ANNEX C-1 to E/C.18/2024/CRP.33

Draft paper from the Subcommittee on Environmental Taxation proposed for final approval by the Tax Committee in October 2024

Other Environmental Measures other than Carbon Taxes

Proposed new title: Environmental Taxation (Other than Carbon Taxes)

This paper on environmental taxation other than carbon taxes is the output of the Subcommittee's Workstream 5 and comprises seven sections and an appendix. The appendix,titled "*Inventory of Select Environmental Taxes and other Measures*", is presented as ANNEX C-2 to E/C.18/2024/CRP.33.

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1. Introduction

Environmental taxation can be a powerful tool to steer consumption and production to more sustainable pathways, thereby contributing to achieving the UN Sustainable Development Goals (SDGs)[1]. The objective of this paper is to serve as practical guidance for developing countries in the process of introducing, extending or updating their environmental taxation. The paper does so by presenting real life country examples and based on them, identifying common characteristics that contribute to the effective application of these taxes. This paper also showcases different possible avenues of applying a specific tax, in order to present options from which developing countries can choose the best fit for their specific needs and objectives.

Environmental taxation has the potential to reduce pollution, increase the economic viability of cleaner alternatives while also mobilising domestic revenues. Therefore, the paper pays special attention to the double dividend that environmental taxation can achieve, namely, environmental protection and revenue generation in times of a globally strained fiscal environment due to rising energy and food prices.

Environmental taxes include a wide range of different taxes which can be tailored to each country's specific needs and objectives. Environmental taxes include air pollution taxes, consumer and producer plastics taxes, waste incineration and waste landfill taxes, pesticide taxes, energy taxes, water use and discharge taxes, motor vehicle taxation and even different taxes aiming to preserve bio- diversity. The common feature of these taxes is that they are based on the polluter pays principle.[2] Also, they all can enable synergies between the SDGs. For example, the less plastics are produced, the less waste is generated. The less waste is generated, the less soil and ground water pollution is caused by waste landfill sites. The less waste is disposed at landfill sites, the more waste is recycled. The higher the electrification rate in road transport, the less local air pollutants are emitted from internal combustion engine cars. This in turn reduces the number premature deaths.

This paper covers in detail seven high-impact environmental taxes. They are taxes on: air pollution, plastics production and consumption, pesticides in agriculture, sewerage (wastewater), energy use, solid waste landfill and solid waste incineration. For each tax type real-life practical examples are presented. The selection of examples is without prejudice to the success and effectiveness of environmental taxes applied in countries not listed in this paper. After each section a summary of guidance is presented based on the examples. It is also to be noted that although carbon dioxide (CO2) taxes are environmental taxes, they are not included in this paper, as they are covered by other workstreams of the United Nations Tax Committee.

Certain environmental taxes are commonly implemented at sub-national level. In other words, states,

[1] https://sdgs.un.org/goals

municipalities and even cities can implement their specific environmental taxes. This paper showcases such examples. These examples can serve as guidance for entire countries and also for sub-national entities within developing countries.

Beyond the taxes covered in detail, this paper also presents an inventory of other environmental measures that can be used by developing countries to address their specific needs. It is important to note that this inventory also includes non-tax measures, such as fees, charges and regulation, in order to provide the widest possible options of policy makers, thereby serving as a complementary component to the main paper. The inventory is presented as an appendix to this paper and is provided in ANNEX C-2 to E/C.18/2024/CRP.33.

2. Air pollution taxes

As urbanization and industrialization continued progressing in developing countries, air pollution became 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 released directly into the atmosphere. They include 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 result from various anthropogenic activities, such as burning fossil fuels for electricity generation, transport, industrial processes, agriculture and waste treatment.

Taxes were adopted by numerous countries to reduce air pollution. They target either specific pollutants or polluting behaviors. Directly levying the tax on targeted pollutants is straightforward. It means that taxes are either applied to pollutants emitted to the atmosphere, such as the concentration of sulphur dioxide. The tax can be imposed also on the polluting fuel. For example, transport fuels with different sulphur contents. 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 sulfur emissions reduction.

2.1 Practical country examples

This section provides guidance by displaying three country examples. It does not aim at fully describing the tax regime of these countries. Instead, it focuses on highlighting the features that can help developing countries to design effective environmental taxation, tailored to their country specific needs.

