Boom and Bust: The fiscal implications of fossil fuel phase-out in six large emerging economies

GSI REPORT

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Global Subsidies Initiative

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Executive Summary

Soaring commodity prices in the first half of 2022 have resulted in windfall revenues for fossil fuel producers and public pressure to reduce fuel prices. Hence, some governments have reaped high revenues from fossil fuel production while losing income from taxes on consumption. Public revenues from fossil fuels, which are already erratic, will become increasingly unreliable as the clean energy transition gathers pace. To comply with the Paris Agreement, the world will have to phase down fossil fuels, which will erode related revenues. The rate of change is unpredictable, and countries need to plan for all eventualities.

This report examines the possible fiscal consequences of phasing out fossil fuels in six emerging economies and suggests strategies for managing the transition. The countries—Brazil, Russia, India, Indonesia, China, and South Africa (BRIICS countries)—represent 45% of both the world's population and its carbon dioxide (CO_2) emissions, 25% of global GDP, and a significant share of the world's poor. The BRIICS countries are particularly vulnerable to the fiscal impacts of the energy transition because of their high reliance on fossil fuel revenues (Table ES1). The aim of this report is to support BRIICS and other governments in planning for a managed transition to net-zero and to reduce the risk of revenue crises that could reverse progress on poverty eradication and economic development.

Table ES1. Government revenues from fossil fuels in the BRIICS countries, 2019

	USD billion	% total government revenue	% GDP
Brazil	51.3	8.4	2.7%
China	151.7	4.8	1.1%
India	92.9	18.0	3.4%
Indonesia	21.7	15.7	1.9%
Russia	156.6	33.7	9.3%
South Africa	6.3	5.5	1.6%

Note: Values presented take into account only first order, direct government financial revenues.
Sources: Revenue data was gathered and estimated by the International Institute for Sustainable Development (IISD) for this report.

In the 2015 Paris Agreement, countries agreed to hold "the increase in the global average temperature to well below 2°C … and to pursue efforts to limit the temperature increase to 1.5°C." We find that an energy pathway consistent with limiting global warming to 1.5°C to 2°C will cause substantial reductions in government fossil fuel revenues in most of the BRIICS countries. The projections are based on 2019 revenue data and scenarios for energy demand and supply to 2050 by the International Energy Agency (IEA). Our objective was to project trends in revenues from fossil fuels rather than precise point-in-time estimates. We kept the analysis as simple and transparent as possible by making few complex assumptions. Notably, countries are assumed to maintain the same average tax burden as in 2019.

Our projections based on the IEA's Sustainable Development Scenario (SDS; consistent with 2°C warming) indicate that direct public fossil fuel revenues could fall to around 35% of 2019 levels for Brazil, China, Indonesia, and Russia by 2050, while India's and South Africa's revenues could fall to around 65% of 2019 levels (Figure ES1). However, the SDS is not sufficient in its ambition, as 2°C equates to an unacceptable risk of extreme global warming. Further, the scenario relies heavily on unproven CO_2 removal technologies and makes optimistic assumptions about the rapid deployment of carbon capture and storage to compensate for some CO_2 emissions. The SDS is therefore likely significantly overestimating the continued extent of fossil fuel use.

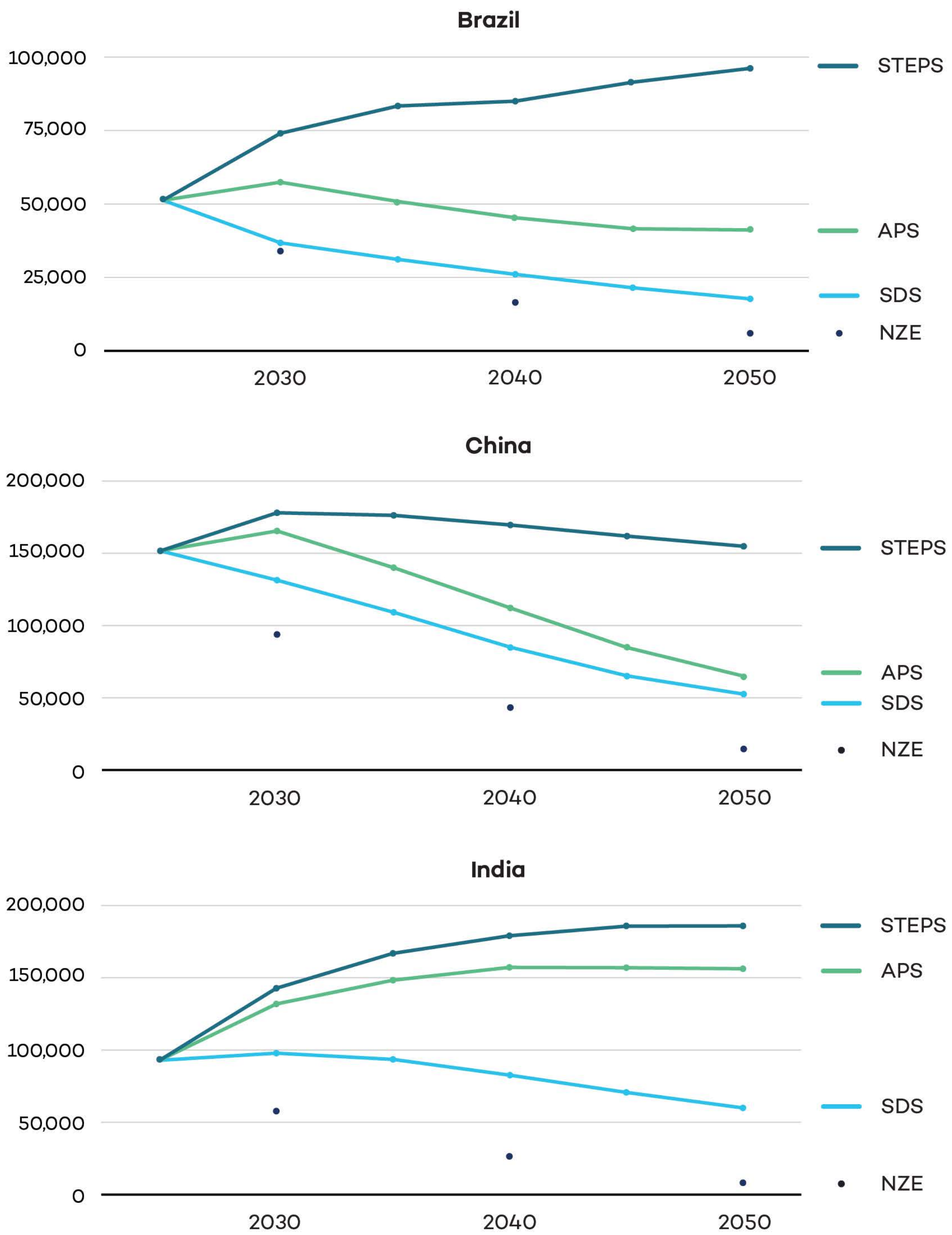
The decline in fossil fuels, and therefore fossil revenues, would be more pronounced under energy pathways consistent with a 1.5°C temperature ceiling. The IEA has not published country-level estimates of energy demand and supply for its Net Zero Emissions by 2050 Scenario (NZE), which limited our ability to project revenues. As a broad illustration, we estimated that fossil fuel revenues would fall to around 10% of 2019 levels by 2050 under NZE (Figure ES1), assuming revenues fall in proportion with the IEA's projected change in the global supply of coal, oil, and gas. Our other projections are based on country-level projections of fuel demand and supply, plus predicted changes in prices.

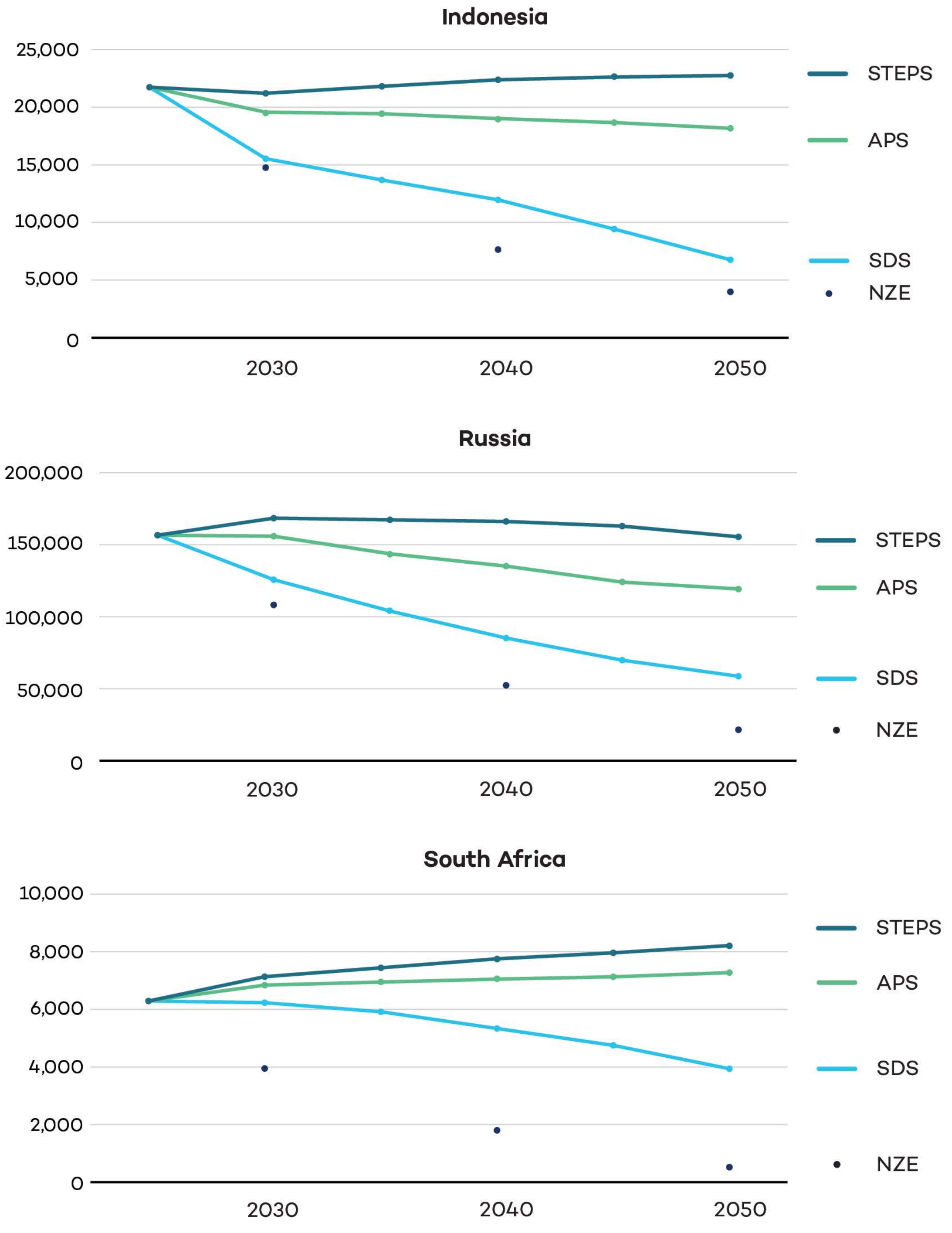
Other research indicates that the fossil fuel phase-out needs to occur sooner than modelled in NZE. A March 2022 report by the Tyndall Centre found that a 1.5°C temperature ceiling would require all countries to cease coal production by 2040 and oil and gas production between 2034 and 2050 (the range reflects equity principles and transition capacities). The phase-out is necessary to meet climate objectives, but the fiscal impacts could be severe.

The SDS and NZE scenarios are normative: they show what needs to happen to meet climate objectives. The IEA's other two scenarios are based on current policy settings and commitments. Our revenue projections based on the Stated Policy Scenario (STEPS or "business as usual") suggest that most BRIICS countries are likely to experience some increase in fossil fuel revenues until at least 2030 (Figure ES1). However, the STEPS pathway is untenable because it would result in a temperature increase of 2.6°C by 2100. The revenues we project under STEPS are likely to be short-lived because countries will increasingly implement policies to achieve their climate commitments. This trend is illustrated by our revenue projections for the Announced Pledges Scenario, which assumes all countries will meet their climate commitments in full and on time (Figure ES1).

Comparing the projections, we find the potential revenue gap is huge. Total public fossil fuel revenues in BRIICS countries could be USD 178 billion lower by 2030 and USD 216 billion lower by 2050, based on SDS compared with business as usual (STEPS). This revenue gap increased to USD 278 billion by 2030 and USD 569 billion by 2050 for our projections based on NZE.

Figure ES1. Projections of fossil fuel revenues in BRIICS countries based on IEA scenarios (USD million)





Notes: 1. STEPS = Stated Policy Scenario, APS = Announced Pledges Scenario, SDS = Sustainable Development Scenario (below 2°C); NZE = Net Zero Emissions by 2050 Scenario (1.5°C). 2. NZE is based on global energy supply only, while other scenarios used country-level data on fossil fuel demand and supply, as well as predicted changes in fuel prices.

Source: Authors' projections based on IEA, 2022d (Extended Dataset) and NZE datasets (see the main report).

The wide range of possible revenues indicates that the future is difficult to predict. In our view, the most likely outcome is that BRIICS countries will experience a near-term boost in fossil fuel revenues under existing policy settings (STEPS) before a decline associated with the global clean energy transition (APS, SDS, and NZE). Countries should consider all reasonable scenarios and establish policies that can respond to these. The year 2030 might seem distant, but billions in revenue are not replaced overnight, and governments need to start early to shift and diversify their income streams. Putting in place a fiscal transition strategy is a no-regrets policy that will prevent shortfalls in public revenues and ensure fossil revenue dependence does not become an impediment to reform.

Fiscal transition plans can be designed to accelerate the energy transition while reducing poverty and inequality. There are two key elements. First, the near-term boom in fossil fuel revenues needs to be used strategically. Various options are available, but we propose a new financial mechanism that uses public revenue to leverage private sector lending and private investment in decarbonization and just transition projects: green, social, and sustainability (GSS) bond support funds. Under this proposal, individual governments would use a share of their fossil fuel revenues to provide a debt guarantee for bond issuances by private or public sector borrowers for eligible projects (such as renewable energy or job creation projects). This would help to fund the energy transition and, by promoting investment, boost economic growth and, ultimately, government revenues. We estimate that USD 10 billion investment in a GSS bond support fund could support USD 400 billion in investment.

Second, declining fossil fuel revenues will require governments to cut spending or increase other revenue streams. This can be done through economic and fiscal diversification that supports decarbonization and sustainable development. The main approaches include (i) removing subsidies and increasing taxes on fossil fuels (including carbon pricing), and using some of the revenues to protect vulnerable consumers; (ii) swapping remaining well-targeted subsidies from fossil fuels to low-carbon energy where possible; and (iii) introducing new taxes and charges in the energy and transport sectors. These measures can be designed to ensure progressive outcomes, including in emerging economies.

Finally, we trust that the revenue data and projections presented in this report will assist analysis by others of related topics, including

- The implications of Russia's invasion of Ukraine given Russia's high fiscal vulnerability to changes in fossil fuel use.
- The impact of high fossil fuel prices on the speed of the transition (and associated risks and opportunities).
- The impact of the energy transition on the fiscal capacity of the BRIICS countries to service foreign debt.

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Abbreviations and Acronyms

APS	Announced Pledges Scenario
bbl	barrel of oil
BRICS	Brazil, Russia, India, China, South Africa
BRIICS	Brazil, Russia, India, Indonesia, China, South Africa
CBI	Climate Bond Initiative
CO_2	carbon dioxide
EU	European Union
EV	electric vehicle
FFDC	fossil fuel-dependent country
GDP	gross domestic product
GSS	green, social, and sustainable [bonds]
IEA	International Energy Agency
IISD	International Institute for Sustainable Development
IFC	International Finance Corporation
IMF	International Monetary Fund
IPSF	International Platform on Sustainable Finance
NZE	Net Zero Emissions by 2050 Scenario
OECD	Organisation for Economic Co-operation and Development
RWA	risk-weighted asset
SDS	Sustainable Development Scenario
SOE	state-owned enterprise
STEPS	Stated Policy Scenario
tCO_2e	tonne of carbon dioxide equivalent
TPES	total primary energy supply
UNFCCC	United Nations Framework Convention on Climate Change
VAT	value-added tax
WEO 2021	World Energy Outlook 2021

1.0 Introduction

Fossil fuels are an important source of government revenue for many countries. This is particularly true of resource-rich countries and provinces where oil rents range up to 40% of GDP, natural gas up to 30%, and coal up to 7% (2019 data) (World Bank, 2022c).[1] Consumer fuel taxes are widespread. In recent years, they comprised approximately 4.5% of government revenue in advanced economies and 4% in developing economies but rose to over 10% in some countries (International Energy Agency [IEA], 2021e).

