

Energy Transition Outlook

A New Energy Disorder: Resetting the energy transition agenda

July 2022

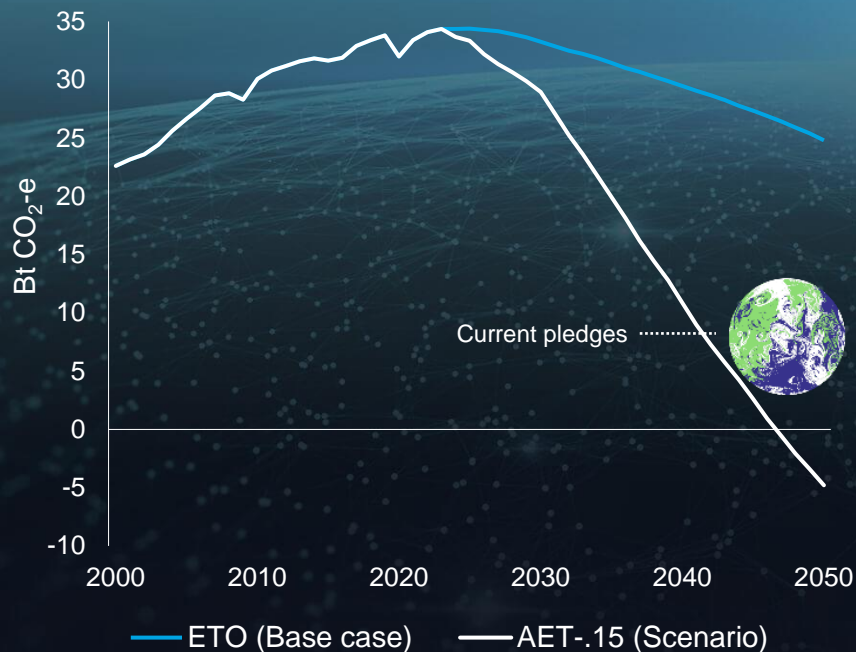




Wood Mackenzie's Energy Transition Outlook

Strong policy action and technology development will be required to reach the goals of the Paris Agreement

Global energy-related CO₂ emissions (net)



Scenario	Trajectory	Policy	Enablers
Energy Transition Outlook (WM ETO)	Consistent with 2.5 °C global warming	Evolution of current policies and aligns with SPOs released in Q1 2022	Steady advancement of current and nascent technologies
1.5 °C Scenario (WM AET-1.5)	Consistent with 1.5 °C warming (Global net zero emissions by 2050)	Aligned with most ambitious goal of Paris Agreement	Early peak energy; rapid hydrogen and carbon removal deployment; consumer shift



Key metrics

Risers and fallers



- Fossil fuel use in total energy peaks in 2032; oil demand begins to plateau in 2030s; gas growth continues until 2040
- Fossil fuel has a 60% share of generation today, but will fall to 30% by 2040



- Low carbon hydrogen reaches 5% of energy demand by 2050. Green hydrogen costs fall around 75% by 2050; blue hydrogen costs decline by around 8% due to gas and carbon costs.
- Battery costs to reach US\$100/kWh mark by 2028, but supply chain challenges increase costs near term.



- Energy emissions peak in 2026, placing the world on a 2.5 °C warming pathway
- Emissions markets increased 50% with China's ETS launch. Average global carbon price hit US\$25/t in H1 2022 in markets where it is priced. Cumulative CCS capacity to reach 1.8 Bt in 2050



- Wind and solar share of power output rises to 50% by 2050, and that of hydro and nuclear falls to 20%, from 25%
- Total renewables - wind, solar, nuclear, and hydro - reach 69% in output by 2050. Gas 16%, coal 12%



- Electric vehicle stock to reach 978 million units by 2050 from 17 million units in 2021
- EVs will save 14.4 million b/d oil demand by 2050, about 50% more than the gains provided by ICE efficiency



