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Global Energy Perspective 2026



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Global Energy Perspective 2026: Key takeaways

Since the publication of McKinsey's previous *Global Energy Perspective*, the world's energy system has once again weathered unexpected storms that impact both its near-term outlook and long-term trajectory. Energy-related shocks are increasingly global shocks, with three recent "gray swan" events—the closing of the Strait of Hormuz, the Russia–Ukraine war, and the COVID-19 pandemic—having severe impacts on energy availability, demand, and prices.¹ As a result, we have revised our bottom-up energy model and shifted the focus of this year's report to a broader energy-system view that explores affordability and security alongside decarbonization.

The *Global Energy Perspective 2026* presents a new set of scenarios that reflect the global energy system with all its uncertainty and complexity. Executives can use these scenarios for strategy management to help them decide which bets to make now, which options to preserve, and which signals would justify changing course.

Highlights from this year's analysis:

- **The energy transition has become an energy expansion.** In 2025, global energy demand grew 2.7 percent, with oil, gas, coal, and renewables all expanding simultaneously. Across nearly every scenario, energy demand continues to grow, with the central question increasingly being what will supply that growth?
- **Geopolitical fragmentation could add a material risk premium to energy.** In the event of a fragmentation scenario—Fragmented Energy Order—rebuilding concentrated supply chains outside China could raise solar capital expenditure by 20 to 25 percent, and battery-storage capital expenditure by 40 to 50 percent in the European Union and the United States. Trade friction could also raise fuel costs through longer routes, higher insurance costs, and reduced trading flexibility, making geopolitics an increasingly important component of energy economics.
- **Artificial intelligence is the biggest growth segment but the post-2030 demand picture remains highly uncertain.** While data centers are the fastest-growing load segment in OECD power markets, with electricity demand from data centers alone growing at a projected 24 percent CAGR to 2030 in the Continued Momentum baseline scenario, the pipeline beyond that timeframe becomes highly uncertain and could be dampened by efficiency breakthroughs in computing power.
- **The grid is the energy transition's ultimate speed limit.** The world will require more energy, and a disproportionate amount of that demand growth comes from electricity. Transmission, storage, firm capacity, permitting, and interconnection now determine how quickly low-cost generation becomes reliable, usable energy. Across all scenarios, infrastructure readiness is already the most common binding constraint. When it lags behind, electrification stalls, regardless of how cheap renewables become.

¹ The Strait of Hormuz crisis affected a larger share of global energy than any other disruption in the last century (see Exhibit 4).

- **The next energy crisis is as likely to be driven by equipment, labor, batteries, or critical minerals as it is by barrels of oil.** An increasingly electrified and digitized energy system introduces critical dependencies across equipment, minerals, semiconductors, ports, grids, and digital infrastructure. Energy security is now a system-architecture challenge, not simply a fuel-diversification challenge.
- **In a high-growth world, oil demand could reach nearly 130 million barrels per day by 2035—a 30 percent increase from today.** In the Hydrocarbon Resilience scenario, oil demand is projected to grow by more than 2.5 million barrels per day annually over the next decade—roughly twice the growth rate of the previous decade. This underscores the risk of underinvestment if companies plan exclusively around an early peak in oil demand.
- **Nuclear returns as a major source of firm, low-carbon power in the Decarbonization Delivers scenario.** Average annual net nuclear additions more than double through 2050 in this scenario, from 18 gigawatts to 40 gigawatts, as nuclear costs decline, timelines improve, and small modular reactors move from first-of-a-kind projects toward repeatable deployment. With most nuclear OEMs likely to be from Asia in the latter half of this century, the center of gravity for new-energy technology may continue to shift East.² Rising demand and the need for reliable 24/7 supply strengthen the strategic role of nuclear power alongside renewables.
- **Cheaper generation may not mean cheaper energy—the total system cost increasingly matters.** Global transmission and distribution investment is projected to rise from \$443 billion in 2025 to \$970 billion annually by 2050, partially offsetting falling generation costs. Energy-system economics increasingly depend on the entire system—generation, grids, storage, firm capacity, flexibility, and integration—not on the levelized cost of electricity alone.
- **All scenarios project a widening gap to the Paris Agreement-aligned 1.5°C warming trajectory.** The current focus on energy affordability and security leaves the world on a concerning pathway toward intensifying temperature increases. Even Decarbonization Delivers—the most optimistic high-growth scenario in this year’s report—misses the Paris Agreement target by a projected 0.8°C.
- **There is no single “most likely” energy scenario—the range of plausible outcomes has widened dramatically, increasing the need for executives to take a stance.** While scenarios help executive teams understand the possible evolution of the global energy system, this insight needs to be translated into an organizational point of view on which future is most likely to unfold if executive teams are to avoid decision paralysis. Scenario planning, while critical, is not a substitute for strategic action.

² *The path to a new era for nuclear energy*, International Energy Agency, January 2025.

Foreword

The global energy system is more diverse, more fragile, and more unpredictable than ever before. Today's headlines could be about record-breaking low-carbon investment and renewable capacity buildout in 2025. But they are not. Instead, the zeitgeist reflects the disruptive forces of geopolitics and AI, structural challenges in the system, concerns about affordability, and, ultimately, how to secure sufficient energy to support economic growth. The unprecedented levels of capital expenditure in AI—2026 spending alone is estimated to reach the GDP of Sweden³—and the disruption to energy flows following the closure of the Strait of Hormuz (the largest disruption in modern history) is akin to the scale of the Industrial Revolution and major global conflict, combined.

This year's *Global Energy Perspective* reflects this reality. It takes stock of the energy system and explores a wider range of known unknowns—what happens if fossil fuel demand continues growing to meet rising energy demand and data center buildout? What happens if geopolitical fragmentation intensifies and global GDP decelerates? And what if the costs of low-carbon technology fall fast enough that clean energy continues to scale without sustained decarbonization policies? Our new energy-system scenarios widen the aperture to capture these possibilities.

Any of these scenarios could unfold, as could others that we cannot yet anticipate. Gray swan events, such as the COVID-19 pandemic, can change the world overnight. Other events, such as geopolitical conflict, cyberattacks on energy infrastructure, or extreme climate shocks, could have equally momentous impacts, but their scale and timing are difficult to predict. And then there are the less dramatic though highly consequential surprises that 11 years of the *Global Energy Perspective* have taught us to expect: Once-marginal technologies such as solar have exceeded every annual projection, while hydrocarbon fuels have set new records despite expected declines.

At every twist and turn, the energy system has been shaped by context, and the world looks very different from how it did when the Paris Agreement was signed in 2015. The post-2009 era of global cooperation and low interest rates provided fertile ground for low-carbon technology to take root. It achieved something genuinely important, funding the early deployment of solar, wind, and battery technologies until the economics became largely self-sustaining. In 2025, low-carbon investment exceeded fossil fuel investment for the second consecutive year, and renewable capacity grew faster than at any point in history.

But what we are experiencing is an energy transition that is not fully living up to its name. In 2025, oil demand hit its highest level since 2019. Coal set another consumption record and is projected to remain part of the system over the long term across most scenarios. Natural gas demand expanded across every major region. The global energy system did not transition in 2025—it grew, across every energy carrier, at 2.7 percent. Total energy demand continued to rise, and will very likely keep climbing for the next 25 years.

How, then, should we plan for a world and global energy system as unpredictable as this?

The cost of betting on a single central case, or not thinking broadly enough about possible outcomes, has never been higher. The ongoing disruption in the Strait of Hormuz is the clearest illustration of this risk. Within weeks of the conflict's onset, maritime traffic through the world's most critical energy chokepoint fell by more than 90 percent, energy prices surged across fuels and continents, and strategies built around diversified liquefied natural gas (LNG) supply were stress-tested in real time.⁴

³ Sophie Berglund, "The \$758 billion question: Putting AI spending in perspective," Peak Asset Management, August 4, 2026.

⁴ McKinsey DeepBlue analysis, based on raw automatic identification system (AIS) vessel-tracking data.

Despite this disruption, markets were more resilient than expected. Saudi Arabia and the United Arab Emirates were able to reroute part of their exports through pipelines.⁵ The United States released strategic petroleum reserves and expanded production and export capacity to provide additional supply.⁶ China reduced imports by drawing on strategic reserves and curbing domestic demand. In each case, advance preparation prevented the crisis from escalating into a catastrophic global supply shock.⁷

Those who prepared adequately understood that Hormuz was a calculable consequence of structural dependencies within the energy system. The same logic applies to AI, geopolitical fragmentation, and technology cost breakthroughs: Each of these forces is observable today, each could materially reshape the energy system within the decade, and none has a single deterministic outcome. Importantly, the implications of Hormuz are expected to continue to evolve and deliver surprises over the next three to five years; we should expect the same from these other forces too.

McKinsey's *Global Energy Perspective 2026* responds to this new era for energy with an explicit widening of our scenario framework. Through five scenario deep dives, the report explores a range of distinct and plausible outcomes for how the energy system may evolve to 2050. Our aim is to support executives in better understanding the risks and opportunities they face and the market signals that might warrant a change in strategic direction, so they can form a view on the trajectory of their industry.

This is a report designed for a time of genuine uncertainty, in which the most important strategic capability is not the ability to pick a single correct forecast, but to build portfolios that remain robust across a range of possible futures.



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⁵ Spencer Kimball, "Oil pipelines around the Strait of Hormuz won't end the threat Iran poses to Middle East crude exports," CNBC, July 17, 2026.

⁶ Ari Natter, "U.S. begins 86 MMbbl strategic petroleum reserve release," *World Oil*, March 13, 2026.

⁷ Ravi Agrawal, "Why energy prices didn't soar higher this year," *Foreign Policy*, July 30, 2026.



Why energy scenario thinking must evolve

The global energy system has consistently defied long-range outlooks for energy carriers and their projected makeup of the overall energy mix. Understanding the pattern of those surprises across 11 years of McKinsey's *Global Energy Perspective* is not a historical exercise but the foundation on which this year's expanded scenario framework is built. It is also a lens through which we assess our long-term forecasts to inform a 25-year projection to the best of our knowledge today.

Since the Paris Agreement, questions about how the energy system will evolve have always centered on decarbonization, affordability, and security. These three considerations remain unchanged. What has changed, however, is their hierarchy and emphasis, as affordability and security of supply move to front of mind for many decision-makers. Elements including accelerated GDP growth in emerging markets, faster data center buildout following advances in AI, and an increasingly fractional geopolitical landscape have each contributed to shifting prioritization.

This year's *Global Energy Perspective* unpacks the forces that have prompted a new set of energy scenarios. In this chapter, we explore shifting energy-system assumptions from the past decade, why the affordability lens has broadened to a system-cost view, how security of supply risks are exposed in a geopolitically fragmented world, and what AI-driven energy demand could mean in the decades to come.

A decade of shifting assumptions

Hydrocarbon energy infrastructure is inherently long-lived and capital-intensive. Pipelines, LNG terminals, refineries, power stations, and drilling platforms represent decades of committed capital and cannot easily be idled or quickly repurposed in response to shifting market signals. This physical “stickiness” means that inaccurate forecasting does not self-correct quickly—an underestimation of coal demand in 2021 can translate into underinvestment in mining and logistics infrastructure that may only become visible as a system constraint three to five years down the line. The enormous installed base of the world's conventional hydrocarbon energy system generates its own demand gravity.

The low-carbon system faces the opposite challenge: Infrastructure that does not yet exist must be built at a pace that aligns with energy-system projections. Grid connections, transmission lines, long-duration storage, dispatchable backup capacity, and offshore wind projects all require coordinated investment across multiple stakeholders, and many have long lead times. New grid infrastructure often takes five to 15 years to plan, permit, and complete.⁸ Critical equipment such as cables and large power transformers can take two to four years to procure, and in offshore wind, project permitting alone takes nine years, on average.⁹ When any element lags behind—as grid upgrades consistently have—the entire system can underperform relative to forecasts.

The growing operational complexity of the energy system itself further compounds this challenge. As the share of variable renewable energy rises, system operators must manage rapid fluctuations in supply and demand, balancing the system on a subhourly basis rather than a seasonal one. Annual long-term models tend to smooth out these peaks and troughs, further obscuring investment requirements.

Meanwhile, the long-term impact of today's energy-system disruptions are hard to predict. While the world appears to have navigated the energy crisis related to the closing of Hormuz, the medium-to-long term cost implications of the disruption are less certain, with economic growth forecasts already cut.¹⁰ Tying such impacts back to future energy demand outlooks becomes yet another consideration among an increasing set of interconnected and interdependent energy-system challenges.

This inherent system complexity means previous *Global Energy Perspective* projections have not always got it right. Some technologies have been underestimated and others overhyped (Exhibit 1). Solar PV deployment was persistently understated, for example, with buildout accelerated by faster-than-expected cost declines and China's dual role in the market. On the supply side, China's manufacturing scale and overcapacity pushed module prices down sharply, while on the demand side, China itself became the largest source of new solar deployment. Coal and lignite also exceeded expectations as strong demand from Asia, energy-security concerns, and the durability of existing assets have prolonged their use.

As the share of variable renewable energy rises, system operators must manage rapid fluctuations in supply and demand, balancing the system on a subhourly basis rather than a seasonal one.

⁸ *Electricity 2026: Analysis and forecast to 2030*, International Energy Agency, February 2026.

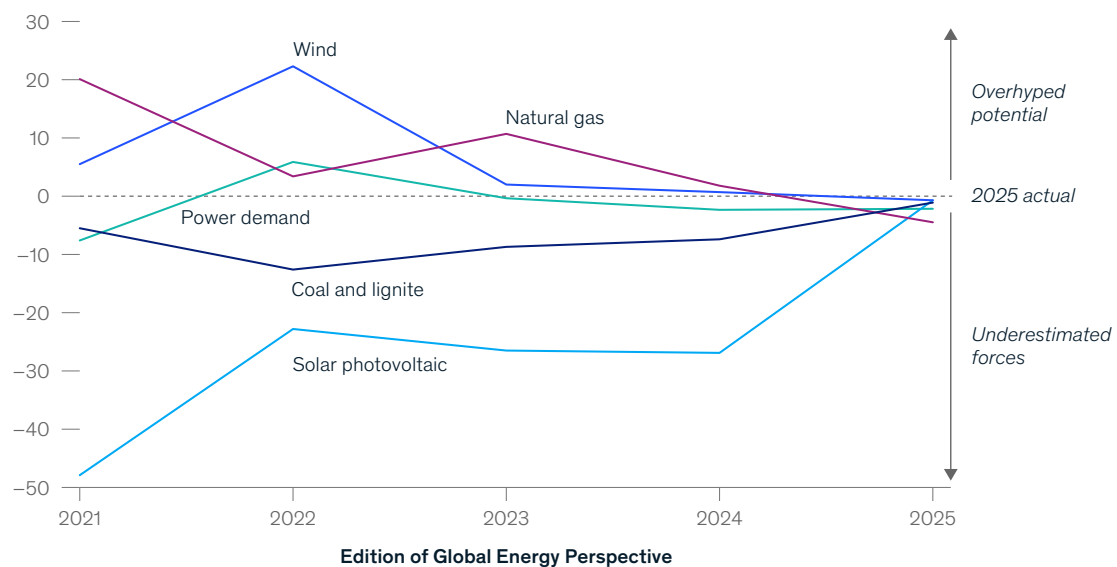
⁹ *Building the future transmission grid: Strategies to navigate supply chain challenges*, International Energy Agency, February 2025; *Renewables 2023: Analysis and forecast to 2028*, International Energy Agency, January 2024.

