ANNEX C to E/C.18/2023/CRP35

Paper for first consideration by the Tax Committee from the Subcommittee on Environmental Taxation

The role of carbon taxes and other measures to support energy transition

Table of Contents

1. Introduction

For countries to reach their carbon reduction targets under the Paris Agreement on Climate Change and other net zero commitments, it will be necessary to transition away from fossil fuel energy production to more renewable energy sources. This is often referred to as "energy transition," although there is no single accepted all-encompassing definition. Nevertheless, it is clear that there can be diverse paths towards such an energy transition, with different roles played by taxes, other forms of pricing, subsidies and regulations. Carbon taxes can facilitate the transition. However, countries – developing ones in particular - may face a significant challenge when implementing a carbon tax, if the costs of fossil fuels increase without cheaper renewable energy alternatives in place. The UN Tax Committee mandated its Subcommittee on Environmental Taxation to *work on practical tax policies/measures/incentives with the potential to accompany countries' efforts in transitioning from fossil fuel energy to renewable sources*. In doing so, the Subcommittee will collaborate with the Subcommittee on Extractive Industries Taxation.

The issue is particularly relevant for resource-rich developing countries with sizable extraction industries where the issue relates not just to transitioning to affordable clean energy but also to replacing public revenue streams and employment where necessary as existing industries are impacted by the change. This paper, however, does not deal with the specifics of the extractive industry as these are being dealt with in another paper being produced by the Subcommittee on Extractive Industries Taxation.

This paper focuses on the impact of carbon pricing and related measures on consumers, rather than on the producers of energy products. Consumers include businesses and governments as well as households. There is also an inevitable overlap between the supply side and demand side. For example, taxes imposed throughout the supply chain are likely to impact the final cost to consumers and may affect the demand for cleaner technologies.

The paper therefore considers certain taxes throughout the supply chain and not just ones levied on end consumers, as the burden of the tax is likely to be borne by the end consumers in both situations[1]. In addition to carbon taxes, the paper considers other forms of excise duties which are important policy levers for developing countries and generally simple to administer. It also considers the use of differential value-added tax (VAT) rates, although it is noted that, for efficiency reasons, policy guidance is often against introducing distortions in VAT[2]. Finally, according to the Subcommittee's mandate, this paper does cover direct taxation issues.

Chapter 2 provides a broad definition of the energy transition, including a discussion of the context and the support that carbon taxation may provide.

Chapter 3 puts carbon pricing methods in an energy transition context, especially when considering the focus on consumers. A key issue is to what extent the tax burden is passed on to the consumer via the price or a subsidy relieves the cost burden, so potentially impacting consumption.

Chapter 4 then looks at evidence of how carbon pricing actually impacts consumption. It also focuses on issues of regression, fuel poverty and how to achieve a just energy transition.

Energy transition will involve developing new energy products and technologies. These include biofuels, using bio-mass, and hydrogen. **Chapter 5** looks at whether pricing or subsidies can influence

[1] For a further discussion on who faces the cost of a carbon tax, see UN Handbook on Carbon Taxation p. 50 ff.
[2] THOMAS, Alastair, VAT rate structures in theory and practice, OECD Tax Policy Working Paper.

consumer behaviour in adopting such solutions. For example, the production of hydrogen may release differing amounts of C02 emissions or none at all – depending on the process. But the use of hydrogen once produced does not release C02. Therefore, taxing the end consumer of hydrogen according to the embedded carbon content is a challenge. Another aspect which is considered is the impact of carbon capture, storage and utilization (CCSU).

Chapter 6 considers the use and impact of various indirect taxes focusing on the sectors with the greatest emissions – energy use in industry, building and transport. These indirect taxes could range from carbon taxes (to create a price signal which encourages investment in green technology and encourages consumers to switch to cleaner products) to reductions in VAT, for example, to encourage insulation or the use of low emission vehicles.

Chapter 7 examines capacity building aspects to support energy transition, such as the need for stakeholder engagement and recycling of revenues.

The **Appendix** contains an overview of measures taken by a selection of countries to address energy transition. The overview covers four developing countries with differing profiles as follows:

- Chile – a South American country with no fossil fuel production but with mining for rare earth mineral resources needed in the energy transition;
- Ghana – an African country with both fossil fuel production and significant mining industries;
- Indonesia – a populous East Asian country with historically important fossil fuel industries and rare earth mineral resources; and
- Jamacia – a Caribbean Island dependent on energy imports.

Based on this paper, and the case studies above, there are several practical ideas policymakers may wish to consider.

Box 1: Practical Considerations

- Tax consumption of energy, not its supply (Chapter 3)
- Use carbon pricing mechanisms (explicit/implicit) as a market signal to engage the private sector (Chapter 3)
- Consider cash transfers rather than vouchers to support low-income households (Chapter 4)
- Target support on low-income groups rather than consumers generally (Chapter 4)
- Verify and certify origin of hydrogen (green/blue/grey) and biomass content of fuels (Chapter 5)
- Consider revenue and complexity aspects of eroding VAT base to incentivize transition (Chapter 6)
- Work with the UN and others to build administrative capacity (Chapter 7)
- Introduce higher tax rates on higher levels of domestic energy consumption (Case Studies)
- Provide incentives to accelerate decommissioning of fossil fuel production (Case Studies)
- Support renewables by lower taxes on capital investment and imports (Case Studies)
- Phase out subsidies for burning fossil fuels (Case Studies)
- Aim to trade carbon credits both domestically and internationally (Case Studies)

2. What is meant by the Energy Transition

As outlined in the 2021 United Nations Handbook on Carbon Taxation for Developing Countries (the Handbook), carbon taxation along with other carbon pricing mechanisms is a relevant instrument that can contribute to the achievement of the Sustainable Development Goals (SDGs), particularly SDG 13 [Climate Action]. SDG 13 interacts with various other SDGs, not least with SDG 7 [Affordable and Clean Energy]. Energy transition plays a crucial role in advancing progress toward achieving these SDGs.

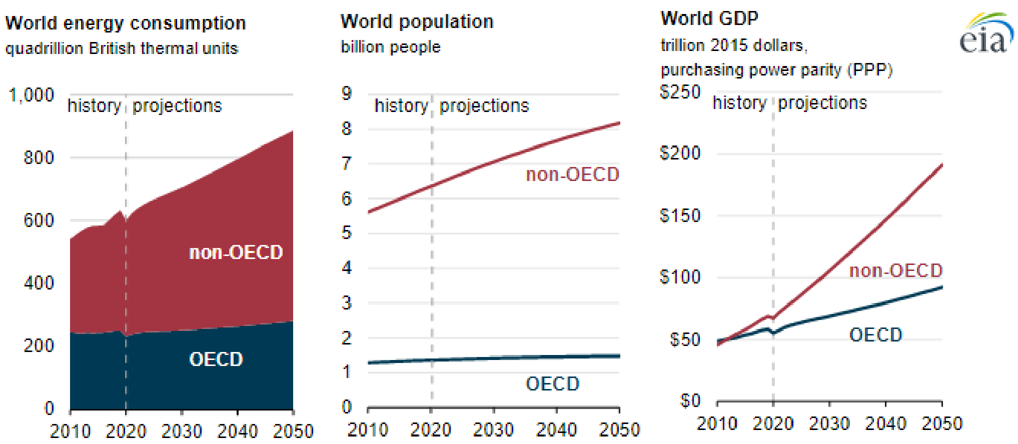
2.1. Energy transition – context considerations

Energy transition can be seen as putting the requirement for 6ecarbonization in context.

In 2021, the UN Framework for Climate Change (UNFCC) estimated worldwide carbon emissions at 36.3 billion tonnes. More and more countries are setting net zero emission targets for 2045 or 2050, at which time emissions need to be reduced to zero.

Decarbonisation should be seen in the context of, inter alia:

- Global population is currently about 8 billion but expects to grow to 9.7 billion by 2050; and
- Global energy consumption is expected to grow significantly up to the same period (from about 600 exajoule in 2020 to nearly 900 exajoule in 20500, with energy consumption growth in developing countries to almost double in certain sectors[3].



Source: U.S. Energy Information Administration, *International Energy Outlook 2021* (IEO2021) Reference case

A transition in the use and generation of energy will be required to balance these considerations. There are many aspects to energy transition, depending on the focus of analysis. These can be technical, e.g., choices on energy sources and novel ways to produce or consume energy products; societal, e.g., aspects of just transition, impact on employment; organisational, e.g., how to source material, how to organise energy markets; or financial, e.g., how the costs of energy transition should be determined and allocated.

[3] International Energy Outlook Consumption - By 2050, global energy use in the Reference case increases nearly 50% compared with 2020—mostly a result of non-OECD economic growth and population, particularly in Asia - U.S. Energy Information Administration (EIA)

2.2. Energy Transition – definition and transition requirements

There is no single definition of energy transition, and energy transition analysis can be broken down along various lines[4].

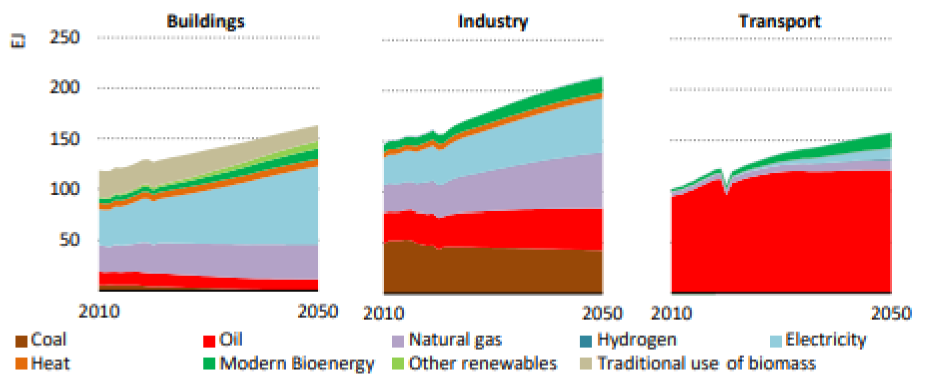
The International Energy Agency considers global and sectoral pathways to net zero emissions by 2050 and has developed a Stated Policy Scenario [STEPS] on this basis. Relevant pillars to transition to decarbonised energy are:

- Energy efficiency
- Behavioural change
- Electrification
- Renewables
- Hydrogen and hydro-based fuels
- Bio-energy
- Carbon capture, utilisation and storage

The speed and scope with which the global energy system needs to transition in order to achieve decarbonisation by 2050 will require an integrated approach per sector, across the value chain, to ensure all pillars are addressed. The sectoral approach develops more in-depth pathways to transition for:

- Fossil fuel supply
- Low emissions fuel supply
- Electricity sector
- Industry
- Transport
- Buildings

Figure 1.7 ▷ Total final consumption by sector and fuel in the STEPS

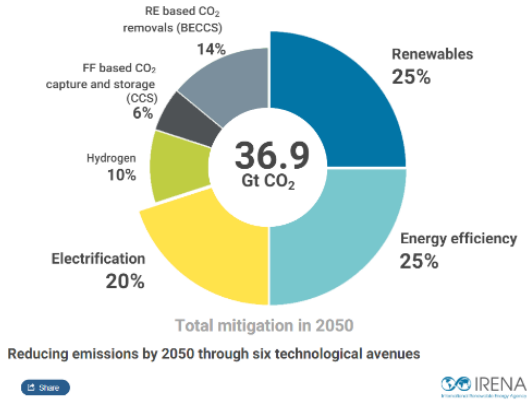


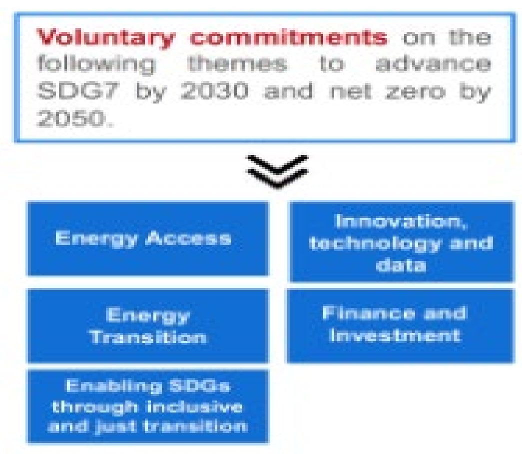
[4] The OECD Development Center has developed an Equitable Framework and Finance for Extractive-based Countries in Transition [EFFECT], focused on fossil fuel producing and mineral-rich developing countries. It contains a framework for designing "realistic, just and cost-effective" pathways to a low carbon environment. *Equitable Framework and Finance for Extractive-based Countries in Transition (EFFECT) | en | OECD*

Common aspects considered for energy transition appear to be:

- Managing carbon emissions from the current/"old", often fossil fuel based, energy sources;
- Ensuring availability of the "new"/more renewable, low carbon energy sources; and
- Overall facilitating a "transition".

The International Renewable Energy Agency[5] considers more specifically that energy transition should be the transformation of the global energy sector from fossil-based to zero-carbon sources by 2050[6]. The International Renewable Energy Agency (IRENA) outlines a pathway for this transformation to limit global temperature to within 1.5 degrees centigrade of pre-industrial levels by 2050 and focuses on six approaches, as illustrated in this diagram.





Most aspects of energy transition are covered under SDG 7 "Affordable and clean energy". In addition to energy transition, the UN Energy Pledge under SDG 7 includes improving access, resilience and finance.

A framework of Energy Compacts is set up to bring together voluntary commitments on all SDG 7 targets in support of achieving all SDGs by 2030 and net zero emissions by 2050. The UN Energy Compacts compile information on ensuring access to affordable, reliable and modern energy systems, increasing the share of renewable energy in the energy mix, enhancing clean energy research and technology and expanding infrastructure.

3. Carbon taxes/subsidies on consumption throughout the production/ distribution value chain

This chapter puts carbon pricing methods in an energy transition context, especially when considering the focus on consumers. A key issue is to what extent the price is passed on to the consumer or a subsidy relieves the cost burden, so potentially impacting consumption.

When considering a framework to assess how environmental taxation can influence energy transition, it is important to assess how such taxes in general and carbon taxation in particular can achieve multiple goals simultaneously. This includes considering the interlinkage between the need for carbon reduction and climate change with a push towards ensuring access to affordable, reliable, sustainable and modern energy for all.

---

[5] IRENA IRENA – International Renewable Energy Agency
[6] Aligned with the UN Subcommittee on Extractive Industry Taxation's workstream on Energy Transition, which considers the IRENA definition, strategy and approaches.

As outlined in the 2021 United Nations Handbook on Carbon Taxation for Developing Countries (UN Handbook]), motives for introducing a carbon tax[7] would include:

- the reduction of carbon emissions;
- the revenue raising capacity;
- to promote investment in new technology.

In the broader context of energy transition, the motives for introducing a carbon tax provide a context that can help balance the need for specific design features or clarify the case for complementary policies. When aiming to balance carbon reduction with other objectives, the tax considerations in an energy transition setting would necessarily aim:

- to ensure additional costs (e.g., in the form of carbon taxation) are imposed on activities/behaviours that undermine energy transition;
- to support activities/behaviours that encourage/facilitate energy transition and to encourage the development of new technology (e.g., use of targeted subsidies, carbon or energy tax exemptions, etc.);
- to determine the impact of energy transition on a country's fiscal budget. In addition to covering the revenue raising capacity of carbon taxation, other issues include considerations on revenues lost, e.g., from oil and gas taxation and requiring additional funding to invest in new technology and infrastructure.

3.1 Reducing carbon emissions in consumption

Carbon taxation is seen as an important instrument in reducing carbon in consumption, as an incentive to avert or mitigate climate damage caused by CO2 emissions. The UN Handbook provides comprehensive guidance on designing and administering such taxes, while also addressing potential undesired effects and how these taxes interact with other policy instruments. Different countries use various mixes of taxation strategies or measures to establish explicit or implicit carbon pricing, such as fuel taxes or fuel subsidies reform. In the case of developing countries, several instruments already in place may be useful in carbon reduction and energy transition. For example, the African Tax Outlook Platform[8] shows that, whilst most African countries have not yet implemented a carbon tax, many have enacted taxes related to energy, transportation, and environmental pollution more generally. This trend is further observed in the case studies featured in Chapter 7 of this paper.

Whilst various taxes could give an explicit or implicit carbon price signal, an explicit taxation on carbon, rather than a more general taxation on energy volume or content, could be more appropriate when considering tax in an energy transition setting. A volume taxation or energy content taxation could help with carbon reduction but penalize low/no carbon fuels, which will be needed for an energy transition. For example, biofuels have a lower energy content than fossil fuels. A pure volume-based taxation that would tax all energy products at the same level, would penalize a switch to biofuels as a high volume of biofuels may be needed to achieve the same activity if powered by fossil fuels. Aligning fuel taxation with carbon content or switching existing fuels taxes to carbon taxation could put fuel and carbon reduction in line with energy transition aspirations. Countries are increasingly reviewing their fuel taxation to improve alignment with carbon content taxation[9]. Sweden's carbon taxation introduction in 1991 in effect replaced part of the country's energy and fuels taxes, which are currently largely carbon

[7] Chapter 2, part 6 of the 2021 UN Handbook on Carbon Taxation for developing countries
[8] ATO (ataftax.org) – a publication intended to make available reliable tax statistics and analysis pertaining to African tax administrations.
[9] Financing for Sustainable Development Report 2021 UN, p45

content related. Other countries have introduced a carbon component into existing fuel taxation (such as France, Portugal and Mexico).

3.2 Considerations for industrial consumption

A significant part of energy consumption is industrial, so carbon pricing considerations consider not only private but also business consumption. When considering carbon emissions, businesses often refer to Scope 1, 2 and 3 emissions. Scope 1 are the direct emissions a company produces by operating the installations and assets it owns or controls, like emissions from its own furnaces to produce its products. Scope 2 emissions are indirect emissions for the business in question, created by the production of the energy that the business is buying to heat e.g. its furnaces. Scope 3 emissions are also indirect but they do not cover emissions related to anything the business uses, but rather they cover the emissions produced by its customers when using the company's products or the products produced by suppliers making products that the company uses. Scope 3 emissions are therefore not under control of the businesses itself, are hard to tackle but can account for more than 70% of a business's carbon footprint[10].

To effectively integrated carbon taxation within an energy transition framework, it is important to consider its impact along production value chains. Putting a cost to carbon often increases costs for consumers, private and business alike, at least in the short run. The UN Handbook considers such potential adverse effects to the introduction of a carbon tax[11] on households' income and on businesses. Chapter 4 of this paper offers additional considerations on rising energy prices. Particular attention is being given to the impact on value chains, especially in energy-intensive sectors like petrochemicals, steel, fertilizers and glass, where energy costs constitute a significant portion of products prices[12]. The EU ETS has seen varying degrees of cost pass-through, ranging from 20% to 100%, depending on the sector. Factors such as trade intensity, utilization rates and market power influence the extent to which such costs are passed through to consumers. It is worth noting that most ex-post studies on the impact of carbon prices focus primarily on developed countries and the EU, given the availability of data on carbon price to assess such effects.

The correlation between cost pass through with factors such as market power could be different in developing countries compared to European contexts. For example, European studies do not to take into account regulated prices. In South Africa, the carbon tax was introduced whilst e.g. electricity output rates remained regulated. South Africa settled for a tax with a headline rate that would then be discounted with a 60% tax free threshold. Depending on the sector, other discounts could be afforded, such as a percentage discount for reduced emissions against a particular benchmark. Managing the interaction with a regulated price and limited ability of passing through carbon costs tends to require such adjustments which are likely to complicate taxation and/or result in a relatively low-level tax on all emissions and limiting revenue raising capacity. When considered in the framework of energy transition though, having the headline tax at all has been seen as encouraging investment in alternative energy in South Africa, especially during high energy prices and in view of continued capacity issues.

