INTERNATIONAL MONETARY FUND

The Economic Implications of the Energy Transition in Asia-Pacific

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WP/26/1

2026
JAN

WORKING PAPER

 WP/26/1

IMF Working Paper
Asia Pacific Department

The Economic Implications of the Energy Transition in Asia-Pacific
John Spray, Sneha Thube and Alice Tianbo Zhang*

Authorized for distribution by Florence Jaumotte, Lamin Leigh and Pritha Mitra
January 2026

ABSTRACT: This paper examines the economic effects of the global energy transition and the large uncertainty surrounding future fossil fuel demand on countries in the Asia-Pacific region. Under the paper's baseline, coal demand is expected to shrink by 15 percent by 2035, although depending on global policy ambition and technological uptake, the decline could be as large as 45 percent. Model simulations indicate that one-third of global coal capital stock and one-quarter of Asia-Pacific coal capital stock could become stranded if the speed of the transition is underestimated. By contrast, global natural gas faces both upside and downside risks: when energy policy targets coal alone, natural gas extraction benefits, prompting an 18 percent rise in capital stock, whereas a fuel-agnostic transition would reduce gas capital stock by 16 percent. Impacts differ across countries, with high-cost coal exporters facing early losses, low-cost producers potentially gaining market share, and some gas exporters benefiting under select scenarios. At the same time, new growth opportunities will emerge for countries with strong critical mineral endowments and green energy potential.

RECOMMENDED CITATION: Spray, John, Sneha Thube, and Alice Tianbo Zhang. 2026. The Economic Implications of the Energy Transition in Asia-Pacific. IMF Working Paper No. 26/1. International Monetary Fund.

JEL Classification Numbers:	Q5, Q4, Q2, C68, O53
Keywords:	energy transition scenarios; IMF-ENV model; stranded assets; Asia-pacific countries

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The Economic Implications of the Energy Transition in Asia-Pacific

Prepared by John Spray, Sneha Thube and Alice Tianbo Zhang [1]

[1] The author(s) would like to thank Florence Jaumotte, Jaden Jonghyuk Kim, Lamin Leigh, and Pritha Mitra. We also thank Ian Parry, P. Juarros, Charlotte Gardes-Landolfini for helpful comments.

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1. Introduction

At the 28th Conference of the Parties of the UNFCCC (COP28), policymakers made a historic call to transition away from fossil fuels in energy systems. A sharp contraction in the global demand for fossil fuels is primarily expected due to falling costs of renewable energy sources and global efforts to electrify and decarbonize. The International Energy Agency (IEA) estimates that between 2022 and 2050, global coal use will decline by 46 percent, oil by around 4 percent and natural gas increases by 5 percent under stated policies (IEA (2024) and IEA(2025)). Due to its high carbon content, demand for coal falls further under more ambitious IEA scenarios until 2050, and will likely fall faster than that for oil and natural gas, the latter of which is often considered a transition fuel in the medium term.[2] Beyond the targets that countries committed to under the Paris Agreement, efforts to phase out coal ramped up in April 2024, when the G7 announced plans to phase out “existing unabated coal power generation during the first half of the 2030s or in a timeline consistent with keeping a limit of 1.5°C temperature rise within reach, in line with countries’ net-zero pathways.”[3] Yet the speed and magnitude of the contraction could vary across fossil fuels and depend on the ambition and implementation of global policies along with future cost pathways of alternate energy technologies, technology developments and breakthroughs in industrial production processes.

Renewable and low-carbon sources of energy have become increasingly competitive, driving significant growth in their use in the wave of electrification. Globally, between 2010-2024 the share of renewables (solar and wind) in total electricity generation has increased from 1.78 percent to 15 percent. During the same time, the installed electricity capacity of all renewables, including solar, wind, hydro, biofuels, geothermal and marine energy, increased from 1.2 TW in 2010 to 4.4 TW in 2024 (IRENA 2025), surpassing the installed capacity of both coal and natural gas in 2024, which are 2.2 and 2 TW respectively. The levelized cost of electricity (LCOE) generated from most renewable energy sources continued to decline. Solar photovoltaic (PV) technology is leading the reduction in costs, followed by onshore wind energy. Between 2010-2023, the global weighted LCOE of solar photovoltaic fell by 90 percent while that of onshore wind decreased by 70 percent (IRENA, 2023). Solar PV and onshore wind are now more cost-competitive than fossil fuels in many countries, including the G7 economies and several Asia Pacific nations[4] (IRENA, 2023).

The ongoing global energy transition will have profound economic implications for countries around the world, but how large these effects will be and who they will impact is an open question. Should the energy transition continue at the pace expected under current policies, the global economy will face substantial energy demand shifts. In particular, fossil fuel exporters will face complex and interlinked challenges of adjusting to economic transformation while seeing increased financial sector risks from stranded assets and declines in revenues (Mesa Puyo et al., 2024). Key factors that determine the country-level impact of the energy transition include: 1) the type of fossil fuels a country produces and exports, with coal exporters expected to experience strong demand declines in the medium term; 2) the cost of extraction, with lower-cost producers expected to gain market share while high-cost producers lose market share or wind down production; and 3) country characteristics, with stronger economic headwinds for countries with less diversified economies. However, the

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[2] By 2050, nearly 60 percent of oil and gas and 90 percent of coal must remain unextracted to allow for a 50 percent probability of limiting warming to 1.5C relative to pre-industrial levels (Welsby et al., 2021). This implies that oil and gas production need to peak now or within the next decade in most regions of the world to achieve the Paris Agreement temperature goals.

[3] Climate, Energy and Environment Ministers’ Meeting Communiqué (Torino, April 29-30, 2024). Available at https://www.g7italy.it/wp-content/uploads/G7-Climate-Energy-Environment-Ministerial-Communique_Final.pdf. The communique does not provide detail on the speed of the phase down and there remains uncertainty on whether the goals will be met in light of differing priorities across the political spectrum within G7 countries. Most recently, in COP30 Korea joined the ‘Powering Past Coal Alliance’ and announced a phaseout of unabated coal power generation by 2040.

[4] Countries that follow this trend in the region include Australia, China, India, Indonesia, Korea, Philippines, and Vietnam.

quantitative magnitude of these effects and how they will differentially influence countries in the Asia Pacific region is little understood. Understanding the origin and concentration of coal financing is crucial for assessing its implications for financial stability. Schwerhoff and Sy (2024) show that coal investment is shifting away from Europe toward producers like Australia, Indonesia, and South Africa, while the Middle East and Sub-Saharan Africa contribute only marginally. They also show that except for the Middle East, most regions invest over 60% of their coal financing within their own region, meaning financial risks are largely concentrated where the projects are located and any policy changes would primarily impact local financial sectors. This paper uses one of the IMF's in-house global computable general equilibrium macroeconomic model (IMF-ENV) to quantitatively assess the likely impact of potential pathways for the global energy transition. The model baseline is calibrated to match policies that have already been implemented until 2023 while alternative scenarios explore differing speeds and patterns of global fossil fuel demand with a particular focus on demand for coal given its particular relevance in the Asis Pacific region.[5] These scenarios range from the G7 drawing down coal use, G7 plus China and India drawing down coal use,[6] and all countries lowering emissions to a level that keeps global temperatures below 2°C. This allows the observation of fossil fuel demand under a set of realistic global policy actions.

The Asia Pacific region is an ideal region to study these issues. The region produces close to 80 percent of the world's coal, 8 percent of global oil and 15 percent of global gas (see Appendix Figure A3). The region contains both the largest coal exporters (Australia and Indonesia), and the largest coal importers (India, Japan, China). It also contains countries which have declared their intention to rapidly scale up the production and use of renewable energy, signaling the start of the region's energy transition as well as opportunities for growth in green sectors.

This paper has three main findings:

i. *Uncertainty about the energy transition pathways is strikingly large.* Under the baseline scenario of 2.7°C average warming by the end of the century, the IPCC AR6 model ensemble median projects that between 2022 and 2050, coal production will decline by around 21 percent. If the energy transition is accelerated, under an optimistic scenario (which corresponds to the IEA's net zero by 2050 scenario), demand for coal will decline by around 81 percent with the possibility of phase-out by 2050. On the other hand, rising and unabated coal[7] use could materialize under the pessimistic scenario, leading to 3.6°C of warming on average by 2100. For natural gas and crude oil, their relatively lower carbon content coupled with residual demand, especially in the transportation sector, might sustain the market for these fuels in the short to medium term.

ii. *Model results indicate that the uncertainty of the energy transition will create significant economic risks.* The divergence between the baseline and the more ambitious policy scenarios, particularly regarding the speed of coal phaseout, increases the likelihood that investments made under baseline assumptions become stranded. If investments proceed under the assumption that policy ambition will not rise beyond current settings, about one third of global coal capital stock and about one quarter of coal capital stock in Asia-Pacific could become stranded. Compared to the baseline natural gas capital could grow if decarbonization targets coal specifically (increase of 18 percent globally and 14 percent in Asia Pacific), while this incentive disappears with a fossil fuel agnostic energy transition plan (decrease of 16 percent globally and 20 percent in Asia Pacific).

[5] In particular, global coal supply has been calibrated as projected under the current policies scenario in IEA (2023)

[6] See Chateau et al. (2023) for discussion on the coal transition in India.

[7] Abated coal is also projected to rise under a pessimistic scenario but at a far slower pace. See Table 1 in Section 6 for more details.

These variations stem from how policies target fossil fuels: limiting only coal can boost natural gas, while stricter policies covering all fossil fuels would reduce both.

iii. *The impacts will vary by country's characteristics.* The transition process will vary among different economies, depending on factors such as whether a country imports or exports fossil fuels, the types of fossil fuels involved, available technological alternatives, extraction costs, and opportunities for diversification.