¹⁰ Pierre-Olivier Gourinchas, "War darkens global economic outlook and reshapes policy priorities," International Monetary Fund, April 14, 2026.

Exhibit 1

Previous editions of the Global Energy Perspective have underestimated some technologies and overestimated others.

Delta of previous projections to 2025 actual values,¹ %



¹Power demand measured in terawatt-hours; technologies measured as share of the generation mix.
Source: McKinsey Global Energy Perspective, 2021 to 2025

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Wind, by contrast, was overestimated, as rising financing and equipment costs, failed auctions, and project cancellations—especially offshore projects in 2023—slowed deployment. New technologies such as carbon capture and storage (CCS) and hydrogen, though not shown, were somewhat overrated too, with high costs, limited infrastructure, and weak offtake delaying deployment. Power demand has broadly tracked projections.

Demand-side management, though not shown, has been another underrecognized lever, and may need to become a more active system resource going forward, given the long lead times for grid buildout, new generation, and firming capacity. This is particularly the case in Europe, where 50 percent more flexibility could be needed by 2030, yet more than 70 percent of households in the European Union still lack dynamic pricing contracts, smart-meter rollout remains uneven, and persistent market barriers continue to limit demand-response participation.¹¹ The value of this lever can be seen in the United States, where the Department of Energy estimates that virtual power plants already provide about 30 to 60 gigawatts (GW) of capacity and could reach 80 to 160 GW by 2030, addressing 10 to 20 percent of peak load and saving about \$10 billion a year in grid costs.¹² The fundamental challenge is not whether flexibility is needed, but whether there is sufficient economic value for the stakeholders delivering it to drive investment into the market.

¹¹ *Unlocking flexibility: No-regret actions to remove barriers to demand response*, European Union Agency for the Cooperation of Energy Regulators, April 9, 2025.

¹² "Virtual power plants projects," U.S. Department of Energy, energy.gov, accessed August 12, 2026.

This reflection on previous projections teaches us vital lessons when constructing scenarios for the future energy landscape: Technology evolution (and hence cost) can move faster than anticipated, shifts in policy can have material impacts, and the compounding effects of these forces can have significant consequences a few years down the line.

Across most major markets, utility-scale solar and onshore wind are now the cheapest sources of unfirmed new electricity generation—not on a policy-adjusted basis, but on a raw levelized cost comparison.

Affordability lens broadens into a system-cost view

Decarbonization was the defining trend of the past decade, driven by the ambition of the Paris Agreement and policy favoring low-carbon technology deployment, such as carbon pricing, renewable obligation certificates, and feed-in tariffs.

These policy mechanisms, effectively made possible by subsidies and an associated transfer of wealth, created the market conditions that allowed solar, wind, (and in certain geographies battery technology) to scale along learning curves until generation costs fell below those of traditional technologies (when transmission and distribution [T&D] costs are not factored in).¹³ Across most major markets, utility-scale solar and onshore wind are now the cheapest sources of unfirmed new electricity generation—not on a policy-adjusted basis, but on a raw levelized cost comparison.¹⁴ By contrast, for technologies where deployment is not yet economically self-sustaining, such as green hydrogen, sustainable aviation fuel (SAF), industrial decarbonization, and CCS, deployment remains largely policy dependent.

While the levelized cost of electricity (LCOE) continues to fall for many technologies, global investment in T&D is expected to more than double by 2050, rising from \$443 billion a year in 2025 to \$970 billion a year in 2050—an average growth of 3.2 percent per year (Exhibit 2). This growth is driven primarily by distribution, which is expected to expand at a 4.2 percent CAGR from 2025 to 2050, compared with 1.1 percent for transmission (excluding inflation). Total T&D spend is expected to increase substantially over the next 25 years, pushing up the overall system cost of electricity and partially offsetting LCOE savings on the generation side.

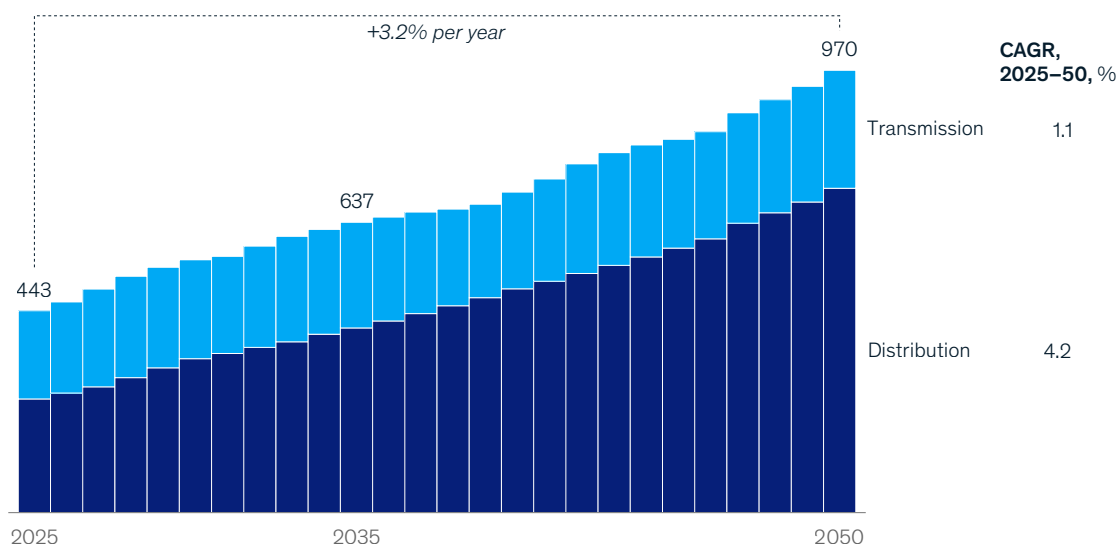
¹³ "How current policies on renewable energy are shaping our future," ACEN Renewables, acenrenewables.com, accessed September 2, 2026.

¹⁴ *Electricity 2026: Analysis and forecast to 2030*, International Energy Agency, February 2026.

Exhibit 2

Global investments in transmission and distribution are expected to more than double by 2050.

Yearly global investments in power transmission and distribution, \$ billion



Source: McKinsey Platform for Industrial Electrification

McKinsey & Company

The net effect of these two opposing forces—falling generation costs and rising network costs—determines the system cost, and therefore the affordability of the energy transition for households, industry, and public budgets. It is also where the transition becomes a country-level story rather than a global one: LCOEs converge globally as technologies mature, but system costs are shaped by each country's unique generation mix, network configuration, and the pace at which grid buildout must catch up with renewables deployment. Ultimately, the way these factors translate into prices is a localized decision that is somewhat but not fully correlated, with regulators making decisions such as how much of the price is passed onto customers.

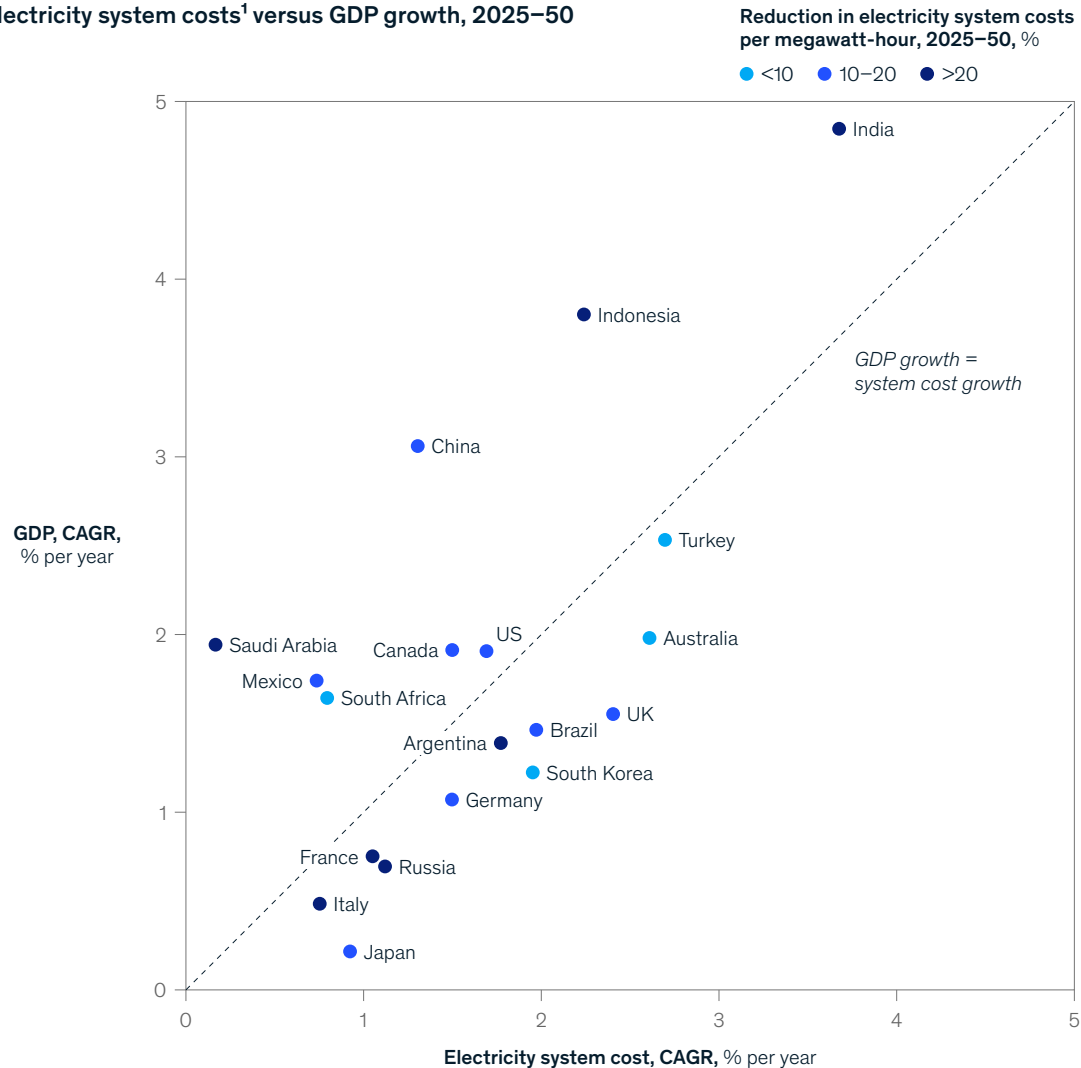
In large emerging markets, including China, India, Indonesia, Mexico, Saudi Arabia, and South Africa, as well as in certain advanced economies such as Canada, GDP growth is projected to outpace system cost growth, leading to an improving affordability trend, even where absolute system costs are rising quickly to fund new capacity (Exhibit 3). For these markets within the G20, affordability remains a financing and access challenge where the key question is how to fund network buildout and reliable supply without pricing electrification out of reach for households and industry.

By contrast, many advanced economies, including France, Germany, Italy, Japan, South Korea, and the United Kingdom, as well as developing nations Argentina and Brazil, could see system costs outpacing GDP growth in the years to 2050, even though a 10 percent reduction in cost per megawatt-hour (MWh) is helping to contain the gap in several of these G20 markets. For this group of countries, affordability is primarily a political-economy challenge: How much of the energy transition bill should be borne by residential tariffs, industry, taxpayers, or public balance sheets?

Exhibit 3

The dual movement of rising system costs and GDP shapes the affordability trajectory for each G20 member.

Electricity system costs¹ versus GDP growth, 2025–50



¹Electricity system costs include generation, transmission, and distribution costs.
Source: McKinsey Energy Solutions

McKinsey & Company

In Turkey and the United States, system cost growth is projected to be roughly in line with GDP growth.

The dual movement of rising system costs and GDP, but at different paces, shapes the affordability trajectory for each G20 member, and the wedge between advanced and emerging economies persists throughout the period 2025 to 2050. Countries are responding to affordability pressures through three broad approaches:

Shielding consumers from high prices. This response is most prevalent in advanced economies where governments have used their fiscal capacity to absorb part of the cost shock instead of passing it fully onto households. The United Kingdom's Energy Price Guarantee and associated household bill support during the 2022–23 energy crisis is a prime example, reducing the number of households experiencing “energy burden” by an estimated 3.2 million.¹⁵ Adopting a regulated return across the industry is another way of shielding consumers, pushing the cost shock onto shareholders in the industry instead.

Redesigning markets to reduce exposure to volatile fuels. Spain and Portugal's Iberian exception mechanism illustrates the market-design approach. Rather than compensating consumers only after prices had risen, the mechanism proactively reduced the passthrough of high gas prices into wholesale electricity in order to lower prices for Iberian consumers.¹⁶

Accelerating lower-cost domestic energy supply. This response is especially relevant where affordability, security of supply, and industrial strategy overlap. China's accelerated scaling of solar, wind, battery storage, electric vehicles (EVs), and grid infrastructure has reduced technology costs both domestically and abroad, for example.

Whatever route is followed, it is clear that affordability is now a central constraint of the energy transition as renewables make up a larger share of the energy mix. However, affordability cannot be solved in isolation: Decisions on generation, grids, storage, dispatchable backup, market design, and cost recovery need to be taken together.

In advanced economies, the key question is who pays for the system buildout. In emerging economies, the question is whether the system can be built at all without slowing access, industrial growth, or electrification. In some emerging economies, consumers may begin to solve the affordability problem themselves when the grid becomes expensive and unreliable and distributed solar becomes cheaper (see sidebar “Country portrait: Pakistan”).

However, affordability cannot be solved in isolation: Decisions on generation, grids, storage, dispatchable backup, market design, and cost recovery need to be taken together.

¹⁵ RAF002/2425: *Domestic energy affordability support schemes: Impact and economic evaluation*, UK Government, November 2025.

¹⁶ “State aid: Commission approves Spanish and Portuguese measure to lower electricity prices amid energy crisis,” European Commission, June 8, 2022.