2.1.1 China’s environmental protection tax

China's environmental protection tax (EPT) law took effect on 1 January 2018. The EPT replaced the Pollutant Discharge Fee (PDF), which had been in place for about 40 years. The evolving progress of PDF and the final adoption of EPT reflect China's continuous efforts of 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 entails a stronger legal, executive,and binding obligations than its processor, the PDF. Most notably, the EPT imposes taxes on 44 major air pollutants, including SO2, NOx, and PM2.5.

The 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 (approximately USD 0.16 to 1.6) per unit of pollution equivalent under the guidance of the central government. In practice, provinces determine their tax rates by striking the balancebetween environmental impacts and budgetary capability to address pollution.
At the time of writing of this paper, three tiers of tax rates exist in different provinces: the highest tier 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 monitoring bodies. Estimations are usually based on 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 standard, tax credits are eligible for respectively 50% or 75% deduction.

It is widely considered that EPT has played an important role in helping China to progressively achieve the reduction of air pollution. 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, representing a reduction of 25.8%.

2.1.2 Chile's green tax

Chile faces significant challenges arising from local environmental pollution, including health problems and premature deaths caused by intensive economic activities, geographic and climatic conditions as well as production and consumption patterns. In its updated Nationally Determined Contributions (NDC) under the Paris Agreement, Chile pledged to reduce GHG emissions to 95 million tones of CO2 equivalent 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 is imposed on both stationary and mobile sources.

Targeted stationary sources include 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. The air quality coefficient incorporates the pollution potential of the specific location. 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.

2.1.3 Denmark's sulphur tax

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

Compared to the regimes in China and Chile, the Danish sulfur tax provides two options for boiler owners liable to the tax, namely being levied either on the sulphur content of the fuel used (actual emissions of sulphur dioxide (SO2)), or on the polluting fuel itself (similar to fuel tax). The intention of the Danish authorities providing options to the polluters is to motivate actions of removingthe sulphur dioxide from the flue gas before injecting it into the atmosphere. Over time, the direct- emission-based levy became less relevant in practice, as it requires the installation of the equipment to measure emissions.

The rates have been revised periodically since the 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 KK per kg sulphur in fuels or 12.1 DKK per kg SO2 in 2021.

2.2 Conclusions for air pollution taxes

The selected country examples showcase different options for implementing an air pollution tax. A difference among them, is that the taxes in China and Chile target only pollutants, while Denmark's case focuses on both pollutants or polluting behaviors by taxing the fuel. Air pollution taxes can also be designed

to cover both global air pollution (CO2) or only local air pollutants with the complimentary implementation of carbon pricing policies. The revenue recycling also tends to differ, unlike in the case of carbon taxes tackling a global pollutant, air pollution taxes aim to improve local air quality and revenues generated from their implementation, typically go back to local communities. Hence, it is particularly important to align them with local circumstances, which should be reflected in the tax design. In this spirit, four specific lessons are worth highlighting:

- Applying flexible tax rates: In China and Chile's cases, the central authorities allow local tax rates to be determined to meet local needs.
- Returning the revenue to local communities: In these three cases, tax deductions of China, tax revenue recycling in Denmark and tax credits in Chile are applied to incentivize local action.
- Providing alternative tax base: Denmark provides options of levying the 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. Plastics taxes

Taxing plastics is a policy used by numerous countries at different stages of development. Plastics taxes represent a market-based instrument in the repertoire of tools available to policymakers aiming at addressing the ecological and resource-related challenges posed by plastic pollution. Plastic taxation can be implemented 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. Taxes at the producer level also tend to lead to technological innovation of sustainable materials and packaging, thereby aiming to curtail plastic waste at its origin. To address plastics use at consumption level, countries typically impose a small charge on the final consumption of single use plastic products (for example, a plastic bag, plastic cutlery or plastic bottles),

with the objective of instilling a change in consumer behaviour. The small charge does have a revenue raising potential, its main objective is however to incentivise consumers to use reusable bags instead of single use plastic bags that end up as waste. It is to be noted that the taxation on plastics are not the only option for countries to address the adverse environmental effects of plastic pollution. Some countries, among them Kenya and Rwanda opted to completely ban certain uses of plastics.

