

Financial Policies to Achieve the Paris Agreement

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The Commonwealth

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The Commonwealth

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Acronyms and Abbreviations

CBAM	Carbon Border Adjustment Mechanism
CfD	Contracts for Difference (United Kingdom)
COP	Conference of the Parties
CO ₂	carbon dioxide
CSP	concentrated solar power
EU	European Union
GW	gigawatt
IFRS	International Financial Reporting Standard
IMF	International Monetary Fund
IPP	independent power producers
ktCO ₂ e	thousand tonnes of carbon dioxide equivalent
kWh	kilowatt hour
LCOE	Levelised cost of electricity
LSS	Large Scale Solar (Malaysia)
MW	megawatt
MWh	megawatt hour
NDC	Nationally Determined Contributions
NZ	New Zealand
PPA	power purchase agreement
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme (South Africa)
RM	Malaysian ringgit
SWF	sovereign wealth fund
TCFD	Task Force on Climate Related Financial Disclosure
tCO ₂ e	tonnes of carbon dioxide equivalent
UK	United Kingdom
WTO	World Trade Organization

Executive Summary

This report examines three policies – carbon taxation, renewable energy auctions and capital market policies – to reduce emissions and limit climate change.

The first part of the report discusses the main design features of a carbon tax. It argues that a well-designed carbon tax should:

- Cover most emissions, which can be achieved by the tax being levied on both the carbon content of fuels and on emissions from industrial processes.
- Be easy to administer, which can be realised by levying the tax upstream on the producers, refiners and importers of fossil fuels, and on large industrial emitters. This is because levying the tax on these relatively few, large and sophisticated taxpayers simplifies administration and audit.
- Be consistent with a just transition, which can be achieved by earmarking revenues from the carbon tax for payments to low-income households. This policy may also boost public support for carbon taxation.

The second part of the report discusses renewable energy auctions in Malaysia, the United Kingdom and South Africa. It argues that in all three cases, these auctions have significantly increased renewable electricity generation capacity and reduced its costs. In terms of the design of successful auctions, three key lessons from these case studies are:

- If the government guarantees electricity generation companies a price per kilowatt hour (kWh) of electricity generated, this reduces risk, lowers hurdle rates and contributes to lower costs over time.

- By regularly auctioning significant electricity generation capacity, the government increases regulatory certainty and this can lead to economies of scale that drive down costs.
- Maximising the benefits from clean energy also requires that policies are put in place to finance improvements to the grid and increase electricity storage.

The third part of this report examines capital market reforms to limit climate change. It argues that:

- Businesses that are at the cutting edge of the low-carbon energy transition often face constraints in access to financing. These can be ameliorated by public programmes to provide seed financing and venture capital.
- Central banks and financial regulators have an important role to play in assessing the impact of physical, transition and liability risk on the future finances of financial institutions. They also have a role in encouraging (or in some cases mandating) that companies make climate-related financial disclosures.
- Sovereign wealth funds should ensure that their investments are consistent with limiting climate change. This includes by setting high-level targets for emissions from their portfolios, investing in the clean energy transition, and engaging with high-emitting companies to ensure they have policies in place to reduce their emissions over time.

In conclusion, carbon taxation, renewable energy auctions and capital market reforms are powerful policies that can help limit climate change and achieve the Paris Agreement's goals.

Introduction

The world is committed to limiting climate change, with 195 (UNFCCC 2024) parties having ratified the Paris Agreement. This commits countries to limit climate change to well below 2 degrees Celsius and pursue efforts to limit climate change to 1.5 degrees Celsius. At the Conference of the Parties (COP) 28, countries further committed to 'deep, rapid and sustained reductions in greenhouse gas emissions' and reaffirmed their commitment to limiting climate change to 1.5 degrees Celsius (UNFCCC 2023).

There is, however, considerable evidence that the world is not currently on track to limit climate change to 1.5 degrees Celsius. Annual global greenhouse gas emissions continue to rise (IEA 2023a), forecasted emissions exceed the carbon budget consistent with limiting climate change to 1.5 degrees Celsius (UNEP 2022), and fossil fuel production, given current plans, is forecast to further increase (SEI et al. 2023).

Relative underinvestment in clean energy and overinvestment in fossil fuels are two reasons why the world is not on track to achieve the Paris Agreement's goals. It is estimated that global investment in clean energy needs to more than double from \$1.7 trillion per annum in 2023 to \$4.2 trillion per annum (IEA 2023b) in 2030 to limit climate change to 1.5 degrees Celsius. In addition, current annual investment in oil and gas is almost double the estimated amount in a scenario consistent with achieving the Paris Agreement's goals, signalling a risk of protracted fossil fuel use that may put the 1.5 degrees Celsius goal out of reach.

Market imperfections provide an economic explanation of this underinvestment in clean energy. Climate change can be viewed as 'a tragedy of the horizons', as many of the costs of climate change are incurred in the future beyond the business cycle, the political cycle and the horizons of most investors, while in contrast the costs of limiting climate are borne in the short and medium term (Carney 2015). Thus, sovereigns and markets may overinvest in carbon-intensive industries and underinvest in the low-carbon economic transition.

'A tragedy of the commons' may also result in overinvestment in carbon-intensive industries. Individuals capture the profits generated by carbon-intensive industries, but the costs of emissions are borne by humankind. Likewise, low-carbon economic transition projects generate benefits in terms of the emissions foregone, but this does not result in a direct monetary benefit for the investor. These external costs and benefits will lead to the market overinvesting in carbon-intensive industries and underinvesting in the low-carbon economic transition in the absence of corrective public policies.

Limited reporting and information on emissions may also contribute to financial flows being inconsistent with the goals of the Paris Agreement. Environmental, social and governance funds are growing, with the total assets under management of such funds nearly trebling from just over US\$200 billion in 2021 to over US\$600 billion by 2024 and, in many cases, these funds wish to make investments that are consistent with limiting climate change to 1.5 degrees Celsius (Kynge 2017). However, these funds are hampered in making such investment decisions by a lack of information on the current and likely future carbon emissions of different investments, albeit initiatives such as the Task Force on Climate Related Financial Disclosures (TCFD) and International Financial Reporting Standard (IFRS) S2 are increasing the information on carbon emissions available to investors (TCFD 2023).

These market imperfections provide an economic rationale for countries to implement public policies to lower investment in fossil fuels, increase investment in clean energy and reduce emissions. Countries' commitments to reduce emissions under the Paris Agreement and their Nationally Determined Contributions (NDC) provide a further reason for such policies.

This report examines three financial policies to reduce emissions: carbon pricing, renewable energy auctions and capital market policies. Its focuses are on how these policies have been implemented in practice and the policy decisions governments must make when designing and implementing these policies.

1. Carbon Taxation

1.1 Introduction

Carbon pricing is an often-cited policy for reducing emissions, with the leaders of the International Monetary Fund (IMF), World Bank and World Trade Organization (WTO) recently calling for a 'fair price on pollution' to cut emissions (Georgieva et al. 2023). The IMF has also called for those countries that are the largest emitters to establish a carbon price of US\$25–75 per ton of carbon depending on their level of economic development, with richer countries being expected to set a higher carbon price than poorer countries (IMF 2022).

There is also increasing empirical evidence that carbon pricing reduces emissions, with emissions in sectors covered by the European Union's (EU) Emissions Trading System having declined by over 37 per cent since 2005 (Georgieva et al 2023.). Meanwhile, a recent meta-analysis of 21 carbon pricing schemes concluded that carbon pricing caused an immediate and substantive emissions reduction for at least 17 of the jurisdictions covered by these schemes, despite the low level of prices in most instances (Bachelet et al. 2024).

The idea behind carbon pricing is simple: price carbon dioxide and so incentivise emitters to reduce emissions by transitioning to clean energy and/or reducing their energy consumption. Pricing carbon internalises the external cost of emissions and places this cost on those who are responsible for emissions and can take action to reduce them. As such, it provides an economic incentive for polluters to decide for themselves how to reduce emissions. As rationale economic actors, emitters, under carbon pricing, should reduce emissions in the lowest cost way, be that investing in new technologies or reducing energy consumption. This contrasts with the regulatory approach that mandates that polluters undertake certain actions and prohibits other actions to reduce emissions, which may result in emitters reducing emissions through actions that are not lowest cost and are economically inefficient.

Despite the benefits of carbon pricing, it has proved to be politically fraught in some jurisdictions. Australia, Canada and the United States are examples of countries where there has been political debate and a degree of controversy around

carbon pricing. In Australia, the Gillard administration introduced a carbon pricing scheme in 2012, but this proved politically contentious. It was subsequently terminated by the Abbott administration, who argued that it was causing electricity prices to increase (Crowley 2017). Canada introduced a federal carbon pricing scheme, but home heating oil was subsequently exempted from this scheme for three years due to concerns that it was making it unaffordable for some Canadians to heat their homes (Barnard 2023). In the United States, political concerns about the potential unpopularity of the federal government taxing carbon were a motivation behind the subsidy driven approach to reducing emissions taken by the Biden administration in the Inflation Reduction Act of 2022.

It is, however, important not to overstate the political constraints on carbon pricing by 'cherry picking' jurisdictions where its introduction has been stymied or reversed. This is because, while there are certainly examples of political opposition, globally carbon pricing is increasing. The World Bank (2023a), for example, reports that while a decade ago only 7 per cent of global emissions were priced, by 2023 this had risen to nearly a quarter of global emissions. There is also clearly an upward trend in the number of countries introducing carbon pricing.

The EU Carbon Border Adjustment Mechanism (CBAM), which comes into force in 2026, is further increasing demand for carbon taxation (European Commission 2023). Under this mechanism, imports of carbon-intensive goods (initially aluminium, cement, electricity, fertiliser, hydrogen, iron and steel) will be charged, but carbon taxes paid on these goods during their production will be creditable, reducing the amount paid to the EU. Countries exporting these goods to the EU then face a question: should the carbon in these goods be taxed domestically or by the EU (in which case, the EU will receive the revenue)? The United Kingdom (UK) is also committed to introducing a carbon border adjustment mechanism, which will provide a further motivation for carbon taxation in countries that export carbon-intensive goods to the UK (UK Government 2024a).

The growing demand for carbon taxation can also be seen in the number of developing countries

that are considering implementing such a policy. Botswana, Brazil, Columbia, Chile, Gabon, Indonesia, Malaysia, Morocco, Nigeria, Pakistan, Senegal, Thailand and Turkey are all considering implementing carbon pricing.¹

Carbon pricing can be implemented through carbon taxation or emissions trading schemes. Emissions trading schemes cap the total amount of emissions and allow companies with low emissions to sell their unused allowances to companies that are larger emitters. This creates a supply and demand for emissions allowances, which in turn creates a market price for emissions. The cap on emissions can be reduced over time and can be used to ensure that the total amount of emissions is within a pre-allocated carbon budget (World Bank 2023b).

A carbon tax directly sets a price on carbon. It does this by taxing carbon dioxide and carbon dioxide equivalent emissions, and/or by taxing fossil fuels according to the carbon embedded in the fuel, which will be realised when the fuel is combusted. Under a carbon tax, it is the price that is predetermined, while, in contrast, under an emissions trading scheme it is the total amount of emissions that are predetermined.

According to the IMF (Parry et al. 2022), carbon taxes are simpler to administer than emissions trading schemes. Carbon taxes are normally administered by finance ministries, and these ministries have significant experience in the design and administration of taxes. In addition, a carbon tax can, to a significant extent, use elements of a country's existing tax administration architecture. In contrast, emissions trading schemes are normally administered by environment agencies, who require new capacity to monitor downstream emissions and supervise allowance registration and trading.

Developing countries may, therefore, favour implementing carbon pricing through carbon taxes, as opposed to more complex to administer emissions trading schemes. Therefore, this report focuses on the design of carbon taxes. More specifically, it discusses the following.

- What should be taxed?
- Who should be taxed?

- How should the tax be monitored, audited and reported?
- Are rebates and exemptions from the carbon tax required?
- What policy measures can be implemented to improve the popularity of the carbon tax?
- How should the carbon price be determined?
- How have different jurisdictions taxed carbon in practice?

1.2 What should be taxed?

A key question when designing a carbon tax is what should be taxed? Here, there are two approaches. The first approach is the fuels approach. Under this approach, fossil fuels are taxed according to the carbon dioxide embedded within the fossil fuel. This carbon dioxide is emitted when the fuel is combusted. Under the fuels approach, the carbon tax is levied on the miner, refiner, processor, distributor or seller rather than on the emitter. Much of the economic burden of the tax will, however, be passed onto emitters through higher prices for fuels (Gugler et al. 2023), leading to lower energy consumption and/or a transition to clean energy. The second approach is the direct emissions approach, which involves the direct measurement (or evidence-based estimation) of emissions, with the carbon tax being levied on those emissions.

The fuels approach is often seen as administratively the simplest approach. The reasons for this are that there is no requirement for emissions to be directly measured under this approach and that most jurisdictions already have well-established systems for the reporting of fossil fuel mining, refining, importation and distribution.

Countries can implement the fuels approach either by introducing a new carbon tax or by increasing the amount of existing excise taxes on fossil fuels. It has been argued that increasing existing excise taxes on fuels is the best approach, as this is administratively the simplest as pre-existing infrastructure can be used to report on fuel production, distribution and sales, and for tax collection. Such an approach may also reduce the requirement for new primary legislation, as the rates of pre-existing excise taxes may be increased through regulations or the annual budget. In contrast, in most jurisdictions, a new carbon tax would require new primary legislation.

¹ This list only includes developing countries and does not include carbon pricing schemes that are under consideration by developed countries and/or sub-national schemes (World Bank 2023a).

