Look Forward

Energy Futures

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Energy is Everything. It's the defining feature of today's global landscape.

The rapid growth of AI and the enormous energy required to power it are driving an unprecedented convergence between the technology and energy sectors. Electricity is taking on a larger role besides AI across the economy, even as affordability pressures intensify and grid investment becomes more urgent. At the same time, the "molecules economy" is evolving as LNG markets become more globally integrated, and hydrocarbons remain central to meeting demand.

Amid a rapidly evolving and expanding global landscape, the need to secure reliable and sustainable energy has never been more urgent. Securing critical minerals and materials is increasingly recognized as a strategic priority, underscoring the importance of diversified supply chains and long-term resource stewardship.

Advancing greater transparency and standardization in carbon measurement is essential to unlocking the full potential of voluntary carbon markets and enabling credible carbon-differentiated trade.

As energy advances the global economy, climate impacts have continued to intensify. Integrating adaptation and physical resilience into energy planning is becoming foundational to building systems that are durable, flexible and fit for the future.

Understanding these driving forces is central not only to energy markets, but also to the wider world those markets serve. That is why it is more important than ever to bring together deep sector expertise, rigorous data and on-the-ground market knowledge.

S&P Global's *Look Forward: Energy Futures* provides world-leading analysis to help leaders navigate complexity with confidence at a moment when decisions made by policymakers, companies and investors will reverberate for decades. This issue is going to press during the war in the Middle East, one of the most historically important moments in the global energy markets. S&P Global Energy news and price reporters, researchers, and analysts will continue to analyze the impact of the conflict on the physical energy markets, as well as its long-term implications, while staying connected with our customers.

We invite you to share your own views on these topics and ask questions. Your insights and engagements are invaluable. We want to hear from you.

Dave Ernsberger
President, S&P Global Energy

Look Forward: Energy Futures

The global energy system is charting new frontiers, with decarbonization increasingly viewed as a longer-term objective, rather than an immediate priority. The collection of articles in our latest edition of *Look Forward* captures this inflection point: We are firmly in an era of energy expansion, where affordability, reliability, competitiveness and geopolitical resilience are taking precedence over energy transition.

There is a revival in oil and gas investments amid concerns over supply shortfalls and price volatility. At the same time, investors are balancing capital discipline, shareholder expectations and emissions scrutiny. Upstream expansion today is more practical, technologically sophisticated and politically aware than in previous cycles, having adapted to a world where hydrocarbons remain indispensable but contested.

The recalibration is especially visible in Europe, where industrial competitiveness and energy affordability have moved to the forefront. While the European Green Deal remains foundational, policymakers are balancing decarbonization with pragmatism, recognizing a sustained role for gas in stabilizing power systems and preserving industrial capacity. Although political consensus on climate ambition may be less unified, investment opportunities remain abundant.

Energy expansion is not confined to advanced economies. Extending access to reliable energy in Africa is central to economic growth and social development. Here, the priorities are clear: mobilizing capital, improving project bankability and unlocking infrastructure investment.

Meanwhile, materials and minerals critical for the global energy system, such as copper, are becoming increasingly embedded in geopolitical competition. Supply chains once governed primarily by cost efficiency are now shaped by national security interests.

Even climate policies are evolving in this new context. Carbon accounting frameworks are central to policy dialogue, as credibility and comparability are essential in this complex, multipolar energy landscape. Resilience to physical climate risk is indispensable as the US expands generation capacity and grid infrastructure. Adaptation, in other words, is as crucial as mitigation. After a period of enthusiasm, sustainable chemicals now face economic and policy headwinds, demonstrating that not all decarbonization-linked industries advance in a linear fashion.

Together, the articles in *Look Forward: Energy Futures* depict a world in which energy demand is rising, supply is expanding and strategic competition is intensifying. The energy transition has not disappeared; it is just not the primary goal. In its place stands a more immediate imperative: secure, affordable and scalable energy systems capable of sustaining economic growth in an uncertain geopolitical era.

Ashutosh Singh
Executive Director, S&P Global Energy

Atul Arya, Ph.D.
Senior Vice President and Chief Energy Strategist, S&P Global Energy

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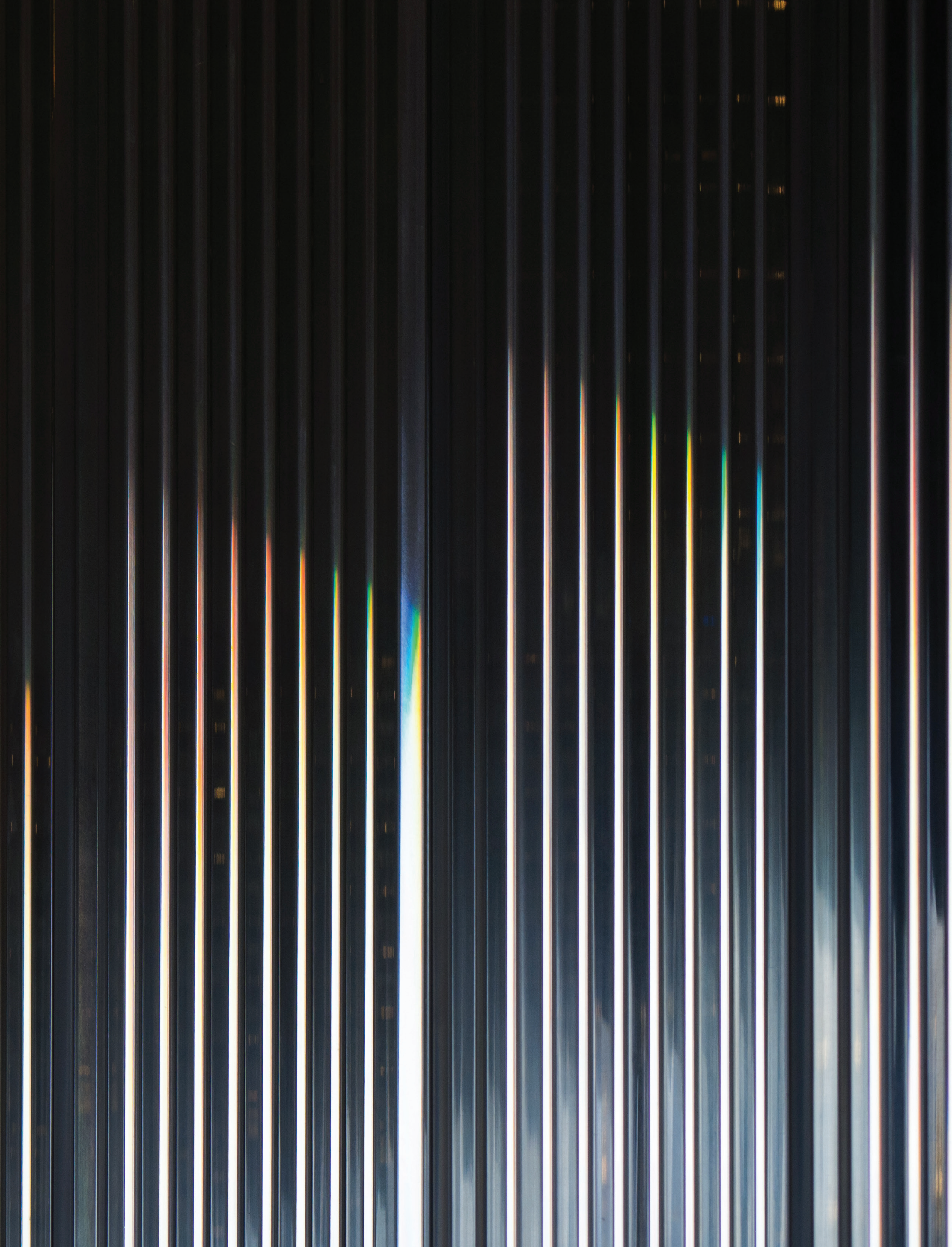

The multidimensional energy future

The multidimensional energy future continues: A multispeed, multifueled and multi-technology transition with different road maps and end points for different countries.

Atul Arya, Ph.D., Senior Vice President and Chief Energy Strategist, S&P Global Energy

Highlights

Strong economic growth in emerging markets and developing economies is leading to higher-than-forecast energy demand, and this trend is expected to continue.

Data centers and their unrelenting need for power have emerged as the latest vector in energy demand growth, with natural gas as the fuel of choice.

Costs for new energy technologies are declining at varying speeds. Both electrons and molecules remain the foundations of the global energy system. Electrification is increasing, but so is oil and gas demand.

Reassessments of energy and climate policies that started in 2024 and accelerated in 2025 have resulted in oil and gas companies trimming their clean energy investments and portfolio choices.

The global energy system is charting new frontiers as it enters the era of AI. The energy landscape has seen significant shifts in the last 12 months, with power demand accelerating, global energy and climate policies shifting, and energy companies reassessing their portfolio and investment strategies. The energy transition will be continuous and everlasting.

Energy addition as well as energy transition

Projections made during the COVID-19 pandemic that demand for hydrocarbons — coal and oil specifically — was approaching a peak/plateau have proven incorrect. The pace of recovery in energy demand post-COVID-19 has varied worldwide. In 2025, demand for oil, gas and coal reached new highs. So did demand for solar photovoltaics and wind energy. Renewables continue to grow faster than hydrocarbons, but the overall share of renewables in the total energy mix remains small. There are no signs of decline in demand for hydrocarbons in the near future. In short, energy addition continues globally.

The share of hydrocarbons in China's energy mix continues to decline with the massive deployment of renewables. China is leading the energy transition away from hydrocarbons, and the EU is following closely behind. Transition to renewables continues apace in the EU, driven by the goal of enhancing energy security through decarbonization and reducing dependence on imported oil and LNG.

Power sector emissions in the US have fallen significantly since the start of the shale gas revolution, as inexpensive and abundant gas has displaced coal for power generation. However, this trend is reversing due to the revival of coal for power generation and natural gas playing a bigger role than renewables in meeting data centers' energy needs. This marks an unprecedented reversal of the energy transition.

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Hydrocarbons continue to be the dominant energy supplier in India, with coal and oil fueling the Indian economy. Although the installed capacity of renewables in India's power mix will continue to expand, coal and oil demand will also grow: a case of energy addition. The energy mix in most emerging markets and developing economies (EMDEs) is dominated by hydrocarbons. Oil remains the fuel of choice for transportation. Recent work by S&P Global Energy CERA Consulting indicates that energy demand in many EMDEs has been underestimated in various scenarios and forecasts. This has far-reaching consequences, including a lack of financing for energy projects and the slow development of local hydrocarbon and mineral resources.

Power demand for data centers exceeds all projections

Since the launch of ChatGPT in November 2022, hyperscalers and leading generative AI firms have committed hundreds of billions of dollars to train large language models in the hopes of gaining a first-mover advantage, garnering recognition for the "best model" and ultimately being the first to achieve artificial general intelligence. This approach is exceedingly resource-intensive: Training a top LLM can use tens of thousands of graphics processing unit chips, each of which may require five to eight times the energy used by typical chips, significantly increasing energy consumption.

According to S&P Global Energy estimates, data center power demand worldwide could grow 12%-16% annually over 2025–30. The range of forecasts across the technology and power sectors is quite broad, which fuels uncertainty. In the S&P Global Energy "power sector perspective" scenario, global data center power demand reaches 1,550 TWh by 2030, roughly equal to total power consumption across Latin America in 2030. By 2030, data centers could account for 6% of global power demand, compared to 2%-3% today. In comparison, electric vehicles account for about 1% of global electricity demand in 2026, with expectations of rising to 1.5%-2.5% by 2030.

According to S&P Global Energy estimates, data center power demand worldwide could grow 12%-16% annually over 2025–30.

Beyond the global picture, data center impacts on power demand will vary significantly by region. In developed economies where demand has been flat or even fallen in recent years, data centers represent a growth opportunity. In the US, the largest data center market, power demand growth averaged only 0.3% per year over the past 15 years. Now, demand growth projections have risen. In Europe, data centers offer growth in a depressed macroeconomic environment and a region where consumers are increasingly integrated into and influencing power market operations through granular pricing and demand response. In contrast, in emerging markets such as China and India, data centers are not the only drivers in the overall demand story. In China, for example, data centers are expected to account for 7%-17% of all incremental power demand during 2025–30 and to represent only 2%-5% of total electricity consumption by 2030.

Power market stakeholders worldwide face substantial challenges when preparing for data center loads.

Electrification can only go so far

Electrification — due to its superior energy conversion efficiency and cost-competitive renewables — has long been the preferred path to reduce emissions and meet net-zero emission goals. Although electrification is progressing rapidly around the world, meeting climate targets is becoming more challenging as electricity demand outpaces infrastructure, putting severe pressure on supply chains. Some of the hurdles that must be overcome include:

- a lack of transmission lines
- slow permitting
- supply chain constraints, including a scarcity of copper, lithium and rare earth minerals
- achieving long-duration storage at scale
- maintaining reliable 24x7x365 electrical infrastructure

The industrial sector is the largest global energy user. Decarbonizing and electrifying this sector would require a significant increase in fossil-free electricity use for direct thermal heating and pressure to substitute for metallurgical coke, methane, ethane and naphtha as feedstocks. At present, only 15% of industrial energy use is derived from electricity. Substituting fossil fuels with renewable power is feasible for some industrial processes, but it would be costly. There are also limitations on the effectiveness of electricity in decarbonizing industrial processes that require high-grade heat, such as steel, cement, fertilizer and chemical production. While electrochemical production of chemical compounds like ammonia is promising, it is still in the early stages of development.

Liquid fuels with high energy density are well suited to heavy-duty transport, so shifting the world's trucks, planes and shipping fleets from oil-based to renewable electricity will take years. Electrification is progressing, but electrifying everything will require new technologies and infrastructure.

Electrification is progressing, but electrifying everything will require new technologies and infrastructure.

Oil and gas companies are going back to oil and gas

Shortly after the Paris Agreement on climate change was enacted, many legacy fossil fuel companies announced decarbonization targets that heralded an "age of cleantech": They diversified away from their core business of finding, extracting and processing carbon molecules into the world of electrons. Companies pointed to natural gas as the bridge between fossil fuels and electricity and planned to use incentives, creative financing and energy trading to deliver acceptable, low-volatility equity returns from their low-carbon business. In addition, many companies invested in reducing methane emissions, scaling carbon capture and sequestration (CCS) and making green hydrogen economically viable.

The last two years have seen a reversal, with companies resetting targets and divesting assets. S&P Global Energy analysis estimates that between 2023 and 2025, the global integrated oil companies cut their aggregate 2023–28 low-carbon capital spending by 25%. Even within their low-carbon investment programs, there has been a shift in the molecules/electrons mix from 50/50 to 58/42, with more focus on bioenergy/bio-feedstocks, fewer greenhouse gas emissions from operations, CCS and offsets. While government-owned oil and gas companies' low-carbon investment programs have largely remained in place, most are on a much smaller scale.

Announcements in the first quarter of 2026 indicate that further reductions are planned, including in technologies such as CCS, which thus far has not been affected.

Energy and climate policies are uncertain and unpredictable

The global climate policy landscape has continued to evolve over the past year. Competing priorities — energy access, security and affordability — alongside geopolitical upheaval and political swings have fragmented the approach to decarbonization and future energy systems. This, in turn, has created a fragmented investment outlook. In the US, federal climate policy is undergoing significant change. This is not new for the country; federal regulations and incentives have always shifted with changes in administration. Under presidents Barack Obama and Joe Biden, the US Environmental Protection Agency developed aggressive standards targeting fossil fuel-fired power plant, vehicle and oil and gas production emissions while advancing cleantech development and deployment through supportive policy frameworks and incentives. President Donald Trump's administration has embarked on a deregulatory agenda focused on energy dominance, advancing fossil fuel infrastructure. Given the president's extensive use of executive power, it is unclear how durable future policies will be.

In Europe, the long-standing consensus on rapid decarbonization has fractured, and countries are resetting their energy commitments. Geopolitical tensions and affordability concerns have pushed climate and the environment down voters' list of priorities. While the long-term political ambition to decarbonize remains, the mantra is now "do no harm." Competitiveness is a key theme, with deindustrialization a recurrent concern for energy-intensive industries. A slower, more affordable transition is the implicit plan to protect competitiveness. Nonetheless, electrification and renewables are still viewed as critical to Europe's energy security. Regulation of transport emissions has created tensions between the established climate agenda and the protection of Europe's industrial base. In 2025, emissions requirements on car manufacturers were softened, and the EU is on track to scrap its plan to phase out the sale of new petrol and diesel vehicles by 2035. Concerns about the cost of sustainable aviation fuels suggest that those targets will soon be reviewed as well. The tension between cost and climate was also apparent in discussions on 2040 emissions targets. The EU approved an ambitious headline goal — a cut of 90% below 1990 emissions — but the agreement was conditional on outsourcing part of the target to non-EU countries using international credits.

As the 15th Five-Year Plan (2026–30) begins, Beijing is prioritizing a "Green Industrial Revolution" to align its 2030 carbon peaking goal with a new era of high-quality, innovation-led growth. China's large-scale deployment of renewables aims to reduce reliance on imported fossil fuels, and the role of coal is shifting toward supporting renewables and grid resilience. In 2027, the Chinese national Emissions Trading Scheme will expand to include steel, cement and other heavy industry to create a broader price signal for carbon.

Whither the energy transition?

The energy mix is in continuous transition, and history tells us that while there are occasional surprises, abrupt and radical changes are very rare. The driving force in prior transitions was a shift to more useful energy sources, such as from wood to coal, which has a higher energy density, or to a source with better functionality (coal to gas) at a lower cost.

The idea that advances in energy technology can and should follow a trajectory like that of the semiconductor industry — a notion termed Moore's Curse by Canadian scientist Vaclav Smil — is impractical for many reasons. Energy infrastructure is capital-intensive, with a productive life spanning many decades, and alternative technologies are more expensive, less widely accessible and do not offer the same functionalities.

S&P Global Energy's 2025 energy and climate scenarios vividly demonstrate the multidimensional nature of the energy transition. In all scenarios, fossil fuels retain a significant share of the global primary energy mix to 2060. In 2025, political and public sentiment, including in many EMDEs, shifted strongly to prioritize economic growth over climate mitigation. The Adaptation scenario is closest to demonstrating the impact of this shift, with high economic growth fueled by strong demand for fossil fuels.

Broad range of outcomes for energy demand, energy mix and GHG emissions
Energy and climate scenarios and net-zero case: Key metrics

	Global GDP (CAGR 2024–60)	2060 TPED (change vs. 2024)	2060 fossil fuel percent of TPED	GHG emissions (change vs. 2024)	Global temperature (estimated change by 2100)
CI Base Case 2025	2.4%	+17%	52%	-31%	2.5°C
Adaptation	2.8%	+32%	64%	+1%	3.2°C
Fracture	2.0%	+3%	53%	-29%	2.5°C
Renaissance	2.8%	-3%	32%	-71%	1.9°C
Net-Zero 2050 case	2.7%	-18%	15%	-107%	1.5°C

Data compiled July 2025.
CAGR = compound annual growth rate; TPED = total primary energy demand.
Source: S&P Global Energy.
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Looking forward

The global energy system continues to surprise. In the past two decades, there have been monumental supply surprises: the shale oil and gas boom in the US, the growth in solar photovoltaics enabled by a steep decline in costs, and more recently a boost in electric vehicle sales led by China. We are now seeing the biggest surprise in decades: surging electricity demand from data centers. The scale of the global energy system means that any significant change in fuel mix and emissions will take time, and continuing investment in conventional energy will be necessary. A well-functioning energy system is critical to fuel economic growth. Policymakers will prioritize affordability, energy security and energy access. The energy future will be multidimensional, proceeding at different rates with a mix of technologies and priorities around the world.

Electricity affordability at a crossroads

Rising or persistently high power prices have turned electricity affordability into a major global barrier to electrification, digital infrastructure expansion and the energy transition.

Bruce Thomson, Global Social Specialist, Sustainability Methodologies and Research, S&P Global Ratings

Patrick Luckow, Cross-Regional Power and Renewables Research Lead, S&P Global Energy

Ashish Singla, Director, South Asia Power and Renewable Research, S&P Global Energy

Sylvain Cognet-Dauphin, EMEA Power and Renewables Research Lead, S&P Global Energy

Energy affordability is a frequent focus of policymakers, but this consideration grew in prominence over 2025, particularly in regions experiencing the most acute rate increases. The combination of increased electrification of the global economy, rising demand from data centers, resource adequacy and grid reliability considerations, volatile commodity prices, higher interest rates, and cost inflation, among other things, has heightened concerns about energy affordability and economic competitiveness. With these factors showing no signs of abating, the topic of affordability will remain prevalent among policymakers, consumers and utilities in the year ahead.

Highlights

The affordability of electricity has become a major obstacle to electrification, digital infrastructure growth and the broader energy transition in many markets globally.

This has resulted in fast-forming policy and regulatory responses being decided on a market-by-market basis, through levy shifts, tariff redesign, and capacity and grid decisions, all of which will present important risks to public- and private-sector entities in the coming years.

Yet the forces driving electricity price changes vary widely across regions, and their impacts are equally uneven. Consequently, regulatory responses will remain fragmented, perpetuating an uneven competitive landscape that could hinder progress toward a low-carbon electricity future.

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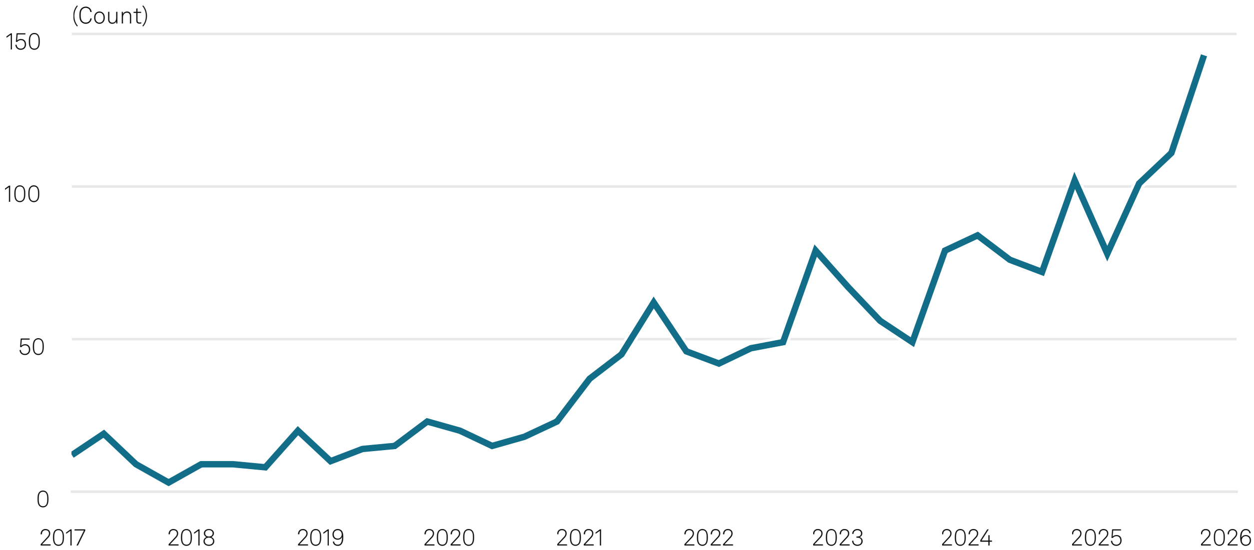
US electricity affordability: From data center hype to real policy pressure

Electricity affordability has emerged as a key concern in the US over the past year, as projections for data center demand growth put recent rate increases under the spotlight. Data released by the US Bureau of Labor Statistics indicated that while the general consumer price index rose by 2.7% over 2025, the index for electricity surged by 6.7%, a reversal from recent history in which electricity rates have lagged broader inflation. This sharp rise in electricity prices has elevated affordability as a top policy issue for 2026 in the US, where power consumption per household ranks among the highest in the world. At the corporate level, mentions of affordability on utility-sector earnings calls, once barely noteworthy, occur at roughly 10 times the frequency they did five years ago. In the political arena, rising electricity prices, already a key topic in gubernatorial races in Virginia and New Jersey in November 2025, are expected to remain a theme in federal, state and local-level elections later in 2026.

Affordability has been a rising topic in US utility sector earnings calls

Number of company mentions of affordability on S&P 500 utility sector earnings calls



As of Feb. 12, 2026.

Sources: S&P Global Market Intelligence; S&P Global Energy.

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Consumers and policymakers are eager to avoid utility investments intended to support new load growth, exacerbating upward price pressures.

With affordability now in focus, the rapid growth in data centers and massive power sector investment required to support these new electricity loads are increasingly a concern. S&P Global Energy anticipates that capacity additions will average 71 gigawatts/year from 2026 to 2035, a significant increase compared with the 43 GW/year observed from 2016 to 2025. This growth is being driven by a rise in net on-grid demand, which is expected to increase from 0.8%/year over the last decade to 2%/year during the next decade. Yet consumers and policymakers are eager to avoid utility investments intended to support new load growth, exacerbating upward price pressures. The issue is complicated by the often-misunderstood drivers of recent electricity price increases, which, in most cases, do not relate to data centers. Retail electricity rates are a product of complex ratemaking and reflect multiple drivers, many of which vary regionally. The largest increases in retail electricity prices over the past five years were concentrated in California, the mid-Atlantic and New England, but the major drivers across these three regions varied considerably.