Assessing consumption and investment choices involves evaluating not just the carbon tax burden but the overall carbon cost. There are considerable challenges to assessing that impact, especially when looking across an entire value chain. It is important to consider other fiscal instruments involved, including the role of subsidies, both for fossil fuels and alternative, renewable energies[13]. Significant

---

[10] What are Scope 3 emissions and how it differs from Scope 1 and 2 | World Economic Forum (weforum.org)
[11] 2021 UN Handbook on Carbon taxation for developing countries Chapter 7
[12] E.g. Ex-Post investigation of cost pass-through in the EU ETS, an analysis for six sectors, CE Delft and OEKO-Institut November 2015
[13] UN 2021 Handbook on Carbon Taxation for Developing countries, p 175 and

work is ongoing through various international organisations to assess carbon pricing metrics[14]. The OECD has been publishing Taxing Effective Carbon Rates and Taxing Energy Use[15], considering the interaction between carbon pricing and fuels taxation, its Inventory of Support Measures for Fossil fuels as well as the recent Inventory of Carbon Mitigating Approaches[16]. Recent work at the World Bank is suggesting a methodology to measure a total carbon price, in a sector, for a fuel or for a whole economy. The methodology intends to capture the full (direct and indirect) and net (positive minus negative) carbon price signal affecting fossil fuel consumption and associated emission, hence considering burdens and incentives in scope 1, 2 and 3[17]. ' To consider an effective carbon price, the IMF considered the effect of a floor price[18]. Considering the potential impact of carbon price through value chains, especially when considering developing countries, IMF studies have been looking into a differentiated floor price[19].

3.3 Creating new markets, products, technologies and approaches

Given the magnitude of changes required to achieve an energy transition[20], energy transition will not only require new energy products, but also new uses of existing products – energy products as well as other products and materials -, new infrastructure, new instruments and installations using energy, new technologies, and new approaches. Carbon taxation and other indirect taxation can play a role here, often in conjunction with other policies and instruments[21]. It needs to be considered whether carbon pricing and taxation would be the most efficient instrument, and how the fiscal signal would interact with other instruments. Extra considerations on the design of the carbon and other indirect taxation will also be relevant.

Adjusting or converting existing fuel taxation to support low carbon energy products are crucial considerations. Traditional fuel volume or energy content-based taxation may not support such solutions sufficiently. For example, the production and consumption of hydrogen for heating and transport requires different installations and furnaces or motors than gas. Traditional fuel taxation considering hydrogen the same as gas may make a switch to hydrogen problematic for the consumer, who will be confronted with significantly higher overall costs. Chapter 5 deals with certain sectors and

---

[14] Carbon Pricing Metrics: Analyzing Existing tools and Databases of Platform for Collaboration on Tax (PCT) Partners, providing an overview of the carbon pricing metrics approaches across the PCT Partners: https://www.tax-platform.org/sites/pct/files/publications/PCT-CPM-Report.pdf. PCT is a joint initiative of the secretariats of the IMF, OECD, UN and World Bank Group.

[15] The ECR publication series broadened the scope of the carbon pricing covered in [Taxing Energy Use] TEU by including emissions trading systems.In that sense, it provides a comprehensive approach (see Figure 3) that integrates carbon prices resulting from taxes and emissions trading systems (OECD, 2021b). The publication, and the database linked to it, define ECR as the total price of emissions3 resulting from taxes (carbon and fuel taxes) and compliance with emissions trading markets, using a methodology to calculate coverage that considers overlapping policies. 4 In addition to defining the ECR for every unit of emissions in a country, the OECD provides country- and sector-level summary indicators, such as an emissions-weighted average ECR (OECD, 2018b)

[16] Inclusive Forum on Carbon Mitigation Approaches - OECD

[17] Measuring Total Carbon Pricing, Policy Research Working Paper 10486 by P Agnolucci a.o for the Worldbank Group

[18] Five Things to Know about Carbon Pricing (imf.org)

[19] *An international carbon price floor can be strikingly effective. A 2030 price floor of $75 a ton for advanced economies, $50 for high-income emerging market economies such as China, and $25 for lower-income emerging markets such as India would keep warming below 2°C with just six participants (Canada, China, European Union, India, United Kingdom, United States) and other G20 countries meeting their Paris pledges.*

[20] See Chapter 2 of this paper IEA projections

[21] See Chapter 9, 3 2021 UN Handbook on Carbon Taxation for Developing countries – Assessing Interaction.

technological solutions in the framework of energy transition – such as green energy and low carbon fuels of non-biological origin.

Other changes in use and approaches may lead to reviews in energy taxation. Renewable energy generation may see a decentralization of production, closer to the point of consumption. Especially in countries where grid connectivity is not a given, consumers may become producers as well. This may lead to adjustments to scope in energy taxation. Often electricity may be taxed under regular energy tax rules, but exemptions or lower rates can be foreseen for off-grid production. Additional regulations may promote decentralized energy production, which will support energy transition, especially if such regulations contain renewable energy requirements. For example, Germany applies a lower electricity tax rate for power generated by wind or solar (including when such power is subsequently distributed) as long as it is not distributed through the traditional electricity grid. In 2022, the German Annual Tax Act approved an income tax exemption on revenue generated by families and businesses from solar power output to the grid. In addition, VAT will no longer be due on the purchase, import and installation of solar and energy storage systems. Similarly, Ghana's Renewable Energy Master Plan 2019[22] promotes renewable energy-based decentralised electrification options in 1000 off-grid communities. To promote local manufacturing and development, the government is considering incentives to attract manufacturers and other operators. Until further notice, machinery and material that cannot be obtained locally will be exempted from import duties and VAT[23] up to 2025.

Developing countries are increasingly exploring voluntary markets to offset carbon production in industrial or private use. For example, Indonesia is working on a Net Zero Emission roadmap for the Energy Sector towards 2060 but expects certain emissions to remain in the end-use sector, namely in certain industrial sectors and in transport. For hard-to-decarbonise sectors, carbon price offsets could serve as a viable option. For example, Ghana signed an agreement with the World Bank in 2019 to reward community efforts to reduce carbon emissions from deforestation and forest degradation. The tax treatment of carbon offsets is dealt with in a separate paper[24]. In order for such offsets to be credible, United Nations Framework Convention on Climate Change (UNFCCC) rules are under development. Countries such as Indonesia and Chile have carbon framework laws that provide an overall context/guidelines under which such offsets could be governed. These legal frameworks set the rules and parameters within which voluntary or mandatory carbon offset programs can operate, so as to provide clarity and certainty for investors and in view of reliable measurement, recording and verification for national and international goals.

3.4 Financing

In line with considerations on long-term financing for climate change[25], there are three main pathways for financing:

- developing fiscal policies and public expenditures in support of energy transition;
- accessing public financing and international financial support;
- attracting private investment and financial sectors.

[22] Renewable-Energy-Masterplan-February-2019.pdf (energycom.gov.gh)
[23] [Placeholder for OECD comment on use of VAT to promote energy transition]
[24] [Placeholder for reference to WS 3 paper on Offsets]
[25] Long-term Climate Finance [LTF] is part of the work of the UNFCCC. The work programme on long-term climate finance was launched by the UN Conference of Parties [COP] 17 and concluded its work at COP19. At COP19 the UNFCCC decided to continue deliberations on long-term finance with three cover elements through 2020: 1) biennial submissions by developed country parties on their updated approaches and strategies for scaling up climate finance, 2) annual in-session workshops; and 3) biennial high-level ministerial dialogues on climate finance. The most recent meeting took place in Bangkok 17-18 July 2023 and focused on "Financing Just Transitions". 2023 Forum of the Standing Committee on Finance: Financing Just Transitions | UNFCCC

The UN Handbook outlines considerations around fiscal policies and public expenditures regarding carbon taxation, which will be relevant for energy transition as well. Chapter 2 of the Handbook (Introduction for Policy makers) elaborates how carbon taxes can generate predictable fiscal revenues with the caveat that increasing decarbonisation efforts will lead to a declining tax base in the long run. Energy transition considerations will enhance the need for a long-term view for budgetary planning and fiscal policies and will benefit from a more net present value (NPV) approach to budgetary planning and fiscal policy. Chapter 9 of the Handbook (Revenue Use) which considers the need for environmental spending as well as support to households and businesses is also relevant in this space.

As the energy transition progresses, certain revenues can be expected to diminish. Fiscal policies and expenditures could help consider alternative sources of income. Particularly countries with (significant)] oil and gas extraction and related income will have to consider a potential loss of revenue from such sources. For example, in the case study analysis in the annex to this paper, Indonesia indicated significant decline in oil and gas revenues in 2020 [26], which impacted its Natural Resources Profit-sharing Funds. Fiscal policies will need to be adapted to ensure financial stability while moving toward more sustainable energy solutions. For instance, the African Tax Outlook sees an increase in environmental taxation. Besides carbon and environmental taxation, energy transition could see the creation of alternative sources of revenue. Chile mentions development of other natural resources as alternative energy and as potential additional revenue sources. Ghana has set up a renewable energy fund designed to finance the promotion, development, management and utilization of renewable energy sources. The Africa Climate Summit[27] recently outlined a strategy to increase green energy production for local consumption as well as export.

In additional to utilizing national revenues, access to international funds has been seen as a relevant source of financing. The Standing Committee on Finance[28] supports the UNFCCC in overseeing financing mechanisms in this space.

Besides public financing, private financing will be relevant. A country's fiscal policies can influence the availability and attraction of private financing for energy transition projects. An overall plan on energy transition or renewable energy development can be helpful in this space as well. In the case study analysis in the annex to this paper, Ghana indicated that, in the context of the Renewable Energy Fund, businesses registered with the Ghana Investment Promotion Centre are afforded various incentives, including "protection against nationalization or expropriation". According to the Indonesia case study, the country's carbon law establishes a framework for carbon reduction initiatives.

Besides fiscal policies, novel approaches to carbon pricing can be considered in this space. A prime example is green bonds. The case study on Chile describes the issuance of sovereign green bonds in dollars and Euros. The country has implemented a Green Bond Framework, issued by the Ministry of Finance, which has been certified and verified by independent parties.

4. Energy security, energy transition and increasing prices: how to respond?

Irrespective of their cause, be it due to higher taxation on fossil fuels, sudden loss of supply due to conflict or any other reason, rising energy prices are inherently unpopular with households and businesses. National energy systems must navigate the "energy trilemma" of finding an effective,

[26] [Placeholder for IEA remarks]
[27] Africa Climate Summit 2023 | Globalabc
[28] Standing Committee on Finance (SCF) | UNFCCC

integrated approach to achieve energy security, environmental sustainability, and energy affordability/ equity. Attaining just transitions with affordable prices is a continuous challenge, particularly when ever more stringent environmental goals are set.

This chapter approaches these complex topics in three steps. Section 1 reviews the relationship between energy security, energy transition and rising prices. Section 2 examines economic insights on how rising prices can be addressed, focusing on vouchers, lump-sum transfers and subsidies. The last section offers some insights into practical experiences on how countries have tried to address rising prices and support disadvantaged groups in society.

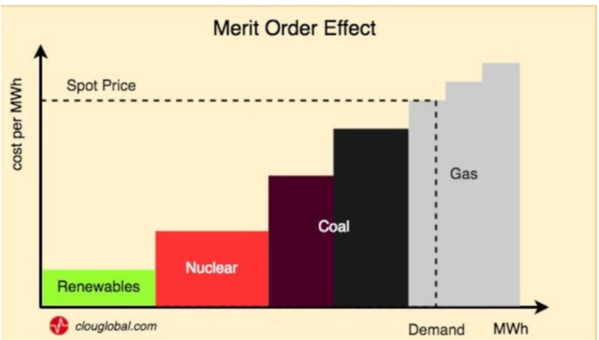
4.1 Energy security vs. energy transition and rising prices

With the climate crisis and the recently soaring energy prices due to geopolitical disruptions, energy security is becoming a focal point of national energy policies in many regions. There is no universally accepted definition of energy security – it is an evolving concept.[29] Energy security is based on the notion of an uninterrupted availability of energy sources. Often also an affordable price is added as a criterion.[30] Other determinants can include that a country has sufficient energy reserves, balanced supply and demand, and balanced energy trade.

Energy security policy plays a particularly important role in the implications of energy transitions because such transitions entail a substantial amount of renewable energy sources. Energy transition is the transition from fossil fuel dependence across the entire economy towards greater reliance on cleaner energy sources. It therefore covers both energy production and consumption. Thus, it is about advancing the decarbonisation in the energy sources, increasing energy efficiency of industrial sectors, building and transportation and will require the setting of new investment priorities. Electricity attains a critical role.

Reducing carbon emissions requires the phasing out of fossil fuels through the economy and greening energy generation and energy consumption (e.g. transport sector, efficiency improvements in homes etc.). Many industrial processes that use for example combined heat and power need to change. Coal and lignite are quite carbon intensive and need to be substituted by gas, or even better, need to be electrified. Where electrification of industrial processes is technically not possible, (green) hydrogen generated by renewable energy sources could be used. Currently it is, however, still expensive and the required quantities are unlikely to be available, even in the mid-term inter alia because of the substantial amounts of renewable energy required for production. At this stage there are only a few pilot production sites and gas networks would have to be renewed to be able to use green hydrogen without natural gas. Energy transition and the increasing electrification will thus entail substantial growth rates in the overall electricity demand in economies.

To better understand the impact of renewable energy on the energy system and the economy, it is important to first understand how energy prices are determined in many jurisdictions. If demand and supply are able to freely determine electricity prices on the market, it is best to have those energy generators produce electricity that have the lowest (short run marginal) production costs. Electricity generation costs will be lowest if one ranks all available energy generation capacity in ascending order, the so called 'merit order'. See figure below. If one uses the installations with the lowest cost to satisfy market demand, one has the lowest overall electricity costs at the market clearing (spot) price. High demand for electricity during peak demand pushes the



[29] Dynamics of energy security and its implications Tri Ratna Bajracharya, ... Anzoo Sharma, in Handbook of Energy and Environmental Security, 2022

[30] https://www.iea.org/about/emergency-response-and-energy-security

bidding price for electricity up, and the relatively inexpensive baseload power supply mix has to be supplemented by 'peaking power plants', which have to charge a premium for supplying electricity. Hereby, the overall price for electricity is determined.

Sometimes, reaching the optimal market clearing price is not possible due to maintenance cycles of installations, transmission grid congestion or other reasons. It also bears mentioning that different types of installations require more lead-time to dispatch electricity and hence may need to come ‘online’ ahead of time. In terms of the merit order ranking wind and solar are relatively cheap, followed by nuclear power, lignite, coal and gas. Renewables, as well as nuclear power generation, are often times subsidised directly or subject to a feed in tariff that reduces their prices on the spot market. Bringing renewables into the energy mix thus displaces more expensive fossil fuel based generation methods. While this should in principle make electricity cheaper, the contrary is often the case.

One reason for this is that renewable energy generation is highly volatile and not always available. The wind does not always blow, nor does the sun always shine. As a consequence, additional electricity generation capacity needs to be readily available for such situations. Once demanded, peak load capacity will be very expensive because the power plants that scarcely operate will have to recoup their costs during the few times that they are actually operating. This drives average electricity prices up considerably. This effect is less grave if renewables are limited in the energy mix, but substantial once renewables become more plentiful. Other reasons why energy transition is expensive include the various subsidies or feed-in tariffs for (renewable or nuclear) energy, but also the substantial investments that must be made for grid-enabling or improvements of the district heating networks or the gas network.[31] Those costs must be borne by society and they usually have to result in energy price increases.

Security of supply requires that generating capacity is always available in case of need. This is not only of the utmost importance for the economy, but also for the electricity grid itself. Electricity grids will suffer due to differences in the grid tensions. To ensure that this does not happen, net operators or other competent authorities will compare the highest electricity demand to the projected true generation capacity and assess the security of supply situation. The planned and unplanned downtimes of the various power generating installations are the basis for this assessment. Depending on the geographical determinants and risk averseness of grid operators, installed renewable energy capacity can be very heavily discounted. For Germany, for example, the projected availability of installed wind generation capacity is merely 1%, while the projected availability for solar power is 0%.[32] As a consequence, to safeguard security of supply, sufficient other (often times fossil fuel based) generation capacity would need to be readily available, even though it is left idle frequently. To put things into perspective, in the first half of 2023 in Germany, the renewable generation attained a share of 57.7% of the net electricity generation for public power supply, that is, the electricity mix that comes out of the socket.[33]

Unsurprisingly, power generators will try to recoup their costs when they actually operate, entailing very high peak load prices. One way of securing the viability of power generators’ business model – a critical ingredient in harnessing the support of the power industry for the long-term energy transition goals - at high levels of renewable in the electricity mix and to avoid high peak load prices, is by paying energy generators for providing power generating capacity even when they are not being used. It should, however, be clear that in any event it is costly to keep a substantial part of the power generation capacity available and out of use. These costs will undoubtedly find reflection in the electricity prices or general taxes.

[31] Often renewable energy generation locations are distant from demand centres necessitating substantial investments in grids.
[32] Bericht der deutschen Übertragungsnetzbetreiber zur Leistungsbilanz 2018-2022.
[33] FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS ISE, Press release July 03, 2023, available at https://www.ise.fraunhofer.de/en/press-media/press-releases/2023/german-net-power-generation-in-first-half-of-2023-renewable-energy-share-of-57-percent.html

The inherent problem of increasing renewable electricity in the electricity mix is that storage capacity is very limited. Short-term electricity storage, in the form of flywheels or other systems, are already used to modulate grid tensions. But these systems do not lend themselves for long-term and large-scale storage. The predominant grid-scale storage that can store energy and then supply it back to the grid when renewable energy sources are unable to generate power is hydropower pumped-storage. Water is pumped into a reservoir on top of a mountain and released when necessary. Such facilities are fairly effective, with an estimated round-trip efficiency level of 80% (water pumped from a lower to an upper reservoir and then released to the lower reservoir).[34] However, such installations are costly to build and require geological preconditions. Even if mountains would be available, they ideally would be close to the source of electricity generation as well as the place of electricity demand because transporting electricity is costly as well and grids may need to be expanded.[35] It is therefore unsurprising that alternative storing mechanisms like batteries are playing an increasing role in storage as they can be deployed where needed and can come in a wide variety of forms (including thermal energy batteries), but for use at scale on a grid-wide basis that solution is prohibitively expensive. Power to gas (hydrogen) is also frequently considered as a storage form, but it is still expensive and not very efficient, leakage is a problem and it requires special pipelines unless it is mixed with natural gas. Electricity storage is therefore a major challenge when striving for high levels or renewable electricity in the energy mix.

This problem of electricity security is exacerbated by the often different supply and demand patterns through the seasons. Clearly, the differences will be co-determined by the local climate conditions, but in general cooling in summer will be done with electricity while heating in winter is done with fossil fuels. If those fossil fuels are to be substituted by renewables, more biofuels and renewable electricity will be needed. Yet renewable energy generation potential may also differ according to season.

Another major challenge for supply security of transitioning energy systems can be found in geopolitical tensions. Transitioning economies seek to phase out particularly carbon intensive fossil fuels such as coal and lignite, potentially relying on less carbon intensive gas (natural gas or liquefied natural gas (LNG)) as a transitory technology. Both Germany and The Netherlands, for example, have taken the decision to phase out coal fire power plants.[36] The increasing geopolitical tensions, especially between Russia and Ukraine, have led to substantially higher gas prices and scarcity of supply. Gas prices are not only relevant for combustion processes but are also critical in setting the electricity price for both industry and households. In the wake of the high gas prices also alternative fuel sources such as oil and coal soared around the globe. The geopolitical challenge has led to immediate policy adjustments including the reconsidering of coal phase-outs, investments in LNG facilities and the re-evaluation of nuclear power.

