HORIZONS

Top of the charts: five low-carbon tech trends worth tracking

December 2023

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Tackling global warming is society's greatest challenge. The world is nowhere near the 1.5 °C global warming pathway, governments are failing to act on commitments to reduce emissions and consumers remain resistant to change. Shifting the world away from fossil fuels to a low-carbon energy system was never going to be easy, let alone quick.

Change is underway in certain key areas, however – and at a much faster pace than one might think. Policy, for instance, has evolved dramatically since the Paris Agreement to provide a framework for a low-carbon future. The US (with the Inflation Reduction Act), the European Union (with REPowerEU), Japan, South Korea, China, Canada and India have led the way, offering generous incentives to promote low-carbon technologies. Policy is also widening to support the build-out of domestic supply chains for low-carbon technologies and to develop new sources of critical minerals to reduce global dependence on China.

And then, of course, there are the low-carbon technologies themselves, many of which are seeing substantive progress in their bid to ramp up to industrial scale and displace incumbent fossil fuels.

In this December edition of Horizons, we chart five key trends on the road to a low-carbon world: the rise of renewable power, the declining price of solar, the broadening of battery raw-material supply, carbon capture and storage, and heat pumps for home heating. Together, they offer a glimpse into how much the energy system will change over the next decade.

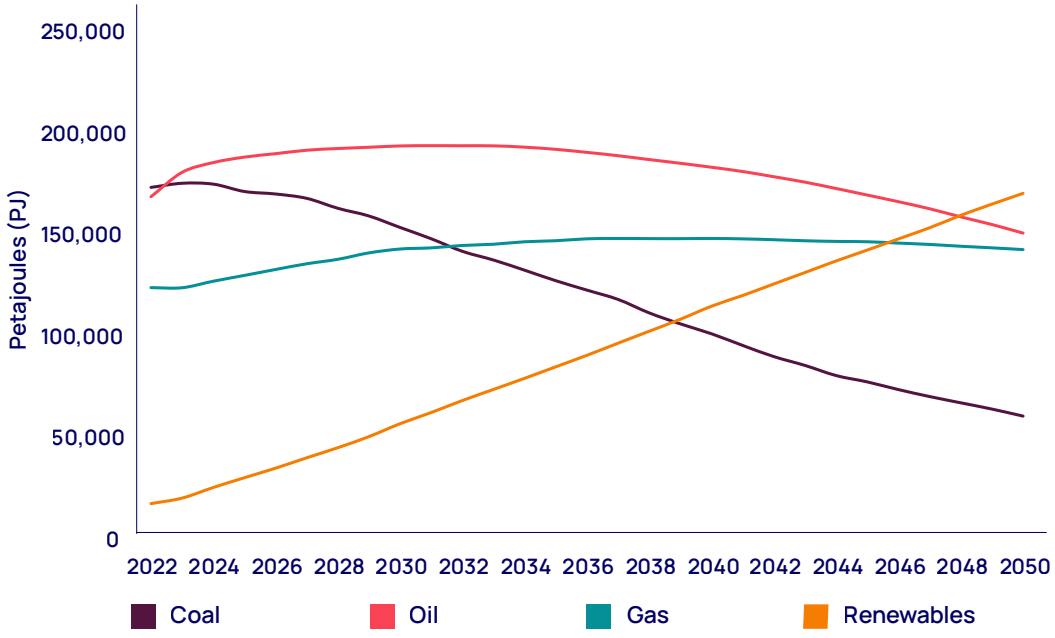
1. The inexorable rise of renewable energy

Hydrocarbons have been the leviathan of the energy landscape to date: dominant, ubiquitous and permanent. From year to year, demand has increased in tandem with economic growth. Changing this dynamic has seemed impossible, with coal, oil and gas so deeply embedded in the economy, from production to distribution and consumption. Things are beginning to shift, however.

Even more striking than the 50% decline in coal consumption to 2050 is the relentless rise of renewables. With an estimated compound annual growth rate (CAGR) of 4% over the next three decades, by 2050, renewables will be the leading source of primary energy supply, eclipsing each of the fossil fuels.

The renewables success story continues to gather pace, led by the rapid growth of wind and solar. By 2050, they will account for more than 50% of the global power supply. The last decade has seen a transformation in power generation, with renewables delivering low-cost power at scale. This has not been without its challenges, but steady technological advances paired with long-term cost declines have made renewables the standout performer of the energy transition.

