SUERF
The European Money and Finance Forum

SUERF Policy Brief
No 654, August 2023

The macroeconomic effects from the energy transition will be large and diverse*

By Alberto Americo, Jesse Johal and Christian Upper
Bank for International Settlements

Keywords: Energy transition, transition risks, macroeconomics.
JEL codes: Q30, Q40, Q50, O30.

The energy transition will have profound and varying effects across the globe. We look at the evolution of clean technologies and the challenges and opportunities the transition poses for fossil fuel and metals and minerals producers in the short and long term. We also describe the likely macroeconomic consequences and identify the countries most exposed. A small number of fossil fuel producers are likely to be severely hit. Meanwhile, a select group of minerals producers should see large benefits. Fuel importers – that is, most of the world – should benefit to varying degrees.

Clean technologies are rapidly challenging the long dominance of fossil fuels. Public policy measures from major economies are adding significant amounts of public financial and regulatory support to the transition. Relatedly, expectations are growing that fossil fuel demand will peak within this decade after over two centuries of essentially uninterrupted growth (IEA (2022)). And this will have profound effects on the global economy, particularly in relation to energy and commodities markets. In a new paper (Americo et al (2023)), we describe how this these effects may manifest in different types of countries.

We find that most of the world, but particularly South and East Asia, should benefit from replacing expensive, polluting, imported fossil fuel with cheaper, cleaner, locally sourced energy. For major undiversified fossil fuel producers in the Middle East and North Africa, the economic benefits of clean energy will be overshadowed by the decline of their main export industry. Producers of key metals and minerals (eg copper, lithium, rare earths) may enter a new commodity supercycle, but global spending on these materials will be much lower than what is spent on fossil fuels today. Overall, resources should shift away from fossil fuel producers and towards energy consumers and metals and minerals producers.

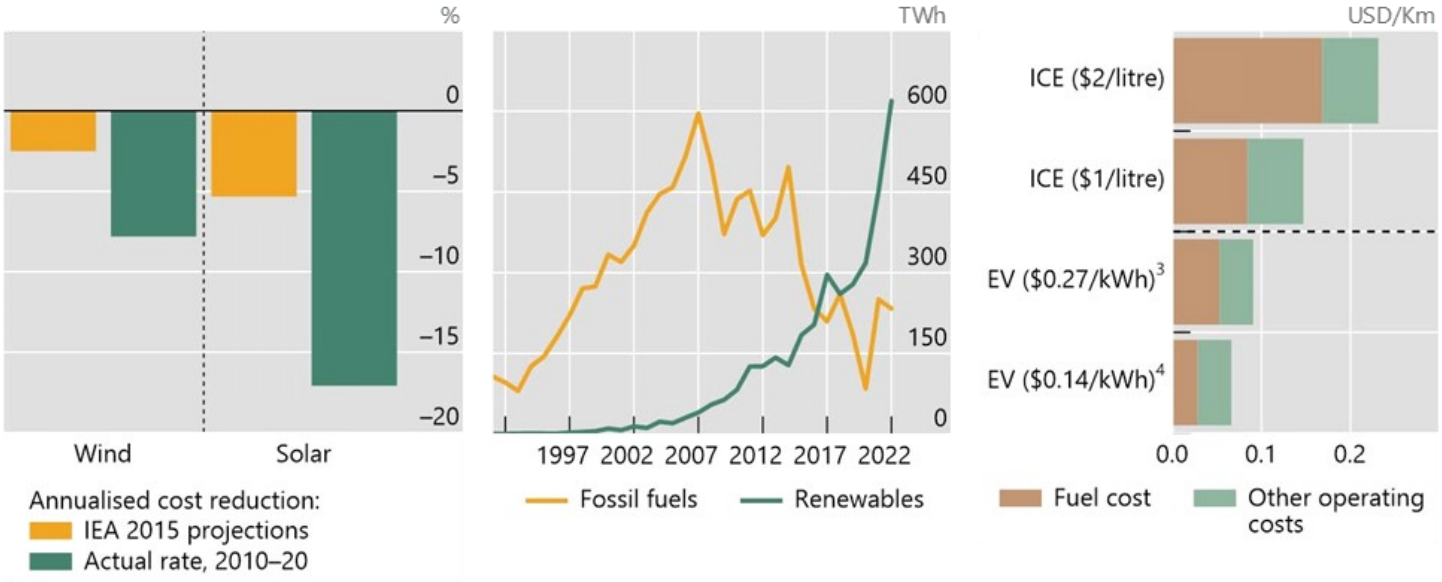
*This policy brief is based on "The energy transition and its macroeconomic effects," BIS Papers No 135. The views expressed are those of the authors and not necessarily the views of the BIS.

