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Discussion paper for the Climate & Recovery Initiative ninth roundtable: Interactions between inflation, energy, economic policy and climate change

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Key points

- Recent soaring energy prices are being fueled by a complex mix of international and domestic factors including the war in Ukraine and the unavailability of ageing coal power capacity in the National Electricity Market. This is contributing to a broader inflationary environment as pandemic-related lockdowns ease.
- These economic conditions are sparking deeper reflection about the interaction between climate and energy issues, inflation and price volatility, which are connected in three ways:
    - The rising costs and instability associated with the fundamentals of fossil fuel markets including geopolitical tensions, more expensive production and tighter financing and policy conditions, among other issues.
    - Worsening climate change that is creating more unstable inflationary conditions including short-term shocks through intensifying extreme weather and supply disruption, and long-term value destruction that may dampen the natural growth rate.
    - Potential, but uncertain, short-term price rises for goods and labour due to an accelerated clean energy transition that would ultimately lead to a deflationary environment as renewables come to dominate.
- While traditional monetary policy is the normal response to inflationary concerns, the dynamics and impact of climate and energy-issues on inflation volatility could dampen its impact. Further, some researchers have raised concerns that traditional monetary policy could make it more difficult to execute the necessary clean energy transition where it contributes to a rise in upfront financing costs for deploying technologies such as renewable energy.
- Increasingly, a range of economic actors are now casting climate and energy policy as core macroeconomic and monetary responses that can take some burden off other blunter approaches, like lifting interest rates, and help bolster the natural growth rate.
- Well-designed policies which accelerate the clean energy transition, electrify homes and industry, and boost energy productivity can assist in addressing Australia's current and future pricing and inflation concerns. Over time, this can give policymakers more technical and political levers to address cost of living issues.
- Over the long-term the best mitigation to persistent and emerging inflation pressures and economic instability will be bringing forward investment in an orderly and accelerated transition to net zero emissions, which will reduce a reliance on inherently volatile global energy markets and install significant larger concentrations of energy with low-to zero marginal operating cost.

Key questions for discussion

- What are the forces that underpins these interactions?
- What are the right changes to our path to net zero in the face of these interactions?
- What are the consequences of these changes for the way we implement climate change policy and the way we implement macroeconomic policy?
- Which institutions are best placed to drive the change?

Introduction

Many developed countries, including Australia, are experiencing worsening inflation at a rate higher than any time over the last decade.[1] This has been driven in part by soaring energy prices either as a direct component of the consumer price index (CPI) basket or as an underlying input cost to the production and transportation of other products.[2] These conditions are forecast to continue throughout the rest of 2022 and persist above the Reserve Bank of Australia's (RBA) target rate over at least the next 12 months.[3] AMP Capital has indicated energy price increases after 1 July 2022 will add a further one per cent to headline inflation.[4]

Like the disruption caused by the COVID-19 pandemic, this economic environment, and underlying energy pricing shocks, has the potential to accelerate or disrupt the net zero emissions transition depending on the response from governments, regulators and industry. Further, there are now well established connections between energy price shocks, inflationary pressures and different aspects of the climate challenge that need to be accounted for in policy and industry response to current events. These include an overreliance on fossil fuels, which in turn exposes economies and communities to geopolitical tensions, production issues and international cartel-like behaviour from some producers, among other concerns. At the same time, worsening climate change is projected to create other economic concerns through issues like supply chain disruption and long-term value destruction that may weaken the effect of traditional monetary policy responses to pricing instability.

Given these risks it would be a mistake to unnecessarily delay the energy transition or lock-in higher greenhouse gas emissions in seeking to solve current energy price shocks and rising inflation. At the same time, well-targeted measures that bring together renewable energy, energy efficiency, energy security and decarbonisation goals can make a medium- to long-term contribution to building greater resilience among households, industry and the economy. This would address the inflationary aspects of fossil fuels and avoid accelerating the price volatility than can be expected with worsening climate change. However, policymakers, industry and regulators will also need to monitor and adjust policy settings for other inflationary pressures that may arise from the economic activity created by the necessary accelerated transition to net zero emissions.

This issues paper details some recent interventions on these topics and highlights areas of policy that will be relevant for addressing current and persistent challenges related to energy markets, climate change, economic policy and inflation.

Current rising energy prices

Immediate rising Australian energy costs (gas, petrol and electricity) have been largely fuelled by soaring prices in global commodity markets. The Federal Reserve Bank of New York has stated that: "global supply factors related to supply chain disruptions and energy markets are associated with recent developments in key measures of inflation across advanced economies."[5] These factors include the war in Ukraine and

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[1] *Consumer Price Index, Australia*, Australian Bureau of Statistics, 2022.
[2] J Alvarez and P Barrett, 'Global Inflation Pressures Broadened on Food and Energy Price Gains', International Monetary Fund, 2022.
[3] 'Statement on Monetary Policy – May 2022', Reserve Bank of Australia, 2022.
[4] D Mousina, 'Econosights: Implications from Australia's energy "crisis"', AMP Capital, 2022.
[5] O Akinci et al., 'The Global Supply Side of Inflationary Pressures', Federal Reserve Bank of New York Liberty Street Economics, 2022.

associated sanctions on Russia, supply chain disruptions driven mostly by COVID-shutdowns in China, and an increase in economic activity and demand as the world opens up after the initial shock of the pandemic.

Global energy prices have hit near-term highs in recent months, fuelling significant price rises in domestic markets. Global thermal coal prices rose above $USD300 per tonne, more than three times their average in the past decade. Gas prices in Asia and Europe have reached above $AUD40 per gigajoule, after averaging below $AUD20 for the last eight years. Oil prices have hit higher than $USD100 per barrel after averaging $USD81 between 2010-19 and briefly dropping to zero last year. However, some futures markets for fossil fuels have fallen in recent weeks on the back of global recession fears, meaning international inflationary pressures may subside more quickly than expected, albeit in weakening macroeconomic conditions that bring their own concerns.[6]

In Australia, these global prices have flowed through and have also been exacerbated by a set of local factors. These include large swathes of ageing coal-fired power capacity being offline due to faults, maintenance or other withdrawals, which has seen even more expensive gas-fired power setting the price in the wholesale electricity market for longer periods. At the same time, periodic lower renewable energy output has also been cited by some industry actors as a component of supply-side concerns, however this has been heavily disputed by market analysts and appears to have had a marginal impact if at all.[7] Other factors increasing pricing pressure on the market have included increased demand for heating due to early-winter-like conditions in parts of Australia[8] and recent flooding at black coal mines.[9] Long after temporary factors ease, international fuel prices are likely to sustain high domestic prices for electricity and gas.