3.1 Practical country examples

This section provides guidance by displaying three country examples. It does not aim at fully describing the tax regime of these countries. Instead, it focuses on highlighting the features that can help developing countries to design effective environmental taxation, tailored to their country specific needs.

3.1.1 The United Kingdom's plastic packaging tax [3]

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. Doing so by increasing the recycling and collection of plastic garbage, preventing it from going to a landfill or being incinerated. 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 GBP 210.82 (around EUR 242.52) 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 upstreamindustry 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 276million Euro) for the UK Treasury (WTS Global, 2022).

3.1.2 Republic of Korea's waste disposal tax

In the Republic of Korea, similar to the UK, manufacturers and importers of plastic products are held financially accountable for the environmental impact of their plastic products. 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

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

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 (approximately 0.018 EUR), and for those over500 ml, the rate is 30.7 KRW (approximately 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,approximately 0.11 Euro/kg) and construction use (75 KRW/kg, approximately 0,053 Euro/kg).

Notably, the Korean system also offers reduced rates to businesses that deal with significant amounts of plastics by imposing a lower rate to large businesses.[4] 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 (approximately 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 (approximately 705,512,30 Euro), divided by total annual sales. For importers, a reduction is available if they import atleast 3 tons of plastic annually or if their plastic imports amount to 90,000 USD (approximately 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.

3.1.3 Denmark's plastic tax

The practice in Denmark is also producer-focused and extends across the upstream supply chain of plastic packaging. 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). In practice, Denmark imposes an excise duty is imposed on plastic carrier bags.

This tax was first introduced on 1 January 1994. It was last increased on 1 January 2020. For the years 2021 to 2023, the rate was set at DKK 69.63/kg (approximately EUR 9.30/kg). From 2024 onwards, the rate is DKK 73.46/kg (approximately 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.

3.1.4 Ireland's plastic bag levy[5]

Ireland introduced a consumer-focused plastic bag levy in March 2002. The initial rate was set at 15

[4] See Martinsson et al (2024) for the effect of reduced rates on the limited effectiveness of environmental taxes.
[5] https://www.revenue.ie/en/companies-and-charities/plastic-bag-environmental-levy/index.aspx

Euro cents per bag. By 2007, it increased to 22. 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 already shortly after its implementation.

A report by the Institute for European Environmental Policy (2022), indicates that by 2014, 12 years after the introduction of the tax, plastic bags constituted only 0.13% of disposed waste. This represents a substantial decrease from the estimated 5% share prior to the levy's implementation. In other words, a 40-fold reduction in waste resulting from plastic bags is to be observed from 2002 to 2014. 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) the plastic bag tax was universally supported by the population of Ireland.

3.1.5 South Africa's plastic bag levy [6]

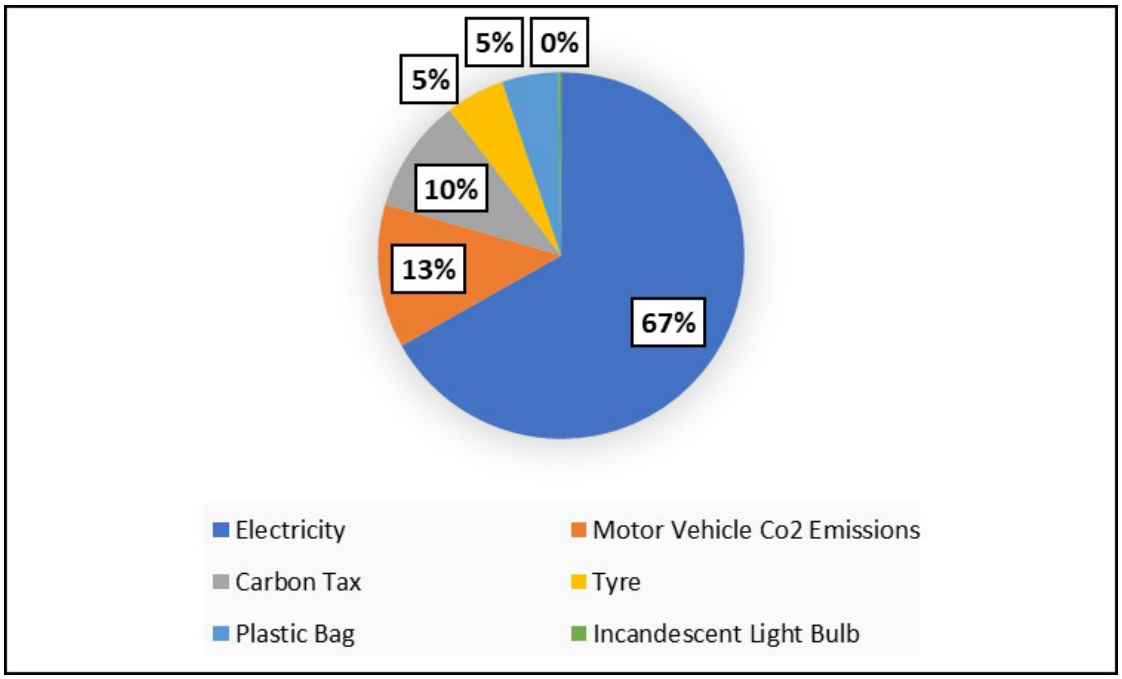
Contrary to the stringent ban of plastic production and usage implemented by other African nations, such as Kenya and Rwanda, South Africa has adopted a multifaceted approach to plastic management. This strategy encompasses measures such as the standardization of plastic bag sizes, regulation of the 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 (approximately 0.022 Euro). It was however later reduced to 32 Rand cents (approximately 0.016 Euro) due to pressure 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, indicatingthat 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 alongside revenues from other environmental taxes in South Africa. It shows that the revenue generated from the plastic tax is not very significant compared to other environmental taxes. For instance, in 2021, out of the six environmental taxes, plastic bag levy generated the second smallest amount of revenue, contributing R579.7 million for the year which is equivalent to only 5 percent of the total environmental revenue.