Achieving the 2015 Paris Agreement undertaking to hold "the increase in the global average temperature to well below 2°C … and to pursue efforts to limit the temperature increase to 1.5°C" could therefore have major fiscal consequences (United Nations Framework Convention on Climate Change [UNFCCC], 2015b). Calverley and Anderson (2022) found that a 50% chance of meeting the 1.5°C target requires all developing countries to cease coal production (and, by extension, consumption) by 2040. For oil and gas, the same study estimated that all countries would need to eliminate oil and gas production between 2034 and 2050 (Calverley & Anderson, 2022). The range reflects equity principles and transition capacities in line with the Common But Differentiated Responsibility and Respective Capabilities principles in the Paris Agreement. Wealthier nations need to decrease their production much faster, while lower-income countries with high fossil fuel dependencies are given more time to do so.

Combined with commensurate drops in fossil fuel consumption, these changes in fossil fuel production would wipe out most fossil fuel revenues by mid-century at the latest. According to the Carbon Tracker Initiative (2021), combined government oil and gas revenues worldwide could drop by around half (or USD 13 trillion) over the next 2 decades under a low-carbon scenario compared with business-as-usual expectations. The IEA has projected that tax revenue from oil and natural gas retail sales could fall by around 90% between 2020 and 2050 under its Net Zero Emissions by 2050 Scenario (NZE) (IEA, 2021b). Beyond fiscal capacity, there is growing concern that delayed or sudden transitions could cause macroeconomic shocks and financial instability (Allen et al., 2020).

Countries' decarbonization strategies can affect the fiscal impacts of reforms. D'Arcangelo et al. (2022) find that decarbonization strategies are likely to include three main components:

1. Emission pricing policy instruments
2. Standards and regulations
3. Complementary policies to reallocate capital, labour, and innovation to low-carbon activities and offset the adverse distributional effects of reducing emissions.

Not all of these policies will have a negative impact on government budgets. Eliminating subsidies and increasing taxes on fossil fuels, implementing emissions pricing instruments (such as carbon taxes and trading schemes), and reducing the social costs of fossil fuels

[1] Oil rents are the difference between the value of crude oil production at regional prices and the total cost of production.

(i.e., by reducing related air pollution and climate change) can all have positive impacts on government budgets (discussed in detail in Section 5).

The fiscal impact of declining fossil fuel demand and potential government response strategies have received considerable attention in relation to fossil fuel-dependent countries (FFDCs) (Box 1).[2] Several studies have also examined the impacts on consumer revenues and recommended alternative income streams (Elgouacem et al., 2020; IEA, 2021b; Organisation for Economic Co-operation and Development [OECD] & International Transport Forum, 2019). Reflecting the growing concern around energy and fiscal transitions, international organizations are increasingly tracking fossil fuel revenues.[3]

Box 1. Fiscal transition in major fossil fuel-producing countries

As the world transitions to low-carbon energy, fossil fuel producers will experience declines in revenue due to lower demand in the medium term (i.e., possibly from 2030, depending on modelled decarbonization scenarios), but the larger impact is likely to be from the fall in prices expected to accompany lower demand (Carbon Tracker Initiative, 2021; IEA, 2021b, 2021d). Oil and gas producers will be the most vulnerable. Even for large coal producers and exporters, coal revenue was well below 5% of GDP in all countries other than Mongolia (7% of GDP) (World Bank, 2022c). Nonetheless, within countries, revenue impacts on coal-producing districts could be significant (Clark & Zhang, 2022).

Vulnerability to fossil fuel phase-out varies significantly between countries depending on revenue dependency, the ease of extraction of fossil resources, and the country's capacity to diversify into other sectors. Carbon Tracker Initiative (2021) compared revenues for 40 "petrostates" based on business as usual and a low-carbon pathway. The study found that more than 20 of the petrostates would see declines in revenue of over 20%. Six countries would see declines of over 50%, including four countries ranking very low on the Human Development Index: Angola, Equatorial Guinea, South Sudan, and Timor Leste (Carbon Tracker Initiative, 2021).

Countries with resources that are expensive to extract are likely to experience disproportionate declines in revenue. With a breakeven price of around USD 88 per barrel (bbl), Canada's oil sands will be among the first to become uneconomic, while lower-cost production, such as onshore oil in the Middle East (with a breakeven price around USD 25/bbl), will remain profitable for longer (Peszko et al., 2020).

Vulnerability is also determined by a country's economic diversification, human capital, institutions, and governance (Peszko et al., 2020). These factors determine a country's

[2] FFDCs derive 20% or more of government revenue from fossil fuels (Elgouacem et al., 2020).

[3] Some International Monetary Fund (IMF) Article IV country reports provide fossil fuel revenue as a percentage of total fiscal revenues; the OECD Taxing Energy Use series provides data on effective carbon taxes (OECD, 2019b); the World Bank compiles data on coal, gas, and oil rents as percentage of GDP (World Bank, 2022c); the Extractives Industries Transparency Initiative uses the IMF Global Financial Statistics framework; and Harvard University academics collected an original dataset on the monthly value of gasoline taxes and subsidies in 157 countries from 2003 to 2015 (Mahdavi et al., 2020).

ability to pivot to alternative economic activity, attract investment, generate alternative revenue streams (Peszko et al., 2020), and it's capacity to ensure fair treatment for extractive workers (Calverley & Anderson, 2022). Norway, for example, derives 15% of its GDP from fossil fuels but is resilient to declines in these revenues given its complex economy (Peszko et al., 2020). Resilience will be lower for countries narrowly focused on fossil fuels and with a poor investment environment. Countries that have diversified into high-carbon industries, such as fertilizer and cement, may see reduced incomes due to high prices for the embedded carbon in these products, such as through border carbon adjustment mechanisms.

In addition to the constraints of planetary boundaries, including climate, the ability of fossil fuel producers to cash in early on their reserves is constrained by logistical factors and potentially falling demand. Based on past reserve-to-production ratios, most countries must wait 45 years on average to liquidate their fossil fuel wealth unless they can find ways to significantly increase their rates of production (Cust et al., 2017). But most of these reserves (60% of oil and fossil methane gas and 90% of coal) need to remain unextracted to keep within a 1.5 °C carbon budget (Welsby et al., 2021).

Section 6 provides a review of economic and revenue diversification strategies.

In 2019, the International Institute for Sustainable Development (IISD) first examined fossil fuel revenue dependence and subsidies in Brazil, China, India, Russia, and South Africa (BRICS) (Gerasimchuk et al., 2019), as well as Indonesia and Mexico (Braithwaite & Gerasimchuk, 2019; Sanchez et al., 2019). A rapid and managed transition to low-carbon energy in emerging economies is vital if extreme damage to economies and livelihoods from climate change is to be averted (Box 2). But this will have major fiscal implications, given that fossil fuels are deeply embedded in BRICS public finances in the form of revenues, subsidies, production-sharing contracts, and energy state-owned enterprises (SOEs). The result is "carbon entanglement," where governments have major economic and political stakes in bringing fossil fuels to market and harnessing their share of the rents (Gurría, 2013).

Box 2. Characteristics of the BRICS countries plus Indonesia (BRIICS)

BRICS is an informal group of large emerging economies: Brazil, Russia, India, China, and South Africa. The leaders of Brazil, China, India, and Russia started meeting at annual summits in 2009, with South Africa joining in 2011. Indonesia is not a member of the group but is included in this report as a large emerging economy that will undergo a challenging energy and fiscal transition due to declining oil revenues and high reliance on coal.

BRIICS represent 45% of the world's population (World Bank, 2022c) and its carbon dioxide (CO_2) emissions, 25% of global GDP (and growing), and a significant share of the world's poor (Table 1). BRIICS countries include major coal, natural gas, and oil producers and rely on fossil fuels for most of their energy. All BRIICS countries had growing economies in 2019 and, except for Russia, growing populations.

In addition, the BRICS countries regularly demonstrate leadership to the wider developing world. If BRICS can implement successful energy transition strategies, their lessons will serve as guidance and motivation for other economies.

Table 1. Relevant statistics for BRIICS, 2019 (or most recent available)

Country	Population growth %	Poverty % population[1]	Average annual GDP growth[2] %	GDP per capita (USD)	Share global CO_2 emissions %	Share of fossil fuels in TPES[3]
Brazil	0.7	4.4	1.0	8,898	1.1	52%
China	0.2	0.5	7.2	10,144	29.5	88%
India	1.0	22.5	4.7	4,135	6.9	76%
Indonesia	1.1	2.7	5.4	2,101	1.9	76%
Russia	-0.2	0	1.6	11,498	4.6	89%
South Africa	1.3	18.7	1.0	6,625	1.3	91%

Notes: 1. Poverty at the international poverty line of USD 1.90/day purchasing power parity; various years (latest available); 2. Average 2010–2020; 3. TPES: total primary energy supply.
Sources: Population and GDP data: World Bank, 2022c; CO_2 emissions and TPES: IEA, 2022a.

Gerasimchuk et al. (2019) is the foundation for this report as it

- Identified the drivers of the energy transition in BRICS
- Quantified each country's fossil fuel revenues and subsidies (2017 data)
- Identified fiscal risks and opportunities, including public finance and SOE exposure
- Outlined options for economic and revenue diversification
- Recommended targeted support for affected consumers, workers, and communities.

The current report takes the next steps by

1. Projecting future fossil fuel revenues in BRIICS based on updated revenue data (2019) and the IEA's *World Energy Outlook 2021 (WEO 2021)* projections of fossil fuel consumption and production from 2030 to 2050.
2. Describing how fossil fuel revenues could be used to support and accelerate the energy transition through a green, social and sustainability (GSS) bond support fund in individual countries.
3. Updating economic and revenue diversification options based on a literature review.

The report aims to inform BRIICS governments about the fiscal risks and opportunities associated with the energy transition and how to utilize finite fossil fuel revenues strategically, develop strategies to break reliance on fossil fuel revenues, and boost and diversify government incomes.

2.0 Methodology

The revenue projections in this report provide a broad illustration of potential fiscal transition pathways in BRIICS to 2050. They use the IEA's modelling of the energy system as provided in the IEA *WEO 2021 Extended Dataset* (IEA, 2022d). The revenue projections were based on conservative calculations rather than modelling, according to which the government revenue forecasts are likely to represent lower boundaries on future realizations. The main approaches, assumptions, and data sources are outlined below.

2.1 Revenue

Fossil fuel tax and non-tax revenue data were collected for coal, natural gas, and oil (including petroleum products) for consumption and production from government sources, where available. Only first order, direct government financial revenues were included in the analysis. Data for India and South Africa were collected as part of IISD's efforts to promote transparency on government support for energy in these countries.[4] Revenue data for Brazil, China, Indonesia, and Russia were collected by updating data from Gerasimchuk et al. (2019).

Revenue data were often not disaggregated to the level of fossil fuels (e.g., data might be provided for all value-added tax [VAT] revenue but not broken down to show fossil fuel revenues). In these cases, major revenue streams were estimated based on tax rates, volumes (consumption, import, or production), and average prices (for ad valorem measures). The aim was to capture the major revenue sources, not every measure. The resulting revenue totals are therefore likely to underestimate actual revenues. Federal revenues were the priority, but subnational-level revenues were included where available.

Government revenue data were collected for 2019 as the most recent "typical year," given the complex energy impacts of the coronavirus pandemic in 2020, energy price inflation of late 2021, and the invasion of Ukraine in 2022. In terms of global economic circumstances, 2019 followed the positive economic cyclical upswing in 2018 but was hampered by growing trade tensions and the weakening economic outlook in late 2019 (IMF, 2021).

2.2 Revenue Projections

For each country and each commodity (coal, natural gas, and oil), an average amount of revenue generated per unit of production or consumption was estimated using IISD revenue data and *WEO 2021* energy production and consumption data for 2019. The revenue data was further disaggregated based on whether revenues were sensitive to fuel price changes (such as ad valorem taxes). Therefore, we had four revenue categories for each fuel type:

- Price-sensitive production
- Non-price-sensitive production
- Price-sensitive consumption
- Non-price-sensitive consumption.

[4] Bridle et al. (2022); Aggarwal et al. (2022).

We kept the analysis as simple and transparent as possible by making as few complex assumptions as possible. Notably, countries are assumed to maintain the same average tax burden as in 2019. This reflects the *ceteris paribus*[5] conditions. To the best of our knowledge, the assumption of consistent revenue settings does not conflict with IEA modelling assumptions (such as an assumption in the model that countries increase or decrease taxes with dwindling fossil fuel demand or reserves).

We recognize that governments do change tax rates, particularly in response to international prices, as witnessed in Q1 and Q2 2022; they also introduce new measures, such as carbon taxes. For example, Indonesia plans to introduce a carbon tax in mid-2022 (Reuters, 2022), and South Africa plans to make progressive increases to its carbon tax (Carbon Tax Act, 1991). Production subsidies can also vary, which can impact revenues through tax expenditures and changes in production levels. Governments might increase production subsidies in response to dwindling reserves. However, such changes are difficult to predict.

We also assumed that the recent spike in energy inflation would be transitory over the 30-year time horizon, and we did not adjust the energy price projections provided in *WEO 2021*. Again, future prices are difficult to predict, and we judged that 2030 was sufficiently distant that present price pressures could have subsided by then.

Average revenues per unit of consumption and production were multiplied by fuel consumption or production projected for each country for three of the *WEO 2021* scenarios. The IEA scenario projections include demand and supply projections per type of fuel at the country or regional level, which account for model representations of energy systems, including market dynamics and technological progress.[6] Because revenues are assumed to remain constant, the only driver of change in our projections is future energy production and consumption and prices.

The three scenarios were

- Stated Policies Scenario (STEPS): a benchmark (business-as-usual) scenario that reflects current and announced policies (but not aspiration targets, as reflected in APS).
- Announced Pledges Scenario (APS): assumes all climate commitments, including nationally determined contributions and net-zero targets, will be met in full and on time.
- Sustainable Development Scenario (SDS): aims to map out a pathway consistent with the Paris Agreement's "holding the increase in the global average temperature to well below 2°C" goal (UNFCCC, 2015a) while achieving universal energy access and improving air quality.

[5] All other things being equal

[6] This is particularly relevant for STEPS and APS, which are exploratory: they build on a set of starting conditions and model assumptions to provide country and regional projections for demand and supply of fuels. SDS and NZE scenarios are normative: they are designed to achieve a specific end point. See for further details and reference: https://www.iea.org/reports/world-energy-model/understanding-weo-scenarios.

The IEA's NZE models a trajectory consistent with the Paris Agreement objective of "pursuing efforts to limit the temperature increase to 1.5°C" (UNFCCC, 2015a), universal access to modern energy services, and major improvements in air quality (IEA, 2021b). We could not project the revenue implications for NZE using the above methods because country- and regional-level details have not been published. However, as a broad indication of possible revenues under NZE, we multiplied 2019 revenue for each fuel in each country by the IEA's projected change in the global supply of those fuels in 2030, 2040, and 2050 (Table 2). The estimate is for illustrative purposes only because, unlike our other projections, it is not based on country-level energy consumption and production or adjustments for predicted changes in prices.

Table 2. Change in global coal, oil, and natural gas supply under the IEA's NZE (% of 2019)

	2030	2040	2050
Coal	45	20	11
Oil	65	30	8
Natural gas	93	54	43

Source: Based on data from IEA, 2021c, as modified by IISD.

All *WEO 2021* pathways except NZE result in a high risk of catastrophic climate change (over 1.5°C) (see Table 3). SDS is not sufficient in its ambition (2°C warming), and the scenario utilizes "negative emissions" from unproven technologies, which facilitates ongoing fossil fuel use.

Table 3. Temperature rise in the *WEO 2021* scenarios (°C), 50% confidence interval

Scenario	2030	2050	2100
STEPS	1.5	2.0	2.6
APS	1.5	1.8	2.1
SDS	1.5	1.7	1.6
NZE	1.5	1.5	1.4

Source: IEA, 2021d.

