STAFF

CLIMATE

NOTES

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Authors’ email addresses:	dmesapuyo@imf.org apanton@imf.org tsridhar@imf.org mstuermer@imf.org cungerer@imf.org azhang@imf.org

* This note was prepared under the guidance of Pritha Mitra and James Roaf. The authors would like to thank IMF colleagues, particularly from the Monetary and Capital Markets, Africa, Middle East and Central Asia, and the Western Hemisphere departments, for insights and helpful comments.

Key Challenges Faced by Fossil Fuel Exporters During the Energy Transition

Diego Mesa Puyo, Augustus Panton, Tarun Sridhar, Martin Stuermer, Christoph Ungerer, and Alice Tianbo Zhang[1]

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Summary

The global energy transition is affecting fossil fuel exporters from multiple angles. It is adding to longstanding uncertainties on the relative movements of fossil fuel demand and supply, which impact fossil fuel–related exports, fiscal flows, investment and subsequently external and fiscal accounts, economic growth, and employment. While policymakers are very familiar with these challenges, they now also face expectations of a permanent decline in the long-term global demand for fossil fuels. As the 28th United Nations Climate Change Conference (COP28) has resulted in a historic call to transition away from fossil fuels, many fossil fuel exporters will now be exposed to greater energy transition risks than in the past.

Key factors that could determine country-level impacts include (1) the type of fossil fuel a country exports—global coal use is expected to decline faster than that of crude oil and natural gas; (2) extraction costs—low-cost exporters may gain market share while high-cost exporters may wind down production; and (3) country characteristics—with greater risks for less diversified economies.

The monitoring and mitigation of fiscal risks will need to be stepped up and, for some, decisions made on the use of remaining fossil fuel revenues, balancing building financial asset buffers, debt repayment, or increasing public spending. Fiscal policy also has a role in reducing domestic emissions, encouraging adoption of low-carbon technologies, and helping those most vulnerable to changes from the transition.

Broader macroeconomic risks can be reduced by accelerating ongoing structural reforms that support alternative engines of growth. Low- or zero-carbon emission energy industries could offer new avenues that build on existing fossil fuel knowledge and infrastructure. Concurrently, improved financial regulation and supervision could reduce financial sector exposures.

Finally, international coordination on the design and implementation of climate policy as well as international transfer schemes (financing and capacity development) could reduce uncertainties surrounding the transition path and the associated adverse economic consequences.

[1] This note was prepared under the guidance of Pritha Mitra and James Roaf. The authors would like to thank IMF colleagues, particularly from the Monetary and Capital Markets, Africa, Middle East and Central Asia, and the Western Hemisphere Departments, for insights and helpful comments.

Context

At the 28th United Nations Climate Change Conference (COP28) policymakers made a historic call to transition away from fossil fuels in energy systems.[2] This resolve came from the first Global Stocktake to assess progress toward climate objectives which recognized the need for deep, rapid, and sustained reductions in greenhouse gas (GHG) emissions in line with the 1.5 degrees Celsius target (relative to preindustrial levels). Countries participating in the 28th UN Climate Change Conference agreed to accelerate efforts to phase-down unabated coal power, phase-out inefficient fossil fuel subsidies, substantially reduce methane emissions, double the average annual rate of energy efficiency improvements, and triple renewable energy capacity by 2030. Finally, an increasing number of countries reaffirmed their commitment to achieve net zero GHG emissions by or around 2050, including many of the largest emitters.

If these climate change mitigation pledges are realized, over the long term, there will be a sharp contraction in the global demand for fossil fuels. Burning fossil fuels—primarily crude oil, natural gas, and coal—for energy supply is the main source of anthropogenic GHG emissions. Reducing these emissions will require the global economy to transition toward renewable energy sources, cleaner technologies, higher energy efficiency, and less energy-intensive lifestyles. To allow for even a 50 percent probability of limiting warming to 1.5 degrees Celsius, nearly 60 percent of proven reserves for oil and natural gas and 90 percent for coal must remain unextracted (Welsby and others 2021; IPCC 2022; IEA 2021).

The extent of contraction could vary across fossil fuels. For a 2050 net-zero scenario to materialize, global coal use declines by 90 percent, oil around 80 percent, and natural gas by over 70 percent between 2021 and 2050 (IEA 2022a).[3,4] In line with its high carbon content, demand for coal is expected to decline more rapidly than for oil and natural gas. With the lowest carbon content, natural gas is often anticipated to endure where its demand may even increase in the near to medium term if it is used as a transition fuel, particularly substituting for coal.[5] Country-level availability and affordability of cleaner energy and energy security needs, especially in the context of fostering economic development, will also influence the demand for each fossil fuel.

Overall, the path of the energy transition remains highly uncertain. While global demand for fossil fuels is expected to permanently decline over the long term, it is difficult to predict relative fossil fuel demand and supply movements during the transition. Key factors will include:

- **The pace of policy commitments and implementation around the globe.** The longer these continue to fall short of the assumptions underlying the net zero scenario—carbon dioxide emissions reached historic highs in 2022, and 2023 is set to become the warmest year on record—the more likely larger and more rapid emissions reductions will be necessary to limit warming to 1.5 degrees Celsius or even 2 degrees Celsius (IEA 2022c). Key measures to reduce the global demand for fossil fuels include widespread downstream carbon pricing, extensive adoption of clean technologies, penalizing emission-intensive extraction processes, and banning polluting technologies such as new internal combustion engine vehicles.[6]
- **Investment in fossil fuel supply.** This will be influenced by investors' projections of fossil fuel demand, where significant underinvestment could risk global energy security (OPEC 2022). Higher capital costs for extractive projects will play a role, as climate and environmental risks are factored into investors' decision

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[2] The 28th United Nations Climate Change Conference (COP28) was held from November 30 to December 12, 2023, in Dubai, United Arab Emirates.

[3] Residual GHG emissions from fossil fuel use will need to be offset through natural carbon sinks and carbon capture technologies.

[4] These projections are broadly consistent with IEA (2023a).

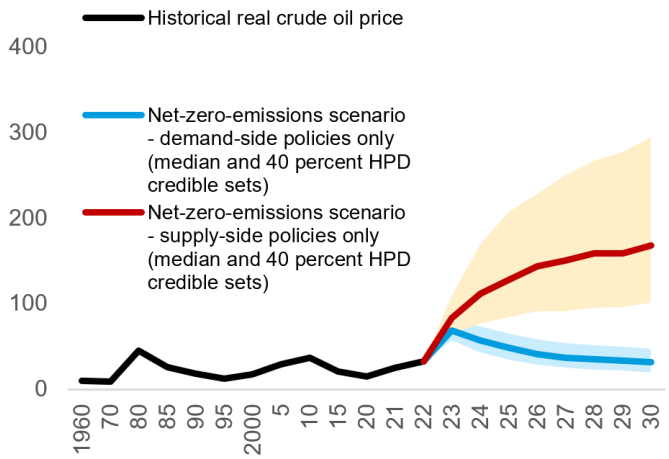
[5] The future of natural gas is nonetheless unclear. The IEA (2022a) highlights that "the depth and intensity of today's crisis have led to concerns about the future cost and availability of natural gas which have damaged confidence in its reliability and put a major dent in the idea of it serving as a transition fuel."

[6] Several cities across the world have announced targets or plans to phase out internal combustion engine vehicles (Wappelhorst 2020).

- making (Boer, Pescatori, and Stuermer 2023). Political decisions by large crude oil–, natural gas–, or coal-producing countries to limit or fully phase out fossil fuel extraction would also have an impact.
- **Technological change.** The unpredictable pace of technological change will influence the depth, speed, and nature of the energy transition. Examples include carbon capture technology that "green" fossil fuel exports and innovation around affordable clean technologies.

Fossil fuel prices will be difficult to predict with a range of likely scenarios. For example, medium-term crude oil price scenarios for the energy transition vary greatly—the IMF's April 2022 *World Economic Outlook* Special Feature (IMF 2022u) projects 2030 prices could plausibly range anywhere from $25/barrel to $135/barrel (Figure 1).[7] At the lower end of the range, IEA (2023a) projects $42/barrel by 2030 in a net-zero-emissions scenario. Low fossil fuel prices could result from faster-than-expected implementation of demand-led decarbonization measures, where fossil fuel producers are caught with significant excess capacity. Meanwhile, current futures curves suggest prices would remain around current levels, and model simulations in the 2023 Saudi Arabia Article IV staff report (IMF 2023w) also indicate that prices could remain relatively high. At another end of the spectrum, preemptive underinvestment in new fossil fuel production capacity due to expected declines in fossil fuel demand could lead to temporary but large fossil fuel price spikes.[8]

Figure 1. Oil Price Projection Scenarios



Source: Boer, Pescatori, and Stuermer (2023).
Note: Brent crude oil spot prices were adjusted for inflation using the United States consumer price index with the base year 2020. HPD credible set = highest posterior density credible interval.

Against this backdrop, this note takes a fresh look at the macroeconomic challenges faced by fossil fuel–exporting countries ("fossil fuel exporters"). Following an overview of how the energy transition could impact fossil fuel exporters, policy considerations are discussed.[9,10] The focus is both on longstanding uncertainties over fossil fuel prices that translate into unpredictable fossil fuel export and fiscal revenues and on the key new challenge of adjusting to permanently lower long-term global demand for fossil fuels.

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[7] Boer, Pescatori, and Stuermer (2023) quantify how fossil fuel prices could evolve during demand-led and supply-led global decarbonization scenarios. Council of Economic Advisors and Office of Budget and Management (2023) highlights the potential for alternative directions for fossil fuel price paths during the energy transition.

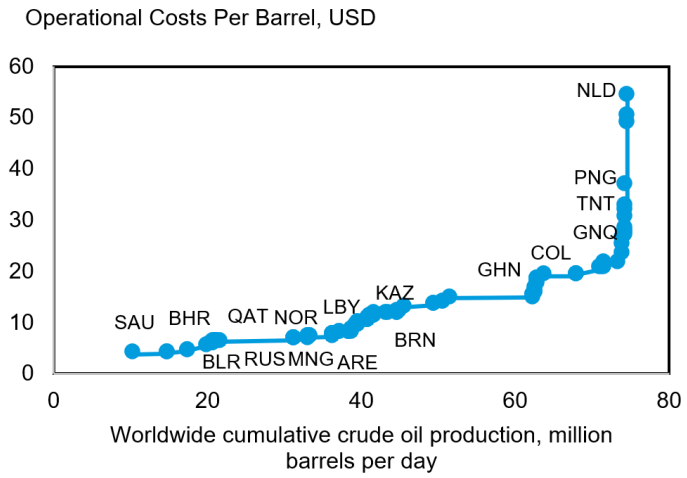
[8] Bogmans, Pescatori, and Prifti (2023) estimate that the perceived increase in the exposure of oil and gas firms to climate policies has led to a 6 percent global decline of their capital expenditures between 2016 to 2019, suggesting that the anticipation of climate policies can indeed lead to substantial contraction of fossil fuel supply capacity in the short to medium term.