[6] https://www.sars.gov.za/customs-and-excise/excise/environmental-levy-products/plastic-bags/

Figure 1 Annual Environmental Levies in South Africa for 2021



Source: South African Revenue Services

3.2 Conclusions for plastics taxes

The selected examples provide an overview of the varied strategies and effects of plastic taxation in tackling the pressing issueof 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 provide examples of the producer-focused approach. On the other hand, Ireland and South Africa have introduced taxes on the consumption of plastic products.

Both production and consumption taxes are Pigouvian taxes, meaning that they aim at reducing their own tax base. Therefore, it is necessary to adjust the level of taxation to induce or keep up changes in producer and consumer behavior. The effects of consumer and producer plastics taxes are however different. A country that is concerned with solid waste may want to choose to tax consumption of plastic bags as this reduces the number of plastic bags disposed in landfill sites or disposed illegally. The examples for consumer taxes demonstrate that there are considerable behavioral effects of these taxes.
On the other hand, a tax on plastics production provides incentives for product innovation. It also incentivizes more efficient production processes and the use of recycled materials.

4. Energy taxes (indirect taxation: excise duties and VAT)

This section aims at providing guidance to developing countries for 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.[7]

Energy taxation consists of excise duties (fuel taxes) and value-added tax (VAT), which is often referred to as general sales tax in somelegislations. Energy excise duties are consumption taxes imposed on fuels used for transport and heating. Electricity and other energy products are often but not always covered by to excise duty regimes. 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. In India, excise duties make up about 26% of petrol and 21% gas oil prices respectively. In Turkey, the excise duty on petrol almost tripled in 2023, 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. The combined impact of VAT and excise duties is even higher, over 50% in most Member States. Electricity and natural gas excise duties typically range between 8% to 12% in the European Union, depending on the consumer type andt heir volume of annual consumption.[8]

Excise duties also represent a sizeable share of domestic revenue mobilisation for governments around the world.[9] Currently, fossil fuels used for road transport are taxed at high in most legislations. Therefore, they account for a high share of revenues. 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.

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[8] 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

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

4.1 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 tax regimes.

4.1.1 Finland

Finland's energy taxation is subject to the European Union's Energy Taxation Directive.[10] 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 in order to 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 and EUR/kilogram.

Finland introduced energy unit-based taxation in 2011, as a feature its energy taxation reform.[11] 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. In other words, 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. Domestic biofuel production can decrease this

[11] 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

dependency and mitigate vulnerability to volatile international prices.[12] Brazil significantly reduced its import dependency by implementing biofuel support policies. Brazil, 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 supportpolicy, that includes lower taxes on biofuels compared to fossil alternatives. The country's first measures to incentivize the use of biofuels date back as far as 1904 in the state of Pernambuco.