Despite the benefits of implementing a carbon tax by amending excise duty rates, many jurisdictions, including British Columbia (Canada), France, Ireland, Norway and Sweden (World Bank 2023a) have in practice implemented the fuels approach through a new carbon tax rather than by increasing fuel excise rates. This may be because increasing fuel prices by increasing fuel excise duty may be unpopular. Fuel excise taxes have a long history, and they have not traditionally been presented by governments, or regarded by the public, as carbon taxes. As such, the public may regard an increase in fuel excise taxes and fuel prices as a general 'tax grab' by government and be unconvinced that these represent a carbon tax required to limit catastrophic climate change. This may, in turn, make the tax increase less popular, more political contentious and less sustainable.

Countries may also want to demonstrate that a carbon tax is not a general tax grab by committing to earmarking the revenue for cash payments to households and/or clean energy programmes. This may be easier to demonstrate and clearer to the public if the revenues being earmarked are from a specific carbon tax as opposed to being financed by a portion of fuel excise revenues. These cash transfer and clean energy programmes may also require new legislation, which undermines the argument that a benefit of implementing carbon taxation by increasing fuel excise duty is that it can be done solely through amending regulations and/or through the annual budget process.

As discussed, regardless of whether a carbon tax using the fuels approach is implemented through a new tax or by increasing fuel excise duty, it is administratively simpler than the direct emissions approach. Yet there are also disadvantages to the fuel approach, including limited emissions coverage. Globally approximately 11 per cent² of total greenhouse gas emissions are from industrial processes unrelated to fossil fuel combustion. For example, carbon dioxide is emitted from limestone during cement production and during fertiliser production, nitrous oxide is emitted. These emissions are not from fossil fuels and are therefore not priced through the fuels approach. But they could be priced through the emissions approach. The fuels approach not taxing industrial

emissions means that it does not incentivise companies to reduce industrial emissions and constrains its overall impact in limiting climate change.

The direct emissions approach is an alternative to the fuels approach. Under this approach, emitters directly measure (or undertake evidence-based estimations) of their emissions. This requires significant capacity on the part of the emitter and, thus, this tax is normally only levied on large emitters in higher emitting sectors such as manufacturing, electricity generation and waste processing.

This approach requires a new tax, that emitters record their emissions and report their tax liability, and that the government establishes a system for the auditing of emissions and tax liability. Although the recording and auditing of emissions under a direct emissions carbon tax may seem burdensome, it only affects larger emitters (as smaller emitters are not liable for the tax) like power stations and cement producers. These sophisticated taxpayers typically have the capacity to report emissions and may already do so under other regulations, making the additional requirements of the carbon tax less onerous.

The Paris Agreement also requires the recording of emissions by source. More specifically, Article 13 of the Paris Agreement establishes the enhanced transparency framework, which includes a requirement for countries to submit national inventory reports on anthropogenic emissions by source (UNFCCC 2022). This includes emissions from all sectors, including industry. Therefore, countries will increasingly have to record and report emissions from industry regardless of whether they implement a direct emissions carbon tax.

Singapore is a good example of a country that has implemented a carbon tax using the direct emissions approach. This carbon tax forms part of Singapore's comprehensive suite of mitigation measures to support the transition to a low-carbon economy. The tax is restricted to large emitters, defined as facilities that directly emit at least 25,000 tonnes of carbon dioxide equivalent (25 ktCO₂e) emissions annually (ibid.), and is levied on seven greenhouse gases, namely: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and hexafluoride (ibid.). This leads to a tax that covers approximately 80 per cent of Singapore's greenhouse gas emissions.

² Quoted figure is from author's conversation with ChatGPT, with the original source data taken from IEA (2022b).

A disadvantage of a direct emissions carbon tax is that it does not normally cover carbon dioxide emissions from transport. This is because there are many small emitters in the transport sector (such as car drivers) who fall below the emissions threshold. Requiring millions of car drivers in a jurisdiction to record their admissions and report their carbon tax liability would be administratively complex, impractical and politically unpopular.

The direct emissions carbon tax not taxing emissions from the transport sector limits its coverage and emissions reduction impact. The example of Singapore, where a direct emissions carbon tax covers 80 per cent of emissions, is not illustrative of the likely coverage in other countries, as in Singapore a relatively small proportion of emissions is from the transport sector, due partly to it having low car ownership per capita compared to other developed countries. A direct emissions carbon tax would, for example, cover a smaller percentage of emissions in the United States, partly because its transport sector accounts for 28 per cent of emissions and is the largest source of emissions (EPA 2022). High car ownership per capita and the limited role of public transport compared to many other developed countries underpin the high emissions from transport in the United States.

Countries can also increase the emissions coverage of a carbon tax by combining the direct emissions approach and the fuels approach. In this scenario, the fuels approach is used to tax emissions from fossil fuels, while large emitters also directly report their emissions and pay a direct emissions carbon tax on greenhouse gas emissions that are not from fossil fuels. This is the approach taken by the Commonwealth Carbon Tax Model Law (2023), which if implemented globally, would cover 79 per cent of emissions.

An alternative approach is to combine a carbon tax on fuels and an emissions trading scheme, with the emissions trading scheme pricing carbon from large emitters. This is the approach taken by Sweden, which levies a carbon tax on fuels and is also part of the EU emissions trading scheme (Sweden Ministry of Finance 2023). Portugal also has an emissions trading scheme (because of it being an EU member) and a carbon tax (World Bank 2023b), which collectively cover 97 per cent of its carbon emissions from energy use (OECD 2021).

In summary, a carbon tax can be implemented by taxing emissions or by taxing fuels. A fuels carbon tax is administratively simpler but cannot cover those emissions that are not from fuels. A direct emissions carbon tax is administratively more complex and can cover emissions that are not from fuels, but it is impractical to apply this approach to emissions from households and other small emitters. A fuels carbon tax and a direct emissions carbon tax can, however, be combined to ensure that the carbon tax covers emissions from both fuels and other sources.

1.3 Who should be taxed?

Under a direct emissions carbon tax, taxpayers must directly measure (or undertake evidence-based estimations of) their emissions and calculate their carbon tax liability given these emissions. This is only practicable for large emitters: it is impractical for households and small businesses to directly measure their carbon emissions. As such, a key design feature of a direct emissions carbon tax is the definition of what constitutes a 'large emitter' and who is, therefore, responsible for paying the tax.

The taxpayer will normally be the operator of a facility (or facilities) that are large emitters. Emissions are normally reported for each facility and the carbon tax is only payable on emissions from facilities that emit more than a specified amount. The emissions floor is specified in carbon dioxide equivalent emissions, as large emitters may emit a range of greenhouse gases. Singapore is a good example of a country that takes this approach, with its carbon tax being levied on facilities that emit 25 ktCO₂e or more in a year.

These large emitters are often concentrated in the power generation and manufacturing sectors, with foundries, cement producers and fertiliser manufacturers being common large emitters within the manufacturing sector.

When determining the emissions threshold for a direct emissions carbon tax, policy-makers must balance a range of competing objectives. One concern is to balance ease of administration with coverage. A very high emissions threshold for facilities paying the carbon tax will result in few taxpayers and a tax that is, all else being equal, easier to administer. However, too high a threshold will reduce the emissions coverage of the tax and reduce its ability to limit emissions. Another concern

is the extent to which certain sectors are exposed to foreign competition from countries that have not implemented carbon pricing or which have a low-carbon price, and this may be seen as a justification for excluding certain sectors from the carbon tax.

Under a carbon tax on fuels, there is a decision concerning where to levy the tax in the fuel processing chain. The tax can be principally levied upstream on miners, midstream on fossil fuel processors, refiners and importers, or downstream on distributors and sellers of fossil fuels.

A carbon tax that was levied upstream on miners of fossil fuels (including petroleum) may initially seem appealing from a tax administration perspective as there are relatively few of these taxpayers and, in nearly all jurisdictions, they must already report the amount of crude oil, gas and coal that they mine. The incidence of the tax would then be passed, through domestically traded oil, gas and coal only, on to refiners and processors through higher crude oil, gas and coal prices, and then onto consumers through higher prices for these processed fossil fuels. However, this approach is not as simple to implement as it would first appear as the carbon tax would also need to be levied on imports of refined petroleum products, gas and coal, as otherwise the tax burden on these imports would be lower than that on domestic production. A further problem with this approach is that in many countries, a significant amount of crude oil, gas and coal is exported, and the tax paid on these exports would be subject to a rebate. This rebate for exports would be required, as otherwise the carbon tax would be taxing fossil fuels that are to be combusted outside of the domestic jurisdiction. In addition, a carbon tax that is levied on fossil fuels that are exported may weigh on the price competitiveness of these exports. These complexities explain why in practice, there is no jurisdiction where a carbon tax on fuels is paid by miners and levied on crude oil, gas and coal prior to their processing/refining.

The second option is to levy the carbon tax midstream. This involves taxing refiners, gas processors, coal processors and fossil fuel importers on refined/processed fossil fuels. Much of the economic burden of the tax will then be passed onto fuel sellers and emitters through higher prices. The advantage of this approach is that in most jurisdictions, there are relatively few refiners and processors, and they tend to be large, sophisticated taxpayers with the capacity to meet

any new reporting requirement under the carbon tax. In the United Kingdom, for example, there are approximately 33 million cars, 28 million households, 8,000 petrol stations, but only 6 refineries. Similarly, in the United States, there are 276 million registered vehicles, 128 million households, 145,000 petrol stations and 129 operable petroleum refineries. These statistics indicate that a carbon tax on fuels levied midstream on refineries would have fewer taxpayers and be simpler to administer than if the tax was levied on petrol stations or households. In addition, refiners and fossil fuels processors will already have to report their production and importation of fossil fuels under existing laws and regulations. An example of a jurisdiction that levies a carbon tax 'midstream' is Sweden (World Bank 2022). The Swedish carbon tax applies to the combustion of all fossil fuels. One of the earliest carbon taxing jurisdictions in the world, Sweden imposes a carbon price of \$127.26 per metric ton and collected US\$2.173 billion in revenue in 2023.

The third option involves taxing carbon downstream. This would involve taxing fuel sellers on the amount of the fuel sold to households and businesses. This option is arguably less efficient from a tax administration perspective due to the large number of fuel sellers (for example, petrol stations).

In summary, under a carbon tax on fuels, the taxpayer is normally the operator of large emitters such as power stations or manufacturers. Under a carbon tax on fuels, there is a strong argument to levy the tax midstream on importers, refiners and processors of fossil fuels.

1.4 How should the carbon tax be monitored, audited and reported?

It is important to build a strong reporting and monitoring system for a carbon tax, both to minimise tax avoidance and to collate the data necessary to better understand the impact of the carbon tax on emissions.

A carbon tax on fuels should require that fossil fuels companies report on their production, imports and exports of different fuels and the associated carbon tax liability. It may be possible to require that taxpayers submit both a forward-looking plan forecasting future fossil fuel production, imports

and exports and a backward-looking report providing this information for the past year. Having both forecasts and actual data on the production, importation and export of fossil fuels can be useful to better understand the impact of the carbon tax on emissions.

The above reporting requirements may appear onerous. However, under a carbon tax on fuels, particularly if the tax is levied midstream, there will be a limited number of large, sophisticated taxpayers. Additionally, these taxpayers may already be required to submit the same or similar information to their regulator. In such cases, every effort should be made to build on, and harmonise, existing reporting requirements and the new carbon tax reporting requirements.

A carbon tax on emissions requires that taxpayers report their (or an evidenced-based estimation of) emissions. A requirement for both – a forward-looking report, which forecasts emissions, and a backward-looking report, which includes information on actual emissions and the associated tax liability – should be considered. The forward-looking report can also include information on changes to production processes and likely emissions reductions.

In some jurisdictions, the requirement for detailed emissions reporting may be new. In such cases, it may be necessary to set a relatively high floor for the carbon tax and emissions reporting, to ensure that only a few, large and sophisticated firms meet the new reporting requirement. In other jurisdictions, there may already be a requirement for large emitters to report their emissions; in such cases, the carbon tax should build on this pre-existing reporting system.

One policy that can also be considered is for a trial period during which large emitters have to report their emissions, but do not have a liability under the carbon tax. The carbon tax can then be charged after a few years, once the emissions reporting system has been tested and bedded in. Singapore successfully followed such a policy with its carbon tax.

It is also important that the government has appropriate powers to audit the carbon tax. Under a carbon tax on fuels, this should include both a financial audit and auditing the amount of fossil fuel production and importation that has been reported. Under a carbon tax on emissions, the government

should have the power to audit the reporting of emissions to ensure that those emissions, and the associated carbon tax liability, have not been under-reported.

The auditing of emissions can often be strengthened using expert auditors with detailed technical knowledge. This is the case under Singapore's carbon tax, whereby there is a pre-approved list of emissions auditors who are employed to audit the emissions of large emitters who are liable for the carbon tax. This approach is also followed by the Commonwealth Carbon Tax Model Law.

1.5 Are rebates and exemptions from the carbon tax required?

Under a carbon tax on fuels, it is commonly the case that taxpayers receive a rebate when they export fuels. A rebate on the carbon tax paid on exported fuels is necessary, as levying the tax on exports may make these fuels uncompetitive in foreign markets, so, reducing exports and foreign exchange earnings. In addition, under their Nationally Determined Contributions (NDC) and the Paris Agreement, countries are primarily responsible for reducing their own domestic emissions: indeed, that is the overarching goal of a carbon tax, and taxing fuels exports does not contribute to this goal.

The rebate of a carbon tax on exported fuels is consistent with World Trade Organization rules. Specifically, Article 1 of the Agreement on Subsidies and Countervailing Measures (WTO 1995) defines subsidies and includes a footnote that clarifies that a rebate does not constitute a subsidy and is, therefore, compatible with WTO rules.

There are also alternatives to offering a tax rebate on exported fuels. These include tax exemptions, credits, reliefs and suspension. For example, under a suspension model, the tax is calculated at the time it would otherwise be due (and may be included in a box in the tax return), but payment is held over or deferred for a period during which time the fuel would need to be exported. If the fuel is exported, the tax will be cancelled. If it is not exported in this time, the tax will fall due at the end of the suspension period. Where a suspension model is used, policy-makers must consider what evidence of intended export a taxpayer should provide at the time the carbon tax is suspended

and what they must then provide to satisfy the tax authority that the fuel has been exported (and therefore no tax is due).

