HORIZONS

Staying power

How new energy realities risk extending coal's sunset

July 2025

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The world is facing a stark reality: coal-fired power could be a bigger part of the energy mix for longer than expected, scuppering efforts to meet climate change goals. New realities for energy markets in recent years have become more, not less, supportive of coal-fired power.

Russia's continued invasion of Ukraine and the turmoil in the Middle East have pushed energy security to the top of government agendas. Power demand growth is surging around the globe. Large loads driven by the proliferation of data centres and energy-intensive manufacturing mean energy markets are pulling in all the power they can get, often regardless of carbon intensity. What's more, coal technology has room to run with the prospect of lower-emission innovations that could make coal more palatable in a renewables-dominated world.

Despite falling coal demand across Europe, the US, Japan and South Korea, the availability of cheap domestic coal resources continues to drive strong demand in the power sectors of many economies across South and Southeast Asia. China is the key driver of our outlook for peak coal as renewables, nuclear and hydro expand, but coal has proved resilient even as the country's energy transition gathers pace.

In this issue of Horizons, we explore how energy security, power demand and technology choices risk the greater use of coal for longer. Anchored by a new high demand case for coal, developed specifically for this Horizons report, we examine the drivers of a higher outlook for coal and what this means for investors, technologies and global climate goals.

When will we see peak coal?

Wood Mackenzie forecasts global peak coal demand in 2026. In our base-case Energy Transition Outlook, global coal-fired power generation falls around 70% between 2025 and 2050. Competitive costs for renewable power, advances in battery storage, a nuclear renaissance and growth in dispatchable natural gas-fired capacity reduce the utilisation of coal assets globally. The largest contraction in coal is in Asia, driven by China. The region accounts for 78% of the world's coal consumption today.

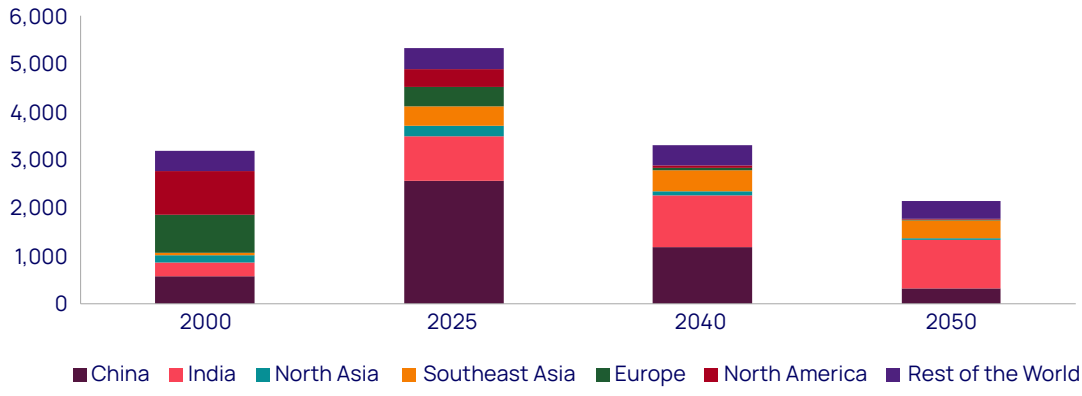
Predictions of 'peak coal' have long proved premature, however. The 1997 Kyoto Protocol, the 2015 Paris Accord and the global agreement at COP26 in 2021 all fired up optimism that coal had had its day, but global coal demand has continued to rise nonetheless. Between 2013 and 2025, China's coal-fired power output increased by more than 36% as its economy doubled in size. Right now, coal is the single largest source of electricity generation globally.

This underscores the reality that coal demand has consistently proven more resilient than expected. We continue to believe that our base-case forecast of peak coal demand in 2026 is the most likely outcome, but have developed a high coal demand case, in which coal demand is more resilient for three key reasons:

- **Energy security and affordability:** For several of Asia's largest and fastest-growing economies, coal is a strategic domestic resource that supports energy security, affordability and employment.
- **Power demand growth:** In an era of rapid power demand growth driven by data centres, artificial intelligence (AI) and wider electrification, governments and companies may opt to run existing coal assets harder and longer, slowing investment in lower-carbon alternatives.
- **Technological improvements:** Progress in the use of coal as a flexible power supply source, and advances in technologies such as carbon capture, utilisation and storage (CCUS) and hydrogen co-firing, could improve the emissions profile of coal plants, extending their operational life.

