the remaining 8% relies on onsite systems, specifically the johkasou.

The johkasou is a compact and efficient onsite wastewater treatment facility, primarily used in rural or peri-urban areas without access to a sewerage system. It treats both blackwater (toilet wastewater) and greywater (nonfecal wastewater) to achieve high effluent quality. Public sewerage systems in Saitama are managed by public enterprises operating as self-sustaining businesses under the Local Government Finance Act of Japan.

Transparency is maintained through the self-support accounting system, covering costs through generated income. A tax is levied annually on land and house owners, with the revenue allocated for city planning expenditures, including sewerage. On average, a household using the johkasou pays about ¥65,000 (approximately $586.91) per year for operations and maintenance.

This case study highlights the challenges in taxing and serving households that remain outside the sewerage system. The Johkasou is a solution found appropriate in Saitama city.

7.5.3 Mumbai, India

Mumbai, a major global city with a population of 13.5 million, faces water supply challenges in its Island City. Island City refers to the southernmost part of the city. The water supply network, featuring tunnels and mains, delivers approximately 3950 Mld of untreated and treated water daily. The Island City, characterized by old structures lacking water meters, collects water charges through Water Tax, especially for unmetered supplies in older buildings.

The water supply tariff, in place since 2008, includes telescopic rates for domestic non-slum consumers. Sewerage charges constitute 70% of the water tariff. The billing structure encourages water conservation, with escalating rates based on consumption levels.

The city implements a Consumer Metering Policy, recommending ultrasonic and electromagnetic water meters. Billing features additional charges for non-functional private water meters, NAP/NAT water meters, and special provisions for non-domestic water usage.

Capital expenditures cover dam construction, water mains, sewer lines, and treatment plants. Funding comes from water and sewerage taxes, government grants, depository works, and internal funds.

[51] [To be included]

Revenue expenditures encompass employee costs, administrative expenses, and operational maintenance, including pumping station repairs and sewerage treatment plant upkeep.

8. Petroleum taxes

8.1 Introduction

As more investors and companies seek greater clarity and confidence in accounting for long-term climate risks and opportunities, businesses are adapting to the "energy transition" — a transformation of the global energy sector from fossil-based systems of energy production and consumption to renewable energy sources. Switching from non-renewable energy sources like oil, natural gas, and coal to renewable energy is made possible by technological advancements and a societal push toward sustainability. Spurred by structural, permanent changes to energy supply, demand, and prices, the energy transition also aims to reduce energy-related greenhouse gas emissions through various forms of decarbonization.

Petroleum taxes, traditionally implemented as revenue-generating mechanisms, possess the inherent potential to serve dual purposes by actively contributing to the green energy transition. By strategically designing tax policies, governments can incentivize environmentally sustainable practices and investments in renewable energy sources. For instance, revenue generated from petroleum taxes can be earmarked for funding renewable energy projects, fostering research and development in green technologies, or providing subsidies for clean energy initiatives. Similarly, they have been used to incentivize investments in transition fuels like gas. This innovative approach transforms petroleum taxes into a catalyst for positive environmental change, aligning fiscal policies with the imperative to transition towards a more sustainable and eco-friendly energy landscape.

While petroleum taxes are typically supply-side focused, their consideration in this paper is solely because some countries, including developing ones, have implemented measures within their petroleum tax regimes aimed at promoting environmental consciousness among sector players, thereby supporting efforts towards environmental protection. While this section does not delve into specific tax measures, it provides a different angle by presenting a snapshot of the legislative and regulatory frameworks implemented by the country examples.

In the choice of countries, it was important to look at what obtains in developed countries such as Norway, where businesses are adapting to energy transition with reasonable transformation of the global energy sector from fossil-based systems of energy production and consumption to renewable energy sources. Renewable energy has become a powerful and cost effective source of electricity. On the contrary, in developing countries such as Nigeria and Trinidad and Tobago, the cost of switching from non-renewable energy sources is so prohibitive that these countries find it so difficult to move at the

same pace as the developed countries. The oil and gas sector still plays a vital role in the development of these countries and more often than not accounts for lion share of revenue generated and therefore is the reason they still find it difficult to abandon its fossil fuel deposits.