Inherent in most of these price shocks is an energy system that is still dominated by fossil fuel sources of energy. A greater deployment of alternative supplies of clean energy and an improvement in the nation's energy productivity have been unnecessarily delayed by decades of political contest over climate change and energy policy, and could have ameliorated some of the current price volatility and supply issues.[10]

In other markets these energy security, supply and inflationary pressures have sparked immediate policy responses across a range of areas, some consistent with the net zero transition and some not. For example, many governments including Australia's have responded with short-term and costly subsidies or tax relief on energy such as petrol for transport.[11] More substantially, the European Commission has released a policy to end the region's reliance on Russian gas known as REPowerEU, which proposes lifting the region's renewable energy goal from 40 to 45 percent by 2030, increasing its binding energy efficiency target, reducing fossil fuel use by industry and diversifying its gas import sourcing.[12] At the same time, some particularly affected Eurozone countries, such as Germany, have also been forced to temporarily

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[6] A Gluyas, 'Recession fears unleash panic in commodity markets', *Australian Financial Review*, 2022.
[7] T Edis, 'What is the real cause of our energy crisis – and what should we do?', *Renew Economy*, 2022.
[8] S Hepburn, 'Why did gas prices go from $10 a gigajoule to $800 a gigajoule? An expert on the energy crisis engulfing Australia', *The Conversation*, 2022.
[9] N O'Malley et al., ''Biggest energy crisis in 50 years': East coast cold snap ignites gas price fears', *The Sydney Morning Herald*, 2022.
[10] M Weaver, 'Heat is on to plug energy crisis in Australia', Australian National University, 2022.
[11] L Fox, 'Explainer: What does cutting fuel excise mean for the government, and for Australians?', Grattan Institute, 2022.
[12] 'REPowerEU: A plan to rapidly reduce dependence on Russian fossil fuels and fast forward the green transition', European Commission, 2022.

increase coal power output[13] and have looked to establish alternative gas import options,[14] reinforcing the ongoing reliance on fossil fuels as part of the immediate energy mix albeit in more crisis-like conditions than Australia. The Biden Administration has linked the inflationary pressure in the United States to the country's continued reliance on foreign fossil fuels and cast a switch to clean energy and increased manufacturing capacity as a solution.[15] In response, the US has committed more national funds to household energy efficiency measures[16] and invoked the Defense Production Act to increase manufacturing of solar panels, transformers and electric grid components, heat pumps, insulation and electrolysers.[17] A recently agreed $USD433 billion package of climate, health and other economic measures, which includes significant tax credits for energy efficient appliances, heat pumps and electric vehicles, agreed between Senate Democrats was framed as the Inflation Reduction Act.[18]

Climate challenges and inflation

There are a range of broader and ongoing inflationary pressures associated with climate challenges that should also be considered as policymakers and regulators respond to the immediate concerns. The European Central Bank (ECB) has categorised the relationship between climate change, the energy transition and inflationary volatility into three themes: fossilflation, climatflation and greenflation.[19] Each of these plays out on different time-scales and to differing degrees of impact, with fossil fuel fundamentals being the most immediate and readily evident, climate risks being the most disruptive and emerging, and green transition inflation being transitory and still relatively hypothetical.

	Timeframe	Impact
Fossil fuel fundamentals (fossilflation)	Short	Inflationary pressures on households and industries that rely on fossil fuels
Green transition (greenflation)	Medium	Prices may rise over the medium-term as the transition accelerates, but becomes deflationary with expansion of zero marginal-cost energy
Climate impacts (climatflation)	Short, medium and long	Productivity and disruptive shocks from climate events will put pressure on prices but long-term trends could also destroy value over time

[13] N J Kurmayer, 'Germany reactivates coal power plants amid Russian gas supply threats', *Euractiv*, 2022.
[14] A Delfs, 'Germany to Wean Itself Off Russian Oil, Gas in Next 2 Years', *Bloomberg*, 2022.
[15] 'FACT SHEET: United States Bans Imports of Russian Oil, Liquefied Natural Gas, and Coal', White House, 2022.
[16] 'Biden Administration Announces Investments to Make Homes More Energy Efficient and Lower Costs for American Families', United States Department of Energy, 2022.
[17] 'President Biden Invokes Defense Production Act to Accelerate Domestic Manufacturing of Clean Energy', United States Department of Energy, 2022.
[18] Summary: The Inflation Reduction Act of 2022, Senate Democrats, 2022.
[19] I Schnabel, 'A new age of energy inflation: climateflation, fossilflation and greenflation', European Central Bank, 2022.

The fundamentals of the fossil fuel markets point to persistent inflationary pressures

The exposure in many countries to recent energy shocks has resulted in deeper reflection about the supply insecurities inherent in global energy markets, the ongoing reliance on fossil fuel-based energy, the price volatility it creates,[20] and the role of the energy transition in easing these tensions. For example:

- International Energy Agency (IEA) Executive Director, Fatih Birol, has stated: "This is not a renewables or a clean energy crisis; this is a natural gas market crisis … well managed clean energy transitions can help reduce energy market volatility and its impacts on businesses and consumers."[21]
- ECB President, Christine Lagarde, has stated the current inflationary concerns are a result of a "the dependency on a small and sometimes hostile number of suppliers of fossil energies."[22]
- The Biden Administration has stated: "In the long run, the way to avoid high gas prices is to speed up – not slow down – our transition to a clean energy future."[23]
- Australian Energy Security Board Chair, Anna Collyer, has stated the Federal Government's policy to bring forward investment in transmission infrastructure to encourage new renewable energy capacity "actually helps us to address at least one of the causes of the current situation, which is a reliance on a commodity that's subject to global pricing, which is both gas and coal."[24]
- Australian Energy Market Operator (AEMO) Chief Executive Officer, Daniel Westerman, has stated that the drivers on the current energy shocks "points to the long-term answer which is a transition to firmed renewables and transmission. That is the long-term answer to de-link us from international price shocks, as well as ageing infrastructure."[25]

While the peaks of the current price shock have been driven by some immediate disruption - particularly the conflict in Europe and increased demand following COVID-19 lockdowns - there are a range of factors inherent in fossil fuel markets and supply that can create long-run persistent inflationary concerns and underpin current concerns. These include:

- Existing fossil fuel electricity generation is now more expensive than most new and existing renewable energy with firming in many developed markets, including Australia.[26]
- Fossil fuels over time are becoming harder to extract as more accessible reserves are depleted, requiring more overall capital and research and development (R&D) spending to access them.[27]

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[20] W Boyd, 'The Shock of the Global', *Legal Planet*, 2021.
[21] F Birol, 'Europe and the world need to draw the right lessons from today's natural gas crisis', *LinkedIn*, 2022.
[22] *Central banks and the green transition: what's next?*, Bank for International Settlements, 2022.
[23] 'FACT SHEET: United States Bans Imports of Russian Oil, Liquefied Natural Gas, and Coal,' op. cit.
[24] D Crowe and M Foley, 'Energy crisis boosts case for renewables, top policy adviser says', *The Sydney Morning Herald*, 2022.
[25] 'Renewables key to avoiding future energy price shocks and shortages, market operator says', SBS News, 2022.
[26] P Graham et al., *GenCost 2021-22: Consultation draft*, Commonwealth Scientific and Industrial Research Organisation, 2021.
[27] K Bond et al., 'Reality Check: The Green Inflation Myth', Rocky Mountain Institute, 2022.