Country portrait: Pakistan

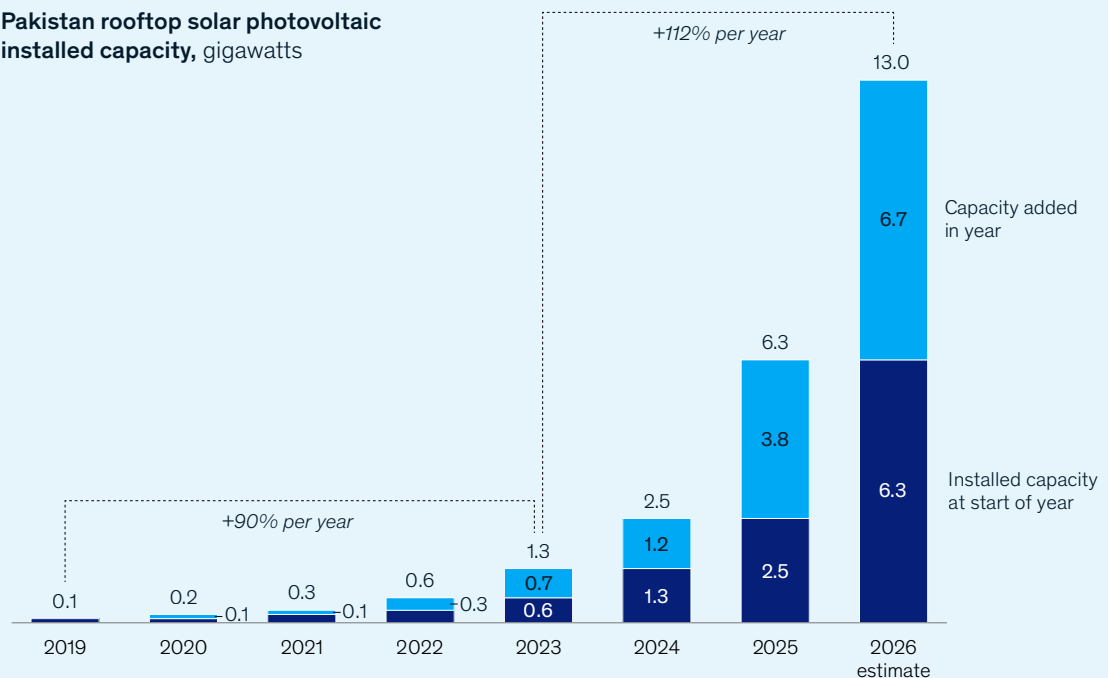
Pakistan is one of the clearest global examples of a market-led, bottom-up energy transition, with widespread adoption of solar PV driven primarily by affordability.

Installed net-metered solar capacity rose roughly tenfold in three years, from about 0.6 GW in 2022 to 6.3 GW by the end of fiscal year 2025 (Exhibit A). About 5 GW was added in the final two years of this period alone. Notably, this growth happened largely without direct climate policy, concessional finance, or a specific industrial strategy targeted at solar installations.¹

Exhibit A

Pakistan's installed residential rooftop solar capacity grew almost tenfold from 2022 to 2025.

Pakistan rooftop solar photovoltaic installed capacity, gigawatts



Source: International Energy Agency World Energy Balances; World Resources Institute; McKinsey Energy Solutions

McKinsey & Company

Pakistan's surge in solar capacity reflects a simultaneous demand- and supply-side cost squeeze. On the demand side, grid tariffs nearly tripled relative to 2019 as the government moved through tariff rationalization and subsidy reductions under its IMF program. This increased costs for power supply that remained unreliable for many.² On the supply side, a global oversupply of Chinese modules lowered solar panel prices by close to

¹ Nabiya Imran et al., *The solarisation of Pakistan's energy economy*, Ember Energy, June 25, 2026.

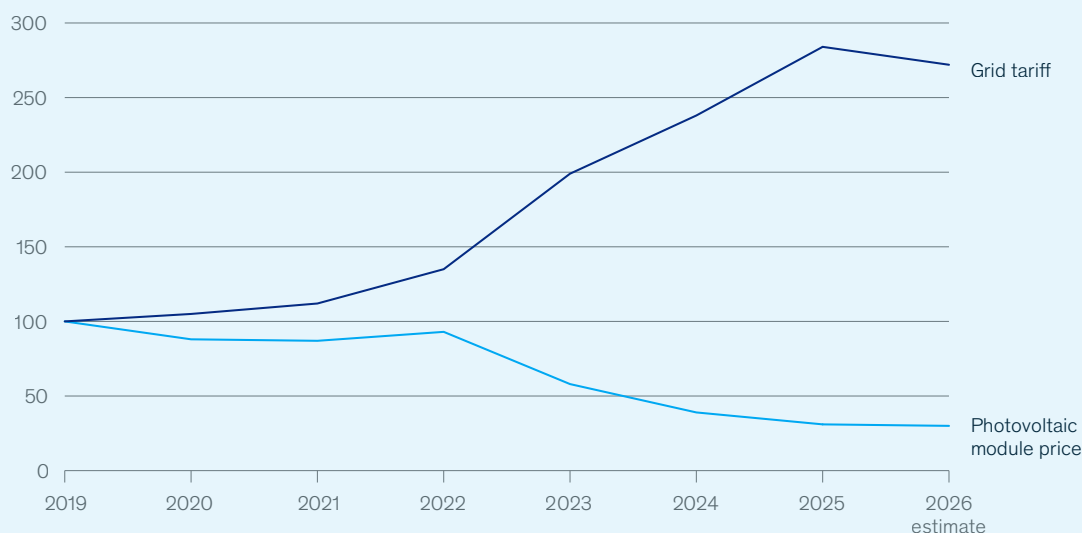
² Faraz Hayat and Numair Liaqat, "Navigating Pakistan's power sector crisis: Challenges, IMF recommendations, and the path to sustainable reform," Consortium for Development Policy Research, April 27, 2023.

70 percent over the same period, to about \$0.08 per watt (Exhibit B). The combined effect made self-generated solar cheaper, more reliable, and more readily available than the grid across residential, commercial, industrial, and agricultural users.

Exhibit B

High grid tariffs and low photovoltaic prices saw Pakistan install about five gigawatts of residential solar from 2023 to 2025.

Pakistan grid tariff and panel price, index (2019 = 100)



Source: International Energy Agency World Energy Balances; World Resources Institute; McKinsey Global Energy Perspective, 2021 to 2025

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However, these same economics could present a structural risk to the national grid. As higher-consumption customers self-generate, fixed-system costs concentrate on the remaining grid users. By the end of 2024, the government estimated that net-metered consumers had already shifted more than \$0.5 billion onto others.³ There are signs the government may take action, with a proposed increase of the general sales tax (GST) on solar panels being considered.⁴

³ "ECC approves amendments to net-metering regulations to address growing burden on grid consumers," Press Information Department, Government of Pakistan, March 13, 2025.

⁴ Matthew Lynas, "Pakistan targets solar sector with higher sales tax on modules, increased duties on batteries and inverters," *PV Magazine*, June 10, 2026.

Security of supply risks expose structural dependencies in a geopolitically fragmented world

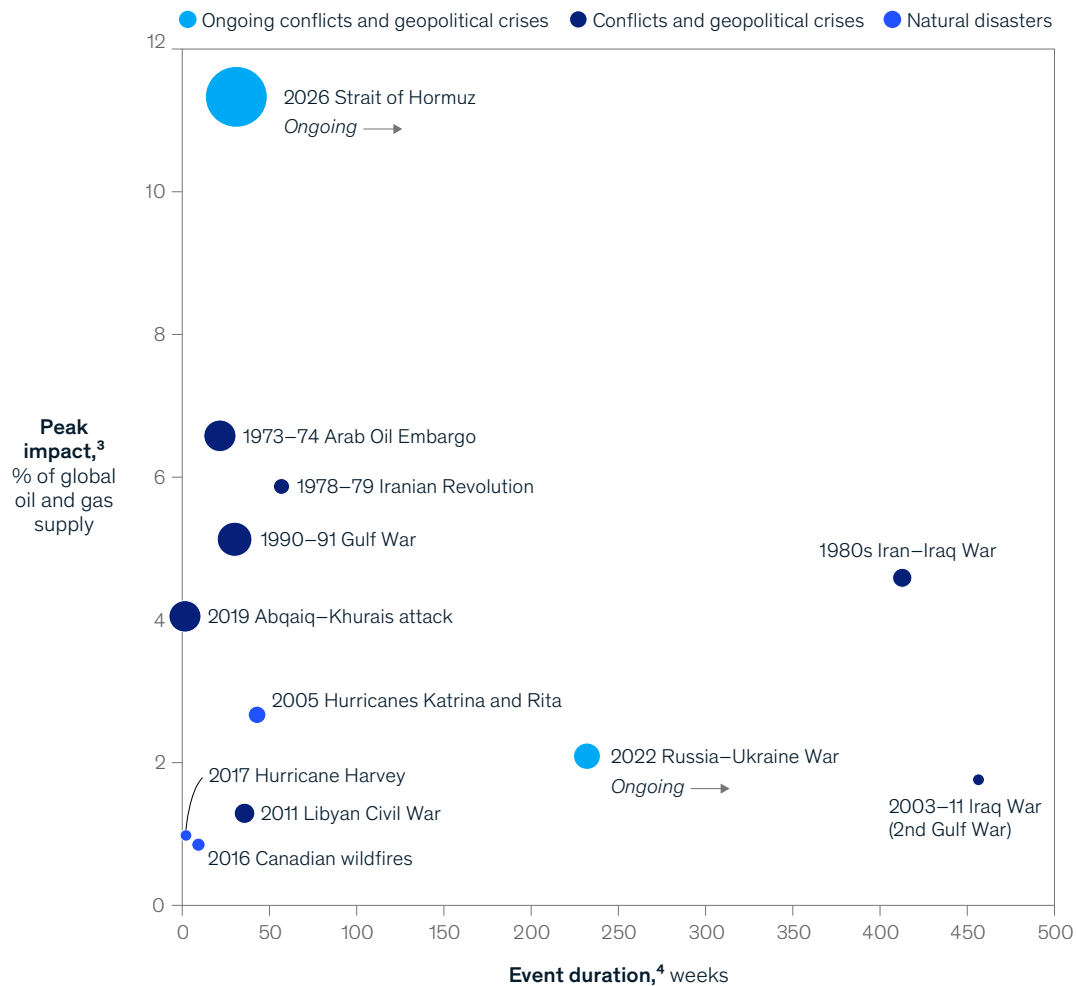
The energy system is not merely a technical and economic construct—it is increasingly impacted by geopolitics in a fragmenting world. In 11 years of publishing the *Global Energy Perspective*, the two largest oil and gas supply shocks have both been geopolitical in origin: the start of the Russia–Ukraine war in 2022 and the Hormuz crisis of 2026. In fact, over the past seven decades, the most severe supply disruptions have all had geopolitical origins, with effects that persisted for years beyond the initial event (Exhibit 4).

Exhibit 4

The Strait of Hormuz crisis affected a larger share of global energy than any other disruption in the last century.

Overview of select energy supply shocks and their impact on the global energy system¹

Bubble size = average shock over the full event,² million tons of oil equivalent per week



¹Excluding effects on Russia.

²Duration-weighted mean of the oil and gas supply made unavailable to the market.

³Defined as the maximum share of global oil and gas supply made physically unavailable at the peak of the event, net only of successful rerouting. Replacement supply, spare capacity, and inventories from other producers are not considered to reduce the shock.

⁴Length of the underlying event/conflict.

Source: International Energy Agency World Energy Balances

Hormuz stands apart. At its peak, the disruption rendered close to 25 percent of seaborne oil trade and 19 percent of LNG supply unavailable to the market—even after part of the flow was rerouted through pipelines in Saudi Arabia and the United Arab Emirates.¹⁷ That the Hormuz crisis has eclipsed even the 1973 Arab Oil Embargo in terms of severity shows how closely today's disruptions rival the defining energy shocks of the 20th century. Within weeks of the conflict's onset, vessel transits through the strait fell by more than 90 percent.¹⁸

The duration of such shocks matters as much as their depth. The impact of the Russia–Ukraine war is measured not in weeks, but in years. And while oil from Russia was largely rerouted to Asian buyers at the start of the conflict, an alternative route could not be found for pipeline gas, meaning losses were sustained rather than reabsorbed by the market. During the 2022 gas crisis, Europe paid an estimated €390 billion in energy subsidies in 2022 alone.¹⁹ This represents more than a decade of efficiency investment, consumed in just months.²⁰

The lesson here is that the energy system's structural dependencies make these kinds of events periodically inevitable in a geopolitically complex world. Security of supply is becoming a portfolio design problem, not a procurement problem. The answer, however, is not to simply diversify the supply base but to identify every point at which a single geography, fuel, technology, supplier, route, permitting regime, or digital platform could determine business continuity.

Recent shocks have reframed energy security around the two structural dimensions of self-sufficiency (the domestic share of primary energy supply) and diversification (how consumption is spread across different energy sources). Looking at where countries are positioned along these dimensions in 2025, and their projected trajectories to 2050, reveals four core archetypes (Exhibit 5):

Diversified independents: Argentina, Brazil, Canada, and the United States are already strong on both dimensions and are expected to largely maintain or improve their positions through 2050. Their strengths rest on their resource endowments: Canada and the United States access oil, gas, and coal from domestic production while Brazil combines pre-salt oil with the largest hydropower base of any G20 economy, alongside a substantial biofuels sector. The reemergence of oil and gas in Argentina shifts the country from import dependence back toward export strength, while solar, wind, and battery energy storage systems (BESS) add further diversification to Argentina's domestic energy mix.

Concentrated independents: Indonesia, Russia, and Saudi Arabia are expected to remain highly self-sufficient but comparatively dependent on concentrated, hydrocarbon-heavy energy systems. Saudi Arabia's primary energy supply is roughly 95 percent oil and gas today, with negligible nonfossil supply; Russia is dominated by gas and oil, with meaningful but smaller contributions from nuclear and hydropower; and Indonesia is heavily reliant on coal and oil, with only a gradual broadening of the mix projected over the period to 2050. For all three countries, the main risk sits on the demand side rather than the supply side. The exposure is not physical supply availability but reliance on a narrow fuel base and vulnerability to changing prices, demand, and policy.

Selective importers: This category comprises countries with a 60 to 85 percent domestic share of primary energy supply, such as Australia, China, India, Mexico, and South Africa. These countries meet most of their energy demand domestically while remaining import-dependent for specific fuels. For example, China is broadly self-sufficient in coal, meeting about 90 percent of its needs, and is also expanding its renewables capacity. However, it still imports about 70 percent of its oil and 40 percent of its gas. India covers about 80 percent of its coal domestically but imports about 85 percent of its oil. South Africa relies on domestic coal but imports most of its liquid fuels, and Australia is a coal and gas exporter, but imports about three-quarters of its oil.

¹⁷ "Strait of Hormuz factsheet," International Energy Agency, February 2026.

¹⁸ McKinsey DeepBlue analysis, based on raw automatic identification system (AIS) vessel tracking data.

¹⁹ *Gas market lessons from the 2022–2023 energy crisis*, International Energy Agency, October 1, 2025.