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.[13]

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. An exemption also applies to electricity used in rail transport, and reductions apply to the electricity consumption of energy intensive industries. A reduced electricity rate applies to a restricted list of industrial uses, such as mining, data centers and agriculture. As renewable electricity 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 adequately equipped electricity distribution systems, electric vehicles could feed back electricity stored in their batteries into the system (vehicle-to-grid). 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. As the taxable event is "release for consumption, stored energy is not taxed. In other words, double taxation is avoided when stored energy is released for consumption.

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. For example, Finland's applies a rate of 527 EUR/litre to gas oil (diesel) consumption in transport (cars). The rate for gas oil consumption in agriculture is lower,

[12] https://www.bloomberg.com/news/articles/2022-03-17/energy-shock-hitting-poorer-nations-reliant-on- imports-hardest?embedded-checkout=true#xj4y7vzkg

[13] See also section 5 of the paper "The Role of Carbon Taxes and other Measures to Support Energy Transition" available on the UN Tax Committee webpage: https://financing.desa.un.org/sites/default/files/2024-09/Carbon%20Taxation%20and%20Energy%20Transition.pdf

Namely, 268 EUR/MWh. Gas oil consumption in agriculture accounts for 11 of the country's total gas oil consumption. [14] This means that the tax relief allows a higher rate to be imposed on most gas oil consumption in Finland, while the reduction applies only to a small portion. This is particularly relevant when considering the impact of energy prices on food costs and food security.

Overall, it remains important to support the electrification of the agriculture sector, which continues to be highly dependent on gas oil globally. 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 ensure that tax policies align with broader sustainability goals and do not lock in the use of environmentally harmful fuels.

4.1.2 Indonesia

In Indonesia CO2 emissions of the transport sector account for 30% of all CO2 emissions.[15] 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. Thereof, over 230 thousand in Indonesia.[16]. The transport sector plays an important part in this global crisis, as many local air pollutants, especially in congested urban areas,stem from vehicles.[17]

Indonesia established an ambitious electrification plan with a target of 600K[18] 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 the largest market in the Association of Southeast Asian Nations (ASEAN). Indonesia also produced 1.5 million vehicles (the second highest number after Thailand).[19] Achieving this target remains very challenging, as it would 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

[14] Own calculations based on Eurostat Complete Energy Balances (nrg_bal_c) using the indicators Available for Final Consumption (AFC) and Final consumption - other sectors - agriculture and forestry - energy use (FC_OTH_AF_E) for gas oil.
[15] 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
[16] 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.
[17] 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
[18] 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
[19] Arthur D Little, Unleashing Indonesia's Electric Mobility Potential, retrieved on 01.08.20230, retrieved from: https://www.adlittle.com/id-en/insights/report/unleashing-indonesias-electric-mobility-potential

by fossil fuels. In this sense, the Indonesian regime does not apply excise duty reductions to energy consumption itself. Yet, these are useful examples 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.[20] Another regulation provides adjustments for the exemption of Luxury-Goods Sales Tax (LGST).[21] 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 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.[22]

4.1.3 The Netherlands

The Netherland's energy taxation is also subject to the European Union's Energy Taxation Directive.[23] 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.[24] The reduced rate applies only to electricity used at public charging stations. As the price of batteries that drive electric vehicles

[20] 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 Borneby the Government for the 2023 Fiscal Year.
[21] Regulation No. 42/PMK.010/2022 concerning the Determination of Types of Motorized Vehicles Subject to Sales Tax on Luxury Goods.
[22] 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
[23]Council Directive 2003/96/EC of 27 October 2003 restructuring the Community framework for the taxation of energy products and electricity.
[24] 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

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 also 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.[25] 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 to protect vulnerable households and small businesses, 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.

4.3 Conclusions for energy taxes

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 highlighted examples for introducing future proof energy taxation in 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. The examples highlight how energy taxation can support the uptake of lowcarbon energy products and uses, thereby accelerating the green energy transition in developing countries. This can be achieved by higher taxes on polluting fuels, that increase the competitiveness of cleaner alternatives. These include biofuels, hydrogen and expanding the use of electricity in transport and heating.