The near-term outlook for the transition is much more uncertain, however. Both fossil fuel demand and supply are bound to decline, but which one declines more rapidly is hard to tell. Weak investment in fossil fuel extraction, which has shrunk significantly since 2014, could push up energy prices. Delays in the expansion of metals and minerals supply or electricity infrastructure also may impede the transition. But we could also see the opposite scenario: fast progress for clean technologies means that tipping points in energy markets arrive quickly. Also, buoyed by public sector support and technological innovation, constraints from infrastructure or metals and minerals may be, as has been the case over the last decade, prove much weaker than currently anticipated.

Clean technologies are rapidly becoming the default option

Cost declines for wind and solar energy have consistently surpassed expectations, with realised costs falling around three times faster than projected (Graph 1 – left-hand panel). Because of this solar and wind energy are now the dominant source of global electricity growth (Graph 1 – centre panel). And because renewable technologies experience sharp cost declines as they scale up (Way et al (2022)), their cost advantages and use should only continue to grow in the coming decades.

Clean energy is growing and improving faster than expected — Graph 1



[1] Consumer price index (CPI). [2] 2022 data are on a trailing 12-month basis. Fossil fuels data are a five-year moving average. [3] Average EU electricity price in 2021. [5] Average US electricity price over the 12 months ending March 2022.

Sources: Eurostat; Fred; IEA; BP; EMBER; Global Energy Monitor; authors' calculations.

The adoption of clean electricity will correspondingly create permanent challenges for fossil fuels, particularly as most countries could use renewables to supply the vast majority of their electricity needs (Tong et al (2021)). Fossil fuel investment in the electricity sector has been in a consistent decline both in terms of share and aggregate spending (IEA (2023a)). Partly as a result, fossil fuel demand in the power sector is already decelerating sharply and is expected to soon enter a period of secular decline (Ember (2023)).

Electric vehicles (EVs) are seeing their popularity explode. Sales have more than tripled since 2019 and essentially all major auto manufacturers are planning to transition to predominantly electric or all-electric fleets over the next decade. The primary hindrances to EV adoption (ie driving range, cost, charging infrastructure) are quickly being resolved, meaning that demand should start to shift from early adopters to mass market consumers.

Similar to how renewables are eroding demand for fossil fuel-based electricity, the rapid adoption and cost advantages of EVs over internal combustion engines (ICE) mean that oil demand should be increasingly challenged. EVs already have far lower and less volatile operating costs than their fossil fuel counterparts (Graph 1 – right-hand panel), meaning that heavy users have strong financial incentives to accelerate their transition. Electrification in transportation is already displacing around 1.5 million barrels a day (BNEF (2022)) – roughly equivalent to the daily consumption of France. This is expected to help drive a peak in transportation oil demand in the next several years and an overall peak by the end of the decade (IEA (2023)).

A wide range of outcomes are plausible for fossil fuel prices. In 2014, oil prices crashed despite growing oil demand. However, a widening of the supply and demand imbalance of less than 2 million barrels a day helped push prices down by approximately 70% in two years (Baumeister and Kilian (2016)). More recently, the reopening of the global economy after the initial phases of the pandemic and the Russian invasion of Ukraine pushed prices up by a similar magnitude. Further complicating the outlook is the fact that fossil fuel producers have only operated in an environment of ever-increasing demand, meaning that their supply response is also uncertain. Their incentives under a declining demand scenario may be to produce more in the near-term rather than holding on to what may be less valuable reserves in the future (Mercure et al (2021)).