A case study for Australia is used to show that while the transition will look different for each country, sound economic policies can help mitigate risks from the transition. As the world's largest coal exporter in value terms, model simulations show that Australia is exposed to the global energy transition and is likely to see lost jobs and declining investment in fossil extractive sectors. However, key features of the Australian economy and the policy environment put it in a strong place to weather this shock. In particular, the Australian economy is highly diversified meaning it can cope with the gradual decline of fossil fuel exports. This has been achieved through creating a supporting and stable macroeconomic environment. Additionally, Australia has used revenues from fossil fuels to maintain low debt and low borrowing costs. This provides fiscal space to help address future shocks. Finally, the Australian authorities have fostered growth in commodities that are likely to remain in demand throughout the energy transition. This includes natural gas which can act as a bridge fuel, iron ore and metallurgical coal needed for steel production, and critical minerals needed for renewable energy. In the latter case, the government has started the careful use of industrial policy to address market failures in the sector. While each country's policy responses will need to be tailored to their own circumstances, Australia represents a useful example.

The remainder of this paper is organized as follows. Section 2 provides context for the global energy transition. Section 3 outlines the model, calibration and the chosen scenarios. Section 4 presents model results on the implications of the energy transition on countries in Asia-Pacific. Section 5 presents a case study of Australia. Section 6 discusses several mitigating factors that could determine country-specific risks. Finally, Section 7 provides conclusions and policy discussion.

2. Context of the Global Energy Transition and its Impact on Asia Pacific

While there is broad agreement that the ongoing energy transition will affect fossil fuel demand and supply going forward, the speed and the composition of these changes remain highly uncertain (**Figure 1**). The UN's IPCC Sixth Assessment Report (AR6) database provides projections from 3000+ global scenarios from Integrated Assessment Models (IAMs) for the demand and supply of fossil fuels under different global warming pathways. **Figure 1** shows the projected global production between 2022 and 2050 for coal (panel A), crude oil (panel B), and natural gas (panel C). The projections are aligned with equilibrium average global temperature by the end of the century under the Shared Socioeconomic Pathway (SSP) scenarios SSP2-4.5, SSP1-2.6, and SSP3-7.0, which correspond to the baseline, optimistic, and pessimistic warming scenarios.[8] The SSPs describe potential future pathways of societal development, focusing on factors like population, education, urbanization, economic development, and their impact on greenhouse gas emissions. Combined with a given radiative forcing level, called Representative Concentration Pathways (RCPs), the scenarios in the IPCC AR6 database characterize the uncertainty of future global warming. The SSP2-4.5 pathway represents a "middle-of-the-road" scenario in terms of socioeconomic development and climate change

[8] See Mitra et al. (2025) for detailed discussion.

mitigation. It aligns with historical emission and temperature trends and corresponds to an average global warming of 2.7°C by 2100 relative to pre-industrial levels under current policies. SSP1-2.6 represents the optimistic scenario with an average warming of 1.8°C by 2100, while SSP3-7.0 represents the pessimistic scenario with an average warming of 3.6°C.

The relatively lower carbon content of natural gas and oil coupled with residual demand in the transportation sector[9] might sustain the demand for these fuels. These fuels can serve as “bridge fuels” while technologies needed for system-wide low carbon electricity generation and transport, and are widely deployed.[10] As a consequence, the AR6 model ensemble projects a median increase in natural gas demand by 37 percent between 2022 and 2050, with a range of 126 percent increase to 4 percent decrease. Similarly, median crude oil demand is expected to increase by 12 percent from 2022 levels, with a range of a 43 percent increase to a 39 percent decrease. The IEA (2024) projections under the stated policies scenario are within the IPCC range for the two fuels but at the lower end, indicating that the IEA is more optimistic about the pace at which natural gas and oil will be phased out by 2050.

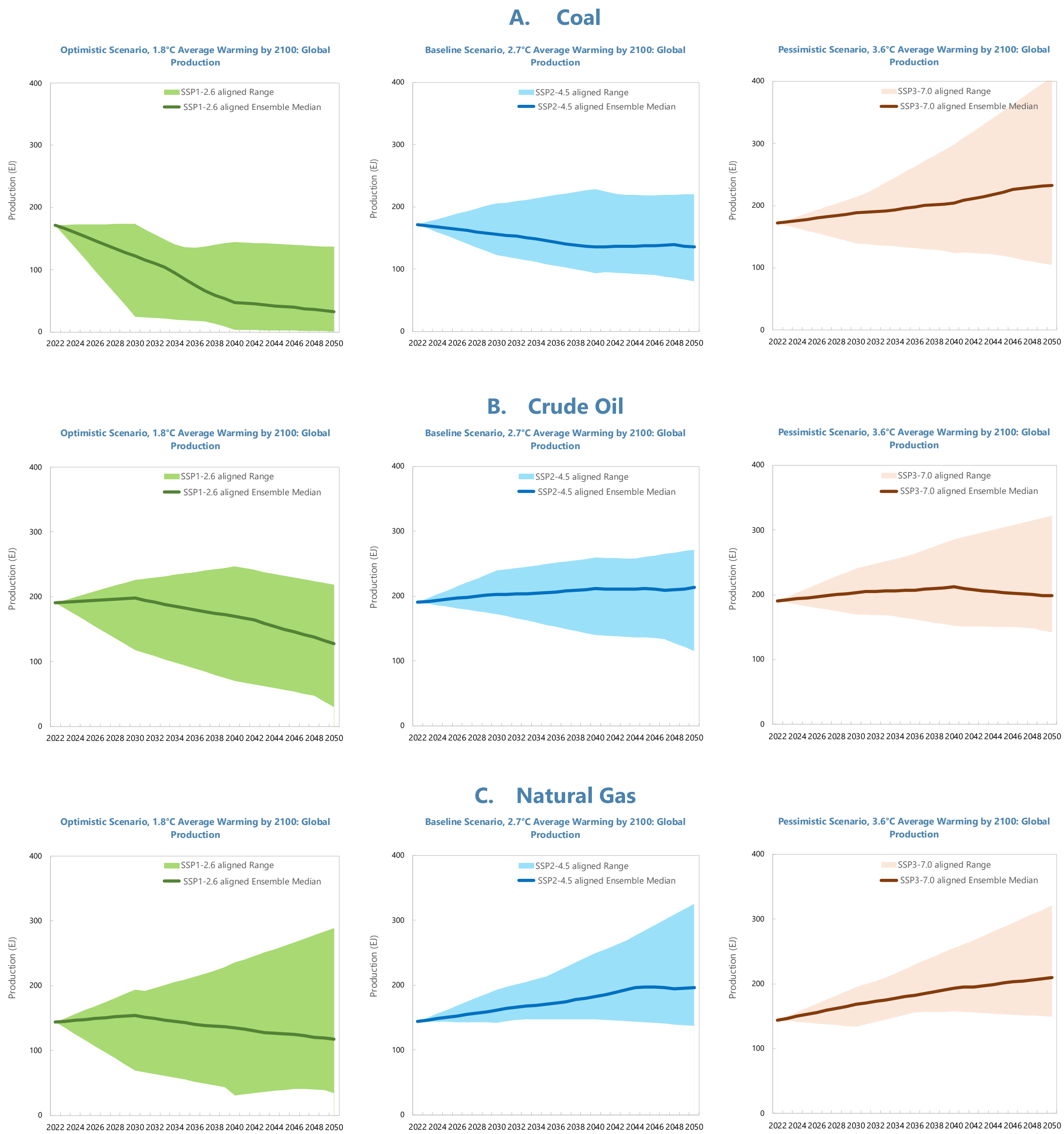
Due to the high carbon content of coal,[11] most projections anticipate that demand for coal will decline faster during the clean energy transition. Under the baseline scenario of 2.7°C average warming by the end of the century, the IPCC AR6 model ensemble median projects that coal production will decline by around 21 percent between 2022 and 2050. However, the range of uncertainty is very wide, with projections varying from a 28 percent increase to a 53 percent decline. If the energy transition is accelerated, under the optimistic scenario, demand for coal will decline by 81 percent with the possibility of a coal phase-out by 2050. On the other hand, rising and unabated coal use could materialize under the pessimistic scenario, leading to 3.6°C of warming on average by 2100. The significant uncertainty in projections that leads to wide range of outcomes is largely due to uncertainty on the speed of technological advancements, substitution options, and enabling policies (see section 6 for further discussion). However, IEA (2025) highlights significant structural changes, such as the growing role of renewables in electricity production and China’s move away from coal-heavy growth and infrastructure investments which reduce the likelihood that global coal demand will continue to rise sharply.

[9] While alternative technologies are arriving – for instance in the form of electric vehicles and green-hydrogen, there remains significant demand for these fuels from consumers and firms which is likely to remain under current conditions.

[10] There remains substantial uncertainty over when negative emission technologies will become economically viable. For example, substantial doubt has been shared on the economic viability of Carbon Capture and Storage, but investment has tripled since 2022 (World Economic Forum, 2025). Table 1 shows the assumptions on its deployment across scenarios.

[11] Coal is classified by rank and type based on its carbon content, use, and emission intensities. There are two primary types of black coal products: metallurgical coal and thermal coal. Metallurgical coal, also known as metallurgical coal or coking coal, is mainly used in steel production and other industrial processes. Thermal coal, also known as steaming coal, is used mainly for generating electricity. Among the different varieties of coal, some may see faster reduction in demand than others depending on the availability of technology alternatives.

Figure 1: The Energy Transition Poses Large Uncertainty on Global Fossil Fuel Demand



Source: Staff calculations[12] based on data from IEA World Energy Balances (2024) and IPCC AR6 Scenarios Database (2022).