Energy prices reached historical highs but have come down since as illustrated here:[37]

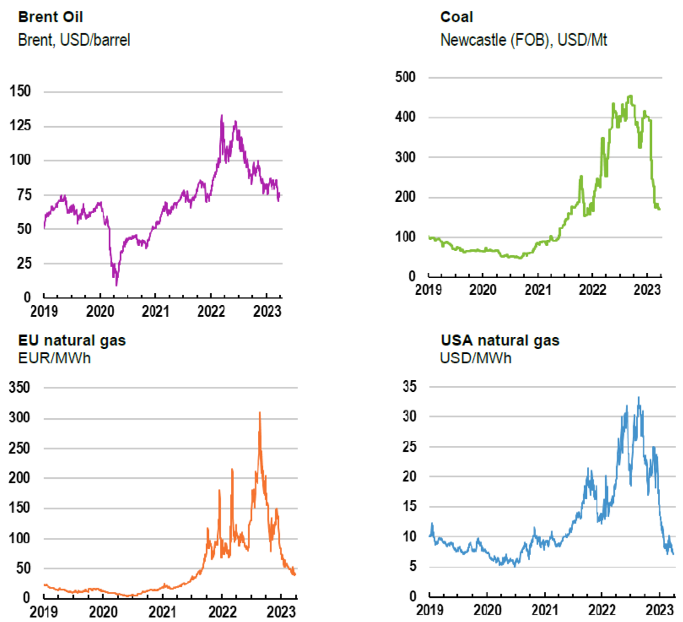
---

[34] Andrew Blakers et al. (2021), A review of pumped hydro energy storage, Progress in Energy, Volume 3, Number 2.

[35] High voltage direct current cables can mitigate transportation losses but this would require conversion stations and associated electricity losses to turn direct current back into alternating current that is used by both households and industry.

[36] Sami Madani (2023) The Dutch and German coal exit: an impact analysis of policymaking, in Weishaar, Kim and Tiche, Climate and Energy Law and Policy in the EU and East Asia – Transition and Policy Cooperation, Edward Elgar

[37] Source: Hemmerlé, Y., et al. (2023), "Aiming better: Government support for households and firms during the energy crisis", OECD Economic Policy Papers, No. 32, OECD Publishing, Paris, https://doi.org/10.1787/839e3ae1-en.

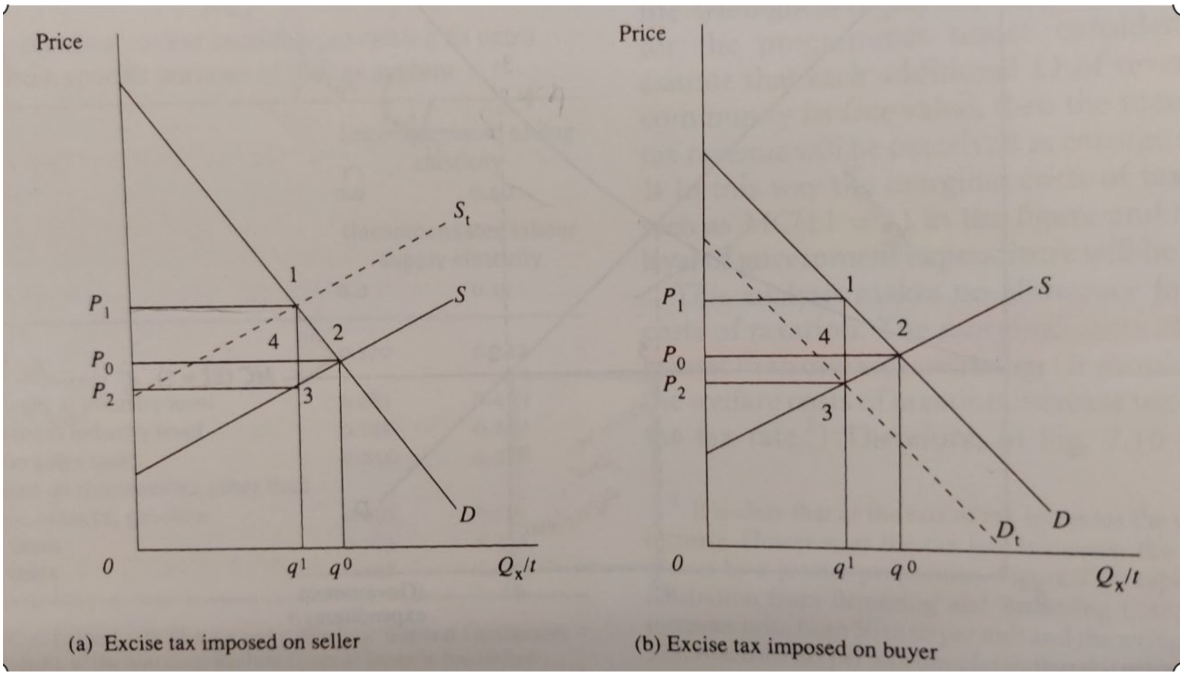


Note: The figure for coal shows weekly prices for Newcastle FOB 6000kcal/kg NAR. Newcastle refers to Newcastle, Australia. Figures in the bottom panel show the evolution of TTF Neutral Gas Price for Europe and Henry Hub for the United States. Data as of 27 March 2023.
Source: Refinitiv.

In summary, energy security plays an important role in the context of energy transition. Both the fundamental challenges of energy security and energy transition will vary depending upon the resource endowment and climate of a country, its scale and structure of its economy, its geology, its energy mix, its environmental and renewable energy ambition as well as its geopolitical situation. Decarbonizing energy generation and vast areas of the economy thus goes far beyond simply getting more renewable energy sources into the energy mix. Many industrial processes need to be adapted, building structures need to be improved, and the transport sector needs to be changed. Electricity needs will go up and critical challenges related to energy storage are not yet resolved. Gas, as a transitioning base-load ready energy source, will become even more important and continue to drive electricity prices through the merit order effect. Energy security in a broad geopolitical sense, but also in a narrower sense focusing on ensuring the availability of electricity, will become more important as the energy transition advances with higher levels of renewables in the energy mix. If more energy generation facilities assume backup functions in the future, electricity prices may continue to be on the rise, posing additional challenges to poor households. The next section examines theoretical insights on how high prices affect consumers and which instruments could be used to address such effects.

4.2. Insights on how consumers are affected and how to address rising prices

The previous section has explained why energy prices may increase, suddenly or gradually, in the context of energy security and energy transition. Prices can be driven by geopolitical concerns, transition costs or carbon taxes or energy taxes. This section reviews the economic insights on why price increases affect energy consumers strongly and which instruments can be considered to address consumers' energy needs. This will be done by reference to taxes, but, from an economics perspective, markets work on the basis of demand and supply. There is a downward sloping demand curve and an upward sloping supply curve. Where these curves intersect demand equals supply, and a market equilibrium is established, giving rise to an optimal price and optimal quantity at which the market clears. For example, if taxes are levied on producers or suppliers, the costs of production increase and the supply curve shifts. If taxes are levied on consumers instead, they increase the price of consumption and hence shift the demand curve. Despite the fundamental difference in the legal incidence of taxation, the economic incidence is the same. There may be differences in terms of administrative costs for tax officials or society at large but otherwise the economic effect of a tax on producers or consumers is the same. The graph below shows that shifting the supply curve upwards or the demand curve downwards leads to identical effects on price, quantity and distribution.



Source: J. Cullis and P. Jones,(1998) Public Finance and Public Choice, OUP, p. 176

Subsidies work much in a similar way. Subsidies reduce production or consumption costs, of producers/suppliers and consumers respectively. Subsidies shift the supply or demand curves so as to allow producers to offer their goods more cheaply and to allow consumers to consume more. Also here the economic effect remains independent of the legal aspect. Who benefits the most from a subsidy will thus not be determined by who receives the subsidy legally.

How is it then determined who bears the economic burden of a tax or who will enjoy the economic gains from a subsidy? This depends on what economists call 'elasticity'. The concept of elasticities is best explained by means of an example of a good: energy. Essential utilities such as electricity and heating are inelastic goods, meaning they are necessities that consumers find difficult to go without. Whether it is cooking, watching television, or charging mobile devices, the demand for energy remains relatively stable, exhibiting minimal sensitivity to price fluctuations. If the price goes up by a certain amount, demand will react relatively less. Similarly if prices for gasoline for example go down by a certain percentage, we will drive more, but the increase is less than proportional to the price decrease. From an economic perspective, this relationship is depicted by a steep demand curve, and demand for such goods is described as being 'inelastic'.

The underlying concept of how much consumption reacts to a change in price, how elastic the response is, is very important. Not only does it give an indication of the change in the quantity demanded, but it also offers insights into the power relationship between producer/seller and consumer. If the demand curve is steeper (inelastic) than the supply curve, it means that relatively more of the costs of a carbon tax will be borne by consumers. Similarly, consumers will benefit relatively less from a subsidy granted to producers. Electricity demand in the European Union is inelastic both for households and industry demand.[38] As a result, price increases through taxes, emissions trading or regulatory measures are largely passed on to electricity consumers.

Elasticities are not 'static;' they can change over time. In the short run, consumers are thought to be unable to find alternative solutions to a price increase and have therefore no other choice than to pay the high prices. They will consume a little bit less but generally pay a larger share of their household

[38] Zsuzsanna Csereklyei (2020), 'Price and income elasticities of residential and industrial electricity demand in the European Union', Energy Policy, Volume 137, February 2020

income for the goods. In the long run, however, consumers are more creative in finding ways to avoid having to pay high prices; they will be able to find alternatives (substitutes). Besides this short-run/long-run relation, it should be pointed out that elasticities are determined for a particular point (range) of the demand curve only. If prices differ too much, the predictive value of the elasticity may be unreliable.

Another important element that must be emphasised in relation to energy products is that because they are necessities for living, taxes on them (either in the form of energy taxes or carbon taxes) will fall more heavily on low-income households. Such households will spend a larger share of their income on energy. This is conventionally described as regressiveness. If fuel costs go up, people will first be more careful not to waste energy but will have to pay higher prices as they need heating. If prices increase too much, however, they simply cannot afford it and will not heat their homes. Low-income households may also lack the financial resources to adapt to price increases as required investments are often expensive (heat pumps, insulation, etc.).

It is therefore important to take a closer look at how low-income households can be supported. Governments wanting to support low-income households can choose from many instruments. Here only three generic forms are considered: lump-sum transfers (cash grant) are compared to energy voucher/stamp/in-kind transfers and to subsidies.

Governments can, for example, offer a lump-sum transfer (cash grant) or an energy voucher/stamp/in-kind transfer that enables households to spend an amount equal to the cash-grant on energy. Would this be good or bad for households? From an economic perspective (apart from potentially different administrative costs, social stigma for having to use vouchers/stamps), we can state that the result will be similar in the sense that it alleviates the budget constraints of poor households, enabling them to buy more energy products. Only the lump-sum cash transfer enables the household to choose freely how to spend money between energy goods and all other goods it needs. For poor households that would have been choosing to spend less on energy, a lump-sum transfer would have been more beneficial. In light of the climate change crisis, perhaps cash transfers would be more suitable than a voucher/stamp/in-kind transfer system.

As an alternative, a government can also opt for subsidies. If the government would decide to subsidize energy, for example, it would become cheaper for consumers. The relative price of energy vis-à-vis all other goods decreases, enabling consumers to purchase more energy while their ability to purchase all other goods has not changed. Households, including poorer ones, will be better off because they can consume more energy. Given that the subsidized good is cheaper now, households will spend relatively more on the subsidized good. As was the case in the previous example with a voucher/stamp/in-kind transfer, the highest level of utility will, however, be reached by cash transfers. This is because only cash transfers allow consumers the freedom of choice to spend the money so as to enable them to purchase the combination of goods that maximizes their welfare. Cash transfers will be clearly preferred by those consumers that have a stronger preference for other goods over energy consumption.

Comparing the various instruments it appears that cash transfers are in general preferable to other forms of support schemes. Cash transfers also avoid a number of pitfalls and complexities.

Subsidies and voucher/stamp/in-kind transfer systems lead consumers to consume more of the supported good. A paternalistic argument may be found in the 'good-specific characteristics' of the product that the donor is of the opinion that it should be consumed more. Examples of this are fresh vegetables or education. This argument may, however, not be equally applicable to energy consumption or carbon emissions because society would like them to be reduced. It should also be pointed out that the frame of reference is shifting because not only the benefit of the recipient is in focus here but also the benefit (utility gain) of the donor that feels better if households spend their money in a certain way. Moreover, in-kind subsidies may be extremely difficult to monitor in practice. Subsidies do not only distort the market but may also be less targeted towards poor income households. Moreover, both subsidies and voucher/stamp/in-kind transfer systems harbour 'public choice' type of risks such as rent seeking lobbying activity from industry for example, or self-interested civil servants that want to expand their bureau.

The insight that cash transfers are appealing is important to protect poor households from the regressivity that is associated with measures taken to advance energy transition or enhance energy security. High degrees of policy acceptability are essential to realize environmental objectives. The next section examines how countries have addressed price increases associated with energy security and energy transition.

4.3. What do we see in practice

The national energy systems must navigate a complex trilemma of finding an effective, integrated approach to achieve energy security, environmental sustainability, and energy affordability/equity. Attaining just transitions that are also perceived as being equitable by poorer households is a continuous challenge, particularly when ever more stringent environmental goals are set. As has been outlined above, energy transition and energy security often lead to higher electricity and heating fuel prices. The tempting solution of simply reducing fuel prices by lowering environmental tax rates or increasing subsidies may not always be expedient. This section offers practical examples of why and how countries have addressed price increases.

In 2018 in France protestors began to voice their dismay against rising crude oil prices and fuel prices, high cost of living and inequality. These grassroots meetings soon turned into a movement pushing for economic justice, political reforms, called 'Yellow Vest Protests' (*mouvement des gilets jaunes* in French). This led to riots and upheaval in Paris and other parts of the country. Eventually contentious policy measures had to be rolled back.

In particular the high energy and fuel prices resulting from the price shock of the Russia - Ukraine war have induced countries in Europe to take more than 400 Energy Emergency Measures between 2021 until February 2023 alone.[39] Several of these measures go beyond addressing energy security of supply challenges but are directly addressing high energy prices and poor households in particular. A few examples are discussed below.

To reduce high fuel prices in Germany, the government decided to substantially reduce the energy tax rate on gasoline and diesel between 1 June and 31 August 2022. This was estimated to reduce tax income by 3.15 billion Euros. This had an initially positive effect on fuel prices. This effect was, however, short-lived. Several reasons contributed to this state: firstly, the EU's oil embargo played a role; secondly, the market was highly concentrated; and lastly, the initial drop in prices led people to fill up their cars more affordably. This surge in demand then quickly drove prices up again. The measure was heavily criticised by economists as being unguided and not helping low-income households, as a redistribution system from low-income households to richer ones.[40] This shows that at times of severe supply disruptions, lowering tax rates may not always be an adequate solution.

Another measure taken by Germany to reduce energy consumption amid the global energy crisis (2021-2022) and to alleviate the cost of living was the introduction of the 9-Euro-ticket. This scheme allowed passengers to purchase monthly local and regional transport tickets – valid in all of Germany – during the month of June, July and August 2022. This measure led to a surge in ticket sales, enabling everyone to use public transport rather than private transportation. It certainly led to more people using public transport. It did, however, only have a limited additional impact on reducing carbon emissions because much travel would have been undertaking anyway by public transport.[41]

[39] ACER (2023) High-level Analysis of Energy Emergency Measures
[40] Tomaso Duso (2022), Der Tankrabatt ist der einfachste und schnellste, aber nicht der beste Weg, DIW Wochenbericht 23 / 2022, S. 342.
[41] Andreas Krämer, Gerd Wilger und Robert Bongaerts, (2022) Das 9-Euro-Ticket: Erfahrungen, Wirkungsmechanismen und Nachfolgeangebot, ZBW – Leibniz-Informationszentrum Wirtschaft,

The high heating bills have also been a point of considerable concern for many poorer households. Poorer households often live in rented homes that are less well insulated. They also have little influence how landlords are investing in alternative heating sources. In the Netherlands for example the government introduced among other things a price cap for energy prices. This price cap will apply for gas, electricity and district heating for households and small-scale users in 2023. Up to a certain level of consumption, these users will not pay more than a maximum tariff. For many users this scheme will result in a reduction of their energy bill.

As seen in the country case study analysis in the annex to this paper, Jamaica helps poorer households by exempting from tax lower levels of consumption. Under the General Consumption Tax ("GCT") Act, 150 kilowatt hours supply of electricity services to residential customers for private and domestic use in any month is subject to GCT at the rate of 0%. GCT is payable at a rate of 15% for the supply of electricity to residential customers at residential premises for private and domestic use per month, where the consumption exceeds 350 kilowatt hours, and commercial and industrial customers as well as on auxiliary and related fees.

4.4 Concluding remarks

The discussion above has shown that higher taxation on fossil fuels or the sudden loss of supply due to geopolitical conflicts can lead to rising prices which are inherently unpopular with households and businesses. Price increases – both sudden and incremental ones – are not easily reconciled with a smooth energy transition process and the realization of more ambitious climate change targets. Both the ability and willingness to pay are inherent elements of an equitable energy and climate transition. Energy poverty has attracted much policy attention. Countries have used many different strategies to support lower-income households or inhabitants.

Yet often times support measures are unguided, affecting broad groups of consumers rather than low-income households. Other times they are quite paternalistic in depriving consumers from the freedom of choice to taking their own decisions on how they would spend money. Support schemes also do not pay close attention to economic theory and at times are even directly environmentally counterproductive. Policy makers will need to take due note of these issues because the climate crisis is not going to disappear anytime soon and energy transition is a long and stony path, more like a cross country marathon than a sprint.

5. Using carbon taxes/subsidies to promote new energy transition technology

5.1 Carbon taxation and green energy that drives the clean energy transition

Carbon taxation can play an important role in supporting the uptake of low- and zero carbon fuels that are essential in each countries' green energy transition. Such fuels include biofuels, biogases, bioliquids as well as renewable fuels of non- biological origin, amongst them hydrogen. Carbon taxation can also support the expansion of renewable electricity production and diversify its use across transport, heating and cooling and industry.

The low or zero carbon content of these fuels can be translated into lower or zero carbon taxes. In turn, lower taxes on these fuels translate into lower prices. Lower prices make these green alternatives more competitive against traditional fuels. As green fuels currently tend to be more expensive to produce than the fossil fuels they replace, lower taxes can help to reduce or eliminate the price advantage of fossil fuels.

Wirtschaftsdienst, 2022, 102(11), 873-879. It is estimated that the measure reduced carbon emissions by 0.3 to 0.5 million tonnes of CO_2.

The challenge of using carbon taxation to promote fuels that drive the energy transition lies within connecting the production and consumption sides of the energy system. The differentiated carbon content of these fuels depends on the way they are produced. For example, hydrogen can be produced using renewable electricity. In this case the hydrogen is carbon free. On the other hand, hydrogen can also be produced using electricity that is derived from fossil fuels. In this case the hydrogen output is not a renewable, green energy source.