There is also a separate issue as to whether certain trade-exposed sectors should be exempted from the carbon tax. The argument here is that some sectors may be especially vulnerable to the increased costs associated with the carbon tax. This is particularly true where opportunities to reduce emissions are limited, and where there is significant competition from imports, especially from regions that do not price carbon. These factors could impact profitability and production, making it harder for these sectors to remain competitive. In such cases, there is a risk of lower domestic production and 'carbon leakage', with production moving abroad to jurisdictions that do not price carbon and emissions being displaced as opposed to reduced.

From the perspective of tax administration, it is generally best practice to limit exemptions from the carbon tax, as exemptions may complicate tax administration. The existence of exemptions also provides a strong motivation for companies to argue that their sector is particularly vulnerable, so as to gain an exemption from the carbon tax.

The argument for exemptions is also becoming progressively weaker. As noted earlier, more and more countries are implementing carbon taxes, while in other jurisdictions, regulatory measures that may also increase the costs of production are being used to limit emissions.

Despite these arguments for limiting exemptions, it remains the case that in some jurisdictions, certain industries have successfully argued that they should be exempt from a carbon tax. For example, under South Africa's carbon tax, energy-intensive and trade-exposed industries are eligible for relief measures to mitigate the impact of the carbon tax on their competitiveness. These measures may include the free allocation of carbon tax allowances.

When designing a carbon tax, various measures short of full exemptions can be applied to specific industries to mitigate its impact on competitiveness. Once such option is for the default position to be that all industries are subject to the carbon tax, but for there to be a process for exempting industries if evidence comes to light that they are being particularly negatively affected by the tax and that domestic production is being replaced by imports that are as, or more, carbon intensive.

Another option is to introduce a carbon border adjustment mechanism with the carbon tax. Under such a mechanism, a charge is levied on carbon-intensive imports, but any carbon price paid during the production of these goods can be deducted from this charge. Such a mechanism aims to create a level playing field between imports and exports and to reduce carbon leakage by ensuring that imports pay a similar carbon price to domestically produced goods. The EU's CBAM, which will come into force in January 2026, is one recent example of such a mechanism. The UK has also recently committed to introducing a carbon border adjustment mechanism.

Another option is to provide a rebate based on an emissions-intensity benchmark for domestic industries that are particularly vulnerable to carbon leakage. Under this system, the taxpayer can claim a rebate equal to the carbon price multiplied by the emissions-intensity benchmark for the good multiplied by the units of that good that have been produced. The emissions-intensity benchmark is the industry average amount of carbon dioxide emissions from the production of that good.

The design of this rebate provides that a taxpayer (in a sector covered by the rebate) that emits more emissions per unit of production than the average will receive less from the rebate than they pay in carbon tax. In contrast, a taxpayer in the same sector that emits less than the average will receive more from the rebate than they pay in the carbon tax. Consequently, this rebate continues to provide an incentive for taxpayers to reduce emissions, while reducing the overall amount of carbon tax paid by the sector. As taxpayers reduce their emissions, average emissions will fall, and the emissions-intensity benchmark can be revised downwards. This process should continue and should lead to continuously lower emissions.

Overall, exemptions for trade-exposed sectors are sometimes employed to reduce vulnerability to competition and carbon leakage, albeit the justification for such exemptions is often weak. The introduction of measures to ensure a level playing field in the form of carbon border adjustment mechanisms and rebates based on emission intensity benchmarks can also help ease industry concerns and are more in line with the overall policy objective of reducing emissions and limiting climate change than are exemptions for certain trade exposed industries.

1.6 What policy measures can be taken to improve the popularity of a carbon tax?

As discussed earlier, the introduction of a carbon tax can be politically contentious. These political constraints have dissuaded governments in some jurisdictions, such as the United States Federal Government, from implementing carbon taxes. In other jurisdictions, carbon taxes have been introduced but certain fuels have been exempted. For example, in Canada, a three-year exemption from the carbon tax was provided for heating oil.

Political opposition to carbon taxation is arguably driven by concerns that it will increase fuel prices, undermine international competitiveness, increase the overall burden of taxation and increase income inequality.

The concern that a carbon tax may increase fuel prices is justified. Even if a carbon tax on fuels is levied upstream or midstream, it is likely to be passed onto emitters (such as car owners) through higher prices (Gugler et al. 2023). The economic literature provides evidence that the demand for fuels is price inelastic, suggesting that most of the carbon tax will be passed on in the form of higher prices (Huntington et al. 2017). In addition, higher prices for fuels are necessary to provide an economic incentive for emitters to use less energy and/or to transition to lower-emissions sources of energy, such as electric cars. If a government concludes that any increase in fuel prices is not politically palatable, then a carbon tax on fuels is probably not the correct energy transition policy for that country. In such cases, other policies to limit climate change should be considered.

There has also been a long-standing concern that carbon taxes may undermine international competitiveness and result in carbon leakage. If this is a significant concern, then a country can consider the carbon border adjustment mechanisms and partial exemptions discussed earlier. However, the evidence that carbon taxes do undermine international competitiveness is mixed. On the one hand, a recent World Bank study concluded that carbon pricing had not significantly reduced international competitiveness (World Bank 2016). On the other hand, a recent study by Deloitte concluded that carbon pricing adversely impacted the competitiveness of emissions-intensive, trade-exposed producers (Coppola et al. 2020), albeit

this study also argued that the revenue generated from carbon taxes could offset the short-term loss of competitiveness.

The impact of carbon pricing on income inequality varies with development. In low-income countries, it is normally the case that poorer households spend less on the forms of energy covered by a carbon tax than rich households do. For example, poor households may not own internal combustion engine cars, may not be connected to the electricity grid and may purchase few carbon-intensive manufactured goods. In such economies, increases in fuel prices associated with the carbon tax are likely to reduce income inequality (Jakob et al. 2020). In contrast, in richer countries, such as Sweden (Atkinson and Andersson 2020), poorer households may spend a larger proportion of their income on fuels, electricity and carbon-intensive goods than richer households. This may lead to a carbon tax worsening income inequality in such economies.

Earmarking carbon tax revenue to support low-income households through cash grants and/or to fund low-carbon energy may both increase the popularity of the carbon tax and reduce or eliminate its impact on income inequality. British Columbia (Canada) is one example of a jurisdiction that has followed such an approach. More specifically, revenue from the carbon tax is used to finance the BC Climate Action Tax Credit (Province of British Columbia 2024), which is a quarterly payment that helps offset the impact of carbon taxes paid by individuals and families. In Canada, a family of four could receive up to C\$1,800 a year from this rebate in 2024–2025 (Government of Canada 2024). Additionally, the government is proposing a doubling of the top-up for rural residents, because of their higher energy needs and reliance on emissions-intensive modes of transport. Through this initiative, the potential for growing inequality between households is reduced by considering the higher energy use of rural households who are on average poorer than urban households.

In practice, there are several ways that governments can illustrate to the public that they are earmarking revenue from the carbon tax. One option is for the government to announce that revenue from the carbon tax will help finance a cash grant or low-carbon energy programme and then include such a programme in the annual budget. Another option is for the carbon tax legislation to include specific provisions mandating that

the revenue from the carbon tax is only used to finance certain programmes, such as cash grants or clean energy programmes. This is the approach taken by the Commonwealth Carbon Tax Model Law. A final option is for the carbon tax legislation to mandate that the tax is paid into a fund that is separate (from the consolidated fund), which can then only be used to finance programmes in certain priority areas. However, in some jurisdictions, there may be constitutional provisions barring the payment of taxes into funds that are separate (from the consolidated fund). In those jurisdictions, the previously mentioned options for earmarking carbon tax revenues can be used instead.

In summary, there are many ways in which governments can improve the popularity of carbon taxes. To mitigate concerns of increased fuel prices and diminished international competitiveness, exemptions, rebates and carbon border adjustments can be implemented. Any impact on income inequality can be addressed by providing cash grants financed using revenue from the carbon taxation, while governments can demonstrate that carbon taxes are not part of a general tax grab by ring-fencing revenues from this tax for specific programmes, such as supporting clean energy. In doing so, public trust and support for carbon taxation can be increased.

1.7 How should the carbon price be determined?

In determining how the carbon price should be set, the main factors for consideration are emissions targets, the social costs of carbon emissions, revenue targets and the price of carbon in comparable jurisdictions.

The principal consideration when setting the carbon price should be reducing emissions. Governments should invest time and effort to model the likely impact of different carbon prices on emissions. The carbon price should then be set at a level that is forecast to result in significant emissions reductions and be consistent with the target set out in that government's Nationally Determined Contributions.

There have been several studies of the carbon prices needed to achieve the Paris Agreement's goals. The High-Level Commission on Carbon Prices concluded that globally, carbon prices needed to reach between US\$50 and US\$100

per tonne of carbon dioxide (CO₂) by 2030 to limit climate change to 2 degrees Celsius (Carbon Pricing Leadership Coalition 2017). While the IMF recently proposed a minimum price for carbon emissions that differs based on a country's income level, with the carbon price floor being US\$25, US\$50 or US\$75 by 2030 for low-income, middle-income and high-income countries respectively (IMF 2022). A country setting its carbon price in line with this recommendation could be considered to be consistent with its commitments under the Paris Agreement.

The social costs of carbon should also be considered when setting the carbon price. The social cost of carbon is an estimate of the economic damages resulting from emitting one additional metric ton of CO₂ into the atmosphere. It reflects the overall impact of carbon emissions on society, including factors like health costs, environmental degradation, extreme weather events and lost agricultural productivity. The price of carbon can be aligned with the social cost of carbon to ensure that all the negative externalities of emissions are fully accounted for in market activities. The feasibility of this approach in practice may, however, be constrained by the difficulties in measuring the social cost of carbon: the overall costs of poorer health, lower agricultural productivity and extreme weather events due to carbon emissions and global heating are difficult to measure and subject to significant uncertainty.

A revenue target can also be a key driver in the setting of a carbon price. In some countries, a motivation for the implementation of carbon pricing is the increased government revenue from this policy. An example of this is Chile, where a major motivation for the introduction of the carbon tax was the need for revenue to finance education reforms (Government of Canada 2024).

Governments should also consider the carbon price in other jurisdictions when setting the carbon price. Setting the carbon price at a similar level to that pertaining in other jurisdictions may reduce the possibility of carbon leakage and alleviate fears that the carbon tax will reduce economic competitiveness.

Overall, when setting the carbon price, the main consideration should be setting a carbon price that is forecast to significantly reduce emissions. The social costs of carbon, revenue targets and carbon prices in other jurisdictions should also be considered.

1.8 Conclusion

This chapter has discussed some of the pertinent issues around carbon taxation. It has concentrated on discussing some of the practical matters that governments should consider when designing and implementing a carbon tax. It has argued that to be comprehensive, a carbon tax should be levied on both fuels and emissions, with British Columbia providing a good example of a carbon tax on fuels and Singapore providing a good example of a carbon tax on emissions.

Taxes are often easiest to administer when they are levied on a relatively few, large taxpayers, and this speaks to carbon taxes being levied midstream on fossil fuel importers, processors and refiners, and on large emitters. It is also important that the carbon tax includes strong reporting and auditing requirements.

The issue of exempting certain sectors from a carbon tax was also discussed. In general, exemptions should be kept to a minimum and if there are sectors that are facing unfair competition from jurisdictions with no, or low, carbon prices, then a carbon border adjustment mechanism or a rebate based on an emissions-intensity benchmark are better options than exempting entire sectors.

The earmarking of revenues from the carbon tax for payments to low-income households and/or programmes to support clean energy are also worth considering, as these may reduce the impact of the tax on poorer households and boost public support for carbon taxation.

Overall, carbon taxation provides a potentially effective way of reducing emissions and achieving the Paris Agreement's goals. It is hoped that this chapter will assist policy-makers design effective carbon taxes that are concordant with a just transition.

2. Renewable Energy Auctions

2.1 Introduction

Renewable electricity generation is a fast-growing market. In 2023, global annual renewable energy additions increased by almost 50 per cent, which is the fastest growth rate in the past two decades and continues the trend of growing renewable energy additions (IEA 2023a). However, more needs to be done to achieve the Paris Agreement's goals. Under existing policies, global renewable energy capacity will fall short of the tripling of capacity needed by 2030 to remain on track to become a net zero world by 2050. This chapter, therefore, discusses renewable energy auctions, which can be an effective tool for further boosting the supply of renewable energy. It concentrates on renewable energy auctions in the United Kingdom, South Africa and Malaysia, and draws conclusions from these case studies to assist other countries that are considering using auctions to increase electricity generation from clean energy.

2.2 Contracts for Difference, United Kingdom

Background

Contracts for Difference (CfD) is the United Kingdom (UK) Government's principal policy for supporting low-carbon power generation. These auctions were designed with the aim of ensuring that the goals of the energy trilemma are met, namely to: reduce emissions from electricity generation, ensure energy security and minimise the cost of electricity to consumers (House of Commons Library 2023).

The Energy Act (2013) provided regulations to govern CfD and enable a range of objectives for the electricity market, including:

Ensure sufficient investment in sustainable low-carbon technologies to put us on a path consistent with our EU 2020 renewables targets and our longer-term target to reduce carbon emissions by at least 80% of 1990 levels by 2050.

Maximise benefits and minimising costs to the economy as a whole and to taxpayers and consumers – maintaining affordable electricity bills while delivering the investment needed.

In 2019, the UK Government updated its decarbonisation targets to achieve net zero carbon emissions by 2050. The UK Government is also committed to fully decarbonising the electricity sector by 2035.

How Contracts for Difference Work?

Under CfD, a government-owned company (the Carbon Contracts Company) signs a contract with low-carbon electricity generators. These contracts include a fixed price (the strike price) that is paid by the Carbon Contracts Company to the low-carbon electricity generator for each unit (megawatt hour, MWh) of electricity generated. This price remains fixed over several years regardless of the wholesale market price of electricity. Generators are awarded a 15-year CfD, which mandates obligations to deliver the contracted capacity within a specified time frame.