Residential electricity bills are increasing in almost every US state, but drivers are varied

	California	New England	Mid-Atlantic
Affordability trend	Local electricity rates up 40% between October 2022 and October 2025	Retail electricity rates up 42% since 2019	20% year-over-year increase in residential rates in New Jersey
Key driver(s)*	Wildfire costs	Transmission, fuel prices	Data centers, capacity costs
Other details	Wildfire-related costs represented 15%-20% of revenue requirements; expenditures expected to rise	Transmission and distribution rates up 50% and 70%, respectively; region remains highly dependent on natural gas-fired generation	Highest concentration of data centers driving demand growth; capacity costs from recent PJM capacity auctions jumped to over $16 billion in 2026–27 from $2.5 billion in 2024–25

Data as of Feb. 12, 2026.
* Retail electricity rates are a product of complex ratemaking and reflect multiple drivers, including, but not limited to, increased demand from electrification and digital infrastructure, system hardening, fuel prices, capacity prices, broader inflation, supply chain impacts, deferred maintenance and increased cost of capital.
Source: S&P Global Ratings.
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Even though customer electric bills as a percentage of household income remain relatively low compared with the recent past, in an environment where budgets are being pressured from all sides, rising rates are fast becoming an important campaign issue at the state, local and federal levels. US states such as New Jersey and Connecticut have delayed or reduced renewable energy requirements to help soften rate pressures. PJM's push to cap capacity market prices resulted in a reserve margin below its target. We expect regulators to manage rate growth by carefully reviewing utility proposals. In anticipation, utilities are emphasizing meeting new demand while limiting rate growth, and many data center developers have pledged to independently procure their full supply requirements and provide greater planning transparency, recognizing the risk that the affordability challenge poses to their industry.

In Europe, fuel price volatility and decarbonization-related investment needs continue to drive affordability pressures

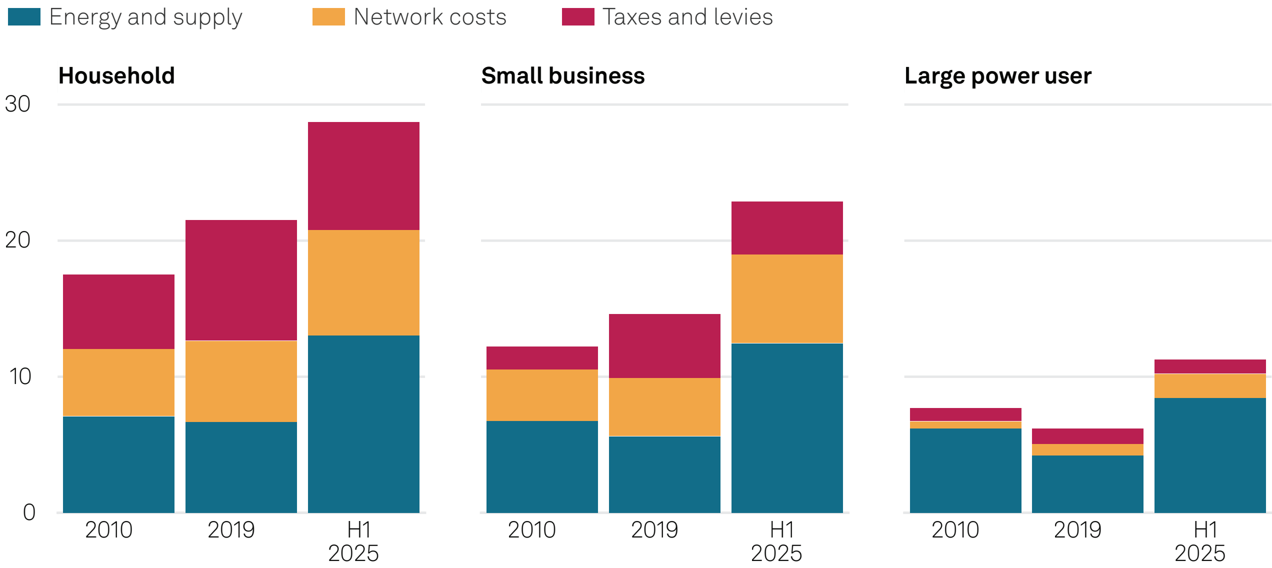
Rising US LNG imports have eased gas supply constraints in Europe, prompting gas prices to fall sharply from their 2021–23 peaks and pulling European electricity prices down from their 2022 high. However, they remain well above pre-2022 levels owing to still-elevated gas and carbon prices.

In parallel, grid costs and taxes have risen significantly over the past decade. Investments in transmission and distribution (T&D) have surged to modernize aging infrastructure, integrate new supply sources and adapt to electrification demands. With overall consumption declining over the same period, unit costs per kilowatt-hour delivered have increased sharply.

Taxation levels have also climbed, largely due to growing renewable support surcharges. Between 2009 and 2023, EU member states provided €700 billion to support electric renewables, a staggering sum that has largely been passed through to retail prices via levies and charges.

Upward pressure across the board: Wholesale, network and tax components push European retail electricity prices higher (2010–H1 2025)

EU average retail electricity price by end-user type (euro cents/kWh)



As of Feb. 12, 2026.

Sources: S&P Global Energy; Eurostat.

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Following the rise in power prices, electricity consumption across Europe declined, illustrating the significant influence of pricing on usage patterns. In 2025, the total average load remained 6% below precrisis levels, according to S&P Global Energy. In the residential sector, despite substantial government efforts to promote the electrification of heating and shield domestic users from rising bills during the energy crisis, electricity consumption per household fell by 3% from 2015–20 to 2024 as retail prices nearly doubled.

As Europe's decarbonization pathway requires widespread electrification of the economy — amid mounting consumer pressure — retail power prices have become a central focus of recent energy policies.

As Europe's decarbonization pathway requires widespread electrification of the economy — amid mounting consumer pressure — retail power prices have become a central focus of recent energy policies. The persistence of elevated retail prices has prompted several member states to shift certain environmental levies from ratepayers to taxpayers to ease burdens.

Germany eliminated its renewable support surcharge from retail bills in 2022 amid the energy crisis. Similarly, the UK decided in 2025 to shift certain renewable support costs from electricity bills to general taxation.

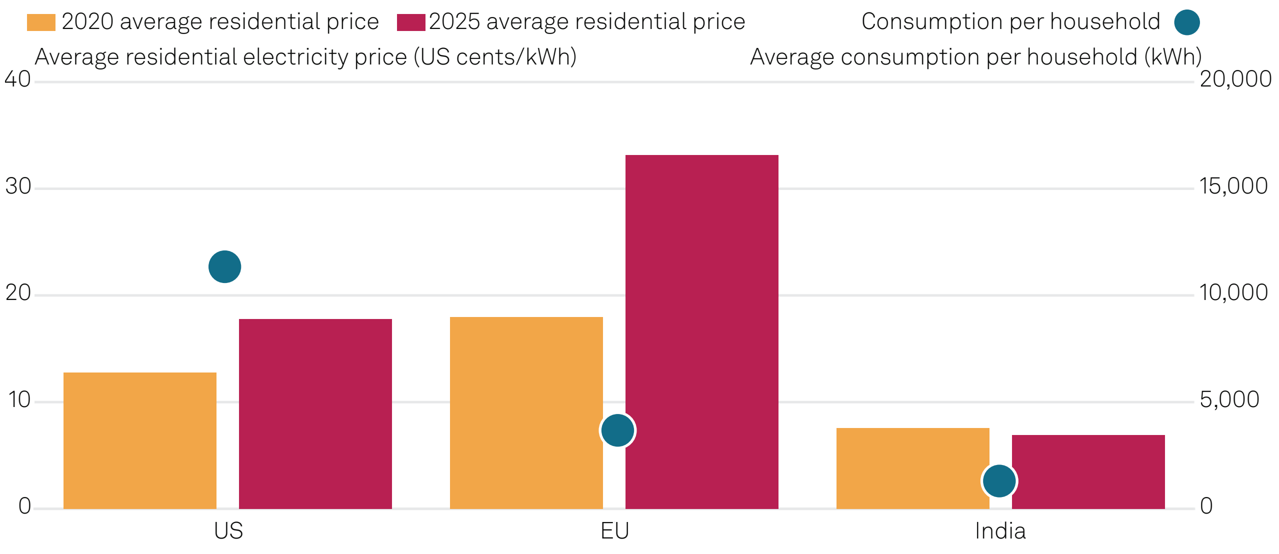
In parallel, concerns over Europe's industrial global competitiveness have led most member states to introduce preferential rates for large power users. For example, in November 2025, the German energy minister confirmed a new industrial price support mechanism aimed at reducing the burden of high electricity prices on the country's industrial consumers.

Yet fiscal constraints loom large. Countries with high public deficits cannot indefinitely subsidize power prices without cutting other spending or raising taxes. In addition, announced power expansion and decarbonization plans will be capital-intensive and require some level of state support to de-risk projects and minimize financing costs, especially for nuclear. Some governments have started to consider reallocating taxes from electricity to higher-emitting fuels to limit the strain on their budgets, but this may spark backlash.

In South Asia, domestic resources and direct subsidies remain essential for affordability

Affordability has long shaped electricity policy in South Asia, where governments have relied heavily on subsidies to keep power accessible for consumers, especially households and the agriculture sector. According to a recent study on India by the International Institute for Sustainable Development, electricity-related subsidies reached $46 billion in fiscal year 2024, or 1.3% of India's GDP, equivalent to about 3.5 US cents/kWh consumed in the country, roughly one-third of the average 10 cents/kWh cost of supply. This level of support suppresses true price signals and discourages investment in emerging or higher-cost generation technologies, reinforcing dependence on legacy fuels. Yet, despite end-user prices (after subsidies) being less than 50% of US tariffs, consumption per household remains 10 times lower. This stark contrast is primarily due to significantly lower income levels.

Rising retail electricity prices highlight affordability issues in the US, Europe; prices are stable in emerging markets such as India, but residential use is much lower due to limited overall income



As of Feb. 12, 2026.

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Affordability has long shaped electricity policy in South Asia, where governments rely heavily on subsidies to keep power accessible for consumers.

Cross-subsidy regimes amplify these distortions. Commercial and industrial consumers are charged higher tariffs to subsidize residential and agricultural users, weakening industrial competitiveness and prompting businesses to seek power alternatives outside the grid.

Utilities, meanwhile, face their own affordability constraints. Serving subsidized consumers often requires procuring expensive LNG- or oil-based power, which many utilities avoid by resorting to involuntary loadshedding. These economics also limit incentives to expand distribution networks into low-revenue or remote areas, shaping long-term demand patterns and grid reach.

Affordability pressures are even more acute in Pakistan and Bangladesh, where rising global fuel prices, heavy reliance on imported energy, currency depreciation and International Monetary Fund-driven subsidy cuts have pushed tariffs higher and strained power sector finances. In Pakistan, these pressures have directly contributed to steep retail tariff increases; coupled with frequent power cuts, they have driven households and industrial consumers toward off-grid solar photovoltaic systems. The shift was accelerated by sharply falling Chinese solar panel prices: Pakistan imported 17 GW of solar panels in 2024, reflecting a structural move toward consumer-driven energy security. To alleviate the burden on households, the government recently introduced a captive power levy on industrial consumers, redirecting revenue from captive generators to reduce residential tariffs.

In Bangladesh, similar affordability dynamics — combined with political sensitivities ahead of the February 2026 elections — have intensified pressure for tariff reform and reduced exposure to volatile international fuel markets. Pakistan and Bangladesh are prioritizing domestic energy resources to stabilize electricity costs. Pakistan is rapidly shifting from imported to domestic Thar coal, cutting fuel costs by more than half, while Bangladesh plans to reduce its LNG imports by expanding its domestic gas production.

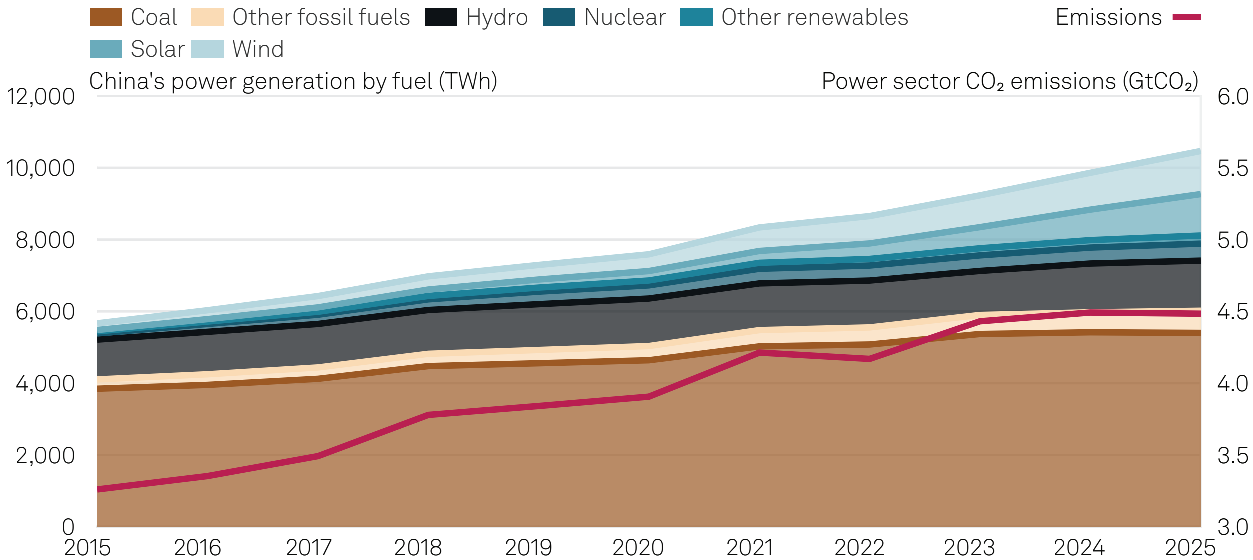
In China, power affordability is not the only challenge; decarbonization has also come into focus

Unlike the US and EU — where a larger share of fuel, grid and policy costs tends to flow through to consumers via regulated cost recovery and market-based pricing — China manages affordability through administrative sequencing of costs, price oversight and a mix of direct and indirect support tools.

China keeps consumer bills steady by shouldering up-front capital expenditure and recovering it gradually via multiyear T&D price controls. The 2023–25 cycle also unbundles pumped-storage capacity and ancillary-service charges from grid tariffs to avoid abrupt retail shocks while funding grid build-out. It backs capital-heavy plants with capacity payments and supports domestic fuel exploration and mining to keep generator input costs in check. This approach has delivered broadly stable retail tariffs since 2020, even as the system expands.

In the past few years, China's power policy has shifted from pure affordability to a dual focus on affordability and decarbonization, with reforms accelerating from 2023. The policy agenda is to keep expanding renewables, add storage and other flexibility, and update market rules while maintaining reliability and stable retail prices. The trade-off is muted scarcity pricing and a greater reliance on administrative balancing, with a larger share of cost recovery pushed to commercial and industrial users while households and agriculture remain more shielded.

China's power sector emissions have stabilized in recent years as rising electricity demand largely matches growth in zero-carbon generation



As of Feb. 19, 2026.

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Looking forward

Electricity affordability has surged to the forefront of global energy policy, as rising — or persistently elevated — retail prices now threaten the pace of electrification, digital infrastructure expansion and decarbonization ambitions worldwide. Governments face mounting pressure to respond through measures such as shifting levies from household consumers to taxpayers or other end-users, reforming tariffs, adjusting supply expansion plans, or cutting other public spending. However, fiscal constraints, mounting public debt and political backlash make these interventions increasingly fraught and difficult to sustain. The underlying drivers of price increases — volatile commodity costs, grid investment backlogs, capacity-market tightness, legacy renewable surcharges and regional-specific factors such as wildfire liabilities or LNG dependence — remain diverse, meaning regulatory responses will likely stay fragmented across jurisdictions. This fragmentation risks perpetuating an uneven competitive landscape, distorting investment signals, delaying the construction of critical infrastructure and ultimately slowing progress toward a reliable, low-carbon electricity future.

Upstream is back … but different

The social license to pursue oil and gas operations has returned, but new realities are constraining the sector.

Bob Fryklund, Vice President, Chief Upstream Strategist, S&P Global Energy

Nick Sharma, Executive Director, Global Upstream, S&P Global Energy

Dan Pratt, Head of Upstream, S&P Global Energy

Judson Jacobs, Executive Director, Upstream Technology, S&P Global Energy

Raoul LeBlanc, Vice President, Upstream Research and Analysis, S&P Global Energy

New global realities — an oil demand plateau, supply chain volatility and investor demand for cash — are shaping the revival of oil and gas production. Success requires concentrating capital in fewer basins, moving faster on go/no-go decisions, converting resources into reserves in under five years and making contractual terms more attractive to investors. To stay competitive with falling-cost alternatives, operators need to aggressively deploy and adapt advancements in AI, data and automation to cut risk, shorten cycles and reduce costs. At the same time, they must rebuild supply chains with creative long-term service partnerships to avoid cost escalation. Finally, they must reallocate capital from transformative but uncertain bets on clean energy investments while decarbonizing operational emissions pragmatically.

Highlights

Companies are pursuing more disciplined and selective exploration strategies, focusing on proven basins and leveraging AI and digital technologies to accelerate workflows, reduce costs and improve subsurface understanding.

The oil and gas industry is facing a shift from resource replacement and growth to revenue replacement, with investor expectations for high cash returns now central to business models.

While investment in clean energy has grown, oil and gas companies are prioritizing incremental decarbonization over transformative investments, as low-carbon ventures have proven less profitable.

Three new realities are shaping global upstream

As the energy transition grows more troubled, the world has recognized a greater role for oil and gas in the future. Headlines suggest upstream oil and gas has regained political support, but the business has permanently changed. Three new realities are shaping the future of upstream.

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- **Revenue replacement versus resource growth:** After 150 years of nearly unbroken growth, market maturity and new technologies are leading oil demand toward a plateau and likely decline in consumption. This means the industry will need to find, develop, produce and deliver less oil in the next 20 years than in the past 20 years. It will also need to replace the profits oil provides to remain viable in equity markets and keep governments funded.

- **Supply chain security and cost competitiveness:** Oil and gas producers have relied heavily on the globalization of manufacturing and trade to deliver low-cost, abundant energy. This is being complicated by increasing friction in global supply chains and the political and regulatory volatility the world is experiencing.

- **Investor-first doctrine:** Shareholder demands for outsized cash disbursements are now fully built into business models across the oil and gas value chain. According to S&P Global Energy, operators now send on average 30% of their free cash flow back to investors, with some offering more than 45%.

As a result of these three trends, S&P Global Energy expects the revival of upstream to look quite different from previous upcycles over the past several years.

S&P Global Energy expects the revival of upstream to look quite different from previous upcycles over the past several years.

A disciplined exploration revival based on converting resources to dollars

Companies must plan for the reality of a plateau or decline in oil consumption as oil's monopoly over transport fuel ends. But the goodbye will last decades, and new resources must be found or produced from existing discovered-but-undeveloped resources to offset the inherent decline that every oil asset experiences. While many key international oil companies and a new contingent of highly capable national oil companies (NOCs) are in the process of rebuilding their exploration portfolios, the current "land grab" is surprisingly limited. Companies have not leveraged the strong cash flows of the past five years to ramp up activity and pursue breakthrough discoveries in dozens of frontier basins. Rather, they are carefully parsing risk and focusing primarily on a concentrated set of highly prospective basins.

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New strategies focus on compressing the exploration cycle (prospect generation to block award to discovery and first production). The race is on to expedite workflows, lower costs and reduce risk. Different strategies are evolving, split between proven basins and frontier basins. This is leading to a set of breakaway companies, challengers and laggards.

- The breakaway global integrated oil companies (GIOCs) excel at capturing significant resources and converting them into dollars. They leverage a concept of planning for success based on deliverability, commerciality and scale. They also leverage massive computing power and AI.

- The challengers are predominantly NOCs that are ramping up their capabilities and competing directly with breakaway companies for acreage, assets and market share.

- The laggards are companies resetting their upstream/exploration capabilities, often after redirecting capital and focus away from exploration toward low-carbon businesses. Many of these companies are building new portfolios based on a mixture of field redevelopment and exploration. However, in exploration, they often find themselves late entrants in emerging basins.

While some players have decided to focus on fewer geographies and basins, others have left the game altogether. As the list of geographies and basins selected for exploration has become more concentrated, so has the landscape of companies involved in exploring them. Small and medium-sized independents have been important drivers of frontier exploration, but over the past five years, the number of players in that segment has halved due to ongoing industry consolidation and a lack of new companies.

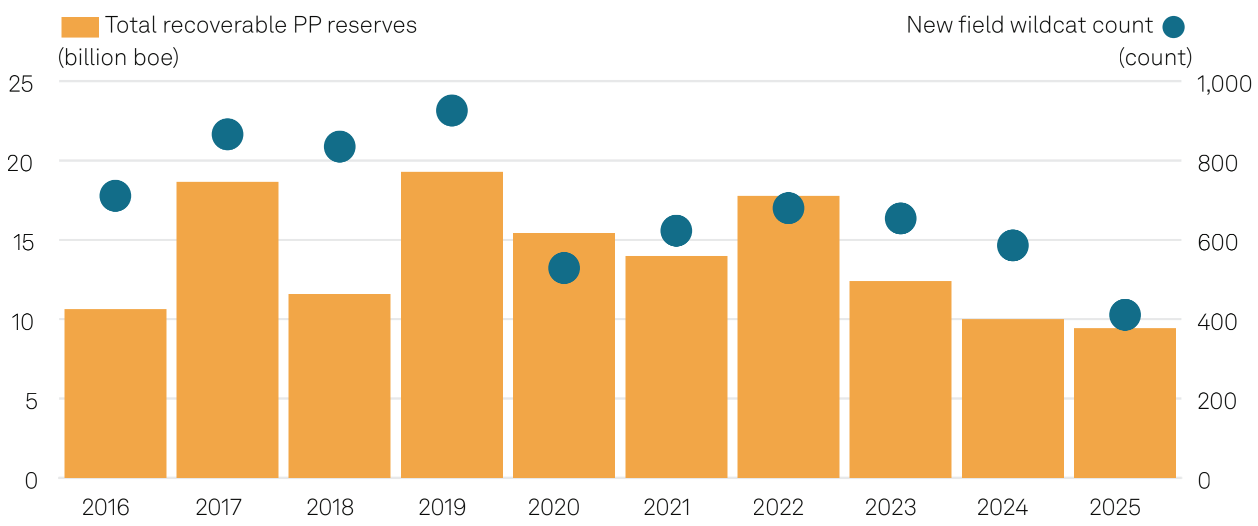
The battleground for these companies is dominantly offshore and ranges across the globe. Broadly speaking, these companies focus on gas from Asia, North Africa and the Eastern Mediterranean, and liquids from the Western Hemisphere, South Atlantic, Norway and the Middle East.

Basins are selected using above- and belowground criteria: the scale of potential, the ability to quickly convert discoveries into production, the presence of multiple play/prospect types, competitive fiscal terms with clear stabilization clauses that protect investors, and proximity to markets. Given the high standards and focus on capital discipline, we expect exploration spending and wildcat wells will recover only modestly, remaining far below the highs of the last supercycle in 2014.

This more selective approach is making it difficult for many countries — especially those without a proven petroleum system — to attract investment. In response, the contractual terms offered by many governments have been shifting in favor of oil explorers. This is particularly true in older petrostates, which face diminishing revenue from declining production. More than 40 countries are offering exploration opportunities in 2026. Given the lackluster results in some bid rounds, further concessions are likely necessary as countries compete for scarce capital.

In addition to bid rounds, there is increasing use of memoranda of understanding and technical study agreements by several of the majors to stretch their exploration dollars and get an exclusive look at prospective areas. Such agreements allow operators to quickly make go/no-go decisions and concentrate on the areas of greatest prospectivity. A few companies conducting business this way will not necessarily move the global metric needle, but it is a model primed for wider industry adoption.

Global conventional annual discovered volumes and new field wildcat count are both on the decline



Data compiled Feb. 25, 2026.

PP = proved and probable.

Data from CERA Upstream Solutions, global excluding North America Lower 48.

Source: S&P Global Energy.

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Industry bets on AI to unlock and speed up resource commercialization and compete with new energies

Partially offsetting these restrained activity levels are two key areas that are affecting the speed of decision-making and the cost of finding and developing resources.

- **Subsurface understanding:** The oil and gas business remains one of the riskiest on the planet. Even in well-established basins, success rates are often below 50%, according to S&P Global Energy data. In frontier areas, the success rate is less than 20%. With the drilling of a deepwater well potentially costing over $100 million, technology that can help reliably appraise the earth's subsurface can have a massive impact on a company's bottom line.

- **Engineering production and development technologies:** Developing even medium-sized discoveries often consumes billions of dollars and more than five years. AI and machine learning tools are being used to accelerate the design and performance of company assets for savings and efficiencies.

At every stage of the exploration process — from prospect generation to discovery to first production — geoscientists and engineers have massive amounts of data to sift through. Using AI allows interpreters to build models of the subsurface more quickly, test more theories and assess risks in more ways. Improvements in subsurface footage and speed of analysis can help operators capture opportunities, lower finding and development costs, and leverage smaller workforces. Industry investment in exploration technologies such as seismic and subsurface modeling has increased 22% over the past three years, according to S&P Global Energy, with an even stronger shift toward digitalization, as well as AI- and machine learning-driven seismic processing and interpretation. These new capabilities have the potential to improve workflow efficiency by 95% to 98%, based on S&P Global Energy data, closely supporting the more agile and active exploration models that companies are adopting. Even larger gains may come from developing already-discovered resources as companies leverage their gargantuan data sets to train models and automate operations.

It is uncertain exactly how useful AI will be to the heterogeneous and complex physical systems of oil and gas upstream developments, but the industry is actively pursuing paths to reduce cost structures to deliver energy more efficiently.

Operators at risk from deglobalizing world and supply chain pressure

Upstream companies continue to adapt to rapidly changing economic structures. For many years, oil and gas producers optimized their supply chains to take advantage of globalized operations and deliver low-cost energy. Steel produced in Argentina was used in platforms designed in the UK and constructed in South Korea before being deployed to Brazil.