Carbon taxes are applied to energy consumption, often as part of an excise duty regime. In most of such cases, the tax applicable to a fuel consists of an energy component and a carbon component. When tax rates are set on the basis of average carbon content of each fuel type, tax regimes including a carbon component regime can be implemented with low administrative burden and do not require verification. The case of electricity and hydrogen are more complicated: To reflect one end, namely production in the other end, namely carbon taxation, reliable verification systems are needed. However, things get more complicated when differences in production pathways and carbon taxation are at the opposite ends of the energy value chain. Verification schemes serve to authenticate the origin of a fuel – be it to demonstrate that hydrogen was produced using renewable energy or that a biofuel was produced from sustainable crop cultivation.

The prevalence of verification schemes differs highly across technologies, with electricity being the most challenging and renewable fuels of non- biological origin being comparatively more feasible, albeit still complex. This chapter also addresses Carbon Capture, Utilization and Storage (CCUS). A technology that does not require certification. Consequently, carbon taxation can have a direct positive impact on the uptake of CCSU in developing countries.

5.2 Electricity and carbon taxation

Electricity plays a key role in the energy transition around the world. Electrification means that heat pumps can replace boilers that are fired by fossil fuels for space and water heating, electric vehicles can replace combustion engines that burn gas oil and petrol and industrial production processes can switch from natural gas and coal to electricity. Of course, the actual contribution of each switch depends on the origin of the electricity. Certifying the origin of electricity remains a challenge that proves to be difficult to overcome. This is due to the fact electricity is a homogenous product. Once it is fed into the grid, there are no differences in the quality and functioning of renewable and fossil electricity.

Between its production and supply to final consumers, electricity has to flow through transmission and distribution systems where its origin remains hard to trace. Some electricity suppliers guarantee green electricity to their consumers. This is however not ensured by knowing exactly where the supplied electricity comes from, but by the supplier buying green certificates that cover the total volume of electricity they supply to their consumers. As robust guarantee of origin certification for electricity- that can be used for the purposes of tax regimes- remain mostly obsolete, few countries can translate the renewable origin of electricity into lower tax rates.

One exemption is Lithuania, where renewable electricity, accounting for 30% of the country's total electricity consumption, is exempted from excise duties. Another possibility is tax exempting auto-producers of renewable electricity. Auto- production means essentially that the producer and consumer of the electricity are the same. Auto- production can be a solar panel installed on the roof top of a family home as well as a hydro power plant next to an aluminium smeltery. In these cases, electricity is not fed into the grid. Electricity consumption is however mostly grid bound. Once electricity is fed into the grid, its hard to trace its origin and determine its carbon content.

Electrification in developing countries also means that imported fuels can be replaced by domestically produced electricity. This in turn increases security of supply and reduces vulnerability to external price volatility.

5.3 Bioenergy and carbon taxation

Bioenergy includes biofuels used in transport, bioliquids used for heating and biogases used both for transport and heating. The carbon content of bioenergy depends on the feedstock and the production pathway used. In many cases, bioenergy is considered carbon neutral as the crops used as feedstock retrieve the same amount of carbon dioxide from the atmosphere as the fuel emits when being combusted. Therefore, carbon taxation could be applied to bioenergy to reflect its carbon neutrality and increase its price competitiveness against fossil fuels.

The problem in this case is that biofuels are hardly ever used in pure form. They are mixed with fossil fuels. Numerous countries around the world put in place blending obligations that require suppliers to add a certain amount of biofuels to their fossil products. Often more than two products are mixed. Consequently, the exact chemical composition of the final fuel is hard to certify. Some countries do not produce biofuels but import them from other countries. In these cases the importing country has even less information about the exact composition of the blended product. This means that the carbon content of the blended product can not be determined with certainty and carbon taxation is difficult to apply.

On the other hand, certain biofuels are similar enough to gasoline and diesel that they do not have to be blended: they can be simply “dropped in” into existing petroleum-based fuels. These drop-in biofuels directly replace petroleum-based fuels and hold particular promise for the future.

There are however some exemptions, most notably, Finland’s tax regime, which reflects the carbon neutrality of biofuels versus fossil fuels. The functioning of the sophisticated Finnish system is partly based on the high level of trust between biofuel producers and the tax authority, as well as a relatively concentrated marked with a lower number of producers. Austria also applies differentiated energy excise rates to biofuels. A lower tax applies to fuels with a biofuel share above the share mandated by the blending obligation. In this case the tax reduction is not proportionate to the increase in biofuel share. As it is hard to determine the exact biofuel content of a mixed product, the same tax reduction applies to a fuel with 5% more biofuel content as to a fuel with 20% more biofuel content. Brazil’s RenovaBio[42] certification scheme is the example closest to rewarding fuel supply proportionately to its biofuel content. RenovaBio is, however, not a tax instrument but a trading scheme. Producers of biofuels obtain certificates which they sell to suppliers. Suppliers are obliged to cover a certain share of their total supply by biofuels. The scheme uses a life cycle analysis-based tool to certify the carbon intensity of biofuels. As in most cases, ensuring a reliable and extensive certification process poses a challenge.

Brazil’s case is also an example for biofuels used in pure form. Hydrated ethanol, a fuel without fossil component, is sold at the pumps. Over 90% of vehicles on Brazil’s roads are flex- fuel vehicles. This means that they can combust both pure hydrated ethanol and non- hydrated ethanol mixed with petrol. When a biofuel is used in pure form and not as part of a blend, carbon taxation can reflect its contribution to decarbonization. Similar examples are found around the world for high- blend fuels. Several countries tax exempt high- blend fuels as they contain a significantly higher share of biofuels. Such high- blend fuels can however be used only in altered engines that are specifically fitted for their consumption. Such

[42] Brazil, Federal Government, Renovabio. Retrieved from: https://www.gov.br/mme/pt-br/assuntos/secretarias/petroleo-gas-natural-e-biocombustiveis/renovabio-1/renovabio-ingles on 14.09.2023.

engines are typically those of heavy- duty vehicles used to transport goods. Consequently, the reflection of reduced carbon content is possible in most cases only for heavy duty vehicles and not passenger cars.

Irrespective of the problem of carbon content, bioenergy poses another challenge. Namely, sustainability. Biofuels, biogases, bioliquids and even solid biomass (wood and wood products) can be sustainable or non- sustainable. This means that bioenergy can be carbon- neutral and non- sustainable at the same time. Bioenergy provides a positive contribution to the green energy transition when its sustainable. Therefore, numerous jurisdictions around the world put in place sustainability criteria for biofuels and in some cases for other forms of bioenergy. The United States updated its Renewable Fuel Standards policy in 2023.

The European Union's successive Renewable Energy Directives set increasingly restrictive sustainability criteria. As of August 2023, there are 16 different approved certification schemes in the EU. Brazil's RenovaBio also defines criteria for producers to participate in the program. These criteria are similar to sustainability criteria. While the exact definition of sustainability varies across these instruments, they typically contain the following elements: definition of sustainable feedstock, with waste and algae often considered the most sustainable as well as definition of a certain level of GHG reduction of the biofuel compared to the competing fossil fuel. Some policy instruments add land use criteria to ensure that the feedstock used to produce the biofuel is not cultivated on land rich in biodiversity, nor does it negatively impact the availability of land for food production.

In most cases the policy instruments determine whether the biofuel is sustainable for not, including if the feedstock and production pathway typically represent a certain GHG reduction compared to fossil fuels, but do not determine the exact carbon content of each product, that would allow its application for taxation purposes.

Bioenergy in developing countries also means that imported fuels can be replaced by domestically produced renewable products. This in turn increases security of supply and reduces vulnerability to external price volatility and opens export possibilities. Brazil for example, today the largest exporter and second largest producer of biofuels in the world, started its biofuel production program in the 1970's to reduce the country's dependency on imported fuels.

5.4 Fuels of non- biological origin and carbon taxation

Fuels of Non-Biological Origin (FNBO) are synthetic fuels. They include hydrogen and its derivates, such an ammonia and methane produced using hydrogen. Hydrogen can be produced from many different sources in many different ways. While each process separates hydrogen from other molecules, their carbon intensity varies significantly. The different production pathways are often designated by colors.

The most common technology is steam-methane reforming. Industrial facilities and petroleum refineries primarily use natural gas as the methane source for hydrogen production. The product resulting from this process is often referred to as grey hydrogen. Black and brown hydrogen use respectively black (bituminous) and brown (lignite) coal in the production process. They are the most environmentally damaging form of hydrogen production. In these processes neither the carbon dioxide nor the carbon monoxide generated during the process is captured. Hydrogen is labelled blue whenever the carbon generated from steam reforming is captured and stored underground through industrial carbon capture and storage (CSS). Blue hydrogen is sometimes referred to as carbon neutral as the emissions are not dispersed in the atmosphere or as low- carbon hydrogen as 10-20% of the generated carbon dioxide cannot be captured. This option is especially of interest for developing countries that wish to continue to make use of their fossil fuel resources in a sustainable way.

Hydrogen can also be produced through electrolysis. Electrolysis is a process that splits hydrogen from water using an electric current. When electricity of renewable origin, including solar, wind, hydro, geothermal and tidal, is used in the process, the resulting hydrogen is labelled green. This is the only truly climate neutral way of producing hydrogen. Other ways of producing hydrogen from renewable, albeit not fully zero carbon sources also exist. Some fuel cell power plants treat and use landfill gas (biogas) as hydrogen source. Biofuels and waste are also potential hydrogen sources. Hydrogen can be produced via pyrolysis or gasification of biomass resources such as agricultural residues, consumer wastes including plastics and waste grease. All the resulting fuels are called Renewable Fuels of Non-Biological origin (RFNBO).

Irrespective of its production pathway, hydrogen emits only water vapour when combusted. In other words, However, as demonstrated above, producing hydrogen can be carbon intensive. Therefore, the certification of the production process is again a key to linking it to carbon taxation. Such schemes are in initial phases around the world. Therefore, they are not yet fit for use by tax administrations. For example, the United Kingdom announced plans for a certification scheme to verify the sustainability of zero and low carbon hydrogen and build sector transparency. The scheme is expected to be functioning earliest by 2025. As of august 2023, the hydrogen certification scheme of the European Union was voluntary. The scheme established green and low carbon hydrogen labels. The programme is currently in its third phase, at the stage of working towards the establishment of an EU Voluntary Scheme recognized by the European Commission for the certification of hydrogen as a renewable fuel of non-biological origin. Once operational, the certification scheme might provide a stable basis for differentiated taxation of hydrogen. This however remains to be determined in the future.

Hydrogen production in developing countries can also unlock export revenues, beyond decarbonizing domestic manufacturing and heavy- duty transport. Many developing countries possess abundant renewable electricity sources, mostly notably solar power. As the price of solar power production continues to fall, so does the price of hydrogen produced by solar power.[43] This in turn increases the viability of hydrogen production in developing countries both for export purposes and domestic use.

5.5 CCUS and carbon taxation

Carbon dioxide (CO2), resulting from the combustion of fossil fuels, can be captured instead of emitting it into the atmosphere. Once CO2 is captured it can be compressed to be stored in deep geological formations or utilized in industrial production processes. Such geological formations are most commonly depleted oil and gas reservoirs and saline aquifers. A wide range of industries present in developing countries, from fertilizers to food and beverages, use CO2. Storing or using CO2 eliminates the globally harmful negative impacts of this greenhouse gas.

Therefore, a direct positive link can be established between carbon taxation and the uptake of CCSU. A well- designed policy combination of carbon taxation and CCUS can create a viable business case for achieving environmental protection and industrial development at the same time, while driving the clean energy transition forward in developing countries. Especially in those developing countries that wish to continue to use their fossil fuel resources in a sustainable way.

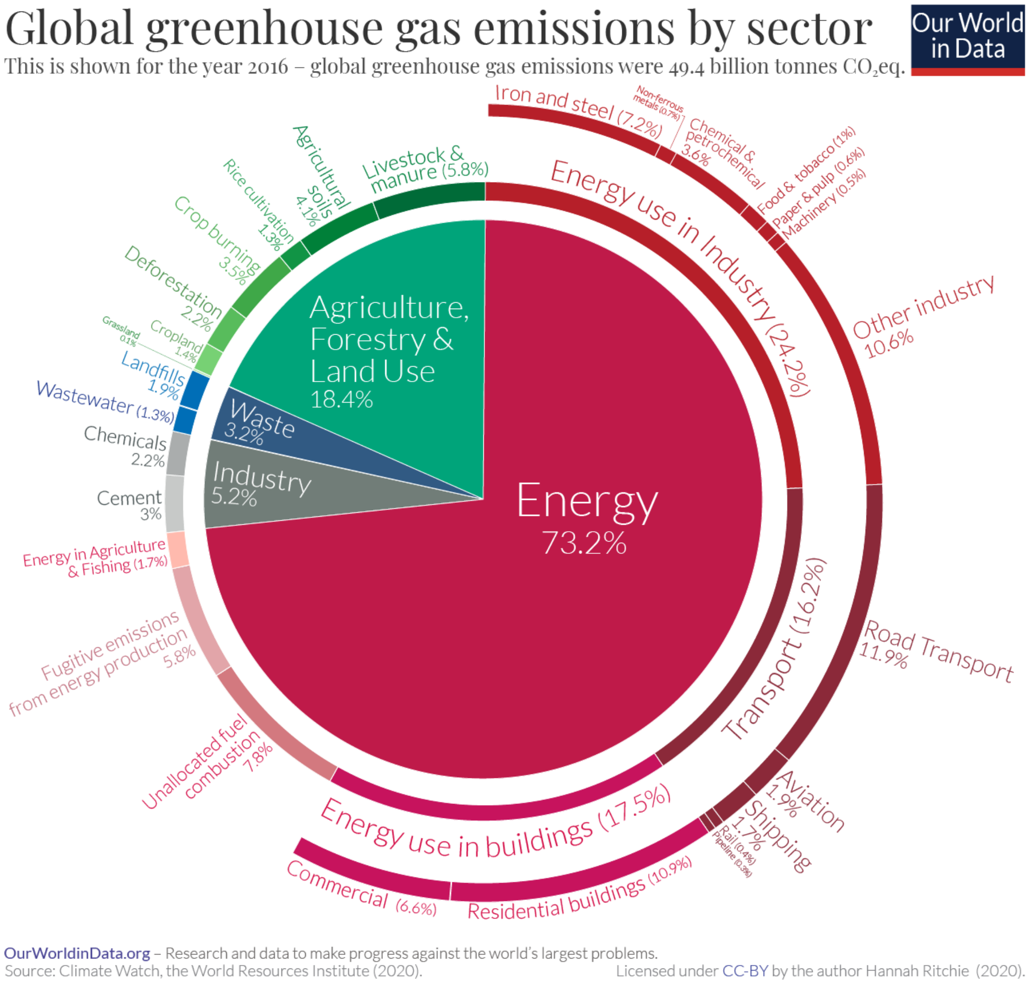
[43] International Renewable Energy Agency, Solar Power Costs. Retrieved from https://www.irena.org/Data/View-data-by-topic/Costs/Solar-costs on 14.09.2023.

In sectors, such as manufacturing and heavy- duty transport, technological options to replace fossil fuels by clean energy sources is limited or currently not available at competitive prices. This means that combusting fossil fuels is likely to continue in the short- to mid-term. CCUS, supported by carbon taxation, can provide a solution for decarbonization in these sectors. In practical terms, it means that the tax burden can be reduced as the carbon dioxide is captured and is not emitted into the atmosphere. When the captured CO2 is sold to industrial users, it does not only avoid the cost of taxes but also generates additional revenue. Therefore, an effective combination of carbon taxation and CCUS policies, can create viable business cases in developing countries.

6. Analysis of indirect tax options by energy sector

6.1 Scope

The chart below sets out the sources of global greenhouse gases:



The focus of this paper is limited to the energy sector and does not extend to other emission sources such as agriculture or forestry. While biomass is defined as a renewable in some countries (see Chile case study), its combustion still contributes to global warming and its use should therefore not be encouraged by tax policy.

Energy is used in buildings, transport and industry and the rest of this chapter will consider each of these in turn. For more detail on carbon tax design, reference should also be made to Chapters 4-6 of the [2021 United Nations Handbook on Carbon Taxation for Developing Countries](https://) (UN Handbook). It should also be noted that, in general, applying VAT to as broad a base as possible and with minimal rate differentiation reduces complexity and scope for unintended behaviours, and that that other more targeted ways of supporting a just energy transition may be more effective.[44]

6.2 Energy use in buildings (17.5%)

Energy use in buildings accounts for 17.5% of global emissions. Two primary strategies for reducing these emissions include: (a) using less energy and (b) ensuring that whatever energy is used comes from renewable sources of electricity generation.

[44] THOMAS, Alastair, VAT rate structures in theory and practice, OECD Tax Policy Working Paper

Energy use can be reduced by behavioural change: adjusting the thermostat. Price signals can help with this – see Chapter 4 [Behavioural responses to increased energy prices] above. Better insulation of buildings is the other main factor that helps to reduce energy use. Indirect taxes can incentivize insulation. Lower rates of VAT or other local consumption taxes and time-limited subsidies for insulation materials and work should be considered. Property taxes could be adjusted to reflect the insulation status of the building, with lower taxes offered to those that comply with the best insulation standards. In Jamaica, reduced energy consumption, and a just transition, is also incentivized by having a zero rate of VAT on first tier (defined) of energy consumption but normal VAT in excess of that.

Energy use for heating rather than cooling may involve direct combustion of fossil fuels: gas, oil or coal. Environmental taxes based on carbon content should help to incentivize a switch from fossil fuel consumption to electricity generated from low carbon or renewable sources.

6.3 Transport: road (11.9%)

Energy use for road transport accounts for 11.9% of global emissions. Emissions can be reduced by (a) taxing or subsidizing the cost of different types of vehicle and (b) taxing or subsidizing road use by types of vehicle.

In terms of the first choice, as seen in the case studies, Chile, Ghana, Indonesia and Jamaica all apply differential rates of import duty on vehicles depending on their engine type, with zero or reduced duty applicable to electric and hybrid vehicles. The same concept could be applied to VAT or other consumption taxes on imported or locally produced vehicles.

Regarding the second option, most countries, including Chile and Jamaica, tax road fuel. Indonesia has different rates of tax on road use and vehicle transfers according to region and vehicle emissions, and aims to phase out existing road fuel subsidies. For a more detailed account of road fuel excise duties please refer to the paper on other environmental taxation other than carbon taxation (forthcoming) – [this is one of the workstreams of the Subcommittee on Environmental Taxation. The paper is being developed].

Many governments rely heavily on revenue from the taxation of vehicles and their use. These taxes are generally cheap to collect and hard to avoid. Differential taxation based on vehicle type should therefore be considered a temporary measure to incentivise switch to electric vehicles.

6.4 Transport: aviation & shipping (3.6%)

Energy use for aviation and shipping accounts for 3.6% of global emissions. According to the OECD's publication "Taxing Energy Use" (2019), emissions from international aviation and maritime transport are not taxed at all. Fuels used in domestic aviation and domestic navigation are sometimes taxed, but rarely reflect a low-end carbon benchmark. Most of these emissions are not subject to emissions trading systems either. The introduction of taxation on such emissions requires international agreement but many countries such as Sweden and the UK have acted unilaterally to legislate airport departure taxes to discourage flying particularly on routes where land-based public transport, notably rail travel, is a viable alternative.