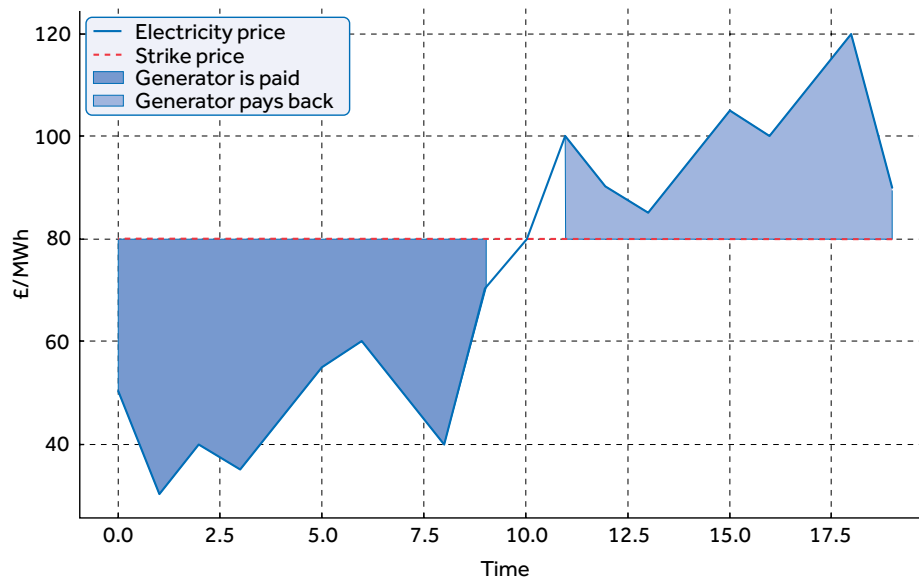
When the wholesale price for electricity is below the strike price, payments are made from the Carbon Contracts Company to the electricity generator. In contrast, when the wholesale market price is higher than the strike price, the low-carbon electricity generator pays the difference to the Carbon Contracts Company. This is shown in Figure 2.1.

CfD are awarded, and the strike price determined, through renewable energy auctions. In these auctions, the government determines, prior to the auction, both the budget and a maximum strike price. During the auction, bidders (low-carbon electricity generation companies) submit sealed bids with their strike price. The government awards contracts sequentially, starting with the lowest strike price, until either the budget is fully allocated or the remaining bids are above the maximum strike price.

What impact have the Contracts for Difference auctions had on electricity generation and emissions?

There were five CfD auction rounds from February 2015 to September 2023. These auctions resulted in contracts providing for 25.7 gigawatts (GW) of electricity, which is equivalent to approximately 34 per cent of installed capacity in the UK (ibid.). Over 65 per cent of the capacity awarded through these

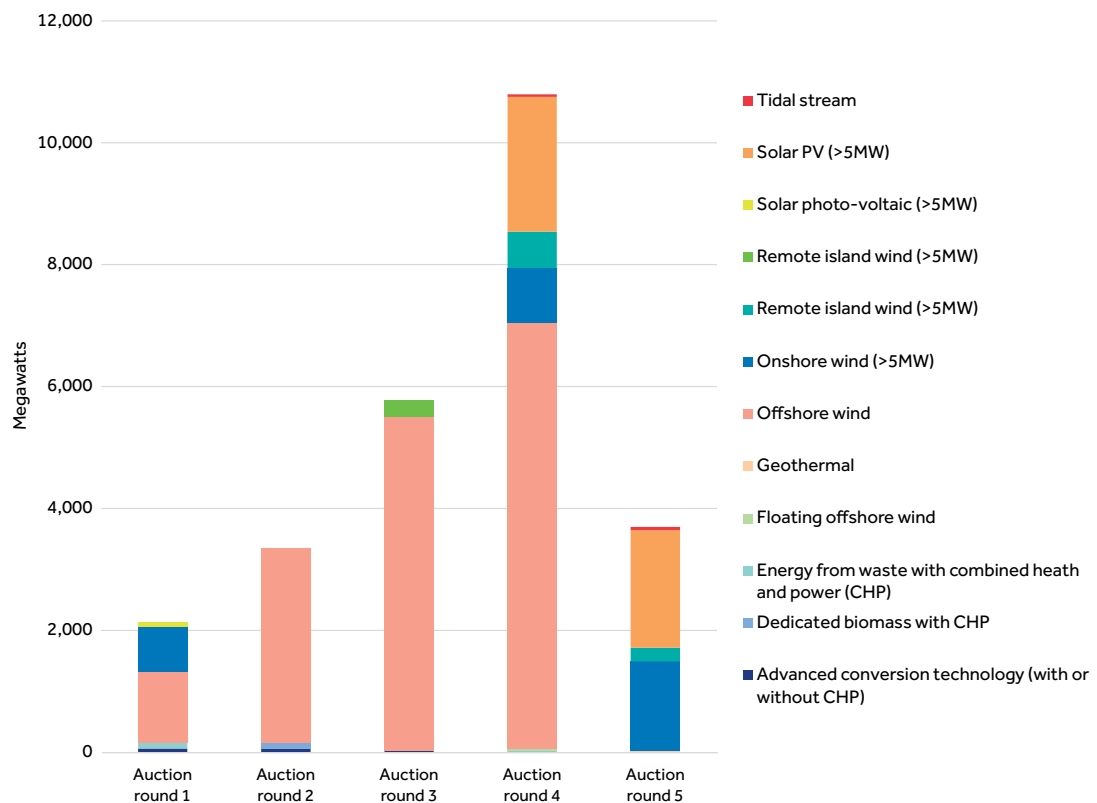
Figure 2.1 Contracts for Difference (CfD)



auctions was for offshore wind (ibid.). The fourth auction round set a record for the capacity awarded at over 10 gigawatts (ibid.), but capacity awarded fell sharply in the fifth auction round, due to no capacity

being awarded for offshore wind. The reasons for this are discussed later. Figure 2.2 shows installed capacity by auction round and electricity generation technology.

Figure 2.2 Installed capacity by auction round and generation technology



Source: Dukes (2023)

The contracts awarded through the auction process have intended delivery dates, but delays, for various reasons, mean that these are not always met. As of October 2023, generation capacity of approximately 2.3 gigawatts was live, all from the first two auction rounds (House of Commons Library 2023). The difference between the 2.3 gigawatts being generated, and the 25.7 gigawatts of electricity generation that has been awarded, is illustrative of both the lag between the contract being signed and construction started, and the time taken to construct power generators prior to their generating electricity. In addition, there is approximately 4.5 gigawatts of renewable electricity generation that is live from investment contracts signed before the CfD scheme commenced.

The Contracts for Difference auctions and previous government programmes have succeeded in increasing the percentage of electricity generated from renewable sources from 11.3 per cent in 2012 to 39.9 per cent in 2022 (IEA UK 2022a). This has driven an increase in the percentage of electricity generated from low-carbon sources (which includes nuclear) from 11.3 per cent in 2012 to 41.5 per cent in 2022 (DUKES 2023; 2024). Generation under CfD made up 15.1 per cent of UK renewable generation in 2022 and 6.3 per cent of total UK generation.

The growth in renewable energy in the UK has contributed to a substantial fall in carbon emissions, from 7 tCO₂ per capita in 2012 to 4.5 tCO₂ per capita in 2022, representing a 35.71 per cent decline (IEA UK 2022a). In addition, given the significant amount of renewable energy capacity that has been awarded but which is not yet generating, carbon emissions will likely fall further going forward.

What has the trend been in strike prices? And has this resulted in net payments to generators?

The strike price fell sharply and consistently across the first four rounds of auctions. More specifically, the average strike price for offshore wind, in constant 2012 prices, fell from £120 per MWh during the first auction to less than £40 per MWh in the fourth auction. Strike prices for solar also fell significantly (House of Commons Library 2023). However, the strike prices for both technologies increased in the fifth auction round.

The UK Government collects a levy from energy suppliers, which is used to finance payments to CfC generators if their strike price is larger than the

market reference price. Under this mechanism, payments were less than £50 million a month in 2016, but increased to a peak of over £200 million a month in October 2020 – due partly to falling market reference prices. Rising market reference prices led to negative payments – that is, CfC generators paying the government for much of late 2021 and 2022 – before payments turned positive again, as the market reference price fell in 2023. The total value of payments from the start of the CfC programme until the end of May 2024 was 6.5 billion (LCCC 2023), equivalent to £123 per capita.

What impact has Contracts for Difference had on domestic electricity prices?

The UK's energy regulator Ofgem adds an allowance for CfD costs to the energy price cap for electricity to account for the costs of this to energy suppliers. The CfD allowance added a total of around £75 to typical domestic electricity bills over the period April 2019 to December 2023 (House of Commons Library 2023). This was 2.8 per cent of the total electricity bill that a household with typical consumption would have paid over this period.

This may seem to be a relatively small amount, but CfD currently only accounts for 6.3 per cent of total generation and much of the generation capacity that has been auctioned has yet to start generating.

What impact has CFD had on the cost of renewable energy?

The costs of renewable energy, particularly offshore wind, have fallen sharply in the United Kingdom. More specifically, the levelised cost of electricity (LCOE) for offshore wind fell from US\$216 MWh in 2014 to US\$75 MWh in 2022, a decrease of 66 per cent.

The CfD policy may have contributed to this fall through four main mechanisms.

First, CfD, by stabilising the price for energy, has reduced the volatility of renewable energy companies' revenues and profits. This reduces risk and should lead to investors accepting lower rates of return (hurdle rates). It may also lead to the provision of debt to renewable energy companies at lower interest rates. In addition, it may contribute to an increase in the supply of debt finance and may allow for an increase in the gearing ratio (more debt and less equity). This may further reduce the cost of capital (as debt financing is cheaper than equity financing). Interviews with clean energy developers

demonstrate that CfD is regarded as having been successful in reducing the cost of capital (UK Government 2024b).

Second, the competitive nature of the CfD auctions is seen by both economists and market participants as being an important factor for driving down costs, particularly where there is significant competition between potential suppliers (ibid.).

Third, the long-term support that the UK Government has provided, both through CfD and the proceeding Renewable Obligations Market, has led to an increasingly mature industry with a track record of delivering projects to budget, which has contributed to increased investor confidence. For example, both onshore and offshore wind generation projects are viewed as less risky assets investments and have attracted more risk-averse investors (Egli 2020).

Fourth, CfD has created more certainty in the supply chain. Auctions being held regularly has provided more certainty over future demand, assisting investment in, and development of, the supply chain.

It is, however, important not to prescribe the total reduction in clean energy generation costs to the CfD programme. The LCOE for clean energy technologies such as onshore wind, offshore wind and solar have fallen globally (Rolan 2022; IRENA 2022b), which is an indication that underlying international trends, independent of the CfD programme, may have driven some of the cost reductions seen in the UK. Global technology development, increasing economies of scale and competitive supply chains have underpinned much of the reduction in global renewable energy costs (ibid.).

Do the CfD contracts subsidise renewable electricity generation?

The question as to whether CfD subsidise renewable energy is difficult to answer. One definition of subsidy is whether the strike price was below or above the market reference price at the time of the auction. As the strike price has normally been above the market reference price, it may be concluded that these higher prices were required to subsidise the construction and operation of renewable electricity generation.

However, this definition assumes that the market reference price would be high enough to stimulate the construction of enough new electricity generation from any technology (including fossil fuels) in the absence of the strike price. Given

that little new generation capacity is constructed without some kind of government support, and that the construction of large new fossil fuel generating facilities may face public protests and legal challenges, this seems far from certain.

In addition, if the market reference price increases ex-post the signing of the CfD, then even if the strike price is above the market reference price at the time the auction is held, the clean energy generation contract may – over the contract term – result in net payments to the government. Thus, an alternative measure of subsidy would be the forecasted (at the time the contract was signed) payments from the government to the CfC generator over the term of the contract. However, as the value of future payments depends on the future market reference price, which is not known with certainty and is difficult to predict, this measure is difficult to forecast accurately.

Furthermore, before the proliferation of renewable energy in the United Kingdom, power generation was largely centred in areas close to where the demand for energy was highest. Therefore, in the past, the grid was not well equipped to deal with transporting energy from many areas of renewable energy production (for example, offshore wind) and the costs of upgrading the grid may not be fully incorporated in the strike price. In addition, the electricity storage, baseload generation, and peak energy production and costs required in a grid with growing intermittent renewable energy sources (such as solar and offshore wind) are not fully captured in the strike price. There is an argument that these costs should be included in the strike price and regarded as part of the subsidy received by solar and wind generators.

With the above caveats in mind, the following conclusions can be drawn:

- the strike price for most auction rounds and most technologies has been above the market reference price (implying a subsidy on that measure), albeit for some offshore wind electricity generation projects the strike price was below the market reference price for the fourth auction round; and
- to date, there have been net payments from the UK Government to CfC generators and these are likely to increase as new CfC generation comes online; however, ultimately, the value of payments depends on future market reference prices, which cannot be forecast with certainty.

Criticisms of CfC and areas for improvement

Although an effective initiative in spurring investment in renewable energy, there are two key areas where the CfC scheme can be improved.

First, the time between the awarding of contracts and the implementation of the project could be shortened. The delay in the materialisation of objectives hampers the ability of the UK to meet its renewable energy targets. Further research is required to better understand the causes of these delays and how they can be mitigated.

Second, the strike price under CfC could be amended, so that it better accounts for the impact of different renewable energy technologies and the location of electricity generation on system-wide costs for the management of the grid.