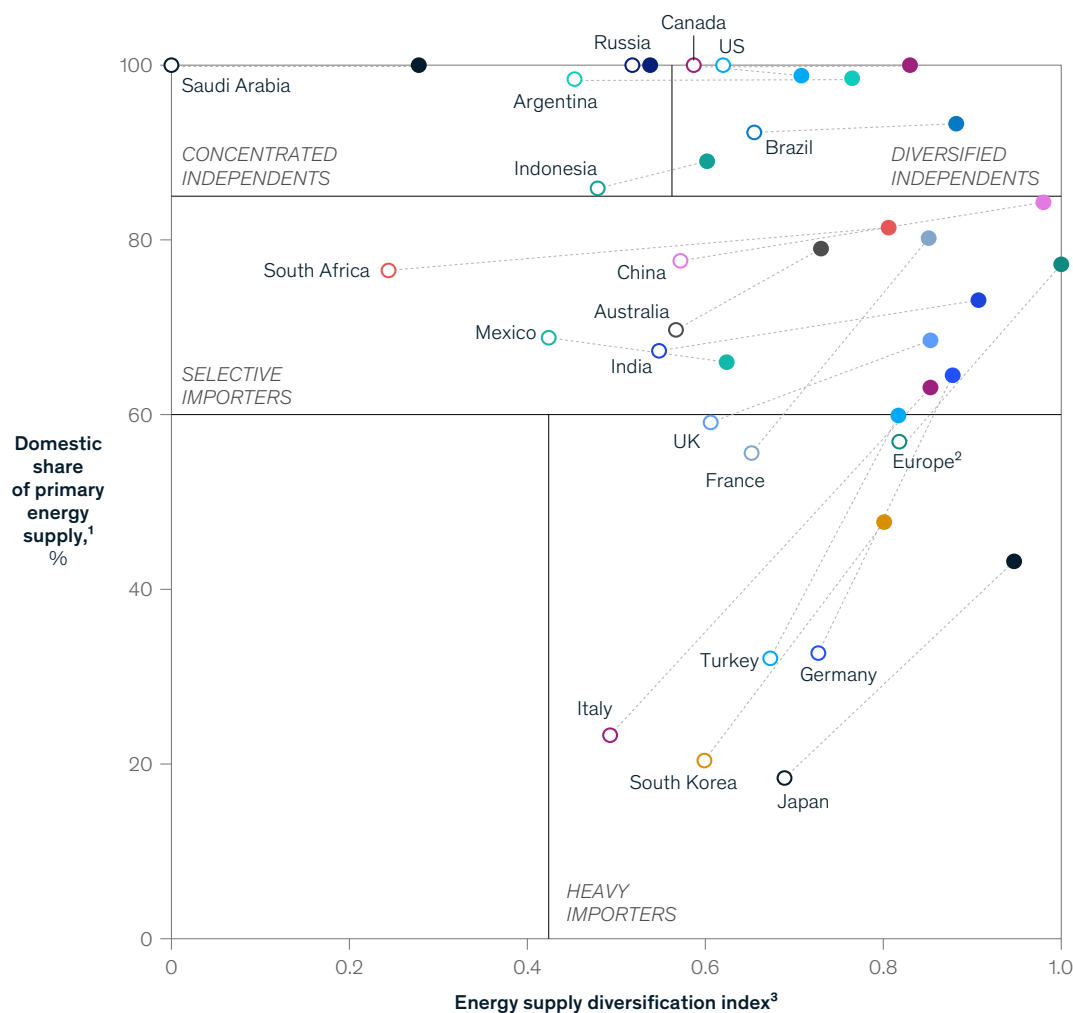
²⁰ *Gas market lessons from the 2022–2023 energy crisis*, International Energy Agency, October 1, 2025.

Exhibit 5

Most countries see their energy supply becoming more diverse by 2050.

Evolution of energy self-sufficiency vs energy supply diversification, 2025–50

2025 ○ 2050 ●



¹Share of primary energy consumption sourced from domestic production. Import shares are calculated separately for each primary energy source (oil, natural gas, coal, nuclear, hydropower, solar, wind, bioenergy, geothermal, and waste) then weighted by each source's share of total primary energy consumption. Nuclear and renewables are treated as domestically supplied.

²Includes EU27, Norway, Switzerland, and the UK.

³Measures the spread of primary energy consumption across sources, calculated using the Shannon entropy index applied to the share of each primary energy source in total primary energy consumption.

Source: McKinsey Energy Solutions

McKinsey & Company

Looking ahead, Europe as a whole, as well as France and the United Kingdom specifically, are projected to move into the “selective importer” archetype by 2050, driven by different mechanisms. In France, assumed nuclear renewal and a rising share of renewables reduces residual fossil fuel imports; in the United Kingdom, offshore wind partly offsets declines in North Sea oil; and in Europe, oil and gas are displaced predominantly by wind, solar, and bioenergy, alongside a stable nuclear base. This would see oil and gas's share of Europe's

energy supply fall from around 60 percent to about 30 percent, making Europe the most energy-diversified economy by 2050, ahead of every individual G20 member.²¹

Heavy importers: This category comprises countries that meet less than 60 percent of their primary energy supply domestically, such as Germany, Italy, Japan, South Korea, and Turkey. These countries remain highly dependent on energy imports despite having diversified energy mixes. Germany imports nearly all its oil and gas, with domestic lignite its only significant fossil resource. Italy has effectively no domestic hydrocarbon supply, and Japan and South Korea import close to 100 percent of their oil, gas, and coal, with only nuclear and renewables making up their domestic supply. Germany, Italy, and Turkey are projected to improve their self-sufficiency by 2050 as renewables materially displace imported fossil fuels in their primary energy mix. Japan and South Korea are likely to remain more constrained, however, with limited land availability, an absence of fossil resources, and geographical isolation limiting the growth of their domestic supply.

While a shift toward renewables lifts self-sufficiency for economies, it can introduce a layer of exposure in equipment supply chains. Today's solar PV, wind, and battery storage equipment supply chains are more concentrated than fuel supply chains have ever been, with dependencies emerging across finished equipment, upstream materials, and manufacturing capacity. At the finished-equipment layer, China accounts for roughly 80 percent of global solar module production, 75 percent of global battery cell manufacturing capacity, and holds a growing share of wind turbine and component output.²² At the upstream materials layer, about 90 percent of rare earth elements used in permanent magnets for wind turbines are refined in China. Battery-material processing is similarly concentrated, with China processing more than 70 percent of lithium, cobalt, graphite, and rare earths.²³ At the manufacturing-capacity layer, most G20 economies do not yet have the domestic industrial base to scale production. Europe's solar and battery manufacturing capacity, for example, remains a small fraction of installed demand.

Overall, most of the countries analyzed are projected to improve their structural energy-security position through 2050, albeit through different mechanisms. Resource-rich economies mainly broaden their fuel mix, while import-dependent economies strengthen resilience through expanded domestic supply. The exposure to concentrated equipment supply chains cuts across this pattern asymmetrically. Those economies that gain the greatest energy independence from a transition to renewables also inherit the largest equipment dependencies. Economies with 2050 positions that depend less on scaling new equipment are correspondingly less exposed.

In this context, the strategic priority for decision-makers shifts from managing import exposure alone—through supplier diversification, reserves, and contracts, for example—to structurally reducing fuel-import dependence while also addressing the equipment-import dependence that partly replaces it. The urgency to become both more diversified and more self-sufficient may only increase as the energy system enters a period of potentially heightened disruption. The Russia–Ukraine war exposed regional gas dependence, and the Hormuz crisis exposed the fragility of maritime chokepoints. The next major disruption may not look like either of these, however. As the system becomes more electrified, digitized, trade-dependent, and materials-intensive, the range of potential shock factors also expands.

In the past, energy-security analysis focused primarily on fuel flows: crude oil, pipeline gas, LNG, coal, and refined products. That lens is no longer sufficient. A disruption to battery minerals, grid equipment, semiconductors, ports, insurance markets, or transmission buildout could now impact the energy system just as materially as a disruption to oil or gas supply. This is why geopolitics is treated as a structural driver of energy-system architecture in this year's *Global Energy Perspective*.

²¹ Comparison is not like-for-like since pooling 30 countries' fuel mixes into one bloc-level figure smooths out any single country's concentration and inflates the diversification score relative to any one member state.

²² *Special report on solar PV global supply chains*, International Energy Agency, August 2022; *Global critical minerals outlook 2024*, International Energy Agency, May 2024.

²³ *Global critical minerals outlook 2025*, International Energy Agency, June 2025.

AI adoption could accelerate faster than expected, and data center electricity demand could rise by orders of magnitude above today's levels, driven by training, inference, cloud migration, and sovereign AI buildout.

A range of hypothetical future shocks, while by no means likely or certain, could have widespread potential implications:

Systemic cyberattack: A coordinated cyberattack could conceivably compromise multiple layers of the energy system at once: grid operators, substations, pipelines, LNG terminals, ports, and digital control infrastructure. Market dispatch could be interrupted, pipelines and terminals shut down, and grid operators forced into manual fallback procedures or load shedding. In such a scenario, the value of redundancy, black-start capability, islanded grids, analog controls, cyber-resilient substations, and dispatchable backup could rise sharply. Digitalization would remain essential, but with cyber resilience as the core design parameter.

Critical minerals squeeze: Export controls, resource nationalism, permitting delays, or processing bottlenecks could each conceivably restrict access to lithium, graphite, rare earth minerals, copper, nickel, cobalt, and other transition-critical inputs. In such an event, copper and transformer constraints would slow grid expansion and data center deployment; tightened battery materials availability could see EV and storage economics deteriorate; and restricted availability of rare earths could impact wind and motor supply chains, for example. Countries with abundant resources, either natural or imported, such as China, could gain strategic leverage, while import-dependent countries might be forced into stockpiling, recycling, friend-shoring, demand destruction, or delayed electrification.²⁴

Compute energy colossus: AI adoption could accelerate faster than expected, and data center electricity demand could rise by orders of magnitude above today's levels, driven by training, inference, cloud migration, and sovereign AI buildout. Power demand would become the central planning constraint in several markets—and to an even greater extent than already expected—with grid connections, firm capacity, cooling, land, water, and permitting acting as bottlenecks. Meanwhile, gas, nuclear, geothermal, storage, and other firming capacities could benefit from growing demand for reliable 24/7 power. This could delay coal and gas retirements unless clean firm supply and grids can scale fast enough. The strategic question might shift from “How much electricity will AI use?” to “Where can AI physically be powered?”

Small modular reactor breakthrough: There are currently nine small modular reactors (SMRs) in operation or under construction worldwide.²⁵ This disruption would see SMRs move from first-of-a-kind projects to repeatable fleet deployment, supported by standardized designs, reduced construction risk, regulatory streamlining, reduced costs, and increased customer demand from data centers, industry, and utilities. Clean firm power could become a leading option for reliability over unabated gas and coal, as well as variable

²⁴ See McKinsey's upcoming *Global Materials Perspective 2026* for McKinsey's latest materials analysis.

²⁵ “Small Modular Reactor (SMR) Global Project Tracker,” World Nuclear Association, updated July 29, 2026.

renewable-energy-plus-battery systems. SMRs could reshape power-market planning by providing high-utilization, low-carbon generation near data centers, industrial clusters, remote systems, and retiring coal sites. This could reduce the long-term need for fossil fuel backup in some regions and increase confidence in widespread electrification. However, it would also likely create new bottlenecks in nuclear supply chains, skilled labor, fuel availability, licensing capacity, waste management, and public acceptance. Major breakthroughs in other energy technologies, such as solid-state batteries and perovskite solar cells, could also have widespread implications for their related supply chains and for decarbonization overall.

Disruption in the South China Sea: Should a major disruption restrict shipping through the South China Sea, China's access to imported energy, semiconductors, and industrial inputs could be affected, along with its clean-technology export routes. The potential implications would be widespread. If China and parts of Asia were to face acute constraints on their energy flows, imbalances in the global energy market could emerge, with shortages in Asia and oversupply elsewhere, potentially leading to a decoupling of global prices. China's clean-technology manufacturing exports could be interrupted, leading to global shortages of solar panels, batteries, and other technologies critical to energy-system diversification. Conversely, China could itself face an oversupply of these goods, leading to further asymmetry in the pace of its renewables buildout compared with that of the rest of the world. Disruption to China's integration with the global economy could also have significant ripple effects beyond energy, potentially resulting in a global economic slowdown.

Withdrawal of clean-energy policy support: Shifts in national priorities across Europe, the United States, or other advanced economies could reduce clean-energy subsidies, weaken emissions regulation, slow permitting reform, or deprioritize clean-energy industrial policy. Were this to materialize, technologies and projects that can proceed on unsubsidized economics and contracted demand, or on the grounds of strategic security-of-supply considerations, would likely continue, while those dependent on policy support, regulated returns, or public funding could slow, be redesigned, or canceled altogether. The impact would likely be strongest on capital-intensive and early-stage value chains such as green hydrogen, CCS, SAF, offshore wind, industrial decarbonization, and domestic clean-technology manufacturing. Fossil fuel demand could become more resilient in some markets, while clean-technology supply chains may consolidate in regions with lower costs, stronger industrial policy, or deeper manufacturing ecosystems.

Accelerating climate disasters: Another year of record-breaking heat waves, droughts, forest fires, and flooding could reverse the security, affordability, and decarbonization hierarchy. An increase in human suffering and economic contraction due to climate-related disasters could heighten public expectations for emissions reductions, leading to new policies that position sustainability as the most urgent national or global priority to solve. This could spark a new wave of decarbonization ambition, targeted policy support, and R&D spending, potentially fast-tracking low-carbon cost evolution and deployment, and propelling the global energy system to a more decarbonized profile in the decades ahead.

These types of shocks and their potential impact on energy-security dynamics are a core impetus for broadening the scenario space in this year's *Global Energy Perspective* and will be explored in depth in upcoming research from the McKinsey Global Institute. A world of resilient supply chains, open trade, and fast infrastructure delivery moves the energy system toward accelerated decarbonization. A world of chokepoints, cyber risk, mineral constraints, and fragmented trade could move it toward greater dependence on fossil fuels or bloc-based energy systems.

AI changes the demand picture, but remains highly uncertain

Artificial intelligence may be the most consequential new variable in energy demand forecasting since LNG emerged as a globally traded commodity and reshaped gas markets.

On the demand side, AI training and inference workloads are power-intensive and location-constrained. Data center electricity demand is the fastest-growing load segment in OECD power markets, with hyperscalers

announcing capacity additions measured in gigawatts.²⁶ In several markets, data center electricity demand is the single largest driver of projected demand growth from now until 2030, with a projected CAGR of 24 percent in this year's Continued Momentum baseline scenario, decelerating to a 5 percent CAGR in the decade 2030 to 2040, with the assumption that AI computing remains as energy-intensive as current standards (Exhibit 6). The picture for data center buildout beyond 2030 remains uncertain, especially since the return on investment for AI is still being proven.