For SDS, APS, and STEPS, the *WEO 2021 Extended Dataset* (IEA, 2022d) provides consumption and production data for coal, natural gas, and oil every 5 years from 2030 to 2050 for most of the BRIICS countries.[7] In some cases, country-level consumption and production projections were not provided for the SDS scenario. In these cases, the IEA only

[7] IISD has the IEA's permission to publish work derived from the *WEO 2021 Extended Dataset* under a CC BY-NC-SA 4.0 licence.

provided data for the region (i.e., Asia–Pacific rather than India). To replace the missing data, we estimated SDS scenario consumption and production based on the country's historical percentage share of regional consumption or production (using data in the *Extended Dataset*; IEA, 2022d). For example, from 2010 to 2020, India accounted for around 10% of Asia–Pacific's oil production. Therefore, we multiplied each of the IEA projections for SDS for Asia–Pacific (2030, 2035, etc.) by 10% to get a rough projection for oil production in India in each of those years.

For Indonesia and South Africa, there were no country-level data in the *WEO 2021 Extended Dataset* (for any scenario, for any year). For these countries, we estimated all consumption and production data from the country's percentage share of the regional total using data from the IEA (2022a) and BP (2021).

For price-sensitive revenues, a price inflator was also applied to adjust revenues based on projected price change. The price inflator was simply the price projections in the *WEO 2021 Extended Dataset* (from 2030 to 2050) divided by average 2019 prices.[8] No average global prices exist for coal and gas; therefore, an average of the *WEO 2021*'s 2010–2020 prices were used as a proxy. Again, 2020 prices could not be used because it was a highly aberrant year, and long-term average prices represent more robust assumptions for long-term projections, as in this report.

[8] The 2019 average oil price was taken from IEA, 2020b.

3.0 Fossil Fuel Revenues

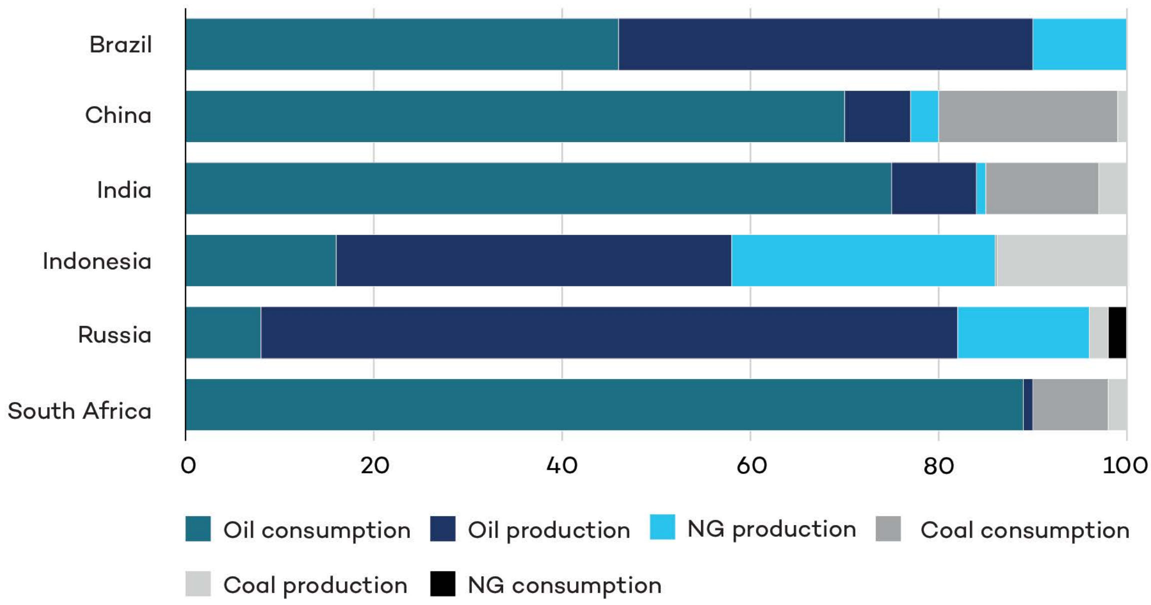
All BRIICS governments derive a significant portion of their revenue from fossil fuels, ranging from 6% of total revenues in South Africa to almost 34% in Russia (Table 4). As a proportion of GDP, domestic fossil fuel revenues were equivalent to 1% of GDP in China to over 9% in Russia. Appendix A provides details of revenue measures for each of the BRIICS countries.

Table 4. Fossil fuel revenues in BRIICS, 2019

	USD million	% total government revenue	% GDP
Brazil	51,260	8.4	2.7
China	151,661	4.8	1.1
India	92,903	18.0	3.4
Indonesia	21,737	15.7	1.9
Russia	156,639	33.7	9.3
South Africa	6288	5.5	1.6

Sources: Fossil fuel revenue data collected by IISD (see Appendix A). Total revenues: Government of India, 2021; Brazil and China: OECD, 2022b; others: World Bank, 2022c. GDP: World Bank, 2022c; Reserve Bank of India, 2019.

Figure 1. Revenue generated by fuel type and incidence (% of total).



Note: NG = natural gas

Source: See Appendix A for sources of revenue data.

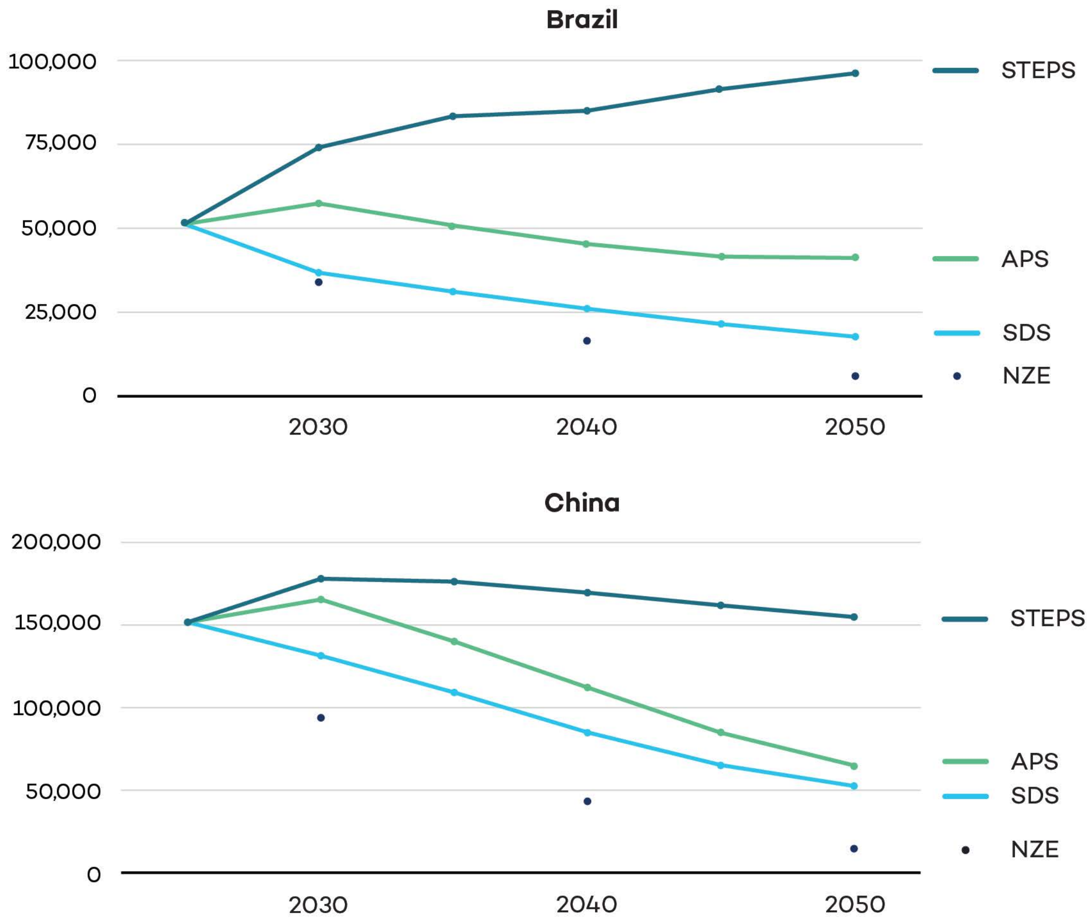
Most revenues were generated from oil (58% of total fossil fuel revenues in Indonesia; up to 90% in South Africa; see Figure 1 and Appendix A). The large oil producers also generated significant revenue from natural gas production (11% in Brazil, 14% in Russia, and 28% in Indonesia). For the major coal producers, coal revenues comprised 10% of total fossil fuel revenues in South Africa, around 15% in India and Indonesia, and 19% in China. Production revenues were largely derived from royalties, corporate income tax, export duties, and dividends from state-owned fossil fuel extraction companies. Consumption taxes were mostly derived from excise and VAT.

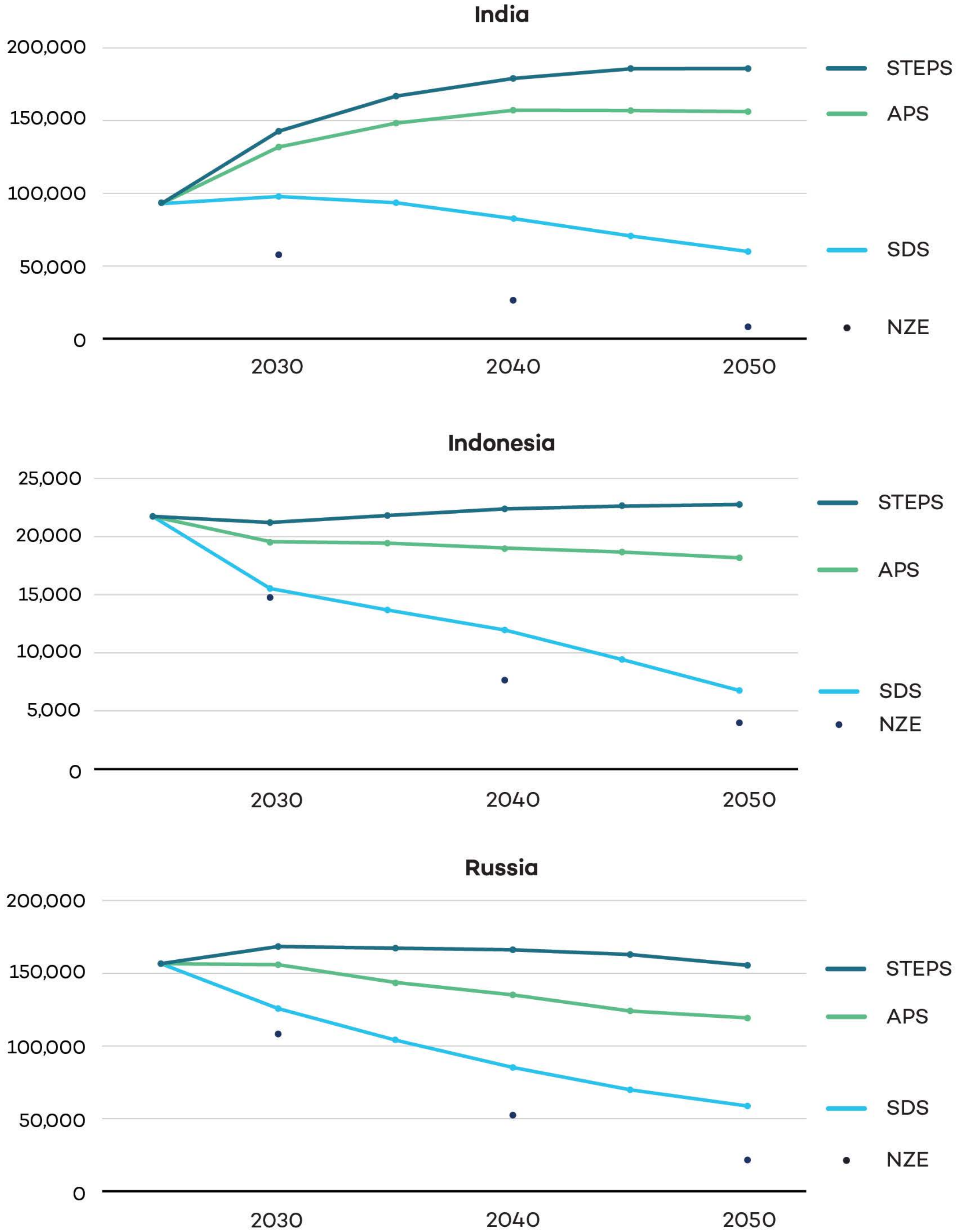
Revenues were not proportional to TPES. For example, around 70% of South Africa's TPES was derived from coal, which generated only 10% of fossil fuel revenues (Table and Figure 1). In China, coal comprised 60% of TPES but generated 19% of revenue.

4.0 Projected Fossil Fuel Revenues

This section provides revenue projections based on the IEA *WEO 2021* scenarios and 2019 revenue data (as described in the Methodology [Section 2]). The key changes in government revenue compared to 2019 for each scenario are discussed below, starting with SDS, given its consistency with the Paris Agreement. Our objective was to obtain projected trends in revenues from fossil fuels rather than precise point-in-time estimates. Projections for each country under each scenario (in USD) are presented in Figure 2.

Figure 2. Projections of fossil fuel revenues in BRIICS countries based on IEA *WEO 2021* and NZE scenarios (USD million) (IEA, 2021b).




India
200,000
150,000
100,000
50,000
0
2030
2040
2050
STEPS
APS
SDS
NZE
Indonesia
25,000
20,000
15,000
10,000
5,000
0
2030
2040
2050
STEPS
APS
SDS
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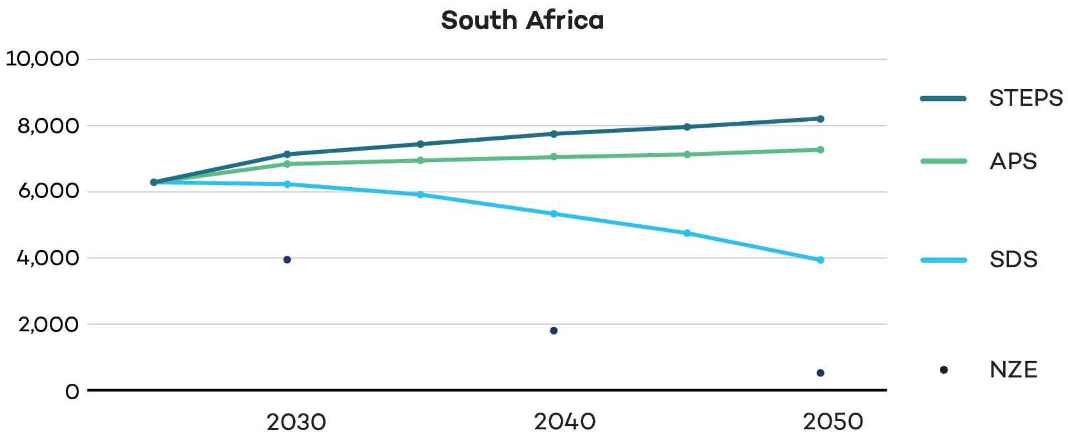
STEPS
APS
SDS
NZE



Note: NZE is based on global energy supply only, while other scenarios used country-level data on fossil fuel demand and supply, as well as predicted changes in fuel prices.

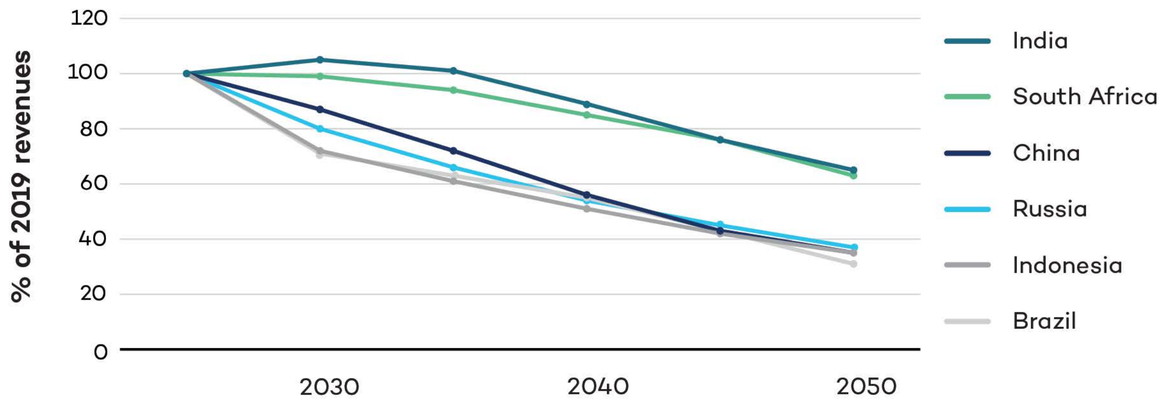
Source: Authors' projections based on IEA *WEO 2021 Extended Dataset* (IEA, 2022d) and NZE data (IEA, 2021c).