In conclusion, the United Kingdom's CfD initiative has been largely effective in spurring crucial growth in renewable energy generation. Initiated in 2013, the scheme has allowed the UK to make great strides in its efforts towards the 2050 goal of net zero. In the five contracts for different auction rounds, a total of 25.7 gigawatts of electricity worth of contracts was awarded, which is equivalent to approximately 34 per cent of installed capacity in the UK. Increased renewable energy generation in the UK has contributed to lower carbon emissions, which have dropped from 7 tonnes per capita in 2012 to 4.5 tonnes per capita in 2022. However, the CfD programme could be further strengthened by shortening the time between contracts being awarded and electricity generation coming online, and by ensuring that the strike price better accounts for the impact of different technologies and their location on system-wide grid costs.

2.3 South Africa: Renewable Energy Independent Power Producer Procurement Programme

Background

The Renewable Energy Independent Power Producer Procurement Programme (REIPPPP), launched in August 2011 by the South African Government, is a key pillar in the country's low-carbon economic transition. It is one of the primary policies to achieve the government's target of net zero by 2050, which was a commitment in South Africa's 2021 NDC (UNDP 2021).

The REIPPPP was designed with the aim of ensuring that renewable energy generation projects would be completed on schedule, deliver clean and reliable energy, and provide overall socio-economic benefits. Renewable energy projects under the REIPPPP have to meet a range of criteria, including job creation, local content, ownership by black South Africans and enterprise development.

How does REIPPPP work?

The REIPPPP is structured around a competitive bidding process, whereby independent power producers (IPPs) bid for renewable energy contracts. The REIPPPP bidding process has four main stages: request for proposals, bid submissions and evaluation, preferred bidder, and implementation.

During the request for proposal stage, the government publishes a request for proposals outlining the criteria and evaluation proposal for bids.

Independent power producers then make bids to the government, and these bids are evaluated on both the cost of the electricity that will be supplied and non-cost criteria. Non-cost criteria include job creation, local content, community development and black economic empowerment.

The government then determines which IPPs are preferred bidders. Once IPPs are nominated as preferred bidders, they then sign a 20-year power purchase agreement (PPA) with Eskom, a government-owned energy company. Prices are indexed to inflation and are guaranteed by the government.

Preferred bidders then proceed with the financing, construction and operation of the renewable energy project.

What impact has the REIPPPP had on electricity and emissions?

Since the inception of the initiative in 2011 to the end of July 2023, there have been six bid windows, with the seventh underway at the time of writing (South Africa Department of Mineral Resources and Energy 2023a). To date, 89 projects have reached their commercial operation date (COD) (ibid.). The COD is the date on which an independent engineer declares that the facility is completed and is now able to produce energy. As at July 2023, the REIPPPP had a very successful completion rate,

with 6.180 GW realised out of the 6.279 GW that had been scheduled to be operational. The reason for the shortfall is that a project in the fifth bidding round was not yet operational due to a delay in financial closure.

The REIPPPP has supported electricity generation from onshore wind, solar photovoltaic, concentrated solar power (CSP), landfill gas, small hydro and biomass. Renewable energy now accounts for 8 per cent of total electricity generation capacity in South Africa, with the remainder being generated from coal (77 per cent), crude oil (14 per cent) and other forms of energy (1 per cent) (South Africa Department of Mineral Resources and Energy 2023b). The country's renewable energy capacity per capita has also been steadily increasing.

The REIPPPP has contributed to lower carbon dioxide emissions from fuel in South Africa, which have fallen from 405 million tonnes (Mt) in 2011 to 392 Mt in 2021 (IEA 2021b).

What has been the trend in prices under the REIPPPP?

In each window of bidding, there has been a decline in the average tariff agreed upon across the three main forms of renewable energy technology awarded (World Bank 2014). In the first round of bidding, the tariffs were as follow:

- Wind: SA\$1.14/kWh
- Solar PV: SA\$2.76/kWh
- CSP: SA\$2.69/kWh

This is significantly higher than the average portfolio cost in the sixth bidding round, which was \$0.49/kWh (South Africa Department of Mineral Resources and Energy 2023a). This shows a significant drop in the average price paid for renewables through the programme.

What impacts have renewable energy auctions had on domestic electricity prices, the cost of renewable energy production and subsidies?

The tariffs for wind, solar and CSP in the first bidding round were substantially higher than the tariff charged by Eskom to consumers, implying that the REIPPPP may initially have put upward pressure on electricity prices. The REIPPPP has, however, played a crucial role in driving down the cost of

renewable energy in South Africa, with the bidding process creating a competitive environment in which prospective companies aim to provide the lowest cost energy to secure a contract. Lower costs for renewable energy combined with rising electricity prices for consumers in South Africa have meant that there is now little if any gap between the electricity price paid by consumers and the tariff required to finance new renewable projects in South Africa (Reuters 2023).

The REIPPPP has also led to new electricity generation capacity and a diversification of electricity generation sources. This is beneficial in the long term given the power shedding seen in South Africa, which in 2022 saw power cuts implemented on more than 200 days.

Criticisms of this system/areas for consideration

The REIPPPP, although largely successful in stimulating the development of renewable energy and contributing to South Africa's movement to net zero, has had some shortcomings.

A key area identified for improvement is the need for grid improvement to help guarantee investment and boost investor confidence (Obisie-Orlu 2023). By failing to upgrade transmission grid infrastructure, bottlenecks have been created. This is particularly evident for wind generation, where there are areas with high prospectivity but which are not attractive for investment due to no, or poor, grid connections.

A sense of uncertainty also stifles the growth of renewable energy generation, thereby hampering the REIPPPP. A key example of this can be seen in Eskom's refusal to sign a PPA with some IPPs that the government had nominated as preferred bidders.

There is also a degree of uncertainty concerning the future role of Eskom. More specifically, it has been legislated that that Eskom be split into three different entities responsible for energy generation, distribution and transmission, respectively. This reform was due to be completed by 2022, but is still ongoing. Progress has been made in establishing the National Transmission Company of South Africa as a separate legal entity to take responsibility for transmission, but the companies responsible for distribution and generation are not yet operational.

Conclusion

In conclusion, since its launch in 2011, the REIPPPP has been a cornerstone of South Africa's transition to renewable energy. Since the first bidding round, 6.18 GW of renewable capacity has been successfully integrated, which represents a crucial boost to the country's efforts to achieve a 45 per cent reduction in emissions (from their 2009 amount) by 2030, in addition to it achieving net zero by 2050. The REIPPPP has also contributed to a reduction in the costs of renewable electricity generation.

2.4 Malaysia: Large Scale Solar (LSS)

Background

Malaysia's Large Scale Solar (LSS) programme, introduced in 2016 (IRENA 2023), aims to reduce the country's reliance on fossil fuels and assist the transition to a more sustainable energy system. With growing electricity consumption, a longstanding reliance on fossil fuels, the uncertainty of global fuel markets and the threat of climate change (IRENA 2022a), the need to spur investment in renewable energy is as seen as an imperative by the Government of Malaysia.

Administered by the Suruhanjaya Tenaga (Energy Commission), there have been four bidding cycles, with the fifth underway at the time of writing (The Star 2024). Malaysia did not have previous experience in undertaking renewable energy auctions, but identified solar energy as an important way to diversify its energy mix away from fossil fuels. The government's decision to focus on solar was partly due to the high prospectivity for this technology in Malaysia. Due partly to its location near the equator, Malaysia has a high solar irradiance, with approximately 1,575–1,812 kWh of solar energy per square metre. This translates to a potential capacity of 269 GW of energy that could be generated from solar (SEDA Malaysia 2021).

The government also regarded the deployment of a renewable energy auction system as a crucial tool to achieve Malaysia's multifaceted low-carbon economic transition and realise the government's goal of net zero by 2050 (The Star 2024).

How does the LSS work?

As discussed earlier, there have been four bidding rounds (2016, 2017, 2020, 2021), with a fifth round underway at the time of writing and expected to be

completed by late 2024. The Energy Commission is the administrator of the schedules, in addition to being the auctioneer. Through its role, the Energy Commission sets out the comprehensive requirements necessary for electricity generators to become a part of this initiative.

To qualify, a request for quotation (RFQ) must be purchased by prospective bidders. The Energy Commission then issues a notification to the bidder indicating if it has been shortlisted. Upon receipt of this notification, bidders move to the RFP stage, in which they receive a draft power purchasing agreement (PPA), non-disclosure agreement (NDA) and the LSS guidelines. It is during this stage that bidders must prove their ability to undertake the project by providing information about their previous experience and ownership structure.

The PPA provides that the off-taker (the state-owned utility Tenaga Nasional Berhad) of electricity from the LSS project is bound by a take-and-pay principle for 21 years, meaning that the solar producer is guaranteed for the stated time to receive a fixed price for the electricity it produces (IRENA 2022a). There is no capacity payment, meaning that the solar plant only gets paid for the electricity it produces. The payment for the electricity produced under the LSS scheme is not tied to inflation.

In the first three rounds of bidding, the prospective projects had to have majority Malaysian equity. The pursuit of local ownership was further evident in the fourth round, which was limited to companies that were 100 per cent Malaysian owned or were listed on the Malaysia stock exchange and had 75 per cent or more of their stock owned by locals. If deemed suitable to construct and manage a project, companies are invited to present their case to the Energy Commission and are then shortlisted and given approval to proceed.

What impact have the auctions had on electricity generation and emissions levels?

The four bidding rounds in Malaysia attracted 70, 116, 112 and 138 bids respectively (The Star 2024). In all cases, the total capacity of the bids (1293 MW, 1632 MW, 6731 MW and 5374 MW, respectively) exceeded the volumes auctioned (300 MW, 460 MW, 500 MW, 1000 MW), indicating a strong interest from potential producers. In the first two rounds of bidding, slightly

more than the amount auctioned was awarded (451 MW and 562 MW, respectively), while in the next two rounds, significantly less than auctioned was awarded (491 MW and 823 MW, respectively).

The fifth round of bidding, underway at the time of writing, has a quota of 2000 MW. Additionally, prospective bidders will be able to undertake projects of up to 500 MW, ten times larger than the amount previously allowed (Ong 2024).

The introduction of LSS has spurred private investment in solar energy in the country. Although still a small contributor to electricity generation in Malaysia, solar production has significantly increased and driven increased deployment of renewables. From 2016 to 2021, solar electricity generation increased from just 310 GW/h to 2,027 GW/h (IEA 2021a). This expansion translates to a 554 per cent increase in solar electricity generation, with further growth anticipated after the latest bidding round. In total, solar electricity generation in 2021 made up 1.13 per cent of total electricity generation in Malaysia (ibid.).

The impact of the LSS programme on overall emissions in Malaysia, has been minimal. This is due to the solar generation constructed under this programme only being a small proportion of total electricity generation. Since the launch of the initiative in 2016, there has been a rise of emissions from fossil fuels, from 217 Mt CO₂ in 2016 to 226 Mt CO₂ in 2021 (ibid.). In the years to come, particularly in the lead up to 2030, this is expected to drastically change as result of the country's pursuit of a 45 per cent reduction in emissions from 2005 levels by 2045.

What impacts have the auctions had on domestic electricity prices and the cost of renewable energy?

The LSS initiative has had a negligible impact on domestic electricity prices in Malaysia. This is due to the small amount of solar energy being consumed as a percentage of the energy mix. More specifically, in 2021 renewable electricity generation made up less than one-fifth of total electricity generation in Malaysia, and solar accounted for less than 7 per cent of this amount. Most – 94 per cent – renewable electricity generation in Malaysia is from hydropower.

Across the four rounds of bidding completed, there has been a noticeable downward trend in solar electricity generation prices. Although Malaysia

does not disclose the final average weighted price of the successful bids, it does provide the initial prices offered by pre-qualified participants (The Star 2024). Across the different bid rounds, these prices were:

- bid round one, prices ranged from 0.39 ringgit (RM)/kWh to RM0.65/kWh
- bid round two, prices ranged from RM0.399 to RM0.53/kWh
- bid round three, prices ranged from RM0.178/kWh to RM0.3240/kWh
- bid round four, first section, prices ranged from RM0.1850/kWh to 0.2481/kWh
- bid round four, second section, prices ranged from RM0.1768/kWh to RM0.1970/kWh (ibid.).

These prices show a clear downward trend. These lower prices were partly driven by economies of scale, with the electricity generation capacity of projects increasing over time. The competitive nature of the bidding process also led to efficiencies and lower prices, albeit factors external to the LSS initiative, such as technological change and increasing economies of scale in global supply chains, also played a role.

The prices paid for electricity from solar generation are also now below the electricity prices paid to fossil fuel generators in Malaysia. More specifically, the Energy Commission in Malaysia set a base tariff of RM0.345 per kWh for electricity produced from coal and gas for 2018, 2019 and 2020, which is significantly higher than the kWh price paid to solar producers through auction rounds three and four.

Criticisms of LSS and areas identified for improvement

The LSS initiative has contributed to a growing role for renewable energy in Malaysia's energy mix. The initiative could, however, be strengthened by removing regulatory barriers (WEF 2023). Key areas for reform are the removal of the one-bid-per-company restriction and increasing the capacity of the projects. This would allow prospective bidders to benefit from economies of scale and thereby reduce the overall cost of renewable power generation, leading to savings for both producers and consumers

Increasing the regularity of LSS bidding rounds another way to improve the LSS initiative (ibid.). Having regular bidding rounds would demonstrate

the government's commitment to the initiative and boost investor confidence. Previously, there has been inconsistency with the timings of bidding rounds. After being relatively consistent in early rounds (2016, 2017, 2019, 2020), the latest round was announced to be in 2024. This delay was because of changing regulations around ownership and local participation. There are some indications that the long delay between the fourth and fifth bidding rounds, combined with the changing local participation requirements, may have depressed investor confidence.

Grid integration challenges and ageing infrastructure must also be addressed to improve the LSS programme (ibid.). Limited government investment in grid connections threatens to hamper further increases in renewable electricity generation and there is a need for significant grid investment based around a long-term plan (IRENA 2022a).