- The withdrawal and engagement of global capital,[28] higher carbon prices[29] and tighter environmental controls[30] further adding to the costs of new fossil fuel development.
- A narrow set of large export suppliers in some commodities who can at times artificially tighten markets and engage in cartel-like behaviour.[31]
- Increasing geopolitical tensions, retreating globalisation and growing international competition.[32]

In response, some research groups are now focusing on the long-term economic impacts of persistent inflationary pressures from fossil fuel commodity markets. For example, an influential recent paper by The Roosevelt Institute tracks the relationship between oil prices, economic volatility and inflation in the US.[33] They concluded the inherent dynamics of fossil fuel markets have long created persistent and volatile inflationary concerns, with oil and gas markets historically generating more pressures than electricity. The researchers further link energy price shocks and insecurity with macroeconomic conditions, identifying that 10 of the last 12 recessions in the United States were immediately preceded by an oil price spike. Importantly, The Roosevelt Institute notes that traditional monetary policy responses have limited effect on these fossil fuel-driven pressures and that, instead, energy and climate policy that accelerates the renewable energy transition is critical to achieving pricing stability mandates. Others, such as Generation Investment Management, have also detailed that nations primarily reliant on oil incomes are typically marked by lower economic growth and are less socially and politically free, arguing that Western dependence on oil is funding these conditions.[34]

The ECB have described these dynamics as fossilflation, with Executive Board member, Isabel Schnabel, stating it "reflects the legacy cost of the dependency on fossil energy sources, which has not been reduced forcefully enough over the past decades."[35] The relatively poor progress to date in the transition of energy systems off fossil fuels, including in Australia, has allowed suppliers to exert strong control over market conditions due to these commodities' central role in a range of economic activities and products. For example, Dolar has noted the embedded nature of oil in most consumer and industry products, and despite improving productivity of use, argues that its price is therefore a dominant factor in headline inflation.[36] The long-term interaction between fossil fuel commodity markets on inflation in Australia is relatively unexplored, however the broader interaction between energy markets, technology cost changes and monetary policy was flagged by former RBA Deputy Governor, Guy Debelle, in a 2019 speech as an area the Bank was "paying close attention to, given the importance of the cost of electricity in inflation both directly to households and indirectly as a significant input to businesses".[37]

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[28] A Good and B Holland, 'Path to net-zero: Investor pressure on oil, gas operators to cut emissions rises', *Standard and Poor's Global Market Intelligence*, 2021.
[29] E Heymann and S Becker, 'Energy price inflation – this time is different', Deutsche Bank Research, 2022.
[30] B Cahill, 'Biden Makes Sweeping Changes to Oil and Gas Policy', Centre for Strategic and International Studies, 2021.
[31] S Osaka, 'Inflation is at a 40-year high. Is clean energy the solution?', *Grist*, 2022.
[32] M Carney, 'Climate Policy is Macro Policy', Brookfield, 2022.
[33] L Melodia and K Karlsson, *Energy Price Stability: The Peril of Fossil Fuels and The Promise of Renewables*, Roosevelt Institute, 2022.
[34] *Fossil Fuels, the Economy and Instability: Why the world's dependence on fossil fuels hurts the economy and creates instability*, Generation Investment Management, 2022.
[35] I Schnabel, op. cit.
[36] V Dolar, 'Soaring crude prices make the cost of pretty much everything else go up too because we almost literally eat oil', *The Conversation*, 2022.
[37] G Debelle, *Climate Change and the Economy*, Reserve Bank of Australia, 2019.

The green energy transition will affect prices differently over different timescales

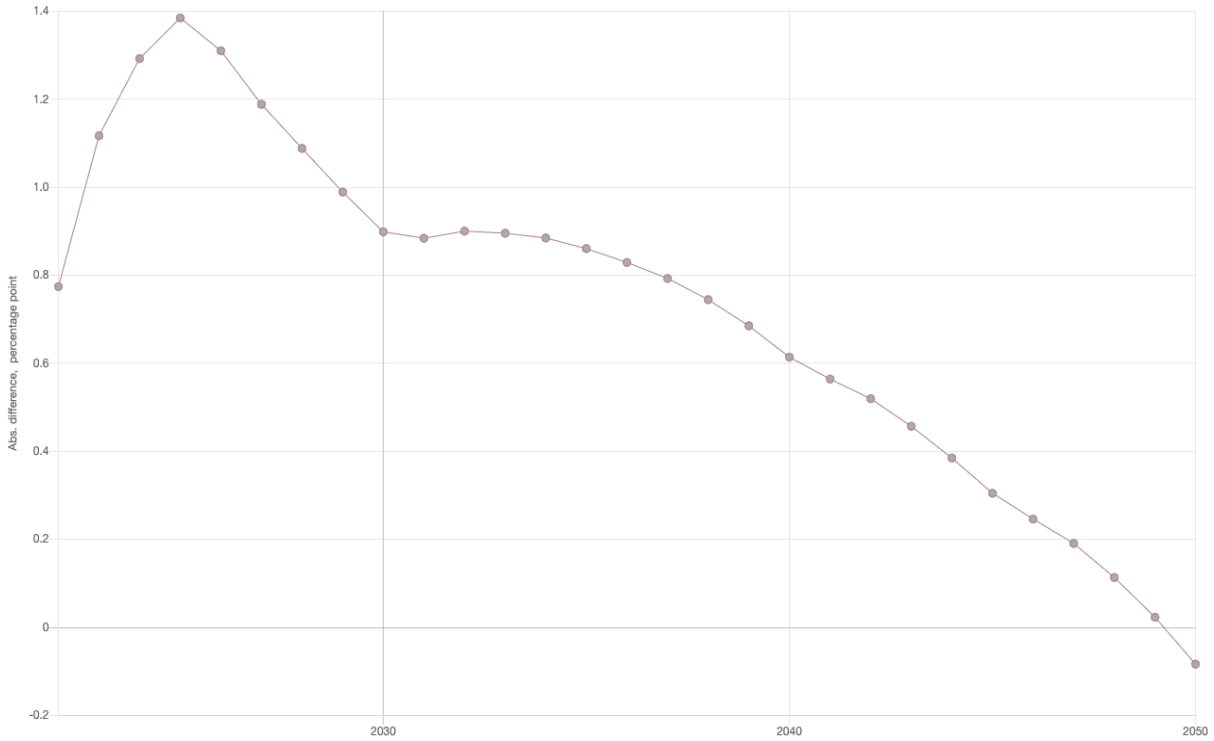
There is now a growing debate about what inflationary pressures may also be created by the response to climate change and efforts to rapidly decarbonise economies. Examples of this potential impact include: a surge in demand for minerals prevalent in green technologies; increased labour demand for the building of new energy and transport infrastructure; and the effect of policies that tax or price greenhouse gas emissions and how that revenue is cycled through the economy.[38] All of these potential causes have multi-faceted and interlinking dynamics and drivers that can affect pricing related to: the scale, cost and crowding of capital required; mismatches in production lags between source materials and manufacturing opportunities; a reliance on narrow supply chains; and changing expectations around production standards such as labour rights, environment impacts and local content goals. None of the issues have easy fixes and will require a significant and stable policy framework, planning and cross-sectoral coordination to get ahead of them.