4.1 SDS

Our revenue projections based on SDS show all BRIICS countries except India experiencing a decline in fossil fuel revenues from 2019 onwards (Figure 3). By 2030, revenues fall by up to 29% (for Indonesia) and by up to 50% by 2040 (for Brazil) compared to 2019 levels. India and South Africa's fossil fuel revenues effectively plateau around 2035. By 2050, revenues were projected to fall to around 35% of 2019 levels for Brazil, China, Indonesia, and Russia and 65% of 2019 levels for India and South Africa. India and South Africa maintain higher revenues because most of their revenue is from oil consumption, which is projected to continue to expand and stabilize in those countries even under SDS, presumably due to population growth, economic development, and expansion of the transport sector.

Appendix B provides charts for SDS showing projected changes in demand and supply for each commodity type (as a percentage of 2019) in each country, together with fossil fuel revenues.

Figure 3. Projected change in government fossil fuel revenue based on IEA's SDS

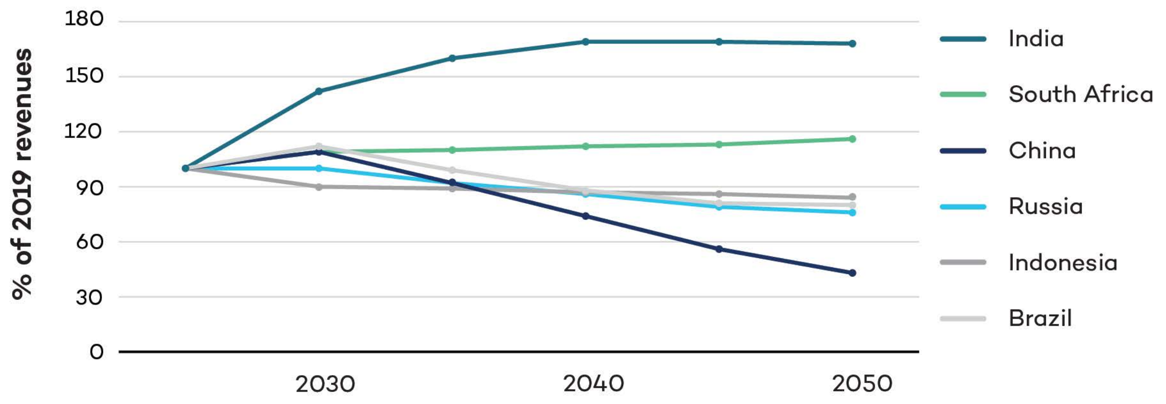


Source: Authors' projections based on IEA's *WEO 2021 Extended Dataset* (IEA, 2022d).

4.2 APS

Under APS (which assumes countries meet their climate commitments in full and on time), Brazil, China, Indonesia, and Russia were projected to experience a fall in fossil fuel revenues from 2030 (Figure 4). India's revenues increase to around 170% of 2019 levels by 2040 and then begin a slight decline[9] while South Africa's steadily and slowly rise, reaching 116% of 2019 revenues in 2050.

Figure 4. Projected change in government fossil fuel revenue based on IEA's APS



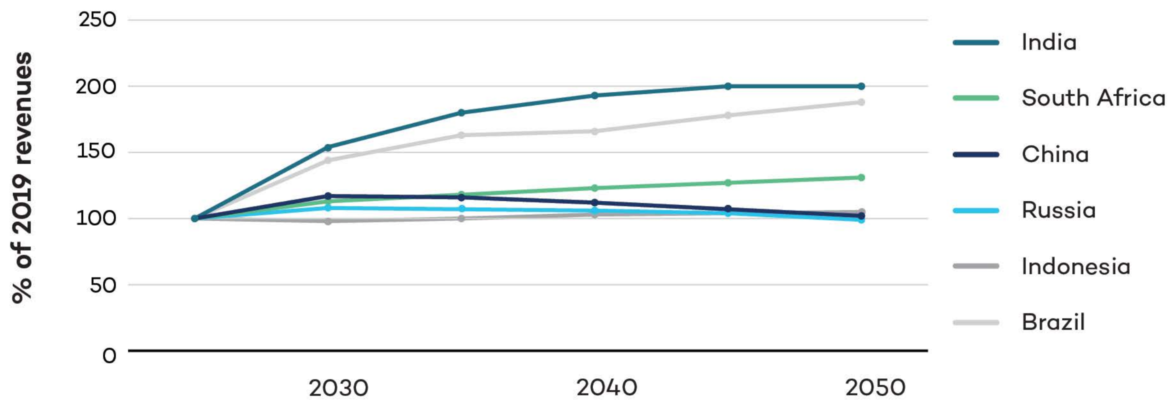
Source: Authors' projections based on IEA's *WEO 2021 Extended Dataset* (IEA, 2022d).

[9] India's APS trajectory may change in response to India's November 2021 announcement of a net-zero by 2070 target (John, 2021).

4.3 STEPS

All BRIICS countries were projected to experience a rise in fossil fuel revenues under STEPS, at least initially (Figure 5). STEPS is the *WEO 2021* benchmark or "business-as-usual" scenario, which projects rising fossil fuel consumption and production in BRIICS until at least 2030 (except for Indonesian oil, given declining reserves). Brazil was projected to increase fossil fuel revenues to 2050, primarily due to expanding oil production. Similarly, India's growing oil consumption would see revenues peak in 2045 then plateau.[10] China and Russia were projected to see peak revenues in 2030, followed by a gradual decline toward 2019 levels by 2050. This projection is due to declining fossil fuel consumption in China and declining production in Russia. Indonesia is a more complex case: revenues increased only slightly from 2019 levels to 2045, with declining oil production revenues being offset by growing natural gas production and oil consumption revenues.

Figure 5. Projected change in government fossil fuel revenue based on IEA's STEPS



Source: Authors' projections based on IEA's *WEO 2021 Extended Dataset* (IEA, 2022d).

4.4 NZE

For NZE, the IEA published only world-level results; therefore, we could not project BRIICS revenues using the same method as for SDS, STEPS, and APS. As noted in the methodology section, we instead made ballpark estimates of revenue based on 2019 revenues for each fuel and NZE's projected global change in the supply of those fuels in 2030, 2040, and 2050 (Figure 2). Our results are consistent with the IEA's statement that tax revenue from oil and natural gas retail sales could fall by around 90% between 2020 and 2050 under NZE (IEA, 2021e). With such low demand, production and associated revenues would also fall.

[10] Under STEPS, the IEA assumes that road freight activity triples to 2040 with the total addition of 300 million vehicles of all types added to India's fleet between now and 2040, including adding an extra 25 million diesel-fuelled trucks (IEA, 2021c)

4.5 Potential Revenue Gap

Comparing the projections, we found that the potential revenue gap is huge. Total public fossil fuel revenues in BRIICS countries could be USD 178 billion lower by 2030 and USD 216 billion lower by 2050 based on SDS compared with business as usual (STEPS). This revenue gap increased to USD 278 billion by 2030 and USD 569 billion by 2050 for our projections based on NZE.

4.6 Discussion

Our results indicate that the energy transition will be accompanied by a fiscal transition. The speed of the transition in the BRIICS countries will depend on how quickly countries shift from current policy settings (STEPS) to a path more aligned with their climate commitments (APS) and a temperature target below 1.5°C–2°C (SDS and NZE). In the near term, BRIICS countries can be expected to follow the STEPS pathway and therefore are likely to see fossil fuel revenues rise (potentially to around 2030). However, as countries implement their climate commitments, pathways will become more closely aligned with APS, SDS, and NZE, with associated declines in fossil fuel revenues.

4.6.1 Revenue as a Share of Total Revenues and GDP

An important consideration is how fossil fuel revenues change as a share of total revenues and GDP. In the medium to long term (i.e., post-2030) under a transition trajectory aligned with the Paris Agreement, the ratio of fossil fuel revenues to GDP and to total government revenues is expected to fall due to the structural phase-down of fossil fuel usage.

Even under a business-as-usual scenario, fossil fuel revenues as a share of total revenues could fall as the non-fossil fuel tax base of emerging economies grows, noting that income taxes tend to rise with per capita GDP (Datt et al., 2021). In a study conducted contemporaneously with ours, Bhandari and Dwivedi (2022) examined India's energy and fiscal transition using a similar research method: using 2019 fossil fuel revenue data and the IEA *WEO 2021* scenarios to project future fossil fuel revenues. Their findings are consistent with ours in that they also observe growth in India's revenues from fossil fuels from 2019 to 2040 under STEPS.[11] However, they also find that fossil fuel revenues under STEPS would fall significantly as a share of the GDP and total government revenues.[12]

We did not attempt to estimate fossil fuel revenue as a percentage of future GDP and future total revenues for BRIICS because GDP growth rates were not available in the *WEO 2021 Extended Dataset* for each of the BRIICS countries. Any projection of future total revenues

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[11] Bhandari and Dwivedi (2022) estimated 2019 fossil fuel revenues for India's state and central governments at USD 87 billion and projected future fossil fuel revenues based on STEPS at USD 154 billion in 2030 and USD 219 billion in 2040. Our estimate for 2019 was USD 92.9 billion, and projections for STEPS was USD 143 billion in 2030 and USD 179 billion in 2040.

[12] GDP growth was assumed to be 10% for India. Total revenues are assumed to grow linearly with GDP, assuming a constant tax-to-GDP ratio.

based on GDP growth should be based on the *WEO 2021* GDP assumptions to ensure they are comparable with projected fossil fuel revenues.[13]

4.6.2 Implications

Revenues need to be maintained and even increased to ensure ongoing progress on poverty eradication and economic development, as well as to support the energy transition. For example, countries will need to continue to invest in infrastructure such as renewable energy equipment, electricity grid upgrades and extensions, and electric vehicle (EV) charging stations. Social support costs are also likely to be significant, including

- Assistance to counteract any burden that the energy transition imposes on lower-income households (such as targeted cash transfers; see Beaton et al., 2013; Coady, 2015; D'Arcangelo et al., 2022).
- Just transitions (i.e., providing businesses, consumers, communities, and workers who currently depend on fossil fuels with viable and fair alternatives) (Gass & Echeverría, 2017; Zinecker et al., 2018).[14]

Declining revenue must not become a barrier to the energy transition. Fossil fuels have well-known social costs, such as impacts from air pollution and climate change (Parry et al., 2021). Like revenues, social costs rise in proportion with fossil fuel consumption and production. As fossil fuel use increases, such as under STEPS, the social cost becomes greater. Social costs have been found to far exceed government revenues (Aggarwal et al., 2022; Bridle et al., 2022). The lack of acceptance of social cost calculations and the internalization of externalities means that, despite benefits to society, energy transition policies are being delayed.

Delaying the transition poses uncertainties and potential future costs (Allen et al., 2020), particularly given the polarized geopolitical environment. In a scenario in which countries delay their transition, they may see an increase in tariffs on carbon-intensive products, such as from the European Union's (EU's) proposed Carbon Border Adjustment Mechanism.

The following sections provide policy solutions. Section 5 describes an innovative mechanism to use near-term fossil fuel revenues strategically to support and accelerate the energy transition. Section 6 outlines reforms to help governments replace fossil fuel revenues and reduce carbon entanglement.

[13] Bhandari & Dwivedi (2022) used a work-around to estimate the GDP growth rate from the projected demand for fossil fuels as projected by the IEA.

[14] The International Labour Organization's 2015 *Guidelines for a Just Transition Towards Sustainable Economies and Societies for All* provided a framework for identifying opportunities and challenges, as well as guiding principles: "The four pillars of the Decent Work Agenda – social dialogue, social protection, rights at work and employment – are indispensable building blocks of sustainable development and must be at the centre of policies for strong, sustainable and inclusive growth and development" (p. 4)

5.0 Making Best Use of the Boom Times: Strategic use of revenues

The urgency and scale of the energy transition, combined with the eventual reshaping of income sources, require BRIICS governments to capitalize on the projected near-term growth in fossil fuel revenues. In addition to the boom in fossil fuel revenues that we projected for some countries under STEPS and APS, governments could raise additional revenue by removing subsidies and increasing taxation on fossil fuels (see Section 6 for details).

5.1 Strategic Use of Revenues

The BRIICS countries currently use fossil fuel revenues mostly for financing general government budget expenditures and, in a few cases, earmarking funds for social or clean energy purposes (Gerasimchuk et al., 2019). The additional fossil "super profits" in the coming years should be used strategically to help fund the energy transition, which will be capital intensive. Public sector intervention is expected to play an important role in supporting the transition, either as a direct source of capital or as an enabler for private capital (D'Arcangelo et al., 2022) (Box 3). Priorities for public spending include

- Investment in renewable energy and associated infrastructure to facilitate a shift in consumption to low-carbon sources.
- Social spending to support a just transition for fossil fuel-dependent businesses, workers, and communities and to compensate for the likely inflationary impacts of the energy transition (Schnabel, 2022).

Governments have a range of reinvestment options available to fund the transition:

- Government-owned assets.
- Subsidies to encourage private investment, such as direct transfers, tax expenditures, feed-in tariffs, research and development investments, and venture capital investments (Bai et al., 2021; Fraschini et al., 2022).
- Capitalization of sovereign wealth funds and SOEs.[15]
- Public finance, such as lending by state-owned banks (Schnabel, 2022).

But how can finite public resources best be used to deliver the large amount of capital needed? The IEA estimates that to achieve NZE, annual global investments in the energy system need to reach USD 5 trillion by 2030 compared to the current USD 2 trillion on average over 2016–2021 (IEA, 2021b). Around 70% of the capital required for renewable infrastructure will need to originate from private sources (IEA, 2021e).

[15] Commodity-rich countries have made extensive use of sovereign wealth funds to reinvest the proceeds originating from the export of commodities in foreign assets but also into economic development and diversification at the country level. Similarly, the use of SOEs and the creation and promotion of new public financial institutions have been indicated as a mechanisms to channel public funds to attract private investment in renewable energy in BRIICS countries (Hendriwardani et al., 2022)

Public policies will play an important role in creating incentives, enabling the flow of private capital to where it is most needed (IEA, 2021b), and establishing the necessary legislative and regulatory frameworks (Eliet-Doillet & Maino, 2022b; Maino, 2022). Public finance can be particularly influential in shaping the energy industry by "crowding in" private sector finance[16] and establishing broader finance policy norms. Further, by enabling markets to allocate resources, public finance leverages private sector expertise to channel funds into productive uses.

Box 3. The rationale for public sector intervention in the energy transition

While some forms of renewable energy (such as grid-scale wind and solar photovoltaic) have become cost competitive with fossil fuels on a levelized cost basis (Lazard, 2022), there are many reasons why government intervention to accelerate the energy transition is both warranted and desirable:

- The levelized cost of energy neglects integration costs for distributed and variable renewable energy, which can be up to 20% of levelized costs (Ueckerdt et al., 2013).
- Governments frequently guide markets during times of major economic transitions (Mazzucato, 2013).
- Governments have a role to play in directing private capital to be deployed where it is most needed, including in the renewable energy sector (IEA, 2021b).
- New technologies generate positive spillovers whose values are not fully internalized by the original investors (Clements et al., 2013; Parry et al., 2021; Rodrik, 2014).
- Carbon is highly mispriced in terms of its social and environmental costs (Stern et al., 2021), rendering the private return to climate abatement technologies below their social return (Rodrik, 2014).
- Firms involved in renewable energy technology investments are more financially constrained than their fossil fuel counterparts, which ultimately leads to underinvestment (Noailly & Smeets, 2021).
- Renewable energy, grid integration, and associated social transition costs will be required at such a scale and involve such novel technologies or policy approaches that the private sector will need to be incentivized to invest the necessary funds.
- Governments have a responsibility to facilitate private investment that will help meet Paris-aligned temperature targets, particularly noting the systemic risks arising from a delayed transition (Allen et al., 2020).
- In the case of just transitions, the private sector alone might not have the resources or the incentives to cover the extensive costs.

[16] Crowding in occurs when higher government spending leads to an increase in economic growth and encourages firms to invest because there are now more profitable investment opportunities.