Conclusion

The LSS programme drove an increase in solar generation from 310 GW/h of electricity in 2016 to 2,027 GW/h in 2021, an increase of 554 per cent (IEA 2021a). However, there remains significant scope to expand solar generation, which currently accounts for less than 2 per cent of total electricity generation in Malaysia.

The programme has successfully contributed to lower solar electricity generation costs, albeit external technological change and increased economies of scale in global supply chains have also played an important role. Going forward, reforms to

the programme to make auctions more frequent, remove the one-bid-per-company restriction and increase the capacity of projects, are needed to substantially increase the percentage of electricity generated by solar.

2.5 Conclusion

Overall, renewable energy auctions in Malaysia, South Africa and the United Kingdom may be judged a success. In all three cases, these auctions have resulted in significant new renewable energy generation capacity being constructed. These auctions have also contributed, through increased regulatory certainty, financial certainty, competition between bidders and economies of scale, to falling renewable electricity generation costs.

Additionally, the case studies provide valuable lessons for other countries on how best to design auctions to increase clean energy electricity generation and drive down costs. In particular, the following lessons can be drawn from these case studies:

- the government guaranteeing electricity generation companies a price per kWh of electricity generated reduces risk, lowers hurdle rates and can contribute to lower costs over time;
- regularly auctioning significant capacity increases regulatory certainty and can lead to economies of scale that drive down costs; and
- maximising the benefits from clean energy also requires that policies are put in place to finance improvements to the electricity grid.

3. Reforming Capital Market Policies

3.1 Introduction

The world is not currently on course to limit climate change to 1.5 degrees Celsius, with a reason for this being underinvestment in clean energy and overinvestment in fossil fuels. As discussed in previous chapters, carbon taxation can make fossil fuels more expensive and renewable energy auctions can reduce the costs of clean energy, thus tilting investment away from fossil fuels.

Fiscal policies alone are, however, unlikely to be sufficient to limit climate change to 1.5 degrees Celsius. One reason for this is that carbon pricing has proved politically contentious and, even today, after many years of economists and international organisations highlighting the merits of such a policy, carbon pricing schemes cover less than a quarter of global emissions (World Bank 2023b) and only 5 per cent of global emissions are priced above the range recommended by the High-Level Commission on Carbon Prices (ibid.).

In addition, high carbon prices, especially if introduced suddenly and without being fully foreseen by markets, might exacerbate transition risks and crystallise a Minsky moment (ibid.), where investors panic and sell fossil fuel assets. Therefore, given the constraints on fiscal policy, there is a role for capital market policies in underpinning the transition to low-carbon energy and limiting climate change. This chapter discusses three capital market policies, namely: public policies to leverage private sector investment in the low-carbon transition; central bank policies to make financial flows consistent with the Paris Agreement's goals; and should, and how can, Commonwealth SWFs invest in the low-carbon transition?

3.2 Public policies to leverage private sector investment in the low-carbon economic transition

Achieving the Paris Agreement's goals requires increased investment, particularly in early-stage businesses that are contributing to the low-carbon

economic transition (Owen et al. 2018). Early-stage businesses in many sectors struggle to raise capital, but there is evidence that financing constraints may be especially acute (ibid.) for those contributing to the low-carbon economic transition. Innovations to reduce or capture greenhouse gas emissions may have timescales spanning many decades and take many years before they are profitable. Such investments may be unattractive to many investors who are seeking short-term profits. In addition, early-stage businesses contributing to the low-carbon economic transition may combine the profit motive with an environmental mission, and since investors are not fully rewarded for external environmental and societal benefits, they may underinvest in such businesses (Bak 2017).

Businesses tend to rely on different sources of financing as they mature and their risk profile changes (Murzacheva and Levie 2020). This is often referred to as the 'financial escalator theory', with the three steps on the financial escalator being: grants and seed financing, business angels and venture capital, and bank debt financing.

The commitment of governments to the Paris Agreement's goals and the financing constraints faced by early-stage businesses contributing to the low-carbon economic transition provide a strong rationale for public policies to alleviate this financing constraint. This section, therefore, examines the role governments can play in increasing the provision of grant and seed financing, venture capital and bank debt financing.

Grants and seed financing

The seed stage of a business start-up is often the riskiest for investors, as there is a high chance that the business will fail. There is often a lack of financial support for businesses involved in the low-carbon economic transition at this stage of the business cycle. Considering this constraint, many countries provide public sector grant financing for proof of concept, early-stage innovation, and research and development.

Innovate UK is a good example of a government grant financing programme for businesses. Its smart grants of up to £250,000 were a significant early-stage financing mechanism for proof of concept, prototyping and marketing. Nearly one in ten of these grants were for environmental and renewable energy projects. This programme is generally regarded as being successful with, between 2011 and 2015, 7,000 applications leading to £160 million in funding for 1,600 projects. It also created more than 3,000 jobs and over £250 million in gross value added (SQW 2015).

Horizon Europe, running from 2021 until 2027, is a key pillar in the EU's low-carbon economic transition (European Commission 2023). It has a budget of 95.51 billion euros, 35 per cent of which will be dedicated to climate-related research and innovation (ibid.). It is estimated that investments through Horizon Europe will lead to 100,000 additional jobs in research and investment activities between 2021 and 2027 (ibid).

Horizon Europe followed on from Horizon 2020, which ran from 2014 until 2020, in which 80 million euros was budgeted to boost research and innovation. Of Horizon 2020's total budget, 64.4 per cent was allocated to investments in sustainable development and more specifically, 32 per cent was earmarked for climate-specific projects, making the programme the second largest funder of climate science in the world (European Commission 2024).

Another example of seed and grant financing is the United States Department of Energy grant programme. This programme was announced in 2021 and has granted US\$54 million for 235 small businesses to research, develop and create commercialisation plans for technologies that will bolster the low-carbon economy (US DOE 2021). These grants are administered through the Department of Energy's Small Business Innovation Research Program and Small Business Technology Program. Examples of projects include experimental bioenergy learning tools and the development of grid-smart building controls.

Business angels and venture capital

Bank borrowing is often not available for innovative high-risk projects at the cutting edge of the low-carbon economic transition. For such projects, venture capital can provide an alternative source of financing. The Canada Nova Scotia Clean

Technology Fund provides a good example of one such fund. Between 2011 and 2017, it invested in 12 seed companies, including bioscience and smart-grid businesses (WCTIJ 2017).

The impact of public sector supported equity investment funds is often greatest when businesses can raise large-scale follow-on funding (North et al. 2013). The chances of securing such funding are greatest when the low-carbon economic transition projects being financed are close to market and have significant commercial potential (Criscuolo and Menon 2015). This has prompted the development of large-scale public funds that are attractive to institutional investors and which can offer both early-stage funding and scale-up funding to commercialisation.

The United Kingdom Innovation Investment Fund (UKIIF) provides a good example of such a fund. It provides long-horizon investment for early-stage businesses focusing on the energy, advanced manufacturing, digital and health sectors. Its sources of finance have included the UK Government, European Investment Fund and private co-financing. In the six years following its establishment in 2009, the UKIIF had invested in over 300 small or medium-sized enterprises globally and had leveraged private investment 20 times the value of the public sector's contribution (Baldock and North 2015).

The Business Development Bank of Canada also provides venture capital to entrepreneurs, particularly those in the low-carbon economic transition space (Business Development Bank of Canada 2023a). This bank managed the C\$400 million Clean Tech Fund, which was a key vehicle to enabling the low-carbon economic transition in Canada. Its investments contributed to 2,000 patents being granted and an 80 per cent increase in exports from companies that the fund invested in. It is also estimated that this fund attracted C\$6 in additional private sector funding for every dollar it invested (Business Development Bank of Canada 2023b).

The Clean Energy Finance Corporation (CEFC) in Australia plays an important part in Australia's pursuit of net zero by 2050. Within this organisation is the Clean Energy Innovation Fund (CEIF), with a value of 200 million Australian dollars (A\$) (CEFC 2023a). This is a specialist venture capital investor established with the aim

of investing in companies focused on the clean energy transition, mobility and smart cities, food and agriculture, and the circular economy and industry. In the 2022–2023 financial year, the Clean Energy Innovation Fund invested a total of A\$54.5 million in new and follow-on commitments. For every dollar invested, there was an additional A\$6.47 invested by private funds, delivering a combined \$407.3 million in climate investment (CEFC 2023b).

Bank debt financing

After the 2008 financial crisis, there was a decline in conventional bank lending, with lending to early-stage businesses particularly constrained (Polzin 2017). This, when combined with the positive externalities from the low-carbon transition, provides a strong rationale for public sector support to bank financing of clean energy (ibid.). The UK's Green Investment Bank provides an example of such a bank in the Commonwealth. It was established in 2012 to draw private capital into offshore wind farms, waste-to-energy plants and energy-saving projects. It was privatised three and a half years later, partly to reduce public debt but also because the UK Government had concluded that there was enough private capital in the market and there was a risk that the bank was crowding out private sector financing (Plimmer 2021). This arguably demonstrates the success of public policies in developing a significant green finance market. By the time of its sale, the bank had invested in 100 projects, with a transaction value of £12 billion, and had committed £3.4 billion of its own capital (NAO 2017). As such, it had stimulated investment in the low-carbon energy transition, particularly offshore wind (ibid.).

The Green Investment Bank was not, however, without its critics. It has been argued that it concentrated too heavily on large infrastructure projects and that it should have financed more early-stage businesses and technologies (Corbishley and Donovan 2017). The National Audit Office (NAO 2017) also concluded that there was insufficient evidence to determine the degree to which the Green Investment Bank had driven growth in the green economy.

New Zealand Green Investment Finance (NZGIF) is a government-owned bank established with the purpose of accelerating investment to enable

New Zealand's low-carbon future (NZGIF 2024). Established in 2019, the bank defines itself as a long-term, purpose-driven investor, providing capital solutions for decarbonisation initiatives across a broad range of sectors. As of July 2023, NZGIF had invested NZ\$288 million in 21 projects, in conjunction with NZ\$436 million of private investment (NZGIF 2023). Investments have varied from areas such as the transport sector, in which electric vehicle deployment has been a focus, to infrastructure, which includes commercial building retrofit programmes. It is estimated that 730–890 ktCO₂ of emissions will be reduced across the lifetime of NZGIF's investments.

The Green Fund, within the Development Bank of South Africa (DBSA), is another example of a government-owned 'green bank' within the Commonwealth. Managed by the DBSA since 2012, the Green Fund 'facilitates the transition to a green economy where market forces do not adequately value the cost to the environment' (DBSA 2024). The fund is aligned with South Africa's NDC and the UN's Sustainable Development Goals (SDGs). During its first four years of existence from 2012 to 2015, the Green Fund was estimated to have created more than 2,300 direct jobs and 9,000 indirect jobs (South Africa Department of Environmental Affairs 2016). Additionally, the Fund approved a total of 55 projects and invested R782 million rand (ibid).

In conclusion, low-carbon economic transition businesses face constraints in accessing seed financing, venture capital and bank financing at different stages of their development. This can lead to investment being below that which is socially optimal and consistent with the Paris Agreement's goals. This provides a rationale for public sector policies, such as grant schemes and green banks, to support financing of the low-carbon economic transition. There are many examples of successful public policies in this area in the Commonwealth. Yet this does not mean that every Commonwealth country should immediately set up a green bank or a grants scheme. Rather, a reasonable way forward for many Commonwealth countries would be to review each step on the financing escalator, to identify the constraints faced by low-carbon economic transition businesses when accessing financing, and to consider whether public funds can ameliorate these constraints cost effectively and leverage private sector finance.

3.3 Central bank policies and regulations to make financial flows consistent with the Paris Agreement's goals

Central banks³ can develop policies and regulations in five main areas to make financial flows consistent with the Paris Agreement (Campiglio et al. 2017). These areas are: assessing the impact of climate change and the low-carbon economic transition on the financial system; accounting for climate risk in financial regulations; encouraging carbon emissions disclosure; assisting financial institutions to assess the extent to which the businesses and projects they finance are contributing to climate change; and greening central banks' portfolios. This section discusses each of these policies.

Assessing the impact of climate change on the financial system

Central banks can lead the way in assessing the impact of physical, transition and liability risk⁴ on the future finances of banks, insurers and pension funds. Such assessments can illustrate the potential climate change-related risks for financial institutions that have invested in businesses and other assets that may suffer losses due to climate change or the low-carbon economic transition. As such, they are powerful tools for nudging (Van Steenis 2021) the financial system to reprice the cost of capital between investments that are well placed to benefit from the low-carbon economic transition and those that are likely to lose out because of liability, physical and/or transition risks. There is increasing evidence that this repricing is already underway with, over a ten-year period starting in 2007–2010, loan spreads falling by 24 per cent for offshore wind and increasing by

38 per cent for coal power stations (Wilson and Caldecott 2021). Meanwhile in Europe, since 2016, the cost of debt to raise capital for coal mining has been rising, whereas for renewable energy a downward trajectory can be observed (University of Oxford 2023). This is a result of more consistent climate change-friendly actions compared to other regions such as North America and East Asia.

The Bank of England has led the way in assessing the impact of climate change on the financial system. It reported on the impact of climate change on the insurance (Authority 2015) and banking sectors (Authority 2018) in 2015 and 2018, respectively. The later report found that:

- Most banks are starting to treat climate change risks like other financial risks and not merely as a corporate social responsibility issue.
- Banks are beginning to consider the impacts of the physical risks from climate change on their assets, such as the impact of increased flooding on mortgages and the impact of extreme weather events on sovereign risk.
- Banks have also begun to assess exposure to obvious transition risks from current government policies. For example, banks have begun to consider how possible future carbon prices might affect their investments in carbon-intensive industries.

The Bank of England further examined climate change's impact on the financial system through its 2021 Climate Biennial Exploratory Scenario (Bank of England 2021a). This report aimed to evaluate the impact of climate change on the financial system through early transition,⁵ late transition⁶ and no additional policy scenarios.⁷ In the early transition

³ In some Commonwealth member countries, a separate (from the central bank) agency is responsible for prudential financial regulation. This report uses the term 'central bank' to refer to the institution or institutions responsible for monetary policy and/or prudential financial regulation.