8.2 Country focus

8.2.1 Nigeria

Nigeria, a significant player in the global oil and gas sector, has implemented regulatory measures to manage emissions from its petroleum industry, acknowledging the environmental impact of hydrocarbon activities. The country has established a legal framework, notably the National Environmental (Standards for Discharge of Petroleum into the Environment) Regulations (1998), developed under the National Environmental Standards and Regulations Enforcement Agency Act (NESREA Act) of 2007. These regulations address diverse aspects, including oil spills, flaring, and emissions. Regulation 3 within these standards mandates oil companies to adopt reasonable measures for spill prevention and pollution control, outlining specific standards for the treatment and disposal of oil and gas wastes. Additionally, reporting all spills to relevant authorities is compulsory under these regulations.

Nigeria's petroleum industry, recognizing its role in emissions management, has initiated efforts to adopt cleaner technologies and reduce environmental impact. Collaboration between government bodies, industry stakeholders, and international partners has facilitated research and development of environmentally friendly practices within the sector.

Nevertheless, Nigeria faces challenges in addressing gas flaring, enhancing monitoring capabilities, and ensuring consistent compliance across diverse oil-producing regions. Future considerations include the need for continuous research, technological innovation, and alignment with international best practices to foster sustainable and responsible petroleum activities.

Looking forward, Nigeria's regulatory framework for emissions in the petroleum industry underscores its commitment to balancing economic development with environmental stewardship. Ongoing collaboration and vigilance in enforcing regulations will be instrumental in fostering a sustainable future for the nation's petroleum activities.

8.2.2 Norway

The Norwegian petroleum tax system operates on entity-based taxation, lacking ring-fencing between licenses or fields on the Norwegian Continental Shelf (NCS). Income from offshore activities cannot offset losses from onshore activities, and vice versa. Norway, known for its dedication to environmental sustainability, has implemented robust legislation to control emissions from the petroleum industry.

These regulations align with Norway's overarching climate objectives and international commitments, emphasizing efforts to minimize the environmental impact of petroleum activities.

Norway's regulatory authorities, primarily the Norwegian Environment Agency (NEA) and the Petroleum Safety Authority Norway (PSA), oversee compliance with emissions regulations. These agencies conduct regular inspections, assess emission reports, and enforce penalties for non-compliance to ensure a high standard of environmental protection.

Norway's stringent legal framework governing emissions in the petroleum industry reflects a commitment to sustainable practices and environmental stewardship. The combination of emissions trading, taxation, and comprehensive regulatory measures positions Norway as a global leader in mitigating the environmental impact of petroleum activities. Continued efforts and adaptability to emerging environmental challenges underscore Norway's dedication to a greener future.

8.2.3 Trinidad and Tobago

Trinidad and Tobago, a significant player in the global energy market, has established a legal framework to govern emissions from its petroleum industry. Companies engaged in upstream operations are subject to a special fiscal regime governed by the Petroleum Taxes Act (PTA). Recognizing the environmental impact of hydrocarbon activities, the country has implemented laws to regulate and mitigate emissions, ensuring responsible and sustainable energy practices.

Trinidad and Tobago's petroleum industry has undertaken voluntary initiatives to address emissions. Collaboration between the government, industry stakeholders, and environmental organizations has led to the development of best practices, technology upgrades, and research to minimize the industry's carbon footprint.

The country faces challenges in balancing economic development with environmental sustainability. Continued efforts are needed to enhance monitoring capabilities, promote research on cleaner technologies, and align emission regulations with international standards. As global energy transitions evolve, Trinidad and Tobago's petroleum industry must adapt to remain competitive while prioritizing environmental responsibility.

Trinidad and Tobago's regulatory framework governing emissions in the petroleum sector reflects a commitment to balancing energy production with environmental preservation. Ongoing collaboration between government, industry, and environmental stakeholders will be crucial for ensuring a sustainable and responsible future for the nation's petroleum activities.

8.3 Conclusion

This section has briefly examined the role of petroleum taxes in facilitating the global energy transition towards renewable sources and promoting environmental consciousness within the petroleum industry. While traditionally serving as revenue-generating mechanisms, petroleum taxes possess the inherent potential to contribute to positive environmental change by incentivizing sustainable practices and investments in clean energy initiatives. By strategically designing tax policies, governments can harness petroleum taxes as a catalyst for advancing the green energy transition, aligning fiscal objectives with environmental imperatives.

The country examples provided, including Nigeria, Norway, and Trinidad and Tobago, offer insights into diverse regulatory frameworks and industry practices aimed at managing emissions and promoting sustainable petroleum activities. While each country faces unique challenges and opportunities, ongoing collaboration, technological innovation, and alignment with international best practices are essential for fostering sustainable and responsible petroleum activities. Looking ahead, it is essential for governments, industry stakeholders, and environmental organizations to continue working together to address environmental concerns, enhance monitoring capabilities, and promote research on cleaner technologies.