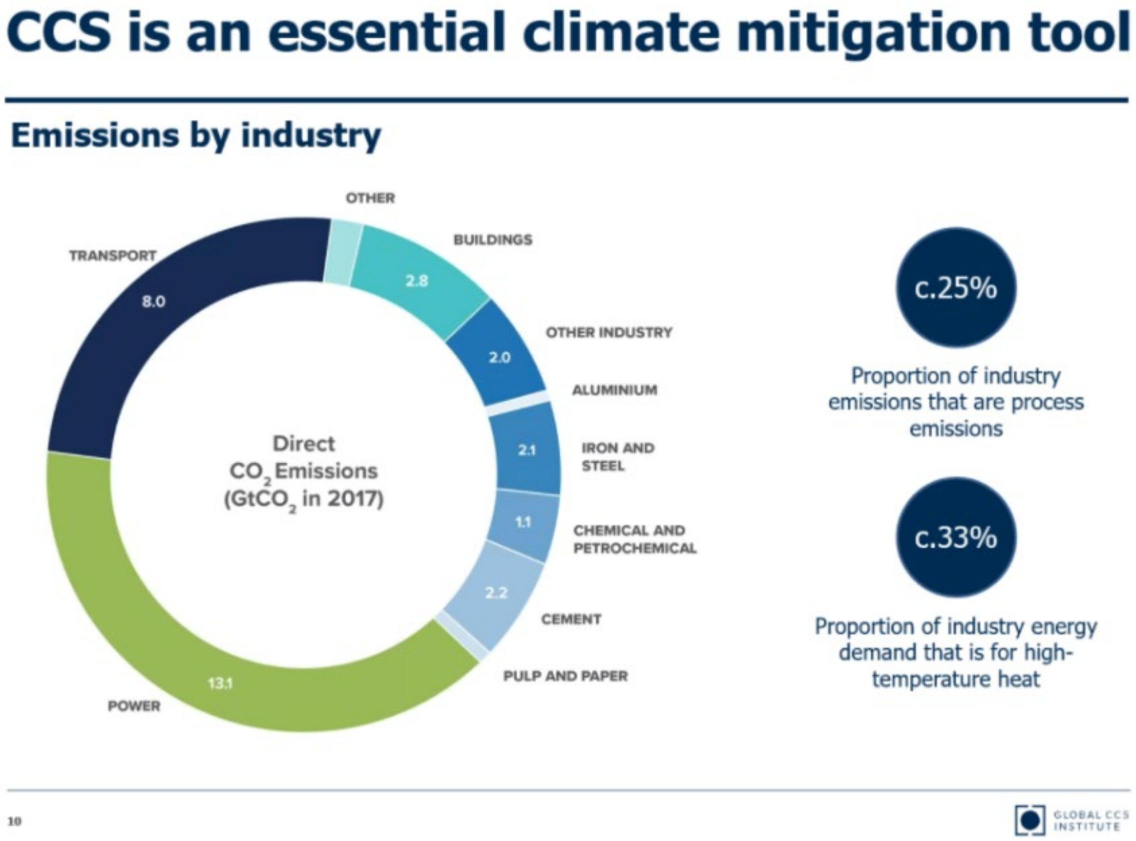
6.5 Energy use in industry (24.2%)

Energy use in industry accounts for 24.2% of global emissions. Industry, in both the private and public sector, is generally very responsive to price signals that encourage the use of low carbon energy sources. For a discussion on the role of carbon taxation as a price signal see the UN Handbook. Industry is generally supportive of carbon pricing as a way of securing shareholder support for making low carbon investment choices and most multinationals in the energy sector already make the assumption in their investment decisions that a price on carbon will be introduced where a country does not already have one, a concept known as 'shadow pricing'.

To keep it both effective and simple, a carbon tax would preferably be applied to as broad a base as possible. For example, Sweden has over the past decade step-by-step abolished several earlier exemptions and currently about 95% of all use of fossil fuels giving rise to carbon emissions are subject to either the national carbon tax or the EU ETS (the European Union Emission Trading Scheme.

To encourage investment in low carbon energy sources, some countries such as Chile, Ghana, Indonesia and Jamaica impose import duty on goods according to their carbon footprint, with zero or reduced duty on solar panels and wind turbines. Chile has an emissions tax on businesses that produce more than a free allowance from non-renewable sources, and allows carbon offsets and reductions for community investments. Indonesia has a carbon tax on coal-fired power plants.

Some industrial processes such as steel and cement manufacturing (see chart below) are very difficult or expensive to decarbonise and here there is a role for carbon capture and storage (CCS) or carbon capture, storage and utilization (CCUS). According to McKinsey, it is currently impossible to chart a 1.5-degree pathway that does not remove CO2 to offset ongoing emissions.



6.6 Fugitive emissions from energy production (5.8%)

The emission of a tonne of methane causes 86 times more warming than does a tonne of CO2. The good news is that it has a half-life in the atmosphere of only about a decade compared with CO2 which can be remain for hundreds, or even thousands, of years.

Over 100 countries representing nearly 50% of global methane emissions and over two thirds of global GDP have now signed up to the Global Methane Pledge that was launched at COP26 in November 2021 in Glasgow. Participants joining the Pledge agree to take voluntary actions to contribute to a collective effort to reduce global methane emissions at least 30 percent from 2020 levels by 2030, which could eliminate over 0.2˚C warming by 2050.

As regards energy production, the key action is to prevent methane leaks from oil and gas infrastructure. The US Inflation Reduction Act includes a fee that will be levied on methane emissions from oil and gas operations, a carbon tax policy instrument that other countries may wish to consider.

7. Energy transition capacity building

As countries try to cut their greenhouse gas emissions and meet their climate change goals, transitioning to a low-carbon economy has become a serious issue. Carbon emissions, which comprise 75% of greenhouse gas emissions, are a big reason the world's environment is worsening.[45] Pricing carbon is one of the most powerful tools governments have, and the role of taxes in making this change is becoming more and more clear. However, implementing and administering a carbon tax requires having an implementation framework that considers the various stakeholders (public, private and international), the resources required, training for the government officials and some business sectors.[46]

This chapter explores the most important aspects that need to be considered to implement, administer and collect carbon tax It also looks at how important it is to include stakeholders in policy development, make the shift easier, and give the right training to key government employees and business leaders.

According to the World Bank Group (2017) effective carbon tax implementation can be achieved by:

- Mapping the key jobs and responsibilities: These functions can broadly be grouped under three headings: determining tax liability, overseeing tax administration, and enforcing the tax, though specific needs will depend on the scope of the tax and how it is designed.
- Allocating responsibilities to prevailing expertise. This allows the country to identify who can administer the carbon tax and determine which existing institutions can assume those functions and where new configurations are needed.
- Develop Standard operating procedures to address measuring, reporting and verification (MRV) of emissions, to enable tax administrations to effectively and accurately administer the taxes, conduct audits and raise assessments
- Building capacity. Strengthening existing capacity and knowledge whilst also acquiring new skills not only by the implementers and administrators of the carbon tax but also by entities who will be liable to pay this tax.
- Ensure coordination. Coordination between government departments during the process is crucial as carbon taxes often relate to a range of policies.

A well-designed carbon tax policy enhances revenue and promotes long-term economic growth, which is in line with the sustainable development goals.[47] To effectively administer taxes including carbon taxes, proficient design, effective processes and efficient revenue administrations and institutions are

[45] Safi, A., Chen, Y., Wahab, S., Zheng, L., & Rjoub, H. (2021),1. Does environmental taxes achieve the carbon neutrality target of G7 economies? Evaluating the importance of environmental R&D. Journal of Environment, 293, 112908. https://doi.org/10.1016/j.jenvman.2021.112908
[46] Du, Q., Yan, Y., Huang, Y., Hao, C., & Wu, J. (2021). Evolutionary Games of Low-Carbon Behaviors of Construction Stakeholders under Carbon Taxes. International Journal of Environmental Research and Public Health, 18(2), 508. https://doi.org/10.3390/ijerph18020508
[47] Carbon Taxation in Africa :African Tax Administration Forum, 2023, p. 5.

required. This will allow for the precise measuring, reporting, and verification of carbon emissions to be able to encourage tax compliance. The success of carbon taxation is essentially dependent on the design and the current administrative and legal framework of each country.

Carbon pricing could bring in money to help pay for the transition while also incentivizing people and companies to lower their carbon footprint. A reduction of 5% in coal consumption would result in a decrease of 9.0% in emissions and a corresponding increase of 1.3% in gross domestic product.[48] As indicated in the UN Handbook, when the carbon tax is based on the fuel approach, implementation can be simple as it can be based on the existing fuel tax administration structure. This approach comes with relatively fewer administrative issues. It however requires the cooperation of other relevant government departments.

7.1 Clear legislation and guidelines

Revenue administrations need to work in conjunction with relevant government bodies to establish the legal framework and regulations for carbon taxes. This includes defining the scope, rates, exemptions, and reporting requirements associated with carbon taxes. The legislation should define the tax base, tax rates, exemptions, reporting requirements, and penalties for non-compliance. For each of the areas above, detailed guides or manuals that are easily comprehended by tax administrators and taxpayers should be developed in relation to the legislation. There should be a deliberate program to engage all stakeholders to sensitize them on the policy direction and to also solicit their views for drafting the legislations and the manuals.

The Fit for 55 initiative in Europe illustrates this particular type of framework.[49] The policy framework under consideration is a distinctive amalgamation of strategies and methodologies designed to curtail the emission of greenhouse gases by 55% relative to the levels recorded in 1990, with the ultimate objective of achieving net-zero emissions by 2050.[50] An energy transition framework or policy outline (in the lines of the Fit for 55 package in Europe) might be interesting to inform stakeholders of how the different policies correlate and highlight the areas where stakeholders can expect change to happen in the short term.

7.2 Training

To ensure that carbon taxes are administered well, it is essential that government officials, particularly those working in tax administration, ministries of finance, and environmental departments, receive adequate training. This entails comprehending how a carbon pricing mechanism can be leveraged to promote equitable pricing of environmentally sustainable commodities, how carbon pricing would help in achieving the Sustainable Development Goals especially SDG 13 [Climate Action] and how the absence of a carbon tax can result in market inefficiencies.

Training programs for government officials play a vital role in improving the capacity and capabilities of the tax administrator. It is crucial to understand the potential indirect implications of a carbon tax on

---

48 Wei, R., Ayub, B., & Dagar, V. (2022). Environmental Benefits From Carbon Tax in the Chinese Carbon Market: A Roadmap to Energy Efficiency in the Post-COVID-19 Era. Frontiers in Energy Research, 10. Retrieved from https://www.frontiersin.org/articles/10.3389/fenrg.2022.832578

49 Christodoulou, A., & Cullinane, K. (2022). Potential alternative fuel pathways for compliance with the ‘FuelEU Maritime Initiative.’ Transportation Research Part D: Transport and Environment, 112, 103492. https://doi.org/10.1016/j.trd.2022.103492

50 Ovaere, M., & Proost, S. (2022). Cost-effective reduction of fossil energy use in the European transport sector: An assessment of the Fit for 55 Package. Energy Policy, 168, 113085. https://doi.org/10.1016/j.enpol.2022.113085

other regulations, including but not limited to income tax, value-added tax, import tax, and transfer pricing.

The training programmes should prioritise the sectors of the economy that are anticipated to experience the greatest impact due to the transition to alternative energy sources. Carbon taxation training programmes should be designed to address taxation of specific segments of the economy which will be most impacted by the implementation of a carbon tax.

Corporate institutions can finance such training programmes for their employees. The provision of resources such as funding for research on emerging technologies and assistance for training programmes by the public sector may aid the private sector in its efforts toward energy transition. Using government revenue from environmental tax reform to reduce labour taxes, mitigate undesirable distributional consequences, fund education and training programmes, and offer specifically targeted programmes for regions with a high share of employment in carbon-intensive industries will improve the public acceptance of environmental taxes, leading to revenue-neutral carbon taxation.[51]

Training should be provided to tax administrators that empowers them to comprehend the energy transition procedure and industry specific knowledge, encompassing techniques to decelerate climate change, allocations towards low-carbon methodologies and technologies, and the significance of immediate incentives that extend into the medium to long term. To be able to successfully implement and administer carbon tax, the country must be able to ensure tax compliance and adherence to their tax obligation. Additionally, technical assistance and training courses that explicitly address comprehending the legislation applicable to carbon taxation, understanding emerging trends in carbon taxes, auditing companies who are liable for carbon taxes and other environmental taxes and being able to adequately defend their audit outcomes during tax disputes is crucial.

Capacity building to equip tax officials with the skills and knowledge to detect tax evasion, and tax risks is crucial. Tax noncompliance can be mitigated by having a structured and documented process on administering penalties for noncompliance. These penalties should be steep enough to deter noncompliance. Additionally, to mitigate the risk of non-compliance, the carbon tax should be designed such that it is easy to understand and administer.

Given that carbon emissions and climate change are global challenges, international cooperation and coordination are also essential. Revenue administrations should collaborate with other countries to share best practices, exchange information on emissions and tax data, and address cross-border tax evasion and avoidance**.** Collaborating with international organizations, sharing experiences, and learning from successful case studies can help countries accelerate their energy transition efforts by avoiding pitfalls and replicating best practices**.** Having coordinated approaches can reduce transition costs.

Multilateral organizations' efforts in capacity building, promoting knowledge sharing and providing relevant knowledge resources on carbon pricing are notable and should be enhanced. In terms of knowledge resources, the Platform for Collaboration on Tax (PCT), a joint initiative of the secretariats of the International Monetary Fund, the OECD, the United Nations and the World Bank Group, recently published a paper comparing the carbon pricing metrics of the four Partner organizations[52]. These organizations also provide capacity-building on carbon pricing (including carbon taxation) individually.

[51] Rotar,L.J.(2023). 6. Carbon Tax and Tourism employment: is there an interplay ? Journal of risk and financial managent.16(3), 193. https://doi.org/10.3990/jrfm 16030193

[52] https://www.tax-platform.org/sites/pct/files/publications/PCT-CPM-Report.pdf

The UNDESA/FSDO's comprehensive capacity development programme in international tax cooperation aims at strengthening the capacities of Ministries of Finance and National Tax Administrations in developing countries toward more efficient and effective tax systems to help enhance domestic resource mobilization in these countries.

The United Nations Department of Economic and Social Affairs capacity development programme in strengthening domestic resource mobilization and international tax cooperation complements the work of the UN Tax Committee (for which UNDESA acts as Secretariat). The various practical guidance materials and tools developed by the Committee and available under the programme have helped address gaps and build the capacities of tax officials in developing countries on crucial topics. UNDESA organizes global and regional workshops on carbon taxation and other environmental taxation matters to help disseminate the guidance contained in the Handbook as well as obtain feedback from developing country officials on priority areas for the Tax Committee to take into account in developing further guidance. This feedback loop has informed the ongoing work of the UN Tax Committee in environmental issues.[53]

Other capacity-building tools include the United Nations Climate Change Learning Partnership, developed by the World Bank's Partnership for Market Readiness (PMR) and the United Nations Institute for Training and Research (UNITAR). UNITAR also offers a web-based training on carbon taxation[54].

Additionally, platforms such as the International Carbon Action Partnership (ICAP) offer courses and other tools to provide a snapshot of emissions trading for developing countries and emerging economies. The ICAP courses covers aspects of the design and implementation of emissions trading systems (ETS) as a tool to mitigate greenhouse gas emissions. Some of the issues covered in the ICAP courses include data collection and inventory generation, registry design and implementation and the opportunities offered by creating a global carbon market of linked domestic and regional systems.

To build technical knowledge on carbon taxes:

- tax administrations should include training in carbon taxation in their staff training programmes;
- taxpayer education plans should include targeted education on carbon tax; and
- capacity-building initiatives should be designed with a whole-of-government approach in mind, to support all relevant government agencies and stakeholders.

7.3 Stakeholder engagement

According to the International Energy Agency, the optimal circumstances for a prosperous transition towards sustainable energy involve well-defined objectives, transparency, and active involvement of all stakeholders. The formulation and implementation of energy policy should involve the participation of various stakeholders, including the government, businesses, civil society, and communities. As emphasized in the UN Handbook, it is important that relevant stakeholders are involved in the design process of a carbon tax policy. This would also apply in the case of designing an energy transition .

[53] In addition to this workstream on the role of carbon taxes and other measures in supporting energy transition, currently, the Tax Committee is also working on the following: the interaction of carbon taxation with other national measures; the interaction between carbon taxes and carbon offsetting programmes; carbon border adjustment mechanisms and how developing countries can avoid undesired spillover effects from the implementation of such measures by other jurisdictions; other environmental tax measures other than carbon taxes that are relevant for developing countries.

[54] https://unitar.org/courses/carbon-taxation-6738

Transparency during the transition process with stakeholder engagement and having clearly defined timelines will provide a strong platform for the rollout of a successful energy transition process. There should be continuous engagement and consultation by the government institutions to clarify key points of the program and receive inputs on how to best mould the strategy so that there are no unexpected economic impacts (domestic and international).

The success of transitioning to a new energy source is contingent upon the effectiveness of communication with pertinent stakeholders. It is important to engage the public and relevant stakeholders in the design and implementation of carbon taxes. This includes educating taxpayers about the purpose and benefits of carbon taxes, addressing concerns or misconceptions, and encouraging behavioral changes to reduce carbon emissions. For example, in order to ensure the administrative provisions are clear and well-functioning, it is critical for the authorities to seek the involvement of relevant stakeholders such as the tax accountants' association and their inputs and comments considered.

It is crucial to clarify the overarching objectives and aspirations of the policy, in addition to defining the particular measures being implemented. It is also vital to effectively address apprehensions and censures. This can be achieved through effective communication and the ability to explain the policy holistically but in simplified and understandable manner to get their buy in with the transition and understand where new opportunities may arise. Similar to the brochures available for all core taxes, the development of carbon tax brochures both hardcopies made available in tax customer service centres and soft copies (websites) should be developed to educate and guide taxpayers on carbon taxes and their compliance obligations being registration, filing, payment and accurate reporting. The brochure should also include an example of a carbon tax calculation, whilst explaining the calculation in simplified and easily comprehensible way. Taxpayers need precise information on their tax obligations.

By establishing connections with stakeholders, governmental institutions can enhance their ability to identify potential challenges and issues that may arise during a transition, including unforeseen economic impacts at both local and international levels. Policy stakeholders consider government meetings and stakeholder surveys as significant means of acquiring.[55] An inclusive and participatory consultation process ought to incorporate a diverse array of stakeholders, including individuals from the corporate sector, environmental organizations, and other pertinent groups. Through the process of dialogue, stakeholders have the opportunity to express their opinions and provide feedback, which can significantly impact policymaking and ultimately result in improved outcomes.

Incorporating the perspectives and opinions of stakeholders and including them in the design and testing phase, has the potential to facilitate the transition towards sustainable energy practices and mitigate opposition to regulatory changes. Consultation by the tax administration with affected industries, environmental groups, experts, intermediaries and taxpayers to identify deficiencies in the administrative processes whilst also reviewing frequently asked questions and misunderstandings identified during audits can help the tax administration improve the way carbon tax is administered.

7.4 Resourcing for energy transition

The process of resource allocation plays a crucial role in the energy transition, wherein tax offices and governmental finance bodies must be equipped with the necessary tools to effectively administer carbon taxes and facilitate their revenue collection. The administration of carbon tax can be integrated through

[55] Ingold, K., Varone, F., Kammerer, M., Metz, F., Kammermann, L., & Strotz, C. (2020). Are responses to official consultations and stakeholder surveys reliable guides to policy actors' positions? Policy & Politics, 48(2), 193–222. https://doi.org/10.1332/030557319X15613699478503

the excise tax system for energy products, as is the case in Nordic countries, France and Mexico. This hybrid approach results in a more effective use of resources, as it aids in avoidance of implementation and administration.