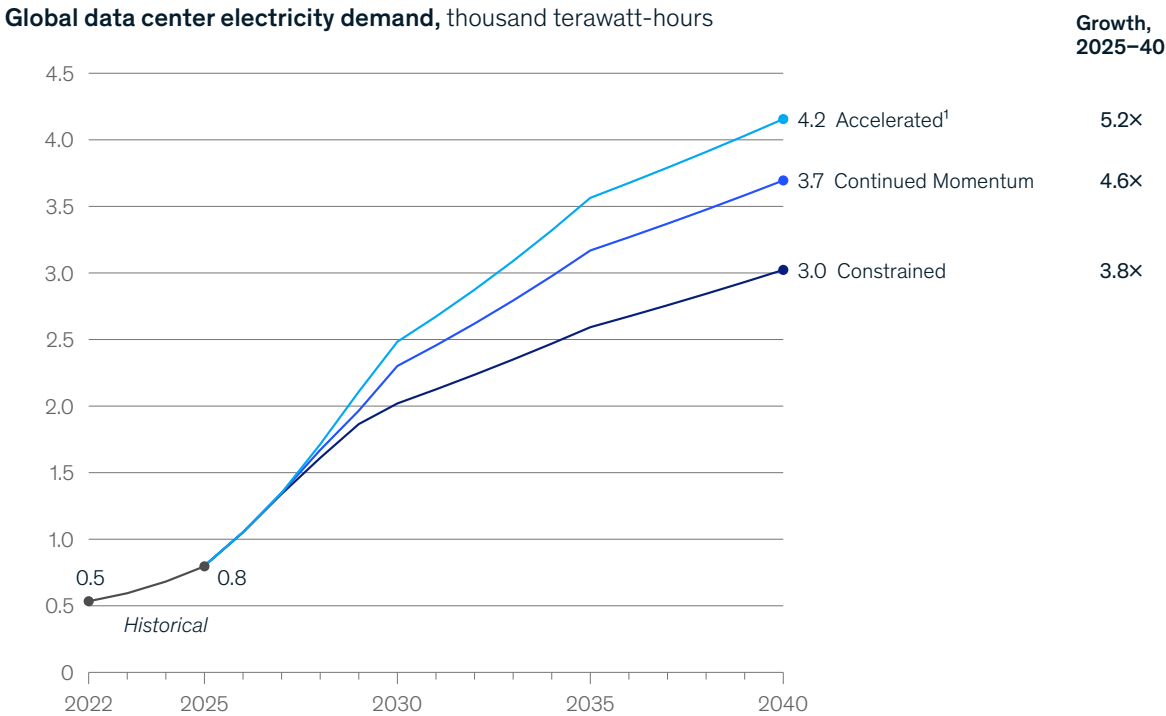
From a supply point of view, AI is also becoming a productivity lever for the energy system. It is already being used to enhance grid forecasting and dispatch, improve power and industrial asset maintenance, accelerate engineering and project development, and boost manufacturing yields.²⁷ These applications could reduce cost, shorten delivery timelines, and transform asset utilization across both conventional hydrocarbon and low-carbon energy systems.

²⁶ "Data centre electricity use surged in 2025, even with tightening bottlenecks driving a scramble for solutions," International Energy Agency, April 16, 2026.

²⁷ Gregory Vogl, Aaron Cornelius, and Xiaodong Jia, "2026 roadmap on artificial intelligence and machine learning for smart manufacturing," National Institute of Standards and Technology, U.S. Department of Commerce, July 3, 2026.

Exhibit 6

In several markets, data center electricity demand is the single largest driver of projected demand growth until 2030.



¹Projections are provided for both a more accelerated and constrained data center electricity demand outlook to acknowledge uncertainty in the data center project pipeline beyond 2030.
Source: McKinsey Proprietary Data Center Supply and Demand Models

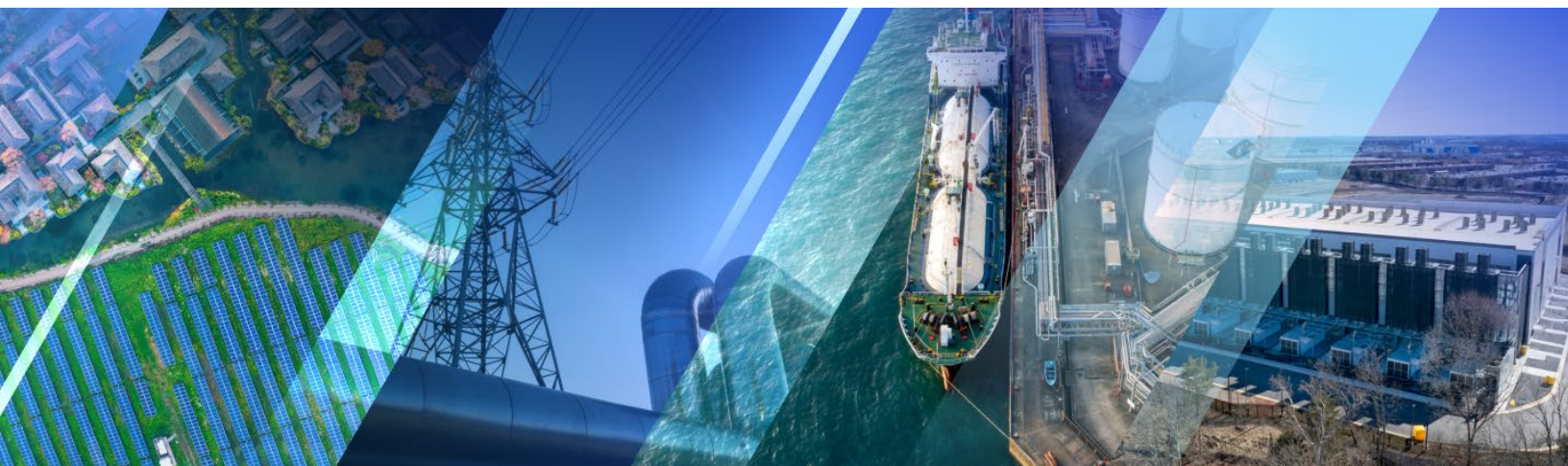
Additional LCOE declines may not come from technology learning alone. Solar modules, wind turbines, batteries, grids, transformers, gas turbines, nuclear components, and electrolyzers all need to be manufactured, procured, connected, operated, and maintained more efficiently. AI could drive improvements in design cycles, supply-chain planning, quality control, predictive maintenance, grid congestion management, and real-time system optimization, essentially casting AI as a risk-mitigation lever for the supply side of the energy system.

The cost of AI usage itself also comes into play as a material variable. Public API prices now range from roughly \$0.20 to \$5.00 per million input tokens and \$1.20 to \$30.00 per million output tokens across the leading AI models, with lower-cost models making high-volume inference increasingly affordable.²⁸ This has two implications for energy: Cheaper tokens could accelerate AI adoption and electricity demand, while pressure to improve AI unit economics could drive faster gains in model efficiency, chip utilization, caching, and data center operations. If these AI-enabled productivity gains materialize, they could help lower generation and system costs, improve reliability, and support faster deployment of all types of energy infrastructure.

In short, AI operates on both sides of the energy system. On the demand side, it increases electricity consumption through data center growth. On the supply side, it could reduce the cost and complexity of meeting that demand by improving how energy assets are designed, built, operated, and integrated into the energy system.

If these AI-enabled productivity gains materialize, they could help lower generation and system costs, improve reliability, and support faster deployment of all types of energy infrastructure.

²⁸ "Compare models," Open AI Developers, openai.com, accessed August 7, 2025.



The new scenario matrix

This year, the *Global Energy Perspective* organizes its scenario framework around two considerations: energy demand growth—how quickly total final energy consumption grows between today and 2050, driven by GDP and population growth, AI, expanded access, and efficiency—and the balance between conventional and low-carbon, electrified energy technologies—whether the system tilts toward fossil fuel infrastructure or toward clean technology (Exhibit 7).

This framing reflects the insight that decarbonization policy, while still important, is no longer observed as the primary driver of the energy system's long-term outlook. Affordability and security of supply concerns increasingly determine which energy technologies get deployed at scale.

Given the rising importance of affordability and security, the *Global Energy Perspective 2026* presents four new scenarios alongside the baseline scenario, Continued Momentum (see sidebar “Methodology: What has changed in 2026?”).

Four new scenarios explore a range of possible energy-system futures:

- **Fragmented Energy Order:** A scenario in which geopolitics fractures the energy system.
- **Hydrocarbon Resilience:** A scenario in which fossil demand keeps rising.
- **All of the Above Energy:** A scenario where every available energy resource is utilized to ensure reliable power.
- **Decarbonization Delivers:** A scenario where decarbonization accelerates.

Methodology: What has changed in 2026?

This year's *Global Energy Perspective* presents four new scenarios—Hydrocarbon Resilience, Fragmented Energy Order, All of the Above Energy, and Decarbonization Delivers—that explore the plausible space within the projected upper and lower energy-demand outlooks to 2050. These four scenarios describe directional outcomes and driver combinations and do not have standalone quantitative datasets.

Fully modeled bottom-up scenarios are still available for the core scenarios presented in previous editions of the *Global Energy Perspective* (Slow Evolution, Continued Momentum, and Sustainable Transformation). These datasets cover all 140+ countries, 77 demand segments, and 76 fuels through 2050, and are available through [McKinsey's Energy Solutions](#) platform. Modeling can also be made available for the new 2026 scenarios, as well as other custom scenarios, on request.

The Continued Momentum scenario continues to function as the baseline against which all scenarios are anchored. It reflects a material upgrade to the underlying methodology used in 2025, which has been expanded to connect recent market developments more directly with long-term scenarios and to assess outcomes through the energy-related lens of affordability, reliability, and decarbonization.

In power, the outlook now captures a broader set of market dynamics and investment signals, including system-wide flexibility, adequacy, grid readiness, and security-of-supply requirements. This shifts the analytical lens from asset-level economics alone to total-system economics—not only which technologies look competitive on a standalone basis, but which combinations of generation, grids, storage, dispatchable capacity, and flexibility could meet demand reliably and affordably over time.

Another major methodological upgrade is the treatment of AI and data center demand. Rather than modeling data centers as a single load category, this year's outlook distinguishes between training and inference workloads, sovereign AI ambitions, geographic deployment patterns, and evolving compute-efficiency trends. This matters because AI affects both sides of the energy system. It can create highly concentrated electricity demand in specific markets, while also improving productivity, asset utilization, and technology cost trajectories across the supply side. As a result, Continued Momentum better captures where AI load may become a binding constraint for grids and firm power, and where efficiency gains could partially offset the increase in electricity demand.

Continued Momentum also incorporates updated assumptions across oil and gas markets, transport, and industrial fuel switching:

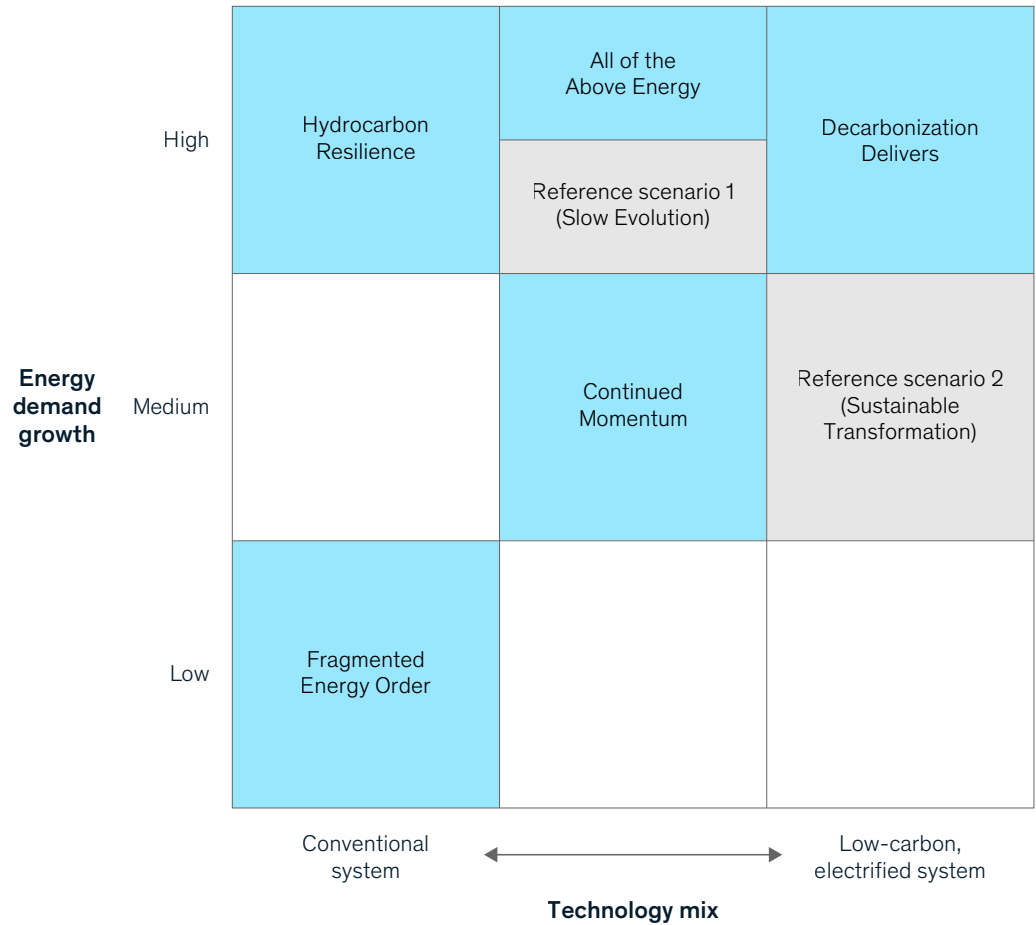
- In gas, the modeling has been strengthened to more fully reflect the geopolitical dynamics that are increasingly important to the global energy system, including LNG trade flows, regional import dependence, security-of-supply considerations, and the potential reshaping of gas markets under fragmentation or supply shocks.
- In oil, the scenario reflects a temporary demand slowdown in 2026 linked to the Strait of Hormuz crisis, followed by a potential rebound in 2027–29 as economic activity normalizes and market oversupply eases.
- In transport, EV adoption has been adjusted to reflect a shift from policy-driven to cost-driven penetration, with a continued slowdown in the United States, a 2026 rebound in Europe supported by high fuel prices, and a more gradual post-2030 uptake where policy support, electricity prices, and commercial-vehicle economics remain challenging. In developing economies, EV adoption continues to grow, but often adds to the total vehicle stock rather than fully replacing internal combustion engine vehicles as car ownership expands.
- In industry, agriculture, and chemicals, fuel switching is assumed to be less pronounced than in earlier outlooks, as existing infrastructure, switching costs, and required incremental capital expenditure slow the pace of substitution.

Exhibit 7

Energy demand growth is expected to be high across most scenarios.

New scenario matrix: Energy demand growth vs mix of conventional and low-carbon technology

Global Energy Perspective 2026 scenarios



Note: No probability assigned to any scenario.
Source: McKinsey Energy Solutions

McKinsey & Company

Eight levers that move the energy system

Eight interconnected levers have a disproportionate influence on the energy system and could ultimately determine which scenario plays out. Each lever affects energy demand or the pace of decarbonization, either amplifying or suppressing energy demand growth and accelerating or curbing the transition from a conventional hydrocarbon system to a low-carbon, electrified system (Exhibit 8).

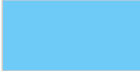
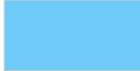
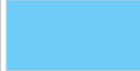
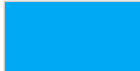
On the demand side, four levers dictate how much energy the system needs to deliver: GDP and industrial growth, AI and data center demand, emerging market development and energy access, and energy intensity improvement. Population growth, while not considered here, is another underlying driver of energy demand.

Exhibit 8

Eight interconnected levers amplify or suppress energy demand growth and the pace of decarbonization.