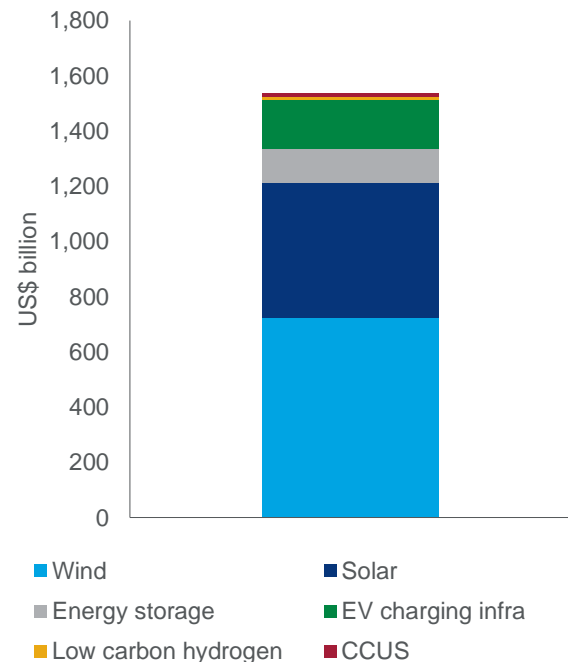
- Over US\$1.3 trillion a year needed to build new energy supply capacity
- As renewables expand and hydrocarbons plateau, infrastructure spend, and decommissioning costs will increase



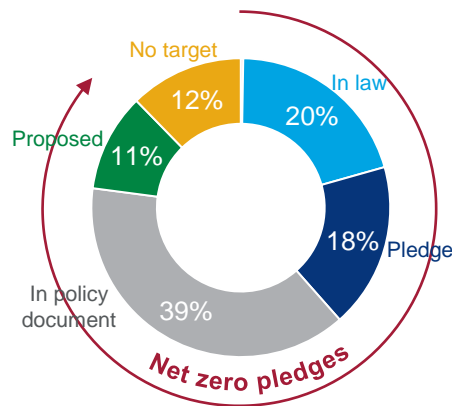
New energy investments will continue to accelerate driven by policy goals, economics, and investors

We expect ~USD\$1.5 trillion in new energy capex through 2025 – and policies such as REPowerEU could push capital investment higher

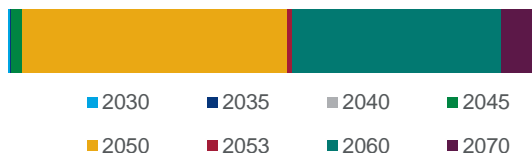
Total global new energy capex by technology, 2022-2025



Proportion of 2020 CO₂ covered by net zero emissions targets



By net zero target year:



GFANZ approach to energy sector funding



Does not recommend divestment from fossil fuels



Phase out high carbon investments



Steward and engage with companies to transition business models



Invest in decarbonization and renewable energy



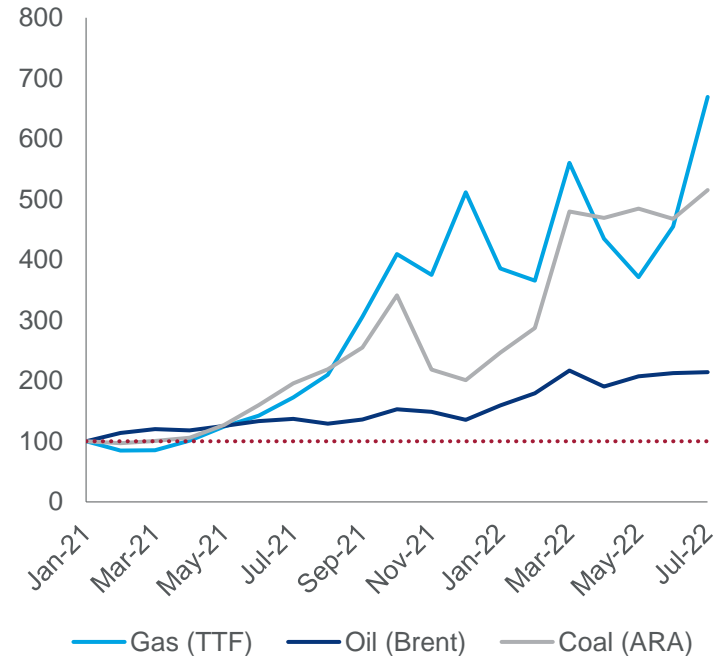
Implications

1

Energy security and price affordability will drive the next phase of the energy transition