[9] Key references include the IMF October 2019 *Fiscal Monitor* Online Annex, Peszko and others (2020), Mirzoev and others (2020), IMF (2022a), Saha and others (2023), and IMF (2023c) (see also Bems and others 2023).

[10] Given its focus on the impact of global fossil fuel market developments, this note does not extensively cover other channels through which global decarbonization will impact fossil fuel producers, such as impacts of border carbon adjustment mechanisms on fossil fuel–related products, the impacts of climate change on damages and losses in fossil fuel–producing economies, or the impact of domestic climate change mitigation policies needed for fossil fuel–producing countries to meet their own GHG emission reduction targets. Given its focus on fossil fuel producers, the note also does not cover how producers of other commodities will be impacted by the energy transition. For instance, transition metals (for example, lithium, cobalt) are critical for scaling up renewable energy supply. Countries that produce these metals could take on a role in the global economy that is akin to that of the fossil fuel producers today. The availability and price developments of these metals could be a crucial determinant for the speed of the energy transition (Boer, Pescatori, and Stuermer 2022).

- **The largest of the less diversified crude oil and natural gas exporters may not experience exceptionally large declines in long-term demand.** Despite the market's long-term contraction (Figure 2), the low production costs of these exporters may result in their capturing a larger share of the global market for these fuels. Similar arguments may apply to countries with less emission-intensive extraction processes and those that minimize environmental damages, such as deforestation and oil spills, during the extraction process.
- **Emerging markets and developing economies (EMDEs) with higher fossil fuel dependency and production costs will be significantly impacted (Figure 3).** This is particularly the case for those that are not able to rapidly diversify their export base or develop alternative engines of economic growth (Figure 4). The world's largest exporters (Figure 5) will also be adversely impacted but those with more diversified economies likely less so.

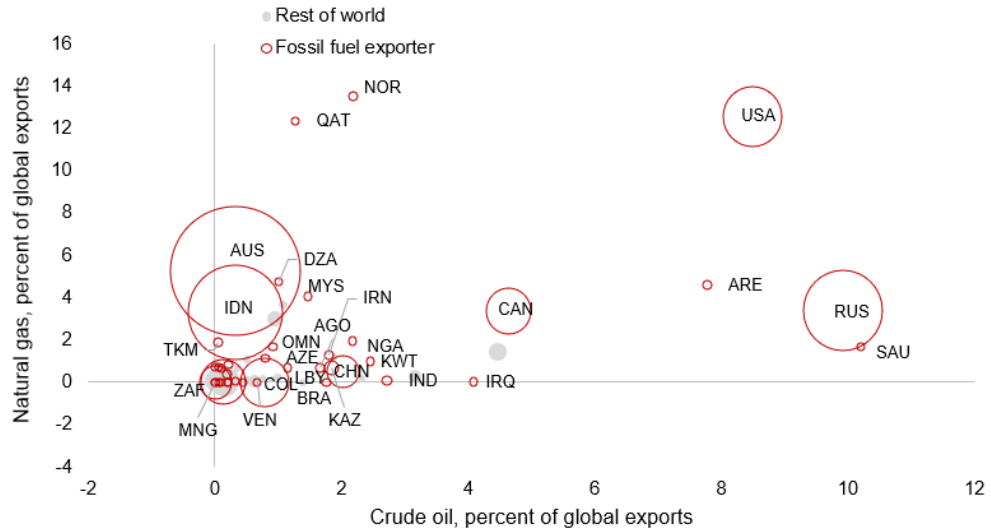
Figure 2. Oil Breakeven Extraction Costs



Sources: IMF (2022v); Rystad Energy Ucube; and IMF staff calculations.
Note: The figure uses 2022 data. The figure refers to country-average operational costs for crude oil production for selected countries and does not include upfront investment costs. Data labels in the figure use International Organization for Standardization (ISO) country codes.

- **The risk of "stranded" or prematurely obsolete assets may rise.** If fossil fuel prices fall short of production costs for prolonged periods, fossil fuel exporters (large and small) that have made significant and often debt-financed investments in extractive infrastructure risk ending up with stranded assets (Figure 2). To some extent, this risk can be mitigated as some fossil fuel extraction–related infrastructure could be repurposed for other uses, such as zero or low-emission hydrogen production or related products.

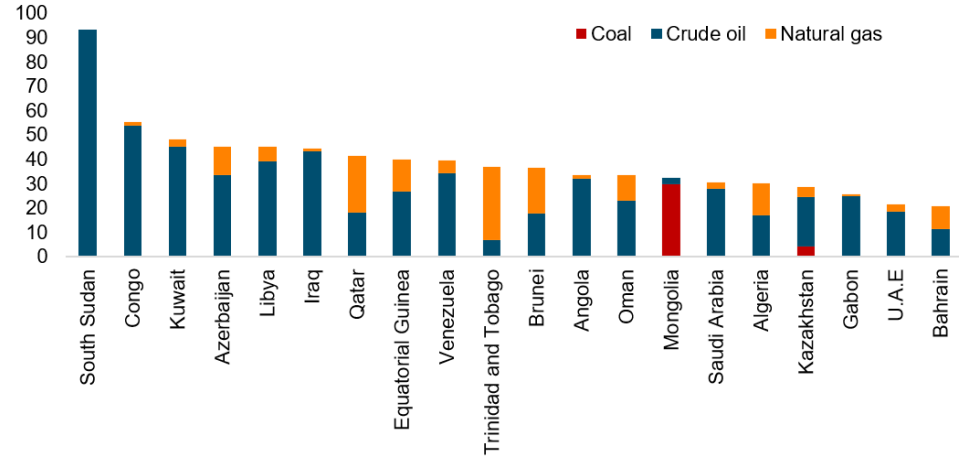
Figure 3. Largest Fossil Fuel Exporters
(Percent of global exports)



Sources: IMF, World Economic Outlook database; UN Conference on Trade and Development; and IMF staff calculations.
Note: Size of bubble refers to the value of coal exports as a percent of global coal exports. Data labels in the figure use International Organization for Standardization (ISO) country codes.

Figure 4. Fossil Fuel Production, 2017–21

(Percent of GDP)



Sources: International Energy Agency; IMF, World Economic Outlook database; World Bank, Commodity Price Data; and IMF staff calculations.
Note: Congo = Republic of the Congo; U.A.E. = United Arab Emirates.

Figure 5. Ranking Countries by Size of Net Fossil Fuel Exports and Commodity Revenues

Table 1. Net Exports of Fossil Fuels (percent of GDP) by Fossil Fuel Producer
(Average, 2017-22)

Rank	Country	All Fuels	Crude Oil	Natural Gas	Coal
1	Libya	40.3	35.2	5.2	-0.01
2	Equatorial Guinea	39.2	28.1	11.1	0.00
3	Qatar	37.3	13.0	24.3	-0.01
4	Kuwait	36.0	33.5	2.5	-0.03
5	Azerbaijan	35.5	28.7	6.7	0.00
6	Angola	34.9	32.2	2.7	-0.01
7	Iraq	33.2	33.7	-0.4	-0.01
8	Brunei Darussalam	32.9	10.6	22.7	-0.49
9	United Arab Emirates	32.6	29.1	3.5	-0.04
10	South Sudan	31.1	31.1	0.0	0.00
11	Republic of Congo	30.6	30.5	0.2	-0.09
12	Oman	23.1	16.6	6.6	-0.03
13	Saudi Arabia	22.1	21.4	0.7	-0.01
14	Gabon	20.7	20.5	0.2	-0.02
15	Algeria	20.3	10.2	10.1	-0.06
16	Kazakhstan	19.1	17.9	1.1	0.11
17	Norway	18.1	7.9	10.1	-0.06
18	Mongolia	14.8	-5.8	-0.2	22.5
19	Turkmenistan	14.3	1.6	12.4	0.20
20	Chad	14.1	14.1	0.0	0.00
21	Venezuela	13.2	13.2	-0.1	0.03
22	Trinidad and Tobago	13.0	3.2	10.0	-0.08
23	Russian Federation	12.3	10.5	0.6	1.12
24	Papua New Guinea	12.1	2.1	10.0	0.00
25	Iran	11.9	10.3	1.5	0.02
26	Bahrain	9.5	8.9	N/A	0.00
27	Nigeria	8.7	7.1	1.6	0.00
28	Ghana	5.8	5.8	0.0	-0.04
29	Colombia	5.6	3.4	-0.1	2.30
30	Canada	4.1	3.2	0.5	0.3

Table 2. Government Commodity Revenue (percent of Total Government Revenue) by Fossil Fuel Producer
(Average, 2017-22)

Rank	Country	Commodity Revenue
1	Kuwait	91.6
2	Iraq	91.2
3	South Sudan	88.7
4	Equatorial Guinea	80.4
5	Brunei Darussalam	77.8
6	Oman	77.0
7	Qatar	72.6
8	Bahrain	63.3
9	Saudi Arabia	63.3
10	Republic of Congo	60.0
11	Angola	58.4
12	United Arab Emirates	53.3
13	Yemen	48.3
14	Algeria	41.8
15	Chad	40.9
16	Gabon	39.8
17	Trinidad and Tobago	37.9
18	Nigeria	35.8
19	Ecuador	30.9
20	Kazakhstan	27.3
21	Russian Federation	23.0
22	Iran	22.4
23	Bolivia	16.9
24	Cameroon	15.5
25	Ghana	10.5
26	Papua New Guinea	10.4
27	Niger	10.3
28	Senegal	10.0
29	Indonesia	7.3
30	Colombia	6.5

Sources: IMF, World Economic Outlook database; UN Conference on Trade and Development; and IMF staff calculations.
Note: In panel 1, shading depicts the relative magnitude of net exports as a percent of GDP, with red representing higher magnitudes. Columns include other related primary products. Data not available for all countries. Panel 2 only includes fossil fuel producers. Panel 1 refers only to trade of primary fossil fuel–related products. Including secondary products like petrochemicals can significantly increase dependence ratios for some countries. For instance, in the case of Trinidad and Tobago, which is major exporter of ammonia and methanol, net exports of primary products related to fossil fuels, largely liquified natural gas, are 11.2 percent of GDP. If petrochemicals exports are included, net exports of petroleum-related products increase to 30 percent of GDP. Panel 2 may include revenue from other commodities different from oil, natural gas, and coal such as other mining products and forestry. However, revenue from fossil fuels is predominant among the countries surveyed. Equally, the figure focuses on total government revenues. As such, it may not reflect the extent to which vulnerability to fossil fuel revenues could be concentrated in certain parts of the government, such as in local governments.