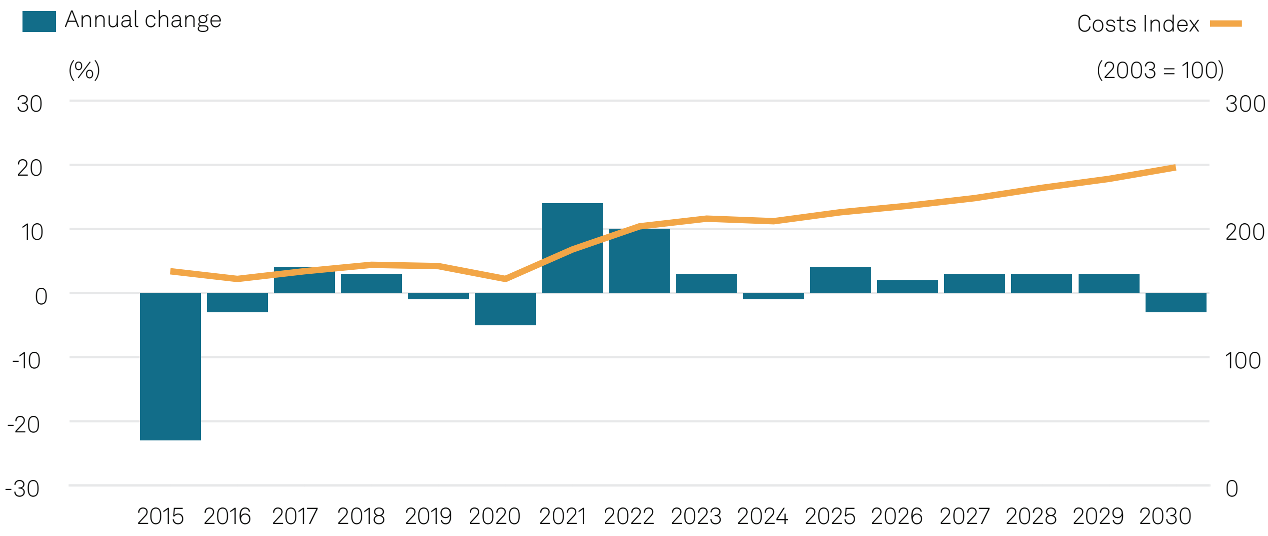
That world order has shifted, and the supply chain has been reset. Revised trade rules and heightened geopolitical uncertainty are forcing upstream players to reconsider their strategies, and the quest for speed is reviving the hunt for more local supplies and suppliers. The key question is whether companies will behave reactively, hoping for a return to “normalcy,” or proactively, investing now to build supply chains better suited to today’s reality.

Upstream companies are reacting differently based on their global portfolios, sizes and skill sets. One increasingly common response is for companies to collaborate through new corporate entities. For example, Shell PLC and Equinor ASA recently combined their North Sea assets into a joint venture called Adura Energy Ltd. Strategically, Adura was formed to extend the life and value of a mature basin by consolidating assets, lowering costs and improving operational flexibility while continuing to supply domestic oil and gas to support UK energy security. As a purpose-built consolidation vehicle, as opposed to a startup explorer, Adura should be able to compete more effectively in the lower-growth, higher-cost upstream environment of the North Sea.

Meanwhile, the system is under pressure from persistent costs. Despite the expected slowdown in project activity, upstream costs will continue to increase in 2026. Although tariffs are a major driver of this uptick, in some service segments, the main culprits are supply chain disruptions and switching costs. In other segments, such as oilfield equipment and services, persistent inflation is driven by tariffs on steel and long lead times for specialized equipment.

Upstream costs expected to increase in 2026 despite project activity slowdown

Upstream Capital Costs Index



Data as of the fourth quarter of 2025.
Data from CERA Upstream Solutions.
Source: S&P Global Energy.
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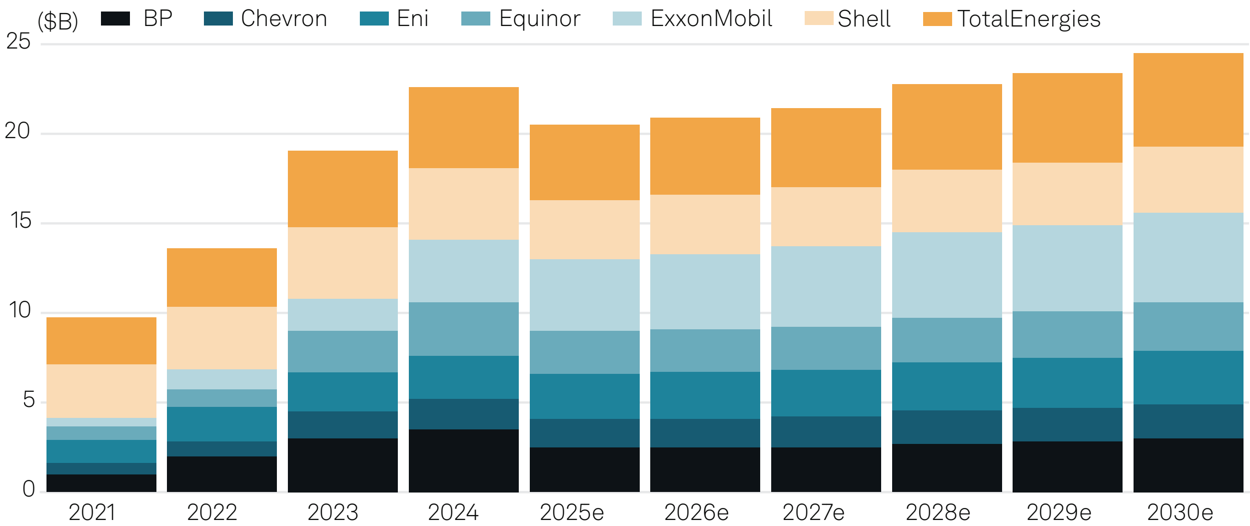
Oilfield service companies are central to this issue, and partnerships with upstream producers are key to performance. Service companies are adapting to tariffs by negotiating with customers and revising sourcing strategies. Trade barriers will continue to strain supply chain relationships, particularly between the US, China, Mexico and Canada. Even with an expected slowdown in project activity in 2026, prices are likely to remain elevated. The oilfield service sector continues to consolidate, and forming partnerships with operators to diversify and expand their offerings is a critical strategy for survival since the supercycle ended in 2014. With fewer competitors in some segments and less equipment, service providers will likely maintain pricing and focus on utilization. For operators, forging long-term partnerships to secure capacity, rather than expecting a reduction in costs, will be essential.

Expect incremental decarbonization over transformative investment

Another important element of the rejuvenated upstream business model is the rebalancing of capital away from the more transformative clean energy businesses. A consensus has emerged that the global adoption of clean energy is more an evolution than a revolution, and that businesses are not profitable enough to replace earnings from oil and gas production through eco-friendly investments. Global clean energy investments continue to grow, exceeding fossil fuel investments for the first time in 2025, according to S&P Global Energy data. However, the overwhelming share of this investment is in electricity, rather than oil and gas, which has tended to favor molecule-based solutions such as biofuels, hydrogen, and carbon capture, utilization and storage. After expanding at a compound annual growth rate of 34% from 2021 to 2024, low-carbon investments by GIOCs fell by almost 10% in 2025. Downward revisions to expenditure for the rest of the decade are likely as well.

A consensus has emerged that the global adoption of clean energy is more an evolution than a revolution.

Global integrated oil companies are spending less on low-carbon investment



Data as of Feb. 12, 2026.
e = estimated.
Based on company guidance and S&P Global Energy estimates. The low-carbon sector includes manufacturing, generation and transmission of alternative energies, including renewables and biofuels; batteries, storage and lithium extraction; alternative transportation and infrastructure for electric vehicles; energy efficiency; carbon sinks and other decarbonization efforts; gas as it pertains to the generation, transmission and distribution sectors (but not upstream or LNG); carbon capture and storage; and emissions reductions in oil and gas operations. Includes capital expenditure and research and development spending; excludes M&A.
Source: S&P Global Energy CERA, Upstream Companies and Transactions Service.
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However, even as these companies emphasize their core oil and gas businesses, they continue to make efforts to deliver their products with lower greenhouse gas emissions (Scope 1 and Scope 2). The technologies and programs aimed at reducing methane emissions are at critical mass, and methane monitoring and abatement are now routine for many field personnel. This trend is not universal, however, and variability among companies and regions remains significant. Nevertheless, many companies, and often the largest producers, are starting to report substantial improvements in reducing venting and fugitive methane. S&P Global Energy's Permian Basin upstream methane emissions benchmark estimates that intensity in 2024 was 0.44% per barrel of oil equivalent, about half the amount of 2022.

Looking forward

It will take several years to see whether oil and gas companies' updated strategies, rush for new acreage, de-risking of the supply chain and investment decisions pay off. Will the challengers and laggards catch up or surpass the breakaway companies? How quickly will the use of AI, machine learning and adaptive AI become ingrained in the exploration process? Will the industry implement zero-methane standards and embark on a CO_2-reduction pathway? Only time will tell.

Europe's policy reset: A competitiveness turn and a more durable role for gas

Despite a fracturing consensus on decarbonization, there are plenty of investment opportunities in Europe.

Coralie Laurencin, Head of European Gas, Power and Carbon Policy, S&P Global Energy

Catherine Robinson, Executive Director Global Gas Cross Commodity Research, S&P Global Energy

European countries are resetting established energy commitments. The long-standing consensus on rapid decarbonization has fractured. This policy reset comes as geopolitical tensions and rising affordability concerns push climate and the environment down voters' list of priorities. At the political level, the long-term ambition to decarbonize the economy remains, but the mantra is now "do no harm." A slower, more affordable transition is the implicit plan to improve Europe's competitiveness. Yet electrification and the deployment of renewables are still viewed as critical elements of Europe's energy security.

Europe's quiet energy and climate policy reset

Governments have revisited energy and climate legislation and softened targets. The result is reduced incentives to cut emissions and increased policy divergence across Europe. Legislative reviews designed to ensure that costs remain acceptable are likely to continue, although there is a lack of consensus on what acceptable means. As a result, while simplification of the regulatory environment is a declared political goal, the landscape for investors is becoming more complex.

Highlights

Europe's energy strategy is undergoing a hard but largely quiet reset. A series of small but consequential policy adjustments are reshaping the energy landscape. Geopolitics, economic strain and affordability pressures have broken the decarbonization consensus, pushing governments to soften targets and rewrite policy.

These shifts add up and imply new expectations of slowing electrification, steadying gas demand, the moderating reduction of oil demand and rising policy risk.

Yet Europe remains one of the world's largest and most valuable low-carbon markets. Opportunities remain strong across renewables, energy storage, gas-fired generation, grids and LNG. Investment in gas and low-carbon energy is accelerating, even in a tougher policy environment. The European power sector is set to attract $1.5 trillion in investments over the next five years, 50% more than in the previous five years. Under pressure from rising energy costs, Europe's energy policy changes are a reset, not a reversal.

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- **Carbon markets:** Several countries are concerned about the impact of carbon costs on industry and the public. The Emissions Trading System 2 (ETS2) — the carbon market for buildings and road transport — was delayed to 2028, and discussions on the future of ETS1 and ETS2 are expected to be contentious.

- **The transport sector:** Regulation of road transport emissions is another point of tension between the established climate agenda and the protection of Europe's industrial base. In 2025, the emissions requirements placed on car manufacturers were softened, and the EU is on track to cancel the 2035 ban on the sale of internal combustion engine cars. Concerns about the cost of sustainable aviation fuels suggest that related targets may be reviewed soon.

- **Long-term targets:** The tension between cost and climate was also apparent in discussions on a 2040 emissions target. The EU approved an ambitious headline target — a cut of 90% below 1990 emissions — but the agreement was conditional on outsourcing part of the target to non-EU countries using international credits.

Policy reset underway: Europe revisits its energy and climate policy

	Changes to legislative framework	Under discussion
Buildings	• Cancellation of national boiler bans • Delayed start of ETS2	• Measures to manage ETS2 price
Industry	• Failure to implement the EU low-carbon hydrogen targets at the member-state level • Cap on industrial electricity prices in some member states	• Measures to manage ETS1 price • Relaxation of power procurement rules for hydrogen production
Transport	• Cars and vans: Delayed emissions reduction mandate; cancellation of 2035 ban on sales of ICEs • Delayed start of ETS2	• Measures to manage ETS2 price • Reduction of clean fuel mandates for aviation

As of Feb. 12, 2026.
ETS1 = the EU's carbon market, which applies to electricity and industrial installations; ETS2 = the EU's new carbon market, which will apply to road transport and buildings from 2028; ICE = internal combustion engine.
Source: S&P Global Energy.
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Slower electrification and more affordable gas supply

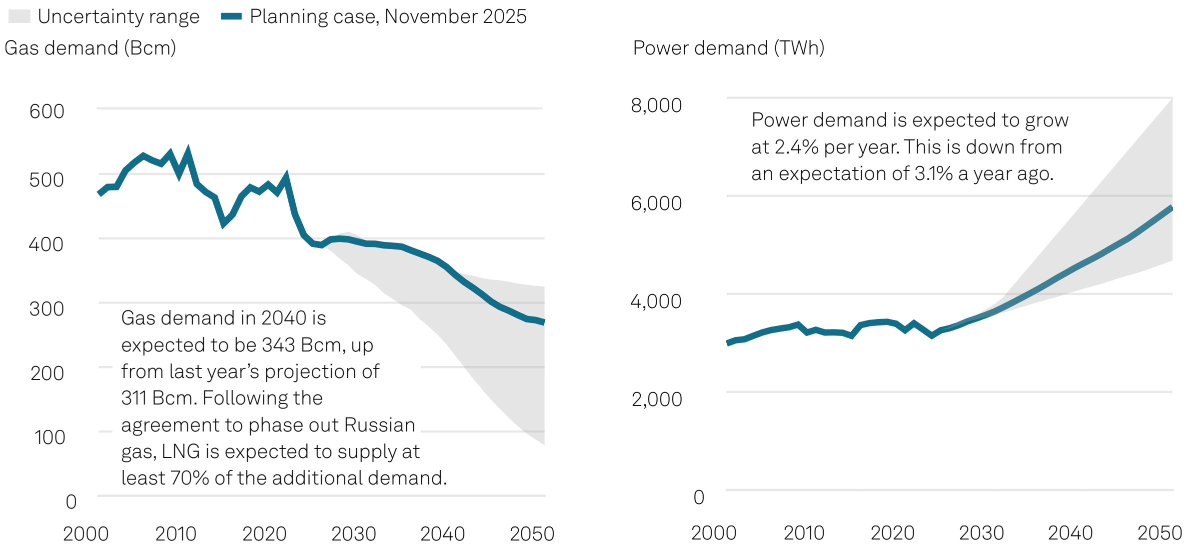
The reset changes the outlook for oil, gas and electricity demand in the next 10 years.

Increased electricity use is central to the EU's legislative framework, but the reality does not yet match the planning. In contrast to markets in the US, China and India over the past two decades, power demand in Europe has been falling due to a combination of energy efficiency, weak economic growth and high prices. The high up-front cost of electrification is delaying expensive last-mile technologies such as electrolytic hydrogen, heat pumps for household use and electrification of industrial heat.

This situation is increasingly acknowledged by policymakers who are reducing electricity demand projections, as Germany and France have done. In time, we anticipate that lower demand expectations will translate into lower auction volumes for renewable capacity.

With slow electrification, European gas demand is expected to remain broadly stable through the mid- to late 2030s. This represents a major shift, as high gas prices since the 2022 energy crisis have reduced demand by about 20%, according to S&P Global Energy. More affordable gas will support consumption.

Power and gas demand trajectories are heading in different directions



Data as of Feb. 12, 2026.

Charts show the gas and electricity demand outlook for the EU, Norway, Switzerland and the UK.

Source: S&P Global Energy.

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Resilient investment opportunities remain in Europe's energy sector

Even though electricity demand growth expectations have fallen, S&P Global Energy anticipates that more than $1.5 trillion will be invested in Europe's electricity sector in the next five years, a 50% increase from the previous five years. Europe's clean investment opportunity is more than double that of North America's and about 40% of China's. Opportunities persist in renewables, nuclear, energy storage, gas-fired generation capacity, transmission and distribution grids, and LNG infrastructure. The landscape is challenging, but Europe welcomes investments.

Despite the reset, the low-carbon transition in power is irreversible. In 2025, 72% of power in Europe came from renewables or nuclear. By 2030, the share of decarbonized power production is forecast to rise to 80%.

Europe will comprise 17% of clean energy capacity investment to 2030

	China	Other Asia-Pacific	Europe	North America	Latin America	Middle East	Africa
Additions of clean energy capacity by 2030 (GW)	2,291	873	825	367	158	144	105
Share of investment	48%	18%	17%	8%	3%	3%	2%

Data as of Feb. 12, 2026.

Technologies include renewable power (wind, solar photovoltaic, biomass, hydropower), nuclear, geothermal, electrolyzers and storage. In Europe, solar capacity is forecast to increase to 650 GW by 2030 (up 260 GW from end-2025 levels) while wind rises to 400 GW (up 105 GW) and battery capacity reaches 160 GW (up 125 GW).

Source: S&P Global Energy.

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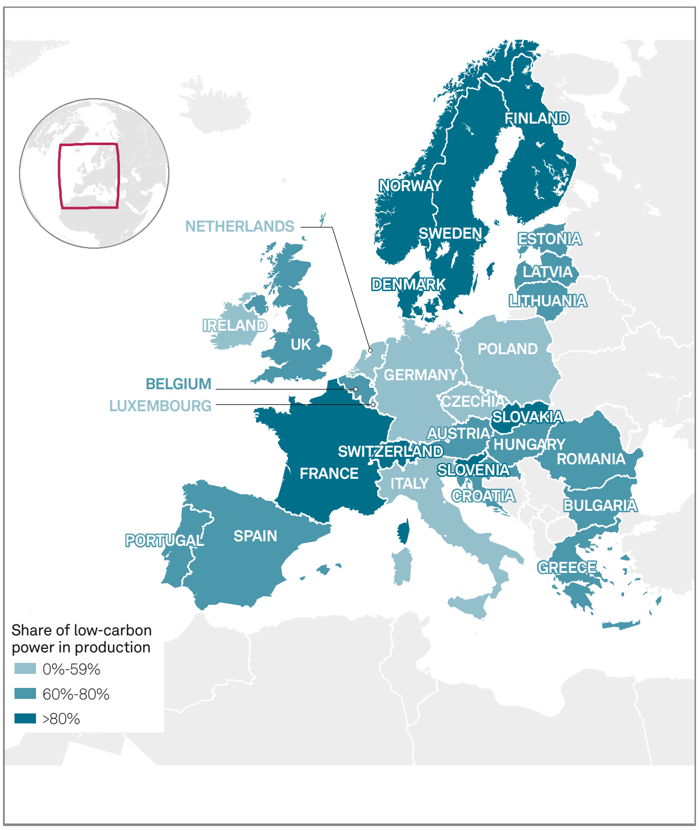
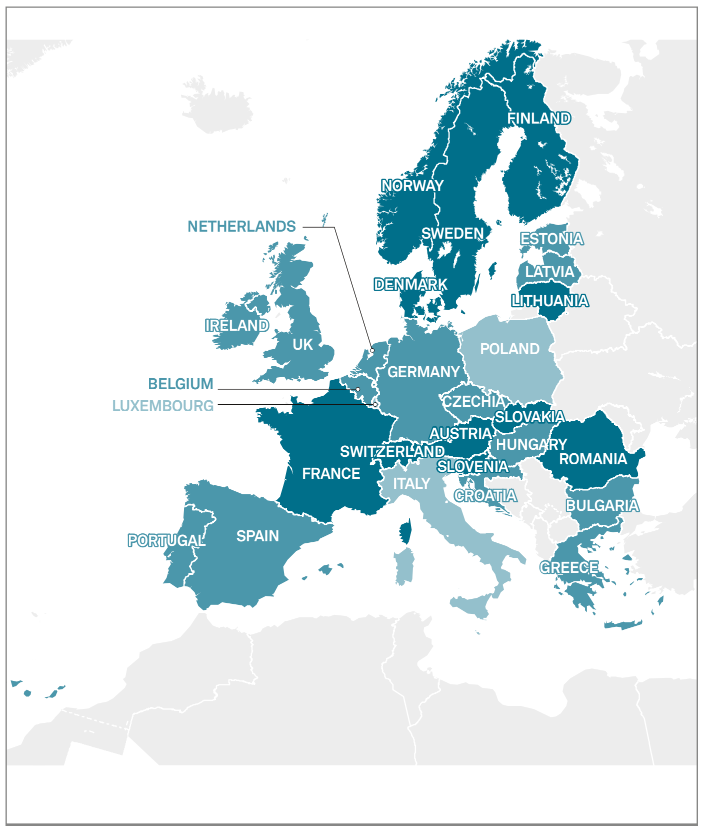
Decarbonization of electricity production in Europe is irreversible





Data compiled Feb. 4, 2026.

Source: S&P Global Energy: 262594-03.

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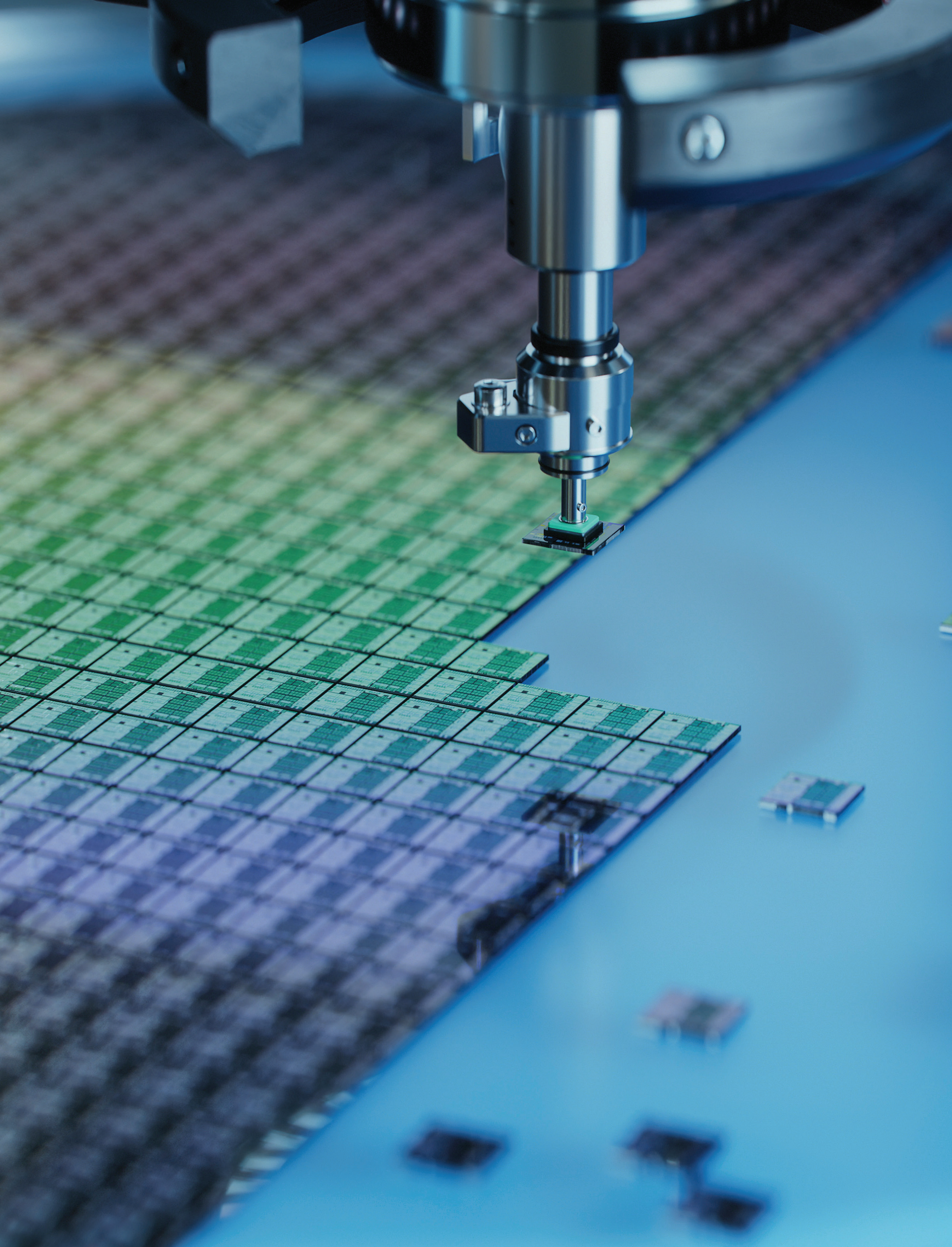
Looking forward

How far and how fast will the energy and climate policy reset go? There remains political tension between those committed to decarbonization and those concerned about cost and competitiveness. However, the tone of recent discussions suggests that protecting industry is now the primary objective. While falling gas and oil prices will reduce pressure on European policymakers, the focus on competitiveness and affordability will shape post-2030s rules and the associated investment landscape for the next 15 years.

The reset is softening targets and adding uncertainty through frequent policy reviews, but the underlying trend will not change. Europe remains committed to adding renewables, reducing energy imports and cutting emissions — just at a more manageable pace.



Has the electrotech age arrived?

Nations are racing to gain energy autonomy and economic growth in the electrotech age.

Chengyao Peng, Head of APAC Power and Renewables, S&P Global Energy

Bing Han, Head of China Power and Renewables, S&P Global Energy

Edurne Zoco, Head of Clean Technologies and Supply Chains, S&P Global Energy

Roger Diwan, Head of Energy Capital Insights, S&P Global Energy

In the electrotech age, the US, China and Europe will likely face real competition for energy autonomy, striving to reduce reliance on rivals and decouple strategic sectors. This push for resilient grids and electrotech supply chains is intensified by the ongoing AI race and looming national security concerns. Yet, over time, the landscape may shift toward competitive interdependency, as nations remain interconnected through technology, supply chains and global markets. Lasting success will belong to those balancing energy autonomy with industrial adaptability, forging ecosystems that thrive amid rivalry and pragmatic collaboration in an electrified, innovation-driven economy.

Highlights

The electrotech age marks a new strategic era for the US, China and Europe to compete in providing abundant and affordable electrons backed by resilient grids and local supply chains to fuel economic growth.