Figure 1:
Total primary energy supply (PJ)



Source: Wood Mackenzie

2. China's cost advantage will continue to drive down solar prices

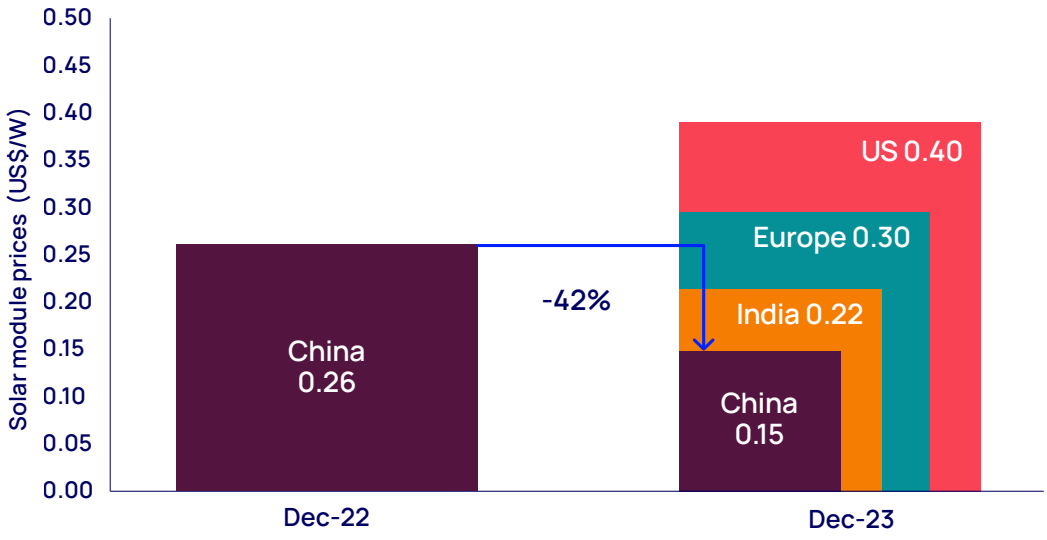
China is the world's solar module powerhouse. Its domestic solar capacity additions this year will be more than double those of the US and EU combined, while its phenomenal cost advantage means it commands more than 80% of global module capacity. China's current domination of solar module supply looks assured for the next decade or more.

The country's colossal manufacturing base is key. Even as its costs continue to tumble, Chinese solar manufacturing could already comfortably supply more than twice the current global module demand of 350 GW. Meanwhile, in other markets, cost inflation drags on solar photovoltaic (PV) cell manufacturing. Critics point to direct Chinese government subsidies for domestic companies (as well as allegations of forced labour), but this isn't the full story.

Falling interest rates, low energy costs, intense domestic price competition and government support for research and development also play their part. Equally as important has been indirect system-level support, with massive investments in transmission, energy storage, flexible capacity and manufacturing. Lower costs and lower curtailment of solar in China have kept its companies buoyant.

With Chinese solar module costs falling 42% between December 2022 and December 2023 alone to reach US$0.15/W, the ambitions of the US, Europe and others to compete look doomed. However, for those needing low-cost hardware to decarbonise, China's solar module manufacturers are open for business.

Figure 2: Solar module prices[1] by manufacturing location



[1] Module type: M10 PERC. All prices are ex-works prices from the factory in the region in question.