How Will Fossil Fuel Exporters Be Impacted by the Energy Transition?

Global decarbonization could affect many aspects of fossil fuel exporters' economies. For a given country, changes in fossil fuel export receipts and investments affect fiscal revenues, fossil fuel industry growth (with spillovers to the rest of the economy), inflation, and the financial sector. As noted earlier, the extent of the impact will depend on the level of a country's economic diversification, policy preparedness, and relative ability to gain global fossil fuel market shares. While country-specific quantification of the macroeconomic impact is beyond the scope of this paper, Box 1 summarizes three recent cross-country studies from the growing literature.

The balance of payments impact could have serious implications for external sustainability. Any change in net fossil fuel export receipts translates directly into the current account. Similarly, changes in foreign investments in the fossil fuel sector—for example, driven by foreign investors' expectations of reduced global oil demand—will affect financial account inflows. Meanwhile, to the extent sovereign risk premiums are impacted—for example, in a country with large external debt service obligations and declining fossil fuel exports—financial outflows related to service of new debt (including rollover of existing external debt) may rise. The impact of these pressures on the balance of payments could be partially mitigated by various factors, such as slow decarbonization in export destination countries, the contraction of fossil fuel–related imports, or, in the case of foreign involvement in fossil fuel projects amid declining export receipts, a decline in associated dividend outflows.[11] Overall, changes in the balance of payments could affect the accumulation of foreign exchange reserves. In fossil fuel exporters with flexible exchange rates, should a nominal exchange rate depreciation result, it could raise inflationary pressures and have marked balance sheet effects such as inflating private and public debt ratios.

Economic growth and, eventually, its key drivers could change. Changes in exports or investment associated with the fossil fuel industry or related industries (for example, cement, fertilizers, petrochemicals, steel) directly impact economic growth and employment (to the extent the industries are labor-intensive). Any subsequent variations in the profitability of these industries could have multiplier effects across the economy—where changes in employment, incomes, and the government's fossil fuel revenues could affect economy-wide private and public consumption and investment.[12] If all these changes are perceived as lasting, then resources (including labor and capital) may shift to other more productive sectors of the economy. Inflation may be affected by changes in domestic demand and domestic fossil fuel prices and exchange rate movements (mentioned earlier).

There may be consequences for fiscal sustainability. Movements in fossil fuel export receipts are typically reflected in government revenues from state-owned enterprises and private (domestic and international) fossil fuel companies— as relevant, these include dividends, royalties, production sharing (profit petroleum shares), and tax payments. Ripple effects across the economy could also affect the broader tax base and the composition of spending. For example, if fossil fuel export receipts and investment decline, spending on (1) retraining programs and cash transfers may need to be increased to support low skill workers transitioning out of the fossil fuel sector, and (2) fossil fuel–related state-owned enterprises may require financial support (transfers). Explicit or implicit government guarantees on state-owned enterprises' debt could weigh on government balance sheets. Governments may need to draw down buffers (for example, sovereign wealth funds) or adjust spending to maintain fiscal and debt sustainability. The next section elaborates on policy options and challenges.

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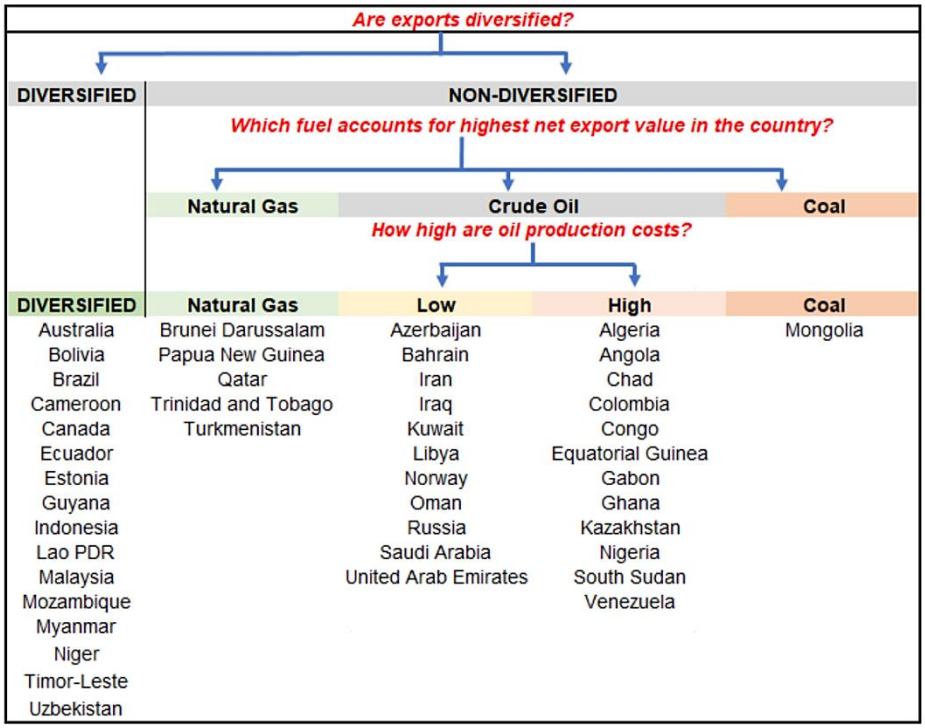
[11] Other factors that may mitigate the balance of payments impact include (1) the significant foreign income some fossil fuel exporters earn on their outstanding net foreign assets accumulated through historical fossil fuel sales (a result of historical petrodollar recycling), (2) lower petrodollar recycling in response to lower revenues from fossil fuel extraction, and (3) greater use of fossil fuels in exports that do not involve combustion and generation of GHG emissions such as plastics.

[12] For countries that produce and domestically consume coal in energy production, this channel could play a major role as coal is the largest source of energy in many countries and the fossil fuel expected to be phased out the fastest.

The financial sector, particularly in economies with significant exposure to the fossil fuel industry, could face higher risks. In addition to the balance sheet effects of any exchange rate movements, excessive volatility or lasting changes in fossil fuel sales will affect asset values. Global stranded assets (as a present value of future lost profits) in the upstream oil and gas sector could exceed $1 trillion under plausible changes in expectations about the effects of climate policy, with most of the market risk falling on private investors.[13] Negative net balance sheet effects could affect the ability of the financial sector to attract domestic or international financing and, in turn, its ability to intermediate funds and support the economy.

Figure 6. Export-Based Exposures of Fossil Fuel Exporters



Sources: IMF, World Economic Outlook database; Rystad Energy; UN Conference on Trade and Development; and IMF staff calculations.
Note: The figure shows all net exporters of fossil fuels (billions of US dollars), subject to data availability, calculated as an average (2017–22). The color scale shows the relative exposure risk. A 5 percent net fossil fuel export (as percent of GDP) was used as the cutoff to categorize export diversification. Ten dollars was used as the cutoff for classifying oil production operating costs per barrel (this does not include capital expenditures and other fixed costs).

Country characteristics will largely determine the extent of the economic impact of the global energy transition. Effects from the macroeconomic channels described earlier will be stronger for less diversified economies—especially countries with fuels that are being phased out sooner (for example, coal), have higher extraction costs (Figure 6), have emission-intensive extraction processes net of any carbon capture schemes (Figure 7), or where fossil fuel extraction could be jeopardized by extreme weather events—resulting in a rapid unwinding of production and significant declines in fossil fuel export receipts. The balance of payments and fiscal effects could be stark for countries with a narrow export base. However, if the drivers of economic growth are more diversified, the spillovers to economic growth could be more contained. For example, a diversified tax base prevents sharp declines in tax revenues and deterioration of financial sector instability.

[13] Semieniuk and others (2022) find that investors are overwhelmingly in Organisation for Economic Co-operation and Development countries, including substantial exposure through pension funds and financial markets.

Figure 7. Global Carbon Intensity of Crude Oil Production (Kilogram CO_2/boe)

Sources: Masnadi and others (2018); and IMF staff calculations.
Note: A total of 5.7 million British thermal units (or 6013.8 megajoule) per barrel of crude oil was used as the conversion unit from carbon dioxide (CO_2) emission per megajoule to barrel of oil equivalent (boe).

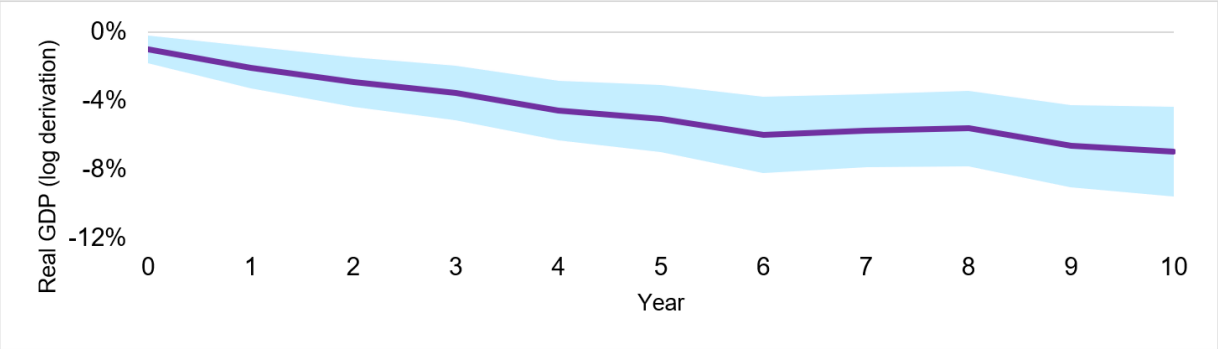
Box 1. What Will Be the Quantitative Impacts of Global Decarbonization on Fossil Fuel Producers?

Declines in extractive activity can persistently weaken real GDP and trade performance across fossil fuel–producing economies. For example, using local projections on 35 past episodes of sustained, exogenous declines in extraction for 13 minerals (oil, gas, coal, metals) and 122 countries since 1950, Bems and others (2023) find that declines in extractive activity can have persistent negative effects on real GDP and the trade balance. Specifically, they show that episodes of large resource extraction declines can weaken growth by 10 percent on impact and 40 percent by the 10th year on average. Private and public consumption, as well as investment, fall in line with the decline in GDP. Consumption and the exchange rate, however, have a delayed reaction, inconsistent with full anticipation of the persistent fall in extraction and related revenues. The real exchange rate depreciates, eventually by about 20 percent, but not enough to stimulate a reallocation of economic activity toward other tradable sectors such as manufacturing that could potentially offset the decline in exports. The results, in fact, reveal significant negative spillover effects onto both the manufacturing and services sectors. Net exports fall in line with extraction. Effects on low-income countries are significantly larger than on high-income countries.