- Russia's invasion of Ukraine has ushered in a crisis of unprecedented scale on the global economy. The war is having previously unimaginable consequences for energy and commodity markets. Oil is trading above US\$100/bbl and diesel has been at record premiums to crude, while global gas/LNG and coal prices are at an all-time high of up to four times their previous 10-year average. The price surge is a direct result of self-sanctioning and fears of supply loss.
- War has catapulted energy security and price affordability at the very top of the political agenda. Countries with domestic hydrocarbon resources will look to fast-track production, complicating decarbonization efforts at least in the near-term. In the longer-term, however, the rationale of energy security and climate goals could converge, accelerating the energy transition; keeping this mind, many are restructuring policies to increase investment in low-carbon sources, even as tighter supply chains threaten to push up costs.
- As Russia pivots to the east, a rewiring of energy trade is underway. China and India will look to benefit from discounted Russian imports, but they will also want to protect their access to European and US markets. Much of Asia is also tied to net-zero goals so expect them to follow the west in developing and adopting low-carbon energy supplies.

Spot price trends (index Jan 2021 = 100)





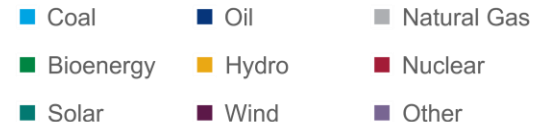
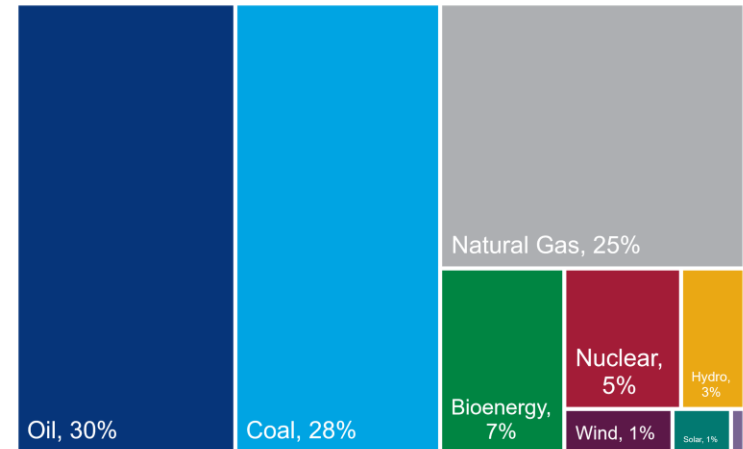
Implications

2

The energy transition will take a detour, but the fundamentals for decarbonisation remain in place

- Hydrocarbons contributed over 80% of total primary energy demand in 2021. Existing infrastructure and industries are carbon intensive and have many years of useful life. Therefore, a significant decline in fossil fuels use will require a rapid scale up in low carbon supply and strong policy push to increase investment.
- Government focus in the near term is to alleviate supply shortages and reduce energy prices. As a result, more investment will go in to increasing the supply of hydrocarbons because that's the quickest pathway to ramp up production and overcome years of underinvestment. A flurry of new technologies are in different stages of development and will be available at a lower cost than fossil fuels in the next decade (see next slide).
- In this base case outlook, we expect the share of fossil fuels to decline from 80% in 2021 to 66% by 2050, with a bulk of the decline occurring post 2030. However, this will not be enough to deliver a global net zero by 2050 which requires the fossil fuels share to fall further reaching 40% by 2050.