The AI race between the US and China has intensified reliance on electricity supply and industrial infrastructure, which are now central to economic growth and national security.

The nations' interests and strategic goals are intertwined as they strive to reduce dependence and perceived vulnerabilities to compete in and win the AI race.

In the electrotech age, power sector investment underpins economic growth and national security

While the US aims for energy dominance by growing domestic hydrocarbon production and restoring supply chain sovereignty through Donald Trump's 2025 "big, beautiful" budget bill and National Security Strategy, China's rapid renewables deployment, grid expansion and centralized industrial strategy give it a clear competitive edge in the near term. For Europe, this escalating rivalry means navigating between two giants while ensuring its own grid and industrial upgrades keep pace.

Renewables and nuclear offer the promise of reliable, low-carbon power. At the same time, modernized grids are critical to integrating them and ensuring supply stability amid increasing electrification, which can directly impact a nation's digital and industrial capacity.

Electrotech supply chains for critical minerals, batteries and advanced manufacturing components are becoming arenas of strategic competition. The ability to secure, scale and adapt these supply chains will influence energy security and the speed at which new technologies can be deployed and commercialized. As cleantech supply chains are increasingly leveraged as a geopolitical tool, resilience and flexibility become as important as cost and efficiency.

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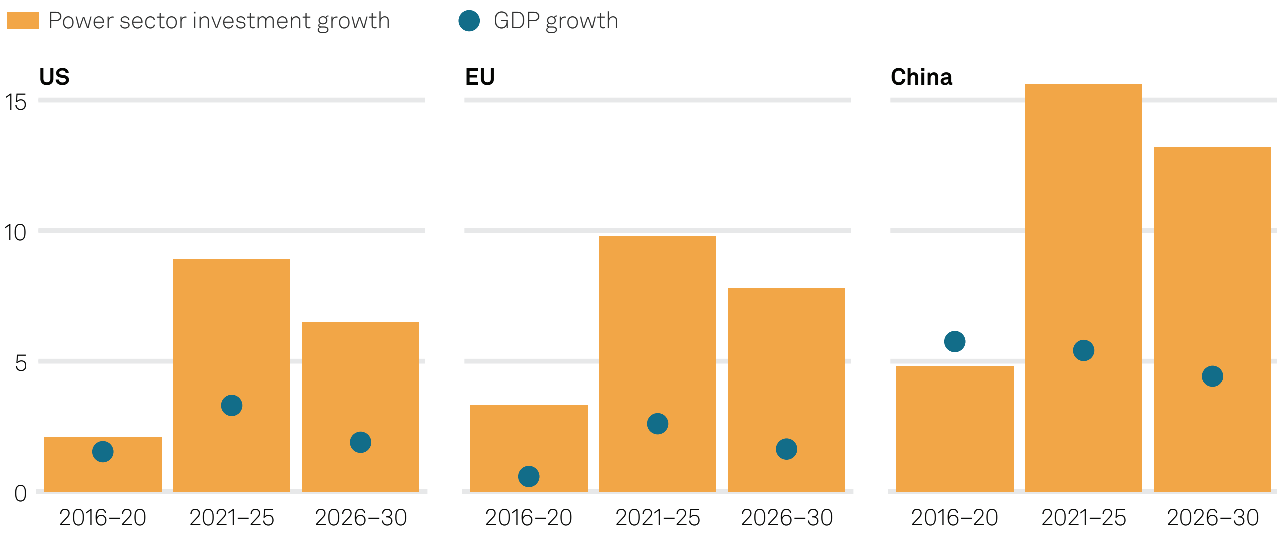
The AI race between the US and China has intensified reliance on electricity and industrial infrastructure, which are now central to economic growth and national security. Emerging high-value sectors such as AI computing centers and advanced manufacturing have higher power intensity than traditional industries, driving power demand growth to outpace GDP growth amid industrial upgrading. Yet a mismatched pace of power supply expansion or grid infrastructure development creates critical constraints that limit the capacity release and large-scale layout of these emerging industries. A persistent gap between power sector investment growth and actual demand growth further worsens this mismatch. Only the dynamic alignment of power supply, grid development and sector investment with emerging industry demand can unlock power's full supporting role for sustainable economic expansion and industrial chain upgrading.

The AI race between the US and China has intensified reliance on electricity and industrial infrastructure, which are now central to economic growth and national security.

Power infrastructure investment mismatch as economic growth leans on electricity

Power sector investment and economy growth by major region (%)



As of Feb. 6, 2026.

Sources: S&P Global Energy; International Energy Agency.

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Supply chain resilience, grid modernization and cybersecurity have become the core pillars for competition

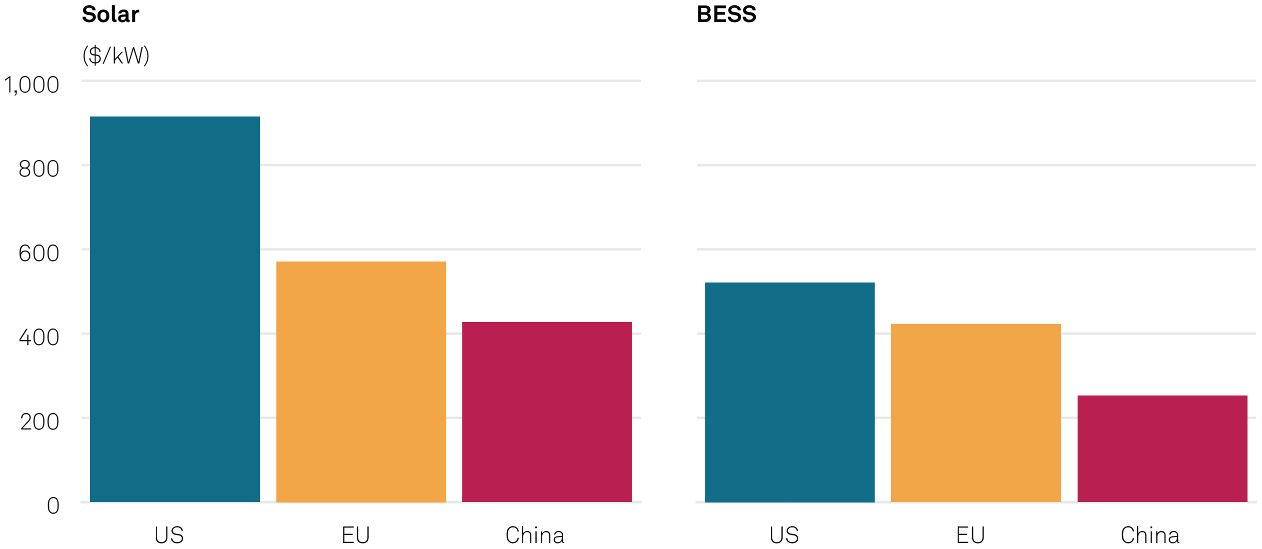
The interplay among electrotech supply chain resilience, grid modernization and cybersecurity will be decisive in shaping which nation can power and propel its digital ambitions.

Is supply chain localization or alliance the way to go?

The large-scale build-out of renewables, nuclear or even gas is viewed as challenging in the US and Europe, owing to hard-coded supply chain bottlenecks, trade restrictions on imported components or added costs due to local requirements. Growing restrictions on Chinese suppliers in several Western markets have exposed the significant variability in the cost of solar and battery deployment across China, the US and Europe. Supply chain localization is the low-hanging fruit of industrial policies to reduce dependence; however, setting up supply chains takes time and requires power.

Cost of solar panels, batteries deployed in China, US and EU vary due to supply chain readiness

Cost of cleantech in major regions ($/kW)



As of Feb. 6, 2026.

BESS = battery energy storage system.

Source: S&P Global Energy.

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The electrotech supply chain is also highly reliant on critical minerals, where China currently holds clear dominance, influencing supply security. As these minerals are not only vital to the electrotech sector but also underpin a wide array of industries and national security considerations, the US aims to establish a new alliance from excavation, mining and refining to reduce dependence on China.

Investment in the grid is critical in the electrotech age

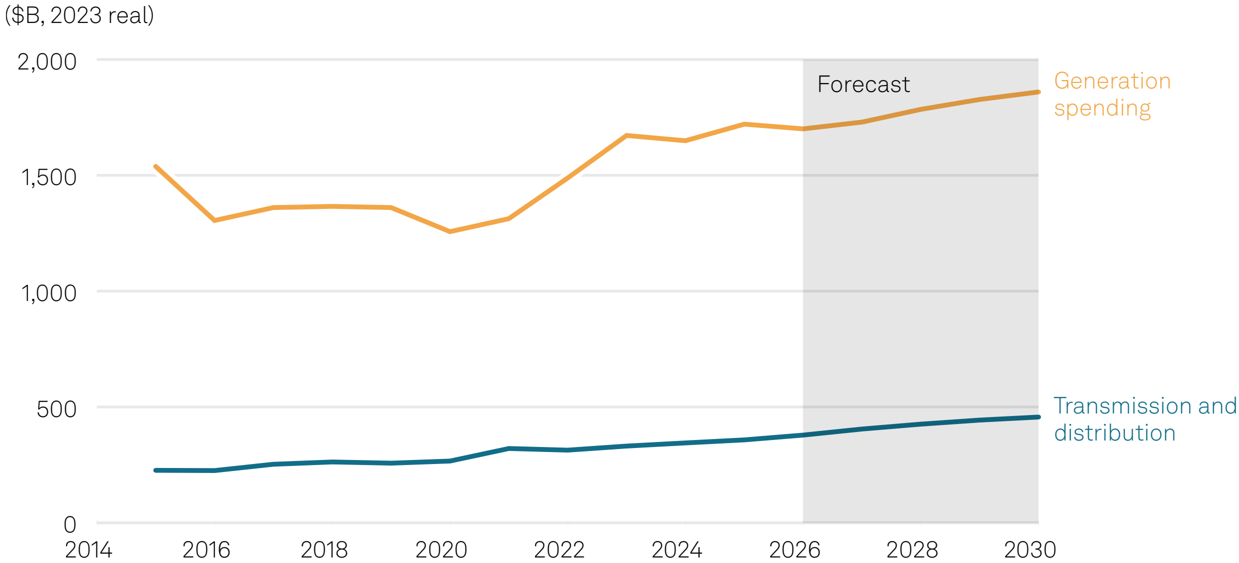
The grid is no longer passive enabling infrastructure; it has become critical. The large-scale energy expansion needed to meet AI-driven demand can only progress as fast as the grid allows. Yet grid investment has trailed both decarbonization and energy innovation for decades, creating a structural bottleneck. As electrification, decarbonization and digitalization accelerate, power systems risk instability unless grids evolve in parallel.

> The large-scale energy expansion needed to meet AI-driven demand can only progress as fast as the grid allows.

According to S&P Global Energy, global transmission and distribution (T&D) spending will keep rising through 2030, but at a slower pace than investment in power generation, much of which flows into clean technologies that require fundamentally different grid designs. Underinvestment, combined with rapid clean energy deployment, is tightening constraints. From hyperscalers to utilities and policymakers, calls are growing to remove permitting, tax and manufacturing barriers, signaling broad recognition that grid modernization is now a national competitiveness issue.

Power grid lacks investment but is key to electrification

Global total energy generation spend vs. transmission and distribution spend ($B, 2023 real)



As of Feb. 12, 2026.

Source: S&P Global Energy.

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Regional challenges vary. In Europe, 40% of grid assets are more than 40 years old and built for a fossil fuel system, demanding accelerated investment and greater resilience. In the US, explosive data center growth driven by AI and cloud computing is straining aging local grids, raising risks of capacity shortages. In Asia-Pacific, the central priority is financing and constructing new transmission infrastructure to keep pace with rapid demand growth.

Because building new lines faces long lead times, new technologies such as grid-forming inverters, AI-driven forecasting and solid-state transformers are emerging to unleash capacity and optimize existing assets. Nations that scale these grid technology solutions will quickly gain a strategic competitive advantage in the electrotech age. Rapid growth in stand-alone and colocated storage tenders (e.g., Spain, China and India) will also play a larger role.

Cybersecurity concerns loom as the energy system digitalizes

Digitalization also introduces new vulnerabilities. Cybersecurity-related incidents worldwide have heightened concerns and pushed cybersecurity higher on policy agendas.

Since 2022, the US has constructed a multilayered legislative and regulatory framework to reduce reliance on foreign suppliers considered high risk. This effort began with tax credit exclusion rules targeting batteries and critical minerals and has since expanded into restrictions on software, electronics and vehicle control systems linked to certain jurisdictions, triggering changes in procurement strategies.

Europe is moving in a broadly similar direction. In January 2026, the EU introduced the Cybersecurity Act 2 (CSA2), which significantly expanded the EU's cybersecurity framework by adding new oversight mechanisms and nontechnical criteria for critical sectors, including the electricity sector. Echoing the logic of the EU's 5G Toolbox, CSA2 heightens scrutiny of suppliers from countries without EU data-adequacy agreements. If fully implemented, the framework could significantly exacerbate supply chain imbalances, given the concentration of manufacturing capacity in a few key countries.

Looking forward: Are nations drifting apart and intensifying competition in the electrotech age?

Europe, China and the US each offer unique strengths in the electrotech age. Europe leads sustainable industry transformation through renewable integration and grid modernization but faces slow demand and supply chain issues. China excels in large-scale manufacturing and cleantech, rapidly deploying solar and batteries, although its expansion has led to overcapacity and grid challenges. The US stands out for advanced innovation and a vibrant tech ecosystem; sustaining leadership will require increased alignment of power, grid investment and industrial capacity with evolving industry needs.

Energy as industrial strategy: US, EU, China strive to secure fuels and scale frontier tech

Market	Policy focus	Industrial strategy
US	Domestic fossil fuel dominance	• Boost domestic oil and gas production • Expand LNG export capacity
	Frontier technology innovation	• AI, SMR, geothermal, fusion
	Supply chain de-risking	• Phase out China-sourced critical components • Build US-EU allied critical mineral supply chains
EU	Energy security	• Reduce Russian gas dependence • Diversify LNG suppliers
	Grid modernization	• Address aging grid infrastructure • Accelerate cross-border grid interconnection
	Cleantech autonomy	• Secure critical mineral supply chains • Foster collaboration between equipment-makers
China	Decarbonization commitment	• Consolidate cleantech supply chain leadership • Support low-carbon alternatives (green hydrogen, CCUS)
	Energy security	• Coal power flexibility retrofit • Advance UHV transmission for power dispatch
	Global cleantech layout	• Export cleantech and grid solutions • Build cross-border energy interconnections with ASEAN, central Asia, etc.

As of Feb. 12, 2026.
SMR = small modular reactor; CCUS = carbon capture, utilization and storage; UHV = ultrahigh voltage; ASEAN = Association of Southeast Asian Nations.
Source: S&P Global Energy.
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There is no clear winner.

The race is not about decoupling from each other, but about building a foundation of energy abundance, affordability and technological autonomy that secures a nation's place at the forefront of global competition. Although near-term action plans seem to drift nations apart and aim to establish or enhance their own autonomy, some level of interdependence with global partners remains inevitable. Nations' interests and strategic goals are intertwined as they strive to reduce dependence and perceived vulnerabilities.

What emerges is a new industrial logic: competitive interdependence. Neither a clean split into blocs nor a return to globalized ease, but a complicated middle where nations try to insulate strategic sectors even as technological and market ties remain too embedded to unwind. The result will not be a winner-takes-all. The electrotech age is, ultimately, a test of coherence between energy policy and industrial strategy, and between digital ambition and physical capacity.

Bridging the gap: Advancing African energy infrastructure projects

Expanding access to finance and increasing project bankability are essential to unlock investment, expand access to energy and unleash economic growth.

Daniel Evans, Vice President, Global Head of Fuels and Refining Research, S&P Global Energy CERA

Gary Clark, Associate Director, Europe and Africa Clean Refined Products, S&P Global Energy, Platts

Samira Mensah, Managing Director, Research and Analytics for Emerging Markets, S&P Global Ratings

Highlights

Africa's population is set to rise by nearly 1 billion people by 2050. This is projected to more than double energy demand, making expanded energy access essential for economic growth and improved living standards.

Existing infrastructure deficits, combined with increased demand, mean accelerating energy infrastructure investment must be a strategic priority for governments across the continent.

Closing the gap will require deeper capital markets, stronger alignment between governments and the private sector, and a larger pipeline of bankable projects to avoid entrenched energy poverty.

Africa's demographic boom is colliding with an energy infrastructure system already under strain. As energy demand accelerates and investment along energy supply chains fails to keep pace, the continent faces a stark challenge: It must transform abundant investment appetite into bankable, financeable projects, or risk deepening energy poverty and lost economic potential.

Africa's infrastructure deficit

Congested, fragile and inefficient supply chains and a lack of critical infrastructure are constraining economic growth and development in Africa, creating energy security risks.

Governments and investors must expand and upgrade energy infrastructure across the continent as rapid population growth and rising energy demand intensify pressure in the coming decades.

Ready to dive deeper? Turn the page and scan the QR code to explore interactive data on spglobal.com and discover related stories.

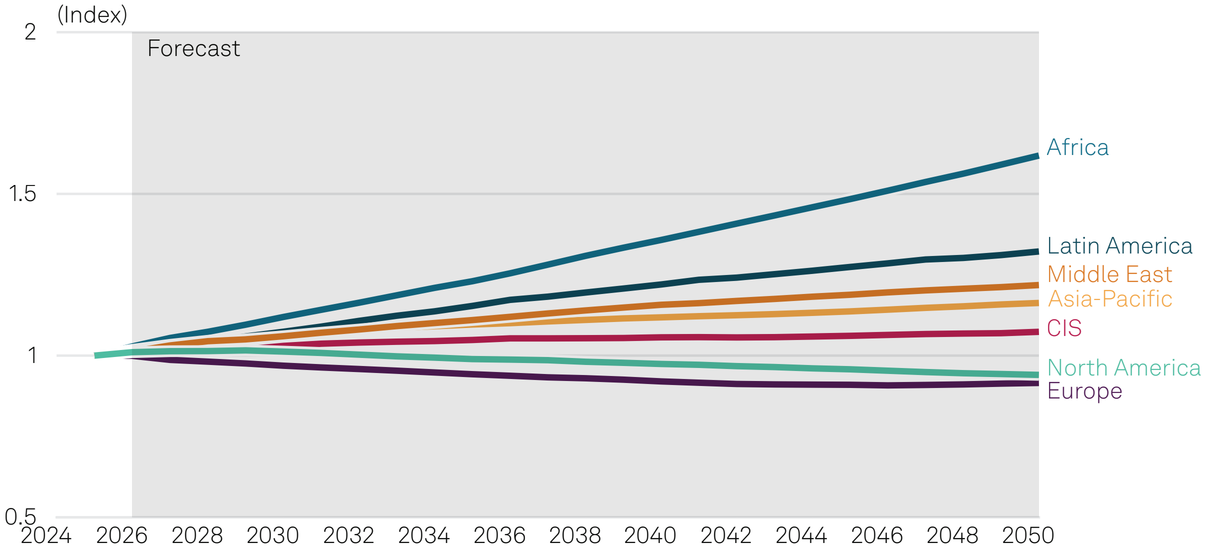
Five trends underpin the case for investment:

1. Energy demand growth

Africa's energy demand will double by 2050, according to S&P Global Energy, driven by rapid demographic growth, urbanization and economic development. Consumers and businesses will require more energy and more infrastructure to deliver it reliably.

Africa's energy demand is set to expand at a faster rate than any other region in the next 25 years

Primary energy demand by region indexed to 2025 levels



As of Feb. 12, 2026.

CIS = Commonwealth of Independent States.

Source: S&P Global Energy.

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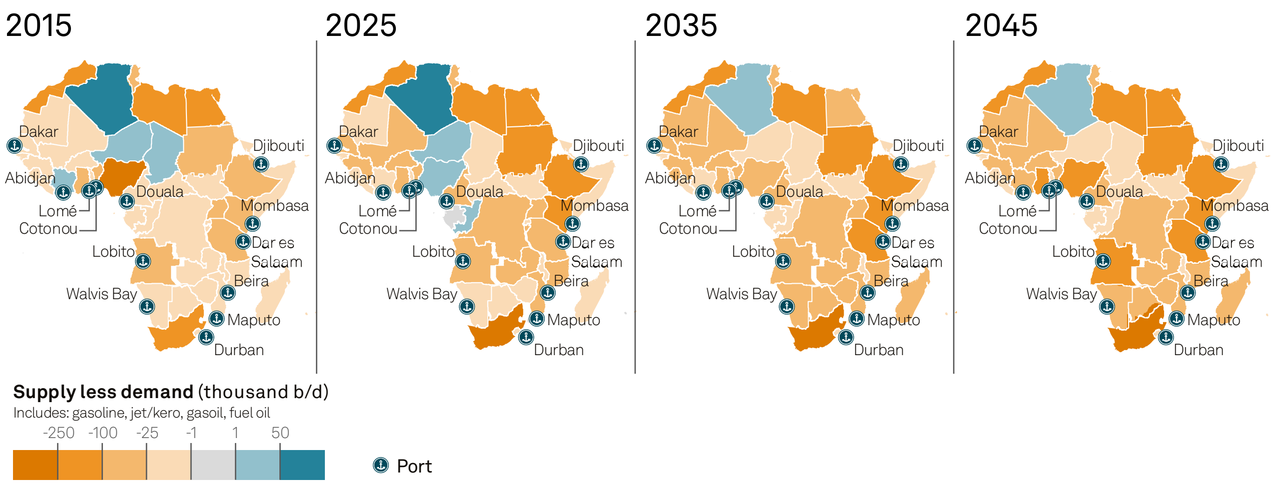
2. Increasing energy imports

Africa's refined products demand has more than doubled since 1990, while refining capacity has increased by less than 10%. If the Dangote refinery in Nigeria had not been commissioned, capacity would have contracted by more than 20% over this period. As refinery closures and underinvestment persist, countries across the continent increasingly rely on imported fuels. This shift places growing pressure on ports, storage and import infrastructure, a trend that will continue unless investment accelerates. Gas import infrastructure faces similar constraints as demand rises faster than domestic supply.

Africa's refined products demand has more than doubled since 1990, while refining capacity has increased by less than 10%.

By 2035, every African country except for Algeria will be a net importer of refined products



Data compiled Sept. 11, 2025.

Source: S&P Global Energy.

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3. Transition to clean cooking

Approximately 900 million Africans lack access to clean cooking fuels, according to research from the World Liquid Gas Association and S&P Global Energy, exposing households to health risks and environmental damage. Policymakers are increasingly positioning LPG as a key solution. However, LPG demand outpaces supply, requiring imports that existing infrastructure struggles to support. Expanding urban storage and distribution networks, as well as rural road connectivity, will determine how quickly access to clean cooking can increase.

Approximately 900 million Africans lack access to clean cooking fuels.

4. Access to electricity needs to improve

Sub-Saharan Africa has the lowest electricity consumption per capita globally. Tariffs are often set below cost-recovery levels, leading to unreliable cash flows and hindering maintenance and investment in new projects. Unplanned outages and aging infrastructure result in economic losses, with studies estimating losses between 1% and 5% of GDP in affected countries.

5. Grid reliability is insufficient

Power systems across Africa rely heavily on single-generation sources, aging assets and underdeveloped transmission and distribution networks. Many areas remain unserved, while frequent power cuts force industrial users to rely on costly oil-powered self-generation. Strengthening grid reliability through diversification, network expansion and targeted upgrades remains essential to improve energy security and reduce costs.

Why African infrastructure projects fail

Despite the scale and urgency of Africa's infrastructure needs, translating demand into delivery remains difficult. Too many energy, transport and water projects stall at the feasibility stage, not because the need is unclear, but because financing is scarce and business cases lack bankability. With a limited pool of capital available, only the most bankable initiatives advance, forcing hard prioritization and sidelining many projects that are economically viable and socially desirable.

These challenges are compounded by the long timelines inherent in infrastructure development. Projects often span multiple political cycles, diluting urgency when short-term political wins are elusive. Misalignment between governments and private investors further slows progress: Public authorities prioritize broad social impact, while private capital focuses on risk-adjusted returns. Bridging this divide is critical. Without collaborative frameworks that deliver outcomes for all, investment will remain constrained. A lack of scale and a perception of elevated, and sometimes unmanageable, risk continue to reinforce these barriers, limiting the flow of capital precisely where it is most needed.