Energy demand and supply across the scenarios

Lower than CM    Higher than CM

Category	Driver lever	Continued Momentum (CM)	Hydrocarbon Resilience	Decarbonization Delivers	Fragmented Energy Order	All of the Above Energy
Energy demand	GDP and industrial growth					
	AI and data center electricity demand					
	Emerging market development and energy access					
	Energy intensity improvement					
Supply response	Conventional energy investment and availability					
	Low-carbon technology cost decline					
	Grid and infrastructure readiness					
	Trade openness and supply chain integration					

Source: McKinsey Energy Solutions

McKinsey & Company

Across almost the entire scenario set, these demand levers trend upward. GDP and industrial growth, AI and data center demand, and emerging-market development and energy access all run above the baseline in four of the five scenarios. Only fragmentation, as explored in Fragmented Energy Order, reverses the trend, and it does so by suppressing GDP growth rather than by moderating consumption.

The one demand lever that pulls the other way is energy-intensity improvement, a composite lever comprising device efficiency, a structural shift toward less energy-intensive activity and conversion-loss savings from replacing combustion with electrification. This lever explains why demand strength and final consumption diverge across the scenarios. Two scenarios can share the same demand drivers, yet still result in different levels of total consumption, depending on how efficiently that demand is met.

The key insight here is that energy demand is no longer the contested variable; strong growth is projected in nearly every future explored.

On the supply side, four levers determine the composition of the energy system: conventional energy investment and availability, low-carbon technology cost decline, grid and infrastructure readiness, and trade

openness and supply-chain integration. Policy is not a standalone lever because it acts on all four others: investment signals for conventional supply, subsidies and carbon pricing for low-carbon costs, permitting regimes for infrastructure, and tariffs and industrial policy for trade.

These supply-side levers influence whether growth is met through incumbent fuels or through electrification, and whether cost declines achieved in one market are available in all of them. They are also where the scenarios genuinely diverge, with two patterns standing out. First, infrastructure readiness is the most frequent binding constraint; where it lags, electrification stalls, regardless of how cheap renewables generation becomes. Second, trade openness is the only lever capable of pulling down every other supply condition with it, since technology that cannot be imported cannot be deployed.

Together, the supply levers dictate whether growth in low-carbon energy carriers becomes genuine substitution or additional supply layered on an unchanged fossil fuel base. For example, the Hydrocarbon Resilience scenario combines high energy demand with strong conventional-energy availability, while Decarbonization Delivers combines high energy demand with faster efficiency gains, stronger low-carbon cost declines, and greater infrastructure readiness. Fragmented Energy Order reflects lower demand growth and weaker supply-chain integration, and All of the Above Energy represents a high-growth, high-buildout world across both conventional and low-carbon energy systems.

Together, the supply levers dictate whether growth in low-carbon energy carriers becomes genuine substitution or additional supply layered on an unchanged fossil fuel base.

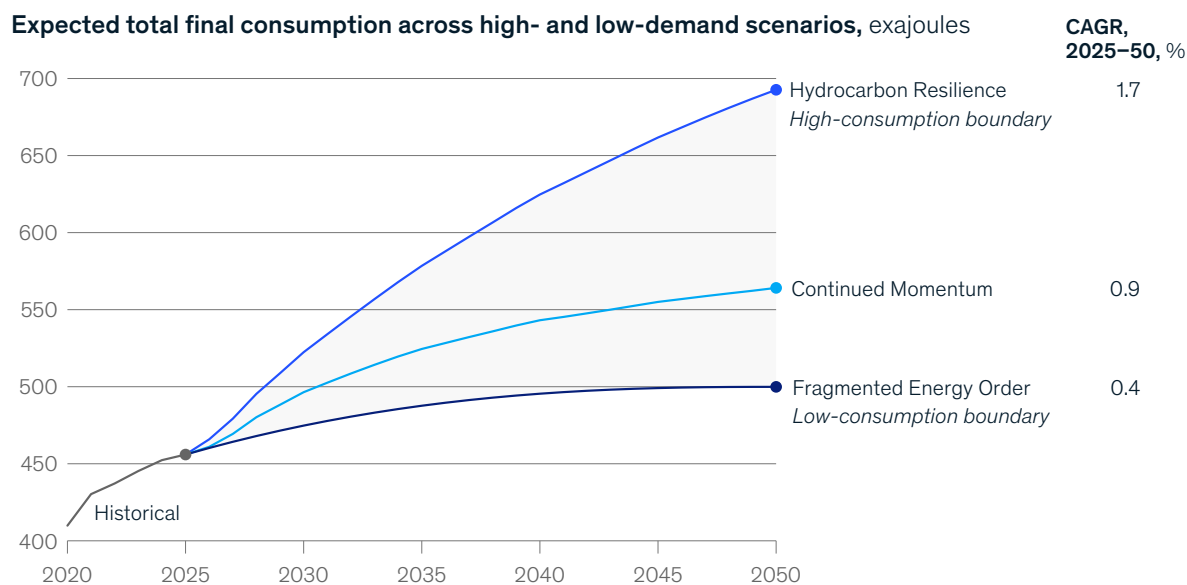
High- and low-demand boundaries

The three high-demand scenarios—Hydrocarbon Resilience, All of the Above Energy, and Decarbonization Delivers—share a common assumption regarding global GDP growth: 2.8 percent per annum, against 2.2 percent in the Continued Momentum baseline. Faster economic growth would drive energy demand higher; what separates the scenarios is not how much energy they deliver, but how efficiently they deliver it.

The upper boundary of total final energy consumption is represented by Hydrocarbon Resilience, reaching about 690 exajoules (EJ) by 2050; a CAGR of 1.7 percent (Exhibit 9). Here, demand is met by a carrier mix weighted toward fossil fuels. Meanwhile, All of the Above Energy and Decarbonization Delivers achieve the same useful energy from lower total final consumption, because higher end-use efficiency and deeper electrification reduce conversion losses versus systems more heavily reliant on fossil fuels.

Exhibit 9

Fuel choices and trade fragmentation drive diverging growth paths, suppressing or elevating total final consumption.



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The lower boundary is represented by Fragmented Energy Order, in which GDP growth decelerates to about 1.7 percent per annum. This scenario suppresses energy demand growth accordingly, as well as the adoption of new technology, leaving total final consumption at 500 EJ in 2050.

Hydrocarbon Resilience and Fragmented Energy Order define the upper and lower boundaries of this year's scenario space. Rather than representing most-likely outcomes, they are intended to approximate the plausible outer ranges of total final energy consumption and provide a stress-testing range for stakeholders to assess strategy robustness.

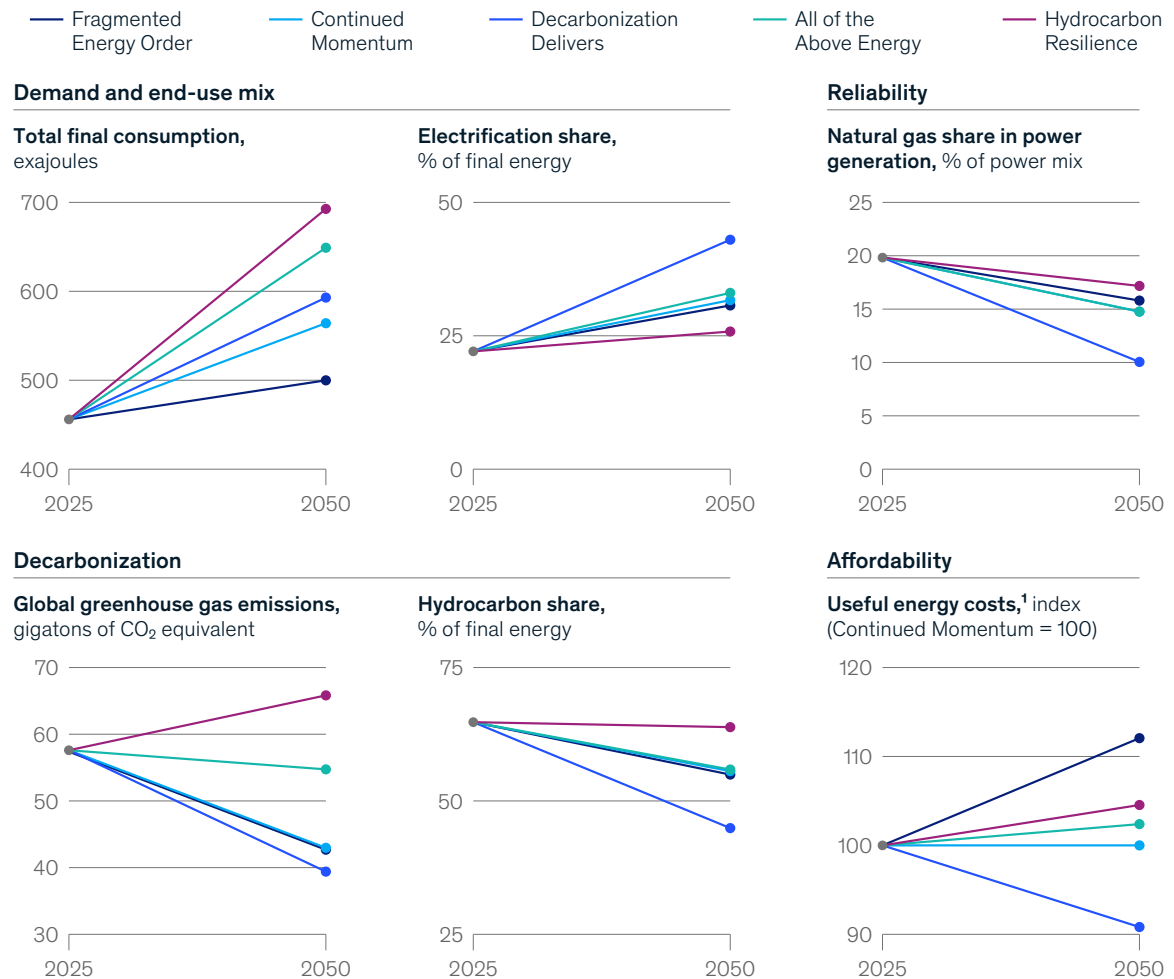
How the scenarios address reliability, affordability, and decarbonization

Reliability, affordability, and decarbonization are impacted differently across the scenarios, with important implications. Six system-level KPIs help to quantify these effects: final energy consumption, electrification, gas share, useful energy costs, global greenhouse gas (GHG) emissions, and hydrocarbon share (Exhibit 10). Together, these metrics indicate how much energy the system needs to provide, how reliability is maintained, how dependent the system remains on hydrocarbon fuels, and the cost burden implied in each scenario.

Total final energy consumption captures the underlying growth of both population and welfare, translating into a strong uptake of demand for goods and services. Despite the improved efficiency of heat and mobility technologies, underlying fundamental growth continues to push up final energy consumption across scenarios (see Exhibit 9).

Reliability, affordability, and decarbonization are impacted differently across the scenarios, with important implications.

Key 2050 projected outcomes across scenarios



¹Useful energy costs reflect the efficiency of the total energy mix in converting total final consumption into useful energy; figures in real 2025 US dollars.
Source: McKinsey Energy Solutions

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Electrification of final energy shows how far the system shifts from direct fuel use toward electricity. Decarbonization Delivers shows the greatest share of electrification, due to accelerated low-carbon technology cost declines, grid readiness, and end-use substitution. The share remains lowest in Hydrocarbon Resilience, where more incumbent fuels meet rising demand.

Natural gas share in power generation is used as a proxy for reliability.²⁹ Gas provides flexible, dispatchable generation, particularly where grids, storage, interconnection, and firm low-carbon capacity remain insufficient. In Hydrocarbon Resilience, the higher gas share reflects greater reliance on dispatchable thermal generation as renewable deployment remains limited. Fragmented Energy Order shows a similar pattern, though gas plays a slightly smaller role as fragmented energy markets and LNG shipping constraints encourage increased use of domestic alternatives, including coal and, where competitive, renewables. In Continued Momentum and All of the Above Energy, gas accounts for about 15 percent of power generation, providing flexibility to balance the growing share of variable renewable energy sources. In Decarbonization Delivers, the share of natural gas falls to about 10 percent as declining renewables costs weaken gas competitiveness. However, the resulting lower dispatchable capacity could increase security-of-supply challenges.

Useful energy costs reflect the affordability burden associated with each scenario. A higher cost does not come from fuel prices only; it can also come from grids, storage, balancing, system integration, infrastructure duplication, supply-chain fragmentation, and capital intensity. High-demand scenarios tend to require larger absolute system investment, but for different reasons. Hydrocarbon Resilience delivers the lowest cost per unit of useful energy, reflecting the prolonged use of existing hydrocarbon-based infrastructure and the reduced need for large-scale investment in electrification and grid expansion. This lowers overall system costs—assuming no major geopolitical shocks akin to the Hormuz crisis or Russia–Ukraine war—but increases GHG emissions. Both carbon costs and climate adaptation costs would likely also increase the overall cost to society.³⁰ All of the Above Energy would require substantial capital investment across the full range of energy sources to ensure sufficient and reliable supply. Significant investment would be needed in Decarbonization Delivers too, but with capital concentrated in low-carbon generation as well as in grids, storage, and system flexibility to integrate renewables while maintaining security of supply. Meanwhile, despite having lower projected demand, Fragmented Energy Order could see rising technology costs and reduced system efficiency due to geopolitical fragmentation and its associated impacts on supply chains.

Global GHG emissions differ by scenario, ranging from roughly 39 gigatons of carbon dioxide equivalent (GtCO₂e) by 2050 in Decarbonization Delivers to about 66 GtCO₂e in Hydrocarbon Resilience (Exhibit 11). Continued Momentum falls in between at about 43 GtCO₂e, as gradual electrification keeps emissions on a similar trajectory to Decarbonization Delivers. However, even Decarbonization Delivers—the most optimistic high-growth scenario in this year’s report—is not aligned with a 1.5°C warming trajectory, which would require the world to achieve net-zero emissions by 2050.³¹ Technology cost declines and clean-energy deployment reduce emissions in Decarbonization Delivers relative to the other scenarios, but rising energy demand still prevents the energy system from closing the gap, leaving projected warming at approximately 2.3°C by 2100, slightly lower than the Continued Momentum baseline. In fact, all scenarios and explorations fall short of the Paris Agreement target to limit global warming to well below 2.0°C, highlighting the risks and trade-offs that may come with an increasing emphasis on affordability and security over decarbonization. These scenarios are not predictions of what will happen, and other outcomes remain possible.