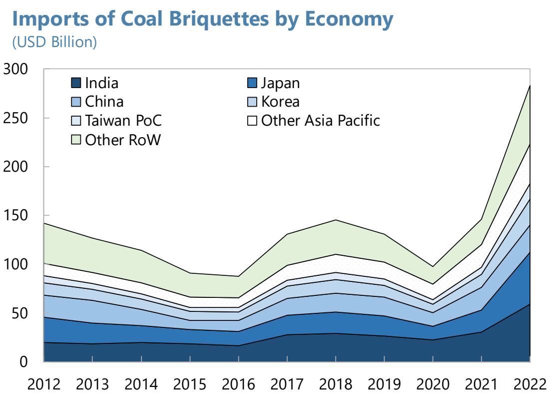
The Asia Pacific region is key to the success of the global energy transition, especially for coal. The region produces close to 80 percent of the world's coal, 8 percent of global oil and 15 percent of global gas (see Appendix Figure A3). Australia and Indonesia are the two largest coal exporters in the world, representing 34

[12] The calculations model the global energy transition pathways based on IPCC climate change scenarios and IEA world energy balances. Historical and projected total energy supply and domestic production are available for 150+ countries and all IMF regions between 1971 and 2100. Additional variables will be added as the work progresses.

and 19 percent of global coal briquette export value in 2023 (OEC, 2025), respectively (**Figure 2**). The Asia Pacific region also accounted for 76 percent of global coal imports, with almost 50 percent from India, China and Japan in 2022 (IEA, 2025).[13] As an illustrative exercise, Appendix Figures A1 and A2 show the impact on energy demand for the region and for individual countries, should current market shares be held at current levels under baseline, optimistic, and pessimistic scenarios. While the rapid change in demand shown in these figures indicates the potential risks, there are issues with the coarse assumption of constant market shares across countries that in practice may change This highlights the value of using a global CGE framework like IMF-ENV laid out in the remainder of this paper, which has varied assumptions on extraction costs, trade costs, and domestic policy across countries and therefore, estimates impacts on shifting market shares, factor demand and sectoral output across countries.

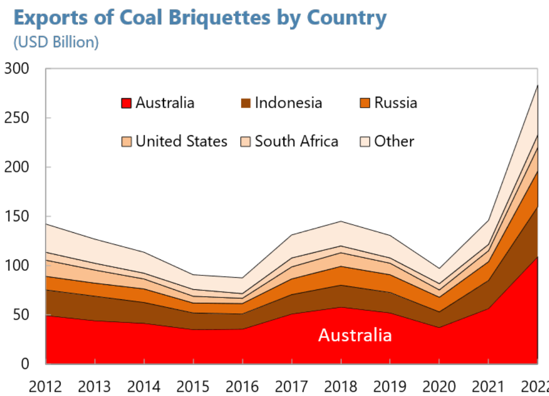
Figure 2: Significance of Asia Pacific Economies in Global Coal Trade

(A) India, China, and Japan account for 50 percent of global coal imports, while the Asia Pacific region represents 78 percent.



Sources: OEC and IMF Staff Calculations

(B) Australia and Indonesia are the two largest coal exporters by value.



Sources: OEC and IMF Staff Calculations

Note: Taiwan POC stands for Taiwan Province of China

3. Model simulations

This paper uses a global dynamic computable general equilibrium model (IMF-ENV) to capture the macroeconomic dynamics associated with the energy transition. The IMF-ENV model (see Annex I for a summary and Chateau et al. (2025) for the full technical description) is built primarily on the near global database of input-output tables of 160 countries and 76 commodities. The model provides a flexible framework that is well suited to analyzing policies that generate large structural changes like those resulting from ambitious decarbonization goals. IMF-ENV has a high level of sectoral and country granularity, the flexibility to incorporate many different types of policy instruments, and the capacity to analyze the general equilibrium effects of policies, as well as their cross-border effects through a detailed representation of trade flows. For the purposes of this paper, the following three core strengths are particularly relevant:

- *Macroeconomic and sectoral dynamics are defined for each region.* Production activities use regional CES production functions, primary factors (land, labor, capital, natural resources), and intermediate inputs. Outputs serve to meet intermediate demand, direct household demand, or as internationally

[13] Note that these figures present coal values instead of volumes. Showing values has the advantage of incorporating different qualities of coal and different coal prices which may vary by country.

traded goods. The model accounts for domestic capital reallocation frictions by differentiating capital by vintage types, highlighting the costs of ongoing investments and unplanned retirements versus gradual decommissioning, especially in extraction and energy sectors.

- *Inter-sectoral economic linkages and sectoral emissions*: The model details economic impacts and GHG emissions for 36 production activities and 28 traded commodities. Emission-intensive sectors like fossil fuel extraction, fossil power generation, and energy intensive and trade exposed (EITE) sectors are specifically represented. In the model, mitigation could be achieved by shifting towards less emission-intensive or emission-free activities, or switching sources of power generation to low emission technologies (solar PV, wind, hydropower, nuclear). Negative emissions are possible in the LULUCF sector, though its emissions are exogenously determined and unaffected by policy. The model tracks global and regional GHG emissions and changes in commodity prices.
- *Accounting for domestic and international policies:* The model is individually calibrated to each G20 country and aggregates the rest of the world into six regions, including Asia Pacific. These regions are interconnected through bilateral trade of commodities, allowing the model to assess the global impact of domestic and international policy changes on trade, commodity prices, and GHG emissions. This is crucial for understanding the effects of global or regional scenarios.

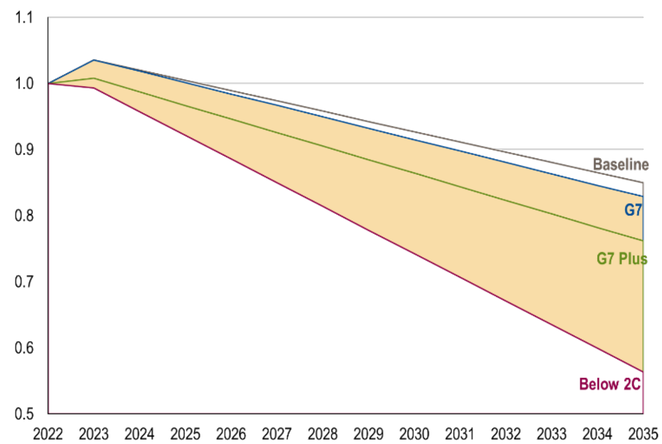
The IMF-ENV baseline is calibrated to represent historical macroeconomic, energy, and emission trends up to the year 2023, with projections extending until 2035. There are two primary components of the calibration process- macroeconomic and energy sector dynamics. For all model regions, the historical years in the baseline are calibrated for regional GDP growth rates and population growth rates (IMF's World Economic Outlook (WEO)), regional GHG emissions (GHG inventory data from UNFCCC and EDGAR), and electricity generation (IRENA) between 2017 to 2021. Medium term macroeconomic projections are taken from IMF's WEO while long-term projections are based on the SSP2 scenario.[14] In the additional policy scenarios, new policies are introduced starting in 2023 and the model solves for an equilibrium in commodities and factor markets both domestically and globally in each year from 2023, allowing us to map out the trajectory of macroeconomic impacts from domestic and international adjustments over the next decade. Considering that demand for coal is particularly important for the Asia Pacific region, global coal supply in the baseline has been calibrated as projected under the current policies scenario in IEA (2023). This falls within the range of the coal demand within the range of the IPCC 2.7°C scenarios (**Figure 1**) and is similar to the demand fall in the median case. In the policy scenarios, coal demand is determined endogenously within the model. While the model has rich detail in its treatment of the domestic and global macroeconomic structures, there are also important caveats. First, it has less detail in its incorporation of microeconomic frictions for labor in the short run. For example, the model assumes that labor can move between sectors without friction that could arise from the need to retrain or migrate. This means the model may underestimate the cost of policy changes in the short run by not including these adjustment costs. Second, the model does not explicitly model the role of technological change, potentially leading it to overestimate the cost of the transition. For instance, if technologies like CCUS and green hydrogen become economically viable and are deployed on a large scale before 2035 then this could make lowering emissions less costly. Third, the underlying database of the model does not have granular detail on critical minerals production or differentiation between different types of coal, primarily metallurgical versus thermal. Instead, these are grouped respectively within a broader category of minerals and under a single coal extraction sector. Therefore, we are unable to quantify the upstream impacts on specific critical minerals as renewables grow or to provide disaggregated results by coal types.

[14] References to the databases - IMF's WEO World Economic Outlook Databases (imf.org), GHG data based from UNFCCC (Annex-I countries), EDGAR (non-Annex-I countries) and FAO (LULUCF) and accessed via Climate Change Indicators Dashboard , IRENA renewables database Data (irena.org). SSP database IXMP Scenario Explorer developed by IIASA .

We examine the impacts of the global transition away from fossil fuels, especially coal, through the modelling exercise. Given the focus on the Asia Pacific region, our scenarios focus on the energy transition away from coal and we discuss various factors that coal-exporting countries should consider.[15] Scenarios differ in two aspects: the level of global ambition and the specific fossil fuel targeted for reduction. Each of the four scenarios imply a progressively lower level of coal demand on the global scale (**Figure 3**). Coal demand in the baseline falls by 15 percent in 2035 relative to 2022. This change is exogenously imposed in the baseline while the demand in the other three scenarios is determined within the model. The regional composition of the demand and supply is endogenous in each of the four scenarios. Our scenarios assume no abated fossil fuel power generation by 2035 which is consistent with the IPCC scenarios (Table 1). Regional emissions are endogenous in the model, except under the Below 2°C scenario, where emission trajectories are exogenously defined using projections from Phase IV of the Network for Greening the Financial System (NGFS). This ensures that global temperature rise is limited to 2°C by the end of the century.

Figure 3: Global coal demand

(Index base 2022)



Source: IEA and IMF-ENV

The first two policy scenarios focus on a coal phase-down approach, whereas the latter two concentrate on a broader decarbonization strategy that is fuel-neutral by design.

- *G7*: In this scenario coal demand for power generation falls to zero in the G7 economies by 2035 as communicated by the G7 communique in March 2024. The G7 phasedown focuses on unabated coal. By phasing down all power generation from coal in these economies, we implicitly model the lack of deployment of CCUS over the next decade, as is consistent with our baseline.
- G7 *plus*: In this scenario along with the G7 there is also a reduced demand for coal in power generation from China and India. Coal demand for power generation in China and India is projected to decline in alignment with their 2030 NDC targets. As these countries are not expected to eliminate coal power by 2035, this scenario represents a moderate reduction in coal demand for both nations.
- *Below 2C*: In this scenario, all countries are constrained by a regional emissions budget that is aligned with a global 2°C temperature target by the end of the century.