Nevertheless, there are competing views about whether some of these dynamics - sometimes referred to as greenflation - will be a major phenomenon, particularly over the long-term. The ECB has characterised greenflation as transitory and medium-term, which will ultimately lead to the deflationary force of a renewable energy-dominated global energy supply.[39] This would see cost pressures build in the near-term as demand for materials and labour grows through an accelerated build of renewable energy and other clean energy infrastructure, but moves to a position where energy production has low fuel costs and zero marginal cost going forward.

The timeline for this cost pressure transition and whether it will be enough to affect headline inflation is also debated. Carney has detailed data from the Network of Central Banks and Financial Supervisors for Greening the Financial System (NGFS) that forecasts rises in headline inflation in the early-to-mid parts of the 2020s for the US and Europe under its Net Zero 2050 scenario,[40] but falling away from there. The headline inflation pressure in these scenarios is mostly attributed to explicit and implicit costs on carbon that would underpin the transition in policy settings and other pricing decisions.[41] The NGFS Net Zero 2050 scenario also forecasts a similar inflation pathway for an Australian transition.

[38] E Heymann and S Becker, op. cit.
[39] I Schnabel, 'Climate Change and Monetary Policy', *Finance & Development*, 2021.
[40] M Carney, op. cit.
[41] *Climate Change: An analysis of the NGFS Macroeconomic Scenarios*, National Institute of Economic and Social Research, 2020.

Graph: Australian inflation deviation under NGFS Net Zero 2050 projections



Source: NGFS Scenario Explorer using NiGEM NGFS 1.21 Net Zero 2050 (with REMIND-MAgPIE 2.1-4.2 inputs)[42]

An earlier and more orderly transition to net zero emissions will make any inflationary impacts of greening the global economy much more manageable than a late and disorderly transition, in which case competition for resources and labour would be more intense over a shorter time frame.[43][44] The BlackRock Investment Institute has stated: "The most effective way to contain inflation during the transition is to ensure the transition is gradual and orderly, so that supply can keep pace with shifting demand across sectors and higher energy costs can be absorbed over time."[45] Most commentators, including BlackRock and Carney, agree that any impact of greenflation also pales into insignificance compared to the likely pricing volatility and macroeconomic impact of worsening climate change (see next section).[46][47]

The cost impact of a green transition may also be more modest than forecast. Like many still-developing technologies, the unit price of renewable energy has been dropping rapidly. The price of solar has dropped almost 90 percent over the past decade, and the price of wind power has fallen by 70 percent.[48] With ongoing technological developments these costs are forecast to fall even further. As a result, the Rocky Mountain Institute, a US-based research group, have disputed whether greenflation will be a major phenomenon, noting that renewable energy is not a fuel but a technology which has an ongoing learning

[42] 'Australia inflation (Net Zero 2050)', NGFS Senario Explorer, 2022.
[43] D Smith, 'Will acting on climate change push up inflation – or would not acting be worse?', Institute of Chartered Accountants in England and Wales, 2021.
[44] M Carney, op. cit.
[45] E Bartsch et al., *A world shaped by supply*, BlackRock Investment Institute, 2022.
[46] M Carney, op. cit.
[47] E Bartsch et al., op. cit.
[48] M Roser, *Why did renewables become so cheap so fast?*, *Our World In Data*, 2020.

curve that will continue to lower costs.[49] Others, like Bloomberg columnist and CPD Fellow Kate Mackenzie, have also pointed to work by the International Energy Agency (IEA) and International Monetary Fund (IMF) showing some risks - such as forecast supply crunches for critical minerals - are overstated in their economic impact.[50]

Given the industrial and economic transition is so far not occurring at a pace consistent with modelled net zero pathways for 2050, greenflation remains to date a more hypothetical proposition unlike the observable pressures created by fossil fuels and intensifying climate change impacts. Where greenflation does exist as a result of the transition it may be important for policymakers to draw a distinction between relative and overall price movements to account for the optimal resource allocation of market-based policy mechanisms, especially as the inflation deviation modelled in net zero scenarios is predominantly a function of assumed carbon prices in the economy. However, greenflation-like pressures may still be created in slower transitions as a result of poor policy settings, production lags, supply chain bottlenecks or changing market drivers such as the recently observed surge in electric vehicle[51] and rooftop solar panel[52] demand due to rising fossil fuel energy prices, albeit with unclear implications for headline inflation and macroeconomic conditions.