Green finance refers to the increase in financial flows from the public, private, and not-for-profit sectors to sustainable development priorities (United Nations Environment Programme, 2018). Subsidized loans are a common public financial mechanism for supporting sectors with high technological potential or strategic interests, including renewable energy (Rodrick, 2014). Such mechanisms have been important at times of major technological disruptions, but they have inherent governance challenges (Mazzucato, 2013; Rodrik, 2014) (see Box 4).

Innovative sustainability-linked and transition finance instruments provide new ways to fund emissions reductions through capital markets, given the appetite of private investors for sustainability (IEA, 2021e). Green bonds and related instruments (e.g., social bonds, sustainability bonds, and sustainability-linked bonds) can channel capital toward assets and projects with environmental benefits (Eliet-Doillet & Maino, 2022a). Against this background, the next section presents an innovative bond mechanism able to crowd in private capital and target innovation.

Box 4. Governance challenges for public sector subsidized credit facilities

In a typical public credit facility, the lender covers a substantial portion of the project under financing. Unless extensively capitalized, it cannot provide finance for numerous projects. In addition, subsidized credit has resulted in problems of (i) "picking" winners and losers, (ii) poor due diligence; (iii) concentration on a small number of loans (increasing risk), and (iv) agency effects due to vested interests (Rodrik, 2014).

For example, during the U.S. public funding of solar energy technology and infrastructure under the Clean Energy Policy Act launched in 2015, most of the funding capacity was used to lend to 16 projects for a total of USD 13 billion, or 82% of the total capitalized facility. This is an example of governments picking winners in public policies (Rodrik, 2014), especially if strong governance and due diligence processes are not in place.

The public lender also holds a large portion of credit risk, given that it is concentrated on a relatively small number of loans, and it can be expensive to buy insurance on these borrowers if the need for credit risk hedging occurs. Loans are less liquid instruments compared to bonds and thus are more subject to friction in terms of reduction of exposure or willingness to sell part of the loan portfolio.[17]

In a loan subsidy program, unless the government provides loans along with other private investors, the government has the main role of due diligence on the eligible projects. This can be expensive and outside the usual competencies of government. An example is Solyndra's collapse during the 2005 Clean Energy Policy Act under a Department of Energy loan program with the objective of supporting "innovative clean tech" (Rodrik, 2014).

[17] From a financial perspective, this occurs because loans are contracts (i.e., agreements between two counterparties) whereas bonds are securities (i.e., anonymous in terms of the receiving party as they only refer to the entity, which has the obligation to repay a given amount at a given time).

5.2 GSS Bonds Support Fund

This section proposes a new mechanism that governments could use to direct private investment toward the energy transition: a GSS bond support fund ("the Fund" hereafter). The proposed mechanism has significant potential to leverage both private sector lending and private sector investment in private equity (ownership).

GSS bonds are debt securities whose proceeds are specifically used to finance (or refinance) environmentally or socially beneficial projects (see Box 5). In the context of GSS bonds, what constitutes environmentally or socially beneficial projects is dictated by the taxonomy and framework referenced by the GSS bonds. Taxonomies are emerging as regulations in countries with the objective of safeguarding the environmental integrity of the projects and assets financed via GSS bonds, with probably the most important example being the EU Taxonomy (Maino, 2022).

GSS bonds are a well-established and broadly accepted financial instrument from public and private investors in both developed and developing countries. The green bond market is subject to strong investor demand and, in some instances, has received cheaper financing in primary transactions compared to comparable conventional bond issuances.[18] As of 2021, the green bond market has achieved the important milestone of USD 1.5 trillion in total issuance. While most issuances originated in developed countries, with the EU and the United States leading in the market, 2021 has also been characterized by an uptake of issuance from developing and emerging economies, particularly BRIICS. Among the BRIICS countries, China has a well-developed green bond market, but other jurisdictions, such as India and Brazil, have also experienced sustained growth in the market and in related regulations. Appendix C discusses recent trends in BRIICS countries in relation to green bonds. Most importantly, this shows that green bonds—and more generally, GSS bonds—are well-established and growing financing instruments in BRIICS, albeit to a lower extent in developed economies. Nonetheless, there is room to further support the adoption of these instruments in BRIICS, noting that to date, only around 15% of the total issuance of GSS bonds originate in BRIICS, which account for approximately 45% of global CO_2 emissions (Table 1).

The recent trend in issuance has been supported by an acceleration of investments eligible for GSS bonds and a strong demand from institutional investors. This has resulted in many cases of preferential financing conditions for GSS bond issuers compared to conventional bonds (Maino, 2022). This "greenium"—a premium investors are willing to pay for a green bond—has become statistically significant (Schnabel, 2022) and has incentivized companies and government agencies to further adopt GSS bonds.

When designing a GSS bond support fund, governments can also refine eligibility criteria for eligible green assets and projects financed by GSS bonds. In particular, they can tilt eligibility criteria toward sectors of the economy where the market's failures are perceived to be more pronounced (e.g., research and development in cleantech, venture capital in cleantech, and other strategic sectors for the energy transition, such as clean transport or energy-efficiency

[18] See https://www.climatebonds.net/resources/reports/green-bond-pricing-primary-market-h1-2021

improvements) or there are specific needs (e.g., renewable energy capacity or integration, electricity infrastructure, or just transitions).

Box 5. What are GSS bonds?

In a typical green bond, the "use-of-proceeds" structure (i.e., what eligible projects will be financed) earmarks capital to a specific project with clear environmental benefits. Green labels are voluntary disclosures by the issuers, and there is no single set of eligibility criteria. However, there are established frameworks, principles, and certification schemes that determine eligibility under those schemes.

Under the Green Bond Principles (International Capital Market Association, 2021), eligible projects include renewable energy, energy efficiency, pollution prevention and control, biodiversity, and green buildings, among others. Another globally accepted set of principles is the Climate Bond Initiative (CBI) Taxonomy and Standard, which uses a traffic light system to indicate whether assets and projects are compatible with a 1.5˚C degree decarbonization trajectory (CBI, 2021).[19] Data compiled from CBI shows that the majority of green projects are related to energy efficiency, green buildings, the energy sector, and transport.[20]

The rapid growth of green bonds worldwide has also seen standards established in individual jurisdictions. Among the BRIICS countries, China has an established framework, while Russia and South Africa are developing guidance. The EU has been leading in terms of setting a supporting regulatory framework for green finance to emerge, making the EU the largest market for green financing instruments, particularly green bonds (Maino, 2022). In particular, the EU's new Green Bond Standard is likely to become a strong reference for similar initiatives in other jurisdictions (Maino, 2022).[21] This newly proposed standard leverages the recently adopted EU Taxonomy, a regulation that defines a "green" asset and activity within the EU. Recent initiatives, such as the International Platform on Sustainable Finance (IPSF),[22] aim to limit the proliferation of fragmented initiatives, as these create a fragmented landscape for global investors.

Issuers can reference within their bond framework one or more green bond standards to which their issuance is compliant. Third-party verification mechanisms, such as second-party opinions, also enhance the quality and transparency of bond issuance.[23]

Social and sustainability bonds are like green bonds but differ in the type of projects to which funds are directed (i.e., social projects or a mix of social and environmental

[19] For example, solar electricity generation projects automatically receive a green light and can be CBI certified.

[20] See data shared by CBI on their interactive data platform: https://www.climatebonds.net/market/data/

[21] The EU Taxonomy documentation is accessible at: https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/eu-taxonomy-sustainable-activities_en

[22] The IPSF was founded in 2019 and includes the EU, China, the United Kingdom, and several emerging market countries. The 18 members of the IPSF account for 55% of greenhouse gas emissions, 50% of the world population, and 55% of global GDP. See https://ec.europa.eu/info/business-economy-euro/banking-and-finance/sustainable-finance/international-platform-sustainable-finance_en

[23] Common third-party verifications are (i) assurance, (ii) second-party opinions, (iii) certification, and (iv) green bond rating.

projects for sustainability bonds).[24] A recent example is the EU's SURE social bonds scheme,[25] which targeted job protection and short-term work schemes in member states during the pandemic. Examples in emerging markets are the issuance of sustainable bonds from the New Development Bank[26] as a response to the coronavirus pandemic. The International Capital Market Association has also published extended principles for social and sustainability bonds in line with its flagship Green Bond Principles, thus providing further standardization and transparency for investors on GSS bonds. For instance, the latest social bonds issued within the EU SURE scheme benefit from a social bond label aligned with the International Capital Market Association's Social Bond Principles.

Social and sustainability bonds have experienced a strong increase in issuance, particularly from governments raising financing to implement fiscal measures in the aftermath of COVID-19, notably in relation to the EU Green Deal and NextGenerationEU program launched by the EU Commission in 2021.[27]

The CBI can certify Shari'ah-compliant investments in renewable energy and other environmental assets through the Green Sukuk category. Proceeds are used to finance construction, refinance construction debt, or pay a government-granted green subsidy.[28]

Under this proposal, countries would allocate a portion of fossil fuel revenues to a domestic fund that would provide an implicit debt guarantee to private issuers of bonds for eligible projects. The fund would be self-contained in each country and not dependent on any upon any international negotiations to establish or fund (although it could become a destination for donor funding). Borrowers would receive a higher rating thanks to the credit enhancement provided by the GSS bond support fund, thus reducing financing costs and attracting more investors to GSS investments (see Section 5.2.3 for details).

The GSS bond support fund proposal has several benefits:

1. It mobilizes private sector lending and investments.[29]
2. It leverages the existing financial infrastructure around GSS bonds.

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[24] The International Capital Market Association principles include i) the Green Bond Principles, ii) the Social Bond Principles, iii) the Sustainability Bond Guidelines, iv) the Sustainability-Linked Bond Principles, and v) Climate Transition Finance. They are accessible at the following link: https://www.icmagroup.org/sustainable-finance/

[25] SURE: Support to mitigate Unemployment Risks in an Emergency. To date, the EU SURE scheme has been the largest social bond scheme, with total issuance between 2020 and May 2021 reaching EUR 90 billion: https://ec.europa.eu/info/strategy/eu-budget/eu-borrower-investor-relations/sure-social-bonds_en

[26] In December 2021, the New Development Bank has issued a USD 500 million sustainable bond targeting "sustainable development activities and providing COVID-19 emergency support loans to the member countries of the Bank." See https://www.ndb.int/investor-relations/borrowings/

[27] See for more details https://ec.europa.eu/commission/presscorner/detail/pt/qanda_21_5211

[28] For a further explanation of Green Sukuk, see https://www.climatebonds.net/projects/facilitation/green-sukuk#:~:text=Green%20Sukuk%20are%20Shari'ah,a%20government%2Dgranted%20green%20subsidy

[29] Public institutions could also benefit from the facility where governments have lower than AAA+ (the case for many of the BRIICS countries).

3. It capitalizes on established bond markets and verification infrastructure (Boxes 4 and 5).
4. It provides transparency for private local and foreign investors and in the allocation of public funds (in contrast to public institutions channelling state revenues toward structural investments).
5. Increasing GSS bond issuances would support the development of the GSS market more broadly in the respective BRIICS countries.
6. It improves incentives for the issuance of GSS bonds but leaves the initiative to private firms and, most importantly, partly delegates monitoring and due diligence activities to the bond market, thus improving efficiency and reducing cost leveraging on economies of scale.

Nonetheless, it is important to acknowledge that GSS bonds are not a perfect instrument. First, third-party verifications on the environmental and social merits of GSS bonds are important but have only recently become a widespread practice and are not universally applied (Box 5). Second, the "use-of-proceeds" structure ensures the earmarking of proceeds toward a specific project, but it does not ensure that the company is transitioning toward being greener or more socially responsible. Third, there is a large heterogeneity on what defines a "green" project or asset, which has led to varying degrees of ambition depending on the local taxonomy referenced by the bond issuers, despite recent initiatives such as the IPSF to drive harmonization in that respect.

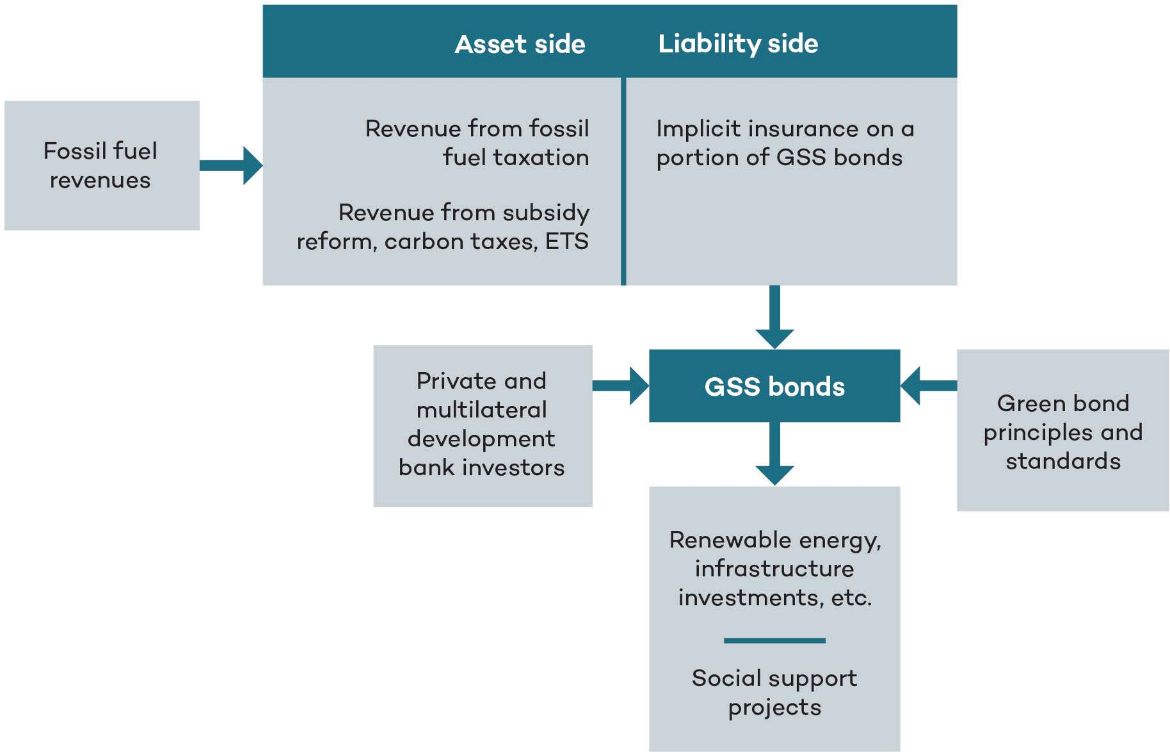
5.2.1 How the GSS Bond Support Fund Would Work

A descriptive diagram of the GSS bond support fund structure is proposed in Figure 6. On the asset side, the GSS bond support fund receives cash flows from fossil fuel revenues. On the liability side, the GSS bond support fund provides an implicit guarantee (or insurance) to the eligible GSS issuers, which could be private companies or public sector entities such as state-owned energy companies or utilities. The GSS bond support fund would provide risk relief by absorbing potential first losses up to a pre-defined amount of the total issued amount (e.g., 5% of the total bond issuance). This might seem like a small benefit, but it can increase the appeal of the bond to investors because it provides a first-loss cushion that effectively grants credit enhancement for investors. In other words, in the event of defaults and the inability of the issuer to repay its bond obligations, investors may be exposed to losses only after the first 5% of losses accrued to the GSS bond support fund.

A similar structure has been used by the International Finance Corporation (IFC, part of the World Bank Group) and Amundi (an asset manager) for a fund to mobilize up to USD 2 billion in private investment into emerging market sustainable bonds to support COVID-19 recovery. The fund provides first-loss provisions to mitigate risks for investors, similar to an earlier fund for green bonds (IFC, 2021; Wheelan, 2017). A similar credit-enhancing mechanism has also been recently proposed in India to support renewable energy financing (Singh et al., 2020).

In line with precautionary and standard risk management measures, the capital provided on the asset side of the GSS bond support fund allows for the risk exposure on the liability side. The asset side capital provides the GSS bond support fund with the capacity to issue insurance against first losses on the GSS bonds.[30]

Figure 6. Descriptive diagram of the GSS bond support fund



Source: Authors' elaboration.