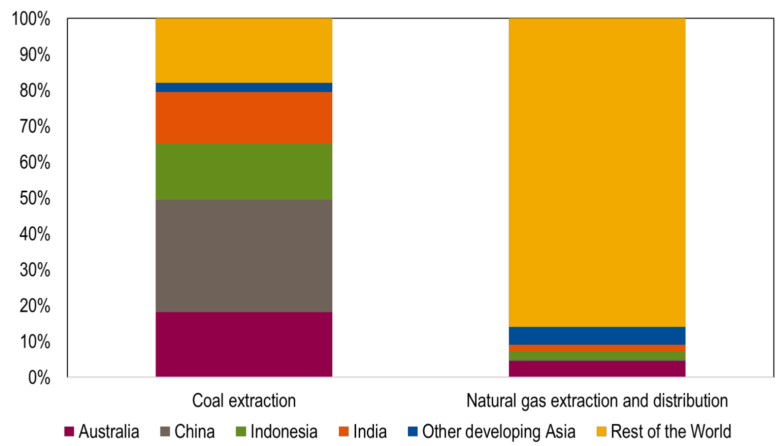
Within the *G7* and *G7 plus* scenarios, it is assumed that the implementation of regulatory measures specifically addressing coal-fired power generation will facilitate a decrease in coal consumption. Differently, in the *Below 2C* scenario, regional emissions caps are defined and met through the implementation of an economy-wide carbon tax, which represents a fuel-neutral approach and serves as a benchmark scenario for determining the least-cost policy pathway.

[15] Previous IMF work discusses the transition away from crude oil and natural gas for exporters of these fuels (see Mesa Puyo et al. (2024)).

4. Results

As shown in Figure 3, the baseline involves a large decline in the demand for coal by 2050 compared to current coal demand levels. Under the baseline by 2035, about 82 percent of the global coal capital is in the Asia Pacific region of which China holds the largest share of capital at 31 percent. Meanwhile, the region's proportion in global capital in natural gas is approximately 15 percent by 2035, with Australia and Other Developing Asia each representing about 5 to 5.4 percent (Figure 4).

Figure 4: Regional shares of capital in coal and natural gas in the baseline (2035)

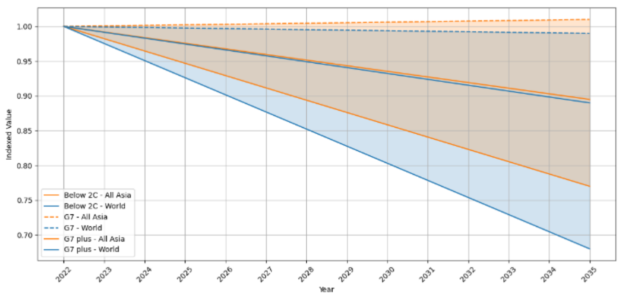


In the policy scenarios, global coal demand falls compared to the baseline and in *Below 2C* scenario the reduction is about 45 percent by 2035. Model results show that an acceleration of coal phasedown policies decreases the capital stock in coal extraction but may lead to an increase in natural gas capital in the medium term (Figure 5). Put differently, if businesses were to underestimate the speed of the transition, the relative gap in global capital stock of 32 percent between baseline and below 2C, could signify the size of stranded assets. This is because higher policy ambition, implies lower fossil fuel demand, and consequently requires a lower level of capital stock. In the Asia Pacific region, the estimate of stranded assets is lower (23 percent by 2035) owing to the more resilient demand of coal and relatively lower extraction costs of producers in the region.

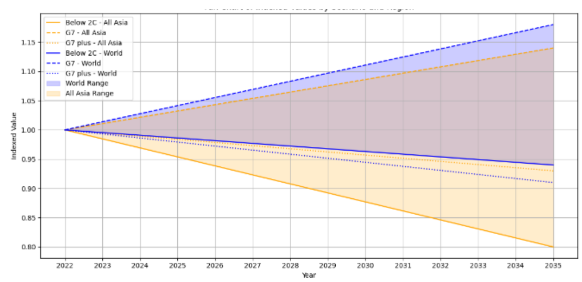
The impact on capital in natural gas faces both upside and downside risks: when energy policy targets coal alone, natural gas extraction benefits, prompting an 18 percent rise in capital stock, whereas a fuel-agnostic transition would reduce gas capital stock by 16 percent. Similar patterns can also be seen in the Asia Pacific region where the increase in natural gas capital could range from 14 percent to a decrease of 20 percent by 2035. The natural gas sector exhibits greater uncertainty because policies focused solely on coal, as in the *G7* and *G7 plus* scenarios, allow gas to expand to meet part of the resulting energy shortfall; by contrast, scenarios that constrain all fossil fuels and impose national GHG budget limits, such as the Below-2C pathway, require broad reductions in fossil-fuel consumption, leading to declines in capital across both coal and natural gas, with more moderate effects on gas due to its comparatively lower carbon intensity.

Figure 5: Impacts of global energy transition in Asia and Rest of World

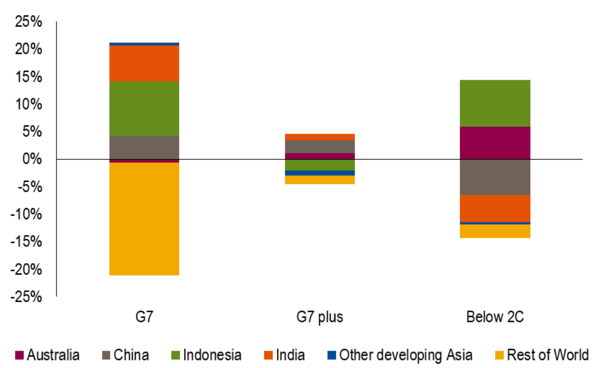
(A) Capital stock in coal mining
(pct rel. to baseline, 2035)



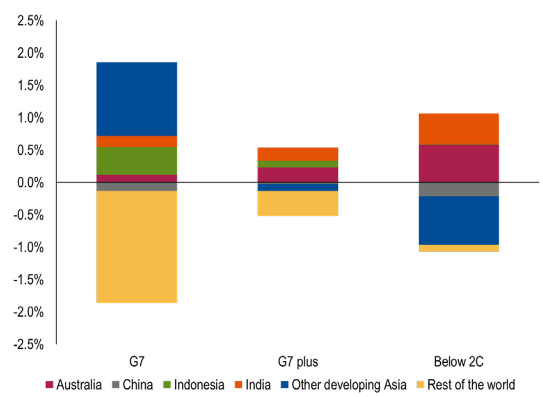
(B) Capital stock in gas extraction
(pct rel. to baseline, 2035)



(C) Changes in shares of global capital in coal mining sector (percentage point difference to baseline, 2035)



(D) Changes in shares of global capital in gas mining sector (percentage point difference to baseline, 2035)



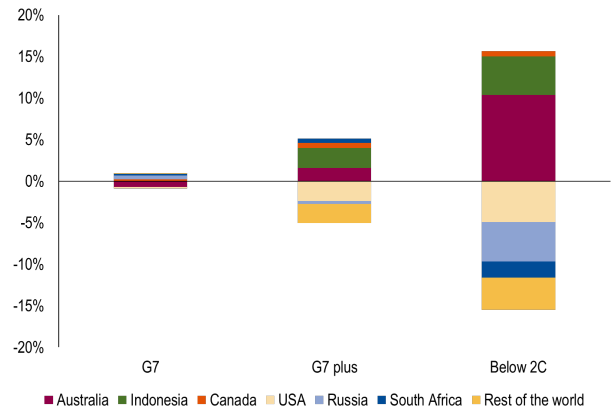
The decline in aggregate coal and natural gas capital affects countries unevenly and induces shifts in the geographical distribution of this capital. Under the *G7* and *G7 plus* scenarios, coal capital becomes increasingly concentrated within the Asia Pacific region. In the *G7* scenario, the share of capital in coal mining increases in Asia Pacific region, primarily in Indonesia, India and China, while it declines in the rest of the world (Figure 5 Panel A and C). Under the *G7 plus* scenario as China and India decrease their coal demand there is a small reduction in coal capital in Indonesia and Australia. In these two scenarios, the rest of the Asia Pacific region could see a small increase in coal mining capital due to general equilibrium price movements in coal. However, under the stronger global demand reduction shock that is realized under the *Below 2C* scenario, the overall share of capital in the Asia Pacific region rises to nearly 87 percent with capital becoming increasingly concentrated in Australia and Indonesia. Importing from these two countries is preferred due to their comparatively lower extraction and transport costs relative to other coal producers. In this scenario, domestic coal capital in India and China also partly declines due to the domestic decarbonization efforts away from coal power generation.

The change in origin of coal imports is also reflected in the shifts in market shares (Figure 6) where in an increasingly decarbonizing world, when global coal demand is falling, the market shares of low- cost producers like Australia and Indonesia increases.

The varying impacts on the capital stock underscore the challenges investors encounter when deciding between short-term and long-term investments in fossil fuels. Capital stock in the coal extraction sector declines across the three policy scenarios, due to decreased new investment in the sector and depreciation of existing capital assets. However, model results demonstrate that the speed of transition, the countries that are leading the transition, and the policies they implement can change the magnitude and the location of coal production significantly. The divergence between the baseline and the more ambitious policy scenarios, particularly regarding the speed of coal phaseout, increases the likelihood that capital invested under baseline assumptions become stranded. If investments proceed under the assumption that policy ambition will not rise beyond current settings, about one third of global coal capital stock and about one quarter of coal capital stock in Asia-Pacific could become stranded. The investment outlook for natural gas faces more uncertainties. Depending on market and policy design, investing in natural gas extraction may have economic rationale if decarbonization targets coal specifically, while this incentive disappears with a fossil fuel agnostic energy transition plan. Considerable uncertainties surrounding international commitments and collaboration on decarbonization policies result in a complex investment landscape, increasing the potential for both over- and under-investment in fossils which is compounded by technological uncertainties (see Section 6).