There are various approaches to resource allocation for the transition towards sustainable energy, including the implementation of explicit or implicit carbon pricing mechanisms and the elimination of detrimental subsidies for fossil fuels.[56]

7.5 Comparative experience

A good way to building capacity is to learn from different countries (developed and developing) on how to address issues. The effectiveness and efficiency of a carbon tax policy is linked to its acceptability once it is implemented. It is critical that once a carbon tax is introduced, people accept or believe it acceptable. South Africa and Singapore can provide useful examples for developing countries considering implementing a carbon tax. Singapore implemented its carbon tax in January 2019 and became the first Southeast Asian country to implement a carbon tax policy.[57] The South African authorities implemented a carbon tax policy in June 2019. The comparison of the Singapore and South African carbon tax policy covering issues on acceptability, administration, collection and compliance is provided in the table below:

	South African Carbon Tax	**Singapore Carbon Tax**
Acceptability	Public consultations were held in order to increase the acceptability of carbon tax prior to implementation. Input from the various stakeholders during these consultations were used to inform the design and result in an effective carbon tax policy.	The Ministry of Sustainability and the Environment (MSE) conducted public consultations on the draft Carbon Pricing Amendment (Amendment) Bill.
Collection	Carbon tax (CBT) is collected by the South African Revenue Authority.	Carbon tax is collected by the National Environment Agency (NEA), not the Inland Revenue Authority of Singapore, and is paid into Singapore's Consolidated Fund.
Compliance	The carbon tax is assessed, collected, and enforced as an environmental fee under the Customs and Excise Act of 1964, as amended by the Carbon Tax Act of 2019. Every licensee is required to submit an annual CBT environmental levy account for each licensed facility in the month of July of the year after the tax period. All licensees must be registered for eFiling since CBT accounts must be submitted and paid through eFiling.	Carbon Pricing Act of 2018 governs compliance. Registered people in Singapore having operational control of taxable facilities would be required to acquire fixed-price carbon credits and surrender them at the end of each reporting period to pay their assessed carbon tax. Failure to pay carbon tax results in one being guilty of an offence and becoming liable to pay a fine that is triple the amount of tax specified in the demand note as being outstanding.

[56] Carley, S., & Konisky, D. M. (2020). The justice and equity implications of the clean energy transition. Nature Energy, 5(8), 569–577. https://doi.org/10.1038/s41560-020-0641-6
[57] https://www.nccs.gov.sg/singapores-climate-action/mitigation-efforts/carbontax/

7.6 Conclusion

Administration of a carbon tax requires appropriate planning and preparation on the part of relevant government agencies, including the ministries in charge of finance, environment and related matters, the tax administration and other agencies, specifically in creating a common understanding in administering it and ensuring that the tax system is reformed accordingly. Implementation of a carbon tax may have unintended impact to other policies, like income tax, VAT, excise tax and transfer pricing. The implementation of a carbon tax requires constant monitoring and review by all parties to simplify the administration of the tax and increase compliance. To ensure the successful implementation of a carbon tax, it is essential to establish a well-defined strategy that includes developing knowledge, skills and capacity to not only implement and administer the tax but also to equip taxpayers with the requisite knowledge designed to encourage voluntary compliance.

Ultimately, a national tax system aiming to drive the energy transition should not only focus on the substantive elements of the tax itself but also strive to bolster the administrative and institutional frameworks supporting it. This will ensure a more seamless, effective, and accountable implementation of measures designed to promote sustainable energy use and reduce carbon emissions.

ANNEX – CASE STUDIES

Introduction

Four countries were chosen for case studies, each representing a group of broadly similar developing countries as follows:

- Chile – a South American country with no fossil fuel production but with mining for rare earth mineral resources needed in the energy transition;
- Ghana – an African country with both fossil fuel production and significant mining industries;
- Indonesia – a very populous East Asian country with historically important fossil fuel industries and rare earth mineral resources; and
- Jamacia – a Caribbean Island dependent on energy imports.

It is to be expected that policymakers will have particular regard to the experience of whichever case study country has the closest profile to their own. However, some common themes emerge:

- None of the countries has any tax incentives to accelerate decommissioning of fossil fuel production;
- Support for renewables is mainly through indirect tax reliefs for capital investment & imports;
- Consumer subsidies for burning fossil fuels are prevalent;
- Carbon credit/offset mechanisms are still at the experimental stage; and
- Administrative capacity needs strengthening to cope with change.

These themes and other ideas from the case study countries are summarized in the Practical Considerations box on Page 5.

The detailed submissions in respect of each of the four case study countries are available as a separate annex.

A. CHILE

A.1 Background on Chile

A.1.1 Relevant economic data

Chile has a GDP of USD 16,265.1 per capita and according to the IMF 2023 projections, a contraction of up to 1.5% is expected, being the only country in Latin America and the Caribbean that will have a decrease in its activity.

Biggest Industrial Consumers

Pursuant to the Energy National Balance Report issued by the Ministry of Energy in 2020, the main industrial consumers of energy were: i) mining, particularly copper mining; ii) paper and cellulose; iii) agroindustry; iv) other industries; and v) steelmaking.

Sources Of Revenue That Finance the Government's Budget

The mains sources of revenue that finance the government's budget are: i) taxpayers (8.7% of the GDP; ii) private mining, particularly, copper (1.6% of the GDP), iii) VAT (9.6% of the GDP); iv) taxes on specific products such as tobacco and cigarettes, combustibles and others (1.0% of the GDP), v) taxes to international commerce (0.2% of the GDP); and vi) others.

Incomes arising from taxes amount to a 21.4% of the GDP.

Population Size

Based on the last national survey (2017), Chile has a population of 17,574,003 people, of which 8,601,989 are men and 8,972,014 are women.

Nationally Determined Contributions Under the Paris Agreement

Chile has established climate change as a priority issue in its agenda. In June 2022, Law No. 21,455 on Climate Change Framework was enacted, being its main objective to achieve neutrality of greenhouse gases no later than 2050.

In 2020, Chile presented its Nationally Determined Contributions (NDC) and following the Glasgow Pact in 2022, it presented an annex to strengthen the NDC in the following terms:

Methane gas emission reduction under the Global Methane Pledge. In 2021, Chile signed the Global Methane Pledge adopted at COP26, which seeks to reduce global anthropocentric methane emissions in all sectors, at least 30% below 2020 levels by 2030. Chile commits to reversing the growing trend of national methane emissions by 2025 (without LULUCF). Chile has committed to strengthening the implementation of measures in relevant sources at a national level and will guide the work for the next update of the NDC.

(1) Fair socio-ecological transition. Seeks to maximize climate commitments and the 2030 agenda for Sustainable Development and Sustainable Development Goals. Chile has established that the Fair Socio-ecological Transition should be understood as follows: "A process that, through social dialogue and collective empowerment, seeks to transform society into a resilient and equitable one that can cope with to the social, ecological and climatic crisis". An Inter-Ministerial Committee for Fair Socio-ecological Transition has been created, being an advisory committee to the President of the Republic.

(2) Enactment of Law No. 21,455 on Climate Change Framework: This law establishes the foundations of governance, institutions, instruments and procedures to face the challenges

imposed by the climate change. It is part of Chile's commitment to face the challenges of climate change, being its main objectives to move towards low-emission development until reaching and maintaining carbon neutrality by 2050 at the latest, reducing vulnerability and increasing resilience to the adverse effects of climate change, and complying with international commitments adopted on this matter. The law recognizes the 2050 Long-term Climate Strategy as the instrument, which, in accordance with the Paris Agreement, will guide Chile in a transversal and integrated manner in meeting the objectives of the law in accordance with the commitments established in the NDC.

(3) Long-term climate strategy adding conservation and protected areas. The strategy is centered in three main elements: i) Transition of the productive sectors; ii) Human settlements and life in communities; and iii) Ecosystem functions and nature-based solutions (NbS).

(4) The biggest transformations to comply with the carbon neutrality goals of the NDC must occur around the energy, silvo-agricultural, transport, circular economy, and mining sectors. In the energy sector, the main transformations identified are the conversion of coal thermoelectric generating units, the reduction of energy intensity and the increase in the use of zero emission fuels. In the transport sector, the goal is to reach zero emission in vehicles, urban public transport, and mining transport fleets, among others; while in the mining sector, the goal is the reduction of operational emissions and the use of energy from 100% renewable sources. Lastly, in the silvo-agricultural sector, progress must be made in the reduction of slurry emissions, efficient use of fertilizers, agricultural production strategies focused on climate change mitigation and the route to carbon neutrality of cattle farming.

A.2 Current energy mix

A.2.2 What is the current total energy use and energy mix?

In Chile's primary energy matrix, fossil resources predominate representing 68% of the total, which include the sum of crude oil (30%), mineral coal (22%) and natural gas (16%). With less participation follow biomass energy (23%), energy coming from hydrological source (5%), solar (2%) and wind (1%).

Final energy consumption (represented by the secondary energy matrix) reached 301,629 Tcal in 2019, being those derived from oil and electricity the main components, concentrating 58% and 22% respectively.

Of the total installed capacity in the National Electric System (SEN), 53.3% corresponds to generation based on renewable resources, that is, hydroelectric, solar photovoltaic, biomass or geothermal origin. The other 46.7% corresponds to natural gas, coal or oil-derived thermoelectric plants.

It is interesting to note that as of July 2021, the annual electricity production reached 47,127 GWh, of which 19,383 GWh corresponded to Non-Conventional Renewable Energies consisting of mini-hydro, photovoltaic, wind and biomass energies.

Energy is responsible for 77% of the country's greenhouse gas emissions.

Locally Produced Vs. Imported Energy. What Is the Currently Existing Energy Import/Export Possibilities Of The Country To Influence The Mix?

Chile mainly imports combustibles from abroad rather than exporting these. In 2022, Chile imported 3,313.218 tons of carbon, 3,179.515 of oil and 1,160.720 tons of natural gas. On the contrary, it exported 2.119 tons of carbon while no oil nor natural gas.[58]

[58] (http://energiaabierta.cl/visualizaciones/importaciones-y-exportaciones/)

With regards to other types of energies, such as electricity, Chile has energy import and export agreements with Argentina, which allows it to secure energy supply and reduce carbon emissions. This exchange is done in a bidirectional line. It consists of a 345 kV transmission line that extends for 409 km. With this agreement, during the day it will be possible to export up to 80 MW from Chile to Argentina. During the night, up to 200 MW can be imported to Chile.

Due to Chile's natural climate conditions, it has high possibilities to become a world pioneer in the export of renewable energies, particularly with regards to green hydrogen. Currently, there are 42 potential projects being evaluate by investors.

A.2.3 What supply security constraints exist?

In Chile, Law No. 20,018 on General Electric Services define the quality of supply as the component of the quality of service that allows qualifying the supply delivered by the different agents of the electrical system and which is characterized, among others, by the frequency, depth and duration of supply interruptions.

In the case of fuels (liquid, gaseous and solid) it has sectoral and specific laws that ensure environmental quality, for example, sulfur content, safety, flash point, and operation, viscosity.

This is a highly technical area highly regulated by the Superintendence of Electricity and Combustibles.

Links to data sets / indicate institutions that offer insights into the energy demand and supply patterns. (Fluctuation in demand: energy demand tends to fluctuate over day and how it changes during different times of the year.

The National Energy Commission, the Ministry of Energy and the Superintendence of Energy and Combustibles offer insights on energy consumption in Chile, demand and supply patterns.

Links:

- https://www.cne.cl/estadisticas/hidrocarburo/
- https://www.cne.cl/normativas/electrica/consulta-publica/electricidad/
- https://www.cne.cl/nuestros-servicios/reportes/
- https://energia.gob.cl/
- http://www.sec.cl/home-mundo-energetico/

A.2.4 Current extractive industry trends and renewables potential

Chile is a highly extractive country, particularly centered on mining industry, which represents at least 15% of the national GDP. Its main extractives industries are: i) mining, ii) agriculture; and iii) fishing; which are in constant growth rather than shrinking.

Currently 66% of energy consumption comes from fossil fuels according to the Chilean Ministry of Energy.

Chile established the National Energy Policy that is reviewed every 5 years and its purpose is to project the country's energy demand and supply for different future scenarios, in a horizon of at least 30 years, so that they are considered in the process of planning of electrical transmission systems.

The foregoing is fostered by the strong development that renewable energies have had in our country, especially solar and wind.

Below is a projection of increasingly renewable energy development.

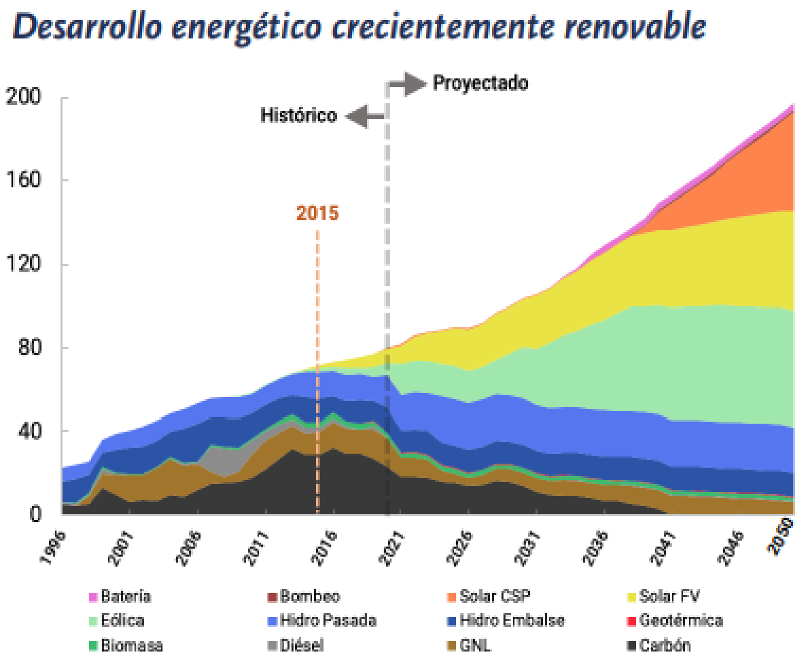


Figura 1. Generación eléctrica por tipo de fuente [TWh], 1996-2050.

Fuente: Comisión Nacional de Energía de Chile y proyecciones del Informe preliminar de la Planificación Energética de Largo Plazo (PELP).

The sector's Energy Policy has established the following goals:

i. 100% zero emission energy by 2050 in electricity generation and 80% in renewable energy by 2023.

ii. 60% less annual greenhouse gas emissions in the energy sector by 2050 (It will allow reaching carbon neutrality before 2050).

iii. 70% reduction in pollution by particulate matter 2.5 for heating by the year 2050 in relation to the year 2018.

iv. Carbon price of at least USD 35 per ton of CO2 equivalent by the year 2030.

v. 100% dry firewood in all urban centers by 2030.

vi. 100% of new buildings, residential and non-residential, to be "zero net energy consumption".

vii. 100% of the sales of new lightweight and mediumweight vehicles and the new incorporation of urban public transport, should be zero emissions by the year 2035.

viii. 100% access to electricity for all homes by 2030 and by 2040 low-emission clean energy to meet heating, hot water and cooking needs.

Chile is fortunate to have unmatched renewable energy resources for the production of zero-emission energy and this is evidenced in the progress in participation in the electrical system that went from 42% to 55% in 2020. On the other hand, we find the non-conventional energies, whose participation went from 8% to 20% in 2020, that is, the goal proposed by Chile was brought forward by 5 years to achieve said objective.

Below is a projection of electricity generation:

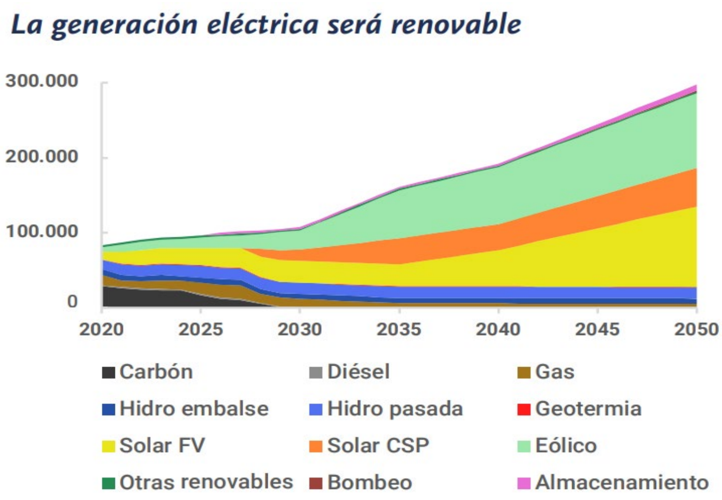


Figura 10. Proyección de generación eléctrica por tipo de fuente [GWh].
Fuente: Informe preliminar de la Planificación Energética de Largo Plazo (PELP), resultados escenario Acelerando la Transición Energética. Ver especificaciones en Anexo IV

A.3 Country's existing fiscal policies

A.3.1. Environmental taxes

Chile has several environmental taxes in force.

(i) *Green tax on polluting emissions:* Law No. 20,780 introduced a tax on pollutant emissions from emission sources and a specific tax on CO2 emissions from thermal sources. It consists of an annual tax established for fiscal benefit that will tax the air emissions of particulate matter (PM), nitrogen oxides (NOx), sulfur dioxide (SO2) and carbon dioxide (CO2), produced by establishments whose emission sources, individually or together, emit 100 or more tons of particulate matter (PM) per year, or 25,000 or more tons of carbon dioxide (CO2) per year.

A flat rate of US$5 per ton of CO2 is applied to CO2 emissions from facilities whose total thermal power capacity of boilers and turbines is at least 50 MWt, while PM, NOx and SO2 have a different formula for rate calculation.

Excluded from the application of this tax are emissions associated with hot water boilers used in services exclusively linked to personnel and generator sets with a power of less than 500 kWt. Likewise, the tax on CO2 emissions will not apply to emission sources that operate based on non-conventional renewable generation means whose primary energy source is biomass energy.

This tax is intended for companies to try to reduce their tax burden through process improvement, fuel change or technological innovation. In this way, it encourages the reduction of polluting atmospheric emissions.

Taxpayers subject to this tax may compensate all or part of their taxable emissions, for purposes of determining the amount of tax to pay, through the implementation of projects of reduction of emissions of the same pollutant. This implementation of this compensation mechanism is subject to the issuance of a regulation by the Ministry of the Environment; regulation which has been approved by the Ministry's Committee but is under process of being reviewed its legality by the General Comptroller of the Republic.

Likewise, taxpayers subject to the tax on polluting emissions may offset all or part of their taxed emissions, for purposes of determining the amount of tax to be paid, through the implementation of projects to reduce emissions of the same pollutant, subject to such reductions are additional, measurable, verifiable and permanent. In any case, the reductions must be additional to the obligations imposed by prevention or decontamination plans, emission standards, environmental qualification resolutions or any other legal obligation.

Likewise, these costs may be deducted as necessary expenses incurred to produce the income pursuant to article 31, number 13) of Law on Income that is, the expenses or disbursements incurred due to environmental requirements, measures or conditions imposed for the execution of a project or activity, contained in the resolution issued by the competent authority that approves said project or activity in accordance with current environmental legislation. The following may also be deducted: a) The expenses or disbursements in which the holder incurs due to environmental commitments included in the study or in the environmental impact statement, with respect to a project or activity that counts or should count, in accordance with the legislation in force on the environment, with a resolution issued by the competent authority that approves said project or activity and b) the expenses or disbursements made in favor of the community and that suppose a permanent benefit, such as expenses associated with the construction of works or infrastructures for community use, their equipment or improvement, the financing of specific educational or cultural projects and other contributions of a similar nature. Both must be stated in an agreement with a national entity.

Additionally, expenses incurred in compliance with the public-private alliance (Alianza de Producción Limpia "Certificado Azul"), referred to in article 10 of Law No. 20,416, and whose purpose is the sustainable use of water resources by companies, can be considered as necessary to produce income.