Model-based evidence also points to significant macroeconomic effects of decarbonization policies in fossil fuel–producing economies. Using the IMF-ENV macro model—a global dynamic computable general equilibrium model developed by the IMF's Research Department—Chateau and others (2022) and Chateau, Jaumotte, and Schwerhoff (2022) simulated the IMF International Carbon Price Floor (ICPF) proposal of Parry, Black, and Roaf (2021). The proposal is that high-, middle-, and low-income countries introduce carbon price floors of $75, $50, and $25, respectively, and countries implement the maximum of either their carbon price floor and the carbon price implicit in their Nationally Determined Contribution (NDC). In this context, by 2030, relative to a baseline scenario where the ICPF is not introduced, the simulations imply there could be an average worldwide ICPF-related reduction of GDP by somewhat more than 1 percent of GDP—with a GDP reduction of 3 percent in Russia, 1.5 percent in Saudi Arabia, and 1.5 percent on average for other oil exporters. However, taking a more wholistic approach, the overall costs may be considerably less. For example, the 2023 Saudi Arabia Article IV Consultation (IMF 2023w) further refines the IMF-ENV model results and finds that if

Saudi Arabia phases out domestic energy subsidies, this will provide positive GDP gains while reducing emissions by around 100 million tons of carbon dioxide equivalent, which is about a third of the NDC reduction target planned for 2030. These positive GDP effects and the associated fiscal savings will considerably reduce the overall costs for Saudi Arabia's economy during the energy transition, including because oil prices are expected to remain relatively high even if all countries adopt their NDC plans.

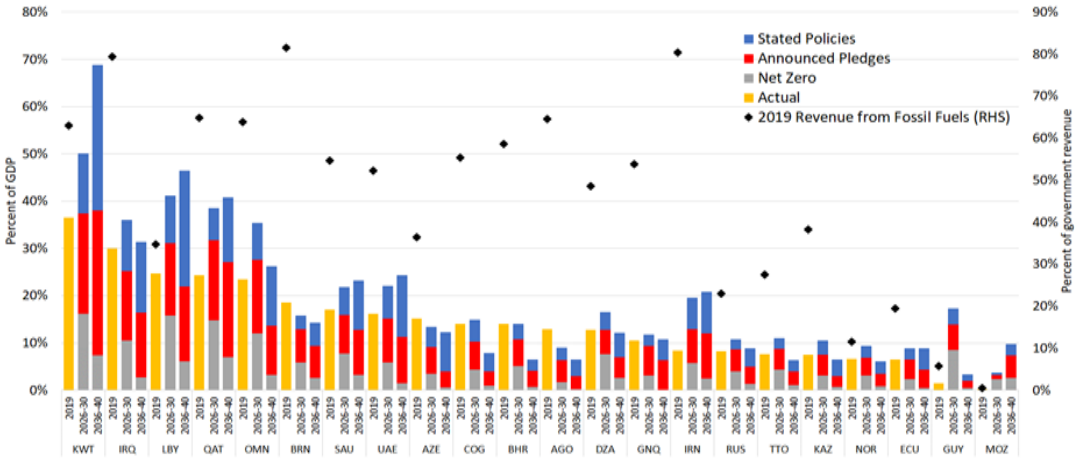
Figure 1.1. Response of Real GDP to a Typical Persistent Extraction Decline Episode



Source: Bems and others (2023).

IMF (2023b) assesses the impact of different global fossil fuel scenarios on public revenues from the oil and gas sectors. It highlights that different global scenarios will have very different outcomes and impacts within a global scenario that will vary significantly across countries. The model accounts for country-level differences in dependence on national oil companies, government fiscal take, extraction costs, and fossil fuel production, with the latter three varying by energy transition scenario.[1] The energy transition scenarios considered come from the International Energy Agency's "World Energy Outlook 2022" (IEA 2022a) and include (1) stated policies (only current policies implemented; peak oil demand in 2035), (2) announced pledges (government targets achieved; peak oil demand in 2024), and (3) net zero (warming limited to 1.5 degrees Celsius and no new fossil fuel developments). As a simplifying assumption, GDP is held constant across scenarios. All groupings of fossil fuel producers see a rapid revenue drop under the net zero due to falling commodity prices and demand. Revenues remain relatively stable out to 2030 under the announced pledges for most country groups but grow for Organization of the Petroleum Exporting Countries and advanced country oil producers due to higher oil prices combined with stable or increasing market share. Revenue in 2030 exceeds 2019 levels for all groups (except low-income oil producers) under the stated policies as demand has not yet peaked and prices are elevated. Over the longer term, revenue for all fossil fuel producers declines to slightly below 2019 levels under the stated policies, except for Organization of the Petroleum Exporting Countries and low-income gas producers (partly driven by Mozambique and new West African production), while the declines are substantial under the announced pledges and net zero, with the slight exception of lower cost producers (for example, Organization of the Petroleum Exporting Countries) and Mozambique in the announced pledges. In general, oil producers see a much larger revenue loss from a faster energy transition than do gas producers.

Figure 1.2. Public Revenue Scenarios



Source: IMF (2023b).
Note: The modeling framework was initially developed for the IMF (2019) *Fiscal Monitor* online annex and has since been further refined. See Baunsgaard and Vernon (forthcoming) for a detailed description of the revenue simulation methodology. The analysis includes countries that are major global producers (for example, the United States) and/or resource dependent (for example, Gabon). Data labels in the figure use International Organization for Standardization (ISO) country codes.

Policy Challenges

Ultimately, each fossil fuel exporter will face a unique combination of policy challenges calling for tailored policy advice. Examples of recent country-specific IMF advice along these lines are referenced in Annex 1. However, against the energy transition backdrop, there are some common policy considerations.

Historical policy challenges stemming from uncertainties around fossil fuel–related exports and fiscal flows will continue as will challenges of hedging against these risks. Concurrently, as part of the transition, fossil fuel exporters will need to invest in more renewable energy to meet their own energy needs while helping their vulnerable populations adjust to the changing structure of the economy.

A central challenge will be developing a view of whether or not, over the long term, a given country will be one of the surviving producers. This will inform decisions on fossil fuel investment and production, and on fiscal, monetary, financial, and structural policies. For many countries, ongoing reforms may need to be accelerated. Risks associated with whichever view is formed should be based on an examination of the country-level consequences under a broad range of transition scenarios that engender several alternative plausible assumptions.

Investment

The forms and levels of investment in fossil fuel production will be consequential. Decisions on investments in fossil fuel extraction operations—both new operations or continuation and expansion of existing operations—will flow through to other policy areas, including fiscal, monetary, financial, and structural policies. In the face of recent geopolitical tensions and trade fragmentation, energy security would need to inform the decision-making process for any investments in fossil fuel infrastructure (IMF 2023a). Similarly, various stakeholders, ranging from

key players in the country's fossil fuel industry to proponents of a faster clean energy transition, may also play an influential role. Overall, several investment considerations will need to be balanced[14]:

- Beliefs over the **most likely decarbonization scenario** and a country's fossil fuel export demand. Persistent downward deviations in demand or price relative to a country's investment and production choices could result in stranded assets.[15] These risks will likely be largest for coal exporters, where the demand may decline more rapidly and smallest for large low-cost crude oil and natural gas exporters that may even expand their share of the global market (see previous discussion) in the coming years (Box 2).[16]

Box 2. Different Approaches to New Hydrocarbon Investments

A handful of countries are actively stopping new investments in fossil fuel extraction. The Beyond Oil and Gas Alliance—including Costa Rica, Denmark, France, Ireland, Portugal, Sweden, Tuvalu, Vanuatu, and Wales—have agreed to stop issuing new licenses and set a Paris-aligned date for ending oil and gas production and exploration. Except for Denmark, however, core members of Beyond Oil and Gas Alliance have declining, minimal, or nonexistent production levels of oil and gas (Climate Action Tracker Brief 2023). In late 2022, the newly elected government of Colombia announced it was considering stopping the issuance of new oil and gas exploration and production licenses (Colombia Potencia de la Vida 2023). However, this is yet to be legislated and new investments in the country's more than 380 existing oil and gas contracts continues to be allowed.

Some countries are still joining the ranks of fossil fuel exporters. Guyana, which began crude oil production in 2019, is on track to become the world's largest per capita producer in the next five years. Since 2020, Suriname announced five commercial discoveries. In Africa, Mauritania, Mozambique, Senegal, and Tanzania are expected to add new liquid natural gas production capacity over the next five years; and oil and gas exploration continues to advance in Kenya, Namibia, and Uganda (*The Economist* 2023a, 2023b).

- **Level of government investment.** Based on financial, political, and a host of other country-specific considerations, the authorities of each fossil fuel–exporting country have specific preferences over public versus private sector involvement in fossil fuel exploration and extraction—for example, providing public sector financing for specific projects or granting exploration licenses to national oil companies (which are state-owned enterprises) versus to international oil companies. Global decarbonization may influence these preferences. For instance, international oil companies (or other private sector parties) may be less inclined to invest in some of the higher cost oil and natural gas exporters. Governments will then have to weigh the benefits of self-financing the investment (or adjusting fiscal terms to make private investment more attractive)—positive returns could be channeled to much needed development projects—against the significant risks of failure amid uncertainties over fossil fuel demand and price. In particular, the failure of debt-financed investments (whether debt is taken on directly by the government or by national oil companies) could compromise debt sustainability.

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[14] Fossil fuel investment strategies can be differentiated by country or by type of company. *The Economist* (2022) provides a summary of differential investment strategies between the private international oil companies, smaller private independent producers, and state-owned national oil companies. The latter are more insulated from market pressures and account for much of current new investment in fossil fuel extraction (close to half of global investments in 2018).

[15] Fossil fuel investors can use spot and forward fossil fuel market prices and options as guides toward assessing the probability that new extraction projects will be net present value positive. However, this still leaves investors with uncertainty about possible market mispricing of climate-related risks (Hong, Li, and Xu 2019).

[16] Some fossil fuel exporters could accelerate development of their own carbon-intensive industrial base to grow domestic demand for their fossil fuels. However, such a strategy runs counter to the domestic GHG emission reduction targets of fossil fuel exporters and could jeopardize export receipts as purchasing countries with carbon border adjustment mechanisms may tax imported products with embedded carbon content to deter displacement of industrial activity to countries with less stringent climate policies (carbon leakage).