Shocks associated with climate change risks will create long-run inflation volatility

The ECB and other commentators have also pointed to the much larger set of inflationary risks that are being created by the shocks and trend changes associated with worsening climate change, sometimes referred to as climatflation. Several short-, medium- and long-term effects have been identified, including: lost labour productivity and supply,[53] lost food production,[54] temperature shocks,[55] supply chain disruption,[56] valuation destruction[57] and rising cost of insurance premiums.[58] For example, worsening extreme weather events like intensifying hurricanes or bushfires may more frequently destroy crops, raising headline CPI via food prices, at least temporarily, as was the case with lost banana crops due to Cyclone Yasi in 2011.[59] The evidence for this interaction between climate change shocks and inflation volatility is supported by a number of actors including the Bank of England (BoE),[60] BlackRock[61] and the Asian Development Bank.[62] Climate-related inflation volatility is already occurring to some degree and is

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[49] K Bond et al., op. cit.
[50] K Mackenzie, 'The world is short of time and not minerals for climate action', *Mint*, 2022.
[51] B Schmidt, '"Best month ever:" EV sales take off as interest in going electric surges', The Driven, 2022.
[52] W Mathis, 'Energy Crunch Spurs 'Insane' Rush for Industrial Rooftop Solar', *Bloomberg*, 2020.
[53] S Dasgupta et al., 'Effects of climate change on combined labour productivity and supply: an empirical, multi-model study', *The Lancet Planetary Health*, 2021.
[54] C Lesk et al., 'Influence of extreme weather disasters on global crop production', *Nature*, 2016.
[55] K Mukherjee and B Ouattara, 'Climate and monetary policy: do temperature shocks lead to inflationary pressures?', *Climate Change*, 2021.
[56] D Super, 'To fight inflation, we must fight climate change', *The Hill*, 2022.
[57] F Drudi et al., *Climate change and monetary policy in the euro area*, European Central Bank, 2021.
[58] G Cockburn, 'RBA, APRA warn of rising costs to insurance from climate change', *The Canberra Times*, 2021.
[59] G Debelle, op. cit.
[60] S Batten et al., 'Climate change: Macroeconomic impact and implications for monetary policy', *Ecological, Societal, and Technological Risks and the Financial Sector*, Palgrave Macmillan, 2020.
[61] P Hildebrand et al., *Climate change – Turning investment risk into opportunity*, BlackRock Investment Institute, 2021.
[62] Y Elhan-Kayalar, 'One Way to Address Inflation: Take Action on Climate Change', Asian Development Bank, 2021.

"already starting to bear on the primary mandate of central banks" albeit with a limited impact in developed economies like Australia.[63]

In the long-run, the ECB and others forecast that the compounding frequency and severity of these climate shocks may also apply a further "dampening force" on the underlying natural rate of interest (*r**) – a figure representing economic growth. As high temperatures and weather events increasingly wipe out capital stock, revenues will be diverted from innovation to reconstruction and adaptation in order to maintain existing output. Likewise, households and firms facing an uncertain climate will increasingly engage in precautionary saving. These factors, among others, will pull funds away from investment, contributing to the already-low growth rates observed in developed economies.[64] ANZ Chief Economist Richard Yetsenga has therefore argued that irrespective of short-term shocks, the overall impact of climate change will be more likely deflationary.[65] The ECB and former BoE Chairman Mark Carney have stated this effect would be counterbalanced by increased investment and productivity driven by the net zero transition and green technologies,[66] and it is unclear how these opposing forces may interact and which might prevail.

It is therefore perhaps better to consider climatflation as a highly volatile and variable set of pressures that increase the likelihood and frequency of overlapping short-term shocks, destroys long-term value, and diverts otherwise productive capital. The ECB argues this impact will make traditional monetary policy in the Eurozone less effective in responding to immediate inflationary pressures, challenging the financial stability mandates of central banks. The ECB has also found that climatflation may have a more limited aggregate impact on advanced countries in the near-term albeit with some balancing from offsetting movements in food prices and core inflation.[67] The BoE has found developing countries with less established central banks and monetary policy architecture will face larger pressures.[68] In Australia, there has been less dedicated work to identify the future implications of climate change on pricing stability. But Debelle[69] and McKibbin and Panton[70] argue climate impacts, mixed with the transitional and policy impacts, at a minimum will make inflation forecasting in Australia more difficult because these once cyclical shocks may take on more permanent features through trend changes, and the ability of the economy to respond to these shocks is uncertain.

Responding to energy-fuelled inflation and preventing future pressures

While traditional monetary policy may be able to address part of the inflationary pressures Australia currently is experiencing, such as post-COVID demand, its impact on energy shock components may be limited due to their global and supply-side nature. Instead, short-term responses will also need to come from other policy areas and focus on those factors that can provide an immediate relief to the most vulnerable, such as bringing existing electricity generation capacity back online, promoting readily available efficiency measures such as avoided use or temporary consumer price alleviation through government budgets. These all have trade-offs including for Australia's fiscal position and the stability of

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[63] D Faccia et al., 'What we know about climate change and inflation', Vox EU Centre For Economic Policy Research, 2021.
[64] *The Implications of Climate Change for Financial Stability*, Financial Stability Board, 2020.
[65] R Yetsenga, 'The Climate & Deflation', ANZ Institutional Banking, 2019.
[66] M Carney, op. cit.
[67] F Drudi et al., op. cit.
[68] S Batten et al., op cit.
[69] G Debelle, op. cit.
[70] W McKibbin and A Panton, 'Twenty-five Years of Inflation Targeting in Australia: Are There Better ALternatives for the Next Twenty-five Years?', Reserve Bank of Australia, 2018.

the energy market, and do not represent the systemic change needed to establish a more resilient position against climate and energy inflation volatility.

In pursuing a short-term response to energy pricing shocks, governments, regulators and industry will also need to avoid responses that lock-in further carbon-intensive activity and risk contributing to further medium- and long-term inflationary pressure through worsening climate change and entrenching fossil fuel fundamentals. In particular, the IEA has warned that short-term measures must not be pursued in a way that disrupts a clean energy transition that will ultimately produce a more resilient system:

"It is legitimate for countries to take emergency measures such as temporary relief from some taxes or charges to ease the burden on consumers, especially the most vulnerable, from periods of short-term market turmoil. But these measures should be implemented in such a way that they do not worsen the investment environment for low-carbon energy sources and technologies – such as renewables, energy efficiency, electricity grids, nuclear power and sustainable biofuels – which are vital for the transition to cleaner and more resilient energy systems."[71]

The World Bank has also noted that some short-term measures in response to previous energy shocks have also led to perverse outcomes:

"For example, price controls in the United States after the first oil price shock in 1973 distorted markets and may have increased oil demand. The promotion of coal use for electricity generation in the late 1970s reduced reliance on oil; however, it created environmental problems, including air pollution and the acceleration of climate change."[72]

There are a range of policy areas that have direct relevance to the response to current circumstances, would build system stability, contribute to climate goals and enhance resilience of homes and industry. Importantly, these policy responses exist both on the supply and demand side of the energy equation, but will mostly require significant design and implementation time, and coordination between different levels of government, industry, civil society and beyond. As AMP Capital has concluded: "The government has little direct influence over the short-term supply issues in the energy market, besides imposing 'caps' on wholesale prices or limiting gas exports. Longer-term, the influence of the government is important in determining a smooth transition from coal-powered energy to a larger share of renewable energy."[73]