Figure 6: Market shares of coal extraction

(percentage point rel. to baseline, 2035)



5. Case study: Australia[16]

Australia is an interesting case study given its position as a large global exporter of minerals and given its ambitious domestic energy transition targets. Australia has commodities spanning the full range of the phases of the energy transition. Australia exports significant fossil fuels (coal, gas, and a small volume of oil), minerals needed for electrification (iron ore, nickel, copper), and minerals required for renewable energy (lithium, rare earth metals, cobalt). The country is also undertaking its own energy transition, moving away from the use of coal in electricity generation to rely on renewable sources.[17] The economic consequences of the transition will, therefore, depend crucially on which goods are demanded at which time, the ability of the global economy to meet these demands, and the resulting commodity price dynamics. These supply and demand patterns will

[16] For more details see Australia Selected Issues Paper 2024 Chapter 2

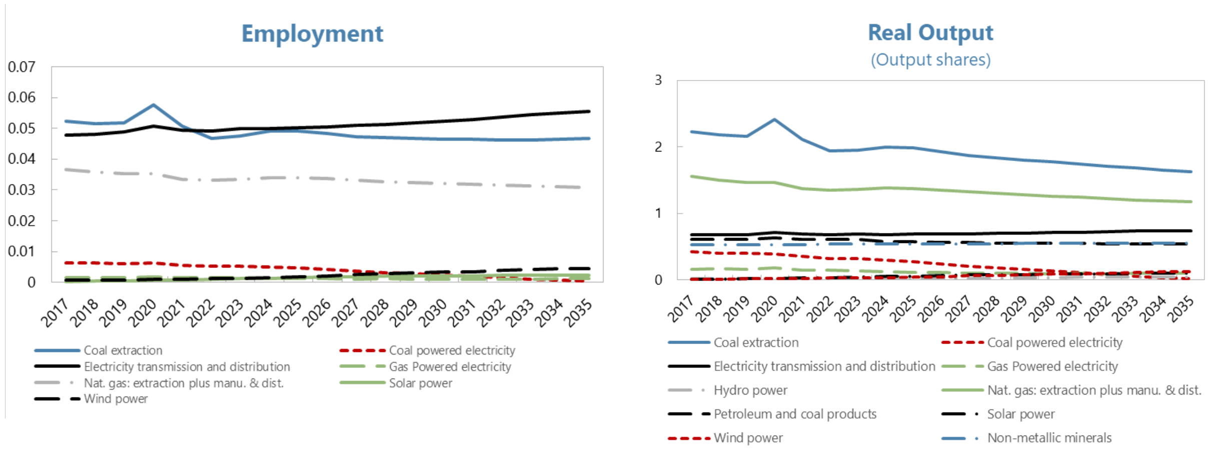
[17] In September 2022, the Climate Change Act formally legislated Australia's Net Zero by 2050 target. It also legislated the 2030 Nationally Determined Contribution (NDC) emissions targets of a 43 percent reduction in emissions from 2005 levels. The most significant near-term target continues to be the aim of securing an 82 percent share of renewable energy in electricity generation by 2030. Australia's Net Zero Transformation: Treasury Modelling and Analysis paper released in 2025 provides modelling on the economic costs and benefits of different speeds of transition (Treasury, 2025)

hinge on shifts in both domestic and international policy and the realization of unpredictable technological development.

Figure 7: Structural shifts in the baseline in Australia

(A) Decline in employment in coal and natural gas, growth in the electricity sector and renewables

(B) Decline in coal powered electricity though overall electricity supply in Australia grows



Using the same set of simulations laid out in Section 3, results applied to Australia show three main narratives. Firstly, coal and gas output is set to fall in the baseline, generating significant adjustment costs. Figure 8 panels A and B show that, under the baseline, real output in coal and gas extraction is expected to fall and be partially replaced by electricity production, especially coming from renewables. This has a corresponding impact on labor and capital demand in these sectors. Notably, output decreases at a slower rate than capital because existing capital equipment continues to generate output despite reduced investment in new capital. As current capital gradually depreciates, output declines steadily; however, total capital in the sector is lower primarily due to decreased allocation of new capital to these sectors.

Secondly, different global scenarios lead to vastly different economic outcomes, which could shape the structure of the Australian economy, labor demand, and investment. Figure 8 panel C shows that by 2035, output from the gas extraction sector could be 7.5 percent higher or 4 percent lower, relative to baseline, while output from the coal extraction sector could be over 10 percent lower than in baseline. This has a corresponding large impact on investment in the sector, demonstrating how difficult it is for investors under the large degree of policy uncertainty. Moreover, should investors incorrectly forecast this demand, the adjustment costs would be significantly larger as the economy would need to rapidly adjust factors of production. This raises the risk of stranded assets in the coal sector should a sharp change in demand occur.[18]

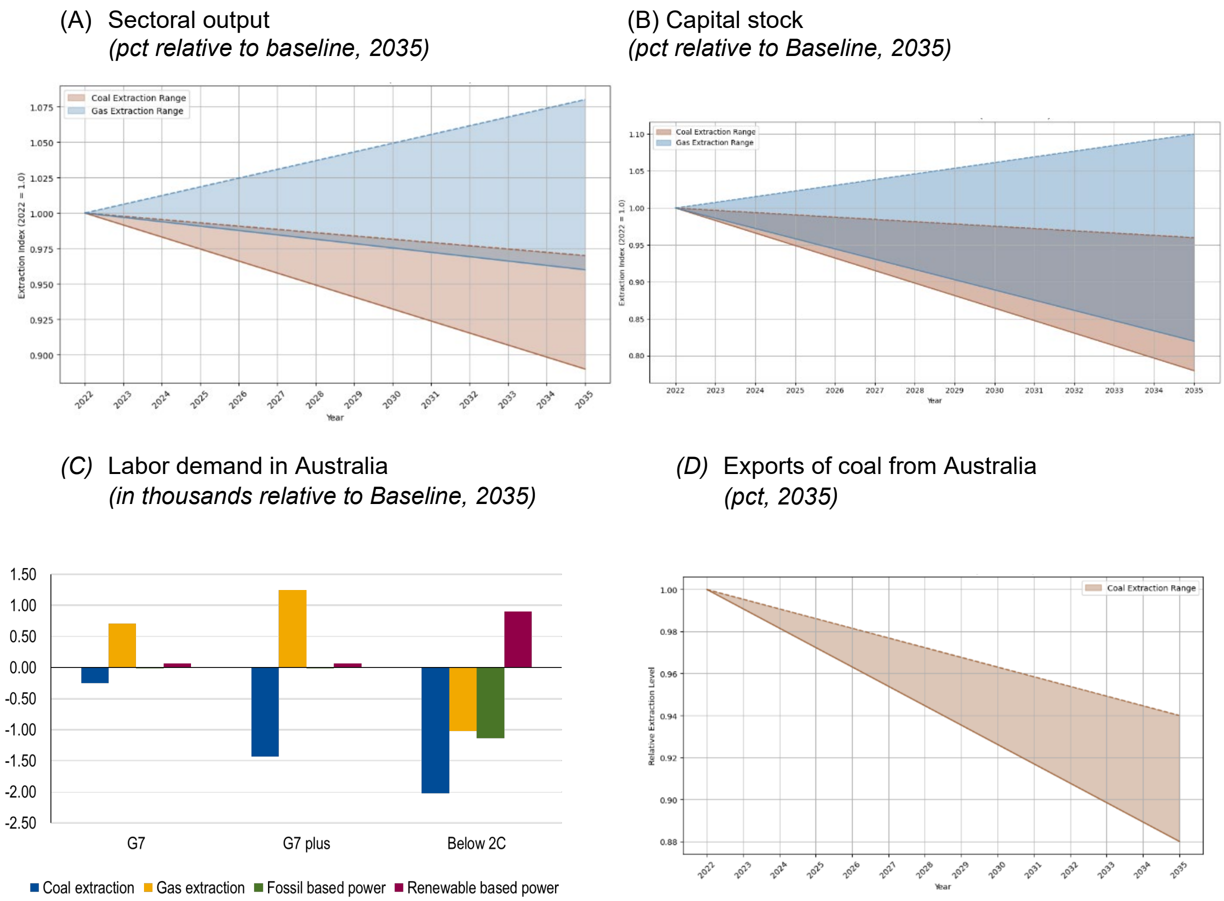
Thirdly, relative to other fossil fuel exporters, Australia's low extraction costs generate resilience to the global transition. As shown in Figure 6, Australia's global coal market share is anticipated to grow in 3 of the 4 scenarios[19] due to its low extraction costs, meaning that the average extraction cost across mines in Australia is lower than that in other countries. This is reflected in the slightly lower variability of decline in capital stock

[18] Discussions with market participants in Australia suggest that they are already absorbing these risks with very little new investment happening in the coal sector.

[19] Most of the decrease in coal usage in the G7 scenario results from the decarbonization of Japan's power sector, which receives the largest share of coal exports from Australia among the G7 economies.

for coal seen in Figure 8 panel B, compared to the global decrease shown in 5A. This, however, does not mean the sector is invulnerable given lower prices will still impact profitability. Moreover, while this resilience will help Australia, the inverse is true for those countries with higher extraction costs.

Figure 8: Implications of a Faster Energy Transition on Australia



As discussed in detail in the 2024 IMF Selected Issues paper for Australia (Spray and Thube (2025)), policy is helping to minimize costs and maximize benefits during the transition. Firstly, Australia has a diversified economy and a range of trading partners, which enables it to address short-term economic fluctuations and shift production to different sectors as needed. This is a result of sustained macroeconomic stability and efforts to develop a supportive business environment. Secondly, Australia has used revenues from fossil fuels to maintain low debt and low borrowing costs. Although not designed with the intention of supporting the energy transition, Australia has a Petroleum Resource Rent Tax which taxes profits at a rate of 40 percent for profits generated from the sale of marketable petroleum commodities.[20] The country also maintains a relatively high Corporate Income Tax rate, which helps the country extract benefit from profits made by mining companies. Thirdly, Australia is building capacity in critical minerals, green metals and developing its renewables sector, which provides a natural hedge to declining fossil fuel demand (see Section 6.1). The Capacity Investment Scheme (CIS) is a national framework aimed at fostering new investments in renewable energy sources,

[20] Between 2012 and 2014, Australia had a parallel Minerals Resource Rent Tax (MRRT) which levied a 30 percent tax on profits from the mining of iron ore and coal on companies with profits exceeding AUD75 million. The IMF 2024 Australia Article IV Staff Report included recommendations for further resource rent taxation such as that which was included in the MRRT.

including wind and solar power, by providing incentives and support measures. Additionally, the scheme emphasizes the development of battery storage to enhance the reliability and stability of the energy grid while transitioning towards a more sustainable and low-carbon economy. The Future Made in Australia (FMiA) program aims to grow Australia into a renewable energy superpower. Notable measures include the provision of production tax incentives for renewable hydrogen (AU$6.7 billion over ten years from 2024–25) and processed critical minerals (AU$7.0 billion over 11 years from 2023–24), and support for battery manufacturing (AU $549 million over 8 years from 2023-24).[21]

6. Beyond the Model: Critical Minerals, Commodity Heterogeneity, and Technology

This section examines three key factors outside the model that may significantly influence Asia Pacific's economic outcomes from the energy transition over the next 25 years. These factors include the potential for expanding critical minerals, variations in extraction costs and grades of fossil fuels and development of green fuels and carbon dioxide removal (CDR) technologies.