The GSS bond support fund would create a multiplier effect. For example, a transfer into the fund of USD 10 billion from fossil fuel revenues could leverage around USD 400 billion in private sector lending for GSS projects (Table 5). This example assumes a liability exposure of 20% on sovereign bonds and 80% on private corporate issuances. By following Basel III guidance on risk-weighted assets (RWAs) based on external credit ratings, we assume a total average risk-weighted exposure of 50% arising from the illustrative exposure on the sovereign (20%) and corporate bonds (80%), which means that for every USD 1 of liability exposure, USD 0.5 in capital on the asset side of the GSS bond support fund needs to be accounted as

[30] Based on the Basel III committee guidance for the measurement of risk exposure using risk weighted assets. The risk weight assigned to an asset depends on its external credit rating. The computation of the total risk exposure of the GSS bond support fund indicates the amount of capital that needs to be provided to the GSS bond support fund against potential losses. This capital on the asset side is earmarked and cannot be used in alternative projects. However, in order to protect it against devaluation due to inflation, the asset-side capital can be invested in low-risk liquid investment products such as short-term sovereign bonds or money market funds. See the following BIS summary on calculation of RWA for credit risk in line with the Basel Framework: https://www.bis.org/basel_framework/chapter/CRE/20.htm?tldate=20250101&inforce=20220101&published=20191215

a capitalization measure (i.e., effectively held in reserve in case of default). This leads to a total monetary exposure of USD 20 billion on USD 10 billion of assets capitalized. By assuming a maximum exposure to a single GSS bond of 5% and an average GSS bond of USD 100 million for illustrative purposes, we obtain an average of USD 5 million in monetary exposure on a single GSS bond with a total average of 4,000 GSS bonds that could be supported by the GSS bond support fund.

Table 5. Schematic representation of the multiplier effect provided by the GSS bond support fund

Item description	Assumed values and computations
Funding capacity on the asset side	• USD 10 billion
Exposures on GSS bonds category	• 20% Sovereign • 80% Private
RWAs	• Sovereign AAA to AA–: 0% • Sovereign A+ to A–: 20% • Sovereign BBB+ to BBB–: 50% • Unsecured Corporate AAA to AA– : 20% • Unsecured Corporate A+ to A– : 30% • Unsecured Corporate BBB+ to BBB – : 50%
Total average risk-weighted exposure (TRWA)	TRWA = 50%
Total monetary exposure (TME) per dollar invested	TME = (1/TRWA) = 2
Total monetary exposure	TME = USD 10 billion × 2 = USD 20 billion
Maximum exposure to a single bond	5%
Average bond size	USD 100 million
Maximum average monetary exposure on a single bond	USD 5 million
Average amount of insurance provided	USD 20 billion/5 million = 4,000 bonds
Total private financing leveraged	4,000 bonds @ USD 100 million/bond = USD 400 billion

The GSS bond support fund represents a relatively simple and self-contained initiative that BRIICS countries can implement to support the adoption of GSS bonds and thus create a fertile ground for capital to be channelled toward a responsible energy transition aligned with climate targets. Finally, an important point to highlight is that the GSS bond support fund proposal does not specify details of governance implementation. However, it is implicit that best governance practices are necessary for such structures to function efficiently.

6.0 Preparing for the Future: How to replace fossil fuel revenues

Declining fossil fuel revenue will require governments to adapt their economic and fiscal settings. This section outlines reforms that can help BRIICS governments reduce fiscal dependency on fossil fuels and replace fossil fuel revenues. The concept of environmental fiscal reform provides a useful framework: it refers to the alignment of taxes and similar measures with the costs of environmental damage implemented alongside socially or environmentally productive spending of the revenues (OECD, 2017).

Climate and energy sector reforms are challenging. There is no "silver bullet" policy or one-size-fits-all fiscal transition strategy suitable for all countries. Governments will need to take regulatory capacities and public attitudes into account when developing strategies to raise energy prices and introduce new taxes (Beaton et al., 2013; Clements et al., 2013; Levi et al., 2020). The following section discusses how some of these challenges can be overcome before we outline economic and revenue diversification options.

6.1 Country Circumstances and Political Economy

Nations differ widely in their capacity to respond to the fiscal, economic, and social challenges posed by a fossil fuel phase-out (as previously discussed in Box 2). Calverley and Anderson (2022) divided oil and gas-producing nations—the most dependent of the FFDCs—into categories based on (i) their dependency on oil and gas revenues and (ii) non-oil and gas GDP per capita (as a measure of their non-fossil fuel wealth and, therefore, capacity to cope with a fossil fuel phase-out).

Among BRIICS, Russia was categorized as having a high capacity to adapt, with significant fossil fuel revenue dependency but also relatively high non-oil and gas GDP per capita. Brazil and China were categorized as having a medium capacity to adapt, while Indonesia and South Africa had a low capacity, and India had the lowest capacity. The varying vulnerabilities and capabilities indicate that no single phase-out pathway will fit all contexts (Calverley & Anderson, 2022; D'Arcangelo et al., 2022). Analysis is required to determine the most economically effective measures based on country circumstances. For example, non-tax measures can deliver greater net revenue gains than taxes under some circumstances (Jimenez & Afonso, 2021).

Public acceptability and political capture by vested interests have been among the biggest deterrents to climate and energy pricing reform (Carattini et al., 2018; Mabey et al., 2017). However, there are approaches that can reduce political opposition and foster positive attitudes to reform. These have been investigated in relation to fossil fuel subsidy reform (e.g., Beaton et al., 2013; Clements et al., 2013; Guillaume et al., 2011) and decarbonization (e.g., D'Arcangelo et al., 2022). The main recommended actions can be synthesized as

- Communications campaigns that target information and knowledge gaps and counter dis/misinformation.
- Stakeholder consultation through transparent and accountable processes extended to all relevant bodies.
- A gradual or phased approach to reform.
- Complimentary policies[31] and compensation mechanisms that reduce poverty and inequality (such as tax cuts, cash transfers, or increased social services).
- Temporary exemptions and grandfathering of provisions, notably in relation to carbon pricing and emissions restrictions.
- Independent bodies responsible for monitoring and reporting on the impacts of climate and climate policies.
- Transparency, good governance, and sound legal processes to ensure vested interests do not dominate decision making and the perception of vested interests does not undermine public trust.

Such policies need to be incorporated into energy and fiscal transition strategies with sufficient lead times to allow meaningful communication and consultation.

6.2 Fiscal Transition Strategies

Fiscal policies can influence both revenue collections and the speed of the transition—notably fossil fuel subsidy reform and carbon taxation—and can have important feedback effects. For example, the removal of producer tax exemptions—prevalent in all fossil fuel-producing countries[32]—would initially boost revenues but then lead to a decline in production and production-related revenues. Carbon taxes create revenue but also contribute to lower fossil fuel use and, therefore, lower revenues. But there are other ways to maintain revenue when there is a base erosion effect.

6.2.1 Removing Fossil Fuel Subsidies and Increasing Taxes

Reducing fossil fuel subsidies, including tax incentives, should be the first port of call for boosting revenues (Cust et al., 2017; Sanchez et al., 2021). Such policies erode revenues while locking in the consumption and production of fossil fuels, along with their associated social costs. Global subsidies to fossil fuels, public finance, and SOE investment exceeded USD 800

[31] Dufour et al. (2022) found that, if well designed and implemented, 60% of energy-related COVID-19 stimulus spending approved between January 2020 and November 2021 could contribute to poverty reduction.

[32] For BRIICS producer subsidies, see Bridle et al., 2022; OECD, 2020; Viswanathan et al., 2021.

billion in 2019 (Sanchez et al., 2021). The elimination of these support measures would not necessarily make all these funds available for new spending, given that phasing out subsidies can have feedback effects (i.e., reduced fossil fuel consumption and production, which would reduce related revenue) and the impact on access to clean cooking and heating fuels needs to be considered. Plus, some subsidy savings would be needed to compensate the poor for higher energy prices. Nonetheless, fossil fuel subsidy reform is likely to have net fiscal benefits (Cordoba et al., 2000).

Where subsidies are large, phasing out fossil fuels could remove a major burden on government budgets. In China, for example, coal is likely to become a net drain on government budgets, given that subsidies far exceed revenues. Phasing out coal production and consumption, therefore, would result in higher revenues, at least at the national level (Clark & Zhang, 2022). Any reduction in fossil fuel use would be accompanied by lower social costs (such as air pollution and climate change), many of which directly or indirectly impact governments. These costs have been estimated at over USD 5 trillion per year globally (Parry et al., 2021).

All BRIICS governments provide significant fossil fuel subsidies (Table 6). Where energy subsidies cannot be removed, they can be targeted toward the most vulnerable or replaced by socially important energy subsidies, such as lifeline tariffs, to avoid social impacts.

Table 6. Fossil fuel subsidies in BRIICS countries

Country	USD billion	Year
Brazil	6.0	2020
China	28.1	2020
India	10	2020
Indonesia	13.2	2019-20
Russia	9.3	2020
South Africa	5.3	2020-21

Note: This does not include electricity generated from fossil fuels.
Sources: IISD & OECD, 2022; except for India (Aggarwal et al., 2022) and South Africa (Bridle et al., 2022).

Increasing existing fossil fuel taxation, even at modest rates, is an administratively simple (although politically challenging) means to increase revenue (Sanchez et al., 2021). For example, a tax of USD 3.5 cents per litre for gasoline and diesel in Indonesia (less than 8% of retail prices) could generate an additional USD 2.2 billion per year in revenue (Laan, Suharsano et al., 2021). Retail prices for all fossil fuels in BRIICS countries (except for natural gas in South Africa) are below their social costs (Parry et al., 2021).[33] This indicates

[33] The IMF included social costs such as air pollution and climate change for coal; natural gas and oil; accidents, congestion, and road damage for diesel and gasoline; and the opportunity cost of the failure to collect VAT on these potential price elements.

that there is scope to raise taxes and, at the same time, shift fossil fuels toward their efficient price. Natural gas consumption is not taxed in any of the BRIICS countries except in Russia, where it generates only 2% of fossil fuel revenues. Such tax increases would have two benefits: encouraging consumers to switch to cleaner energy through higher fossil fuel prices and delivering revenues that could be used to support the energy transition.

6.2.2 Economic Diversification

One way to broaden the tax base is through economic and industrial diversification, which will create new taxable business activities, exports, and employment (OECD & International Transport Forum, 2019). Among BRIICS, economic diversification is particularly important for FFDCs such as Russia and subnational governments in Brazil, China, India, and South Africa (Gerasimchuk et al., 2019) (Box 6). Energy transitions give additional urgency to producer countries to reform and diversify their economies. But economic diversification is very difficult, and few countries have done so successfully. Among producer economies, the IEA observed an upward trend in the share of non-oil and gas exports between 2010 and 2021, but this was mostly due to the falling value of oil and gas exports (IEA, 2021e). Progress on energy diversification in this group was also observed to be extremely modest (IEA, 2021e).

Box 6. Economic diversification for FFDCs

The eventual decline in demand for fossil fuels will require FFDCs to develop new industries and exports and improve their investment environment (Cust et al., 2017). Initially, this might include traditional carbon-intensive value-added industries (such as cement and fertilizer) to capitalize on resource wealth and smooth volatility. But traditional diversification carries a risk of locking FFDCs into low productivity and high emissions. In addition, high-carbon products could become subject to border carbon adjustment mechanisms, impacting exports.

Investing in sovereign wealth funds and strategic investment funds can stabilize incomes (Elgouacem et al., 2020). China, India, Indonesia, and Russia have sovereign wealth funds, and South Africa is considering one (Capapé, 2022).

Ultimately, countries need to build productive capacity in non-resource, low-carbon sectors, which are less exposed to volatile commodity prices and carbon-related risks (Peszko et al., 2020). A shift to knowledge- and labour-based growth will require investments in education, high-quality institutions, and predictable access to finance (Peszko et al., 2020). Diversifying these underlying assets of the economy, notably human capital and good governance, can lead to productive and competitive economies that are more flexible and resilient to external shocks. Macroeconomic simulations carried out by Peszko et al. (2020) found that asset diversification is the best long-term economic strategy for FFDCs.

6.2.3 Revenue Diversification

The tax base can be widened by introducing new measures, particularly broad-based taxes such as VAT and progressive income or corporate taxes (Cust et al., 2017). Environmental taxes have the additional advantage of ensuring that polluters pay for damage while creating an incentive to pollute less and generating substantial revenue (European Commission, 2021). Nordic countries[34] pioneered environmental taxation in the early 1990s, and by 2018 all Nordic countries except Iceland were generating between USD 7 billion and USD 13 billion from environmental taxes (Laan, Roth et al., 2021; OECD, 2021a). Environmental taxes can be levied on energy products, vehicles and transport services, emissions to air and water, point source pollution, noise, and waste, as well as the management of water, land, soil, forests, biodiversity, wildlife, and fish stocks (OECD, 2022a). Several promising alternative revenue streams in the energy and transport sectors are outlined below. No single mechanism is likely to be sufficient to replace all fossil fuel revenues; a number of these policies would be needed.

6.2.3.1 CARBON PRICING

Carbon tax pricing (taxes and trading schemes) can replace traditional revenue streams from fossil fuels during the energy transition but would eventually decline as the economy is decarbonized. The IEA's NZE assumes that carbon taxes are imposed in all countries, which would generate global revenues of close to USD 700 billion each year between 2030 and 2035 before declining steadily due to declining overall emissions (IEA, 2021b). Carbon prices were found to more than compensate for reduced oil and natural gas excise taxes over the next 15 years (IEA, 2021b).

Among the BRIICS countries, South Africa has implemented a carbon tax of ZAR 120 (USD 9)/tonne of CO_2 equivalent (tCO_2e), but the effective carbon price is between USD 0.4 and USD 2.9/tCO_2e due to widespread exemptions (Bridle et al., 2022). China has an emission trading scheme that could eventually integrate permit auctions to generate public revenue (IEA, 2020a). Indonesia has signalled its intention to impose a carbon tax of USD 2/tCO_2 on coal from mid-2022 (Reuters, 2021). India's coal "cess" (special tax) has been in place since 2010. The cess acts as a de facto carbon tax, with a rate equivalent to USD 5.50/tonne of coal or USD 2/tCO_2. The cess raised almost USD 5 billion in 2019/2020 (Aggarwal et al., 2022). An IMF study found that increasing the cess would deliver stronger carbon reduction, health, and economic growth benefits for India than alternative policy measures, including a carbon tax or emission trading scheme (Parry, 2019).

Carbon tax rates in the BRIICS countries would need to be higher to influence consumer decisions and generate meaningful public revenue, but those revenue streams could be significant and be allocated to popular projects, improving public acceptance. For example, the Chinese government could have generated around USD 394 billion in 2019 with a carbon tax of USD 40/tCO_2e, the minimum needed to be consistent with the Paris Agreement goals (IEA, 2022; Stiglitz & Stern, 2017).

[34] The Nordic region consists of Denmark, Finland, Iceland, Norway, and Sweden, as well as the Faroe Islands, Greenland, and Åland.

Bhandari and Dwivedi (2022) estimated that a carbon tax of USD 10/tCO_2e from 2019 would generate less than existing fossil fuel taxes for 2019, but a higher rate of USD 30/tCO_2e from 2030 to 2040 could result in revenues that exceed transitional fossil fuel revenues offsetting a projected decline of coal, oil, and gas in those years.

The political economy aspects are challenging, but several countries with large fossil fuel industries have succeeded in implementing meaningful carbon pricing. Norway implemented a carbon tax with wide coverage (66% of emissions) at a rate of USD 54/tCO_2e, generating USD 1.4 billion in government revenues in 2020 (World Bank, 2022a). Judicious spending of the revenues (green spending, income tax reductions, the sovereign wealth fund, and general spending) has assisted public acceptance of the tax (Arvin, 2021).

6.2.3.2 NON-FOSSIL FUEL REVENUE STREAMS IN THE TRANSPORT SECTOR

Most consumer fossil fuel tax revenues are generated by taxing gasoline and diesel used for road transport (Elgouacem et al., 2020), including in the BRIICS countries (Appendix 1). Excise duties and VAT on road transport fuels are likely to decline not only due to climate policies but also in response to the increasing fuel efficiency of internal combustion engines and declining costs of EVs (OECD & International Transport Forum, 2019). Carbon taxes can raise revenue during the energy transition, but these revenues will also eventually decline. This section presents three alternative revenue streams in the road transport sector that BRIICS governments can use to replace fossil fuel and carbon revenues.