- **Emission intensity of the fossil fuel production process.** Fossil fuel exporters may have incentives to reduce the carbon footprint of their extractive sector as (1) emissions tied to the fossil fuel extraction process can work against a country's achievement of national emissions targets and (2) fossil fuel importers may develop preferences for low-emissions (or "greener") fossil fuel products. Measures to reduce extractive sector emission intensity from tackling methane emissions (including eliminating all non-emergency flaring) to electrifying and greening upstream facilities, equipping oil and gas processes with carbon capture, utilization and storage technologies, and expanding the use of zero- and low-emissions hydrogen in refineries (IEA 2023b, Box 3).

Box 3. Decarbonization Efforts in the Gulf Cooperation Council

Climate change mitigation efforts are already underway in many fossil fuel exporters, such as countries in the Gulf Cooperation Council.

The United Arab Emirates launched a "phasing out of fossil fuel emissions" strategy, which combines new investments in petroleum exploration with carbon capture, use and storage, and measures to reduce emissions in its extractive process (that is, flaring, venting, and fugitive emissions) as well as in other sectors of the economy (that is, expanding renewable energy and improving energy efficiency).

Saudi Arabia announced the Saudi Green Initiative and updated its Nationally Determined Contribution in 2021 with the goal of achieving net zero greenhouse gas emissions by 2060 (IMF 2022j, 2022k). The Green Initiative is centered around three objectives, including targets for increasing the share of renewable energy in electricity generation up to 50 percent by 2030 (Saudi Green Initiatives 2022) and the deployment of the circular carbon economy technologies, including carbon capture utilization and storage. Saudi Aramco, the country's main oil producer, will aim to achieve net zero Scope 1 and Scope 2 emissions by 2050. The country has also joined the Global Methane Pledge to cut methane emissions by 30 percent by 2030 and plan to leverage existing infrastructure and trade routes to become a global leader in the hydrogen market.

Qatar has recently launched the National Environment and Climate Change Strategy and the Climate Change Action Plan with the goal of reducing greenhouse gas emissions by 25 percent by 2030 (IMF 2022g). As part of the National Development Strategy, Qatar has also developed the largest carbon storage plant in the region and is ramping up its installed solar power capacity. Efforts to improve energy efficiency, such as upgrading water treatment plants, buildings, and transportation infrastructure, are also in progress.

Similarly, Bahrain has pledged to cut emissions by 30 percent by 2035 and reach net zero by 2060 (IMF 2023t). Energy efficiency improvements are underway as the National Energy Efficiency Action Plan and the National Renewable Energy Action Plan are being implemented.

Source: IMF (2022b).

Fiscal Policy

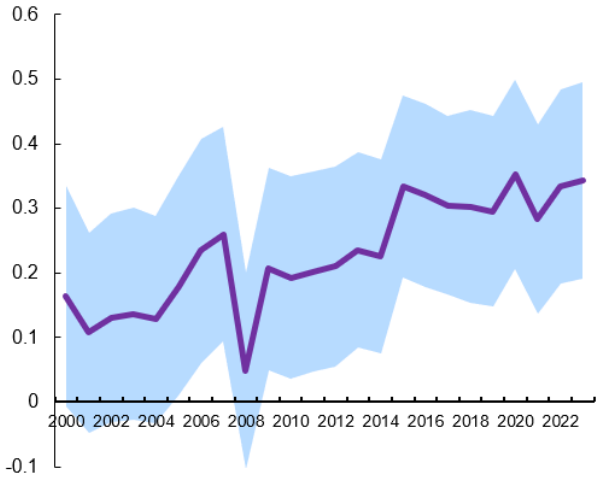
Applying fiscal discipline to maintain macroeconomic stability may become even more challenging than in the past.

- **Historical pressures for procyclical spending may rise due to the uncertain global energy transition path.** For many fossil fuel exporters, ambiguities over how long demand for their fossil fuel exports will last (even where there are proven fossil fuel reserves) may increase social pressures to raise government spending, especially when fossil fuel revenues are high. This type of procyclical fiscal policy (Figure 8) could fuel inflation and depress competitiveness when revenues are high and, conversely, result in recession when revenues decline and spending cuts are needed to maintain fiscal sustainability. Over the longer term, with the prospect of permanently lower or no fossil fuel revenues, concerns can also rise over the government's

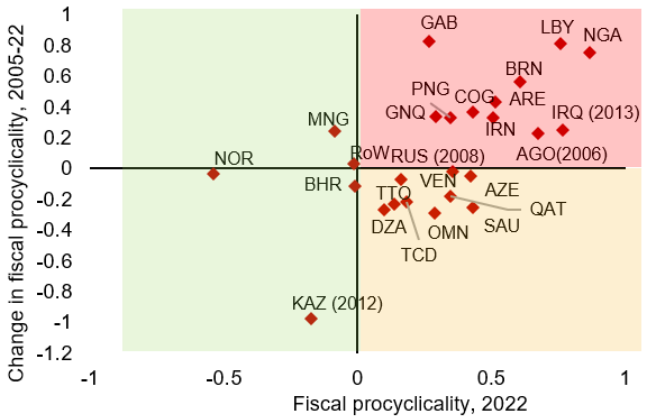
ability to maintain certain levels of public infrastructure, wage bills, social spending, and more broadly debt sustainability, fiscal risk, and balance sheet exposures.[17]

Figure 8. Procyclical Fiscal Policy and Fossil Fuel Exporters

1. Difference in Average Procyclicality of Fiscal Policy between Fossil Fuel Producers and the Rest of the World, by Year



2. Fiscal Procyclicality (as of 2022) and the Change in Fiscal Procyclicality (2005–22)



Sources: IMF, World Economic Outlook database; and IMF staff calculations.
Note: Countries with net fossil fuel exports greater than 8 percent of GDP, subject to data availability, are labeled as fossil fuel producer; country-level procyclicality of fiscal policy is measured as the 10-year trailing correlation between government expenditure and the oil price. Panel 1 includes 95 percent confidence intervals for annual cross-country regressions. Area color coding in panel 2 highlights whether the fiscal stance in 2022 is negatively correlated with oil prices (green) and, if positive, whether fiscal procyclicality decreased since 2005 (orange) or increased (red). Data labels in the figure use International Organization for Standardization (ISO) country codes.

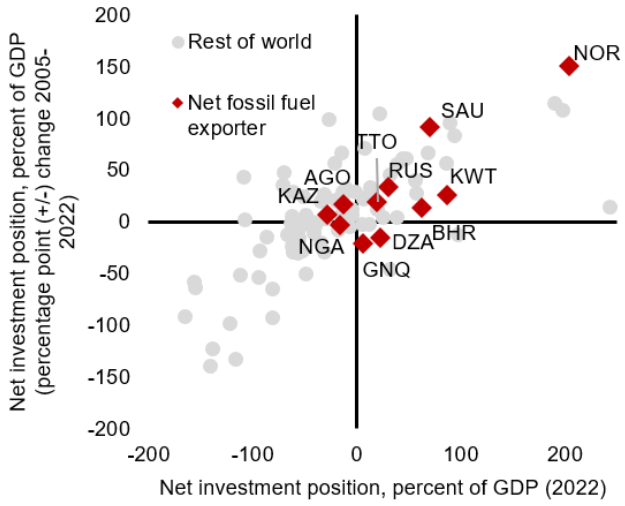
- **Consequently, fiscal discipline measures must remain a priority.** One option—already in place or being adopted in some countries (for example, Gulf Cooperation Council [GCC] countries)—is adopting a medium-term fiscal framework, which needs to be supported by formal fiscal rules and an independent fiscal council—all of which also support building of large buffers (Figure 9), including in sovereign wealth funds. However, such options need to be weighed in the context of a country's debt situation—a highly indebted country may prefer to pay down its debt (until interest on borrowing matches interest on assets) rather than accumulate buffers. Additionally, ongoing plans in many countries to gradually phase out untargeted fossil fuel subsidies (often prominent budget lines for fossil fuel exporters) and channeling some of the savings toward more targeted social assistance could reduce sudden spending pressures when fossil fuel prices are high and help the most vulnerable adjust to the changing structure of the economy (including changes in electricity prices should a switch to renewables imply higher prices).[18] As the economy diversifies, the tax revenue base will broaden. Efficient revenue administration will be important to ensure adequate collection from existing and new revenue sources.

[17] Guidance on managing revenues and designing fiscal frameworks for fossil fuel exporters, including the need for intergenerational equity and smoothing macroeconomic volatility, is summarized in IMF (2012a); Medas, Salins, and Danforth (2016); and Basdevant, Hooley, and Imamoglu (2020). Examples of country-specific advice on managing the energy transition include the Article IV staff reports and selected issues papers for Iraq (IMF 2023g and IMF 2023h), United Arab Emirates (IMF 2023q and IMF 2023r), and Republic of Congo (IMF 2021b and 2021c).

[18] The IMF Fossil Fuel Subsidies database provides estimates of fossil fuel subsidies by country. Clements and others (2013) have case studies of energy subsidy reforms and lessons learned, where removing fossil fuel subsidies (that is, increasing the effective price of fossil fuels) can also encourage greater energy efficiency and a shift toward renewable energy sources.

- **Monitoring and mitigation of fiscal risks may need to be stepped up.** Given revenue objectives and wanting to attract private investment to extend the life of fossil fuel reserves, some governments may adjust fiscal regimes for future extraction to shift energy transition risks away from investors to the government.[19] However, governments will need to weigh the potential benefits against the costs to the government, especially in terms of debt and stranded assets, should risks materialize. More broadly, governments should assess the appropriate mix of production and profit-based fiscal instruments to strike a balance between capturing a fair share of rents and securing a reasonable minimum share of revenue from extractive projects.

Figure 9. Changes in Net Investment Positions



Sources: Global Competitiveness Index 2019; IMF, World Economic Outlook database; World Economic Forum; and IMF staff calculations. Note: The figure highlights countries with net fossil fuel exports greater than 8 percent of GDP, subject to data availability. The change in net investment position is calculated starting in the first year available for SAU (2007), TTO (2011), and MNG (2010). At present, Russia is facing constraints toward reserve accumulation. Data labels in the figure use International Organization for Standardization (ISO) country codes.

- **National oil companies should manage their balance sheets and associated fiscal risks carefully and ensure their investment decisions are driven by commercial and market considerations.** Concurrently, adopting a sovereign asset-liability management framework—which is a priority already for many GCC countries—would allow authorities to monitor sovereign balance sheet exposures in an integrated manner and manage identified risks more efficiently. Adequacy of the fiscal framework could be regularly stress tested, including under more adverse and volatile fossil fuel price scenarios. For countries with (or considering) sovereign wealth funds, shifting the portfolio away from fossil fuels and toward cleaner energy investments can hedge risks of rapid decarbonization which would depress fossil fuel asset values.[20]

Many fossil fuel exporters will also need to decide how to use remaining fossil fuel revenues. In addition to the policy considerations discussed earlier, governments who project a trend decline in their fossil fuel exports (for example, coal or high cost crude oil or natural gas producers) will need to allocate their remaining fossil fuel revenues—key options include building financial assets for future use, repaying government debt, lowering taxes, or raising public spending.[21] Less economically diversified fossil fuel exporters may choose to focus these revenues on developing other economic sectors (simultaneously diversifying the government's future revenue base) and supporting the most vulnerable during this transition. For example, if agricultural growth is part of the diversification strategy, then public infrastructure spending on irrigation and roads could be stepped up while also repaying government debt to create fiscal space for future infrastructure and maintenance spending. Resulting

[19] IMF (2012b) and Luca and Puyo (2016) discuss tailoring upstream fiscal regimes for new fossil fuel extraction contracts.