Monetary policy

Monetary policy is the traditional lever for managing inflation. As noted above, however, financial actors in Europe and the US have suggested that the inflationary impact of fossil fuel markets and climate change may increasingly fall outside the reach of traditional monetary policy.[74] While McKibben et al. have indicated that if monetary policy responds to the inflationary component of climate policy and/or shocks alone it could lead to larger output losses.[75] The ECB and the BoE, among many others, have recognised the need for central banks to understand and, where possible, address these pressures in order to continue fulfilling their pricing stability objectives. The ECB, BoE and others have also identified several climate-related incapacities of conventional monetary policy. These include:

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[71] C F Alvarez and G Molnar, 'What is behind soaring energy prices and what happens next?', International Energy Agency, 2021.
[72] *Commodity Markets Outlook: The Impact of the War in Ukraine on Commodity Markets*, World Bank Group, 2022.
[73] D Mousina, op. cit.
[74] J Woolley, 'Forget greenflation, central banks need to tackle fossilflation', Green Central Banking, 2022.
[75] W McKibben et. al., 'Climate change and monetary policy: issues for policy design and modelling', Oxford Review of Economic Policy, 2020.

- *The tendency for central banks to perceive supply shocks as short-run events.* The common monetary response is to "look through" such shocks with the expectation that prices will self-stabilise. Increases in the frequency of climate-related supply shocks and the persistent impacts of fossiflation will push price shocks into the medium-long term, beyond the envelope of conventional monetary policy.[76]
- *Subdued long-term growth limiting central banks' monetary response options.* Long-term protracted low real interest rates (r*), which will be exacerbated by climate change-driven value destruction, will hamper central banks' abilities to effectively respond to short-run shocks via the conventional method of adjusting interest rates.[77]
- *Limitations in General Equilibrium models.* Traditional equilibrium models are favoured by central banks for their simplicity,[78] which typically predict the behaviour of an individual consumer or firm, which is assumed as rational, informed, and 'representative' of the macroeconomy. The BoE, ECB and the Bank of International Settlements, among others, have argued that these models may lack the granularity and nuance required to effectively respond to climate shocks, which are often highly region- and industry-specific, and will require adjustments and development,[79] or a "suite of models" and other multi-disciplinary approaches.[80]

Central banks in places like Japan and China have also made statements about how monetary policy may require change to address the implications of fossiflation, energy transition and climate change. The NGFS has also discussed specific monetary policy responses to climate issues, recognising that each requires significant tradeoffs between emissions mitigation, monetary policy effectiveness, risk protection effectiveness and operational feasibility.[81] Alongside the inflationary impacts of energy markets and climate change itself, there are also potential implications of traditional money policy for the pace of the clean energy transition.[82] These concerns have emerged because many clean technologies have relatively intense upfront capital needs. Moves to lift interest rates in response to inflationary concerns, therefore, would raise the cost of finance and debt for the transition. Egli et al. have found that general interest rates may increase renewable energy's relative cost to the extent that it slows its deployment, meaning other policy support such as subsidies will be required.[83] Where these traditional monetary responses of lifting interest rates are being further driven by fossil fuel fundamentals and climate shocks, a negative cycle would emerge where the solutions to these concerns will be made harder by the response to the root cause.

In response to these various concerns, some solutions proposed by various actors include, but are not limited to:

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[76] F Drudi et al., op. cit.
[77] ibid.
[78] S Batten et al., op. cit.
[79] P Bolton et al., *The green swan: Central banking and financial stability in the age of climate change*, Bank for International Settlements, 2020.
[80] L Boneva and G Ferrucci, *Inflation and climate change: the role of climate variables in inflation forecasting and macro modelling*, International Network for Sustainable Financial Policy Insights, Research, and Exchange, 2022.
[81] F Elderson and S Mauderer, *Adapting central bank operations to a hotter world Reviewing some options*, Network of Central Banks and Supervisors for Greening the Financial System, 2021.
[82] F Egli, 'Central banking and the transition', *Sustainability Community*, 2022.
[83] F Egli et al., 'A dynamic analysis of financing conditions for renewable energy technologies', *Nature Energy*, 2022.

- *Financial backing of green loans and investments*. In 2021 the Bank of Japan (BoJ) applied its existing "fund provisioning measure" monetary policy to encourage financial institutions to increase their green portfolios.[84] The BoJ provides interest-free funds to banks that make green loans, replenishing their balance sheets. This is intended to ease the risk burden of long-run green investment, with the policy guaranteed to run until 2030 at the soonest.[85] The PBoC has followed the BoJ with its own version of this policy.[86]
- *Green Quantitative Easing (QE)*. This concept proposes a shift in how central banks purchase assets. Rather than increasing the money supply by buying standard government/corporate bonds, central banks would replace their mature assets with "environmental bonds" that finance climate-forward projects and industries.[87] Recent modelling has demonstrated the potential for green QE to influence the relative share of dirty and clean production in an economy, however fiscal levers such as carbon pricing remain significantly more effective.[88] Hence, green QE may not be worth pursuing in the absence of clear fiscal signals.[89]
- *Green inflationary targeting, nominal income targeting and dual interest rate signals.* Different models have been discussed which suggest central bankers should change their inflation targeting strategy to account for climate shocks and/or policy impacts, such as: adopting a moderately higher inflationary target, perhaps temporarily, to account for transition costs; be prepared to 'look through' or exclude clean energy-driven inflationary pressures from targeting;[90] or adopt dual pricing signalling where interest rates rise for some industries but are offset for green activities with the measures noted in the two dot points above.[91] McKibben et. al. have argued that nominal income targeting may be a better alternative given the increased difficulties in inflation forecasting in a climate-affected world.[92]
- *Mandatory disclosure of climate risk*. Central banks will not be able to implement mandatory reporting of climate risk into the market unless they also act as a financial regulator, such as in China.[93] In Australia, a mandatory disclosure regime will require legislation and adoptive measures from other financial regulators.[94] However, while disclosure is normally conceived as a market disclosure exercise that can help change the relative value of assets based on their carbon-intensity, the information that will emerge under such a regime will also be important for central banks and other regulators to better assess and track climate and energy pricing volatility risks.[95] Central banks therefore have an important and self-interested role in helping set market expectations on disclosure standards through advocating for robust regimes that produce time critical and credible information and by demonstrating good practice with their own disclosure.