6.2.3.2.1 Road User Charges

Road user charges include a broad range of excise taxes that are traditionally levied on fuels for the purpose of road maintenance (Atkinson, 2019). This traditional approach to road usage charges means that consumers pay the same rate for road usage, irrespective of their vehicle's weight and emissions or the place and time they drive (OECD, 2019c). As most vehicles run on fuels, this formula for taxing fuel users for road maintenance worked well when the share of EVs was negligible. But with the share of EVs rapidly growing, collecting road user charges through fuel excises alone might prove challenging (Lambert, 2022).

Newer ways of implementing road user charges are being tried out using GPS tracking to make road users pay for how many kilometres they travel, the weight of their vehicle, and the time and place of road usage (Nicholson, 2021). Distance charges can contribute to more sustainable tax policies over the long term (OECD & International Transport Forum, 2019). The technological challenges in BRIICS countries could be prohibitive in the near term, but over the time frame of fossil fuel revenue declines (2030 to 2050), such measures could become feasible. As the share of EVs increases in the fleet of vehicles, road user charges can be a useful policy tool to ensure that road maintenance costs are proportional to their use.

6.2.3.2.2 Vehicle Registration Tax

Vehicle registration tax is imposed on the purchase and registration of a vehicle, either as a one-time payment or annually. Registration fees can replace fuel revenues as drivers switch to EVs. In Norway, where 65% of cars are fully electric (Klesty, 2022), vehicle registration taxes raised USD 1 billion in 2020 (0.25% GDP) (Government of Norway, 2020). Norway's vehicle registration scheme taxes cars based on their weight and emissions of CO_2 and nitrogen oxides, with preferential treatment for EVs (Government of Norway, 2020). Taxes on EVs should only be considered once they are well established in the market to avoid creating a disincentive for electrification.

All BRIICS countries impose vehicle registration fees but at relatively low rates (Table 7). Higher vehicle registration taxes could be progressive if the rate is proportional to the expense of the vehicle, thereby taxing wealthier households more. Increasing the tax rate on imported used vehicles with poor emission standards would also help reduce pollution while raising revenues, given that these are a growing source of pollution in many developing countries (Muiruri, 2020). Taxes on private vehicles should be accompanied by increased financial support for public transport to reduce disadvantaging the poor.

Table 7. Vehicle registration fees in BRIICS countries

Country	Policy
Brazil	Annual payment to national and municipal governments based on the vehicle's value
Russia	Fixed annual fees of RUB 2,000 for registration and RUB 300 for de-registration
India	Once-off payment (road tax) based on the vehicle's price and fuel type (varies by state or Union Territory)
Indonesia	Annual payment of 2% of the vehicle's value
China	Once-off payment of 10% of the vehicle's value
South Africa	Based on the weight of the vehicle and the location of purchase (rural/ urban)

Source: Angloinfo, n.d.; Business Tech, 2020; Expatica, 2022; Government of Pernambuco, 2021; People's Republic of China, 2019; Rawat, 2020.

Vehicle registration taxes are one of the most effective tools for shifting consumer patterns in road transportation (Jordal-Jørgensen et al., 2017). Countries with higher vehicle registration taxes on polluting vehicles are more likely to have lower CO_2 emissions from passenger cars (Runkel & Mahler, 2018). Varying rates of vehicle registration taxes provide direct incentives for consumers to switch to fuel-efficient vehicles. Rates may vary based on the vehicle's price (e.g., Modi, 2021), weight (e.g., Business Tech, 2020), fuel type, or location of purchase. China and India currently exempt EVs from registration taxes.

Phasing in taxes for EVs should be done cautiously. For example, as Denmark announced plans to introduce registration taxes on EVs, vehicle registration in Denmark skyrocketed before plummeting as the tax was rolled out (Paizs, 2017). Ideally, taxes on EVs should be introduced when EVs are cost competitive with motor vehicles.

6.2.3.2.3 Congestion Charges

Road space is a scarce resource, and too many drivers accessing roads (such as in the inner city) can cause them to become congested, leading to lost time and productivity. In China, rising vehicle ownership has led to increasing congestion costs: traveller delays and air pollution (including CO_2) in Beijing were estimated to cost the economy approximately USD 7 billion to USD 15 billion annually (Creutzig & He, 2009).

Congestion charges discourage driving and encourage switching to alternative modes of transport, such as public transport or cycling. Technology (Dedicated Short-Range Communication and automatic licence plate recognition) is already available that can allow congestion charging in developed countries (Marion, 2019), which will become cheaper and more widely available over time.

6.2.3.3 RENEWABLE ENERGY AND STORAGE

The energy transition provides new economic and revenue-raising opportunities that could outpace the costs of the energy transition (IEA, 2021b, 2021e). Taxing clean energy and its constituent materials needs to be approached cautiously to avoid slowing the energy transition.

While renewables generate low rents compared to fossil fuels, they also lead to revenues from personal and corporate income taxes, customs duties, goods and services tax, and VAT, as evident in India (Aggarwal, 2022). The IEA estimated that, under NZE, the annual market opportunity for just five renewable energy manufacturers (wind turbines, solar panels, lithium-ion batteries, electrolyzers, and fuel cells) will grow tenfold to USD 1.2 trillion by 2050—larger than today's oil industry and associated revenues (IEA, 2021e). Revenues from the minerals needed for clean energy could be greater than those currently generated by coal (although the same countries will not necessarily benefit) (IEA, 2021b). Taxing hydrogen (including for export) is another potential revenue stream.

Even for countries that do not mine the minerals or manufacture major components, there is much value to be captured by deploying renewable energy. Structures and ancillary components are often locally manufactured and represent a significant proportion of the total project cost, along with operation and maintenance, civil works, and electrical works (Bridle, 2021). Revenues associated with these activities are derived from upfront capital investments for renewable energy and storage. However, continual replacement of capital over time could lead to a steady stream of investment, employment, and associated revenues.

6.2.3.4 ELECTRICITY

Among the BRIICS, electricity taxes are implemented in Brazil, India, and South Africa (Appendix A). While the energy transition is underway, raising electricity taxes is potentially undesirable from a climate perspective (Lee & Usman, 2018). Electrification is important for energy access and decarbonization when accompanied by renewable generation (such as EVs and heat pumps). Once the transition is well established, higher electricity taxes on upper-income groups and selected industries could generate substantial revenues given its widespread use and relatively inelastic demand (the features that make fuel taxation currently widespread).

While the energy transition is underway, governments can tax fossil feedstocks for electricity to create an incentive for distributors to acquire non-fossil power. Alternatively, governments could impose differential electricity taxes based on the source of energy (OECD, 2021b). Higher rates on fossil fuel-based power would generate revenues while incentivizing a shift to clean energy, thereby reducing climate and health externalities. Increasing taxes on electricity is challenging for many BRIICS countries, given capped retail pricing (i.e., subsidies) and indebted distribution companies. Wider reform of such electricity sectors would be required, including allowing cost recovery and shifting social assistance to targeted cash transfers rather than electricity subsidies.

7.0 Conclusions

The revenue estimates presented in this report indicate that all BRIICS governments depend on fossil fuels for a substantial portion of their revenues. Fossil fuels are not a reliable source of public revenue, as evidenced by our projections based on possible energy transition pathways. A trajectory consistent with limiting global warming to 1.5°C will result in dramatic reductions in revenue unless governments reform their fiscal policies. Russia is the most dependent of the BRIICS, with over one third of government revenue directly derived from fossil fuels. All other BRIICS countries have been categorized as having a low to medium capacity to adapt to a fossil fuel phase-out (Calverley & Anderson, 2022). This suggests that BRIICS economies and public budgets are vulnerable, and planning for the fiscal transition is needed.

We recommend that fiscal transition strategies have two key elements. First, governments should use fossil fuel public revenues strategically while they still can. Most BRIICS countries are likely to receive a short-lived "boom" in fossil fuel public revenues based on current policy settings, which can be augmented by removing subsidies and increasing taxes on fossil fuels. The funds can be used to support social welfare, clean energy, and just transitions, such as through the GSS bond support fund we propose.

Second, governments need to prepare for the inevitable "bust" in fossil fuel revenues. Economic and fiscal diversification can provide new revenue streams while reducing carbon entanglement. Reforms can be done in a way that accelerates the energy transition and reduces poverty and inequality by following the principles of environmental fiscal reform.

While 2030 and 2050 may seem distant, particularly on political time scales, fiscal reform takes time. Governments will need to develop comprehensive strategies to overcome the political economy barriers to reform that include communication campaigns, stakeholder consultation, complementary policies, political negotiations, legislation, and program implementation. Preparation and a phased approach will reduce the risk of disruption (OECD & International Transport Forum, 2019).

The energy crisis of 2021 and 2022 has demonstrated that the world needs to hasten the adoption of clean energy. In addition to mitigating climate change, an energy system dominated by clean energy offers a lasting solution to energy price volatility, energy inflation (by creating alternatives to fossil fuels), and energy security (by providing domestic supplies of safe, distributed energy) (IEA, 2022c).

The full implications for the energy and fiscal transition of Russia's invasion of Ukraine are beyond the scope of this report to assess. However, we trust that the revenue data and projections presented in this report will assist analysis by others. Relevant findings include

- Russia's fiscal system is highly vulnerable to changes in fossil fuel demand and supply.
- Energy security concerns could result in a faster phase-out of fossil fuels than previously anticipated, which could create gaps in government budgets without fiscal reform.

- High fossil fuel prices could drive increased investment in fossil fuels, boosting revenues but also social costs.

In addition, further research is needed on the implications of the fiscal transition on the fiscal capacity of BRIICS countries to service sovereign debt. In the wake of the pandemic and associated economic responses, sovereign debt has ballooned in BRIICS countries, as in many other economies, which could become more challenging to manage in a high interest rate environment (World Bank, 2022b).

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Appendix A. Fossil Fuel Revenues

Table A1. Brazil

2019	USD billion	% GDP	% total government revenue
GDP	1,877,824		
Total general government revenue	609,025	32.43	
Fossil fuel revenues	51,260	2.73	8.42
Consumption	**23,694**	**1.26**	**3.89**
Circulaçao de Mercadorias e Serviços ("ICMS" or Tax on Commerce and Services, similar to value-added tax [VAT]) on oil, fuel and lubricant	22,990	1.22	3.77
Contribuição sobre Intervenção no Domínio Econômico (CIDE) (gasoline tax)	704	0.04	0.12
Production	**27,566**	**1.47**	**4.53**
Corporate income tax (paid by Petrobras)	6,579	0.35	1.08
Contribution for the Program of Social Integration and Contribution for the Financing of Social Security) (PIS-COFINS) (paid by Petrobras)	8,621	0.46	1.42
Withholding personal income taxes (paid by Petrobas)	232	0.01	0.04
Dividends (paid by Petrobras)	333	0.02	0.05
Oil production taxes (Royalties and Special Participation Payments)	8,543	0.45	1.40
Gas production taxes (Royalties and Special Participation Payments)	2,814	0.15	0.46
National Agency of Petroleum, Natural Gas and Biofuels (ANP) fees and charges	444	0.02	0.07

Sources: CIDE: Government of Brazil, 2022a; ICMS: Government of Brazil, 2022b; Royalties and Special Participation Payments: Government of Brazil, 2020; Taxes paid by Petrobas: Petrobas, 2020; ANP fees and charges: National Agency of Petroleum, Natural Gas and Biofuels, 2020.

Table A2. China

2019	USD billion	% GDP	% total government revenue
GDP	14,279,937		
Total general government revenue	3,154,488	22.09	
Fossil fuel revenues	151,661	1.06	
Consumption	**135,471**	**0.95**	**89.32**
VAT	66,149	0.46	43.62
Excise tax	69,321	0.49	45.71
Production	**16,191**	**0.11**	**10.68**
Corporate income tax (CIT)	7,556	0.05	4.98
Revenue from state-operated enterprise (SOE) profits	3,675	0.03	2.42
Natural resource tax	4,959	0.03	3.27

Source: VAT and excise estimated by IISD based on tax rates (OECD, 2019a), consumption volumes (IEA, 2022b), and fuel prices (FX Empire, 2022); CIT from annual reports for Sinopec, China National Petroleum Corporation and China National Offshore Oil Corporation; Revenue from SOE profits from National Bureau of Statistics (2020).

Table A3. India

2019	USD million	% GDP	% total government revenue
GDP	2,746,426		
Total general government revenue	515,470	18.8	
Fossil fuel revenues	92,901	3.4	18.0
Consumption	**80,634**	**2.9**	**15.6**
Cess on crude oil	2,100	0.1	0.4
GST	4,934	0.2	1.0
Customs duties	3,581	0.1	0.7
Excise duty	31,675	1.2	6.1
VAT	28,471	1.0	5.5

Electricity duties on fossil fuel power	4,478	0.2	0.9
State cess on coal	264	0.01	0.1
GST compensation cess	4,968	0.2	1.0
Other taxes	163	0.0	0.0
Production	**12,267**	**0.4**	**2.4**
Royalties	4,240	0.2	0.8
Corporate/income Tax	3,285	0.1	0.6
Dividends and dividend distribution tax	3,269	0.1	0.6
National Calamity Contingent Duty	160	0.01	0.0
Petroleum exploration-related income	839	0.03	0.2
Contribution to National Mineral Exploration Trust (NMET)	30	0.001	0.0
Contribution to District Mineral Foundation (DMF)	444	0.02	0.1

Notes: Total revenue as a % GDP is higher than most official estimates because it includes state revenues.
Source: Aggarwal et al. 2022

Table A4. Indonesia

2019	USD million	% GDP	% total government revenue
GDP	1,119,091		
Total general government revenue	138,192	12.3	
Fossil fuel revenues	21,737	1.9	15.7
Consumption	**3,549**	**0.3**	**2.6**
VAT	2,379	0.2	1.7
Motor fuels tax	1,170	0.1	0.8
Production	**18,188**	**1.6**	**13.2**
Royalties (coal)	1,394	0.1	1.0
Non-tax revenue (coal mining sales)	1,313	0.1	1.0
Non-tax revenue (oil)	5,911	0.5	4.3
Non-tax revenue (crude oil Domestic Market Obligation)	396	0.0	0.3
Non-tax revenue (natural gas)	2,648	0.2	1.9
Non-tax revenue (oil and gas upstream activities)	1,092	0.1	0.8
Fixed fee revenue (coal exploration)	28	0.0	0.0
Land and building tax	1,224	0.1	0.9
Corporate income tax	4,181	0.4	3.0
Penalties, fines, and interest (upstream oil and gas)	0.01	0.0	0.0

Source: Republic of Indonesia (2020) except VAT and Motor fuel tax revenues, which were estimated by IISD based on 2019 prices, tax rates, and domestic sales of gasoline and diesel (Government of Indonesia, 2021).

Table A5. Russia

2019	USD billion	% GDP	% total government revenue
GDP	1,687,449		
Total general government revenue	465,274	27.6	
Fossil fuel revenues	156,639	9.3	33.7
Consumption	**15,561**	**0.9**	**3.3**
VAT	8,963	0.5	1.9
Excise	6,534	0.4	1.4
Local taxes and fees	49	0.0	0.0
Regional transport tax	14	0.0	0.0
Production	**141,078**	**8.4**	**30.3**
Mineral extraction tax	92,160	5.5	19.8
Export duties	35,268	2.1	7.6
SOE dividends and privatization	989	0.1	0.2
Personal income tax	1,514	0.1	0.3
Corporate income tax	9,088	0.5	2.0
Regional property tax	1,956	0.1	0.4
Taxes provided by special tax bodies	103	0.0	0.0

Sources: Federal Tax Service of Russia, 2022; Government of Russia, 2022.