6.1 Demand for Critical Minerals Offsets Losses

The Asia-Pacific region possesses substantial critical minerals whose demand is inversely correlated with global demand for fossil fuels creating an upside risk if prices rise. Figures 9A and 9B show projections from the IEA's Critical Mineral Report. Figure 9A shows projected demand in 2030 for four critical minerals under three increasing intensity scenarios simulated by the IEA.[22] In all instances, demand is expected to increase substantially between 2023 and 2030. In the more ambitious global scenario, demand is projected to increase further indicating that critical minerals needed for renewable energy and fossil fuels are substitutes. Asia Pacific is a major global hub for critical minerals with the IEA estimating that China, Indonesia and Australia have significant supplies of critical minerals. Figure 9B shows the market value of the sum of energy transition minerals is expected to approximately double; however, the scale of the gains is far smaller than the current size of their fossil fuel exports. In separate work, Boer, Pescatori and Steurmer (2024) estimate that the production value of copper, nickel, cobalt and lithium could rise nearly four-fold by 2040 becoming as important as the oil market.

6.2 Low Average Extraction Costs and Commodity Heterogeneity

Variation in average extraction cost and differing quality of fossil fuels create varied risks to the region's different market shares during the transition and is beyond what is captured by the model. As global demand for fossil fuels falls in the global transition, it is expected to result in declines in the price of these commodities. This may lead to the exit of mines with the highest extraction costs from the market. For example, Australia benefits from an average coal extraction cost below the world average (Figure 9C) as well as having coal with a lower carbon content than the global average. This suggests that Australia may see an initial impact on

[21] A 2025 IMF Staff Discussion Note highlights some further lessons on green industrial policies. "Industrial Policies Handle with Care" (see Baquie et al., 2025)

[22] The IEA uses three scenarios to examine future energy trends, including the Stated Policies Scenario (STEP), Announced Pledges Scenario (APS) and Net-Zero Emissions by 2050 Scenario (NZE). STEP reflects current policies and technologies that are in place and under development. APS assumes that all climate commitments, including NDCs, longer-term net zero targets, and targets for access to electricity and clean cooking, will be met in full and on time. NZE sets out a pathway for the global energy sector to achieve net zero CO_2 emissions by 2050 based on emission reductions in the energy sector. See IEA (2024) for more details.

prices more than on quantities of coal exports, and an increase in global market share relative to the baseline IMF-ENV assumption. However, even as market share grows, revenues from coal will continue to fall. Other countries in the region have higher extraction costs and a higher carbon content of coal which makes them more vulnerable to near-term changes in demand. The model accounts for variations in production costs across different sectors by incorporating a representative extraction sector for each country, reflecting the average production cost. In practice, however, each country has a variety of mines with a range of extraction costs that may respond differently to fluctuations in international commodity prices (Figure 9D).

The average extraction cost of critical minerals also varies substantially and will be driven by new discoveries and technological development. Data on mine level extraction costs suggest Asia Pacific mines are relatively globally competitive. For example, average copper extraction costs from mines in Australia, Indonesia, Laos, Mongolia, PNG, and the Philippines are below the global average (Figure 9C). However, future innovation may shift these patterns. For instance, in late 2024 and early 2025 there was a substantial fall in global nickel prices, largely driven by a surge in production from Indonesia. This partly reflects significant new investment and government policies to promote domestic processing.

Asia Pacific has a high proportion of metallurgical coal which is currently an essential input to steel manufacturing and so maybe more resilient to changes in global demand. For instance, Figure 9E shows that China is by far the largest global producer, and this has been steadily rising. Similarly, around half of Australia's coal exports are in metallurgical coal. While it is likely that demand for metallurgical coal will be more resilient in the short term, Figure 9E shows that this is a small proportion of total production and the value is also forecast to gradually decline.

A downside risk to the region's market share, beyond the scenarios presented in Section E, could arise due to geoeconomic fragmentation or if countries prioritize more expensive domestic production over imports. For instance, a Chinese ban on Australian coal imports imposed in late 2020 reduced bilateral coal imports from 17 percent in 2020 to close to zero in 2021-2022. Although Australian coal exporters largely managed to find alternative buyers for the coal, further global fragmentation could present a risk to any exporter's market share, especially during a period of shrinking global market. Further downside risks could materialize if global decarbonization is faster or more ambitious than anticipated and modeled, as shown in Figure 1.

6.3 Technological Change Impacts Demand

Reaching the global net-zero target will require innovation and large technology scaling up, creating uncertainty over demand for renewables, critical minerals, and fossil fuels. Technological uncertainty remains high, and innovation is needed in several key aspects. Development and deployment of technologies like (i) carbon dioxide removal (CDR) and CCUS could allow for continued use of fossil fuels in the hard-to-abate sectors; (ii) battery storage would support higher integration of renewables in the power sectors; and (iii) green hydrogen can play a significant role in decarbonizing the steel production sector while also providing a clean fuel alternative for aviation.

CCUS could allow the continued use of fossil fuels while also lowering the level of emissions. CCUS has long been regarded as a promising solution to maintain fossil fuel use while advancing decarbonization efforts. However, significant uncertainty still surrounds its potential for large-scale deployment by 2050. This uncertainty is demonstrated in Table 1 which shows the average share of coal, crude oil and natural gas production with CCUS in the IPCC AR6 database categories corresponding to the baseline, optimistic and pessimistic scenarios. The cause of the uncertainty is due to three main factors. Firstly, the high cost and energy requirements of current CCUS technologies make widespread adoption challenging, especially in a context where alternates to fossil fuel-based power like renewable energy sources are becoming more competitive. Secondly, policy and regulatory environments globally are highly variable and uncertain, impacting the incentives for innovating and deploying such technologies. This is particularly important for the availability of viable storage space which has been flagged as a major barrier to progress.[23] Most recently, several large G7 economies have provided incentives towards CCUS under green industrial policy packages which could potentially provide a more predictable policy pathway for this technology. Lastly, technological advancements and breakthroughs in CCUS are difficult to predict, adding another layer of uncertainty to future projections. Over the last decade within expert groups, the optimism regarding a substantial scaling up of coal with CCUS in the second half of the century has declined.[24]

Technological change that eases the deployment of existing green technologies can lower the cost of renewables and support the transition. For example, battery storage can support a grid powered by high levels of renewable energy. The pace of innovation in these options will likely be driven by the variability in government policies and incentives around the world, the technological and infrastructural challenges associated with integrating renewable sources into existing energy systems, and the readiness of countries to transition away from fossil fuels. For an extended discussion of this topic in Asia Pacific see Baquie et al. (forthcoming).

Green hydrogen could replace the use of coal in steel manufacturing, creating both up- and downside risks to fossil fuel exports. Currently, the region has some of the highest quality metallurgical coal in the world, which is an essential input in the production of steel. This might suggest that demand for metallurgical coal will remain robust, even while thermal coal demand falls. Indeed, the IEA forecasts that over the next 15 years metallurgical coal will decline more slowly than thermal coal (Figure 9F).[25] Should new technological development reduce the need for coal use in steel production, then Asia-Pacific's coal demand could fall more rapidly. One of the most promising technologies is green hydrogen which can substitute for the need to use metallurgical coal in the production of steel. If it is made economically viable, the domestic production of green hydrogen would hedge some of the risks from a declining coal sector: clean hydrogen can help generate new employment and help lower emissions. In Australia, modelling suggest that, alongside CCUS technologies, clean hydrogen will need to contribute about 50 percent of the emissions reductions in heavy industry to meet the Net Zero 2050 target (DCCEEW, 2021).

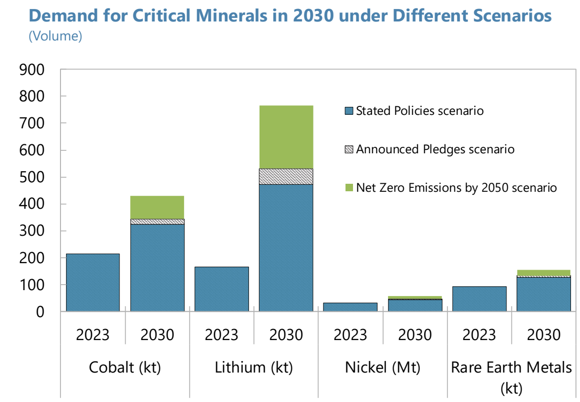
[23] See Energy Monitor (2025) Carbon capture and storage 'becoming a practical solution' despite hurdles

[24] The previous large scale IAM modeling exercise undertaken under the SSP-RCP Version 2 (SSP Database) scenarios projected about 125Mt of coal with CCUS by the end of the century.

[25] IEA World Energy Outlook 2024 projects that relative to 2023 levels steam coal will fall by 32 percent and metallurgical coal will fall by 11 percent by 2035.