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[84] *Climate Change Initiatives: Disclosure Based on TCFD Recommendations*, Bank of Japan, 2022.
[85] *Statement on Monetary Policy*, Bank of Japan, 2021.
[86] G Caswell, 'PBOC plans green credit facility', Green Central Banking, 2021.
[87] P Grauwe, Green money without inflation, *Vierteljahrshefte zur Wirtschaftsforschung*, 2019.
[88] R Abiry et al., *Climate Change Mitigation: How Effective is Green Quantitative Easing?*, Centre for Economic Policy Research, 2022.
[89] L Boneva et al., *To be or not to be "green": how can monetary policy react to climate change?*, European Central Bank, 2021.
[90] I Schnabel, op. cit.
[91] S Jourdan and R van Tilburg, 'The ECB can help fix the energy price crisis: Play the long game', *Energy Monitor*, 2022.
[92] W McKibben et al., op. cit.
[93] *Green central bank policy: People's Bank of China (PBoC)*, CBA Economic Insights Global & Market Research, 2021.
[94] *Confusion to Clarity: A plan for mandatory TCFD-aligned disclosure in Australia*, The Investor Agenda, 2021.
[95] *Report on Promoting Climate-Related Disclosures*, Financial Stability Board, 2021.

Underpinning several proposed changes to the way central banks respond to climate and energy-driven pricing instability is growing debate around the relevance and definition of 'market neutrality' as a guiding principle behind monetary policy.[96] Senior voices in central banking have argued that the 'market neutrality' ideal may need to be set aside, reinterpreted, adapted or be replaced by a philosophy of industry-specific market interventionism to fulfil pricing stability mandates. This approach would have central banks play a more 'hands on' role in the net-zero transition, actively tilting markets in favour of green industry to ensure that the true climate costs of carbon-intensive assets are adequately priced into the market. Some commentators have argued that non-neutrality would jeopardise the mission of central banks, and that by remaining 'apolitical', central banks ensure fair competition.[97] However, Haruhiko Koruda, Governor of the BoJ, has argued that the long-term mitigation of climate-induced price fluctuations does fall within central banks' mandates, and that true market neutrality can only be maintained if climate-harming 'negative externalities' are factored into asset valuations.[98]

Renewable energy deployment

There is a growing body of evidence demonstrating that a rapid and wide-scale deployment of renewable energy generation can have a deflationary impact on energy prices over the short- and long-term. Recent commentary and studies include:

- ECB President Christine Lagarde has stated that while the decarbonisation transition may have transitional inflationary elements (greenflation), the Bank's published evidence suggests a long-term expansion of renewable energy capacity would reduce prices "and we will have lower inflation pressure going forward."[99]
- Bloomberg New Energy Finance has observed an ongoing and immediate deflationary impact on wholesale power prices in Australia because of increasing renewable energy penetration into the NEM.[100]
- Bednář et al. have demonstrated in the Eurozone context that the presence of a larger share of renewable electricity sources proves to be associated with lower inflation, and deflation.[101]

Policies that accelerate the deployment of renewable energy supply across the energy system, therefore will offset more expensive fossil fuel energy supply over the long-term and, once built, can address fundamental fossil fuel-related inflationary pressures. Over the long-term, the variability of supply and low wholesale prices generated by renewable energy-penetration may also create such value deflation for operators that it provides a disincentive to further investment in new generation. An equal focus on response capacity - interconnectors, demand response, storage, and backup supply to maintain reliability standards - has been identified as providing a likely counterbalance to this[102] although further policy and operating rule changes in electricity markets would also likely be required.[103] Carney[104] and the Roosevelt

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[96] I Schnabel, op. cit.
[97] 'The rights and wrongs of central-bank greenery', *The Economist*, 2019.
[98] H Kuroda, *The Bank of Japan's strategy on climate change*, Japan National Press Club, 2021.
[99] *Central banks and the green transition: what's next?*, op. cit.
[100] L Quong and S Sood, 'Deflationary force of renewables shown in Australia power market', Bloomberg New Energy Finance, 2021.
[101] O Bednář et al., '*Energy Prices Impact on Inflationary Spiral*', *energies*, 2022.
[102] *The Future of the Electric Grid*, Massachusetts Institute of Technology, 2011.
[103] ibid.
[104] M Carney, *Climate Policy is Macro Policy*, Brookfield, 2022.

Institute[105] have therefore recently cast energy and climate policy as a pillar of macroeconomic policy, given it is likely to have more influence on long-term pricing and economic growth.

Electrification and energy productivity

The Australian debate about recent energy price shocks has to date focused overwhelmingly on the supply side of the equation. However, there are significant opportunities on the demand side of the energy system that can also help shield households and businesses from energy price instability, reduce exposure to the supply-side inflationary shocks of fossilflation and continue to drive carbon abatement.

In some markets where energy productivity action is more advanced, it is clear that rising energy costs are having less impact on headline CPI. For example, Sveriges Riksbank has indicated that despite an approximate doubling of energy costs in Sweden over recent decades, the proportion of electricity costs in the standard CPI basket has remained consistent as consumers have switched to more energy efficient homes, appliances and cars.[106] The IEA has stated that a further one-third improvement in global energy efficiency is possible by 2030,[107] provided that active steps are taken to ensure that growth in supply of clean energy outpaces growth in energy demand. One such recent step was taken in the US, where a 'National Initiative to Advance Building Codes' aims to incentivise energy-efficient building design.[108] The IEA has also flagged the cessation of fossil-fueled boiler sales and installation of heat pumps as further near-term measures that would help shield consumers from the instability of fossil energy prices.[109]

This focus on weaning households (and, where possible, industry) off gas consumption is also gaining traction among jurisdictions globally. For example, Austria has announced a ban on gas connections to new buildings from 2023.[110] Similarly, gas connection requirements have been removed in the Australian Capital Territory[111] as part of its plan to phase out natural gas by 2045,[112] and Victoria has recently announced a gas substitution roadmap.[113] From a pricing stability and inflation perspective, these electrification policies could be justified given the overall long-run deflationary nature of renewables and the findings of The Roosevelt Institute that suggest electricity markets have more pricing stability than oil and gas, albeit in the US market.[114]

Addressing climate-related inflation with trade, fiscal and other macroeconomic policy

A broader set of economic policies will also be critical to addressing the economic and pricing stability driven by fossil fuels and other climate-related factors in so far as they accelerate the transition to clean energy and help crowd in necessary investment. In particular, Birol has stated that "unless governments sit in the driving seat and mobilise major funds to create a clean energy transition we will have to deal