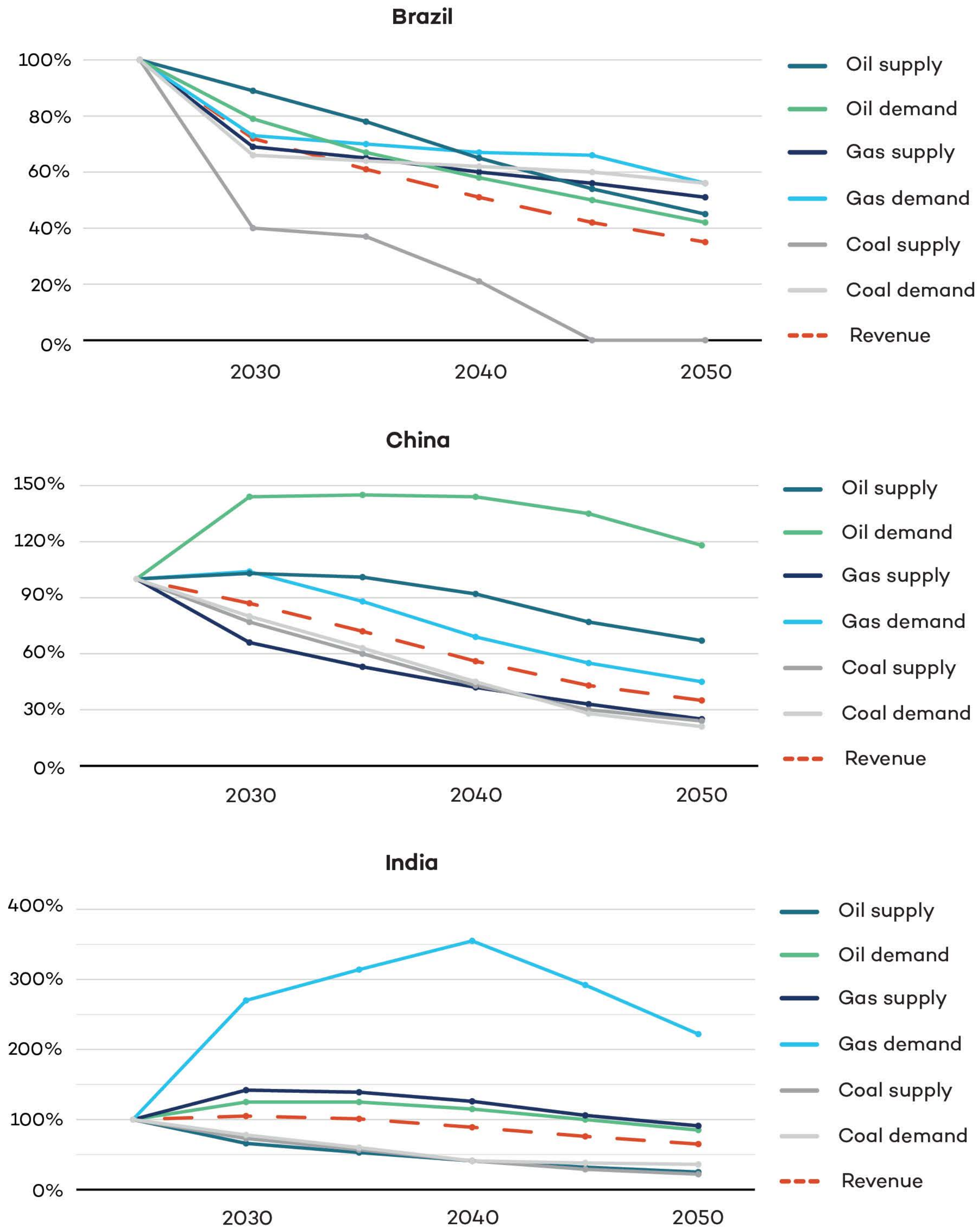
Table A6. South Africa

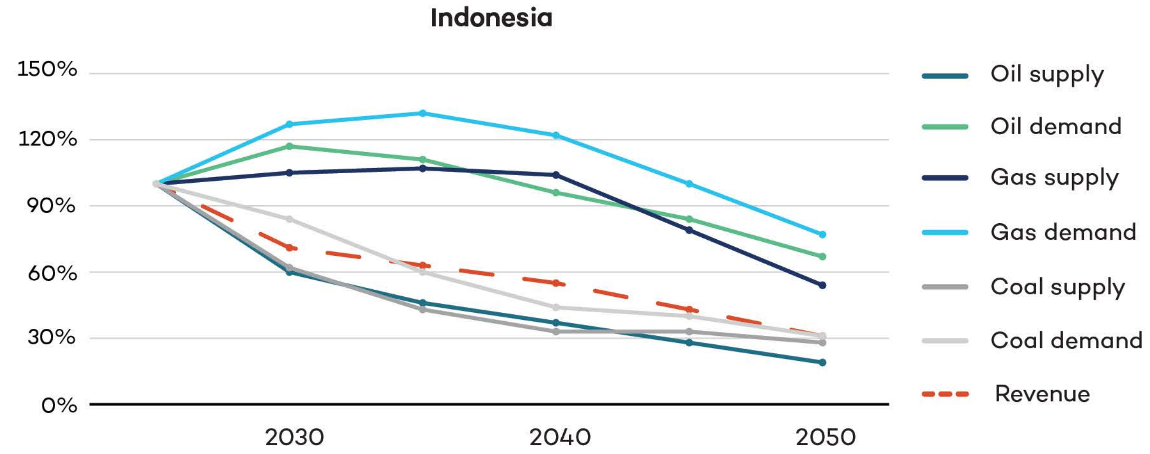
2019	USD billion	% GDP	% total government revenue
GDP	387,935		
Total general government revenue	113,885	29.4	
Fossil fuel revenues	6288	1.6	5.5
Consumption	**6080**	**1.6**	**5.3**
General fuel levy	5032	1.3	4.4
Road Accident Fund levy	289	0.1	0.3
Carbon dioxide tax on fuel	265	0.1	0.2
Electricity levy on fossil power	494	0.1	0.4
Production	**207**	**0.1**	**0.2**
Royalties: Mineral and Petroleum Resources Royalty	106	0.03	0.1
Personal income tax (coal)	5.0	0.001	0.004
Corporate income tax	97	0.02	0.1

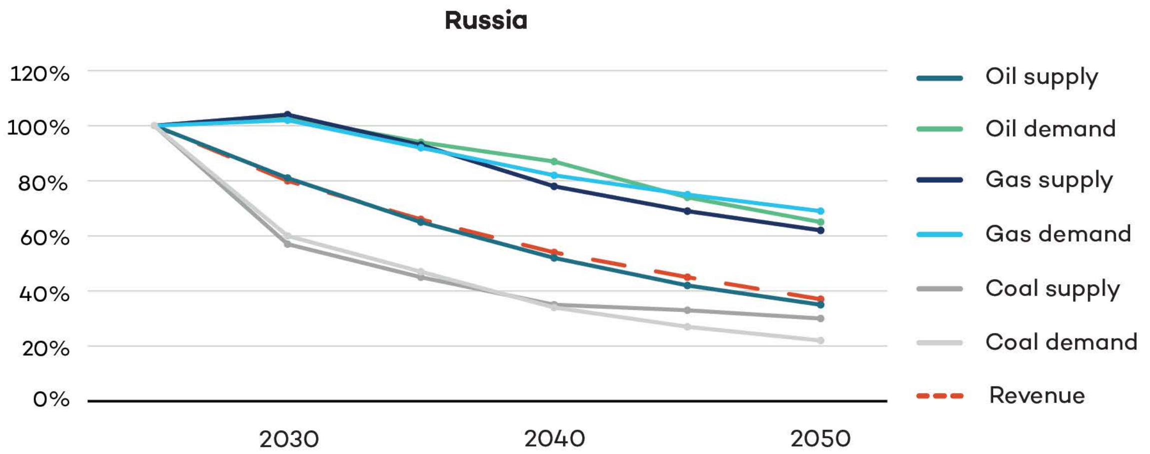
Note: The values in this table vary slightly from Bridle et al., 2022 due to the different exchange rate used.
Source: Bridle et al., 2022.

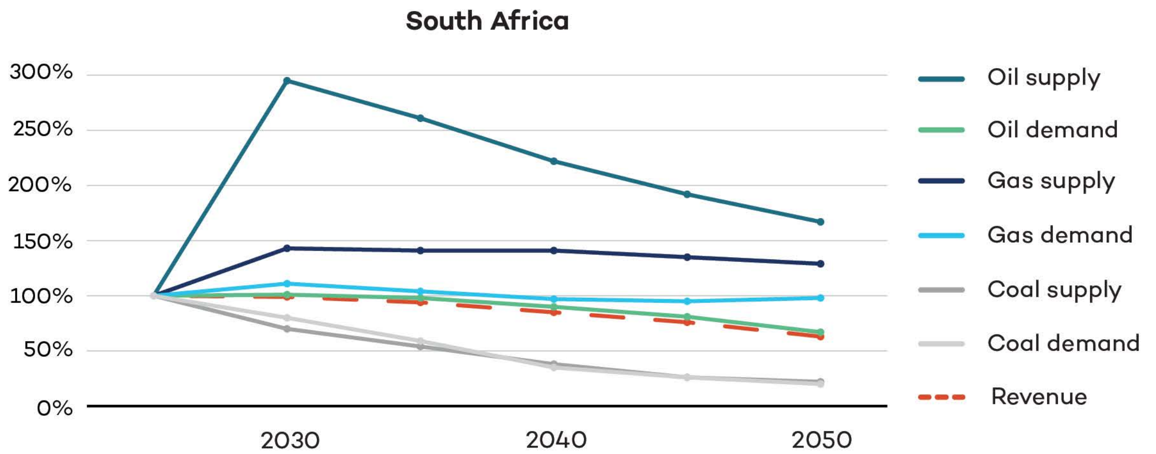
Appendix B. Projected Changes in Fossil Fuel Demand and Supply (and Fossil Fuel Revenues) in BRIICS Countries

Figure B1. Projected changes in fossil fuel demand and supply (coal, oil, and natural gas) and fossil fuel revenues in BRIICS countries based on the IEA's Sustainable Development Scenario (change as a % of 2019)









Notes: Oil supply projections for South Africa should be viewed with caution. The IEA *World Energy Outlook 2021* does not provide projections for South Africa. Therefore, projected demand and supply for South Africa were estimated based on South Africa's historical share from 2010 to 2019 of Africa's demand and supply (as described in the Methodology [Section 2]). In 2019, South Africa's share of Africa's oil production dropped down well below the average (0.002% compared to an average of 0.07%). We could not know if this was an aberration or an ongoing trend; therefore, it has not been corrected. The 2030 projection for oil supply, therefore, shows a bounce-back effect that may not be realistic. But this has little bearing on revenues or total primary energy supply, given South Africa's very low oil production volumes.

BRIICS = Brazil, Russia, India, Indonesia, China, South Africa

Source: Authors' projections based on IEA, 2022d, Licence: Creative Commons Attribution CC BY-NC-SA 3.0 IGO.

Appendix C. Green Bond Market: Origin and the status in BRIICS countries

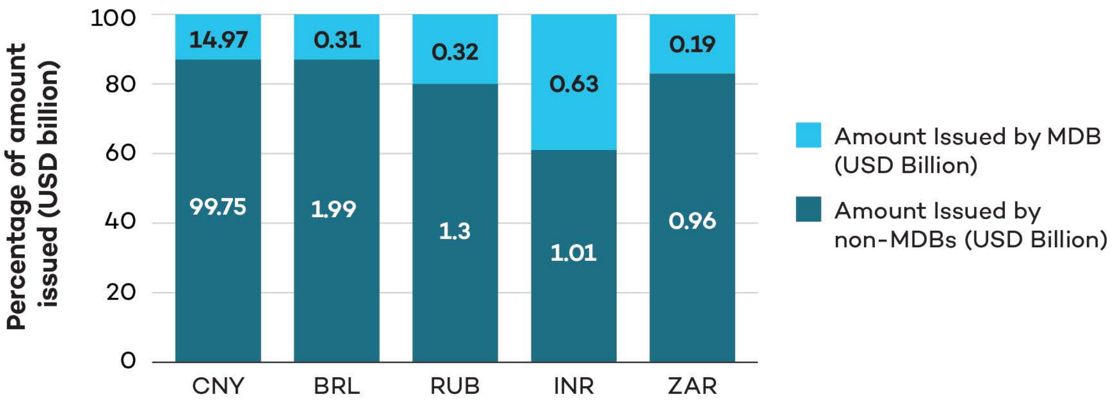
The first green bond issuance was the European Investment Bank's 2007 Climate Awareness Bond, which raised funds for investments in infrastructure for renewable energy and investment in energy efficiency. The early development of green bond markets has been mostly supported by multilateral development banks (MDBs). Following the European Investment Bank issuance, the International Bank for Reconstruction and Development issued its first green bond in 2008, and the International Finance Corporation (IFC) entered the green bond market with the first issuance in 2010. The most used currencies for green bond issuances are hard currencies such as the USD, GBP, and EUR. Other currencies, such as CNY and SEK, represent a sizable portion of the market to date. Other issuance, especially from developing countries, are at times issued in local currencies.

China has been very active in green bonds, with CNY being the third-largest currency of issuance for global green bonds as of 2021. Part of the winning receipt for China has been a strong institutional commitment to sustainable finance. For instance, starting in 2015, the People's Bank of China was among the first central banks to advocate for the inclusion of support for sustainable finance in central banks' policies (Dikau & Volz, 2021). China's issuance topped USD 50 billion in 2019 and 2021, but other BRICS countries have been issuing green bonds at a much lower level (See Figure C.1 for data).

Development banks play a large role in the issuance of green, social, and sustainable (GSS) (GSS) bonds in BRICS countries. The New Development Bank (n.d.), a multilateral development bank created in 2015 by BRICS countries, first issued green bonds in 2016 in CNY currency for a total of approximately USD 450 million. It has issued bonds for renewable energy and water treatment, as well as a USD 500 million sustainable bond to support emergency support loans in response to the coronavirus crisis.

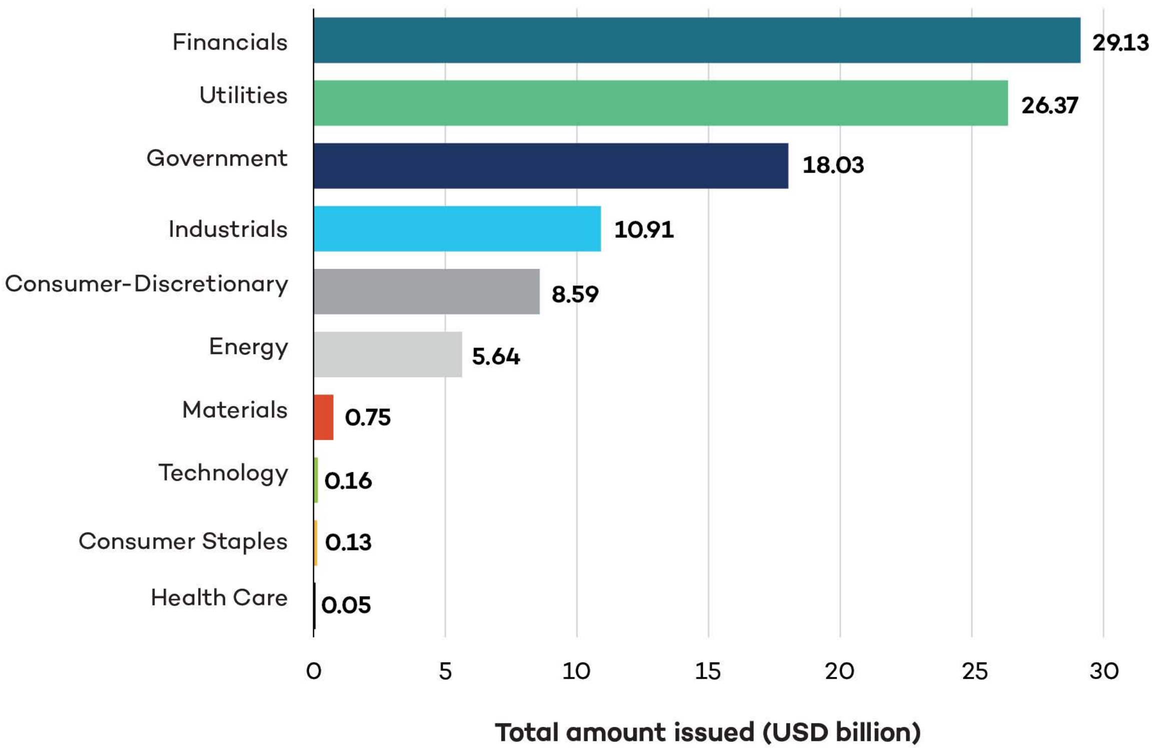
Other development banks active in BRICS countries include the International Bank for Reconstruction and Development and the China Development Bank, which, as of 2021, have issued a total of a total of approximately USD 1.0 billion and USD 14.0 billion, respectively.

Figure C1. Percentage of green bonds issued in BRICS countries by MDBs as a portion of the total issuance (Y axis) and amount issued by MDBs and non-MDBs (column data labels)



Source: Bloomberg Fixed Income Database and author's calculations.

Figure C2. BICS Level 1 economic sector issuance in China between 2014 and 2021



Note: BICS = Bloomberg Industry Classification System

Source: Bloomberg Fixed Income Database and author calculations.

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