Total primary energy demand by fuel type, 2021





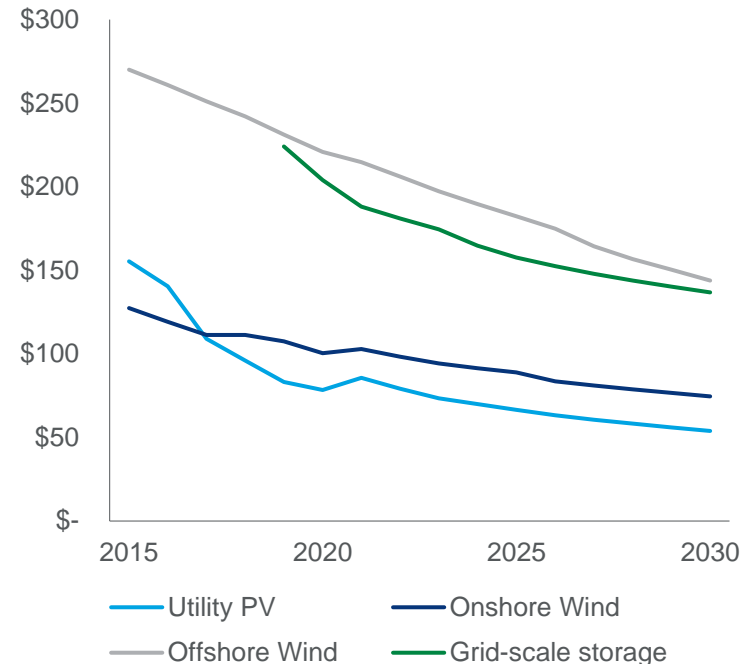
Implications

3

Supply chain issues are impacting every sector of the economy and will take time to resolve

- The Covid-19 pandemic unsettled the logic of just-in-time inventory management for business and consumers. Supply chain issues continue to exacerbate the availability of basic goods as well as critical items for industrial production globally. High commodity prices and rising cost of capital worsen supply chain risks and add to inflationary pressures. Costs have increased 3-5 times across energy and agriculture commodities since January 2020.
- Much can be done to reduce supply chain disruptions: companies could reshore production, diversify suppliers or better coordinate with direct suppliers, and expand technology options to meet demand. Another approach is to stock more inventory. For decades, companies prioritised lowest cost denominators and focused on just-in-time sourcing. But the approach has revealed its weaknesses because it makes supply chains fragile and prone to risks; especially when those are stretched across the world with increasing rough weather and tumultuous geopolitics. Moreover, some governments are waking up to the fact that they are reliant on a single market – China – for manufacturing and raw materials required for the energy transition.
- The current situation is particularly precarious as world recovers from the Covid-19 pandemic and government balance sheets are stretched, with debt/GDP ratio up by 10-20% in many markets. While there is ample scope to lower cost of new technologies in the future, debottlenecking supply chain risks and permitting new supply will take time. Governments have a delicate balancing act to manage near-term energy supply issues vs. long term climate goals.

RE technologies LCOE, US\$/MWh





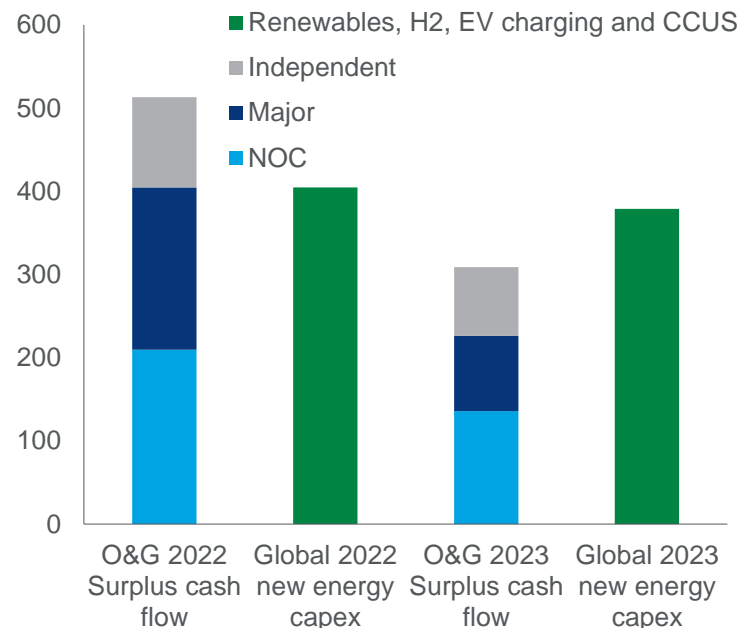
Implications



Capital allocation is uncertain, investors cannot ignore transition risks

- Soaring oil and gas prices present a tremendous opportunity to accelerate decarbonisation and low carbon strategies. We estimate the sector to generate US\$450 billion surplus cash flow in 2022 alone assuming US\$100/bbl Brent. But companies face a capital allocation dilemma. On the one hand, IOCs are under pressure to return windfall cash to shareholders – and being rewarded by the market for doing this. High prices also create more incentive to shift more capital into the legacy business.
- The energy crisis has also put bankers in a bind. War in Ukraine has provided a stark reminder that the world remains dependent on hydrocarbons and that the supply and demand must move in tandem. To ensure this, companies need access to capital to support new production.
- At the same time, a growing number of the world's major banks, asset managers, and insurers are signatories to the Glasgow Financial Alliance for Net Zero (GFANZ), aligning behind the goals of the Paris Agreement. To access capital, oil and gas companies must meet the ever-tightening criteria adopted by many of the world's leading financial institutions. The alliance represents assets of US\$130 trillion, held by 450 financial institutions, and growing.
- If energy majors and mining firms remain cautious on new investment and focus on decarbonization, the supply recovery will continue to lag demand unless governments take active role and set specific targets. We forecast the world needs US\$40 trillion in cumulative capex to meet demand for energy and commodities in the ETO.