In contrast to their fossil fuel producing peers, metals and minerals producers could see major benefits from the expansion of renewable energy and the electrification of transportation. The proliferation of these technologies will require a rapid scaling up of the production of metals and minerals such as copper, lithium, cobalt and rare earths. Tightness and volatility in these markets is already apparent, with prices remaining above their historical levels even after the recent easing of extreme price increases of the past few years.

Nevertheless, these constraints are likely to soften over the long-term. Persistently high prices will help the development of currently underutilised or less viable supplies (eg lithium deposits in Canada, Germany and Mexico) just as the oil price boom incentivised development of the Canadian tar sands and US shale. Relatedly, mining investment has been increasing sharply for several years suggesting that new supply should reach markets in the coming years. And finally, high prices should support the development of alternative technologies; for example, sodium-ion batteries that could ease pressures for lithium, cobalt, and nickel (Bradsher (2023)).

Despite some parallels, the nature of metals and minerals demand will be distinct from that for fossil fuels. Metals and minerals can be used indefinitely, while fossil fuels are inherently single use. Also, a large proportion of future metals and minerals demand should be front-loaded as new technologies are adopted. However, given the scale of change implied by the energy transition, this boom in the quantities demanded for metals and minerals could last for decades, especially given the uneven pace of the transition within and across countries.

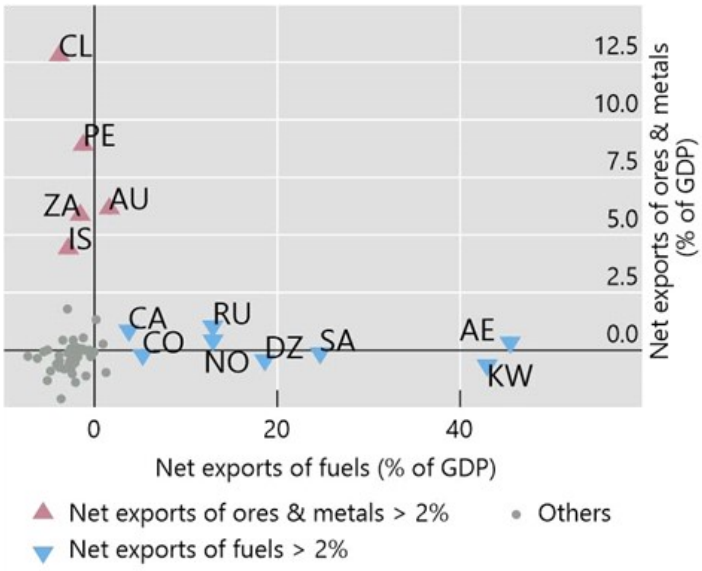
The energy transition will have global implications

The energy transition will have different effects across three broad classifications of countries: fossil fuel exporters, fossil fuel importers and metals and minerals exporters. Given the lack of overlap between metals and minerals exporters and producers of fossil fuels (Graph 2 – left-hand panel), we find this to be a useful starting point to conduct our analysis. We also distinguish between the transition phase and the eventual steady state.

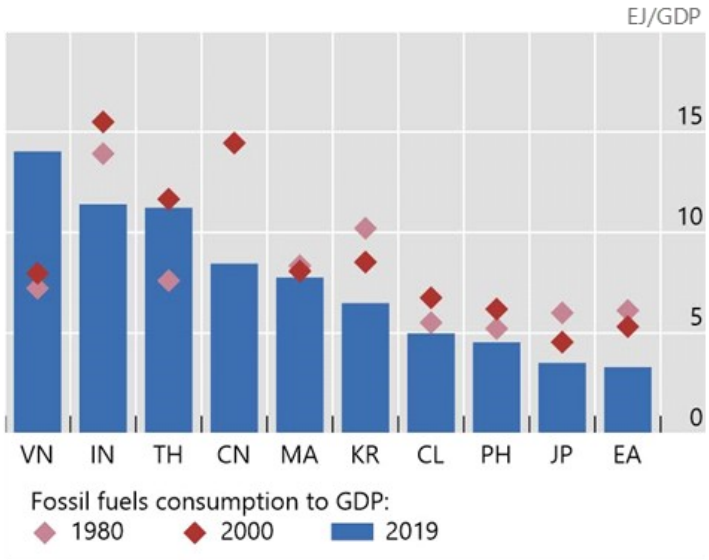
Potential winners and losers at first sight