How to accelerate infrastructure investment

African infrastructure can be accelerated by:

- Coordinated energy master planning and developing regional pricing hubs
- Expanding access to finance
- Focusing on the bankability of projects

Energy master planning and regional pricing benchmarks

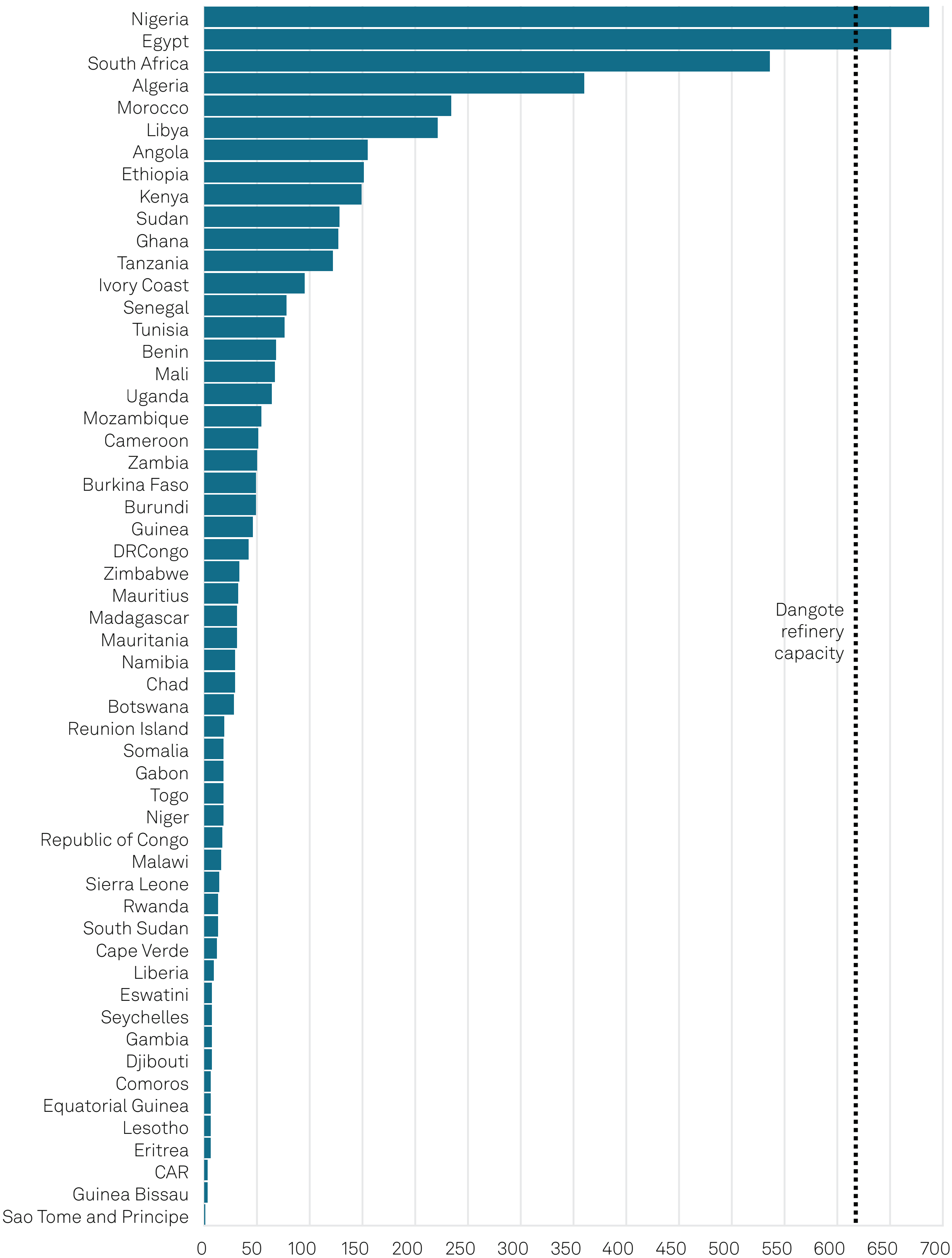
Energy master planning can help resolve the misalignment between short-term priorities and long-term objectives by providing a clear investment framework that aligns governments, developers and investors. For governments, it ensures that privately proposed projects support broader development goals. For developers and investors, a credible master plan provides confidence that projects requiring years to build and decades to operate can remain viable across multiple political cycles.

Scale remains a central challenge for many African countries, where domestic demand is often insufficient to justify global-scale investments.

Scale remains a central challenge for many African countries, where domestic demand is often insufficient to justify global-scale investments. While most countries are net importers of refined products, national-level demand rarely supports investments of the magnitude seen at Nigeria's Dangote refinery.

Demand in most of Africa falls short of volumes needed to justify global-scale investment

Main oil product demand (thousand b/d)



As of Feb. 12, 2026.
Main oil product demand includes gasoline, jet/kerosene, gasoil/diesel and residual fuel oil.
Source: S&P Global Energy.
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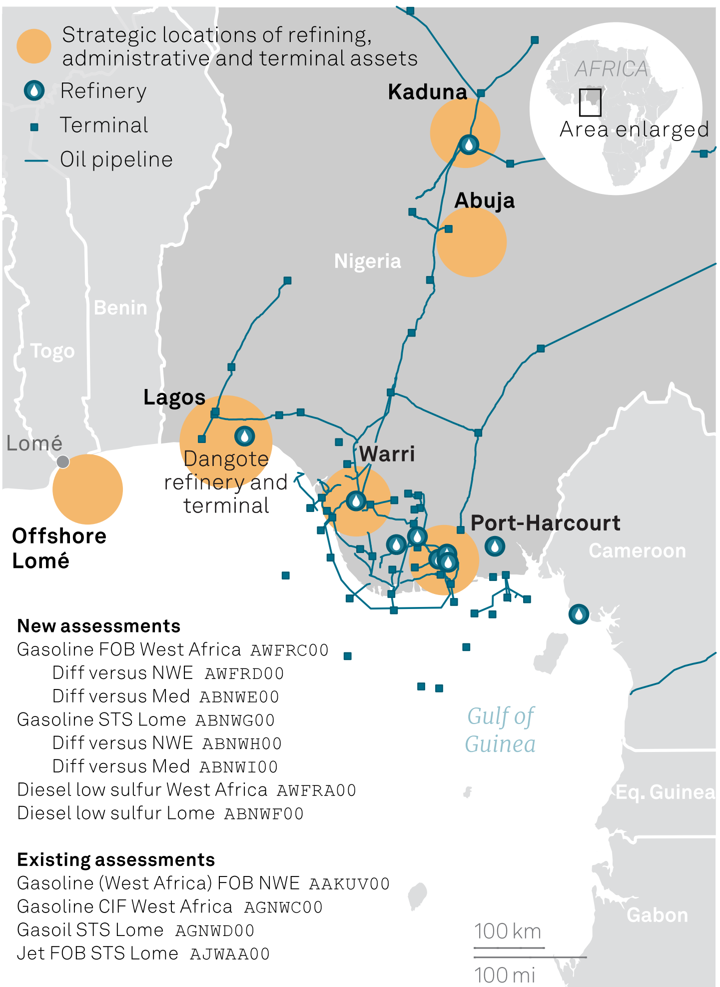
Energy master planning can overcome this constraint by promoting regional integration and ensuring infrastructure is developed to serve regional, rather than purely national, markets. Aggregating projects across borders creates scale, diversifies risk and supports more efficient capital allocation.

Project clustering also facilitates the development of energy hubs. This can be enhanced further by bringing greater transparency to energy trade. Platts, a part of S&P Global Energy, is supporting the development of a West African trading hub by launching refined products benchmarks that facilitate transparent pricing for buying, selling and trading, around which spot market liquidity can grow and risk management tools can be developed. Benchmarks also help integrate regional markets into global trade flows. Transparency attracts trading activity, which supports more infrastructure investment to attract more trading activity.

Fueling the future: West Africa refiners enter the fray



Data as of April 25, 2025.

Source: S&P Global Energy.

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Expanding access to finance

Despite strong investor appetite, many African sovereigns face constrained fiscal capacity and high debt servicing costs that limit public infrastructure investment. While lower global interest rates may ease near-term pressures, a complex set of financial, regulatory and execution barriers continue to amplify economic vulnerabilities. Addressing these constraints is essential to unlocking the continent's growth potential.

Developing deeper capital markets is central to this effort. Outside South Africa, markets remain fragmented and shallow. Countries such as Nigeria, Egypt, Côte d'Ivoire, Kenya and Morocco have meaningful domestic funding sources, but financing costs are often high. Regulatory frameworks that encourage listings and capital formation without overburdening issuers would help unlock domestic savings and improve liquidity through greater debt and equity issuance.

Well-functioning capital markets channel savings into productive investment, reinforcing a virtuous cycle of growth and job creation. Building this depth requires sustained commitment. Multilateral lending institutions play a critical role by expanding market access through local-currency lending, guarantees and risk mitigation tools, alongside regulatory reform and capacity building. Bond issuance and risk mitigation tools provided by market-linked investments enhance market liquidity and funding opportunities for the private sector. However, achieving long-term success depends on a comprehensive, ongoing strategy that includes a variety of initiatives. The issuances by the African Development Bank and the African Export-Import Bank in Ghana, Egypt and South Africa offer scalable solutions for financial asset creation. Additionally, the Islamic Corp. for the Development of the Private Sector, a subsidiary of the Islamic Development Bank, has played a key role in establishing a sharia-compliant market in the West African Economic and Monetary Union.

Blended finance can further mobilize private capital by improving scale and risk-sharing as concessional funding declines. However, persistent barriers — including weak institutions, limited first-loss capital, foreign exchange risk, insufficient project scale and poor project preparation — delay financial close and raise execution risk. Overcoming these constraints will require scalable blended finance structures and targeted risk mitigation tools such as credit guarantees and currency hedging.

Ultimately, stronger capital markets are a critical enabler of infrastructure investment, expanding the pool of available capital and supporting a larger, more resilient project pipeline.

Creating bankable projects

Expanding access to capital alone is insufficient. Making infrastructure projects investable requires a shift in how projects are structured and presented. Bankability in Africa depends not just on project economics, but on a credible end-to-end framework for managing risk over the full life of an asset. The constraint is rarely the need for infrastructure. Rather, it lies in demonstrating how to mitigate political, regulatory and financial risks in environments where uncertainty remains elevated.

A critical requirement is resilience across political cycles. Investors prioritize business cases that support long-term value creation over early cash flows that undermine full life-cycle returns. Projects able to demonstrate durability across changing policy regimes are better positioned to attract patient capital and a broader lender base.

Strong governance and regulatory stability are equally central to bankability. Predictable, transparent and durable regulatory frameworks reduce perceived risk and underpin investor confidence. In practice, long-term capital is difficult to mobilize without a stable policy environment that allows returns to be assessed with confidence over multidecade horizons.

Currency risk remains a defining challenge. Many projects are financed in US dollars but generate revenue in local currency, exposing cash flows to exchange-rate volatility. Addressing this mismatch through hedging, local-currency financing or risk-sharing structures is essential, particularly given investors' need for certainty around dividend repatriation.

Ultimately, improving project bankability hinges on stronger alignment between stakeholders. Accelerating delivery will require deeper collaboration between governments and the private sector, including regionally coordinated policy frameworks that enable scale, early regulatory engagement to support projects across their full life cycle and greater openness to private participation. At the same time, public sector stakeholders must mobilize a wider pool of capital — including pension funds, development finance institutions and multilateral banks — while encouraging structures that balance financial returns with broader economic and social outcomes.

Looking forward

Africa's infrastructure challenge is no longer about identifying needs or mobilizing interest; it is about execution, credibility and alignment. In the years ahead, capital will increasingly flow to markets that demonstrate policy stability and regional coordination, and to projects designed to withstand political and financial risks. Governments that act decisively to deepen capital markets, strengthen regulatory frameworks and unlock scale will attract investment. Investors, in turn, will reward transparency, bankability and long-term value creation. The trajectory is clear: Africa's infrastructure gap will close fastest where stakeholders move beyond diagnosis, align incentives and focus relentlessly on delivery.

Plugged in and politicized: Copper in a fractured world

The convergence of decarbonization and digitalization is politicizing the supply chains that power the modern economy.

Francesca Price, Senior Principal Analyst, Critical Mineral Markets, S&P Global Energy

The rapid expansion of electrification and AI infrastructure is transforming copper and other critical minerals into strategic pillars of economic and national security. Yet supply chains remain geographically concentrated and politically exposed, amplifying vulnerabilities in an already fragmented global order. In response, governments are deploying policy levers, including export controls, strategic financing and allied partnerships, to secure access and build resilience as critical minerals shift from niche inputs of the energy transition to core instruments of geopolitical competition and economic statecraft.

Highlights

S&P Global projects global copper demand to rise about 50% to approximately 42 million metric tons in 2040 from 28.4 million mt in 2025, reflecting copper's role as the essential conductor linking power generation, transmission and digital infrastructure.

However, a shortfall of about 10 million mt is forecast by 2040 without major investment. Declining ore grades, rising costs, long mine development timelines and geopolitical risks constrain primary supply growth.

With rapid demand growth projections, monopolistic players and a geographic concentration of supply, governments worldwide are acting decisively to safeguard access to critical minerals such as copper.

The copper paradox

While critical minerals have been an important narrative arc since the early 2000s, the rise in energy transition efforts over the past decade has spurred demand for many commodities. Among the minerals underpinning this transformation, copper occupies a uniquely paradoxical position.

In some jurisdictions, including Australia and the EU, copper has not met formal thresholds for "criticality," owing to its relatively diversified global production base and established market liquidity. Yet its functional importance cannot be overstated. Copper is the connective tissue of electrification, embedded in power grids, electric vehicles, renewable energy systems, data centers, and the semiconductors and cooling infrastructure that sustain AI expansion.

Copper is the connective tissue of electrification, embedded in power grids, electric vehicles, renewable energy systems, data centers, and the semiconductors and cooling infrastructure that sustain AI expansion.

Ready to dive deeper? Turn the page and scan the QR code to explore interactive data on spglobal.com and discover related stories.

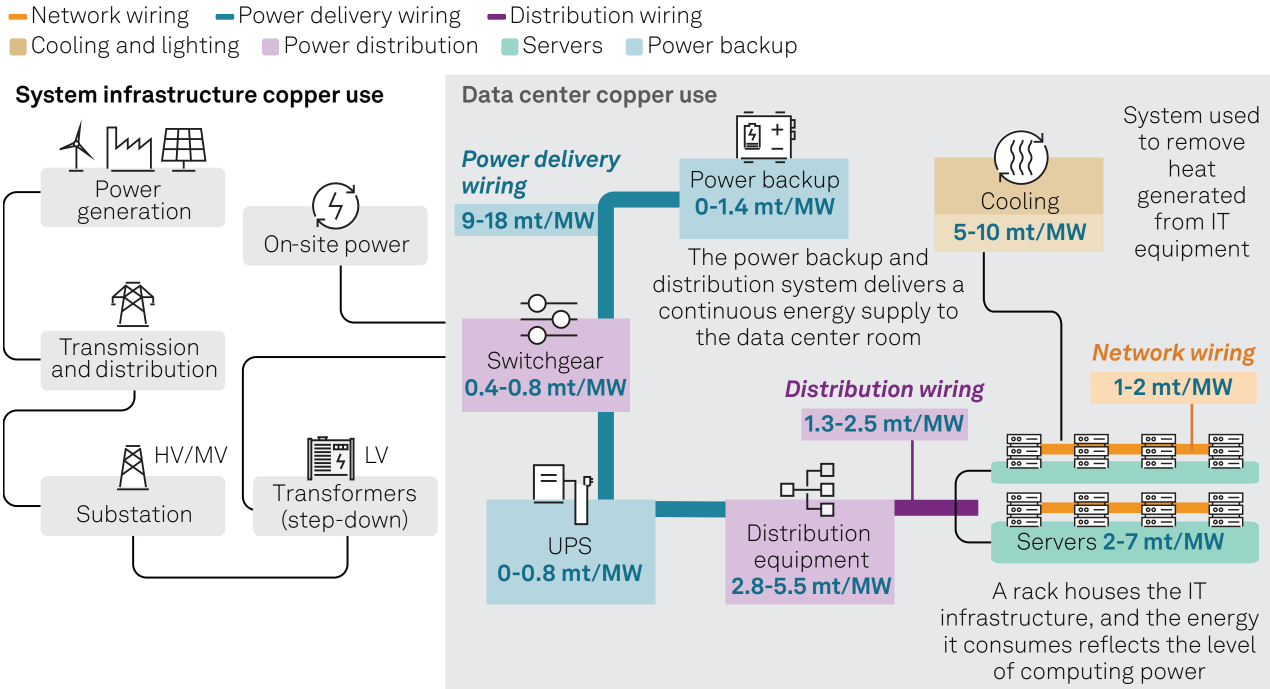
As demand projections climb, concerns are mounting about whether new copper projects can be developed quickly enough to avoid supply deficits. Long lead times, declining ore grades, permitting delays and capital intensity compound these anxieties. Reflecting this strategic calculus, some governments have begun to recalibrate their positions. In 2025, the US moved to designate copper as a critical mineral, signaling a growing recognition that ubiquity does not preclude vulnerability in an increasingly fractured and competitive world.

The metal behind the machine: Copper in the age of AI

In 2025, half of US GDP growth was attributed to AI spending — largely on computer chips and data center infrastructure. As data centers are electricity-intensive, their proliferation is driving investments in copper, an essential element of the electric grid systems that support them.

Copper is the backbone of power delivery, cooling systems and IT infrastructure in data centers

Typical data center ecosystem and associated copper intensity



As of Jan. 8, 2026.

HV = high voltage; MV = medium voltage; LV = low voltage; UPS = uninterrupted power supply; mt = metric tons.

Ranges consider redundancy configurations of N, N+1 and 2N.

Sources: S&P Global Market Intelligence 451 Research; interviews with industry sector experts.

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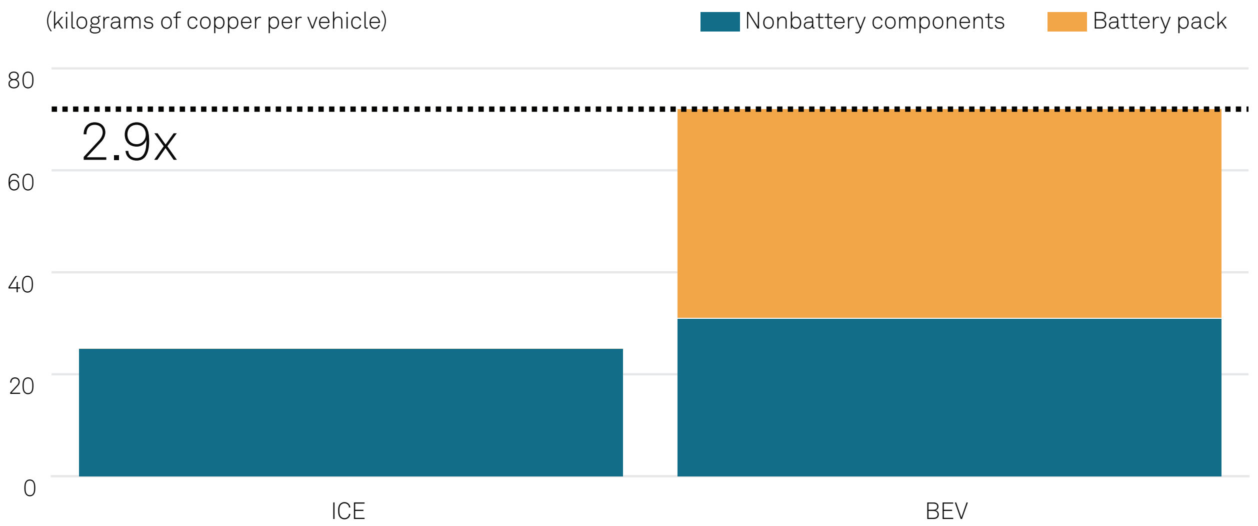
While AI is creating a new vector of copper demand, “core economic” electrical applications — circuit boards, connectors, and components in consumer and industrial electronics — account for most global copper consumption. Appliances such as refrigerators, air conditioners and heating systems also rely on copper for motors, compressors and wiring. With growing urbanization and rising incomes in developing economies, this segment is forecast to expand gradually.

Transportation is an increasingly important demand driver, particularly with the global push for electrification. Electric vehicles require 2.9 times more copper than a conventional car, and the number of EVs is growing.

EVs use 3 times more copper than conventional combustion vehicles

Global weighted average of copper intensity in passenger vehicles (kilograms of copper per vehicle)



Data compiled July 10, 2025.

ICE = internal combustion engine; BEV = battery-electric vehicle.

The weighted average copper intensity was calculated by dividing global copper demand by global vehicle sales for each technology. For nonbattery components, the calculation used the copper content of major systems such as the powertrain system, transmission system, chassis, electronic controllers and body, adjusted for vehicle size by country. For battery components, the calculation considered average battery capacity and cathode material preference by country.

Source: Argonne National Laboratory (2025).

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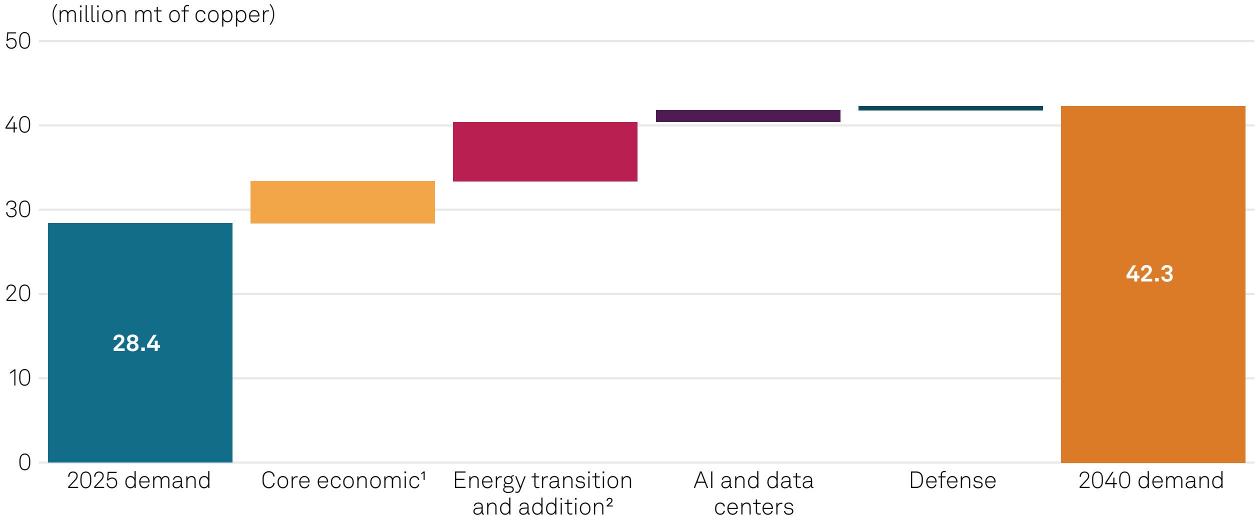
Closely related is the growth of renewable energy systems, where copper is used in wind turbines, solar installations, grid connections and energy storage. The broader push toward decarbonization and grid reinforcement has become a major structural driver of copper demand.

As defense strategies shift toward network-centric warfare and AI-enabled capabilities, the copper intensity of military equipment has also increased. Although defense represents a relatively small share of total global copper consumption in aggregate terms, it is strategically significant, relatively price-inelastic and can provide incremental demand during periods of rising geopolitical tension.

The broader push toward decarbonization and grid reinforcement has become a major structural driver of copper demand.

The energy transition is the primary driver of copper demand out to 2040

Net change in global copper demand by sector, 2025 vs. 2040 (million mt of copper)



Data as of Jan. 8, 2026.

1. Includes copper demand from construction, cooling, appliances, fossil power generation, machinery and internal combustion engine vehicles.

2. Includes copper demand from transmission and distribution, renewable power generation, and electric vehicles.

Sources: S&P Global Energy; S&P Global Market Intelligence.

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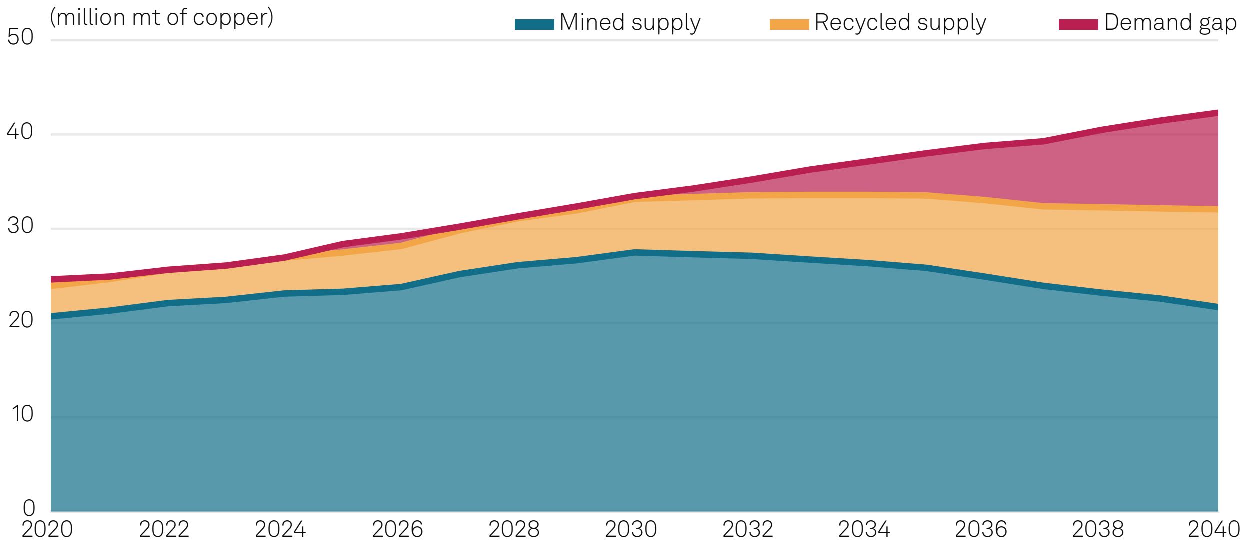
By 2040, global copper demand is projected to rise by about 50% to approximately 42 million mt from 28.4 million mt in 2025, driven mostly by core economic demand and the energy transition (e.g., renewables, EVs, grid expansion).

Assessing the copper supply gap

Even as global demand accelerates, copper supply is on course to decline as existing resources age. Without a meaningful expansion of copper supply, the result could be a shortfall of 10 million mt by 2040.

As global demand accelerates, copper supply is on course to decline.