(ii) *Mining tax:* The income generated by the mining activity obtained by a mining operator are subject to a mining tax pursuant to certain tax rates, such as the mining royalty.

(iii) *Water license:* It is a tax license that must be paid by the owner of a water right that has not been used in whole or in part, or in its absence, when the works for the collection or restitution of the water ordered have not been carried out pursuant to law.

(iv) *Water tax:* The sale of water as well as its supply on a permanent, regular or continuous basis, in certain places where the consumer resides, is taxed with value added tax. The supply of drinking water made by a Rural Drinking Water Committee constituted as a functional community organization, which acquires or captures the water, to distribute it to its associates, which as a general rule is taxed because it is a commercial benefit, it will not be subject to tax, as long as the supply is made to them at cost price without adding any value, since it is understood that under these circumstances the aforementioned institutions act as final consumers, when acquiring the water without resale. Services that are directly related to agricultural activities, such as, those related to cooperative activity in their relations between cooperatives and cooperatives", are not taxed with VAT.

(v) *Fuel tax:* Law No. 18,502 of 1986, Taxes on Fuels, established a specific tax on vehicular consumption of certain fuels: automotive gasoline, oil diesel, compressed natural gas and liquefied petroleum gas for vehicle consumption. This specific tax is accrued at the time of the first sale or importation made by the distributor of these fuels to the seller of these (that who has the authorization of fuel facilities from the Superintendence of Electricity and Fuels). This tax must be declared and paid by the distributor within the first 10 business days following the week in which the transfers were made.

This is a specific tax based on a fixed and variable base component.

(vi) *Tobacco tax:* The consumption of tobacco in different ways is subject to a tax.

(vii) *Green tax on new vehicles:* The purchase of all new vehicles, light and medium, is subject to a one-time tax, with the aim of encouraging the use of less polluting vehicles. Certain vehicles are exempted from this tax (ie taxis, vehicles with more than 9 seats, police cars). The tax rate is subject to a formula according to its urban performance and its nitrogen oxide (NOx) emissions.

A.3.2 Current carbon price, if any, and scope

In Chile there is no fixed carbon price; it is determined based on the demand of the market.

Nevertheless, within the framework of the Partnership Market Readiness of the World Bank, Chile is part of the Project Price to Carbon Chile, an opportunity to support national efforts in terms of mitigation and strengthening of regulatory and institutional capacities for the implementation of green taxes and the design and implementation of a Monitoring, Reporting and Verification (MRV) process. Its main objective is to assess options and scenarios for the implementation of a more comprehensive system of carbon pricing instruments in Chile in the future, through a transparent process of consultation and participation.

Fossil Fuel Subsides and Decommissioning: In Chile there are no subsidies to fossil fuels. Likewise, there are no rules for decommissioning fossil fuel production. Nevertheless, there is a draft bill being discussed at the Senate which prohibits as of January 1st, 2030, the injection to the National Electric System of energy produced by fossil fuels.

A.4 Country's planned fiscal policies

The main energy transition plan is the National Energy Policy that is reviewed every 5 years and its purpose is to project the country's energy demand and supply for different future scenarios, in a horizon of at least 30 years, so that they are considered in the process of planning of electrical transmission systems.

Likewise, as mentioned above, there is a draft bill being discussed at the Senate which prohibits as of January 1st, 2030, the injection to the National Electric System of energy produced by fossil fuels. Additionally, there are governmental plans to promote energy transition and promotion of renewables, particularly hydrogen, through the National Strategy on Green Hydrogen published in 2020. This Strategy seeks to seize the opportunity to produce and export H2V and its derivatives, including ammonia, methanol, and synthetic fuels. One of its main objectives is to produce the cheapest green hydrogen in the planet by 2030 (less than 1,5 USD/kg).

A.4.1 Proposed/target carbon price, if any, and scope

According to National Energy Policy, a carbon price of at least USD 35 per ton of C02 by 2030 and by 2050 at between USD 50 and USD 80 per ton of C02. (https://4echile.cl/wp-content/uploads/2021/04/5.-Options-for-a-mix-of-carbon-pricing.pdf.)

As Chile is part of the Project Price to Carbon Chile, the Ministry of Energy and other public entities are focused on developing and implementing these matters.

A.5 Country's approach to carbon credits/offsets

The commercialization of carbon credits coming from national forests is a market little known in practice in Chile. On November 4, 2003, the North American foundation The Nature Conservancy (TNC) bought the Valdivian Coastal Reserve (RCV) in a public auction of the bankruptcy of Bosques S.A. TNC's strategy was the development of the RCV project of 50,251 hectares, whose focus was the capture of more than 800 tons of CO_2 per hectare. Likewise, it was avoided, that product of the deforestation due to industrial activity, more than 350,000 tons of CO_2 were emitted into the atmosphere.

After 10 years, the TNC symbolically delivered the first REDD+ carbon credit to CONAF (Reduced Emissions from Deforestation and Forest Degradation). The following year they sold the first carbon credits to Cheeseman's Ecology Safaris through the company Carbon Tree Conservation Fund. Other sales have continued to be made, and the income obtained has been invested in RCV conservation projects.

Nevertheless, there is no national participation on a carbon credits scheme.

Likewise, Chile has a strong commitment to climate action, environmental protection and sustainable growth. This commitment is reflected in the fact that, in 2019, Chile was the first country in America to issue sovereign green bonds in dollars and euros for a total of US$2,377 million.

The bond in dollars was issued for an amount of US$1,418 million and achieved a historically low interest rate of 3.53%, while the bond in euro achieved the lowest interest rate in history obtained by the country in that currency (0.83%) with a significant demand from investors specialized in green bonds; achieving an initial demand of 4,015 million euros, 4.7 times the amount offered.

The net proceeds from the bonds will be used exclusively to finance and refinance, in whole or in part, public projects corresponding to six eligible categories of Green Sectors, for example, clean transportation, renewable energy, water management and green buildings.

Likewise, Chile has in force a Green Bond Framework which was issued by the Ministry of Finance and has been certified by the Climate Bonds Initiative and verified by Vigeo Eíris agency.

The Chilean Public Debt Office has received various awards and recognitions for specific transactions: i) Green Finance, The Banker, 2019; ii) Green Bond of the Year-Sovereign, Environmental Finance Bond Award 2019; iii) Financing, Netexplo Smart Cities Accelerator UNESCO 2019; iv) Sovereign Issuer of the Year, Latin Finance Awards 2019; v) Best Public Debt Office/Sovereign Debt Management Office in Latin America, GlobalMarkets Awards 2019; vi) Green Bond of the Year for Latin America, GlobalCapital Sustainable and Responsible Capital Markets Awards 2019.

A. 6 Country's administrative capacity

In the last decades Chile has developed high administrative capacity to cope with changes in tax legislation, audit and dispute resolution related to environmental aspects.

In 2010, Law No. 20,417 was enacted and created three relevant institutions:

i. The Ministry of Environment which has a specific department of socio-ecological transition and a division on climate change. The latter division consists of the following departments: i) Climate Mitigation and Transparency; ii) Climate Change Adaptation; iii) Climate Finance and Means of Implementation and iv) Ozone Department.
ii. The Environmental Assessment Service, public organism dedicated to managing the System of Assessment of Environmental Impact, which is an preventive instrument of environmental management that allows the authority to determine, before the execution of a project, if it complies with the in force environmental legislations and its potential significant environmental effects.

iii. The Environmental Superintendence: public entity exclusively dedicated to executing, organizing and coordinating the monitoring and oversight of the Environmental Qualification

Resolutions, measures of the Prevention and/or Environmental Decontamination Plans, including the fulfillment of any other environmental measure to be implemented.

Likewise, in 2012, Law No. 20,600 created the environmental courts, which are specialized jurisdictional organs, whose aim is to resolve environmental controversies.

With regards to tax matters, in 2010 tax and custom courts were created to solve controversies arising by taxpayers against the Internal Revenue Service and the Customs Service.

The Electricity and Combustible Superintendence is the entity dedicate to oversight and monitor all matters related to the energy market.

Lastly, Law No. 21,455 on Climate Change Framework in 2022, established the incorporation of a Ministry's Council for Sustainability and Climate Change, who will issue opinions on different national plans.

B. GHANA

B.1 Background on Ghana

B.1.1 Political environment

Ghana is a unitary state and governed a constitution, the 1992 Constitution. The country has maintained a stable political environment since 1992 and has made appreciable progress in institutionalizing a multiparty democratic governance within the framework of the 1992 Constitution. The 1992 constitution shares the power of governance amongst the executive, the legislature, and the judiciary. Since 1992, there have been smooth transitions of power from one democratically elected government to the other without any challenge.

B.1.2 Relevant economic data

The Ghanaian economy recovered from the slowdown in 2020 due to the COVID-19 pandemic, from a reported real GDP growth of 0.5% in 2020 to 5.4% in 2021. Real GDP growth in 2022 is expected to contract to 3.7% due to several endogenous and exogenous factors including the Russia-Ukraine war and debt overhung. This is expected to decline further to 2.8% in 2023 because of the anticipated global recession. However, the IMF deal is expected to enhance policy credibility and expected to stimulate growth in the medium to long term. Consequently, the Ministry of Finance forecasts an overall average growth in the medium term (i.e., 2023 – 2026) to be around 4.3%.

Populations size: The population of the Country stood at 30.83 million in 2021. Besides residential customers, industries are the main consumers of electricity in the country.

B.2 Current energy mix

B.2.1 What is the current total energy use and energy mix?

Hydro generation, as well as thermal generation fueled by crude oil, natural gas, and diesel, continue to be the main sources of Ghana's power supply. Ghana also exports power to Togo, Benin, and Burkina Faso. Ongoing grid expansions, which include the completion of transmission lines and Bulk Supply Points (BSPs) across the nation, will allow further exports to other neighboring countries in the sub-region. The total installed capacity for existing plants in Ghana is 5,134 Megawatt (MW), with a dependable capacity of 4,710 MW consisting of Hydro 38%, Thermal 61% and Solar less than 1%. Nearly 5,750 gigawatt hours of electricity were consumed by industry in Ghana in 2021, this is an increment of about 5% on prior year.

Ghana published a Renewable Energy Master Plan in 2019 with the aim to achieve the following by 2030: increase the proportion of renewable energy in the national energy generation mix from 42.5 MW in 2015 to 1,363.63 MW (with grid-connected systems totaling 1,094.63 MW); reduce dependence on biomass as the main fuel for thermal energy applications; provide renewable energy-based decentralized electrification options in 1,000 off-grid communities; and promote local content and local manufacturing and assembly in the renewable energy industry.

Nationally determined contributions under the Paris Agreement

In line with Article 4 of the Paris Agreement and UNFCCC decisions, Ghana has updated its nationally determined contribution under the Paris Agreement from 2020 to 2030, considering its unique circumstances. The update affirms the country's resolve to address the impacts of climate change on the country's economy and its vulnerable people. The update covers 19 policy areas and translates into 47 adaptation and mitigation programs of action. The 47 climate actions are expected to build the resilience of over 38 million people, generate absolute greenhouse gas emission reductions of 64Mt CO2.

Ghana requires between US$ 9.3 billion and US$ 15.5 billion of investment to implement the 47 nationally determined contribution measures from 2020 to 2030. US$ 3.9 billion would be required to implement the 16 unconditional programs of action till 2030. The remaining US$ 5.4 billion for the 31 conditional programs of action would be mobilized from the public, international, and private sector sources, and carbon markets. Ghana will need an additional

US$ 3 million biennially to support coordination actions and the regular international reporting of the nationally determined contribution.

B.2.2 The extractive sector

Ghana remains Africa's largest gold producer alongside South Africa. Gold is the most commercially exploited mineral in Ghana, accounting for about 95% of country's mineral revenue. Other commercially exploited minerals are manganese, bauxite, and diamonds. Ghana is already working with international partners for lithium mining and processing, and significant progress has been made in this regard. Ghana's gold output will accelerate in 2022, underpinned by a strong project pipeline. Production growth will hold steady thereafter due to high prices and continued exploratory investment, while the potential beginning of large-scale production in northern Ghana represents an upside risk.

Fitch expects Ghana’s oil production to peak in 2027, driven by Tullow Oil’s multi-year, multi-well drilling campaign at its Jubilee and Tweneboa-Enyenra-Ntomme fields. A final investment decision is still expected for development of the 110,000b/d Pecan field, which would be important for Ghana to maintain oil production through the long term.

B.3 Country’s existing fiscal policies

There are numerous incentives for the promotion and development of renewable energy.

i. There are duty and VAT exemptions enjoyed by participators within the renewable energy industry. All solar panels imported into Ghana are exempt from VAT and industrial or energy plant, machinery or equipment are exempt from import duty. Additionally, all off-grid solar system components are VAT exempt as well.
ii. The government has established a renewable energy fund that provides financial resources for the promotion, development, management, and utilization of renewable energy sources. Businesses registered with Ghana Investment Promotion Centre to provide renewable energy receive benefits such as tax incentives, protection against nationalization or expropriation among others.
iii. The Renewable Energy Act 2011 (Act 832) as amended by Act 1045 in 2020 provides the legal framework for the transition of renewable energy in Ghana
iv. Sections 70 and Section 80 and of the Income Tax Act 2015 (Act 896) provide those contributions to approved Decommissioning Fund and approved Rehabilitation Funds are exempt from tax. However, any surplus in the account that remains shall be taxed at the applicable CIT rate.

B.4 Country’s planned fiscal policies

Ghana published a Renewable Energy Master Plan in 2019 with the aim to achieve the following by 2030:

i. Increase the proportion of renewable energy in the national energy generation mix from 42.5 MW in 2015 to 1,363.63 MW (with grid-connected systems totaling 1,094.63 MW)
ii. Reduce dependence on biomass as the main fuel for thermal energy applications.
iii. Provide renewable energy-based decentralized electrification options in 1,000 off-grid communities
iv. Promote local content and local manufacturing and assembly in the renewable energy industry.

v. The Government of Ghana projects that there is the need to procure an additional generation capacity of 225 MW by January 2024 and an additional 200 MW by January 2025 to preserve the security of supply in Ghana. There is a stated desire to add more renewable sources such as by harnessing wind power on the coast and establishing solar parks in appropriate areas.

vi. The government is developing incentives to attract manufacturers, assemblers, and other operators in this subsector. The recently published Renewable Energy Master Plan proposes incentives for renewable energy manufacturing and assembling firms including substantial tax reduction; exemption of materials, components, equipment, and machinery that cannot be obtained locally for manufacturing or assembling, from import duty and VAT up to the year 2025; and exemption from import duty on plants and plant parts for generating electricity from renewable energy sources.

B.5 Country's approach to carbon credits/offsets

In July 2019, Ghana signed a landmark agreement with the World Bank that rewards community efforts to reduce carbon emissions from deforestation and forest degradation. The five-year Emission Reductions Payment Agreement with the Forest Carbon Partnership Facility Carbon Fund commits the latter to making initial results-based payments for reductions of 10 million tons of CO2 emissions (up to US$50 million) by the former.

B.6 Country's administrative capacity

The Environmental Protection Agency (EPA) is the main institution responsible for the technical coordination of the implementation of climate change projects and programs

National Development Planning Commission (NDPC) is the state planning agency and responsible for ensuring that climate change issues are integrated into the national planning process; and for coordinating the preparation of sectoral and annual national progress reports, which cover climate change-related issues.

C. INDONESIA

C.1 Background on Indonesia

C.1.1 Relevant economic data (GDP, expected growth/shrinkage)

According to the Indonesian Central Bureau of Statistics ("BPS"), Indonesia's GDP is at IDR 5,091.2 trillion or equivalent to USD 326 Bn. (at the current exchange rate of approx. IDR 15,600/USD 1 as of 22 December 2022). The growth per quarter is at 3% average, with the highest at 7% in Q3 2021.

Biggest industrial consumers

According to the infographic below by BPS, the largest industrial consumer based on GDP is on transportation and storage.

Sources of revenues that fund the Government's budget

Government revenue is mainly from Domestic Tax revenue, which consists of Withholding Tax, Value Added Tax, Land and Building Tax and customs.

Size of population: Indonesia's population is at 268 million, in which 50.76 percent of the population is under the age of 30

Nationally determined contributions under the Paris Agreement

Indonesia's nationally determined contribution (NDC) was submitted in in 2016, where under the Paris Climate Agreement, the country has pledged to reduce its carbon emissions by between 29% (unconditional) and 41% (conditional) by 2030. Its most recent submission called the Enhanced NDC, released in September 2022, further increases its ambition with a reduction target of 31.89% (unconditional) and 43.2% (conditional) by 2030 to align with its Long-Term Low Carbon and Climate Resilience Strategy (LTS-LCCR) 2050 with a target to achieve net-zero emission by 2060 or sooner (GoI, 2022).

C.2 Current energy mix

C.2.1 What is the current total energy use and energy mix?

The country's energy mix is dominated by fossil fuels – their share in total primary energy supply remained around 86% between 2009 and 2020. According to the Indonesian Ministry of Energy and Mineral Resources ("ESDM"), the current energy mix in Indonesia consist of Oil at 32%, Gas at 19%, Coal at 38% and renewable energy at 11%.

To meet this rising energy demand, Indonesia would either utilise more of its domestic coal resources, while also turning to international oil and gas markets to import energy from overseas; or pursue the huge untapped potential of renewable sources that can provide local and affordable solutions to fossil fuels.

Supply security constraints: According to ASEAN, Member States adopted more than 50 measures favourable to investment in 2020, as compared with 29 in 2018 and 27 in 2019. Many business and investment measures related to the pandemic were offered to support investors. They were mostly investment facilitation and promotion measures to support, attract and retain investment. These measures granted investment incentives; simplified procedures; reduced business costs; extended deadlines for tax, duties and utility payments; and offered special assistance to help investors. Member States introduced series of national stimulus packages. They also cooperated, agreeing not to impose export restrictions and to facilitate the smooth flow of supply chains and sourcing in the region, particularly on essential goods. This was crucial, as much of FDI in ASEAN is connected to global value chain (GVC) activities or regional production networks that involve intra- and inter-firm linkages.

C.2.2 Current extractive industry trends and renewables potential

Indonesia's extractive industry activities are divided into two main stages, namely upstream and downstream activities. Upstream activities relate to exploration activities and production operations of natural resources. Meanwhile, downstream activities are activities related to processing, refining, transporting, and selling natural resources.

Mining extractives

Mining in Indonesia is also an integral part of extractive industry activities. According to the Mineral Law, mining activities consists of general survey, exploration, feasibility study, construction, mining, processing and/or refining or development and/or utilization, transportation and sales, as well as post-mining activities.

Decline of extractives

According to EITI, the government's revenue from oil and gas amounted to USD 6.5 billion, a 51% decline from its pre-pandemic target of USD 13.2 billion in 2020. Mining and coal revenues yielded USD 2.3 billion as of August 2020, a 35% decline compared to the previous year. Due to the significant decrease in extractive revenues flowing to the central government, subnational governments saw a sharp decline in their share of revenues from the country's Natural Resources Profit-Sharing Funds (DBH SDA).

Potential for renewables in the country

By the end of 2020, Indonesia had a total installed electricity generation capacity of 70 gigawatts (GW) connected to the grid. Coal-fired power plants accounted for half of the total installed capacity. Coal-fired power capacity has seen immense growth of nearly three times in the same period. These investments have resulted in a relatively young coal fleet, with an average age of less than 10 years. Most of these plants are sub-critical, implying lower efficiency in electricity generation. Three-quarters of the total financing for the coal-fired power plants built between 2016 and 2019 came from international sources, including from other Asian countries and China. Renewables accounted for 12% of the total installed capacity in 2020. This comprises one-half hydropower (including large power plants) and one-half other renewables. Renewable power capacity grew modestly in 2020, with a total of 165 megawatts (MW) added. Many of these additions were in the form of hydropower. Solar capacity additions were next, with a total of 30 MW (IESR, 2021a).