Figure 1: Asia drives the future of coal

Global thermal coal power demand by region, million tonnes (base case)



Source: Wood Mackenzie

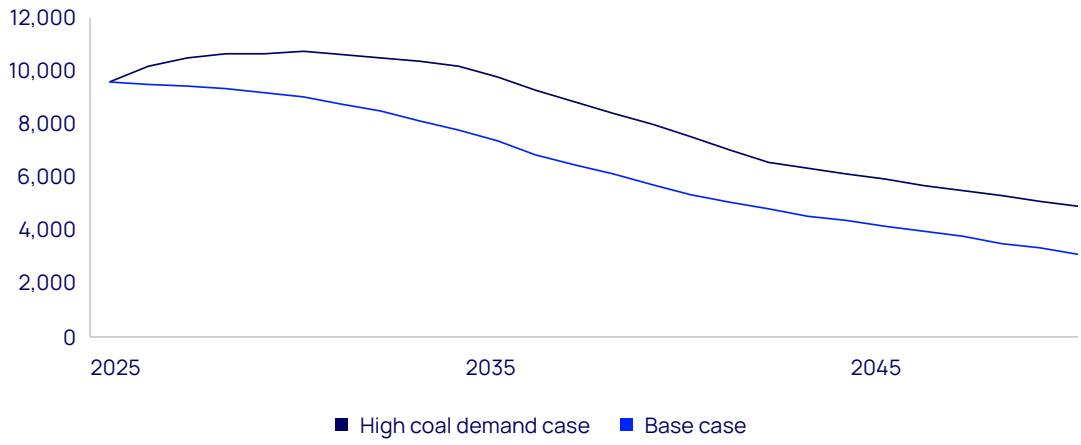
In our high coal demand case, the world's power systems are still dominated by low-carbon sources of power. But nine countries in Asia hold the cards to the future of coal. In a departure from our base case, coal demand in India, Indonesia, Vietnam, Pakistan and Bangladesh grows faster, reflecting stronger capacity growth and young asset lifetimes. Markets such as Malaysia, Thailand and the Philippines with an effective moratorium on new-build coal could alter course if cheaper coal can sway the debate. In recent years, China has proven adept at running its coal assets harder to meet strong demand growth and could repeat this as its power demand climbs.

In our high coal demand case, coal generation is, on average, 32% higher than in our base case from 2025 to 2050. Coal still peaks, but around four years later than our base case, in 2030. This is followed by a slower plateau for coal through 2050.

With higher coal burn, there is a corresponding slowdown in zero-carbon power capacity, energy storage and natural gas-fired power. Wind, solar, energy storage and natural gas capacity falls by around 2,100 GW from 2025 to 2050. Reducing carbon emissions would become an even greater challenge. Without significant investment in carbon capture and storage capacity, unabated emissions from the coal sector rise by 2 billion tonnes compared with our base case.

Figure 2:
Is higher-for-longer coal demand on the cards?

Total global coal electricity generation, unabated, terawatt hours (TWh)



Source: Wood Mackenzie

Energy security and affordability rise to the top

China and India are the bedrock of global coal demand. The world's largest coal producers and consumers, both regard their vast coal resources as pillars of their energy security and are working to limit energy imports. China mined more than 4 billion tonnes of thermal coal last year, covering 90% of its total coal demand, and its government has been clear that despite massive investment in clean energy, it will prioritise energy security ahead of phasing out coal. India continues to expand domestic coal production to reduce its import reliance, producing over 1 billion tonnes for the first time in the 2024-25 fiscal year.

Coal production globally sustains substantial direct and indirect employment, serving as a vital driver of local and regional economic activity. Provinces and states such as Shanxi in China and Jharkhand in India rely on coal-mining royalties and taxes as essential revenue sources. These funds underpin economic development, social welfare programmes and infrastructure investment.

Coal-fired power also helps to keep energy prices low across Asian markets. Domestically produced 5,500 kcal/kg bituminous coal in India and China currently ranges between US$3-$4 per mmbtu at the power plant. Domestic coals cover 85% to 90% of demand in China and India.