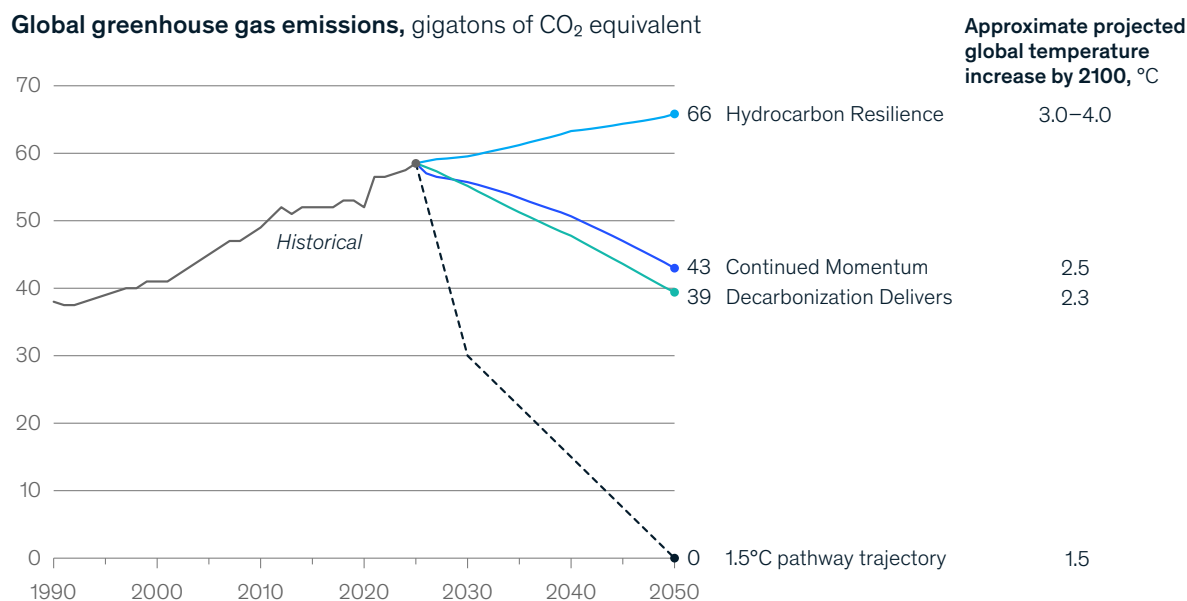
²⁹ Gas is not a complete proxy for reliability, as reliability also depends on grid readiness, dispatchable capacity, storage, demand response, and supply-chain robustness.

³⁰ Carbon cost and climate mitigation costs are not included in this analysis.

³¹ “For a livable climate: Net-zero commitments must be backed by credible action,” United Nations Net Zero Coalition, un.org, accessed September 8, 2026.

Exhibit 11

All scenarios and explorations fall short of the Paris Agreement target to limit global warming to well below 2.0°C.



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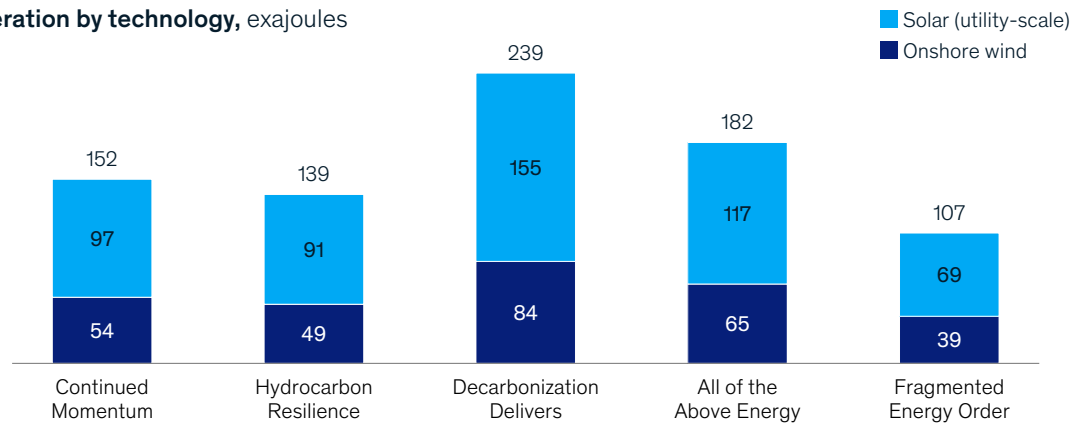
Hydrocarbon share of final energy consumption tracks dependence on fossil fuel-based energy carriers and therefore the scale of the decarbonization challenge. In Hydrocarbon Resilience, oil, gas, and coal are required to serve growing energy demand. A high-demand pathway supplied largely by hydrocarbons could also emerge if elevated financing costs constrain capital investment in renewables, power grids, storage, and related infrastructure. In these circumstances, energy systems with lower upfront capital requirements—despite higher ongoing fuel costs—may offer a pragmatic way to meet rapidly growing energy needs. This dynamic could be particularly relevant in fast-growing economies, where expanding energy access and affordable mobility through imported second-hand vehicles remain important developmental priorities. By contrast, Decarbonization Delivers and the low-carbon end of the scenario space reduce hydrocarbon dependence more materially as electrification, renewables, efficiency, and firm low-carbon power scale faster.

Physical land use represents another dimension worth tracking alongside these six core metrics. Solar PV and onshore wind both require ground at scale as deployment grows. Decarbonization Delivers, which depends heavily on solar and wind to decarbonize, requires the largest land footprint of the five scenarios at roughly 1.6 million km², an area comparable in size to Mongolia, the world's 18th-largest country. Hydrocarbon Resilience and Fragmented Energy Order, by contrast, require less than 1 million km², reflecting their lower reliance on utility-scale renewables (Exhibit 12). This land-use trade-off is not captured by the core cost, reliability, or emissions metrics, but does carry its own siting, permitting, and biodiversity implications for scenarios leaning heavily on solar and wind.

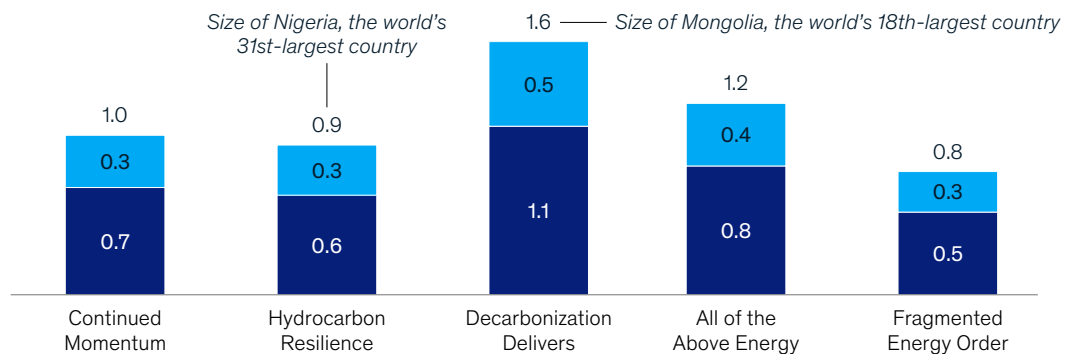
Exhibit 12

Scenarios with higher wind and utility-scale solar will require proportionally more land in 2050.

Generation by technology, exajoules



Global land footprint by scenario in 2050, million square kilometers



Note: Figures may not sum, because of rounding. Assuming land-use density for solar (utility-scale) at 50 megawatts per square kilometer (MW/km²) and onshore wind at 8 MW/km².
Source: McKinsey Energy Solutions

McKinsey & Company

The core takeaway here is that no scenario should be judged on a single dimension. Increased low-carbon penetration does not automatically ensure reliability, and lower generation costs do not always translate into reduced system costs. Understanding the interplay and trade-offs between reliability, affordability, and decarbonization is paramount to any energy strategy.



Scenario deep dives: Exploring the plausible space of energy-system evolution

The energy scenario deep dives in this year's *Global Energy Perspective* sit within the plausible space defined by the projected upper- and lower-energy-demand outlooks to 2050 and describe directional outcomes and driver combinations (see sidebar “Methodology: What has changed in 2026”). Each scenario begins from the Continued Momentum baseline and adjusts a specific combination of the eight structural levers explored in the previous chapter.³²

Continued Momentum: The baseline scenario

Continued Momentum is based on several trends that are observable today and projects energy-system evolution into the future by extrapolating these trends, without assuming any breakthrough conditions. In this scenario, global GDP expands at 2.2 percent per year—2.8 percent over the period 2025 to 2030, moderating to 2.0 percent over 2030 to 2050. Renewables continue to be deployed along current learning curves, lifting electricity's share of final consumption from 22 percent today to 23 percent by 2030 and 32 percent by 2050. Grid buildout continues, but trails generation deployment by three to five years in most major markets.

Data center demand roughly triples in the second half of this decade, from 2.3 EJ in 2025 to 6.8 EJ in 2030, lifting its share of global electricity consumption from 2.3 percent to 5.9 percent. This represents the fastest-growing demand segment in this scenario, even as annual growth eases into the 2030s.

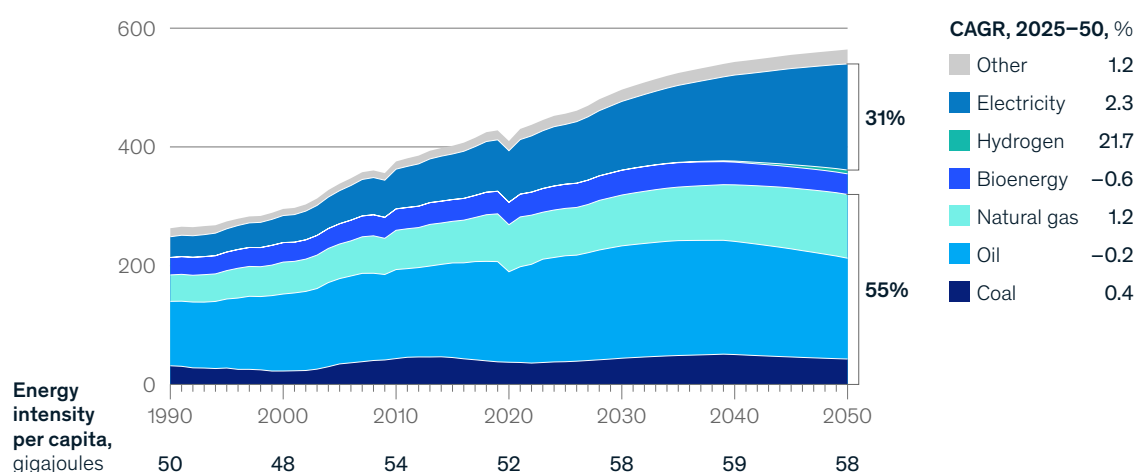
³² The four new scenarios presented in *Global Energy Perspective 2026* do not have standalone quantitative datasets. Fully modeled bottom-up scenarios are available for the core scenarios presented in previous editions of the *Global Energy Perspective* (Slow Evolution, Continued Momentum, and Sustainable Transformation). These datasets are available through McKinsey's Energy Solutions platform and are the only scenarios for which full quantitative datasets are available across all 140+ countries, 77 demand segments, and 76 fuels through 2050. Additional datasets can be provided on request.

Based on observable trends, fossil fuels are projected to remain in demand through the late 2020s, reaching 317 EJ by 2030, up from 295 EJ in 2025, before growth begins to slow in the early 2030s. The trajectories diverge by fuel: Oil demand is projected to begin easing from around 2030 and plateau through the mid-2030s, before declining from about 2036. Gas demand continues to rise through 2032 and beyond, while coal demand increases in absolute terms through the 2030s, peaking in about 2040 (Exhibit 13).

Exhibit 13

Fossil fuel demand is projected to remain on a growth path, before starting to decelerate in the early 2030s.

Global final energy consumption for Continued Momentum scenario, by fuel, exajoules



Source: McKinsey Proprietary Data Center Supply and Demand Models

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Global energy consumption per capita is projected to continue rising, from 56 gigajoules (GJ) per person in 2025 to 58 GJ by 2030 and 59 GJ by 2040. This reflects ongoing development in emerging economies that outweighs the efficiency gains achieved in advanced economies.

From an emissions and warming perspective, Continued Momentum is not a comfortable scenario. The implied warming of 2.5°C by 2100 sits well above the Paris Agreement's 1.5°C ambition, illustrating the observable trajectory of the global energy system as of mid-2026. (See sidebars "Reference scenario 1: A shift toward incumbent fuels" and "Reference scenario 2: Faster substitution reshapes the global energy mix" for a comparative analysis of our historical anchor scenarios, Slow Evolution and Sustainable Transformation.)

Reference scenario 1: A shift toward incumbent fuels

Reference scenario 1, Slow Evolution, is the scenario in which fossil fuel displacement happens more gradually. In this scenario, the global energy system shifts toward incumbent fuels, for several reasons: low-carbon technology cost declines are less than expected, policy ambition weakens, and bottlenecks across grids, storage, permitting, and dispatchable capacity remain binding constraints on renewables buildout. Renewables capacity continues to grow, EV adoption rises, and electrification advances, but the system struggles to absorb new-energy technologies at the pace required to materially change the global fuel mix before the mid-2030s.

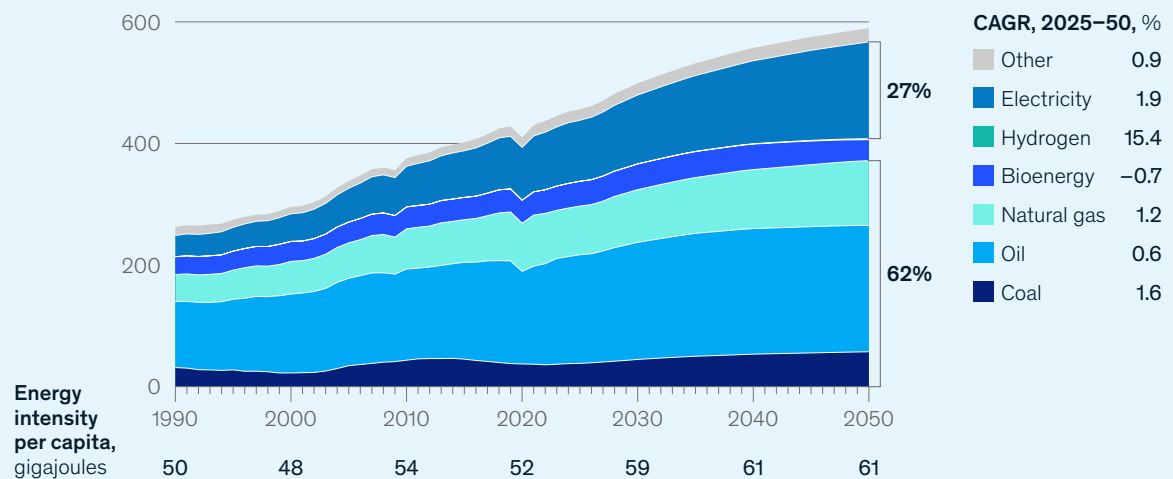
In other words, the defining feature of a Slow Evolution scenario is not a collapse in clean-technology investment, but rather that this investment does not result in sufficient fossil fuel substitution, despite new sources of supply being added. Under this scenario, global fossil fuel consumption continues to rise through the 2020s and 2030s, projected to reach about 370 EJ by 2050, with the peak arriving in about 2050 rather than in the late 2030s (exhibit).

Oil demand remains resilient in transport, petrochemicals, aviation, and emerging-market mobility, with demand still near 200 EJ in 2050, equivalent to about 96 million barrels per day (MMb/d).

Exhibit

A Slow Evolution scenario could see fossil fuel demand peaking around 2050.