By 2040, the world will need an additional 14 million mt of copper to meet growing demand
Total copper market balance, 2020–40 (million mt of copper)



As of Jan. 8, 2026.
Recycled (secondary supply) represents end-of-life scrap.
Mined supply includes operating production and risked production from committed, probable and possible projects.
Sources: S&P Global Energy; S&P Global Market Intelligence.
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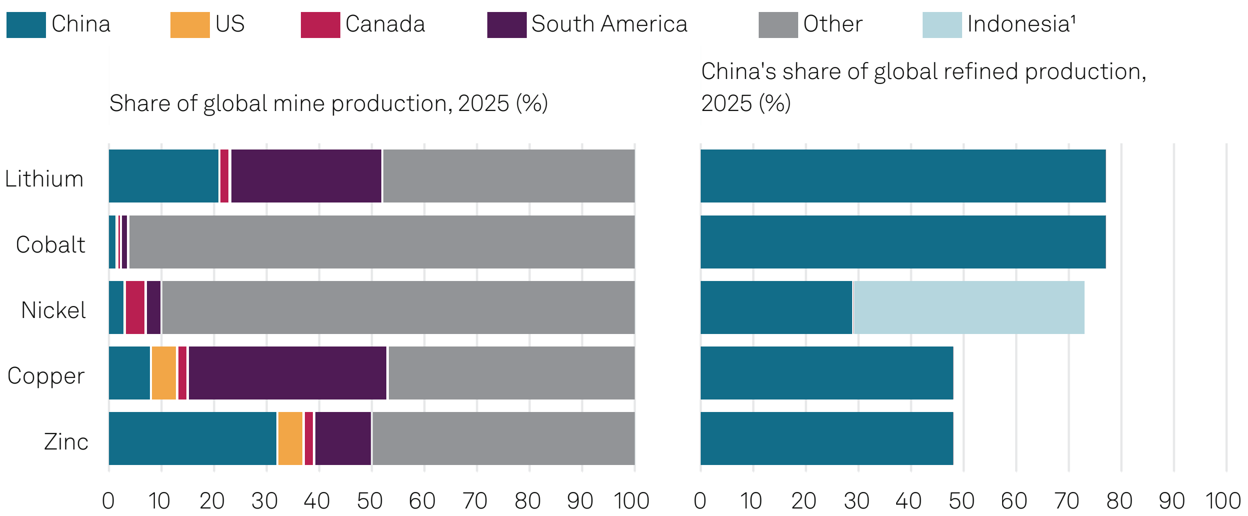
Meeting the growing demand is limited by above- and belowground challenges. The supply response is multifaceted but constrained:

- **Mined copper (primary supply):** Mining faces declining ore grades, rising costs and increasingly complex extraction conditions. Without new investment, output from existing mines will decline. The pipeline of new projects is hampered by long development timelines — averaging 17 years — due to permitting delays and aboveground risks, including regulatory uncertainty, community opposition and rising costs.
- **Recycling (secondary supply):** While copper's recyclability offers relief, secondary supply alone cannot close the gap. Even with aggressive improvements in collection and processing, recycling could provide, at best, only about a third of the total supply needed by 2040.
- **Processing criticality:** The economics of processing are increasingly precarious, with treatment and refining charges under pressure and regional disparities in operating costs and regulatory environments. The geographic concentration of smelting and refining in China — about 50% of total capacity — amplifies China's critical role in preserving the industry's balance.

Subsidies, sanctions and strategic stockpiles

Against a deteriorating geopolitical backdrop, security of supply for copper and other critical minerals has become a policy priority. Western governments are increasingly focused on reducing dependence on monopolistic or geopolitically sensitive suppliers by promoting domestic production, reshoring or "friend-shoring" of processing capacity, strategic stockpiling, and targeted financial and regulatory support.

China does not dominate mined production of all critical minerals, but accounts for a significant proportion of refined output



As of Feb. 10, 2026.

1. Represents Indonesia's share of primary nickel production, the vast majority of which is owned or operated by China-headquartered companies.

Sources: S&P Global Market Intelligence; London Metal Exchange.

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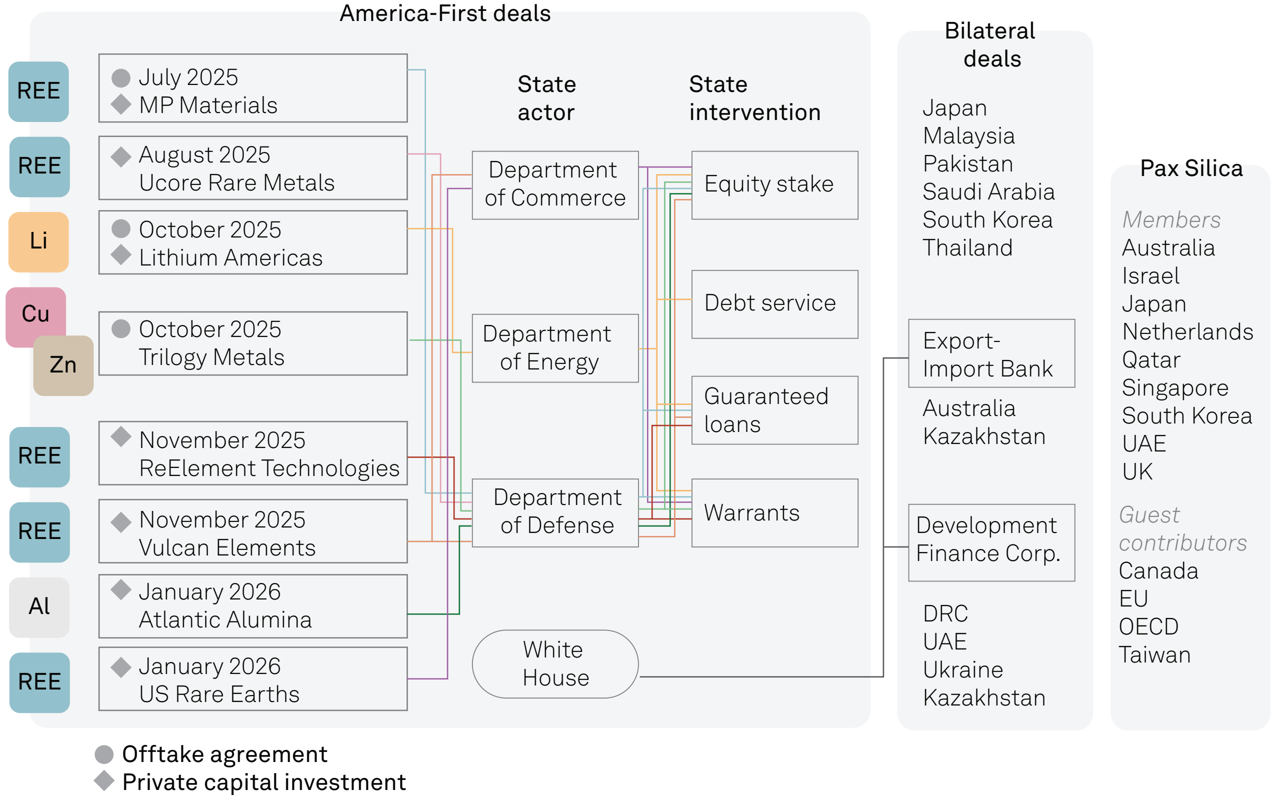
In response, many governments have introduced policies aimed at diversification. Since January 2025, US President Donald Trump has adopted a three-pronged approach: accelerating permit approvals and driving "America-First" deals for domestic projects, brokering private capital and deploying public financial institutions as strategic instruments, and leveraging the Pax Silica initiative, which aims to combine capital, reserves, processing knowledge and downstream demand across allied jurisdictions.

Complementing these measures, Project Vault represents a strategic expansion of US critical mineral stockpiling, designed to build buffer inventories of copper and other essential inputs for defense systems, clean energy infrastructure and advanced manufacturing. With the intention of insulating key sectors from sudden supply disruptions, export controls or geopolitical coercion, Project Vault embeds resource resilience at the core of American industrial strategy.

The US government has pivoted toward state-capital tools to secure critical minerals
Trends in US critical mineral deals, July 2025–January 2026



Data as of Feb. 12, 2026.

OECD = Organisation for Economic Co-operation and Development; REE = rare earth elements; Li = lithium; Cu = copper; Zn = zinc; Al = aluminum.

Source: S&P Global Energy.

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The EU introduced its Critical Raw Materials Act to accelerate domestic mining, processing and recycling while securing strategic partnerships abroad. Japan and South Korea have also pursued long-term offtake agreements and overseas investments. Resource-rich countries, meanwhile, are increasingly asserting greater control over their mineral endowments through export restrictions and local processing requirements.

The result is a more fragmented and politicized market. Export controls, investment screening and industrial subsidies have become more common, and competition for access to deposits in Africa, Latin America and Southeast Asia has intensified. At the same time, companies face pressure to meet higher environmental, social and governance standards, particularly in jurisdictions associated with governance or human rights risks.

Looking forward

Looking ahead, the geopolitical contest over copper is likely to deepen as electrification, AI infrastructure and defense modernization drive demand growth. Supply expansion is capital-intensive and slow, often constrained by permitting delays and community opposition, which increases the strategic leverage of existing producers. As a result, critical minerals are evolving into core instruments of economic statecraft, sitting at the intersection of energy security, industrial competitiveness and geopolitical influence.

Aligning the math of carbon accounting

Why has carbon accounting moved to the forefront of global climate policy dialogue?

Kevin Birn, Head of Carbon Research and The Center of Emissions Excellence, S&P Global Energy

Marie-Louise du Bois, Global Director, Price Reporting – Energy Transition, S&P Global Energy

Roman Kramarchuk, Head of Integrated Narratives and Policy Analysis, S&P Global Energy

Carlos Pascual, Senior Vice President and Head of Geopolitics and International Affairs, S&P Global Energy

Carbon accounting — *the math of emissions* — underpins the language of carbon markets and emissions performance. It is how emissions are calculated, reported and compared. Over the past year, carbon accounting has moved from a back-office exercise to the foreground of global climate dialogue. Proposed changes to carbon accounting standards and new regulations impact market access, trade, investment, competitiveness and decarbonization.

Aligning the math of carbon accounting

There has been a growing realization that existing carbon accounting standards are too flexible, with aspects subject to interpretation or different methodological choices. This has led to inconsistencies and incomparability of emissions. Without comparability, buyers and sellers cannot differentiate, trust and transact on varying emissions profiles. Consequently, companies with lower-carbon products are unable to benefit, and those that could improve their carbon competitiveness are not incentivized to do so. This hinders the effectiveness of carbon markets and the development of carbon-differentiated markets more broadly.

Highlights

Carbon accounting is the language behind emissions performance and carbon markets. Often taken for granted, it defines climate policy exposure, compliance costs, carbon competitiveness and public perception. In short, it is a big deal.

Harmonization to create a common language has pushed carbon accounting to the forefront of climate dialogue. Three key critical developments in 2026 — the implementation of the EU's Carbon Border Adjustment Mechanism (CBAM), revisions to the Greenhouse Gas Protocol and new industry-driven, product-level carbon accounting efforts — have created pressure to address carbon accounting issues.

Getting this right would align decarbonization incentives with economic benefits. Getting this wrong could negatively impact trade, market access, investment and decarbonization, with knock-on effects on affordability and security.

Without comparability, buyers and sellers cannot differentiate, trust and transact on varying emissions profiles.

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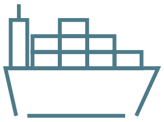
Governments and industry share an interest in a more consistent approach to carbon accounting that can reduce trade friction, increase comparability and give market participants the confidence in emissions data they need to invest in low-carbon products.

Three key developments are driving carbon accounting to the forefront and have material implications for the future of carbon differentiation and commodity markets.

Key regulatory and stakeholder initiatives are behind increasing need for and interest in greater comparability in product-level carbon accounting



Starting in 2026, the EU's Carbon Border Adjustment Mechanism imposes a cost on imports of aluminum, cement, chemicals, fertilizer, and iron and steel based on their carbon intensity

GHG Protocol/ISO Scope 2 and Scope 3 guidance is being reviewed, and draft Scope 2 changes are out for consultation

Growing international consensus on the importance of creating more detailed and harmonized **product-level carbon accounting standards**

As of Feb. 12, 2026.

ISO = International Organization for Standardization.

Source: S&P Global Energy.

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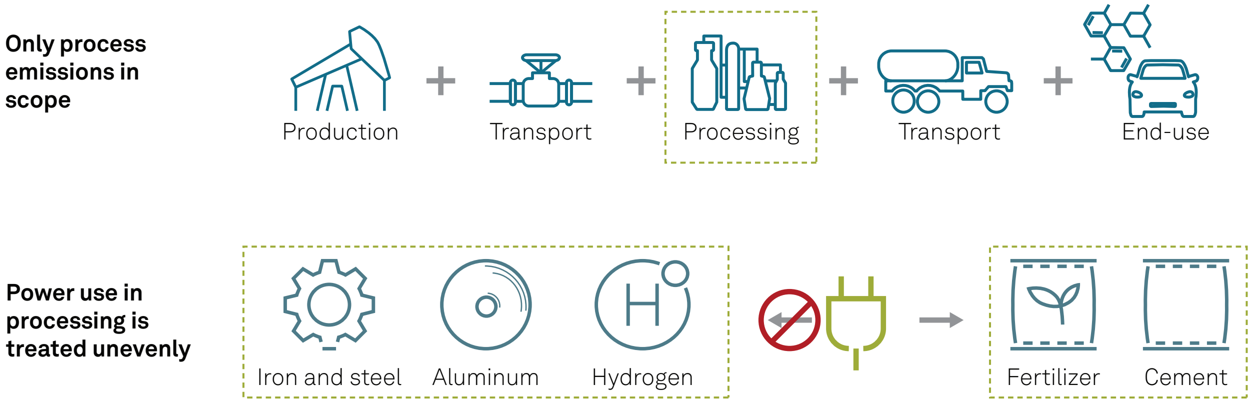
Carbon Border Adjustment Mechanism implementation

The EU's Carbon Border Adjustment Mechanism places a carbon cost on imports to Europe based on carbon intensity and relative differences in carbon prices. The EU prices carbon internally through its Emissions Trading System, which requires domestic power and industrial facilities to cover their emissions with allowances. This raises costs for European manufacturers relative to competitors in countries without comparable measures. CBAM seeks to address this imbalance by applying an equivalent carbon cost to selected imported goods, ensuring that products entering the EU market and domestic producers face the same carbon price.

On Jan. 1, 2026, the EU's CBAM started charging a fee on imports based on the difference in carbon intensity and relative carbon price. This policy now affects steel, aluminum, cement, fertilizers, hydrogen and electricity, with an expansion to other products planned.

EU's CBAM has nuances that can impact compliance costs



As of Feb. 12, 2026.
CBAM = Carbon Border Adjustment Mechanism.
Source: S&P Global Energy.
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Assessing the carbon intensity of commodity imports is central to CBAM, which is defined by a specific accounting methodology. Under CBAM, manufacturing and industrial processing, such as smelting iron into steel, are covered. However, there are some unique treatments and inconsistencies. For example, emissions associated with power use are counted for fertilizer and cement imports, but not for iron, steel, aluminum or hydrogen. The policy tool's focus on process emissions means upstream feedstock production emissions are out of scope. Yet the greenhouse gas intensity of feedstock can vary, and properties such as feedstock quality influence the intensity of processing.

These nuances, in addition to the headline price and the carbon pricing policy of the origin nation, impact import compliance costs, influencing product competitiveness and market share. Any uncertainty around these parameters can hamper market activity. For example, as CBAM implementation on Jan. 1 approached, the lack of precision in default carbon intensity values led market participants to delay negotiations and deals. Then, as the European Commission introduced the possibility of a CBAM exemption for fertilizers, uncertainty around costs and the durability of CBAM stifled European fertilizer trade ahead of the spring planting season. Broader uncertainty in fertilizer costs may influence farmers' purchasing decisions, potentially leading to reduced fertilizer applications, which could inadvertently impact crop yields.

Some of the EU's major trading partners have raised concerns over the protectionist nature of CBAM and its impact on developing economies. Criticism made it into the final presidency report of the 2025 UN Climate Change Conference (COP30), indicating further debate. Other countries signaled an interest in creating their own version of the policy tool, and in the next two years, Norway and the UK are set to introduce their own CBAMs. While the UK's version shares similarities with the EU model, it differs in its compliance threshold, sector coverage and default emissions intensity values. If CBAM-like policies are pursued internationally without alignment on the underlying accounting and reporting, trade could be negatively affected.

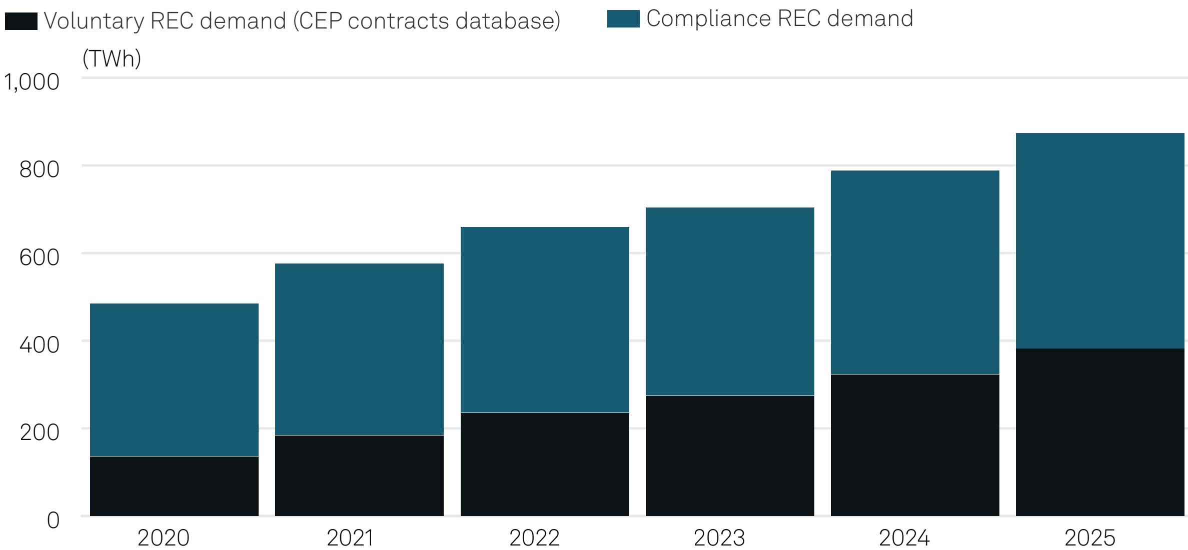
If CBAM-like policies are pursued internationally without alignment on the underlying accounting and reporting, trade could be negatively affected.

GHG Protocol modernization

The GHG Protocol is the most widely used carbon accounting standard. It underpins corporate reporting and is currently being revised. Significant changes could lead to the restatement of corporate emissions for prior years and to changes in the relative understanding of emissions performance.

The GHG Protocol has issued the first round of feedback on proposed changes to Scope 2 guidance. Future consultations are expected, which will cover the GHG Protocol's corporate standard (Scope 1) and corporate value chain standard (Scope 3).

Usage of RECs, particularly for voluntary purposes, has been increasing strongly
Total US REC demand



As of Feb. 12, 2026.
REC = renewable energy credit; CEP = clean energy project.
Sources: S&P Global Energy; Lawrence Berkeley National Laboratory.
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The scope of some potential changes is notable. The proposed update to Scope 2 guidance could introduce hourly matching and geographical deliverability for companies' grid electricity claims. Under the proposal, for renewable certificates to count when a facility uses grid power, the renewable power must come from a nearby source during the same hours the electricity is being consumed. This change would be significant for voluntary REC markets and virtual power purchase agreements, which have supported clean energy projects globally. Achieving hourly matching could require more complex combinations of clean energy technologies, such as batteries to complement intermittent renewables. Meanwhile, locational matching could impact demand for renewable projects' generation in regions far from demand centers.

In North America, this reframing of Scope 2 may significantly reshape REC markets, potentially leading to further market fragmentation. While the definition of a deliverable market boundary in the US has yet to be determined, proposed changes could be material, given the concentration of voluntary clean energy procurement in Texas.

Overall, discussions point to disagreement over the definition of physical deliverability within electricity procurement and market-based accounting. The outcome could significantly reshape the procurement of incentives and market behavior.

Industry-driven, product-level carbon accounting efforts

There is a growing realization that a "green premium" — a higher price for lower-carbon products — has yet to consistently emerge. Many corporate strategies and government policies were developed under the assumption that some form of carbon-based competition would take hold in the market. Without this signal, companies have struggled to allocate capital toward larger-scale decarbonization projects and the development of lower-carbon products.

Inconsistencies in product-level carbon accounting are a barrier to realizing this green premium. Existing standards and best practices were designed to be intentionally vague to ensure emission estimates were consistent over time and to be flexible enough for applicability across multiple sectors. These approaches helped accelerate corporate reporting and emissions disclosure. Today, however, the market needs less flexibility and more uniformity. This will ensure better comparability across similar products and different sectors, helping to generate changes in consumer behavior and support greater consistency in global carbon policy.

Product-level consistency is key as this is how companies compete and nations trade globally. The current lack of comparability means buyers and sellers cannot differentiate products based on emissions performance. There are limited financial incentives for lowering carbon intensity or for investing in improving the carbon competitiveness of products. Companies that have committed to cutting emissions, assuming the market would value lower carbon, face an untenable reality: Their obligation to protect shareholder value could be at odds with their commitment to lower emissions.

Product-level consistency is key as this is how companies compete and nations trade globally.

The recognition of this challenge contributed to the creation of a new industry association, Carbon Measures, to develop a new framework for product-level carbon accounting, as well as the decision by the International Organization for Standardization and GHG Protocol to seek greater alignment between their standards.

Looking forward

The implementation of CBAM, revisions to the GHG Protocol and creation of new initiatives such as Carbon Measures have highlighted carbon accounting and created pressure to address these issues now. The potential for solutions exists, but so does the potential for these efforts to run at odds with one another.

Greater alignment in carbon accounting standards would build the trust needed to incorporate carbon into market transactions, aligning decarbonization and economic incentives. Experience shows that product-level carbon accounting is essential to differentiate products and stimulate investment in decarbonization. Data quality, transparency on emissions allocation to coproducts (e.g., oil and associated gas), consistency in system boundaries and comparability in units are part of the fabric needed to make a market work.

Common sources of differences in carbon accounting methodologies that require alignment

System boundaries	• Greenhouse gas estimators may choose (for justifiable reasons) different boundaries, stages and exclusions • Guidance and alignment around direct emissions is generally good, but not universal • Choices around some indirect emissions are a source of inconsistency
Coproducts	• Some processes (e.g., refining) can result in many diverse coproducts • Different choices are being made on how to allocate emissions of integrated processes to coproducts
Units	• Even within the same sector, different units are being used in reporting emissions intensities • Normalizing between units is often not possible, which limits comparability
Quality	• Nearly all GHG data is estimated, varying in quality and often composition • It is impossible to compare estimates based on quality, leading to unfair comparisons and large discrepancies in data quality between companies and regions

As of Feb. 12, 2026.
Source: S&P Global Energy.
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The consequences of getting this wrong are profound, from a perpetuation of limited decarbonization incentives to a dislocation of trade, with knock-on effects on affordability and security.

Harmonization to create a common language will be the challenge in 2026. Differences of opinion could prove too strong to find consensus. But the goal will be to make 2026 the year in which action accelerates to realign carbon accounting, ensuring a transparent, equitable basis to measure and report emissions across regions.

Why climate adaptation is key to US energy expansion

Are major US power producers prepared for climate physical risk?

Lindsey Hall, Global Head of Sustainability Thought Leadership, S&P Global Energy

Rick Lord, Head of Sustainable1 Research and Innovation, S&P Global Energy

Matt MacFarland, Senior Editor, Sustainability, S&P Global Energy

Kuntal Singh, Lead, Climate Physical Risk, S&P Global Energy

Paul Munday, Director, Global Climate Adaptation and Resilience Specialist, S&P Global Ratings

Climate physical risks are projected to have a significant financial impact on the largest US power producers — about $68 billion annually by 2040, according to our projections. Many companies are already engaging in adaptation and resilience efforts to strengthen power plants and infrastructure. However, our data suggests there is room for further climate adaptation planning.

Highlights

US power producers face the challenge of meeting growing energy demand while preparing for how climate change will impact their assets.

Many companies are already engaging in adaptation and resilience efforts to prepare for the physical effects of climate change. In the absence of adaptation, our projections show that the companies in our analysis face nearly $68 billion in annual financial impact from climate physical risks by 2040. That projection rises to approximately $77 billion by 2050.

Despite these projected costs, some companies have yet to disclose plans that describe how they will adapt to the climate physical risks their power plant assets face.

Nearly one-third of planned US power generation capacity is being developed by companies that lack an adaptation plan, making a significant portion of energy expansion in the US more vulnerable to climate risk.

Energy and sustainability are inextricably linked priorities shaping corporate strategies in 2026

On the energy front, worldwide demand is soaring due to a growing global population, the electrification of developing markets and the AI boom.

On the sustainability front, there is growing recognition that the world will overshoot the goal of the Paris Agreement on climate change to limiting global warming to 1.5 degrees C by 2050. Companies' exposure to extreme weather events and chronic climate hazards such as extreme heat, water stress and drought has created significant financial costs across all sectors.

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These costs are projected to continue climbing without steps to adapt to the changing climate. Yet data from the S&P Global Corporate Sustainability Assessment shows that the majority of companies worldwide do not have a climate adaptation plan. These plans represent a company's efforts to adapt to, and cope with, the climate hazards it identifies as the most material to its operations. The utilities sector is a leader in climate adaptation and resilience, and it is standard practice for power producers to prepare for and respond to extreme weather impacts on their infrastructure. But not all major US utilities have disclosed adaptation plans that result from detailed climate assessments.