Graph 2

Fossil fuel versus metals exports for selected resource producers[1]



Fossil fuel intensity of GDP



[1] 2019 or previous latest available figures.

Sources: IMF; World Bank; OWID; authors' calculations.

Effects on fossil fuel exporters

The near-term effects of the energy transition on fossil fuel producers are hard to predict. A fast transition would put severe pressure on their current accounts, creating balance of payments and/or exchange rate challenges. This shock would flow through to fiscal accounts and impede potential demand-side responses from governments. Worsening prospects for fossil fuels would make a significant amount of fossil fuel investment unnecessary and cut off another growth channel. These issues may also be aggravated by financial stress: commodity price crashes are typically associated with an increase in non-performing loans and bank funding costs (Kinda et al (2016)). However, if capital pulls back from the sector faster than demand for fossil fuels falls, existing producers could see one final windfall. This windfall would have essentially the opposite effects of a rapid transition and could buy affected countries' additional time to deal with the transition.

The long-term steady state for energy markets and fossil fuel producers is much clearer. Undiversified producers may see major threats to their fiscal sustainability and balance of payments. And given the scale of the potential impact from the transition, even countries with substantial savings could see these funds erode quickly. Diversified oil and gas producers may just see a shift in economic activity. Weaker exchange rates, lower competition for workers and reduced wage pressures could make certain industries and regions more competitive and set the stage for new forms of development if supporting policies are in place – a sort of 'Dutch disease' in reverse.

The transition will be particularly challenging for countries such as Saudi Arabia, Kuwait, the United Arab Emirates and Algeria where fossil fuel rents account for a large share of their economies and almost their entire export bases; one needs to look no further than the 2014 oil price crash to see the potential macroeconomic challenges facing these countries. Meanwhile, even more diversified countries such as Russia, Norway and Colombia, that are heavily reliant on fossil fuels exports, could face balance of payments and/or exchange rate pressures.

Effects on fossil fuel importers

Fossil fuel importers will have the inverse experience of their exporting peers. Under a slow transition, importers could see higher energy prices and inflation as well as weakening current account balances and exchange rates. This would flow through to the broader economy via lower investment and consumption. And in many cases, it would worsen fiscal balances both through slower growth and perhaps increased energy subsidies. However, under a fast transition, importers may benefit twice over. A sharp fall in price fossil fuel prices would act as a positive supply shock, leading to better outcomes for their current accounts, fiscal balances, investment, consumption and inflation rates. Meanwhile, the increased use of lower-cost domestic energy sources would reinforce these effects.

However, the build out of new infrastructure may dampen the positive macroeconomic effects of a fast transition (Schnabel (2022)). Some estimates suggest that clean energy investment will need to increase from around 1.3% of current global output currently to approximately 2.7% by 2030 to achieve climate goals (IEA (2021a)). Whether these investment-led inflationary pressures are realised will depend on how energy consumption spending (currently around 5% of global output) and fossil fuel investment (roughly 1%) evolve. If clean energy investment reaches sufficiently high levels, it is also highly likely that fossil fuel spending and investment have fallen sharply, thus reducing net inflationary pressures.

In the long term, the energy transition will deliver a positive supply shock to the global economy. The implementation of lower cost clean technologies should reduce price levels and generally weaken energy's influence on economic activity. The transition should lead to an improvement in the trade balances of importers due to reduced energy imports. This in turn should lead to higher domestic consumption and a structural easing of financial conditions as more financial resources are held locally.