[20] Equally, the green transition increases the value of financial hedges against future fossil fuel price volatility, as discussed in Daniel (2001) and applied by Mexico.

[21] These considerations also apply to all fossil fuel exporters, but the significance of the choices made now are likely greater for fossil fuel exporters facing permanent fossil fuel revenue declines. More broadly, for all countries, a range of considerations should influence how the revenues from fossil fuel extraction are deployed. For instance, investments into physical investments and human capital should be paced in line with the country's ability to spend these funds effectively and without overheating the economy. Paying down government debt needs to be weighed against the benefits from maintaining a sovereign "safe asset" yield curve to facilitate the operation of domestic financial markets as well as the opportunity cost of alternatively increasing a buffer of liquid financial assets (for example, in a sovereign wealth fund) to be drawn on quickly in case of crisis. The split between financial investments at home or abroad also needs to be weighed, including (1) benefits from diversification and offsetting currency inflows (relative to fossil fuel exports and foreign direct investment) versus (2) avoiding possible exchange risks for foreign investment valuations and the benefits from supporting domestic capital markets by investing at home.

reductions in sovereign risk premiums could support other sectors as well through reduced private sector borrowing costs. Active labor market policies, in particular government-sponsored job search assistance and training programs, could help fossil fuel industry workers transition to other industries.[22]

Fiscal policy can also support domestic emissions reduction in fossil fuel exporters, including:

- **No-regret measures.** A gradual phase out of fossil fuel subsidies and introduction of carbon taxes, where politically feasible, are the most efficient instrument to discourage fossil fuel use while also generating near- and medium-term revenues, promoting the switch to lower carbon sources of energy in the domestic economy and improving public health and local air quality. However, basic emissions monitoring and verification systems must be developed. More broadly, revenue recycling, emissions coverage, decisions on use of offsets, and interactions with other energy policy instruments should be accounted for.
- **Other fees and taxes.** Methane fees could encourage a shift to cleaner extraction technologies and subsequently lower emissions, including from venting, flaring, and fugitive emissions in natural gas transportation systems (Parry and others 2022). Alternatively, carbon tax on the carbon content of fossil fuels collected at the extraction point could be considered if carbon taxes and border carbon adjustment mechanisms are implemented widely in importing countries.[23] A carefully calibrated combination of both an upstream carbon tax and a carbon tax on consumption would allow for a more even distribution of tax revenue between net importers and exporters of fossil fuels, while still achieving the same price and production outcomes. However, this would require domestic and international political coordination. For example, the upstream carbon tax could be part of a coordinated agreement on an international carbon price floor, with importing countries adjusting the carbon tax imposed on fossil fuel imports to provide a rebate for any upstream carbon tax paid on fossil fuel extraction in the exporting country (IMF 2019). On the production side, these would require the participation of several large exporters, which would in turn raise international fossil fuel prices, potentially subsequently discouraging fossil fuel use.[24]
- **Promotion of domestic innovation, adoption, and production of low-carbon technologies.** These include tax incentives and green subsidies for specific domestic firms, industries, sectors, or regions—such as feed-in tariffs or contracts-for-difference for clean power projects to provide stable prices in power purchase agreements or pursuit of carbon capture technologies.[25] However, such policies will need to be time bound, transparent, monitored under a strong governance framework, and complemented with carbon pricing while not distorting trade and investment flows (IMF 2023b). Governments can also invest directly in cleaner energy (such as solar or wind electricity generation) and ensure their investment portfolio is green.

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[22] Card, Kluve, and Weber (2010) provide a meta-analysis on active labor market policies studies. See Hyman (2022) for an extended analysis of the US Trade Adjustment Assistance offering retraining incentives coupled with extended unemployment insurance. The World Bank has an active Just Transition program to support such policies, with emphasis on buffering the impact of coal phase outs on affected communities. For instance, the report "Global Perspective on Coal Jobs and Managing Labor Transition out of Coal" (Ruppert Bulmer and others 2022) uses historical case studies from Poland and the United States to inform how coal phase out policies could be designed in India, Indonesia, and South Africa. See also UNFCCC (2023) and IMF (2022t) on best practices in implementing a just transition and engaging on social safety net policy.

[23] The European Union is introducing a tax on the emissions incurred to produce certain goods imported into the common market, and other countries could follow suit. The purpose of European Union's tax (called the Carbon Border Adjustment Mechanism) is to level the playing field between EU companies, which face a high price on each ton of carbon dioxide emissions (around $100 per ton), and international competitors that do not have a similar carbon price level. The European Union's tax is being introduced progressively, with it covering a small set of goods from 2026 to 2030 (iron and steel, hydrogen, cement, electricity, fertilizers, aluminum) and potentially expanding to include unrefined petroleum products after 2030.

[24] Parry, Black, and Roaf (2021) elaborate on downstream carbon taxes, and Stepanov and Makarov (2021) discuss introduction of carbon taxes in a fossil fuel producer like Russia.

[25] Contracts-for-difference are subsidy payments made to power generators when there are deviations from a fixed reference price.

Exchange Rate, Monetary, and Financial Sector Policies

Different approaches can be applied to managing the macroeconomic impact of more uncertain and volatile net fossil fuel export receipts and related investment flows.

- **Diversified economies with exchange rate flexibility** (for example, Australia, Canada) can readily absorb disruptive swings in the country's external position and exchange rate adjustment can support economic rebalancing (for example, competitiveness gains in non–fossil fuel sectors following a depreciation). The inflationary impact of any exchange rate adjustments can be contained through effective monetary policy. If needed, fiscal policy can partially offset adverse consequences of interest rate changes. This, combined with well-developed financial markets (supporting financial stability), can avert weakening of (or large fluctuations in) economic growth.
- **Less diversified fossil fuel exporters**, both low-cost (for example, most GCC countries) and high-cost (for example, some Central African Economic and Monetary Community currency union countries) that have less flexible or fully fixed exchange rates would benefit from greater exchange rate flexibility in the long term, but the pace at which this is achieved and its timing will need to account for several considerations.[26] The imminence of lasting shifts in export revenues and international reserves levels will be key. So too will be the impact of an immediate and sudden move to greater flexibility, which may be challenging as many of these countries have high exchange rate pass-through to inflation where a large portion of their consumption basket consists of imported goods. It also takes time to develop tools and markets—that facilitate hedging and diversification of financing—to manage exchange rate and balance sheet risks. Similarly, developing a credible alternative nominal anchor or adequate monetary policy frameworks (as would be needed for inflation targeting), capacity, and, in some cases, central bank independence require time and premature shifts to new regimes could jeopardize policy credibility. It will be equally important to strengthen the financial sector framework, deepen foreign exchange markets, and develop a strategy for carefully sequenced liberalization of capital flows (IMF 2022c, 2020). More broadly, there may be large political, or adjustment costs associated with suddenly abandoning a peg, especially if there are public concerns about the appropriate alternative regime (Al-Sadiq, Bejar, and Otker 2021; Prasad and Espinoza 2012; IMF 2022b).

Financial regulation and supervision can help limit financial sector exposures to international fossil fuel market developments. Interagency collaboration, broad strengthening of the safety and soundness of the financial system and incorporating transition challenges into financial sector risk analysis will be key, given large exposures to some fossil fuel exporters and to companies actively developing new fossil fuel capacity, in the context of integrated financial markets and potential risks to financial stability. Distinct financial sector vulnerabilities can be identified through regular stress tests assessing how financial sector institutions would cope with sudden repricing of their portfolios, specifically assessing scenarios involving changes in domestic and/or global climate policies. Subsequently, regulators can request vulnerable institutions to reduce exposures to climate risks and build capital and liquidity buffers.[27] Regulators facing capacity limitations can begin by strengthening data collection and developing a climate information architecture, tools, and other capacity building. After building a foundation for stress testing, basic testing can be applied with exercises that gradually grow in ambition and scope—in line with the development of expertise in policymaking agencies and participating private

[26] An increase in resource extraction could diminish long-term growth through rapacious rent-seeking (the voracity effect), negatively affecting the quality of institutions through political economy effects (Lane and Tornell 1996; Tornell and Lane 1999) and by increasing corruption (Mauro 1995; Leite and Weidmann 1999). Over-appreciation of the real exchange rate, in response to positive commodity price shocks, contracts the tradable sector, especially manufacturing (Frankel 2012; Krugman 1987). A potential reversal could be expected when resource extraction activity declines, but evidence from past episodes of extraction sector declines does not support this (Bems and others 2023)—underlining that reform momentum is not a foregone conclusion.

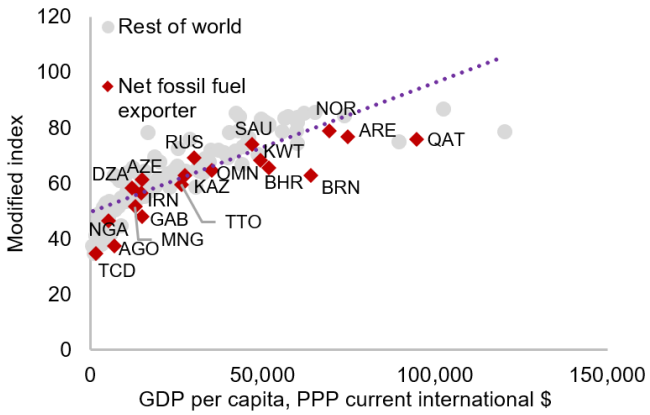
[27] Financial sector stress tests on transition risks could be based on the Network for Greening Financial Systems climate scenarios. More details are found in Grippa and Mann (2020) for how to conduct financial sector stress testing to transition risks, Adrian and others (2022) in the context of Norway, NGFS (2023), and Dikau and others (2022). The Network for Greening Financial Systems, Financial Stability Board, and the Basel Committee on Banking Supervision with IMF participation are also working on the role and characteristics of prudential transition plans.

sector financial institutions. More generally, adoption of green regulations and incentives can create opportunities for portfolio flows (for example, from mutual funds).