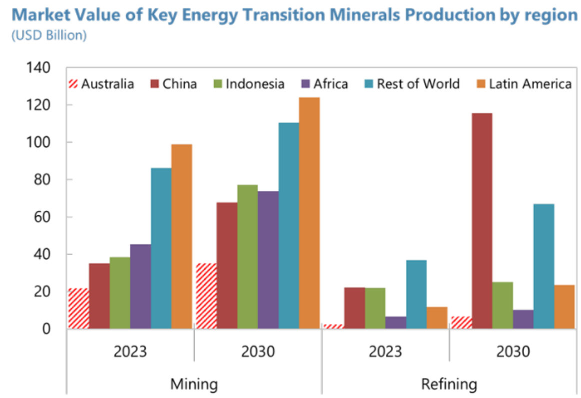
Figure 9: Potential Mitigating Factors

(A) Demand for critical minerals forecast to increase



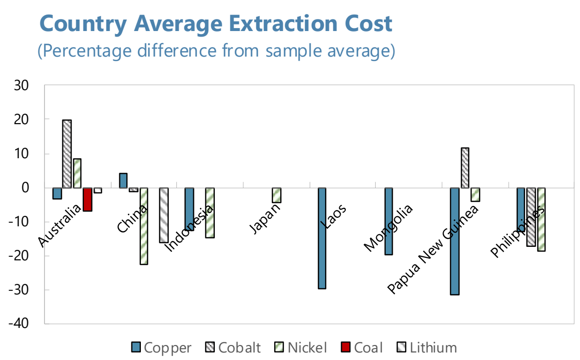
Sources: IEA Critical Minerals Report

(B) but expected increase in market value set to fall short of export revenues from fossil fuels



Source: IEA Critical Minerals Report

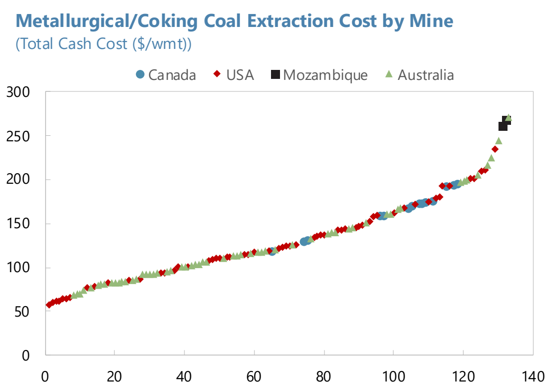
(C) Average extraction costs for mines in Asia-Pacific tend to fall below the average from the global average.



Sources: S&P and IMF Staff Calculations

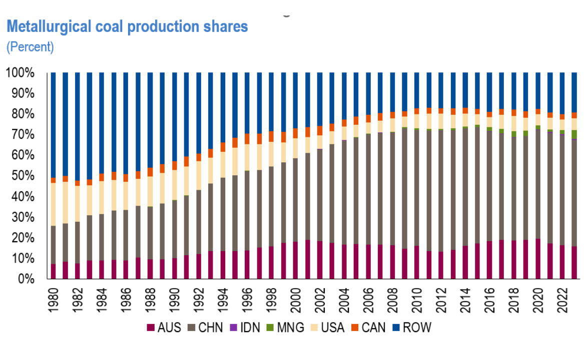
Note: Average costs vary by mineral - Copper, Cobalt & Nickel (c/lb), Coal ($/wmt), Lithium ($/LCE). Sample includes data from mines in 45 countries.

(D) Large mine-level variation in extraction costs across countries

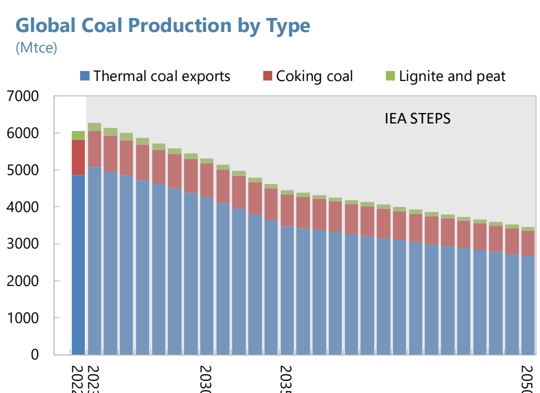


Sources: S&P

(E) Metallurgical coal production shares



(F) Coal of all types expected to decline



Sources: IEA World Energy Outlook 2024

Table 1 Percent CCUS Assumed in Global Fossil Fuel Production

	2040	2060	2080	2100
Baseline Scenario (2.7°C warming)				
Coal	1.7	8.3	17.0	26.6
Crude Oil	0.1	0.2	0.2	0.6
Natural Gas	0.7	2.0	3.6	7.2
Optimistic Scenario (1.8°C warming)				
Coal	20.1	53.6	64.9	63.9
Crude Oil	1.6	3.3	3.6	3.6
Natural Gas	11.1	32.9	35.4	31.2
Pessimistic Scenario (3.6°C warming)				
Coal	0.4	1.9	3.4	4.9
Crude Oil	9.8	9.7	9.7	9.7
Natural Gas	0.2	0.4	0.7	0.7

Note: This table shows the average share of coal, crude oil and natural gas production with carbon capture, utilization, and storage technology (CCUS) in the IPCC AR6 database categories corresponding to the Fund baseline, optimistic and pessimistic scenarios. It is important to note that these figures show the percentage of coal used with CCUS, but the nominal level will also depend on the level of demand (Figure 1) meaning the share could rise at the same time as the level is falling.

Source: IPCC AR6 Scenarios Database (2022).

7. Conclusions

This paper has three main conclusions:

Firstly, there is considerable uncertainty regarding future fossil fuel demand pathways. For instance, the median projections from the IPCC AR6 model ensemble suggest coal production by 2050 could decrease by 81 percent in an optimistic scenario or remain near current levels in a pessimistic scenario. For natural gas and crude oil, their relatively lower carbon content coupled with residual demand in the transportation sector might sustain the demand for these fuels over the next 25 years.

Secondly, scenario analysis on changes in global coal demand using the IMF-ENV global model suggests that the energy transition will have a substantial impact on the region's economy by 2035, with the effect on various fuels largely contingent upon policy choices. The divergence between the baseline and the more ambitious policy scenarios, particularly regarding the speed of coal phaseout, increases the likelihood that investments made under baseline assumptions become stranded. If investments proceed under the assumption that policy ambition will not rise beyond current settings, about one third of global coal capital stock and about one quarter of coal capital stock in Asia-Pacific could become stranded. In contrast, compared to the baseline investing in natural gas extraction may have economic rationale if decarbonization targets coal specifically (18 percent increase), while this incentive disappears with a fossil fuel agnostic energy transition plan (16 percent decrease). This variation in the range of outcomes introduces complexities for investors assessing long-term commitments and raises a risk of stranded assets or carbon lock in. Accordingly, clear and consistent policy signals remain critical to enable investors to make well-informed investment decisions.

Thirdly, the impacts will vary by country characteristics. Coal exporters with high average extraction costs will see the largest initial impacts, those countries with low average extraction costs will also see shrinking demand even as their market share increases. Gas exporters could even see an increase in revenues under some scenarios. Producers of critical minerals will likely gain, but initial projections suggest that this will not offset losses from fossil fuel exports. Deployment of technologies like CCUS could prolong the use of coal while others like green hydrogen could replace coal in the hard-to-abate sectors, large scale adoption of these technologies is not projected under current policies.

Policy lessons are discussed in detail in the 2024 Selected Issues Paper for Australia. These include the importance of building a diversified economy which can weather shocks to any individual sector and using revenues to maintain fiscal space. Where job displacement occurs, support to households including active labor market policies can help mitigate losses. Narrowly targeted green industrial policy, if well designed, can help maximize opportunities; however, the rapidly changing landscape of technological development will require policy to remain highly nimble. Financial sector risks will need to be closely monitored, including exposure to stranded assets.

Annex I. Overview of the IMF-ENV model

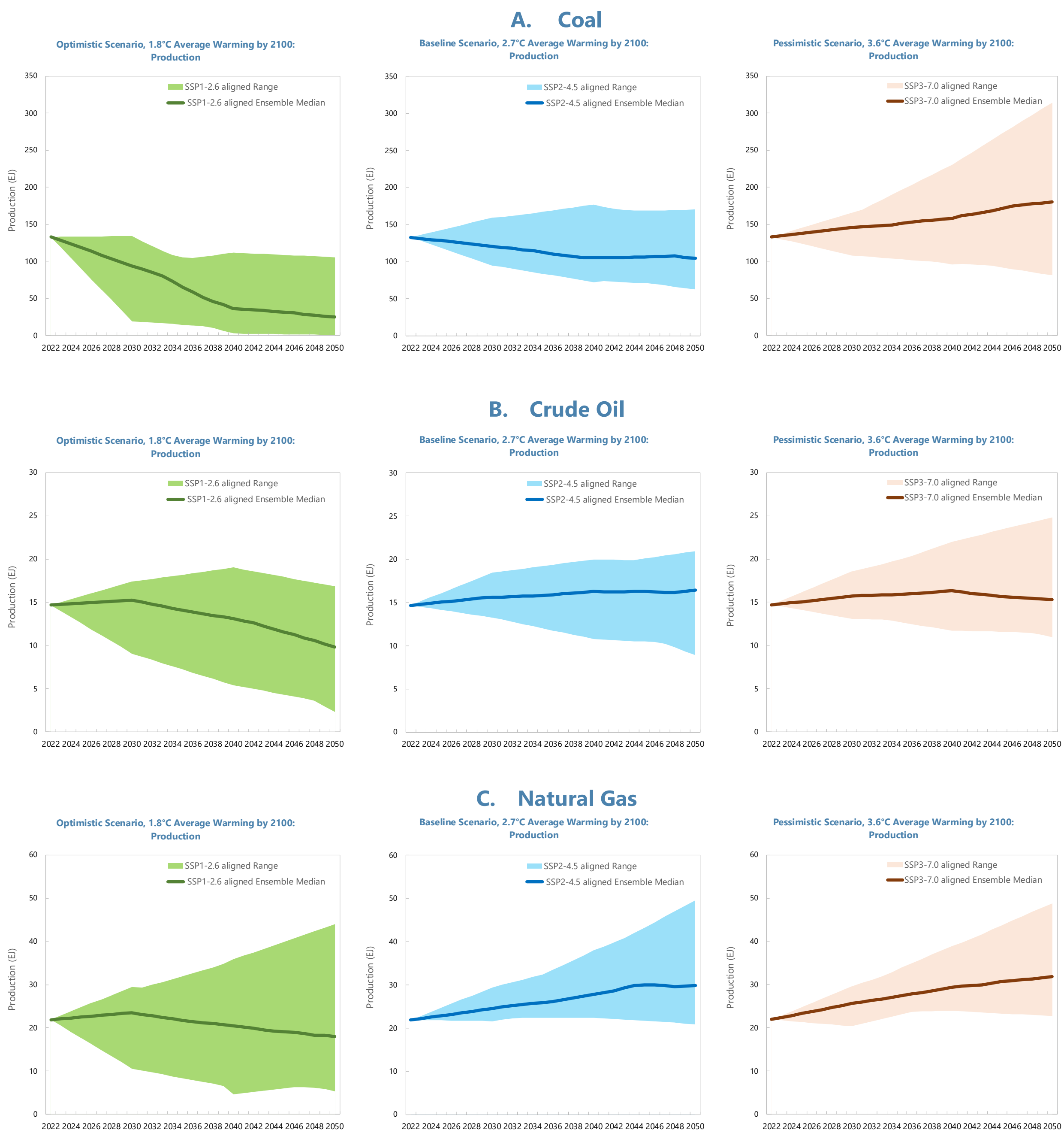
The IMF-ENV model is a global dynamic computable general equilibrium (CGE) model. The model is built primarily on the near global GTAP database of input-output tables of 160 countries and 76 commodities and solves recursively. IMF-ENV provides a flexible framework that is well suited to analyze policies that generate large structural changes (i.e., changes in the sectoral composition of economies) like those resulting from ambitious decarbonization goals. The model has a high level of sectoral and country granularity, the flexibility to incorporate many different types of policy instruments, and the capacity to analyze the general equilibrium effects of policies, as well as their cross-border effects through a detailed representation of trade flows. Policies that can be simulated include different carbon pricing schemes (carbon taxes on different activities, sources and gases, national and regional ETS, CBAM), energy policies (subsidies, feebates, direct and indirect regulations), sectoral regulations (overall and sector-specific energy efficiency standards, requirements to install household heat pumps, regulatory policies on land, fisheries, and forestry sectors), and new green technologies (CCUS, EV penetration). IMF-ENV can provide impacts of policies on emissions, real macroeconomic variables, sectoral economic activity, and international trade patterns.