Electrification should be accompanied by the decarbonization of electricity production. As the cost of renewable electricity production continues to fall, the decarbonization of electricity production becomes more viable. At the same time emerging technologies, such as renewable hydrogen and other fuels of non-biological origin and energy storage enter markets. These technologies are essential for sector coupling and the decarbonization of other sectors, such as transport and industry. Energy tax design can accelerate the uptake of these technologies, thereby abating both global carbon dioxide emissions and

[25] 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.

local air pollutants.

5. Waste landfill and incineration taxes

The world keeps generating more and more waste. This 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% until 2050.[26] Waste taxation can help to combat this problem by reducing the amount of waste generated and by increasing recycling. This chapter aims to display different avenues which developing countries may choose to introduce waste taxation.

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, can be incinerated with energy recovery. In other words. the waste is burnt to produce electricity 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 move waste management from the bottom two levels of the hierarchy, namely waste incineration and landfill towards the top two levels, namely waste reduction and recycling.

Landfill means the disposal of waste at dump sites, often as a method of 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 environmental consequences. These include the pollution of soil, air and water. Hazardous chemicals from waste can leak into the soil and from there into agricultural produce. 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 n 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.[27] 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.

[26] 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

[27] United States Environmental Protection Agency, Basic Information about Landfill Gas, retrieved on05.08.2023, retrieved from: https://www.epa.gov/lmop/basic-information-about-landfill-gas

Numerous countries around the world introduced landfill taxes to make use of this dual power.

Incineration means the combustion of waste. 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.[28] Separated municipal solid waste (MSW) is considered to be a renewable resource in the United States and the European Union as well. In the latter, 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 if separate collection obligations are fully met.[29] Elsewhere, in 2021 the Government of Brazil approved the country's first urban solid waste tender for energy production.[30]

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. 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.[31]

5.1 Practical country examples for landfill waste taxes

This section provides guidance by introducing three country examples. It does not aim at fully describing the waste taxation of these countries. Instead, it focuses on highlighting the features that can

[28] 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
[29] 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/
[30] 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/
[31] https://task36.ieabioenergy.com/news/swedish-waste-incineration-tax-abolished/

help other countries to design successful tax regimes.

5.1.1 Catalonia, Spain

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. The Zero Waste Plan is based on a philosophy of the same name, which follows the circular economy model where waste is understood as a resource. It promotes tools to facilitate the reuse and recycling of waste materials.[32]

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. The more waste is avoided and recycled, the less waste goes to landfill. The less waste goes to landfill, the less tax municipalities 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.[33]

As a result of Catalonia's overall 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. [34]

5.1.2 Australian Capital Territory, Australia

Several Australian jurisdictions apply waste taxes.[35] The Australian Capital Territory (ACT), home to Canberra, the country's capital, applies the highest waste taxes among its counterparts. These taxes,

[32] 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.

[33] Ajuntament de 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

[34] 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

[35] 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.

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 costly. Mixed C&I waste with less than 50 per cent recyclable material costs $199.20 per tonne to dispose of at landfill.[36]

As urbanization accelerates in many developing countries, so do construction and demolition (C&D) activities. This in turn results 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). While in Brazil almost 97% of waste is collected, 40% of the collected waste is disposed at inadequate sites by the municipalities themselves.[37] 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 generated by the waste disposal tax, is used to improve enforcement and compliance. They also fund actions and strategies that contribute to waste minimization.

5.1.3 Wallonia, Belgium

The Belgian region of Wallonia introduced a decree in 2007 that establishes nine (9) distinct taxes for waste, including a landfill tax.[38] The landfill tax specifically targets non-household waste and aims to

[36] 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

[37] ABREMA, https://www.abrema.org.br/panorama/

[38] 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

reduce waste production while encouraging the adoption of more environmentally friendly processing methods.

Wallonia also applies different rates to different types 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 267.55 / tonne of a mix of hazardous and non-hazardous waste. Similarly to the ATC system, the level of the tax reflects the environmental damage of specific types of waste.

The tax revenue is allocated exclusively to a waste management fund.[39]

In Wallonia, 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.[40]

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 industries and households exactly proportionate to their waste production. Albeit in different ways: in the case of industries by imposing a tax at the disposal site, and in the case of households by taxing disposal bags. 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. At times, changes to the system, for example altering the day of the collection of a specific color bag, results in confusion and waste accumulated in the streets of Brussels.[41]

5.2 Conclusions on waste landfill 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. Also, 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 direct 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

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.