Source: Wood Mackenzie

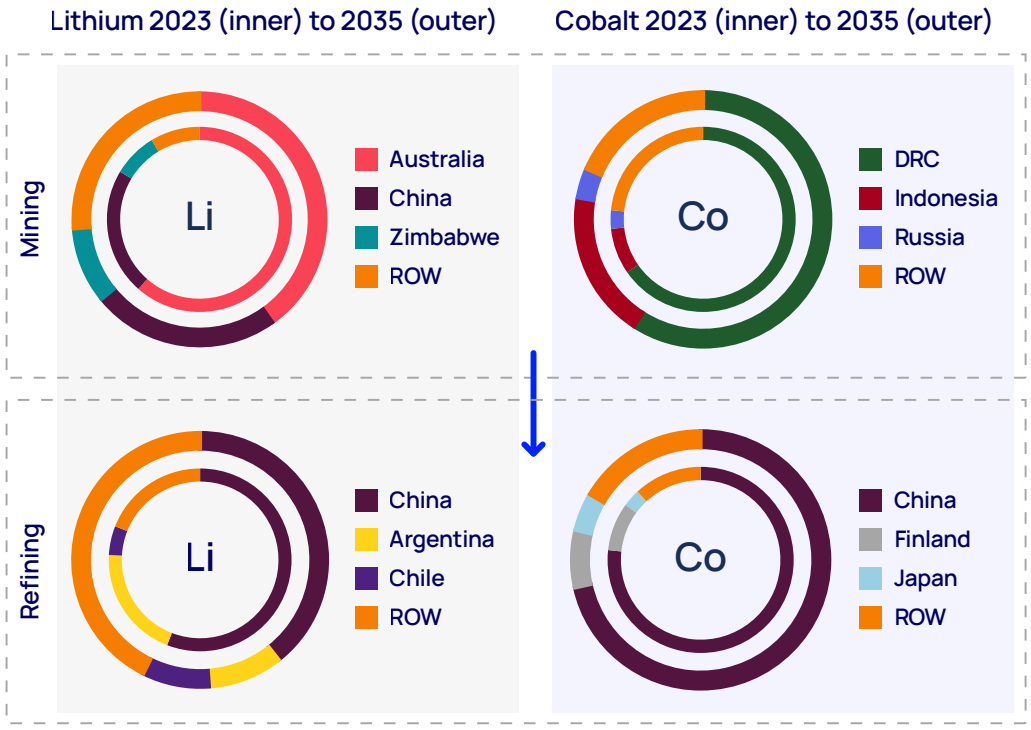
3. Searching wide, digging deep: broadening battery raw-material supply

The energy transition is creating new levels of demand for base metals and battery raw materials. The sharp upturn in demand as a result of climate policies and measures that are driving new low-carbon markets around the world has brought the potential bottlenecks of mineral extraction and refining capacity into sharp relief.

The lithium and cobalt value chains are concentrated in a handful of primary mineral suppliers and China, which dominates the processing capacity that exists today. The outlook for redressing these bottlenecks is beginning to look encouraging. While currently dominant suppliers and processors remain in a strong position, the diversification of both primary mineral supply and refining capacity is expected over the next decade.

Lithium and cobalt are compelling examples of the potential for a redistribution of the supply base. Thanks to price signals that are driving new investments and expanded capacity, the future value chains for base metals and battery raw materials will be both deeper and broader.

Figure 3:
Lithium and cobalt mining and refining market 2023-2035



Source: Wood Mackenzie

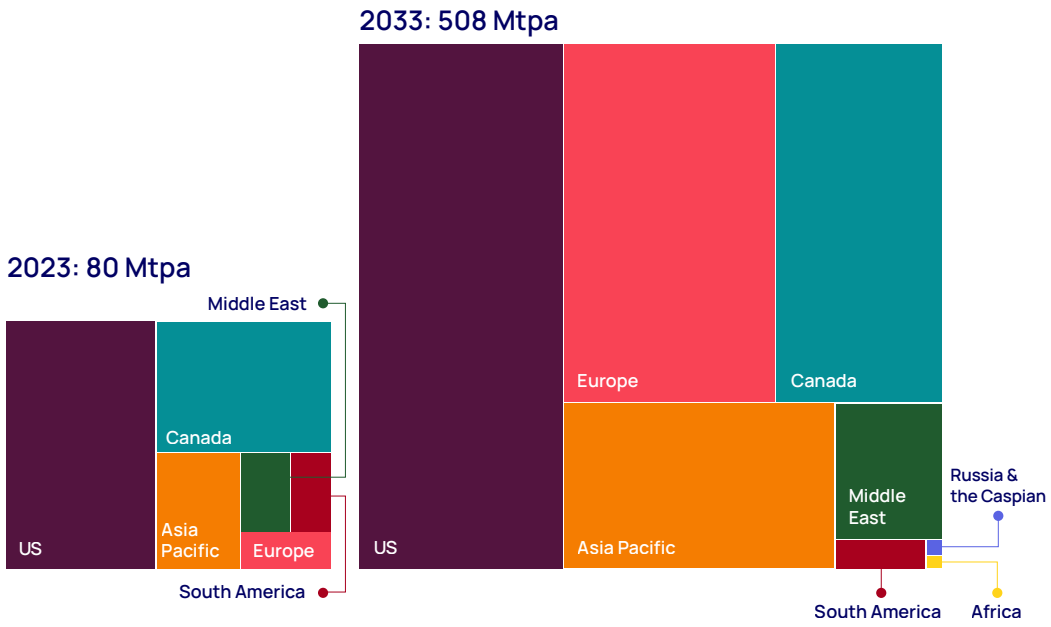
4. Carbon capture and storage's decade of delivery to global scale

Over the next decade, carbon capture, utilisation and storage's (CCUS) storage capacity will increase from 80 Mtpa to more than 500 Mtpa. Given previous false starts, scepticism lingers. However, support and regulation have changed the dynamic and injected significant momentum into the sector. The US's Inflation Reduction Act (carrot) and the EU's more recent Net Zero Industry Act (stick) continue to expedite CCUS activity.