Methodology

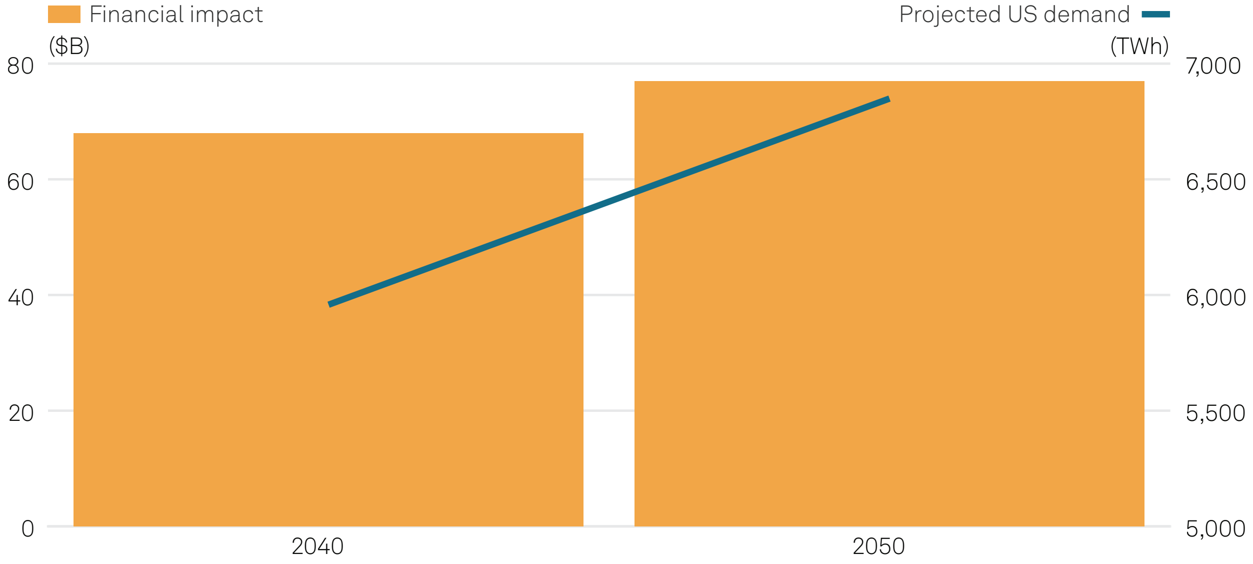
The S&P Global Sustainable1 Climate Physical Risk data set models the financial impact associated with changing exposure to acute (e.g., floods and cyclones) and chronic (e.g., drought and extreme heat) climate hazards on a company's assets. Financial impact is expressed as the annual average cost over each future decade, and realized costs will vary from year to year depending on whether and how severely events materialize, as well as the performance of existing or planned adaptation and resilience investments. The modeled financial impacts presented here do not reflect a company's adaptation and resilience efforts and thus represent a "worst case" projection for climate financial impacts that could be offset, at least in part, by investments in adaptation and resilience. This analysis captures projected physical damages and disruptions associated with acute events such as major tropical cyclones, which can be readily identified in company filings, as well as the drag on business operations due to chronic hazards such as water stress and extreme heat, which are less readily identified and attributed in company reporting.

Adaptation and resilience take many forms, and for utilities, investment in strengthening assets and infrastructure against extreme weather is standard practice. In this analysis, we review S&P Global Corporate Sustainability Assessment (CSA) data on whether companies have disclosed a climate adaptation plan as defined by the CSA. The CSA defines a context-specific adaptation plan, in which a company assesses the adaptation and resilience needs of individual assets based on their local conditions, as follows: "A context-specific plan integrates physical and nonphysical measures aimed at reducing — to the extent possible and on a best-efforts basis — all material risks that have been identified through a climate risk assessment." Thus, the typical resilience and risk management investments a utility makes may not qualify as climate adaptation planning unless they result from climate risk assessments.

Companies' exposure to extreme weather events and chronic climate hazards such as extreme heat, water stress and drought has created significant financial costs across all sectors.

These intertwined trends — the global energy expansion and the reality of physical climate risks — are especially apparent in the US, where AI development is driving rapid data center expansion and electricity demand is projected to increase 42% by 2050 in S&P Global Energy's Base Case energy scenario. Electric utilities and power producers are playing an increasingly pivotal role in this environment, and their readiness to adapt to the changing climate is key to their ability to meet demand now and in the coming decades.

Climate physical risk costs for major US power producers and US power demand are projected to grow at a similar rate
Total annual financial impact on S&P 500 electric utilities in the 2050s under the SSP2-4.5 climate change scenario ($B) and projected US electricity demand under the S&P Global Base Case scenario (TWh)



As of Feb. 2, 2026.
SSP = shared socioeconomic pathway. SSP2-4.5 is a medium climate change scenario that contemplates strong mitigation, in which total greenhouse gas emissions stabilize at current levels until 2050 and then decline to 2100. This scenario is expected to result in global average temperatures rising by 2.7 degrees C (2.1 degrees C-3.5 degrees C) by the end of the century.
No inflation assumptions are applied and results are presented in nominal 2024 prices. Financial impact represents annual average cost over each decade. Financial impact combines both chronic, year-over-year pressures and acute conditional losses under elevated hazard scenarios. In reality, realized costs will vary from year to year depending on whether and how severely events materialize.
Chart reflects the 29 constituents of the S&P 500 index in the electric utilities, multi-utilities, and independent power producers and energy traders Global Industry Classification Standard groups.
Projected US electricity demand from the S&P Global Energy Base Case scenario, July 2025.
Sources: S&P Global Energy; S&P Global Sustainable1.
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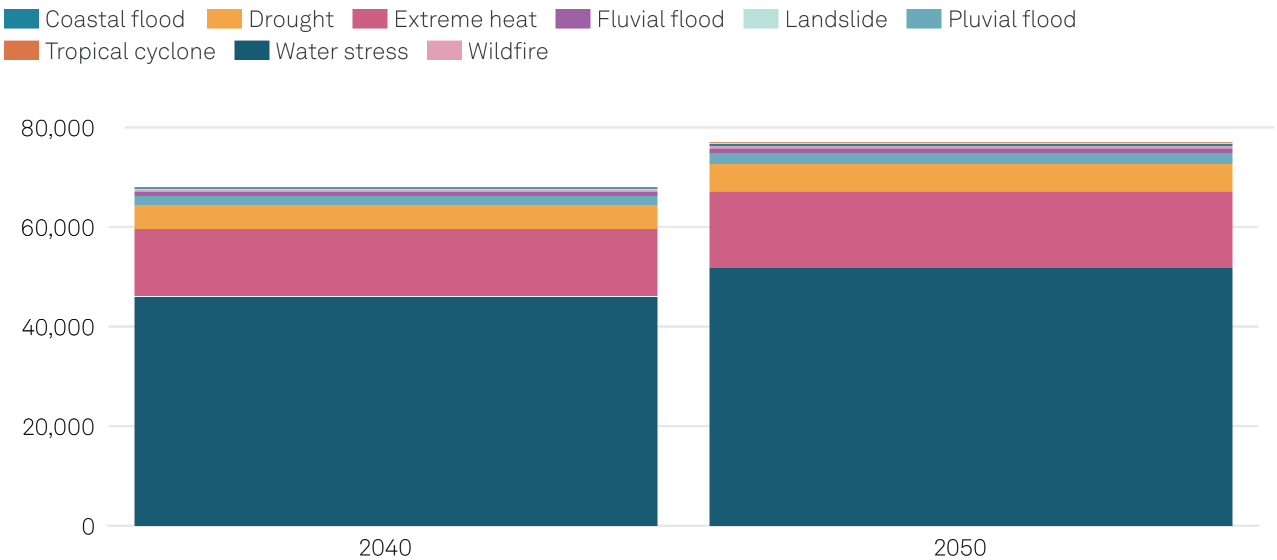
In this analysis, we identify the most material climate physical risks facing the 29 electricity producers in the S&P 500 index. These companies own 3,668 existing and 550 planned power plant assets, and we quantify the projected baseline costs they face from climate change if no adaptation action is taken. We then focus on companies that lack adaptation plans to highlight where risks to current operations may exist and how physical climate risks could affect US energy expansion.

Water stress and extreme heat are top climate physical risks

Over the coming decades, water stress — the ratio of all water withdrawals to total renewable water supply in an area — will be the biggest climate physical risk facing large US power producers. It will account for more than two-thirds of these companies' costs in the 2040s and 2050s. Extreme heat poses the second-largest cost across the coming decades, followed by drought. Extreme heat is defined as the fraction of days exceeding the local historical 90th percentile of daily maximum temperature. Drought is modeled using the 12-month Standardized Precipitation Evapotranspiration Index (SPEI-12) and expressed as the fraction of days falling below the local historical 10th percentile of SPEI-12.

Water stress is the top climate physical risk facing US power generation

Total annual financial impact on S&P 500 electric utilities under the SSP2-4.5 climate change scenario ($M)



As of Feb. 2, 2026.

No inflation assumptions are applied and results are presented in nominal 2024 prices. Financial impact represents annual average cost over each decade. Financial impact combines both chronic, year-over-year pressures and acute conditional losses under elevated hazard scenarios. In reality, realized costs will vary from year to year depending on whether and how severely events materialize.

Chart reflects the 29 constituents of the S&P 500 index in the electric utilities, multi-utilities, and independent power producers and energy traders Global Industry Classification Standard groups.

Source: S&P Global Sustainable1.

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Water-related risks are fundamental to power generation, as large quantities of fresh water are needed to cool thermoelectric power plant equipment and for a plant's basic operation — using heated steam to power the turbines that convert mechanical energy into electrical energy. Water stress and drought can restrict a plant's access to the volume of water it needs, leading to reduced generation or full stoppages. During periods of extreme heat, a plant may need even more water than usual to maintain an ideal working temperature.

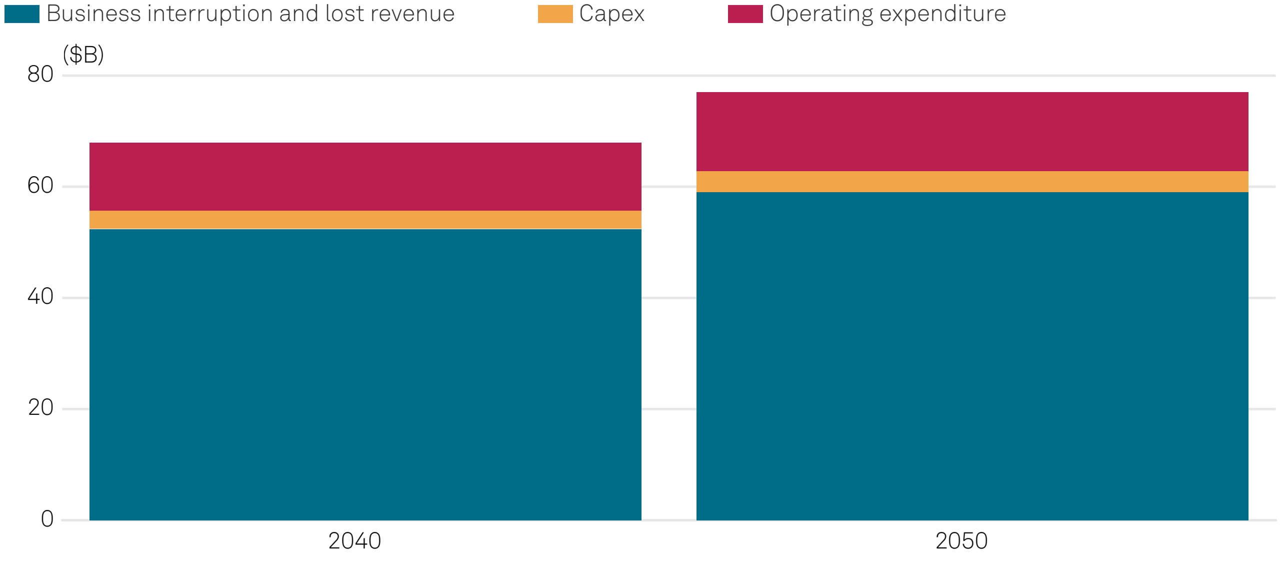
The S&P Global Sustainable1 Physical Risk data set models how these risks flow through to companies as financial impacts. These projected costs, absent any adaptation, could represent nearly $68 billion in annual financial impact by 2040 for the 29 power-producing companies in the S&P 500, based on our models. For context, that equates to about 16% of the group's total 2024 revenue. The projected cost rises to approximately $77 billion by 2050. The majority of these costs (about 77%) will appear in the form of lost revenue due to business interruption. For power plants, examples of climate risk-related business interruption include reduced generation or planned shutdowns due to high heat or reduced water availability. The remaining financial impact is projected to come in the form of higher capital expenditure and higher operating expenses.

Physical risks resulting from climate change can be acute, driven by events such as floods or storms, or chronic, arising from longer-term shifts in climate patterns. For example, Duke Energy Florida Inc., a subsidiary of Duke Energy Corp., estimated $1.1 billion in direct costs from the impact of three hurricanes in 2024. This is an example of the costs of acute hazards that cause substantial damage to infrastructure and assets. Our models project much greater financial impacts from chronic hazards such as water stress that affect a company throughout a given year and accumulate over time.

Over the coming decades, water stress — the ratio of all water withdrawals to total renewable water supply in an area — will be the biggest climate physical risk facing large US power producers.

Business interruption and lost revenue account for nearly all of electric utilities' financial impact from climate physical risks

Total annual financial impact on S&P 500 electric utilities under the SSP2-4.5 climate change scenario ($B



As of Feb. 2, 2026.

No inflation assumptions are applied and results are presented in nominal 2024 prices. Financial impact represents annual average cost over each decade. Financial impact combines both chronic, year-over-year pressures and acute conditional losses under elevated hazard scenarios. In reality, realized costs will vary from year to year depending on whether and how severely events materialize.

Chart reflects the 29 constituents of the S&P 500 index in the electric utilities, multi-utilities, and independent power producers and energy traders Global Industry Classification Standard groups.

Source: S&P Global Sustainable1.

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Addressing physical risk with adaptation

These projected costs represent a baseline of risk and do not reflect existing or planned adaptation measures. Taking action to harden corporate assets and operations against climate hazards could lower their impact.

Climate mitigation and climate adaptation are two key prongs of a comprehensive climate strategy. In simple terms, mitigation refers to human intervention to reduce emissions or enhance the sinks of greenhouse gases. Delays in climate mitigation mean the world is warming, which is contributing to more frequent and severe climate hazards.

As a result, in 2026, companies and communities are putting more focus on adaptation, or measures to prepare for and adjust to current and future climate change impacts. Adaptation can take many forms based on an area's terrain, weather conditions and economic strength, as well as the climate physical hazards that pose the greatest threat to a business asset. Examples of climate adaptation are already widespread across the public and private sectors: In the US, cities are opening cooling centers to provide relief during heat waves. Green or cool roofs are a recognized solution for building owners to combat higher air-conditioning costs from more frequent extreme heat. Cities are building sea walls to protect against stronger storm surges during hurricanes and tropical cyclones. For example, following Hurricane Sandy in 2012, New York City, along with the state and federal governments, committed more than $1.7 billion for five capital projects to reinforce Lower Manhattan's coastal areas, beginning construction in 2022.

S&P Global research has shown that returns on adaptation and resilience investments are significant. For the nonresidential real estate sector, for example, we estimated that the timely implementation of wet and dry floodproofing could save $3.55 for each dollar invested, and green and cool roofs could save $7.45 per dollar invested.

In 2026, companies and communities are putting more focus on climate adaptation, or measures to prepare for and adjust to current and future climate change impacts.

For power companies, as in any sector, the most effective adaptation and resilience measures will account for the type of asset and the specific climate conditions of the local area. The S&P Global Corporate Sustainability Assessment (CSA) evaluates a wide range of sustainability practices at the company level, including whether a company has an adaptation plan, and whether that plan considers the specific context of a company's operations. An "overall" corporate adaptation plan refers to a company reporting on relevant climate physical risks and the actions it is taking to address them in general, while a stronger "context-specific" adaptation plan describes how a company will adapt to risks based on the location, vulnerabilities and other attributes of its operations. A context-specific plan integrates physical and nonphysical measures aimed at reducing — to the extent possible and on a best-efforts basis — all material physical risks identified by a company.

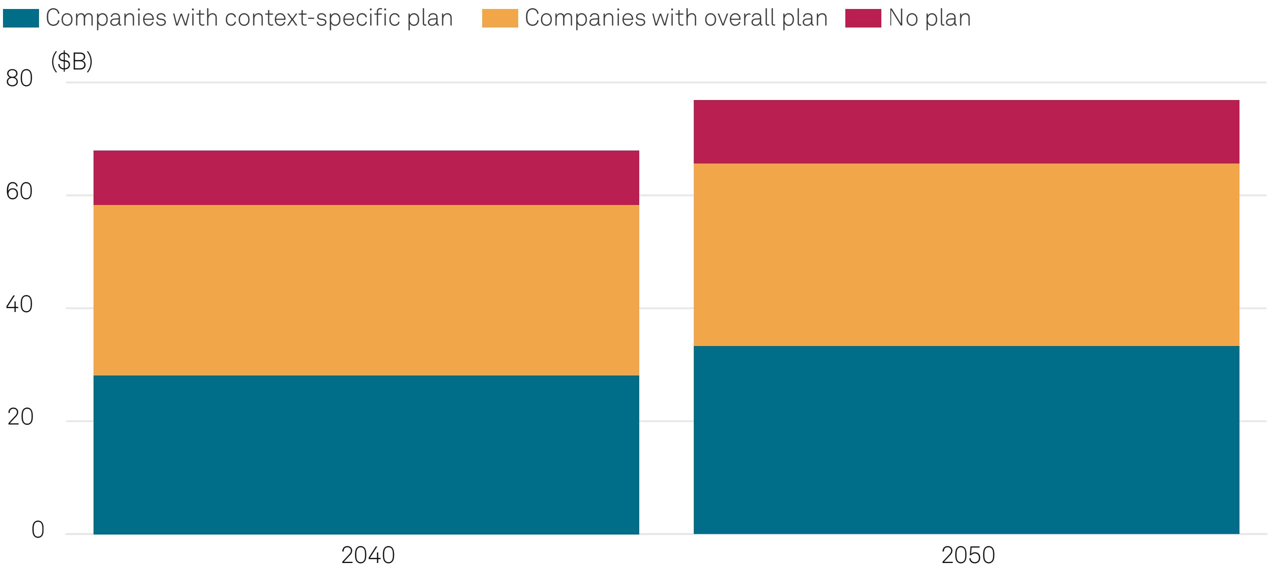
Investment in power infrastructure to harden assets against extreme weather is standard practice for utilities and may be a regulatory requirement in some markets. Adaptation plans as defined in the CSA are the result of a detailed climate physical risk assessment.

Seven of the 29 US power companies in this analysis had a context-specific adaptation plan in the 2024 or 2025 CSA cycle. These companies face about $26 billion in annual financial impact but are taking location-specific action to respond to the climate hazards their assets face.

Another seven companies in the analysis have no adaptation plan recorded in the CSA. These companies are projected to face more than $9 billion in annual financial impact from climate physical risks by 2040. Without plans, they may face the full impact of those risks.

Companies without adaptation plans face $10B in annual financial impacts by 2040

Total annual financial impact on S&P 500 electric utilities under the SSP2-4.5 climate change scenario ($B)



As of Feb. 2, 2026.

No inflation assumptions are applied and results are presented in nominal 2024 prices. Financial impact represents annual average cost over each decade. Financial impact combines both chronic, year-over-year pressures and acute conditional losses under elevated hazard scenarios. In reality, realized costs will vary from year to year depending on whether and how severely events materialize.

Chart reflects the 29 constituents of the S&P 500 index in the electric utilities, multi-utilities, and independent power producers and energy traders Global Industry Classification Standard groups. This analysis includes companies that reported having adaptation plans in the 2024 or 2025 S&P Global Corporate Sustainability Assessment.

Source: S&P Global Sustainable1.

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Climate risk and capacity growth

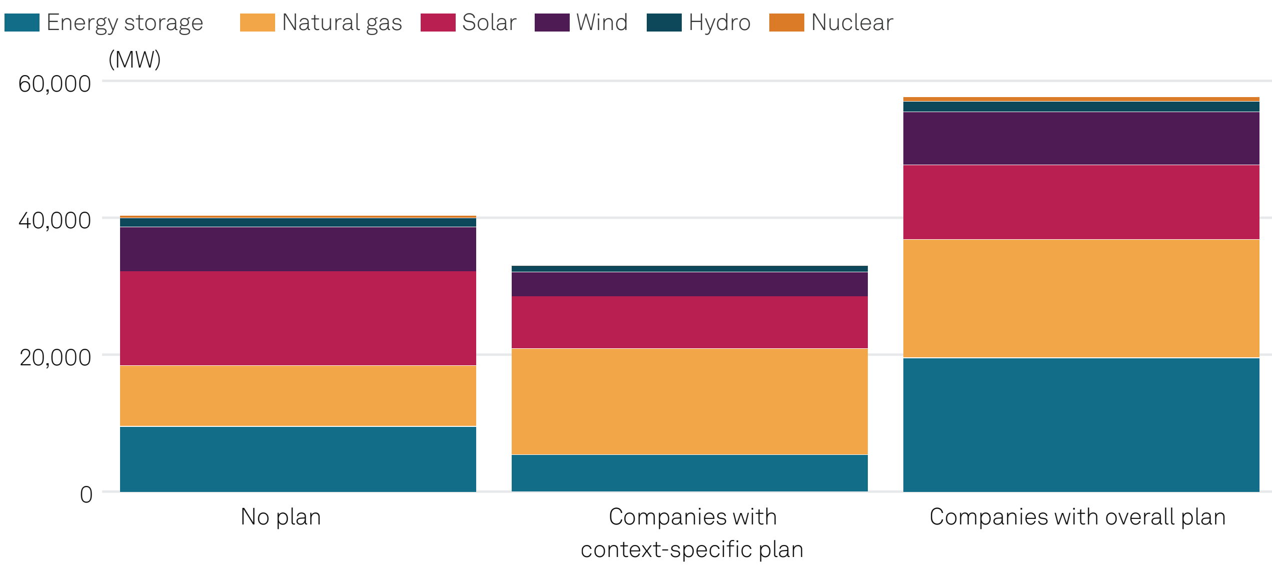
In addition to their existing operations, the power producers in the S&P 500 have 550 power plants in the planning stage with a total generation capacity of 130.9 gigawatts — about 10% of existing US operating capacity in 2024, according to S&P Global Market Intelligence data and the US Energy Information Administration. The extent to which companies are building climate resilience into these sites as they are developed will influence how effectively they meet US electricity needs in the coming years.

About 40 GW of this total is planned by companies that lack an adaptation plan, which could put a significant share (about 31%) of US power expansion at greater physical climate risk. A further 57 GW of this total is being developed by companies with overall adaptation plans rather than context-specific ones, meaning these future assets may be less prepared for the climate physical risks in their local areas.

Natural gas is the largest individual fuel source across these planned locations, but clean energy represents more capacity in aggregate: 89.2 GW. Companies without adaptation plans have over 20 GW of wind and solar capacity on the horizon. These assets may contribute to a utility's efforts to mitigate greenhouse gas emissions, but they are still likely to face physical climate risks.

About 40 GW of power is planned by companies without a physical risk adaptation plan

Planned power plant capacity by adaptation planning strength of parent company, S&P 500 (MW)



Data as of Feb. 2, 2026.

Reflects 550 planned power plants owned by the 29 constituents of the S&P 500 index in the electric utilities, multi-utilities, and independent power producers and energy traders Global Industry Classification Standard groups. Each of these companies was assessed in the 2024 and 2025 S&P Global Corporate Sustainability Assessment (CSA). The level of adaptation planning associated with the capacity of planned power plants is based on the owning company's CSA assessment. For example, for a company without an adaptation plan and five power plants under development, the planned generation capacity of those five sites is counted under "No plan."

This analysis includes companies that reported having adaptation plans in the 2024 or 2025 S&P Global Corporate Sustainability Assessment (CSA).

Sources: S&P Global Sustainable1; S&P Global Market Intelligence.

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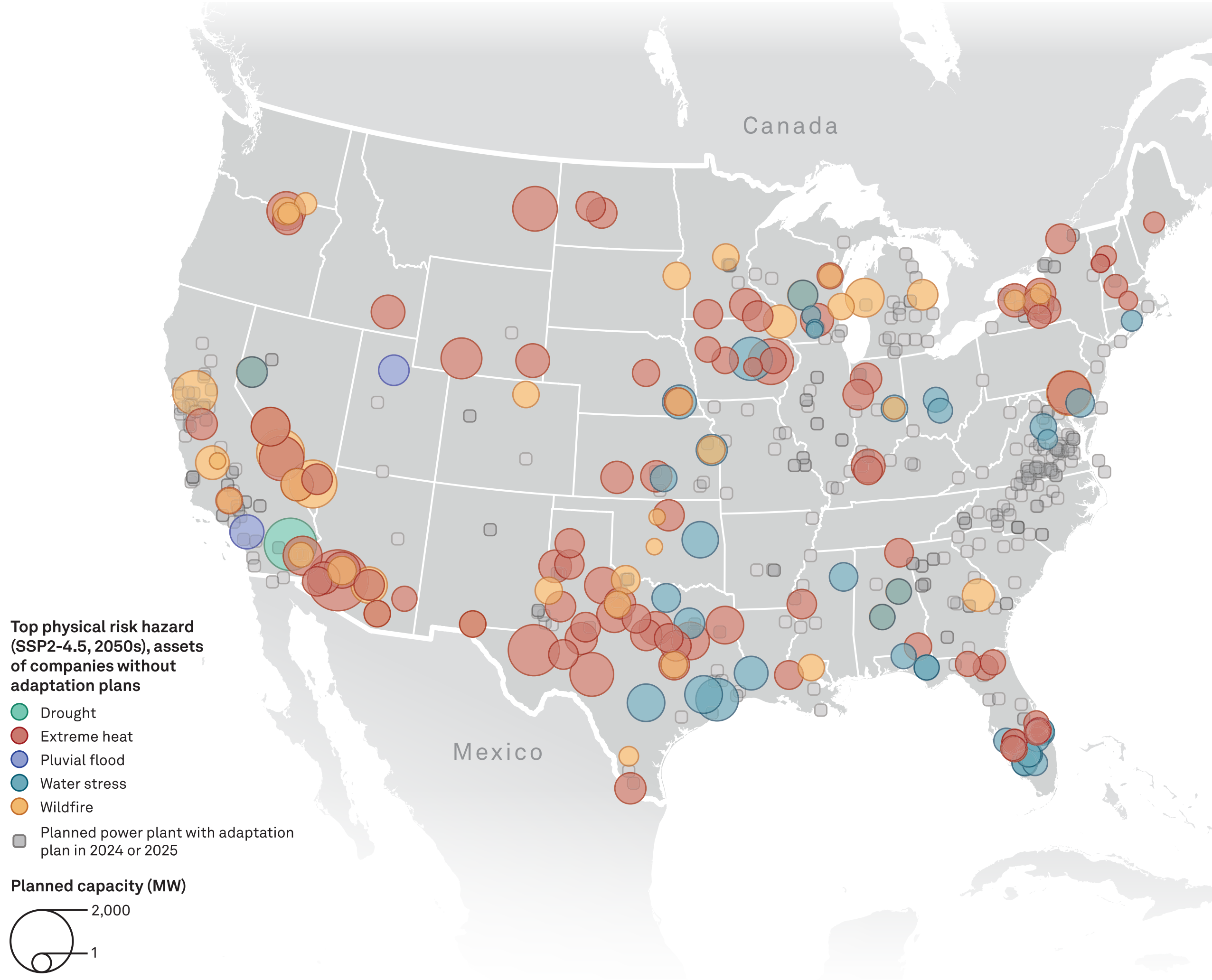
From a geographic perspective, many of the 184 future power plant assets being developed by companies without adaptation plans are clustered in California, Arizona and Texas. Extreme heat will become an increasingly significant risk in the southwest US as the climate warms, and drought and atmospheric conditions have already made wildfires a more frequent and destructive feature of California's power market.