Structural Reforms

Accelerating ongoing structural reforms to diversify export bases and develop alternative engines of growth will reduce the global energy transition's adverse macroeconomic effects. This may be most challenging for the less economically diversified fossil fuel exporters whose non–fossil fuel exports could be globally less competitive (Figure 10). The GCC (Box 4) and other fossil fuel exporters have already begun the process to different degrees—in many of these countries, key reforms in labor, capital, and product markets are a gradual process, requiring much time to advance. Examples include expanding availability and types of education, facilitating greater labor force participation, modernizing labor market institutions, broadening access to finance by liberalizing financial markets, increasing the bankability of projects, and supporting product markets by strengthening the judicial system, encouraging fair competition, reducing red tape, and closing physical infrastructure gaps.[28]

Figure 10. Economic Competitiveness Relative to GDP Per Capita, 2019



Sources: IMF, World Economic Outlook database; Schwab (2019); and IMF staff calculations.
Note: The figure uses a "Modified Index" that is an average of the following pillars from the World Economic Forum's Global Competitiveness Index 4.0: infrastructure, information and communications technology adoption, macro stability, health, skills, product market, financial system, market size, and innovation capability. Data labels in the figure use International Organization for Standardization (ISO) country codes. PPP = purchasing power parity.

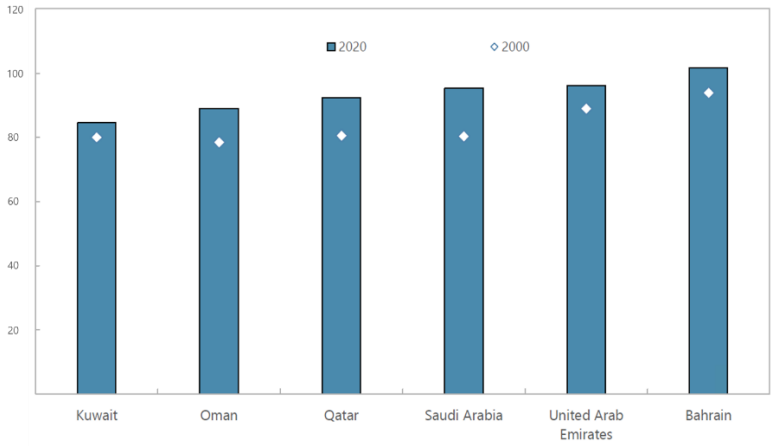
At the same time, there may be an opportunity to develop low- or zero-carbon emission energy industries building on existing fossil fuel knowledge and infrastructure. This could create new jobs and facilitate retraining of workers, transfer of knowledge, and adoption of new technologies. For petroleum producers and power generation companies, including national oil companies, this could mean shifting to renewable energy—advancing economic diversification and development (for example, rural electrification) in many EMDEs. Zero-carbon emission petrochemicals industries could also be developed or expanded—including fossil fuel transport terminals and petrochemical companies switching to low- or zero-carbon emissions hydrogen or ammonia (used for hydrogen transport). IEA (2022b) predicts a rapid rise in demand for these fuels with low-carbon emissions hydrogen production rising from very low levels in 2022 to over 30 million tons per year in 2030 (equivalent to over 100 billion cubic meters of natural gas, Box 5). Low- and zero-carbon emission hydrogen-based liquid fuels and other linked synthetic liquid hydrocarbons are an alternative to oil, especially as they can often use existing infrastructure and combustion equipment. As such, they are expected to gain market share in the oil-dependent aviation and shipping sectors. Additionally, hydrogen could accelerate renewables (solar, wind) deployment since it provides seasonal energy storage and facilitates global energy transport from production sites.

[28] IMF (2019) elaborates on the implementation of structural reforms and their impact on growth. IMF (2014) focuses on economic diversification in resource rich countries. Cherif and others (2022) discusses potential use cases and risks of using sectoral industrial policy to support growth and diversification. Lashitew, Ross, and Werker (2021) explore drivers of successful economic diversification in resource-rich countries. See also Budina and others (2023).

Box 4. Economic Diversification in the Gulf Cooperation Council

Countries in the Gulf Cooperation Council are accelerating efforts to diversify their drivers of economic growth and exports (Figure 4.1).

Figure 4.1. Gulf Cooperation Council Diversification Index



Sources: IMF (2022b); and Prasad and others (2022).
Note: The series are based on a multidimensional index which quantifies diversification across three angles—trade, output, and revenue—as well as an overall weighted index. An increase in the index is interpreted as an increase in diversification for the relevant indicator.

In Saudi Arabia, the non-oil sector growth has accelerated since 2021, reaching 4.8 percent in 2022 spurred by strong domestic demand, especially in the wholesale, retail trade, construction, and transport sectors (Mati and Rehman 2023; IMF 2023w). Non-oil revenue doubled since 2017 due to value-added tax rate increases and high regulatory compliance, while non-oil exports reached a record $84.4 billion in 2022. The Vision 2030 reform agenda has continued to boost the share of manufacturing and service sectors in GDP, reducing oil reliance. Saudi Arabia's economic diversification is further underpinned by key reforms in labor market, digitalization, and governance. The share of high-skilled jobs has increased to more than 40 percent in 2022, and female labor force participation doubled in four years to reach 37 percent in 2022. Digitalization has bolstered the efficiency of government operations and improved financial sector resilience. New laws have been adopted to promote entrepreneurship, protect investor rights, and reduce the cost of doing business. As a result, new investment deals and licenses grew by 267 percent in 2022.

Similar efforts to diversify the economy and reduce hydrocarbon reliance are well underway in Bahrain, Qatar, and the United Arab Emirates (IMF 2022b). In the United Arab Emirates, for instance, non-hydrocarbon GDP growth was expected to reach 5.3 percent in 2022, driven by a strong rebound in tourism activities from hosting the Dubai World Expo and spillovers from the FIFA World Cup in Qatar (IMF 2023q, 2023r). Progress on the Comprehensive Economic Partnership Agreements will further boost trade, attract foreign direct investment, and enhance integration with global value chains. Sustained investments in renewable energy infrastructure and digitalization will further support the United Arab Emirates' diversification efforts.

In Qatar, non-hydrocarbon sector growth accelerated to 6.8 percent in 2022 driven by World Cup–related activities. But the North Field expansion project, while beneficial to non-hydrocarbon activities in logistics, transportation, and manufacturing during the construction phase, will deepen Qatar's reliance on fossil fuels once completed. While non-hydrocarbon GDP accounts for about two-thirds of total GDP, non-hydrocarbon revenue only accounts for about 20 percent of total government revenue. Existing diversification strategies need to be accelerated to mobilize non-oil revenue through the implementation of value-added tax and global

minimum corporate income tax, enhanced spending efficiencies through subsidy reforms, and increased investments in human capital, green infrastructure, and digitalization (IMF 2022g).

In Bahrain, one of the most diversified economies in the region, non-oil sector growth rose to 6.2 percent in 2022, driven by growth in public, financial, hospitality, and manufacturing sectors (IMF 2023t). Notably, Bahrain's financial sector represented 17.5 percent of real GDP in 2022, ahead of the hydrocarbon sector (16.9 percent) for the first time. Non-hydrocarbon exports reached a record 34 percent of GDP in 2022, and non-oil revenue mobilization almost doubled and reached 6.4 percent of GDP after the introduction of value-added tax in 2019.

In Oman, diversification efforts have achieved important results over the past two decades. Non-hydrocarbon exports reached a record 20 percent of GDP in 2022, tax revenues more than doubled from their 2013 levels, and the share of non-hydrocarbon activity reached close to 60 percent of GDP. The diversification agenda continues under Vision 2040 through a multipronged approach, focused on an array of measures to attract foreign investments, including by streamlining business regulations; developing interlinkages between and within sectors; fostering economic clusters; integrating small and medium enterprises into the industrial value chains around Special Economic Zones; and cementing Oman's potential as a global leader on green hydrogen.

Box 5. Switching to Lower-Carbon Emission Hydrogen: Case Studies

Trinidad and Tobago is leveraging its liquefied natural gas and petrochemicals infrastructure and know-how to develop low- and zero-carbon emissions hydrogen. Specifically, ammonia, one of Trinidad and Tobago's main petrochemical exports, is anticipated to become the most likely form of sea transport for low- or zero-carbon emissions hydrogen by 2030. In late 2022, Trinidad and Tobago unveiled a new 35-year roadmap for a green ammonia and methanol industry—a sustainable export sector that will outlast the country's finite hydrocarbon reserves. The roadmap (1) seeks to invest in carbon capture technology in the domestic petrochemical industry to market low-carbon emission ammonia and methanol produced with natural gas and (2) then shifts to offshore wind and solar photovoltaic farms, along with electrolysis capacity, to produce ammonia and methanol with zero-carbon emission hydrogen (IMF 2023m).

Colombia is shifting current hydrogen production from high to low- and zero-carbon emissions. Two pilot projects began operations in 2022 to produce zero-carbon emissions hydrogen (using renewable energy inputs and electrolysis) at competitive prices—in part owing to the country's policy framework for investment in clean energy and technology. The first pilot is gradually replacing hydrogen from steam-methane reforming with zero-carbon emission hydrogen in a refinery used to lower the sulfur content of refined products. If the pilot is scaled, zero-carbon emission hydrogen could eventually replace the 150,000 tons of high-carbon hydrogen currently consumed in Colombia. The second pilot is blending small volumes of zero-carbon emission hydrogen in the natural distribution network of Cartagena, reducing its carbon footprint (Ministerio de Minas y Energia 2021).

International Cooperation

Some of the adverse consequences of the global energy transition could be eased by overcoming challenges in international cooperation. These challenges center around varied political and social interests within and across countries, expectations of energy transition scenarios, and preferences over whether current or future generations should bear the bulk of transition costs. Perhaps the largest incentive to find consensus on these issues and collaborate are the benefits:

- **A global coordinated, gradual, and credible forward-looking international climate policy and implementation path**—including large fossil fuel importers and exporters coordinating to avoid fossil fuel shortages and gluts. Any resulting improvement in the predictability of fossil fuel demand and reduction in price uncertainty will reduce the likelihood of stranded assets as fossil fuel exporters can make more informed investment decisions on any new (potentially debt-financed) fossil fuel extraction. Similarly, the financial sector will be better positioned to choose the pace and extent of asset portfolio reallocation away from fossil fuels, and governments will be able to do the same with respect to anticipated fossil fuel revenues, spending decisions, and structural reforms supporting economic diversification.
- **Minimizing transition costs for the populations of low- and middle-income fossil fuel exporters.** International transfer schemes—comprising financial and capacity development—could reduce these potentially significant costs for less diversified and higher cost fossil fuel exporters. In exchange for governance, structural, and fiscal reform commitments (including related to "greening" the economy) by fossil fuel exporters, international transfers schemes could partially compensate these countries for having historically emitted very little while being impacted the most by climate change and being forced to forgo fossil fuel revenues critically needed for their economic development.[29] Recent global initatives, especially the Just Energy Transition Partnership, have emerged as possible instruments through which advanced economies could support EMDEs in their decarbonization and energy transition efforts—though this support has mainly been in the form of loans.[30] Given high debt levels in many low- and middle-income countries, international transfer schemes in the form of grants may be preferable to loans. At the same time, the financial feasibility of these transfer schemes will also need to be considered.