Countries that import energy have an economic incentive to double down on domestic coal production

Comparatively, seaborne thermal coal markets have proven to be extremely volatile. While prices can be competitive with domestic markets, prices for an equivalent imported coal climbed to more than US$14/per mmbtu following Russia's invasion of Ukraine in 2022. Pacific basin LNG prices are currently more than double the price of domestically produced coal. Like imported coal, LNG prices have surged as high as US$36 per mmbtu. Countries that import energy have an economic incentive to double down on domestic coal production.

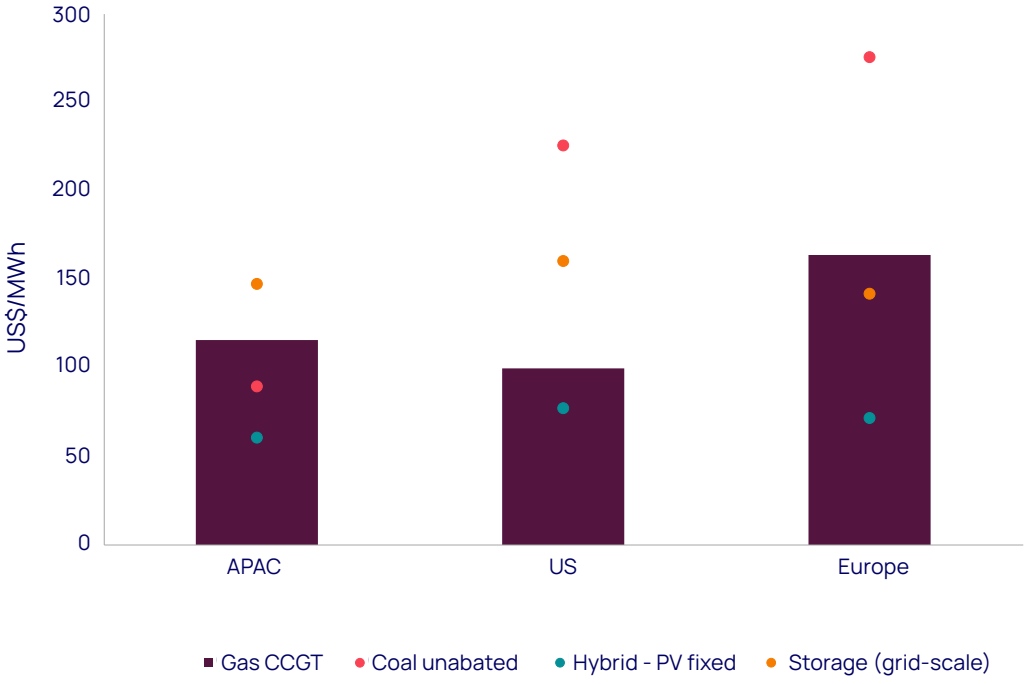
Power demand is keeping coal in the energy mix

Almost all major economies have made the wind-down of coal-fired power assets a cornerstone of their decarbonisation plans. Lately, many power generators around the world have been extending the lifetime of coal plants or increasing utilisation rather than reducing it. There are four core reasons.

Many power generators around the world have been extending the lifetime of coal plants

Figure 3:
Even with economic advantages, zero carbon power has not displaced coal

Levelised cost of electricity by region, 2030



Source: Wood Mackenzie

- A rapidly electrifying global economy is colliding with the realities of energy technologies today. AI's massive appetite for power is driving a strategic race for power supply across every major energy market.
- Zero-carbon power cannot do it all. Energy storage has not evolved fast enough to convert wind and solar into baseload resources. In the US, natural gas is now doing much of the heavy lifting as power demand surges, but cannot do it all, making coal a reluctant lifeline for baseload demand.
- Investors are getting 'sticker shock' when replacing coal-fired power. While solar power is the lowest-cost source for new power generation, in most developed economies, renewables face tariff threats, higher production costs from reshoring and infrastructure delays. The cost of new gas capacity has nearly doubled in the US. While softer LNG prices will support gas demand growth in Asia, most of the demand growth will be in industrial and residential sectors. In both China and India, natural gas remains only around 3-4% of total fuel inputs into power.
- With replacement costs of coal escalating, the value of existing coal assets is rising. Much of this value is tied to the value of capacity rather than to the value of selling energy during high energy price hours. For example, capacity markets in the US have awarded a premium to dispatchable capacity, including coal-fired power.