The top climate physical risks facing US energy expansion

Locations of planned power plants owned by S&P 500 companies without a climate physical risk adaptation plan



Data compiled Feb. 2, 2026.

Sources: S&P Global Sustainable1; S&P Global Market Intelligence.

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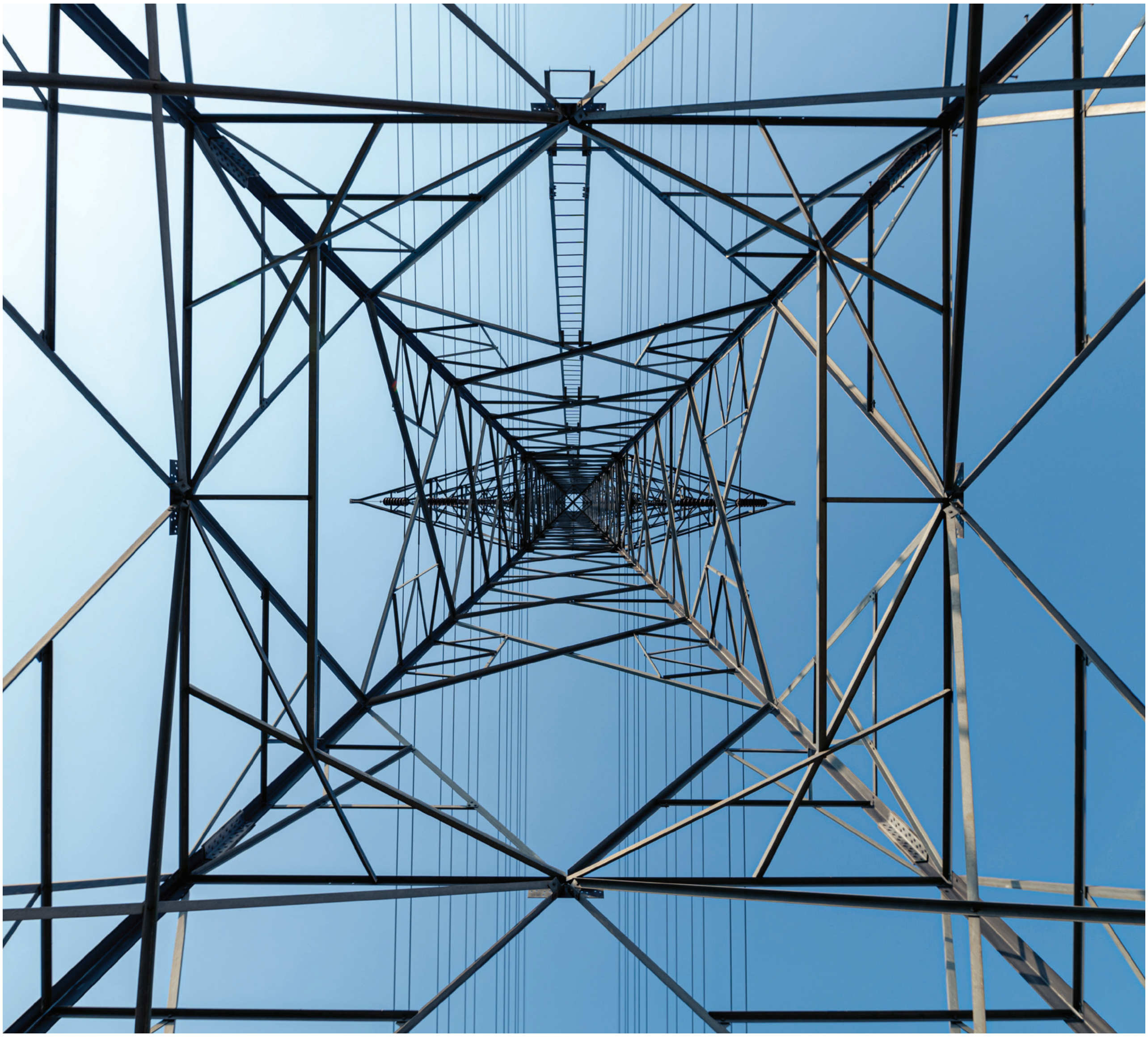

Looking forward

Electrification and widespread data center construction are accelerating demand for power globally, but particularly in the US. Previous research has noted that the US is already home to 40% of global data center power demand, and that figure is expected to reach 45% by 2030. As power producers scramble to meet that demand, they will also need to reckon with the hazards of a warming climate. Bending the trajectory of climate change toward less severe scenarios through emissions mitigation will remain important in the long term, but improving the resilience of power assets and infrastructure in the short and medium term will be a key factor in US energy expansion.

The rise and fall of sustainable chemicals: What would make it different this time?

Sustainable chemicals have been around for decades, and after a period of euphoria, they are now facing significant headwinds.

Olivier Maronneaud, Global Head, Methanol and Circularity, S&P Global Energy

Andy Orszynski, Director, European Ethylene and Derivatives, S&P Global Energy

Kunle Dosumu, Principal Analyst, Polymers and Circularity, S&P Global Energy

Sustainability pathways for chemicals offer alternatives with lower carbon footprints and higher bio or circular content. As brand owners water down or delay their voluntary commitments for increased sustainability, affordability is being questioned, particularly in a chemical industry facing a sustained downturn. Will new regulations create the required environment to support investment opportunities in sustainable chemicals?

Highlights

The global chemical industry is in a prolonged downturn, longer and deeper than previous cycles. Consequently, many global chemical producers have reduced investments in sustainable chemicals to cut costs and prioritize their core businesses.

Nevertheless, progress is being made. S&P Global Energy estimates that as of 2025, the top 12 global chemical producers have commercialized close to 2 million metric tons of sustainable polymers, or 14% of their aggregated 2030 voluntary pledge to commercialize 14 million mt by 2030.

This progression is insufficient to meet the stated pledges, and a combination of regulations mandating the use of sustainable chemicals, technological developments and increased consumer awareness is necessary to foster investments in this sector.

Pathways to sustainable chemicals

Sustainable chemicals are characterized by attributes that reduce the effect of chemical production, use or disposal on the environment and ensure positive social impacts. In 2021, the UN Environment Programme established a framework defining sustainability objectives for chemicals. Initial steps to improve the production footprint include improving energy efficiency, increasing process yields, limiting waste streams from conventional processes, and accessing renewable power through suitable contracts and/or upstream investments. More advanced approaches include reducing greenhouse gas emissions through electrification (e.g., steam cracker furnaces or fired heaters) and using low-carbon power and process design in certain steps to replace heat and steam. Lower-carbon fuels, such as electrolytic hydrogen,

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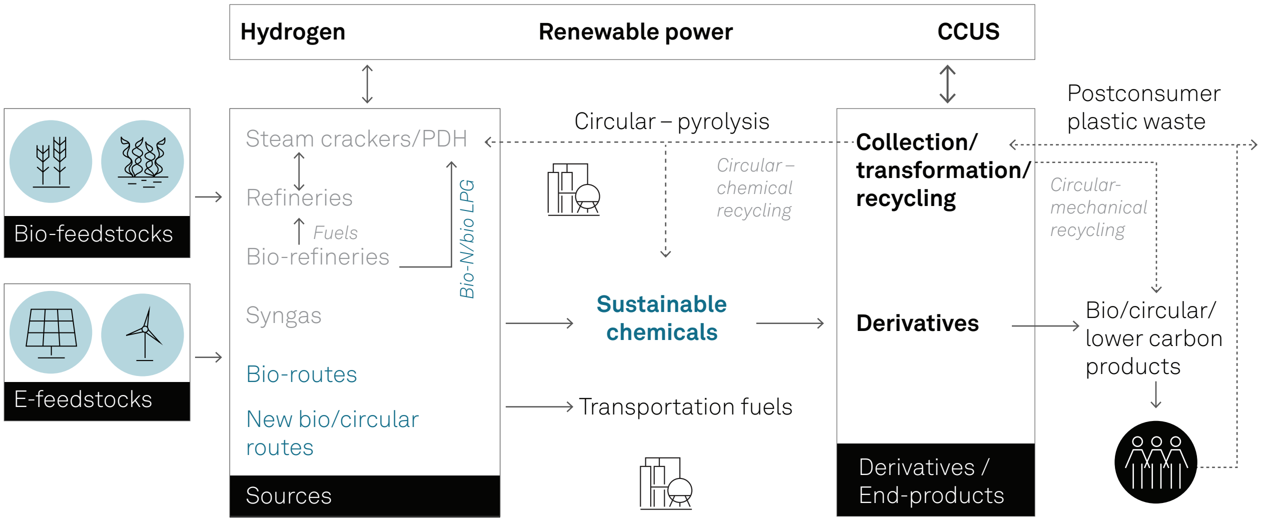
capturing process emissions (carbon capture, utilization and storage) or transitioning from conventional feedstocks to circular or biogenic raw materials can also achieve a more sustainable production footprint. There are many different routes and pathways available for companies:

- Biogenic routes, including bionaphtha, bio-LPG, ethanol, sugar and biogenic waste
- Circular routes, including mechanical recycling and chemical recycling processes
- E-routes, including e-methanol and e-naphtha

Chemical companies can take different pathways to more sustainable production



Data as of Feb. 9, 2026.

CCUS = carbon capture, utilization and storage; PDH = propane dehydrogenation; Bio-N = bionaphtha.

Source: S&P Global Energy.

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Some feedstocks are classified as drop-in solutions and could be fed directly into existing facilities. Others require the implementation of dedicated processes and the development of new value chains. Although these pathways could displace conventional feedstocks, including naphtha or NGLs, their impact on the chemical industry would differ based on the process and stage at which they enter the value chain.

Drivers behind sustainable chemicals

There are two main reasons why companies aim for more sustainable production. The main driver is the implementation of a tighter regulatory environment. Regulation could impact chemical companies either directly or indirectly through downstream industries and end-use markets, down to end-consumers. In the past 15 years, regulations have been developed across several jurisdictions to reduce pollution and health hazards related to the production, use and disposal of chemicals and polymers. This is the case for plastics, which account for about 50% of total chemical production, with the development of a comprehensive framework in Europe, such as the Single-Use Plastic Directive, the Packaging and Packaging Waste Regulation and the End-of-Life Vehicle Regulation, promoting recycling and circular feedstock. In Europe and several other countries, the implementation of Extended Producer Responsibility schemes and subsequent taxes on virgin plastics have supported funding for circular initiatives and recycling projects. Apart from the regulatory push, some companies set voluntary

> The chemical industry is in a period of prolonged downturn, which is both longer and deeper than previous cycles.

targets and market sustainable products, relying on consumer awareness and brand recognition, to command a markup on their sustainable products and packaging and justify sustainability investments.

In most instances, sustainable chemicals compete with their conventional equivalents, which are derived from traditional hydrocarbons such as crude oil, coal, natural gas or NGLs. Hence, the state of the chemical industry impacts the competitive landscape and the fate of sustainable chemicals.

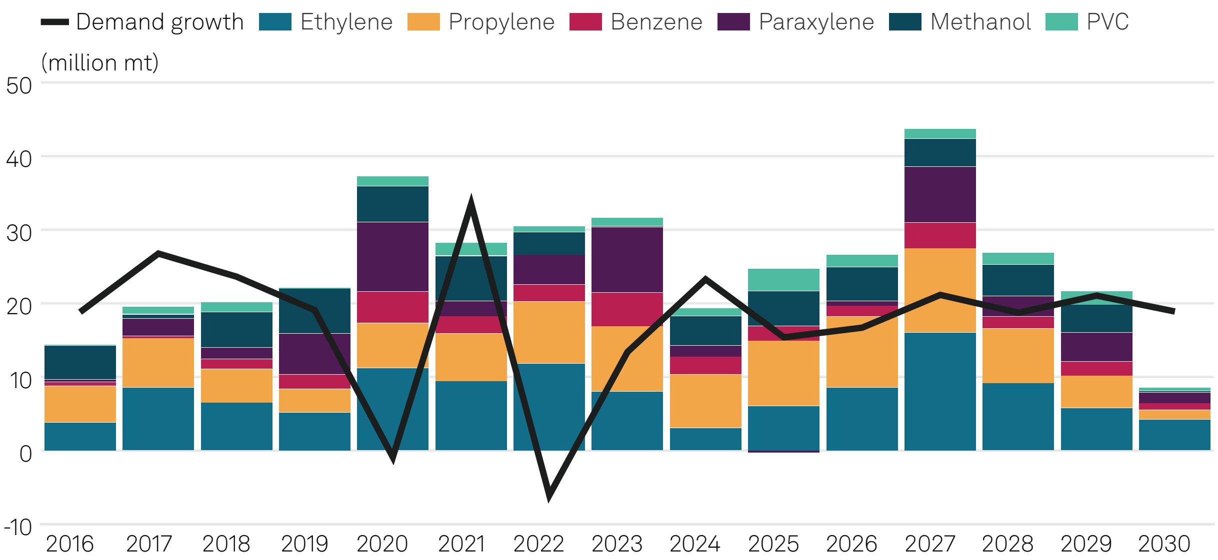
Downturn in the chemical industry is impacting investments

The chemical industry is in a period of prolonged downturn, which is both longer and deeper than previous cycles. While the underlying demand for chemicals and polymers continues to grow, driven largely by population growth and prosperity in highly populous developing regions, demand has fallen short of expectations, primarily due to a slowdown in China's economy.

Meanwhile, on the supply side, China continues to execute a strategy of increasing self-sufficiency — and reducing reliance on imports — through significant investments in domestic petrochemical building blocks and derivatives capacity. As a result, global supply growth has significantly outpaced demand growth in all but two years since the COVID-19 pandemic, and this trend is likely to continue for the remainder of the decade.

Global annual nameplate capacity growth for base chemicals is set to continue outpacing incremental demand increases until 2030

Selected base chemicals (million mt)



As of Feb. 9, 2026.

PVC = polyvinyl chloride.

Source: S&P Global Energy.

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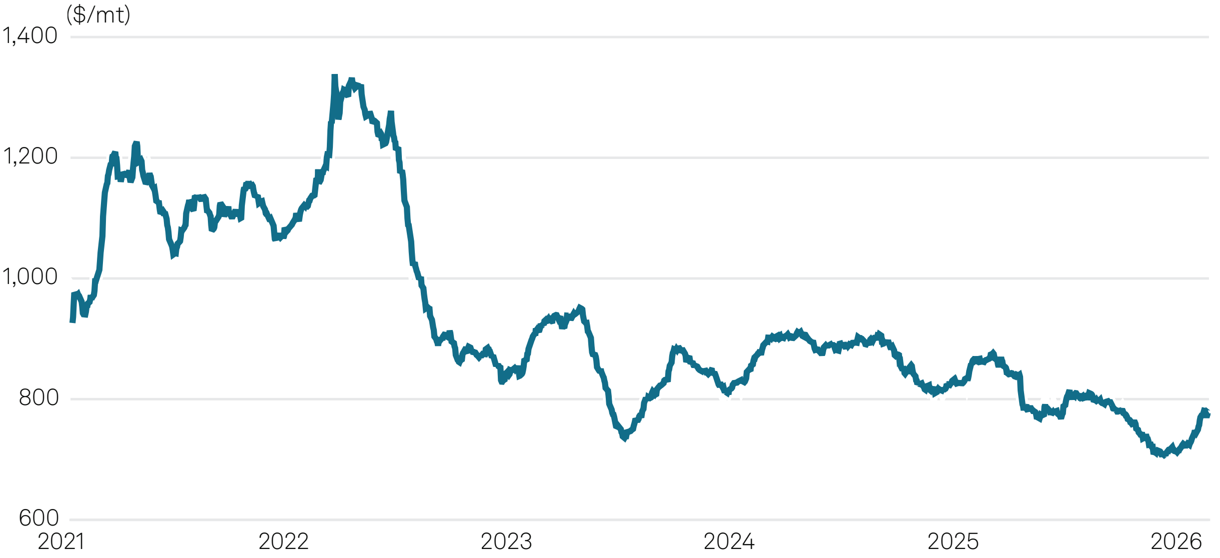
This imbalance has led to a decline in global capacity utilization across the chemical value chain and a slump in margins. Recovery is expected after 2030 when demand catches up with supply.

Oil and natural gas prices peaked in 2022, and their decline over the past four years resulted in prices for many petrochemicals nearly halving from their peak over the same period.

Platts' petrochemical pricing index has nearly halved from its 2022 peak as a prolonged downturn grips the global chemical industry



As of Feb. 9, 2026.
Platts is part of S&P Global Energy.
Source: S&P Global Energy.
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As a result, sustainable chemicals faced growing headwinds in securing investments, scaling up production capacity and gaining market share in an environment where the traditional materials they aim to replace are low-cost and abundant.

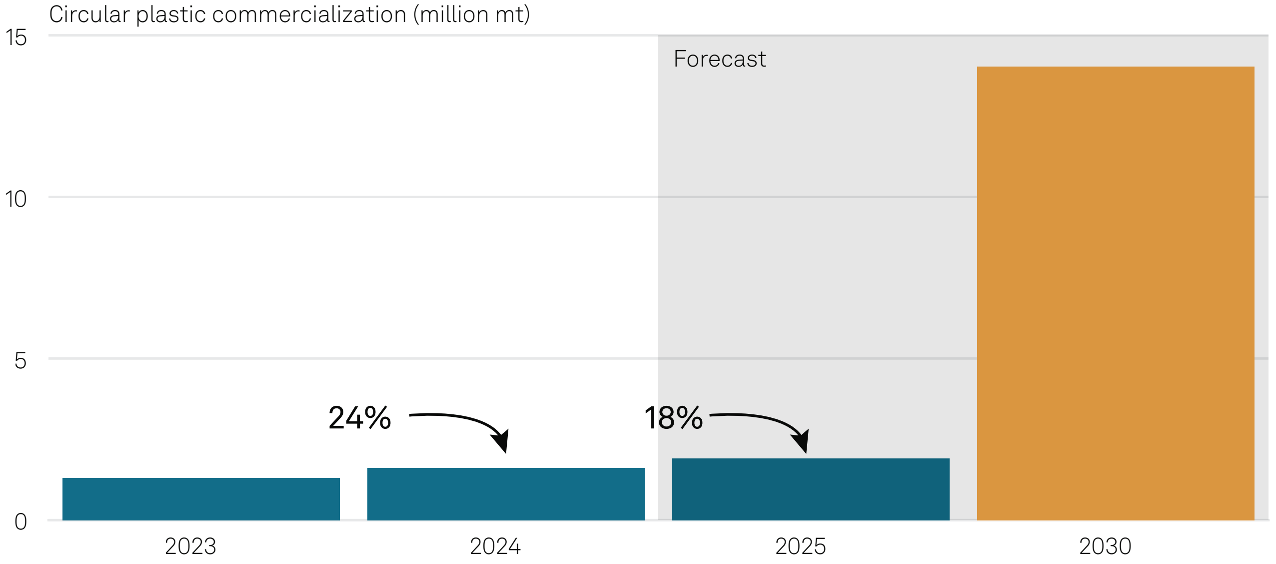
Limited progress despite ambitious targets

Sustainable chemicals account for less than 10% of global chemical demand. Mechanical recycling of plastic (the process of turning plastic waste back into new materials without altering the chemical structure of the polymers) is by far the most developed pathway operating on a commercial scale. Bio-based chemicals are a growing segment of the chemical industry, behind mechanically recycled plastic; however, growth is hindered by feedstock availability and concerns over competition with food or biofuels, where regulations tend to be supportive. Despite the growing interest in the past 10 years, chemical recycling remains the least-developed segment, requiring significant investment to scale up technologies and develop infrastructure for collecting and sorting plastic waste.

Over the past few years, global chemical companies have announced ambitious targets to commercialize sustainable chemicals and polymers via diverse pathways. More than 400 projects have been announced and investigated by technology companies and project developers. However, since 2024, momentum has noticeably decelerated. The environment of low prices and slim margins within the chemical industry has rendered many of these projects uneconomical or lower-priority as companies pivot to reduce costs and improve their profitability.

S&P Global Energy has been tracking these targets, particularly through the progress of the top 12 global chemical companies with their pledges. Collectively, these companies announced the objective to commercialize 14 million metric tons of sustainable polymers by 2030. Progress has been made; however, many companies have not communicated a comprehensive five-year strategy for the pathways they will adopt. In 2023, the group collectively sold an estimated 1.3 million mt of sustainable polymers. Sales volume increased in 2024 by an estimated 24% but is anticipated to decline to 18% in 2025, equating to 14% of the group's stated 2030 pledge. The current environment has made it more challenging for companies to comply with their pledges and meet their 2030 targets without a significant acceleration in new investments.

Progress in sustainable polymers' penetration by global chemical companies is decelerating as priority shifts toward core businesses



Data as of Feb. 10, 2026.

F = forecast.

Inferred progress for the top 12 global chemical producers, based on publicly reported progress by half of the group.

Sources: S&P Global Energy; company reports.

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Recent major developments include Exxon Mobil Corp.'s successful startup of its third chemical recycling facility in Baytown, Texas, in January, bringing its total annual processing capacity to about 113,000 metric tons/year. ExxonMobil has active plans to increase its chemical recycling capacity using its proprietary Exxtend technology in North America and Asia. LyondellBasell Industries NV is constructing its first industrial-scale chemical recycling plant in Wesseling, Germany, based on its MoReTec technology. The facility is expected to have a capacity of 50,000 mt/year and to start operations in 2026. Dow Inc.'s Fort Saskatchewan Path2Zero expansion project was paused due to difficult market conditions, but the company recently confirmed that the project will proceed with 1.3 million mt/year of net-zero ethylene and polyethylene capacity by 2029.

Looking forward

The prospect of a wave of investments and new capacities in sustainable chemicals has faded in recent years. Progress continues but at a slower pace, with a focus on the most viable sectors and pathways. The potential for sustainable chemicals to materially displace conventional feedstocks is expected to be limited over the next five to 10 years. As crude oil demand for fuel applications is expected to decline, growth in chemicals is forecast to continue. For sustainable chemicals to become a significant portion of the chemical industry, several conditions will need to materialize:

- A comprehensive set of regulations that mandate the use of sustainable chemicals, similar to the recent implementations in Europe with recycling and recycled content targets
- Technological developments and the ability to scale up to improve the competitiveness of certain pathways
- Consumer awareness regarding the benefits of sustainable chemicals
- The ability to provide a different value proposition to customers and to dissociate from the competition with virgin chemicals, particularly in a low crude-oil price environment

About the Look Forward Council

In today's rapidly evolving world, challenges like geopolitical tensions, supply chain disruptions, global health crises, and climate change are deeply interconnected — impacting markets in complex and far-reaching ways. Meeting these challenges requires broad, cross-sector analysis and fresh thinking that moves beyond traditional silos to see the bigger picture.

The **S&P Global Look Forward Council** brings together leading experts from across our organization to deliver research that illuminates long-term trends and transformative market shifts. Covering areas from capital and commodity markets to energy and sustainability, the Council provides the forward-looking intelligence our clients need to navigate uncertainty and make confident, informed decisions.

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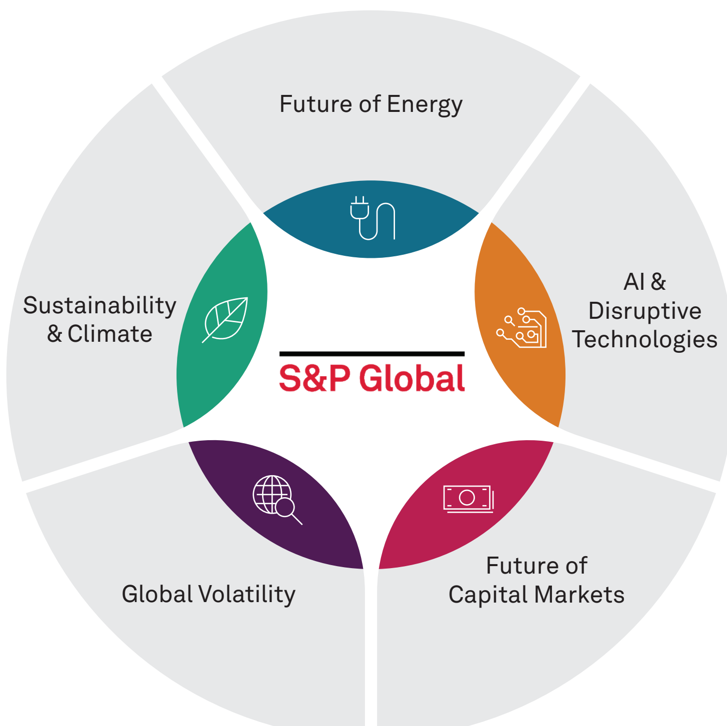
2026 key themes: A Volatile World



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