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[105] L Melodia and K Karlsson, op. cit.
[106] *Commodity Markets Outlook: The Impact of the War in Ukraine on Commodity Markets*, op. cit.
[107] *Energy Efficiency 2021*, International Energy Agency, 2021.
[108] 'FACT SHEET: Biden-Harris Administration Launches Initiative to Modernize Building Codes, Improve Climate Resilience, and Reduce Energy Costs,' op. cit.
[109] *Energy Efficiency 2021*, op. cit.
[110] I Todorović, 'Austria to ban gas boilers in new buildings in 2023', *Balkan Green Energy News*, 2022.
[111] 'Now we're cooking with … electricity! Gas no longer a requirement in Canberra suburbs', ACT Government, 2020.
[112] 'Gas-Free ACT', Conservation Council ACT Region, 2022.
[113] *Victoria's Gas Substitution Roadmap*, The State of Victoria Department of Environment, Land, Water and Planning, 2022.
[114] L Melodia and K Karlsson, op. cit.

with extreme volatility in energy.[115] The widespread deployment of renewable energy across the system will require significant upfront capital that some authors argue will require direct government policy to catalyse and coordinate both public and private investment at scale.[116]

This paper does not have the space to consider the broader scope of options here, but they span carbon pricing, market rules (such as mandatory disclosure), tax incentives and other subsidies, with packages of all having been found by the IMF as having complementary macroeconomic impacts.[117] The Group of Thirty (G30) - an independent global body of economic and financial leaders from the public and private sectors and academia - has argued governments must take steps to ensure its policy on climate is both predictable and credible to influence the necessary change across finance and the private sector.[118] The large scale of investment required for the full transition, and the long lead times that are often involved, mean that policy needs to give as much clear insight into future demand and pathways as possible to provide the necessary platform for decision makers to initiate the relevant scale of activity. Policy steps recommended by the G30 include: communicating the goals of climate policy clearly; command broad political support; build a track record of action; and delegating decisions to independent institutions (learning from the experience of establishing central banks). The G30 recommends government policy contain the following elements:

- Carbon prices that increase in a gradual and predictable way.
- Complementary public funding for low-carbon infrastructure and R&D; as well as targeted environmental regulation.
- Ensuring the benefits of the transition to net zero are shared equitably.
- Converging the level of national strategy ambition over time to support an efficient global response to climate change, with “carbon border adjustments” allowing leading countries to pursue more ambitious targets while avoiding carbon leakage.
- Multilateral and national development banks, development finance institutions, and the IMF, working to reduce the cost of capital for sustainable projects in developing countries, including sharing project risk and collaborating with local governments.

Furthermore, consideration across trade and economic development policy is also required to try to avoid replicating the existing inflationary dynamics of fossil fuel markets, such as cartel behaviour or wide exposure to geopolitical tensions, in new clean energy systems. For example, Birol has flagged that it is important that a similar concentration of suppliers in critical minerals relevant to the clean energy transition do not emerge. “Potential energy security vulnerabilities do not disappear in a renewables-rich and more electrified energy system. Policy makers need to pay close attention to new clean energy supply chains, in particular the geographical concentration of many critical minerals – such as lithium, cobalt and rare earth elements – that are crucial components of many clean energy technologies.”[119] At the recent Sydney Energy Summit, Birol also highlighted China’s dominance of the solar supply chain, saying it was currently responsible for 80 percent and on track to capture 95 percent by 2025.[120] Some like Sharma have observed that Russia and Ukraine are larger suppliers of critical metals used to manufacture

[115] D Sheppard, ‘Russia may cut off gas in winter, IEA warns Europe’, *The Australian Financial Review*, 2022.
[116] M Mazzucato, *Financing the Green New Deal*, Nature Sustainability, 2022.
[117] ‘Chapter 3 Mitigating Climate Change—Growth-and Distribution-Friendly Strategies’, *World Economic Outlook 2020*, International Monetary Fund, 2020.
[118] *Mainstreaming the transition to a net-zero economy*, Group of Thirty (2020).
[119] F Birol, op. cit.
[120] S Paul, ‘U.S., IEA urge Asian countries to diversify energy supply chains’, *Reuters*, 2022.

products like solar panels, electric vehicles and wind turbines,[121] again underscoring the potential for outsized supply impacts from geopolitical disruption with concentrated sources of supply. However, these concerns may again be more transitory than permanent, as many of the supply issues relate to resources required for initial construction of long-standing assets needed in the shift from fossil fuels to renewables, rather than as a consumable in ongoing production, albeit with some replacement and maintenance needs.

Long-term consideration of where and how the necessary components of green technology are sourced and made will be critical for Australia being able to pursue a more orderly transition that limits future price volatility, with implications for domestic industry development and trade agreements. There are multifaceted policy and industry responses required to accelerate supply chain diversification across finance, social licences issues and regulatory approvals. It will also require a proactive use of foreign and trade policy that is externally-focused, looking to leverage existing multilateral architecture and is seeking to coordinate with global partners to pursue efficiency and diversity of supply.

The recent Sydney Energy Summit recently identified several actions that could strengthen supply chains in this regard including:

- Accelerating project investments and partnerships that expand and diversify the supply of critical minerals and other key materials.
- Accelerating industry partnerships and R&D deployment to expand and diversify manufacturing capacity for key products.
- Increasing transmission grid connections within and between countries to support the scaling of renewables.
- And supporting partnerships and making investments that accelerate research, development, deployment and commercialisation of key emerging technologies.[122]

However, given the lack of ongoing fuel needs and the lower interaction to volatile foreign markets, a transition to a renewables-dominated energy supply, electrification and greater energy productivity can help establish a more stable political economy over time.[123]

Further reading

- The Roosevelt Institute (2022) - Energy Price Stability: The Perils of Fossil Fuels and the Promise of Renewables
- Mark Carney (2022) - Climate Policy is Marco Policy
- Isabel Schnabel (2022) - A new age of energy inflation: climateflation, fossilflation and greenflation
- Bank of International Settlements Green Swan 2022 Conference panel (2022) - Central banks and the green transition: what's next?
- Philipp Hartmann et al. (2022) - Central banks, climate change, and economic efficiency
- Group of Thirty (2020) - Mainstreaming the transition to a net-zero economy
- Warwick McKibbin, Adele Morris and Augustus Panton (2020) - Climate change and monetary policy: issues for policy design and modelling

[121] V Sharma et al., 'Russia and Ukraine are important to the renewables transition. Here's what that means for the climate', *The Conversation*, 2022.
[122] *Sydney Energy Forum: outcomes*, Australian Government, 2022.
[123] L Melodia and K Karlsson, op. cit.