The countries most reliant on energy imports and which should benefit most from the transition are mostly in in South and East Asia. Vietnam, India, Thailand, and China are highly reliant on fossil fuel, have limited domestic supplies, and thus have large incentives to make the transition quickly (Graph 2 – right-hand panel). India's historical sensitivity to energy prices demonstrates the macroeconomic risks and opportunities that currently energy poor countries face as the transition proceeds.

Effects on suppliers of metals and minerals

The energy transition will be clearly positive for producers of metals and minerals, but as is typical with resource-based booms, may create challenges as well. Potential supply and demand mismatches could shift the terms of trade sharply in favour of exporters. The build-up of new mining capacity should further support growth by increasing investment demand, while capital inflows associated with the boom are likely to significantly ease financial conditions (Drechsel and Tenreyro (2018)).

That said, there are some issues that metals and minerals producers may have to confront in the long term. The real exchange rate and wage pressures that accompany a boom could make some regions and industries less competitive (Corden (1984), Alberola and Benigno (2017)). Fiscal spending and non-commodity revenues tend to move procyclically with commodity prices (Bova et al (2018)). Similarly, while commodity exporters typically enjoy easier financial conditions during a boom, they often experience sudden stops and financial sector issues during the bust.

The strong performance of Peru and Chile – two of world's largest copper producers – during the previous commodity boom support this reasoning. During this time, they saw strong foreign direct investment, improving fiscal conditions, strong wage growth, and increasing labour market formalisation. After the end of the commodity supercycle, Chile and Peru retained most of the economic gains they achieved during the boom but still experienced some macroeconomic retrenchment.

A wide range of countries should benefit from the transition. Some countries – Australia, Brazil and Chile – stand to gain due to their large deposits of different types of metals and minerals. Meanwhile, others may do so from the exploitation of a single product, such as Bolivia from lithium, the Democratic Republic of Congo from cobalt, and Peru from copper. And finally, China's dominant position in refining will allow it to take advantage of increased production even if its own domestic supplies are relatively limited. However, the current market structure of metals and minerals markets cannot be taken for granted. Measures such as the US Inflation Reduction Act and the European Union's proposed Critical Raw Minerals Act to encourage domestic mining and a lower reliance on Chinese refining could influence market share over the long term. And as mentioned previously, the development of new reserves or the use of demand reducing technologies could further reduce market power.

Conclusion

The energy transition will eventually have far-reaching and permanent implications for the global economy and individual countries. It will be a net benefit for the global economy through lower energy costs, lower economic volatility and a cleaner environment, but may also imply more energy price uncertainty in the short-term. However, for major fossil fuel producing nations, the energy transition will require a difficult and fundamental shift in the structure of their economies. And metals and minerals producers should benefit twice over from the benefits of a cleaner energy supply and increased demand for their products.

Still, countries do not have to be passive in response to the transition. Fossil fuel exporters can use the coming years to embark on structural reform, diversify their fiscal bases and build buffers against future economic and financial volatility. Meanwhile, fossil fuel importers can use the energy transition as an opportunity to make their economies more resilient; they can take cost-effective climate action while also permanently reducing risks from fossil fuel-based balance of payment shocks. Also, metals and minerals producers can reform their budgeting practices to ensure that they minimise their exposure to the booms and busts of the commodity cycle. But some governments may need support in these efforts given the high cost of capital faced by emerging market economies. The international official sector and advanced economies can help this process along by following through on their repeated promises of technical assistance and larger-scale financial support to these countries (Persaud (2023)).

Despite the nearer-term uncertainty, the energy transition means that the world will eventually see lower energy costs and less pollution. However, while the outlook is positive for most countries and the world, some people, regions and countries may nevertheless be left behind. In other words, how potential future abundance is shared globally could be a major issue in the years and decades ahead.

References

Alberola, E and G Benigno (2017): "Revisiting the commodity curse: a financial perspective", *BIS Working Papers*, no 609, February.

Americo, A, J Johal and C Upper (2023): "The energy transition and its macroeconomic effects", *BIS Papers*, no 135, May.