Free cash flow vs global renewables capex, US\$ billion



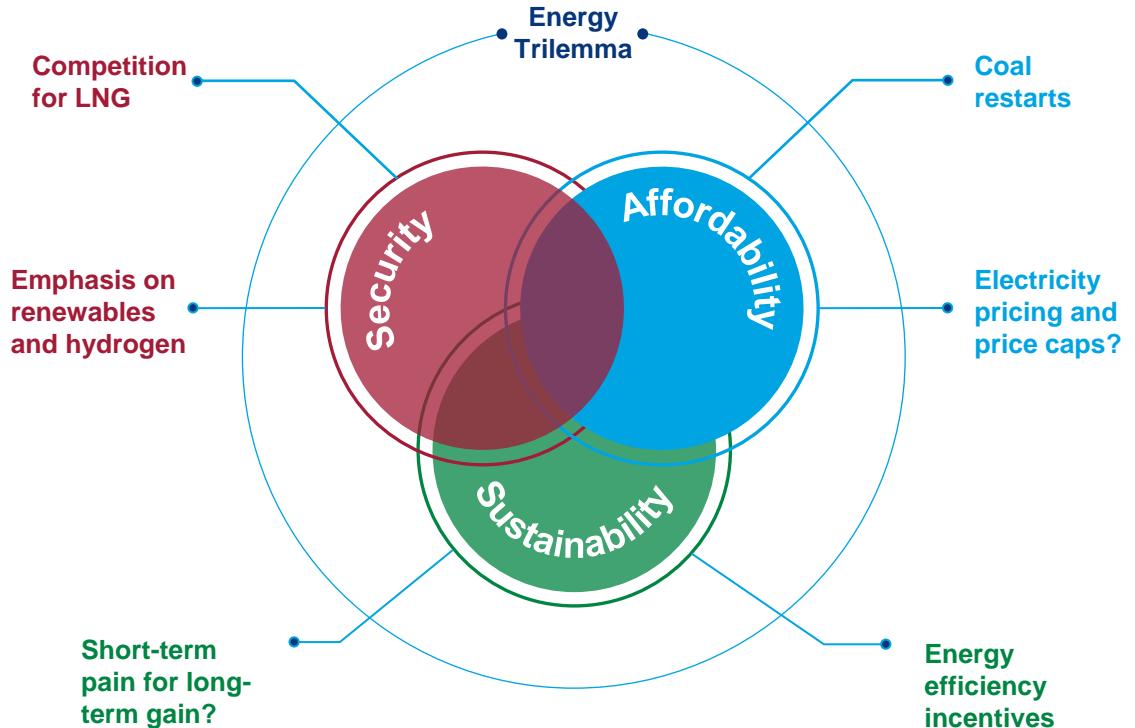


Implications

5

Effective crises management skills and coordinated policies are essential to deliver global net zero

- Delivering a secure, affordable and clean energy system looks extremely challenging in the current environment. Russia's war on Ukraine and the resultant supply crunch has exposed the weaknesses of energy policymaking. Rationing energy supplies to keep lights on in the affluent markets of Europe and Japan was unthinkable few months ago. But it's happening now!
- Restarting mothballed coal plants is akin to reversing the energy transition. Although recession risks would help keep emissions under check for the near term, we estimate the world is currently on track to reach 2.5 °C warming; and a rapid reduction is needed to meet the goals of the Paris Agreement, and that is a tall order in present circumstances.
- A fresh thinking that brings together energy, nature and new technologies could tackle the trilemma. Carbon pricing is the answer because it creates a level-playing field and helps capital allocation to climate-friendly technologies such as Hydrogen, CCUS, Geothermal and SMR Nuclear.
- The ball is again in the government's court; can they rise to the challenge?





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