[39] 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

[40] https://www.brussels.be/waste#:~:text=Household%20waste,yellow%2C%20blue%20and%20orange%20bags.

[41] https://www.thebulletin.be/bumpy-start-new-rubbish-collection-procedures-brussels

to effectively improve their management according to the specific characteristics of the jurisdiction. Other types of waste subject to differentiated tax rates are most commonly industrial waste, hazardous waste as well as construction and demolition waste. 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 along the urbanization in developing countries.

Electronic waste is another specific type of waste that can be addressed through taxation. Taxes on electronic waste typically aim to increase recycling of components of electronic appliances. For example, the government of California applies an Electronic Waste Recycling Fee.[42] The European Union, on the other hand, applies a specific legislative framework to manage electronic waste known as the Waste from Electrical and Electronic Equipment (WEEE) Directive. The directive however does not include tax measures.[43]

5.3 Practical country examples for waste incineration taxes

This section introduces 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 successful tax regimes.

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 tax regime.

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 (EU_ETS). For 2023, two rates were set: one rate for emissions subject to EU-ETS 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

[42] https://www.cdtfa.ca.gov/taxes-and-fees/covered-electronic-waste-recycling-fee/
[43] https://environment.ec.europa.eu/topics/waste-and-recycling/waste-electrical-and-electronic-equipment-weee_en

CO2 is captured and stored.

5.3.2 Spain

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".[44] 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).

The waste disposal tax is accompanied by 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.

The implementation of the tax 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.[45]

Unlike Norway where the tax base is emission- unit based, Spain applies a volumetric unit tax base. The taxable amount is calculated based on the weight of the waste, measured in metric tons.

5.3.3 Austria

Austria has a long history of evolving waste management policies. It was one of the first countries to ban landfill.[46] As landfill is banned the combustion of waste and accompanying incineration policies [47] play 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 monitoring waste management, are organized in

[44] https://sede.agenciatributaria.gob.es/Sede/en_gb/iva/novedades-iva/novedades-normativa/ley-7-2022-8-abril-contaminados.html
[45] https://www.eea.europa.eu/publications/managing-municipal-solid-waste/spain-municipal-waste-management/download
[46] https://ieep.eu/wp-content/uploads/2022/12/AT-Landfill-Tax-final.pdf
[47] 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.)

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. 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 for waste incineration taxes

The main feature of waste incineration taxes that can be useful for developing countries that are considering the introduction of such policies, is that they are always part of an integrated waste management 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 incineration taxes can be applied based on different tax bases. Such are measured or estimated 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. This means cooperation among public bodies, such as the Ministry of Finance and the Ministry of Climate or Environment and the Chamber of Commerce. Extensive stakeholder involvement is another crucial feature for the design of effective taxes. The most important stakeholders waste collection operators and waste management facilities, as well as citizens. The cooperation of the latter in the initial separation of the waste is essential.

6. Pesticides taxes

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.

6.1 The impact of pesticides and the potential role of a pesticides tax

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.[48] The adoption of GM crops has led to resistance among pests, escalating

[48] See: Statista. “Global Share of Highly Hazardous Pesticides in Use 2018-2021, by Selected Country,” May15, 2023. https://www.statista.com/statistics/1382198/global-share-of-highly-hazardous-pesticides-in-use-by- selected-country/

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.

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. Revenue generated from pesticide taxes supports environmental conservation, funds research for saferagricultural technologies, and promotes sustainable farming. Tax reliefs for organic farming, suchas reduced tax rates and exemptions, provide additional incentives to apply 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 effectiveness of the tax. 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.

6.2 Practical country examples

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.

6.2.1 Norway

The Norwegian pesticide tax, first adopted in 1988 and updated in 1999, is follows the polluter pays

principle. The tax is area-based and differentiates between 7 bands of pesticides, according to 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 (almost USD 6 million) a year (PAN Europe 2005 as cited in IIEP 2014). Overall, thebanded 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).