C.3 Country's existing fiscal policies

What environmental taxes it currently has that are relevant to the energy transition (i.e., exclude taxes on landfill, agriculture, waste, plastics etc.).

(i) *Fuel Tax*: Based on the Regional Tax Law provisions with further tariff identification based on stipulation of regional decisions. The imposition is on purchase of fuel with maximum tariff of 10%. The calculation refers to tariff x sale price of fuel before VAT.

(ii) *Sales Tax on Luxury Goods of Motor Vehicles ("PPn BM")*: Initially regulated based on the VAT and Sales Tax on Luxury Goods Law and then further clarified in the Government Regulation provisions that stipulates the imposition of this tax only one time at the manufacturer stage or at the time of importation. The tariff ranged from 0% - 95% under with higher CO2 emission will be subject to higher tariff.

(iii) *Motor Vehicle Tax*: Based on the Regional Tax Law provisions with further tariff identification based on stipulation of regional decisions. The imposition is based on ownership and/or control of motor vehicles. The calculation is determined with relative respect of road damage and/or environmental pollution due to the use of motor vehicles. Tarif ranged from 1% - 10% and will be charged on annual basis.

(iv) *Motor Vehicle Certification Tax*: Based on the Regional Tax Law provisions with further tariff identification based on stipulation of regional decisions. The imposition is based on transfer of ownership of motor vehicles. The calculation is determined by result of tariff x sales value of motor vehicle, with 20% tariff for the 1st transfer and maximum of 1% for next transfer. An incentive of 90% tariff reduction all over Indonesia and 0% tariff in Jakarta and Bali is available for electric vehicle.

(v) *Carbon Tax*: Carbon Tax is implemented through separate new instrument introduced as "Carbon Tax", separate from current available instrument at Central Government level (Excise, Income Tax, VAT, Sales Tax on Luxury Goods, or Non-Tax Revenue), or Regional Government level (Vehicle Tax and Fuel Tax). Therefore, there is no VAT charges and imposition regulated specifically. The Carbon Tax would be anticipated to be provide an indirect impact to the flow of transactional taxes. Implementing regulation is anticipated to include the carbon credit mechanism and treatments.

As a background, Presidential Regulation No. 98 of 2021 on the Implementation of Carbon Economic Value to Achieve Nationally Determined Contribution Targets and Control over Greenhouse Gas Emissions in Relation to National Development (Regulation 98/2021), which, combined with Law No. 7 of 2021 on the Harmonisation of Taxation Regulations (Law 7/2021), sets out Indonesia's carbon reduction road map (Carbon Road Map) towards net zero emissions (collectively, the Carbon Law).

The Carbon Law is based on the following key principles:

- Carbon Emissions Reduction Strategy: To achieve Indonesia's carbon output goal of net zero emissions by 2060, the carbon emissions reduction strategy sets a minimum target of a 29% - 41% reduction of Indonesia's carbon emissions by 2030
- Targeting of Priority Sectors: The Government will target carbon emission reductions from the Priority Sectors (as defined below) to cover approximately 97% of Indonesia's total target NDC carbon emission reductions.
- Development of Renewable Energy: The Government wants to synchronise the introduction of the Carbon Tax (as defined below) with the phasing out of coal, gas and biogas power plants and the introduction of new and renewable energy, such as waste-to energy, wind, solar, geothermal, and other green energy sources.

The Carbon Tax will be introduced in stages in line with the Carbon Road Map (described below) at a rate that will be no less than the market carbon price of CO2 equivalent. If the market carbon price is less than 30 rupiah per kilogram of CO2 equivalent, the carbon tax rate must be at least 30 rupiah per kilogram of CO2 equivalent.

The Carbon Law does not specify the goods and carbon producing activities to which the Carbon Tax will apply.

The Carbon Road Map requires the Carbon Tax to be implemented in the following stages:

i. 2022 to 2024: The Carbon Tax will initially be applied from 1 April 2022 (delayed to 1 July 2022) only to coal-fired power plants, with an initial rate of 30 rupiah per kilogram of CO2 equivalent and will then be subject to a carbon emission cap and tax system.
ii. 2025 onwards: The Carbon Tax will be expanded to cover all other relevant carbon producing sectors, including the other Priority Sectors, by taking into account the economic conditions, impact and scale of implementation of the Carbon Tax.

The Carbon Law creates a legal framework for trading carbon so that Indonesian entities will be able to trade carbon credits with other local and foreign entities and offset their carbon emissions against certain activities which mitigate or reduce the impact of their carbon emissions.

The Carbon Law states that the Indonesian Government will establish a carbon trading bourse and issue further regulations to facilitate carbon trading in Indonesia. Under the carbon trading framework, there is expected to be a cap-and-trade system whereby carbon producing activities (and/or entities) are allocated certain carbon emission caps (Allocated Caps) that can be traded by business entities domestically and internationally. While it is not yet clear when the carbon trading bourse will be established, Government officials have indicated that a fully operational carbon trading market will be operational by 2025, in time for the next stage of the Carbon Tax.

The carbon trading framework also provides that entities (to be further identified) without Allocated Caps may offset their carbon emissions by providing an emissions reduction statement outlining their actions to reduce and mitigate carbon emissions, and the results of those actions. We expect that these arrangements will be subject to further implementing regulations. However, in practice, this mechanism may allow relevant businesses to convert emissions reduction statements into carbon credits that can be traded on the carbon trading bourse or be linked to results-based incentive payments.

Current Carbon Price, If Any, and Scope

Since Carbon Law is still in the early stages, there are currently no regulations stipulating carbon price. Hence, Indonesia does not levy an explicit carbon price and will be stipulated in the future through implementing regulations. Fuel excise taxes, an implicit form of carbon pricing, cover 13.9% of emissions in 2021, unchanged since 2018. Fossil fuel subsidies cover 33.2% of emissions in 2021, unchanged since 2018. In 2021, fuel excise taxes amounted to EUR 1.02 on average, down by EUR 0.07 (6.4%) relative to 2018. Fossil fuel subsidies have increased to an average of EUR 6.46 per tonne of CO_2e, up 57.6% since 2018.

Fiscal Instruments with Respect to Heating/Cooling of Buildings: Not applicable in Indonesia.

Regulatory instruments that affect energy transition: Please refer to Carbon Tax above.

Fossil Fuel Subsidies & Rules for Decommissioning Fossil Fuel Production

PT Pertamina (Persero), a Government owned company, is committed to carrying out the Government's mandate in distributing subsidized fuel oil (BBM). In an effort to ensure that the distribution of subsidized fuel can be on target and on the right quota, Pertamina has implemented a new mechanism, namely by registering fuel through the subsiditepat.mypertamina.id website specifically for four-wheeled vehicles (cars).

This well-targeted subsidy is important, considering that the Government itself has made a major contribution in allocating funds of up to IDR 520 trillion for energy subsidies in 2022.

C.5 Country's planned fiscal policies

Indonesia, led by MEMR (Ministry of Energy and Mineral Resources), is developing a Net Zero Emission Roadmap for the Energy Sector with a target of 422 $MtCO_2eq$ by 2050, and 129 $MtCO_2eq$ of total energy sector emissions by 2060, focusing on intensifying renewable energy electrification in end-use sectors. In the Net Zero Emissions scenario, energy sector emissions are projected to peak in 2030 at 680 $MtCO_2eq$. The roadmap envisions a zero-emission in the power sector by 2060, while the remaining emissions are from end-used sectors, namely industry and transport.

Heating/Cooling of Buildings. Proposed/Target Carbon Price, If Any, And Scope. How Any Revenue Gap Might Be Plugged. Government Departments Involved: Not applicable in Indonesia. For Carbon Tax, please refer to the sections above.

C.6 Country's approach to carbon credits/offsets

There is no information yet on any current and prospective membership of any emissions trading scheme.

Trading Opportunities Foreseen for The Country, Such as Tree Planting: Since Carbon Law is still in the early stages, there are currently no regulations stipulating carbon price. Hence, Indonesia does not levy an explicit carbon price and will be stipulated in the future through implementing regulations.

Relevance Of Agricultural Sector: Indonesia's agriculture consists of forestry and farms, in which forestry is the dominant agricultural sector. The agricultural sector is relevant in emission reduction, in which they are targeting to improve emission reduction from 29% to 41%.

C.7 Country's administrative capacity

A*bility To Cope with Changes in Tax Legislation, Audit and Dispute Resolution*: Carbon law is Still in early stages. There are regulations related to carbon, but implementing regulations are still ongoing. Please refer to the Carbon Tax Section above.

Identification Of Government Department Responsible for Carbon Measuring and Control: According to Government Regulation No. 98/2021, the steering committee shall be formed in order to provide directives for policy and for implementing CEV instruments to achieve NDC and GHG Emission controls for development. The steering committee shall be tasked to provide directives regarding CEV policies to achieve NDC and GHG Emission control for development. The organization of the steering committee are as follows:

- Minister of Home Affairs
- Minister of Finance
- Minister of Environment and Forestry
- Minister of National Development Planning / Head of Development Planning Agency
- Minister of Energy and Mineral Resources
- Minister of Industry
- Minister of Transportation
- Minister of Public Works and Public Housing
- Minister of Agriculture
- Minister of Maritime and Fishery Affairs
- Minister of Trade
- Head of the Meteorology, Climatology and Geophysics Agency; and
- Head of the Peat and Mangrove Restoration Agency.

D. JAMAICA

D.1 Background on Jamaica

D.1.1 Relevant economic data (GDP, expected growth/shrinkage)

According to the World Bank, Jamaica's Gross Domestic Product ("GDP") for 2021 was 14.66 billion USD, up from 13.81 billion USD in 2020, which had declined from 15.83 billion USD in 2019.

Jamaica's energy statistics ("JES")

Government of Jamaica's ("GOJ") Ministry of Science, Energy and Technology May 2022 JES, indicates that Jamaica's petroleum consumption by activity for 2021 saw 34% being consumed by road and rail transportation, 30% by electricity generation, 16% by shipping, 9% by bauxite/alumina processing, 6% by cooking and lighting and 1% by other.

Sources of revenues that fund the Government of Jamaica's (GOJ) budget

GOJ data, presented in Fiscal Policy Paper FY 2022/23 Interim Report, indicates that economic growth for the first quarter of fiscal year 2022/23 was estimated at 5.7% compared to corresponding quarter for financial year 2021/23 which recorded real economic growth of 14.2%. The GOJ anticipated a year of strong growth for financial year 2022/23.

GOJ Revised Revenue Estimates 2022/2023 for the financial year ended 31st March 2023 amounts to J$826,889,079,003 from five revenue streams:

- Taxation - J$603,785,225,493
- Non-Tax Revenue - J$66,498,900,000
- Capital Revenue – J$8,529,000,000
- Grants – J$4,473,023,510
- Loan Receipts – J$143,602,930,000

Size of population: Based on World Bank data, Jamaica's total population size as of 2021 was 2,827,695. There is an ongoing national census which started in September 2022.

Nationally determined contributions under the Paris Agreement

Jamaica's National Energy Policy 2009-2030 ("JNEP 2009-2030") revised GOJ's Energy Policy Green Paper 2006-2020. JNEP 2009-2030 is expected to be durable up to 2030 and beyond, yet flexible and adaptable to meet new challenges and opportunities as they arise. Among other things, Jamaica aims to develop viable renewable energy resources, with renewables expected to represent no less than 20% of the energy mix by the end of 2023. Jamaica also aims to advance new, environmentally friendly technologies to increase energy supplies, particularly in the transport sector and encourage cleaner more efficient energy production, conversion, and use. Broadly, the Strategy Framework included in JNEP 2009-2030 addresses both supply and demand energy issues, placing priority on seven key areas:

- Security of energy supply through diversification of fuels as well as development of renewables
- Modernizing the country's energy infrastructure
- Development of renewable energy sources such as solar and hydropower
- Energy conservation and efficiency
- Development of a comprehensive governance/regulatory framework
- Enabling government ministries, departments, and agencies to be a model/leader for the rest of society in terms of energy management

- Eco-efficiency industries.

GOJ Climate Change Policy Framework for Jamaica 2015 provides that adaptation planning is the main area of focus to address the impact of climate change in Jamaica. GOJ is also committed to implementing mitigation measures such as demand side management in electricity production and using alternative energy sources such as solar, wind, hydropower and bio-fuels to produce energy.

GOJ in its "Update of Nationally Determined Contribution (NDC) of Jamaica to the United Nations Framework Convention on Climate Change (UNFCCC)" dated June 2020, provides that Jamaica has broadened its NDC's sectoral scope and the delivery of greater emission reductions, whereby it will bring emissions from the land use change and forestry sector within its NDC for the first time. By 2030, it is projected that emission reductions from these two sectors will be between 25.4% (unconditional) and 28.5% (conditional) relative to a business-as-usual scenario, which is 1.8 to 2.0 MtCO2e lower compared to the range of 1.1 to 1.5 MtCO2e in its previous NDC.

Business-as-usual emissions in 2030 in the energy sector is projected to be 8.2 MtCO2e, in the land use change and forestry sector, with total business-as-usual emissions in 2030 for sectors in the NDC projected at 7.2 MtCO2e.

D.2 Current energy mix

D.2.1 What is the current total energy use and energy mix?

The Jamaica Public Service Company Limited ("JPS") is the sole distributor of electricity in Jamaica. GOJ's Jamaica Energy Statistics, provides that up to 2019, petroleum was JPS's main source of electricity generation. However, by 2020 JPS's main source of electricity generation was natural gas, with petroleum second, followed by wind, hydropower and solar respectively, with a repeat in electricity generation ranking in 2021.

In terms of percentages, the Office of Utilities Regulation 2021-2022 Annual Report, provides that natural gas is the dominant energy source used for electricity production. This accounted for over 62% of system net generation for 2021, with renewable energy accounting for 12.4% of the electricity energy mix, which was down by 1.09% relative to the 2020 level and below the 15% target specified in the National Energy Policy. The 2021 decline in renewable energy is primarily attributable to the lower-than-expected net energy output from the interconnected wind generation facilities.

D.3 Country's existing fiscal policies

The following legislation apply in Jamaica:

i. Environmental Protection Levy ("Levy") is chargeable on both imported goods and locally manufactured goods. The levy is assessed on the importer at the point of importation and on manufacturers of local goods, at the point of sale of the manufactured goods. The levy on imported goods is at the rate of 0.5% on the cost insurance and freight (CIF) value of goods imported into Jamaica. The Levy on locally manufactured goods is at the rate of 0.5% on 75% of the selling price (excluding GCT and SCT) of locally manufactured goods. The tax is not energy sector specific.
ii. The Office of Utilities Regulation ("OUR") regulates the electricity sector in Jamaica, which includes JPS and other independent power producers. The Income Tax Act of Jamaica imposes income tax at the rate of 33 1/3% on entities regulated by the OUR
iii. Under the General Consumption Tax ("GCT") Act, 150 kilowatt hours supply of electricity services to residential customers for private and domestic use in any month is subject to GCT at the rate of 0%. GCT is payable at a rate of 15% for the supply of electricity to residential customers at residential premises for private and domestic use per month, where the

consumption exceeds 350 kilowatt hours, and commercial and industrial customers as well as on auxiliary and related fees.

iv. Also, under the GCT Act, ethanol and petroleum products are exempt from GCT, but subject to Special Consumption Tax at varying rates.

v. The GCT Act also provides that energy efficient vehicles such as hybrid motor vehicle and electric motor vehicle are subject to a tax rate of 0% on importation.

vi. Further, under the GCT Act, certain energy savings devices (solar and wind in particular) are exempt from GCT.

vii. Section 21 of the Electricity Bill provides that the Minister may by order, prescribe renewable energy targets which may include a feed in tariff set for each source of renewable energy. The electricity generated from renewable sources to be injected into the transmission lines or distributions lines must be granted access when available and shall only be denied by the system operator on the ground of technical reasons which must be communicated in writing to the licensee within 48 hours.

D.4 Country's planned fiscal policies

Jamaica Information Service ("JIS") article dated March 25, 2021, titled "Leveraging Energy from Renewable Sources Key to Creating New Jamaica indicated that the Minister of Science, Energy and Technology, indicated that leveraging the power of renewable sources for Jamaica's energy sector is a priority. The Minister indicated that Jamaica has set a target of achieving 33% of electricity generation from renewables by 2030 and 50% by 2037. By 2025, the Minister projected that Jamaica will be generating approximately 22% of electricity from renewable sources. For 2025, Jamaica is targeting 320 megawatts of solar and wind, 120 megawatts of liquefied natural gas and 74 megawatts of hydro waste energy and/or biomass. The Minister asserted that Jamaica is well on its way to developing an eclectic mobility subsector. To meet its energy's targets, the GOJ has appointed a board for the entity responsible for procuring new electricity generation capacity in accordance with the Electricity Act 2015. Fiscal policies have not yet been indicated.

In an article dated 17 September 2021, the JIS stated that then Minister of Housing, Urban Renewal, Environment and Climate Change, indicated that Jamaica will explore the possibility of entering the carbon market.

Current carbon price, if any, and scope

The OECD Pricing Greenhouse Gas Emissions country notes on Jamaica indicates that 79.6% of greenhouse gas emissions in Jamaica are subject to a positive Net Effective Carbon Rate in 2021, unchanged since 2018. Jamaica does not levy an explicit carbon price. Fuel excise taxes, an implicit form of carbon pricing covering 79.6% of emissions in 2021, remained unchanged since 2018.

D.5 Country's approach to carbon credits/offsets

The Government of Jamaica's "National Policy for the Trading of Carbon Credits 2010-2030" draft dated 13 October 2013, sets out four goals:

Goal 1: A clear, flexible legal and regulatory framework for the carbon credits trading sector that is responsive to changes in the international arena.

Goal 2: A well-developed governance and institutional framework that leads to the maximization of opportunities for carbon credits trading.

Goal 3: Diverse initiatives implemented to reduce carbon emissions and generate carbon credits through the regulatory and voluntary markets as well as contributing to the social, economic and environmental development of the country.

Goal 4: A carbon credits trading sector that attracts investment through a financial and economic system in which benefits, and risks are distributed equitably.

D.6 Country's administrative capacity

Jamaica is a small island developing economy which may require capacity building to cope with changes in tax legislation, audit and dispute resolution, depending on the magnitude of the changes.

The Ministry of Science, Energy & Technology as well as the Ministry of Finance and the Public Service, will likely be the ministries responsible for carbon measuring and control.

Case Studies: Key Features

	Chile	**Ghana**	**Indonesia**	**Jamaica**
UN Human Development Index	0.855	0.632	0.705	0.709
Fossil fuel production	No	Yes	Yes	No
Relevant minerals mining	Yes	No	Yes	No
Population over 100 million	No	No	Yes	No
Net zero target	2050	No	2060	No
Energy from fossil fuels	68%	?	86%	?
Energy from non-biomass renewables	8%	?	?	?
Carbon price target 2030 in $/tonne	35	None	?	None
Existing tax on emissions	Yes	No	No	No
Import duty exemptions for renewables	?	Yes	?	Yes
Road fuel taxes	Yes	?	No	Yes
Road fuel subsidies	No	?	Yes	?
Accelerated tax relief for decommissioning	No	No	No	NA
Carbon credits/offsets mechanism in place	No	No	No	No
Administrative capacity	Good	Low	Fair	Low