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Coal-fired technological innovation

As the world expands electrification, it is also maximising existing power assets, including the latest coal fleets, within a renewables-heavy grid. When the average life expectancy of a coal plant is between 50 and 60 years and fleets in China, India and Southeast Asia are young, there is an economic incentive to maximise plant lives, optimise operations and deploy technologies to reduce emissions.

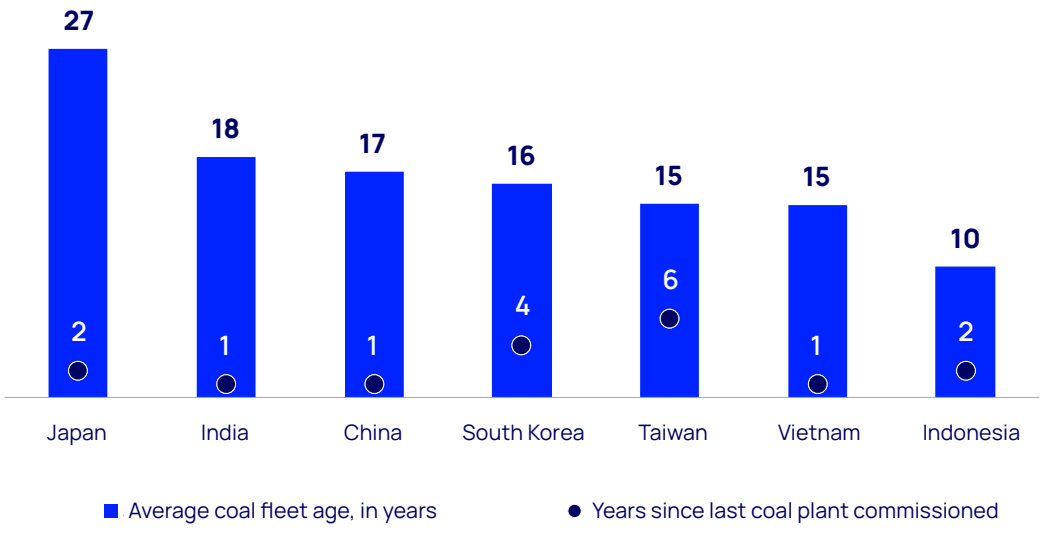
Latest coal-fired plant innovations provide flexibility

Between 2020 and 2025, China has deployed 200 GW of advanced coal plant capacity via retrofits, corresponding to more than 15% of its current 1,200 GW fleet. The new capacity allows flexible 'deep load-following' operations. India is on a similar path, with about 6 GW of its 228 GW coal fleet undergoing pilot-phase retrofits.

Upgraded coal units support variable renewable generation in a similar vein to gas power plants. Supporting high renewable output periods, these plants can sustain lower minimum power output levels in the 20-40% range, compared with 50% for traditional coal plants. Flexible coal plants can achieve faster ramp-rates of 5% or more of maximum load per minute and quicker hot starts of two hours or less, compared with 1-2% and four hours for normal coal plants.

These plants typically require support from capacity payments or other market mechanisms, however. Such support helps to offset higher operating costs from lower efficiencies, higher fuel consumption and increased maintenance from unit cycling and ramping. Without adequate compensation, plant economics become challenging. Policy support will be critical to the widespread adoption of flexible coal operations.

Figure 4:
Asia's coal fleet is still years off the average life expectancy



Source: Wood Mackenzie

CCUS remains the holy grail of coal power

CCUS technology theoretically solves coal's biggest challenge: to maintain operations while capturing CO_2 emissions. Currently, coal plants with CCUS are few and far between. Only two commercial-scale operations exist – one in the US and one in Canada, with a Chinese demonstration plant under construction.

The biggest barrier to CCUS projects at power plants is their exceedingly high operating and capital costs. Higher utilisation rates for coal-fired power would help support the economic argument for investing in CCUS. Carbon storage costs, however, will be a limit to how far coal with CCUS can scale up in Asia. Markets such as Japan and South Korea require capital-intensive cross-border CCUS trade because they have limited domestic storage capacity. If these countries abate thermal capacity, they are likely to jump to natural gas, which generates less carbon per TWh of electricity.