While North America and Europe drive much of the CCUS growth, other regions, including the Middle East and Asia, will deliver material capacity over the coming decade. A diverse range of companies is leading developments in CCUS. However, the oil and gas sector is at the helm on many of these projects, given its complementary experience in sub-surface operations, managing volatile fluids at scale and working in offshore environments.

This scale of development does not come cheap, however, and to deliver the 2033 outlook, more than US$70 billion is set to be invested in transport and sequestration infrastructure before 2030. The next 10 years will be pivotal, and delivering projects at scale and accelerating growth will be key to the technology delivering to its potential.

Figure 4:
CO_2 operational storage capacity 2023-2033



Source: Wood Mackenzie

5. Heat pumps: a genuine alternative for domestic heating

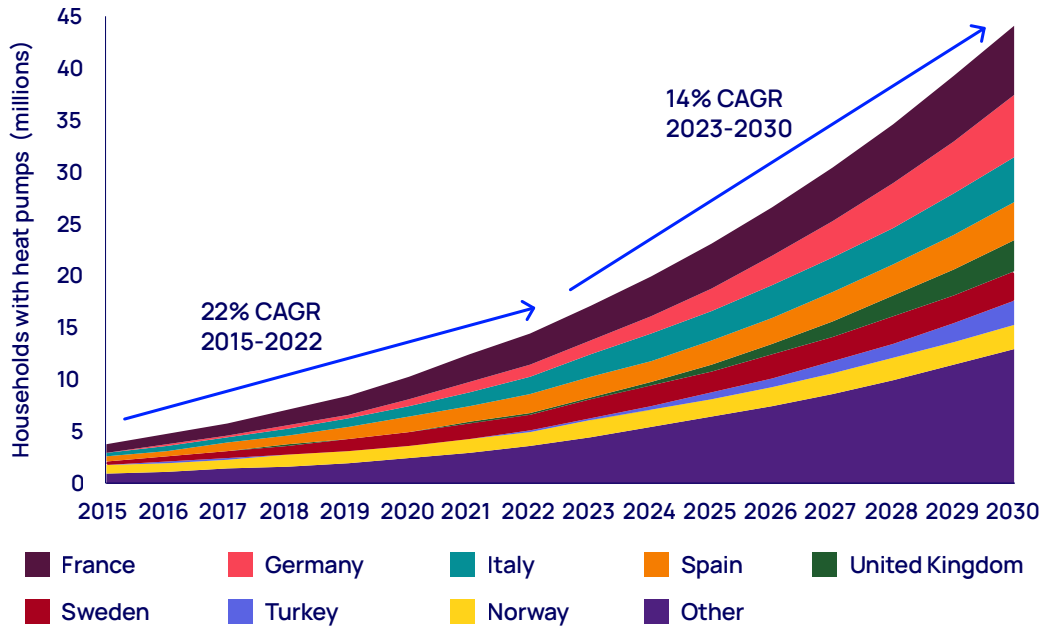
The transformation of European heat and power production is a central facet of the region's climate and energy security strategies. Close to 10% of Europe's energy consumption is associated with heating and around one-third of that is supplied by natural gas.

There are notable shifts taking place in this segment of the European energy system, changes that give credence to the view that Europe is establishing new, lower-carbon forms of energy production and consumption.

Driven by a combination of relatively high natural gas market price signals, strong climate policy goals and increased financial incentives in major markets like France, Europe's heat-pump sector is booming. Year-on-year growth has been in excess of 30%, while connections of air- and ground-source heat pumps are breaking records. In Finland, a country of 5.5 million, more than a million heat pumps are now installed.

More energy efficient and less emissions intense, this heat pump trend is a cornerstone of European residential and commercial climate action.

Figure 5: Installed European residential heat pumps, 2015-2030



Source: Wood Mackenzie

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