6.2.2 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 (approximately USD 3.3) active substance in 2015 (Böcker and Finger2016). Total revenue generated in 2021 was about SEK 150 million (around EUR 13 million). [49]Thereis 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).[50]

[49] 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
[50] https://one.oecd.org/document/ENV/WKP(2020)2/En/pdf

6.2.3 France

France has a two tier tax scheme 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. Pesticides that are mutagenic, carcinogenic, or hazardous to reproduction are taxed relatively high under 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 thatthis 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 hectare 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 gives incentives to switch to low-dose pesticides. For this reason, the French tax is consistent with the policy objective of reducing overall pesticide use but is not fully consistent with the targets of a differentiated scheme, which is to reduce the load caused by pesticides. The high reductioneffects induced by a relatively low tax was confirmed in a simulation study by Jacquet et al.[49], in whicha 20% reduction is reached by a 16% ad valorem tax.[51]

6.3 Conclusion for pesticide taxes

Pesticide taxes serve as a critical economic tool in addressing the environmental and health challenges associated with pesticide use. The experiences of Norway, Sweden, and France illustrate that tailored tax regimes can effectively reduce the reliance on harmful pesticides while promoting sustainable agricultural practices. France's differentiated tax approach, which balances higher levies on hazardous chemicals with incentives for organic farming, provides a nuanced model for encouraging eco-friendly practices. The design of these taxes must consider local agricultural contexts and policy goals, ensuring they contribute to broader efforts for environmental conservation, soil health, and sustainable food systems while aligning with national and global sustainability targets.

[51] 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.

7. Water and sewerage taxes

Clean water and efficient drainage are vital for thriving communities. Beyond their fundamental role in public health and providing preventative measures against waterborne diseases, clean water also 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. Therefore, access to clean water and efficient drainage systems is essential for sustainable communities, 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.

7.1 Purpose and common types of sewerage taxes

Taxes related to water and sanitation are implemented at local government/municipality levels inmost 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.

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.

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 to be noted that developing countries use the terms ‘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 benefitfrom 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. Sewerage fees are compulsory levies by municipalities which 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.

a) **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.
b) **Infrastructure or capital improvement fees:** Levied for infrastructure upgrades or expansions, ensuring that the systems can meet growing demand or comply with regulations.
c) **Property tax assessments:** Some municipalities incorporate water and sewer costs into property tax assessments to fund these services collectively.
d) **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.

7.2 Practical Country Examples

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.

7.2.1 Dumaguete, Philippines

In 2012, the Philippines initiated activities related to Fecal Sludge Management (FSM) [52] 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 managing treatment plants. The desludging service follows a 5-year cycle. Households pay desludging charges through their monthly water bill at a PHP 2.00 (approximately USD 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,

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

user fees, penalties, and monitoring mechanisms.

Furthermore, Dumaguete established a City Septage Management Authority, ensuring program operation andfostering 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 the engagement of multiple public agencies and private sector participants. A high level of cooperation is beneficial to improving environmental effectiveness in sewerage tax administration.

7.2.2 Saitama, Japan

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[51].

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. The tax revenue allocated for city planning expenditures, including sewerage. On average, a household using the johkasou pays about ¥65,000 (approximately USD 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 proved to be an appropriate solution for Saitama city.

7.2.3 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 and the lack of l 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, which uses ultrasonic and electromagnetic water

meters. Billing includes additional charges for non-functional private 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. Revenue expenditures encompass employee costs, administrative expenses, and operational maintenance, including pumping station repairs and sewerage treatment plant upkeep.

7.3 Conclusions for water and sewerage taxes

Addressing the challenges associated with water and sewerage systems requires a strategic approach to taxation. The feasibility of these taxes depends on several factors, including economic capacity, infrastructure readiness, public acceptance, and robust enforcement mechanisms. Balancing revenue generation with affordability is crucial, as is ensuring that taxpayers perceive tangible benefits. Public education campaigns can bolster awareness and support, while strong enforcement systems are necessary to combat tax evasion. In developing countries, challenges such as affordability, equity, and infrastructure limitations are prominent, often disproportionately affecting low-income groups and straining service quality. To address these issues, a comprehensive evaluation of economic, social, environmental, and infrastructural factors is vital.

Collaborative efforts are essential to overcome these challenges, ensuring that water and sewerage systems are both sustainable and accessible, thereby safeguarding public health and promoting equitable economic growth. Case studies such as those from Dumaguete, Saitama, and Mumbai offer valuable insights into how different jurisdictions navigate these challenges, underscoring the need for context-specific approaches that address local realities while striving for global sustainability.