⁴ 'Physical risks' arise due to climate-related floods, hurricanes and other extreme weather events damaging property and impacting insurance liabilities and other financial assets. 'Liability risks' refers to possible future claims by parties that suffer the effects of climate change on those companies that are judged to have caused global warming. 'Transition risks' refers to the losses that may arise due to changes in current or expected future returns due to changes in public policies, technology or physical risks related to the low-carbon transition.

⁵ The early transition scenario assumes that the transition to net zero starts in 2021, with public policies gradually intensifying over time. In this scenario, net zero is reached in 2050 and global warming is limited to 1.8 degrees Celsius, and while some sectors are negatively affected the overall impact on gross domestic product growth is limited.

⁶ The late transition scenario assumes that the implementation of policy is delayed until after 2031 and is more abrupt and disorderly. Global warming is still limited to 1.8 degrees in this scenario, but the late and abrupt policy implementation leads to a recession, falling employment and higher risk premiums across financial markets.

⁷ The no additional action scenario assumes no new policies to limit climate change and temperatures rising to 3.3 degrees Celsius above pre-industrial levels. This results in more extreme weather events, permanent impacts on living conditions, lower economic growth and increased macroeconomic uncertainty.

scenario, the report concluded that climate-related credit losses would be 30 per cent lower than in a late transition scenario (Bank of England 2022). Additionally, mortgage losses are relatively small in the early transition scenario, whereas in the late transition scenario, there are large mortgage losses due to increased unemployment and a macroeconomic downturn. In the no additional action scenario, mortgage losses are higher than in the other scenarios and are geographically concentrated in the areas most heavily impacted by flooding, with more than half of these losses arising from just one-tenth of UK postcodes.

Other Commonwealth central banks and financial regulators are also undertaking important work assessing the impact of climate change on their financial systems. Australia, Canada, Singapore, New Zealand and the United Kingdom are planning to, or have, executed a stress test on the impacts of climate change on their financial systems (UNEP 2024). In addition, the central banks of 12 Commonwealth countries are members of the Network for Greening the Financial System (NGFS). This is a group of central banks willing to share best practices and contribute to the development of climate risk management in the financial sector to mobilise finance to support the transition to a sustainable economy. This network (NGFS 2024), in 2023, published climate change scenarios that Commonwealth central banks can use when examining the possible impacts of climate change on their financial systems.

Accounting for climate risk in financial regulations

Commonwealth central banks could in theory go further by amending financial regulations to account for climate change-related risks. For example, central banks could mandate lower reserve requirement ratios for banks that lend more to projects, businesses or sectors that are contributing to the low-carbon economic transition. The *Banque du Liban* (the Central Bank of Lebanon) has implemented such a policy by lowering the reserve requirements of commercial banks that provide significant lending to green projects. Alternatively, central banks could mandate higher reserve requirements for banks that were providing substantial lending to carbon-intensive businesses and projects.

The *Banko Sentral ng Pilipinas* (the Central Bank of the Philippines) also has policies in place to allow for lower reserve requirements for lending to green

projects. More specifically, the bank provides an additional 15 per cent single borrower limit (SBL) and allows a 0 per cent reserve requirement ratio (RRR) for lending to, or financing of, green or sustainable projects (HKTDC Research 2023). To qualify, projects must be aligned with principles outlined by the Philippines Government to ensure they are meeting environmental goals.

There are, however, three significant risks to central banks using binding regulations to address climate change-related risks (Campiglio et al. 2017). First, reducing capital requirements for banks' lending to low-carbon economic transition projects could, especially if those projects are not low risk, undermine the overall objective of prudential policy, which is to reduce the risk of financial instability. Second, if applied to banks' exposure to high-carbon sectors (for example, utilities), climate-aligned prudential policy would constrain lending to those businesses within sectors that have low emissions or credible plans to reduce emissions. Third, unless all jurisdictions implement similar reforms, high-carbon businesses may simply avoid the climate-aligned prudential policy in one jurisdiction by raising finance in another. This would result in more capital being raised in those jurisdictions least concerned with climate change.

Due to these risks, few central banks have used binding financial regulations to mandate lower reserve requirements or similar for financing of low-carbon transition projects and to address climate change-related risk. And arguably, more work needs to be undertaken to understand both the impact of climate change on financial stability (ibid.) and the impact of prudential regulation on the financing of the low-carbon economic transition before Commonwealth central banks consider implementing such a policy.

Encouraging carbon emissions disclosure

Investors' limited understanding of their exposure to climate-related financial risk also impedes the low-carbon economic transition. If investors understood how the businesses and projects they were invested in were exposed to climate change-related risk, they would arguably shift capital away from these high-risk investments and towards the low-carbon economic transition. There has, therefore, been a sustained effort to support disclosure of climate-related risk by the private sector.

The work of the Task Force on Climate-Related Financial Disclosures (TCFD 2021) has been key in encouraging the private sector to disclose climate-related risk. It has developed a single accessible framework for climate change-related financial disclosures, with recommendations structured around governance, metrics and targets, strategy, and risk management. Commonwealth central banks and financial regulators have been strong supporters of the TCFD initiative.

As of October 2023, the TCFD had disbanded after completing its remit. The recommendations from the TCFD are now incorporated into IFRS S1 General Requirements for Disclosure of Sustainability-Related Financial Information, and IFRS S2 Climate-Related Disclosures.

IFRS S1 refers to the general requirements for the disclosure of sustainability-related financial information. The aim of IFRS S1 is to enable companies to communicate and showcase to investors information concerning sustainability-related risks and opportunities over the short, medium and long-term. The required disclosures that must be covered by an entity are (IFRS 2023a):

- a. the governance processes, controls and procedures the entity uses to monitor, manage and oversee sustainability-related risks and opportunities;
- b. the entity's strategy for managing sustainability-related risks and opportunities;
- c. the processes the entity uses to identify, assess, prioritise and monitor sustainability-related risks and opportunities; and
- d. the entity's performance in relation to sustainability-related risks and opportunities, including progress towards any targets the entity has set or is required to meet by law or regulation.

IFRS S2 is the framework for climate-related disclosures and sets out disclosure requirements for a company to disclose information about physical risks and transition risks, in addition to climate-related opportunities. Building on IFRS 1, IFRS 2 specifically sets out requirements to understand (IFRS 2023b):

- a. the governance processes, controls and procedures the entity uses to monitor, manage and oversee climate-related risks and opportunities;

- b. the entity's strategy for managing climate-related risks and opportunities;
- c. the processes the entity uses to identify, assess, prioritise and monitor climate-related risks and opportunities, including whether and how those processes are integrated into and inform the entity's overall risk management process; and
- d. the entity's performance in relation to its climate-related risks and opportunities, including progress towards any climate-related targets it has set, and any targets it is required to meet by law or regulation.

Commonwealth central banks have been strong supporters of the TCFD initiative and the new IFRS. The following paragraphs highlight work by central banks and financial regulators in Australia, Canada, the UK and Malaysia on climate-related financial disclosures.

The Australian Securities and Investment Commission (ASIC) updated its regulatory guidance in August 2019 to encourage TCFD-aligned reporting and welcoming TCFD as the preferred market standard. As of 2024, in preparation for legislation mandating the reporting of climate-related disclosures in Australia, ASIC believes entities are well placed to report under the IFRSs as they are founded on the pillars of the TCFD framework (ASIC 2024).

The Canadian Government provided COVID-19 relief financing to larger employers that was partly dependent on them publishing TCFD-aligned disclosures. In 2023, it also created the Canada Sustainability Standard Board (CSSB) to develop disclosure standards that largely align with IFRS S1 and IFRS S2 (PWC 2024). In March 2024, The CSSB announced its first proposed disclosure framework and at the time of writing, this was open for public consultation (FRAS Canada 2024).

The UK Government has mandated climate-related financial disclosures since April 2022 for large companies and financial institutions (UK Government 2022). It has also indicated its intent to align with future ISSB standards (UK Government 2024c).

The Advisory Committee on Sustainability Reporting in Malaysia (ACSR), formed in May 2023 and chaired by the Securities Commission Malaysia (SC), has recently undertaken a consultation on

IFRS S1 and S2. This consultation aims to update domestic sustainability reporting requirements and ensure that the IFRSs are used as the baseline standard (ACSR Malaysia 2024).

These initiatives by central banks and financial regulators in Commonwealth member countries have played an important role in the global movement towards reporting climate change-related financial disclosures in conformity with the new IFRS. At COP28 in 2023, close to 400 organisations from 64 jurisdictions committed to adopting the new IFRS S1 and IFRS S2, which were first issued in July 2023 (IFRS 2023c). The Investor Group on Climate Change, with over US\$120 trillion of assets under management have signed on, in addition to 25 stock exchanges, as well as the African Securities Exchanges Association and the Arab Federation of Capital Markets, which represent 44 stock exchanges combined. This indicates the growing willingness of jurisdictions to adhere to uniform practices in this area, ensuring that climate-related risks can be identified and understood.

Assisting financial institutions to assess the extent to which the companies and projects they finance are contributing to climate change

Central banks also have a role to play in assisting financial institutions to better understand the extent to which the businesses and projects they are investing in are contributing to the Paris Agreement's goals. *Bank Negara Malaysia* (the Central Bank of Malaysia) has undertaken important work in this area. More specifically, it has recently introduced a principle-based taxonomy (Bank Negara Malaysia 2021) to assist financial institutions in assessing and categorising the businesses and projects they invest in according to the extent to which they contribute to climate change and the low-carbon economic transition.

This taxonomy uses five broad principles (climate change mitigation, climate change adaptation, no significant harm to the environment, remedial measures to transition and prohibited activities) to place businesses and projects into three broad classification themes (climate supporting, transitioning or watching). Figure 3.1 further describes these classification themes and the different actions financial institutions should undertake, depending on whether a company or project falls into the climate-supporting, transitioning or watching theme.

Greening central banks' portfolios

Central banks are also beginning to consider how they can green their investments. The reference interest rate was traditionally the main tool used by central banks to operate monetary policy, but since the 2008 financial crisis, there have been significant quantitative-easing programmes. Under these programmes, central banks have stimulated their economies by buying government and corporate bonds. This has also led to some central banks becoming significant investors in corporate debt.

Most quantitative easing corporate debt programmes aim to be market neutral. In practice, this means that central banks' purchases are allocated across sectors of the economy according to the amount of eligible debt that is outstanding in each sector.⁸ This approach results in central banks investing in large carbon-intensive companies, as such companies are significant issuers of investment-grade corporate debt. Central banks purchasing significant amounts of carbon-intensive debt may signal to the market that those securities are liquid and low risk and, thus, have the unintended consequence of furthering carbon lock-in for the economic system. It also seems somewhat paradoxical that central banks are highlighting the financial risks of climate change while also investing in carbon-intensive companies.

It has, therefore, been suggested that central banks should green their quantitative-easing programmes (Van Lerven and Ryan-Collins 2017). This could involve excluding corporate bonds from carbon-intensive companies and favouring bonds from low-carbon projects in quantitative-easing programmes. Alternatively, central banks could continue with market-neutral quantitative-easing programmes and run an additional asset purchase scheme for low-carbon financial assets only.

The greening of quantitative-easing programmes is, however, a controversial policy (Krogstrup and Oman 2019). Quantitative easing was intended to be a cyclical policy instrument aimed at providing a temporary stimulus to the economy, and using quantitative easing to engineer a low-carbon structural change may not be entirely consistent with that objective. Expanding quantitative-easing programmes beyond investment-grade corporate debt to the financing of riskier low-carbon transition

⁸ This is, for example, the approach taken by both the Bank of England's Corporate Bond Purchase Scheme and the European Bank's Corporate Sector Purchase Programme.

Figure 3.1 Bank Negara Malaysia's climate change principle-based taxonomy and its implications for financial institutions



Source: Adapted from Deloitte (2021)

projects may also lower the quality of the portfolio, especially if central banks lack the expertise to evaluate the relative credit risk of different green projects and technologies.

Despite these controversies, there have been careful steps by Commonwealth central banks to green their asset purchases. The Bank of England, for example, recently published a discussion paper outlining options for greening its corporate bond purchase scheme (Bank of England 2021b). Interestingly, the Bank of England rejected the policy of divesting from high-emissions bonds and buying low-emissions bonds for two reasons (Hauser 2021). First, high-emissions bonds are issued by companies that arguably need to be persuaded to embark on policies to reduce their emissions, and selling these bonds risks them being purchased by investors with a low commitment to the Paris Agreement. Second, simply selling high-emissions

bonds penalises those companies that have high emissions but also a credible plan to reduce such emissions. Thus, instead of indiscriminate portfolio decarbonisation, the Bank of England's proposed strategy includes incentivising companies to take decisive action to achieve net zero, leading by example and learning from others, and ratcheting up investments over time. It intends to operationalise this strategy through targets for eligibility, tilting and escalation (see Figure 3.2).

This section discussed central bank policies to make financial flows consistent with the Paris Agreement. Two important, and relatively uncontroversial, policies that central banks can pursue are encouraging climate change-related financial disclosures by companies and assessing the impact of climate change-related financial risk. Countries with significant capital markets should consider further action in these areas.

Figure 3.2 Proposed tools for the green corporate bond purchase scheme

Source: Adapted from [Hauser \(2021\)](#)

3.4 Should, and how can, Commonwealth sovereign wealth funds invest in the low-carbon transition?⁹

Sovereign wealth funds (SWFs) are government-owned investment funds with macroeconomic objectives. There are 26 such funds in the Commonwealth, with US\$1.6 trillion in assets under management. A further 15 Commonwealth countries are considering establishing such funds. SWFs could play an important role in making financial flows consistent with the Paris Agreement for three reasons.

First, the investment policies of SWFs should, as state-owned funds, arguably be aligned with their country's international commitments under the Paris Agreement. Other large investors, such as pension funds, are in contrast responsible for investing on behalf of individuals who are not signatories to the Paris Agreement and may not be committed to its goals.