Baumeister, C and L Killian (2016): "Forty years of oil price fluctuations: why the price of oil may still surprise us", *Journal of Economic Perspectives*, vol 30, no 1, pp 139–60.

Bloomberg New Energy Finance (2022): *Electric Vehicle Outlook 2022*.

Boer, L, A Pescatori and M Stuermer (2021): "Energy transition metals", *IMF Working Papers*, no 2021/243, October.

Bova, E, P Medas and T Poghosyan (2018): "Macroeconomic stability in resource-rich countries: the role of fiscal policy", *Journal of Banking and Financial Economics*, vol 1, no 9, May, pp 103–22.

Bradsher, K (2023): "Why could dominate the next big advance in batteries", *New York Times*, 12 April.

Corden, W (1984): "Booming sector and Dutch Disease economics: survey and consolidation", *Oxford Economic Papers*, vol 36, no 3, November, pp 359–80.

Drechsel, T and S Tenreyro (2018): "Commodity booms and busts in emerging economies", *Journal of International Economics*, vol 112, May, pp 200–18.

Ember (2023): *Global Electricity Review 2023*. April.

IEA (2021a): *Renewables 2021*.

IEA (2022): *World Energy Outlook 2022.*

IEA (2023a): *World Energy Investment 2023*.

IEA (2023b): *Oil 2023.*

IRENA (2022): *Renewable power generation costs in 2021.*

Kinda, T, M Mlachila and R Ouedraogo (2016): "Commodity price shocks and financial sector fragility", *IMF Working Papers*, no 16/12.

Mercure, J, P Salas, P Vercoulen, G Semieniuk, A Lam, H Pollitt, P Holden, N Vakilifard, U Chewpreecha, N Edwards and J Vinuales (2021): "Reframing incentives for climate policy action", *Nature Energy*, vol 6, pp 1133–43.

Persaud, A (2023): "Unblocking the green transformation in developing countries with a partial foreign exchange guarantee", *Climate Policy Initiative.*

Schnabel, I (2022): "A new age of energy inflation: climateflation, fossilflation and greenflation", panel remarks at The ECB and its Watchers XXII Conference on Monetary policy and climate change, Frankfurt, 17 March.

Tong, D, D Farnhan, L Duan, Q Zhang, N Lewis, K Caldeira and S Davis (2021): "Geophysical constraints on the reliability of solar and wind power worldwide", *Nature Communications*, vol 12.

Way, R, M Ives, P Mealy and J Farmer (2022): "Empirically grounded technology forecasts and the energy transition", *Joule*, vol 6, no 9, September, pp 2057–82.

About the authors

Alberto Americo *is a Senior Macroeconomic Analyst in the Monetary and Economic Department at the Bank for International Settlements. Alberto joined the BIS in 2020. Previously he worked in the Securities and Financial Market Data division at the ECB. Alberto holds a BSc and an MSc in economics and social sciences from the University of Turin.*

Jesse Johal *is a Visiting Economist in the Office for the Americas at the Bank for International Settlements. Jesse joined the BIS in September 2020. Prior to the BIS, he worked as a senior economist in the Financial Markets Department of the Bank of Canada. He holds a MA in economics from the University of Waterloo (2009) and a BA in economics from The University of British Columbia.*

Christian Upper *is a Senior Adviser in the Representative Office for the Americas, Monetary and Economic Department, at the Bank for International Settlements. Prior to his current role, Christian headed the Monetary and Economic Department's Macroeconomic Analysis, Emerging Markets, Financial Markets and Monetary Policy and Exchange Rates units. Before coming to Basel, he spent seven years at the Deutsche Bundesbank. Christian holds a doctorate in economics from the European University Institute in Florence and a Master of Science in economics from the University of Warwick. His research focuses on the interaction of financial markets and institutions and the macroeconomy. His work has been published in refereed academic journals as well as in policy publications.*

SUERF Secretariat
c/o OeNB
Otto-Wagner-Platz 3
A-1090 Vienna, Austria
Phone: +43-1-40420-7206
www.suerf.org • suerf@oenb.at