[29] Such transfer schemes have a basis in economic theory. For instance, Harstad (2012) argues that climate coalitions implementing demand-side decarbonization have limited effectiveness if some countries do not participate. In that case, polluting activities are displaced to the countries outside the coalition. The paper argues that, in that case, the first best policy for climate coalitions can be to pay producer countries for foregoing extraction of their fossil fuel endowments, leading to higher global fossil fuel prices and encouraging all countries to reduce fossil fuel use.

[30] More broadly, EMDE fossil fuel exporters could benefit from international climate mitigation and adaptation agreements. For instance, the Paris Agreement (UNFCCC 2016) Article 6 has established a framework for countries to voluntarily cooperate in the implementation of their NDC using Internationally Transferred Mitigation Outcomes—Belianska and others (2022) provide a broader discussion of international carbon credits in the EMDE context. Fossil fuel producers with lower marginal abatement costs could attract investments by selling emission reduction credits. As part of the historic agreement reached during the 2022 UN Climate Change Conference, small producers that are most vulnerable and impacted by climate change may benefit from the Loss and Damage Fund under the authority and guidance of the UN Framework Convention on Climate Change.

Future Work

Future work will examine how to address these policy challenges. Emphasis on political-economy considerations in developing policy strategies will be critical to their feasibility. It will also be important to build on measures fossil fuel exporters already have underway and recent country-specific IMF advice and analysis.

A critical area of analysis will be exploring possible global energy transition paths and the impact of the energy transition on the volatility of energy prices. As part of these scenarios, the complexities of carbon lock-in could be further analyzed to show the impact of the energy transition on current decarbonization efforts. For example, some large international oil companies may focus on decarbonizing oil and gas operations rather than developing further renewable-based power production. It would also be important to look at implications of underinvestment in the oil market on energy security and ultimately the energy transition path. Similarly, modeling the development of the renewable energy market (especially pricing) can inform broader models on the global energy transition path. In addition, quantitative analysis comparing optimal and current decarbonization policies would improve our understanding of the depth, speed, and efficacy of ongoing climate mitigation efforts and highlight ambition or implementation gaps.

Discussions on economic diversification for fossil fuel exporters, which has underpinned their reform agenda for decades, could be enriched with further recommendations on industrial strategies. For example, an update of existing studies weighing the desirability (or undesirability) of various policies could be informative. From the external sector perspective, future work could examine foreign direct investment management, where reduced inflows for hydrocarbon sectors might be partially offset (or more than offset) by inflows related to green investments—given the significant size of hydrocarbon-related foreign direct investment, there could be serious implications for foreign exchange reserves, the exchange rate, and the financial sector.

Developing or enhancing transition finance frameworks is another key area of research. For instance, there are ongoing debates over the adjustment of financial regulation and supervision as well as financial sector policies to the global energy transition. The differentiated impacts of financial sector policies on listed versus non-listed companies (among them, national oil companies) in the fossil fuel sector could be developed. Equally, adequate frameworks for adoption of green regulations and managing new types of green portfolio flows could be explored. On a different note, fossil fuel asset retirement obligations and options for financing of these plans could also be analyzed.

The complexities of the job market impact of the transition could be explored. For example, different types of fossil fuel extraction activities have different labor intensities, where the type of technology applied is also an important factor. Consequently, the teaching approaches and types of skills taught in retraining programs will vary substantially across fossil fuel exporters.

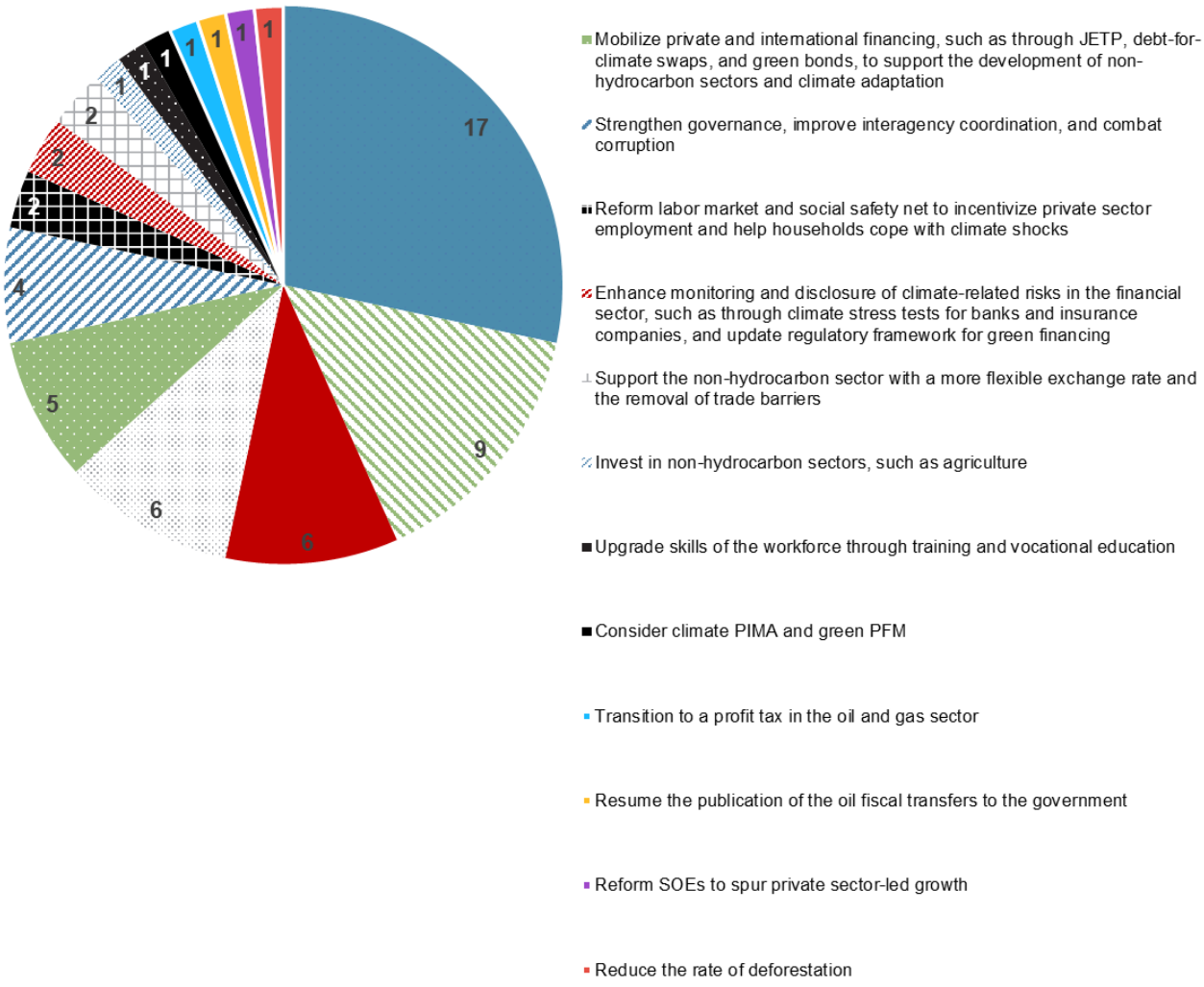
Finally, the impact of the energy transition on domestic fossil fuel markets could be analyzed. For example, for EMDE coal producers, changes in domestic demand will be significant where most of the coal consumed is produced domestically.

Annex 1. Climate Transition Policies Covered in Article IV Consultations of Large Fossil Fuel Exporters

Over the past few years, climate transition policies have been discussed in Article IV Staff Reports and Selected Issues Papers for many of the largest fossil fuel exporters (IMF 2018, 2021a, 2021b, 2021c, 2021d, 2022d, 2022e, 2022f, 2022g, 2022h, 2022i, 2022j, 2022k, 2022l, 2022m, 2022n, 2022o, 2022p, 2022q, 2022r, 2022s, 2023d, 2023e, 2023f, 2023g, 2023h, 2023i, 2023j, 2023k, 2023l, 2023m, 2023n, 2023o, 2023p, 2023q, 2023r, 2023s, 2023t, 2023u, 2023v, 2023w).The IMF's policy advice focused on climate change mitigation and fiscal reforms (Annex Figure 1.1), emphasizing phasing out of energy subsidies while providing targeted transfers to the vulnerable (Algeria, Angola, Bahrain, Bolivia, Republic of Congo, Equatorial Guinea, Indonesia, Iraq, Kuwait, Malaysia, Mongolia, Nigeria, Qatar, Russia, Saudi Arabia, Turkmenistan, United Arab Emirates). Carbon pricing policies, including carbon tax and emission trading systems, are described as major efforts toward climate change mitigation in advanced economies (Canada, Norway), and their implementation is encouraged in EMDEs (Bolivia, Colombia, Republic of Congo, Indonesia, Kazakhstan, United Arab Emirates). The reports also support the efforts of countries seeking to expand renewable energy, enhance energy efficiency, and reduce the carbon intensity of fossil fuel extraction (Bahrain, Colombia, Republic of Congo, Iraq, Kuwait, Qatar, Trinidad and Tobago, Turkmenistan, United Arab Emirates).

Climate change adaptation policies are not as thoroughly covered. Exceptions are coverage of (1) investments in climate-resilient infrastructure, such as transport, irrigation, flood protection, water and sanitation, and telecommunications, and to improve climate-related disaster assistance (Republic of Congo, Kuwait, Norway, South Sudan, Trinidad and Tobago, Turkmenistan); (2) mobilization of financing, particularly initiatives such as Just Energy Transition Partnership (Indonesia), debt-for-climate swaps (Papua New Guinea), and green bonds (Bolivia), to help unlock additional support for climate adaptation in low-income and developing countries; and (3) structural policies to diversify the economy and reduce dependence on hydrocarbon revenues, such as through state-owned enterprise and labor market reforms (Azerbaijan, Republic of Congo, Kuwait, Turkmenistan).

Annex Figure 1.1. Climate Transition Policies in Fossil Fuel Exporter Article IV Consultation Staff Reports and Selected Issues Papers



Source: IMF Staff Calculations.
Note: JETP = Just Energy Transition Partnership; PFM = public financial management; PIMA = Public Investment Management Assessment; SOEs = state-owned enterprises.

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