IMF-ENV is based on a neoclassical framework that optimizes the behavior of households and firms to provide the general equilibrium effects of policy shocks. Production functions are defined as nested CES functions that allow us to simulate the substitution possibilities between different production factors, and domestic and international intermediate inputs, including different energy sources. Land is used as input in the agriculture sector. Natural resources are necessary for economic activities associated with forestry, fisheries, minerals, and fossil extraction sectors. Capital and labor and required in all production sectors. A prominent feature of IMF-ENV is that it features vintage capital stocks to capture frictions in capital mobility in such a way that a firm's production structure and behavior are different in the short and long term. In each year, new investment is flexible and can be allocated across activities until the return to the "new" capital is equalized across sectors; the "old" (existing) capital stock, on the contrary, is mostly fixed and cannot be reallocated across sectors without costs. Consequently, short-term elasticities of substitution across inputs in production processes (or substitution possibilities) are much lower than in the long term and make adjustments of capital more realistic. In contrast, labor (and land) market frictions are limited: in each year, labor (land) can shift across sectors with no adjustment cost until wages (land prices) equalize, while the labor (land) supply responds with some elasticity to changes in the net-of-taxes wage rate (land price). The model assumes that all markets attain equilibrium in each period, and hence, it is not well suited to analyze potential disequilibrium that could arise in the short term, especially in the labor market. The magnitudes of sectoral labor reallocations and relative wage changes are, however, indicative of the size of the adjustment needed and frictions that can be expected in the transition.

The model links economic activity to environmental outcomes. Emissions of greenhouses gases (GHGs) and other air pollutants are linked to economic activities either with fixed coefficients, such as those for emissions from fossil fuel combustion, or with emission intensities that decrease (nonlinearly) with carbon prices—marginal abatement cost curves. This latter case applies to emissions associated with non-energy-input uses (e.g., nitrous oxide emissions resulting from fertilizer uses) or with output processes (like methane emissions from waste management or carbon dioxide emissions from cement manufacturing). Further details about the model can be found in Chateau et al. (2025).

Annex II. Additional Figures

Figure A1. APD Fossil Fuel Production During the Energy Transition



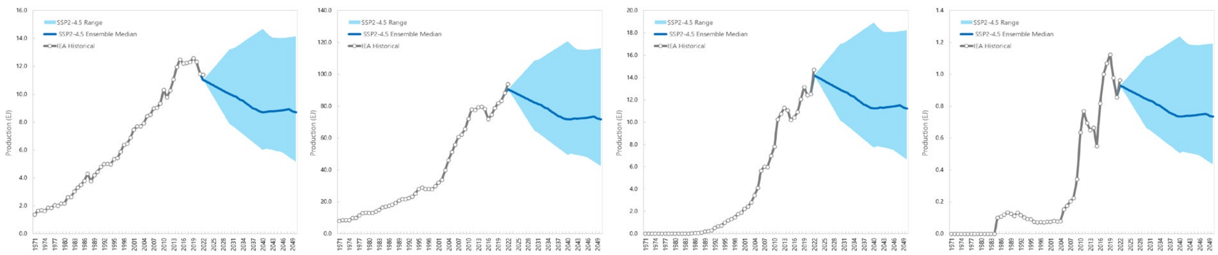
Source: Staff calculations based on data from IEA World Energy Balances (2024) and IPCC AR6 Scenarios Database (2022).

Figure A2. Historical and Projected Fossil Fuel Production of Large Exporters in APD

Baseline Scenario, 2.7°C Average Warming by 2100

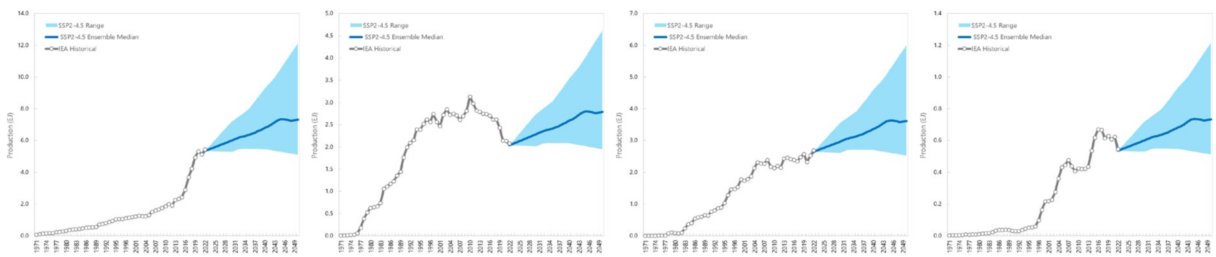
A. Coal

Australia | China | Indonesia | Mongolia



B. Natural Gas

Australia | Indonesia | Malaysia | Myanmar

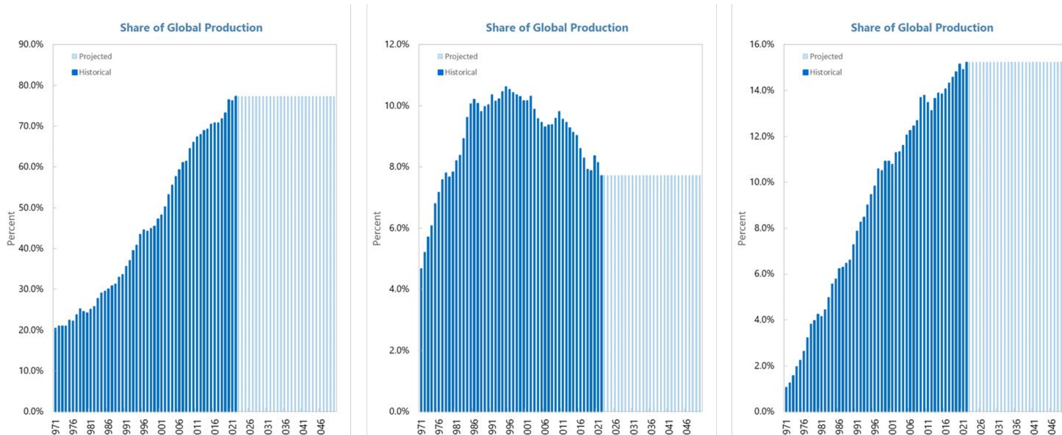


Source: The Global Energy Transition Tool (2024) based on data from IEA World Energy Balances (2024) and IPCC AR6 Scenarios Database (2022).

Notes: Projections assume that each country's share of global production is constant at historical 2022 levels.

Figure A3. APD Historical and Projected Shares of Global Fossil Fuel Production

A. Coal | B. Crude Oil | C. Natural Gas

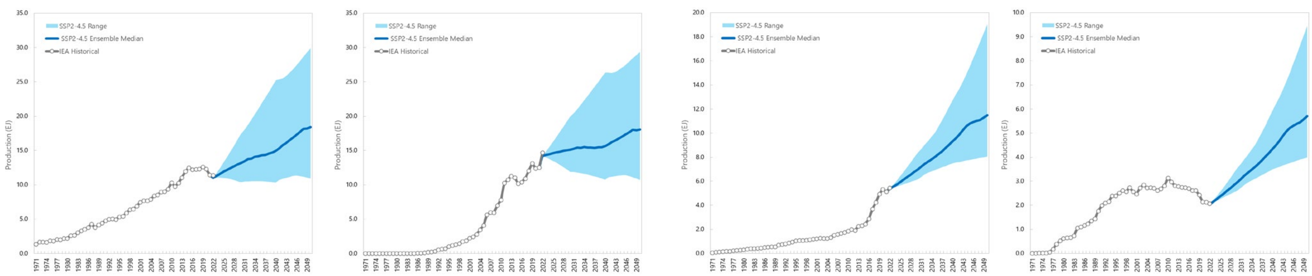


Source: The Global Energy Transition Tool (2024) based on data from IEA World Energy Balances (2024).

Figure A4. Historical and Projected Fossil Fuel Production under Baseline Production Shares using IMF-ENV

A. Coal | **B. Natural Gas**

Australia | Indonesia | Australia | Indonesia



Source: Historical data from the Global Energy Transition Tool (2024) based on data from IEA World Energy Balances (2024) and projections are estimates from IMF-ENV.

Notes: Unlike Figure A2 where projected shares are kept fixed to those in 2022, in this chart projections assume that each country's share of global production is aligned with the IMF-ENV baseline model results in 2035.

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