To address cost challenges, investment incentives and adequate policy support are required, including grants, capital investment and production-based tax credits, infrastructure development, and government-backed CO_2 offtake agreements, coupled with clear permitting and liability policy frameworks.

Coal plants can co-fire with alternative fuels

The next generation of co-firing technology to reduce coal-plant emissions rests with ammonia and hydrogen. Co-firing involves burning ammonia or hydrogen alongside coal to generate electricity. Japan and South Korea are leading the charge to test and implement this technology in their coal fleets. Other countries, including Indonesia, India, Malaysia, the Philippines and Singapore, are conducting trials and studies.

Future success with ammonia and hydrogen co-firing depends heavily on several factors, including overcoming high costs, a need for significant government incentives and technological challenges. Infrastructure and logistics also present major hurdles. Initial optimism in Japan and South Korea appears to have subsided amid high costs and relatively limited gains: achieving 50% ammonia co-firing in coal plants results in similar net CO_2 emissions to those from unabated gas-fired plants. Plus, additional harmful nitrogen oxide emissions are generated during co-firing.

Conclusion: a higher and longer coal consumption pathway exists

The world's first coal-fired power station began operating in 1882. Fast forward nearly 140 years, and the world is still dependent on coal to fuel the global economy. While several markets, especially in Europe, have transitioned away from coal, rising electrification expectations, trade tensions and energy policy risks require a new debate about coal's role and the pace of decarbonisation.

Our high coal demand case is neither a sure thing nor desirable. However, it does reflect a growing shift in energy markets around the world: countries want more control over energy resources to expand affordable and reliable electrification. As a result, energy investments could take a different tone in the next 5 to 10 years – away from net-zero pathways to falling back on established options, including coal-fired solutions.

From our high coal demand case, we see several implications for energy markets around the world:

- **Coal producers:** Higher demand will expose the lack of investment in replacement supply to offset reserve depletions and closures. Private equity and sovereign wealth funds will be needed to fund any greenfield and brownfield expansions, assuming most Western financial institutions continue to limit thermal coal supply investments. A higher demand outlook for coal, without commensurate investment, could lead to higher coal prices, thereby eroding its core advantage.

The extent to which China embraces coal will influence the cost declines for zero-carbon power technologies globally

- **Emerging technologies:** Governments and asset owners should continue to reposition for a low-carbon-dominated world. If coal demand remains resilient, technologies that lower the carbon intensity of power output must be prioritised. Our high coal demand case is even less palatable without a renewed focus on innovation for flexible load-following coal capacity and CCUS. And if CCUS is rolled out, combining with gas should be viewed as a more efficient option, given the lower levels of CO_2 capture required per unit of electricity produced using gas.
- **Renewables:** China's trade policy also creates uncertainty for renewable developers: the extent to which China embraces coal will influence the cost declines for zero-carbon power technologies globally. Our higher-coal-demand case expects around 1,700 GW less of wind, solar and energy storage capacity than in our base case. This is an avoidable outcome if governments and investors double down on commitments to expand clean energy investment, advocate for tariff-free, cross-border trade and support China's shift out of coal towards renewable supply chains.

- **Natural gas:** Natural gas must retain its primary role in accelerating the energy transition – displacing coal and supporting the expansion of renewables. Expected lower LNG prices from next year should support efforts to supplant coal-fired power in Asia. Gas prices in North America will also support the economic competitiveness of gas versus coal. Ensuring robust supply growth will be critical to avoiding the reduction of around 400 GW of natural gas-fired capacity in our high coal demand case.

Even with the potential tailwind for coal, the world has significant tools to phase it out. Continued innovation in renewables backed by long-duration storage, LNG affordability, and pragmatic climate goals and policy are key levers. Equally, US energy policy could shift back towards net-zero policy goals after the Trump administration. The world will pay an ever-heavier price if governments step back further from their climate commitments.

Without these developments, there is a greater risk of a 3 °C emissions pathway. Our high coal demand case is a window on how, without urgent action, the world could veer towards this outcome. It is also a callout on how it can be avoided.

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