Second, SWFs are often able to make large, illiquid and long-term investments at scale. Such characteristics provide SWFs with a comparative advantage when investing in low-carbon economic transition projects that may be unprofitable in the short term, but which may have attractive long-term returns.

Third, markets and investors often look to SWFs for leadership. Markets may consider that the relationships between SWFs and governments provide them with pertinent insights into how future changes in regulations and public policies will affect relative returns from carbon-intensive and low-carbon economic transition projects. Thus, if a SWF starts investing in low-carbon transition projects, this may leverage further investment by private sector investors who have concluded that future changes in public policies will increase the profitability of that investment.

The One Planet Sovereign Wealth Fund Framework recognises the important contribution SWFs could have in achieving the Paris Agreement's goals (One Planet SWF Network 2024). This group consists of 15 leading SWFs that are committed to accelerating the integration of climate change issues into the management of large, long-term asset pools, thereby improving long-term returns. The achievement of this goal is guided by the principles of alignment (building climate change considerations into decision-making), ownership (encouraging companies to address climate change in their activities), and integration (building consideration of climate change-related risks and opportunities into investment management).

The NZ Super Fund was a founding member of the One Planet Sovereign Wealth Fund group. It was established to help reduce the future tax burden of universal pensions on New Zealanders and has

⁹ This section is based on an earlier article by [Wilde \(2020\)](#).

developed a detailed climate change strategy (New Zealand Super Fund 2019). This strategy is underpinned by the belief that climate change presents material risks that are caused by multiple interacting drivers, including physical damage, loss of natural resources, regulatory action and technological innovation. The NZ Super Fund also considers that this carbon risk is currently underpriced in the market, and that targeting reductions in the carbon emissions of its portfolio is thus consistent with its mandate of 'maximising return without undue risk to the fund'.

The climate strategy of the NZ Super Fund ('the Fund') aims to reduce the carbon emissions of its portfolio and exposure to carbon risk by: reducing exposure to fossil fuel companies and other companies that are also at significant risk from climate change; investing in the low-carbon economy; and international engagement on climate change.

In 2022, the NZ Super Fund significantly reduced its exposure to carbon risk by shifting the reference benchmark to an index that only includes investment in equities that are aligned with the Paris Agreement's goals. This change related to the Fund's passive investments in global equities that are worth about NZ\$25 billion, equivalent to 25 per cent of its assets under management. This change will reduce the exposure of the Fund to carbon emissions and should improve environmental, social and governance outcomes in general.

There has also been increased investment in the low-carbon economy by the Fund. For example, the Fund invested approximately NZ\$1 billion in renewable energy in the United States and made substantial investments in funds focused on energy efficiency and the energy transition. The NZ Super Fund has also established a partnership with Copenhagen Infrastructure Partners to explore the potential for large-scale offshore wind in South Taranaki Bay, New Zealand.

The NZ Super Fund also engages on climate change investment policy in both in New Zealand and internationally. In New Zealand, the Fund is working with other NZ Government-owned investors on a collaborative initiative to engage with NZ companies on climate change. It has released a joint position statement on climate change and will engage directly with large New Zealand companies, initially those listed on the NZX50.

There is also a programme of work at the NZ Super Fund that engages with individual companies in New Zealand to:

- understand their progress on climate change awareness, capability and commitments;
- understand how they are meeting regulatory requirements on climate-related disclosures and reporting;
- support companies to prepare for the transition by sharing knowledge of climate change risks and opportunities from the institutional investor perspective; and
- understand how companies' plans will align with New Zealand's net zero commitments over time.

Much of the NZ Super Fund's global engagement on climate change is undertaken through international collaborations with other investors. The Fund considers that this gives it much wider reach. These collaborations include: the Investor Group on Climate Change, the United Nations Principles on Sustainable Investment, and the Carbon Disclosure Project.

The NZ Super Fund is also committed to defining, targeting and reporting its carbon exposure. It defines 'carbon exposure' as both the current carbon emissions intensity ('emissions intensity') and the potential future carbon emissions from fossil fuel reserves ('fossil fuel reserves'). Its short-term targets to 2025 were to reduce the potential emissions from fossil fuel reserves held by the Fund by at least 80 per cent and to reduce the carbon emissions intensity of the Fund by at least 40 per cent. As of June 2023, the Fund had already achieved these targets, with the estimated reduction in its carbon footprint being:

- 60 per cent, as measured by emissions intensity; and
- 99 per cent as measured by fossil fuel reserves.

These percentage reductions are measured against the Fund's unadjusted Reference Portfolio as of 30 June 2023 (that is, what the Fund would have owned if it hadn't implemented the carbon reductions).

Overall, the NZ Super Fund provides a strong example of a detailed and effective climate change investment strategy.

Singapore's Temasek Fund is also undertaking important work to ensure that its investments are consistent with achieving the Paris Agreement's goals, including by:

- Setting a high-level goal to reduce the net carbon emissions from its portfolio by 50 per cent by 2030 (compared to 2010 levels), with the long-term ambition of achieving net zero emissions by 2050.
- Actively investing in sustainable solutions in food, water, waste, energy, materials, clean transportation and the built environment to spur the development of novel and disruptive decarbonisation technologies with promising potential for scalability.
- Establishing the investment platform GenZero to accelerate decarbonisation globally by investing in nature- and technology-based solutions, as well as carbon ecosystem enablers.
- Setting up Decarbonization Partners with BlackRock to invest in the scaling-up of proven next-generation decarbonisation solutions to reduce and eliminate carbon emissions.
- Engaging on climate transition with portfolio companies in a structured way based around the Climate Transition Readiness Framework. This includes engaging with 16 portfolio companies based in Singapore and 3 portfolio companies based overseas, who together account for 94 per cent of the total portfolio emissions. This engagement contributed to 11 of the engaged companies setting targets to achieve net zero by 2050.

Despite the best practice examples sets by the NZ Super Fund, Temasek and others, there is scope for other SWFs to better align their portfolios with the Paris Agreement. Few SWFs have climate change strategies, report the carbon emissions of their portfolios or consider climate change-related financial risks. Overall, SWFs invest less than 1 per cent of their funds (Capapé 2018) in low-carbon economic transition projects. The managers of SWFs should, therefore, seek to better understand the impact of the low-carbon economic transition on their funds and ensure their funds contribute to achieving the Paris Agreement's goals. They can do this by:

- evaluating the impact of the low-carbon economic transition on their revenues;

- increasing the resilience of their portfolios to climate change risks; and
- investing in the low-carbon economic transition.

Each of these policies is discussed below.

Twenty-six (26) SWFs are financed by revenues from fossil fuel production (IE Foundation 2018). Achieving the Paris Agreement's goals requires an overall decline in the production and consumption of fossil fuels (McGlade and Ekins 2015), and this may result in a decline in revenue for those funds financed by oil and gas production. Conversely, one way to reduce the consumption and production of fossil fuels is to increase taxes on fossil fuel production, which could substantially increase the revenues received by SWFs. One recent study (Wilde and Price 2017) concluded that a 46 per cent global tax on the revenues of oil-producing companies would cause oil production to fall to a level consistent with limiting climate change to 2 degrees Celsius, and that this would also raise US\$1.9 trillion in government revenue per annum. It is, therefore, important that SWFs carefully consider the impact of public policies to achieve the Paris Agreement on their future revenues. This might include SWFs modelling their deposits, withdrawals and total assets under management under different climate change scenarios and adapting their investment policies in light of these findings.

SWFs continue to invest in carbon-intensive and fossil fuel companies. These investments may not be consistent with the Paris Agreement's goals, with a recent study (Carbon Tracker 2019) concluding that all the major oil companies are sanctioning projects that are inconsistent with limiting climate change to well below 2 degrees Celsius and which will not deliver adequate returns in a low-carbon world.

Thus, for SWFs that are seeking to increase their resilience to climate change-related financial risk and maximise their long-term risk-adjusted return, it will be essential to develop specific, detailed policies to manage climate change-related investment risks. These policies may involve identifying and divesting from those sectors that are driving climate change. This may, for example, involve divesting from companies that mine fossil fuels and/or are carbon intensive. The Ireland Strategic Investment Fund and Norway's Government Pension Fund Global have taken

significant action in this area by divesting from selected fossil fuel companies. Likewise, the equity portfolio of Trinidad and Tobago's Heritage and Stabilisation Fund is benchmarked against the MSCI EAFE ex Energy Index, which excludes companies that own oil, gas and coal reserves.

SWFs divesting from companies that mine fossil fuels and/or are carbon intensive may directly reduce the capital available to such companies. Such divestment may also signal to other investors – who see SWFs as 'bellwethers' due to their size, capacity and relationship with governments – that fossil fuel and/or carbon-intensive companies are unlikely to have high long-term risk-adjusted returns.

However, the disadvantage of such a divestment strategy is that it may lead to the ownership of fossil fuel and carbon-intensive companies becoming concentrated among investors who are unconcerned by climate change and achieving the Paris Agreement's goals. This risk can be partly ameliorated by SWFs following the more nuanced policy of only divesting from those companies that have no strategy for making their activities consistent with the Paris Agreement's goals.

An alternative to divestment is for SWFs to actively engage with the managers of those fossil fuel-mining and carbon-intensive companies that they own to ensure that those companies have prudent strategies in place to ensure that their activities are consistent with the Paris Agreement's goals in the medium and long term. However, for SWFs to successfully pursue this engagement strategy, they must have significant capacity to review and understand companies' business plans and own significant stakes in the companies they are trying to influence.

Limiting climate change also requires significant investment in the low-carbon economic transition. This will require investment in new industries, technologies, business models and production processes to decouple economic activity from greenhouse gas emissions. SWFs

should develop detailed policies for identifying and evaluating investment opportunities in the low-carbon economic transition and for evaluating the contribution of these projects to the Paris Agreement's goals.

Overall, SWFs should play a leading role in investing to achieve the Paris Agreement. Their size and long-term investment horizons should give them a comparative advantage over many other investors when developing investment strategies that consider climate change, but to date, many SWFs have not developed such strategies. Going forward, SWFs should rectify this by developing climate change investment strategies that consider how to invest in the low-carbon economic transition and how to reduce climate change-related investment risk. These strategies should be consistent with the commitments of their government owners under the Paris Agreement.

3.5 Conclusion

Commonwealth member countries should consider a range of capital market policies to make financial flows consistent with the goals of the Paris Agreement. This report highlights three broad sets of such policies.

First, low-carbon transition businesses' access to financing at each step on the finance escalator should be reviewed with a view to identifying the constraints these businesses face in accessing finance and considering how public policies can ameliorate these constraints.

Second, Commonwealth central banks should work to better understand climate change-related financial risks and further encourage businesses to make climate change-related financial disclosures.

Third, Commonwealth sovereign wealth funds should develop detailed climate change investment strategies and ensure that their investments are consistent with the Paris Agreement's goals.

Conclusion

The world is committed to limiting climate change to 1.5 degrees Celsius. But 'business-as-usual' will not achieve this goal. Greenhouse gas emissions continue to rise, forecast emissions are higher than the carbon budget consistent with limiting climate change to 1.5 degrees Celsius and, given current policies, fossil fuel production is expected to continue increasing. Countries need to implement new policies if they hope to tackle climate change.

This report has examined three such policies: carbon taxation, renewable energy auctions and capital market policies. These policies, if well-designed and widely implemented, have the potential to significantly reduce emissions and contribute to the achievement of the Paris Agreement's goals.

The idea behind carbon taxation is simple: tax carbon and incentivise emitters to reduce emissions and transition to clean energy and/or reduce their energy consumption. It potentially provides the triple benefit of higher government revenues, increased investment in clean energy and lower emissions. There is also increasing empirical evidence that carbon taxation significantly reduces emissions.

However, well-designed carbon taxes are essential to maximise emissions reductions and build public support for this measure. This report has stressed that three design features are particularly important.

First, the carbon tax should cover most emissions. This can be achieved by the tax being levied on both the carbon content of fuels and on emissions from industrial processes.

Second, the tax should be easy to administer. One way to realise this goal is to levy the tax upstream on the producers, refiners and importers of fossil fuels and on large industrial emitters – because levying the tax on these relatively few, large and sophisticated taxpayers simplifies administration and audit.

Third, the tax should be consistent with a just transition. The earmarking of revenues from the carbon tax for spending on programmes that assist low-income households is one way of achieving this goal.

Renewable energy auctions have become an increasingly popular policy for financing the construction of new clean energy generation capacity. This report examined renewable energy auctions in Malaysia, the United Kingdom and South Africa, and found that in all three cases, auctions increased electricity generation capacity and reduced costs. It also argued that three key lessons could be drawn from these case studies:

1. the government guaranteeing electricity generation companies a price per kWh of electricity generated reduces risk, lowers hurdle rates and contributes to lower costs over time;
2. regularly auctioning significant capacity increases regulatory certainty and can lead to economies of scale that drive down costs; and
3. maximising the benefits from clean energy also requires that policies are put in place to finance improvements to the grid and increase electricity storage.

This report has also examined capital market policies to limit climate change. It argued that businesses at the cutting edge of the energy transition often face constraints in access to financing, which justifies public programmes to provide seed financing and venture capital. Central banks and financial regulators can also play an important role in limiting climate change by assessing the impact of physical, transition and liability risks on the future finances of financial institutions, and by encouraging (or in some cases mandating) that companies make climate-related financial disclosures. The role that sovereign wealth funds could play in limiting climate change – by setting high-level targets for emissions reductions from their portfolios, investing in the clean energy transition, and engaging with high-emitting companies to ensure they have policies in place to reduce their emissions over time – were also discussed.

In conclusion, new policies and increased effort are required to achieve the Paris Agreement's goals and limit climate change. Carbon taxation, renewable energy auctions and capital market reforms are three such policies, and governments should carefully consider implementing these policies as part of their efforts to transition away from fossil fuels to clean energy.

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