Global final energy consumption for Slow Evolution scenario, by fuel, exajoules



Source: McKinsey Proprietary Data Center Supply and Demand Models

McKinsey & Company

Electricity growth is still expected to be strong if a Slow Evolution scenario were to unfold, expanding at about 1.9 percent a year over 2025 to 2050, though grid and system constraints limit how quickly renewables replace dispatchable fossil-fuel-based generation. Electricity's share of final consumption reaches 27 percent by 2050, while total global energy consumption per capita rises to 61 GJ, reflecting stronger fossil fuel retention alongside continued economic development and electrification. Efficiency improves, but not enough to offset new demand from AI, cooling, electrification, industrial activity, and energy access.

Under a Slow Evolution scenario, fossil demand is projected to peak later and then decline more gradually than in the baseline scenario. Emissions decrease, but slowly, putting the world on an implied warming trajectory of approximately 2.8°C by 2100.

For executives, Slow Evolution is the scenario against which they could consider testing their organization's exposure to a delayed delivery of the energy transition. Strategies premised on rapid fossil fuel decline, unconstrained grid buildout, or smooth electrification may be underdeveloped across reliability, fuel security, and legacy system optimization. At the same time, the continued growth of low-carbon energy carriers could mean that entirely delaying new-energy positioning could be a strategic risk.

Reference scenario 2: Faster substitution reshapes the global energy mix

Reference scenario 2, Sustainable Transformation, is the scenario in which policy, technology, and capital alignment convert energy transition ambition into measurable fossil fuel displacement—not overnight, but fast enough to reshape the global fuel mix by the mid-2030s.

Under a Sustainable Transformation scenario, low-carbon cost curves are projected to steepen, policy becomes more consistent, and grid, storage, and permitting bottlenecks begin to ease. Renewables capacity, electrification, EV adoption, and efficiency all accelerate. The defining feature of this scenario is faster substitution, with clean-energy deployment adding supply and eroding fossil demand at scale.

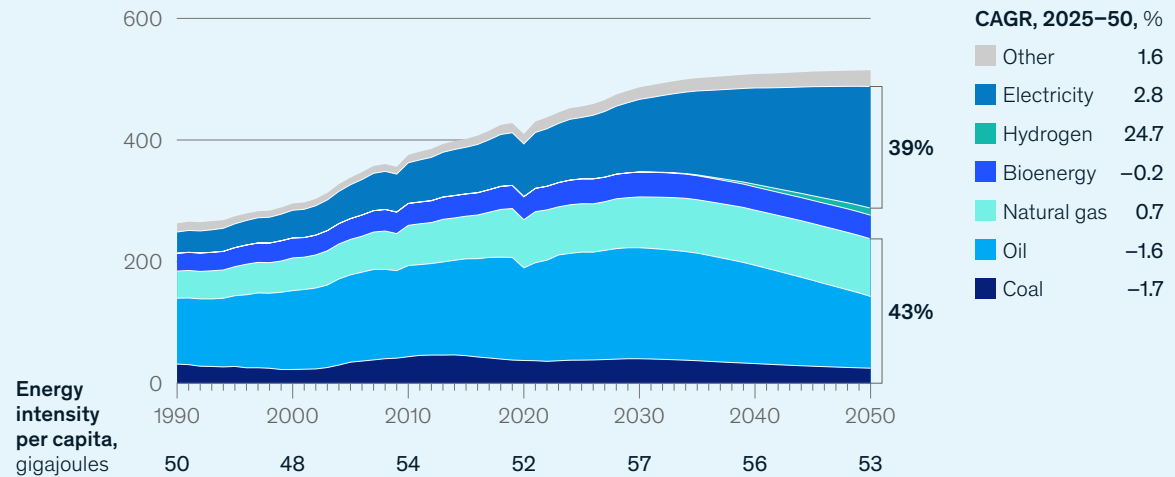
Global fossil fuel consumption is projected to peak around 2030 at roughly 300 EJ, then enter a sustained decline, falling to about 220 EJ by 2050 (exhibit). Oil consumption peaks in the late 2020s and falls sharply thereafter, reaching about 110 EJ by 2050, or about 43 MMb/d, as transport, industry, and petrochemical demand are progressively electrified or displaced.

Electricity becomes the backbone of the global energy system in this scenario, growing at about 2.8 percent annually from 2025 to 2050 and rising from about 22 percent of final consumption in 2025 to about 39 percent by 2050. Bioenergy continues to expand, while hydrogen scales from near-zero to roughly 10 EJ by 2050, becoming a meaningful part of the fuel mix in industry and heavy transport. Despite strong demand growth in power and industry, global energy consumption per capita peaks in around 2030 and then falls to about 53 GJ by 2050, reflecting efficiency gains, electrification, and structural decarbonization.

Exhibit

A Sustainable Transformation scenario sees fossil-fuel demand entering a sustained decline from around 2030.

Global final energy consumption for Sustainable Transformation scenario, by fuel, exajoules



Source: McKinsey Proprietary Data Center Supply and Demand Models

AI adds a layer of complexity. Data center electricity demand is projected to accelerate rapidly in the mid-2020s, then moderate to roughly 15 to 20 percent annual growth later in the decade, before easing further. In this scenario, however, stronger grid expansion, renewables deployment, and efficiency partly absorb the demand pressure from data centers, preventing AI-driven load growth from locking in long-term fossil fuel retention.

Emissions decline materially over the period to 2050, putting the world on a significantly lower implied warming trajectory of about 2°C or below by 2100.

For executives, Sustainable Transformation is the scenario that rewards early and integrated positioning across renewables, grids, storage, hydrogen, efficiency, and digital energy management. It also helps executives test whether strategies can move beyond pilots and scale to system-level delivery. The central risk in this scenario is that grid integration and capital redeployment fail to keep pace with the speed at which the fuel mix is changing.

Hydrocarbon Resilience: A world in which fossil fuel demand keeps rising

Hydrocarbon Resilience is the scenario in which the “addition rather than substitution” dynamic becomes most pronounced as the world continues to rely on fossil fuels to meet the ever-growing demand for energy.

Global GDP increases at a relatively high 2.8 percent annually, with electrification expanding at broadly the same pace as the baseline scenario. At the same time, in this scenario, cost declines in low-carbon technologies are slower than expected. As a result, economic growth remains closely linked to rising energy consumption, with only modest improvements in energy efficiency relative to today.

In OECD economies, infrastructure lock-in plays a key role in how future energy demand growth is met. Conventional energy infrastructure such as drill rigs, pipelines, LNG vessels, refineries, and gas turbines is readily available, operational, and generating returns. New-energy infrastructure, by contrast, requires permitting, grid connections, and financing that remain chronically behind demand growth in this scenario. While renewable capacity continues to be built, it is being added at a pace that increases total energy supply rather than displacing fossil fuel supply because the grid simply cannot absorb it fast enough.

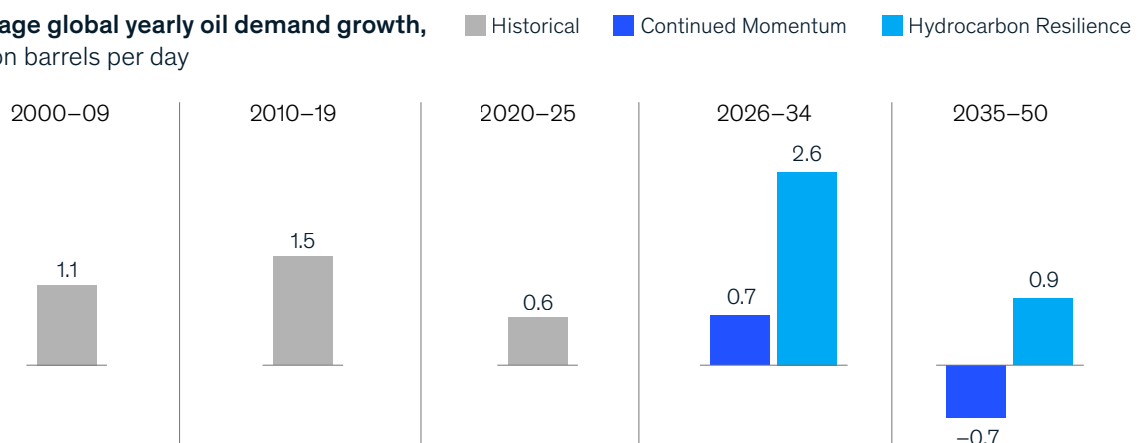
By 2035, total final energy consumption is projected to be 27 percent above 2025 levels. Oil demand does not peak before 2050, and its growth exceeds even historical averages during 2026 to 2035, reaching roughly 290 EJ a year (almost 130 MMb/d) by 2035 (Exhibit 14). LNG investment needs to continue, with new liquefaction capacity required instead of mothballed. Gas-backed power generation also needs to be built in parallel with renewables.

For executives planning exclusively against a Continued Momentum baseline, strategies could be materially under-resourced across conventional fuel assets should a Hydrocarbon Resilience scenario unfold. In fact, oil demand could grow by more than 2.5 MMb/d per annum for the next decade—roughly double the growth of the previous decade—leading to higher oil prices. Were this scenario to play out, significant and timely investments in exploration would be needed to avoid an under-resourced outcome.

Exhibit 14

Oil demand growth accelerates versus historical averages, driven by strong economic growth and continued reliance on hydrocarbons.

Average global yearly oil demand growth, million barrels per day



Source: McKinsey Energy Solutions

McKinsey & Company

Fragmented Energy Order: When geopolitics fractures the energy system

Fragmented Energy Order is the scenario in which geopolitical developments move the world even further toward a more “tripolar energy system,” with blocs coalescing around China and its trading partners, the United States and aligned markets, and Europe and its partners.

In this scenario, countries increasingly aim to meet energy demand within their own bloc through domestic resources, preferred suppliers, local-content requirements, tariffs, and strategic industrial policy. Global energy demand growth slows as the world’s GDP growth decelerates and trade becomes less efficient. While some of these conditions may reflect the current global situation, the key difference from the Continued Momentum baseline is that such conditions and their longer-lasting impacts persist for the next 25 years.

At the same time—and this is the defining feature of this scenario—the energy system no longer converges toward a single technology pathway. Geopolitical fragmentation changes not only where energy technologies are produced, but also which technologies regions deploy and at what pace. China, for example, may lean into its domestic clean-technology manufacturing base, electrification, batteries, grids, coal flexibility, and nuclear power. The United States could combine its domestic oil and gas endowment with renewables, storage, and nuclear optionality to accommodate strong AI-driven power demand. Europe and other import-dependent advanced economies might continue to pursue efficiency, renewables, interconnection, and electrification, but face higher costs as global supply chains splinter.

AI demand diverges in this scenario, too. In blocs with abundant firm power, hyperscaler investment, and sovereign AI strategies, demand from AI accelerates. In markets with limited grid capacity, higher electricity prices, or restricted access to computing infrastructure, it remains constrained.

In this scenario, the widely held assumption that geopolitical fragmentation will slow the energy transition by weakening international climate cooperation is correct, but incomplete. The deeper impact is economic, as the cost of producing and deploying clean-energy technologies outside established supply chains escalates. China’s dominant position across solar manufacturing, battery materials, and selected critical components, for example, could force countries outside its bloc to either rebuild these value chains locally or source components from a narrower pool of geopolitically aligned suppliers. The result is higher costs, slower deployment, and, in some cases, physical shortages.

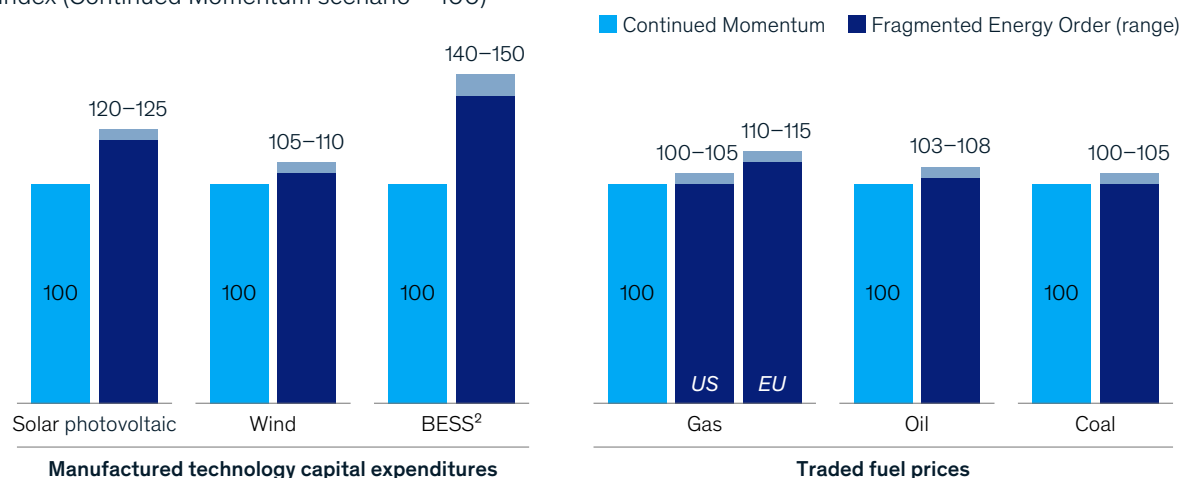
In such a scenario, the system effects extend well beyond the initial disruption of geopolitical separation. For example, five years into deepened fragmentation, the largest impacts would occur where supply chains are highly concentrated and difficult to replicate (Exhibit 15). Solar PV capital expenditure rises by 20 to 25 percent, driven primarily by the higher cost of producing modules outside China. Rebuilding module supply requires countries to replace wafers and cells from China with more expensive regional production, while also absorbing higher equipment, labor, financing, and material costs. Wind-related capital expenditure, meanwhile, increases by a lower 5 to 10 percent because turbine manufacturing capabilities are more geographically dispersed today. The main vulnerability is in the supply of rare earth permanent magnets, particularly for direct-drive turbines, where China dominates refining and magnet production.

Geopolitical fragmentation changes not only where energy technologies are produced, but also which technologies regions deploy and at what pace.

Exhibit 15

Cost increase is steepest for battery energy storage systems in a more fragmented world.

US and EU cost premiums,¹ Fragmented Energy Order scenario, 2035,
index (Continued Momentum scenario = 100)



¹Values shown for 2035, around 5 years after a hypothetical fragmentation shock in 2030; they reflect costs after the initial supply-chain response, not the peak spike at the moment of initial shock. In all categories except gas, the US and EU are equally dependent on China, hence the value is the same.

²Battery energy storage system.

Source: McKinsey Energy Solutions

McKinsey & Company

BESS faces the largest clean-technology cost premium, increasing by 40 to 50 percent, given that cathode and graphite anode processing and active-material production are largely concentrated in China. While European and US gigafactories and allied producers outside of China can expand cell manufacturing, replacing these upstream materials and processing capabilities could prove slower and more costly.

Gas is where a distinct regional divergence appears. European prices are projected to rise by 10 to 15 percent, compared with 0 to 5 percent in the United States. The Continued Momentum baseline assumes that Europe will operate without pipeline gas from Russia and that planned LNG infrastructure is in place by 2030. Fragmentation therefore raises costs primarily by narrowing the pool of available suppliers, increasing competition for LNG cargoes, and reducing trading flexibility. The United States remains largely insulated due to abundant domestic production, although higher LNG-terminal utilization and feed gas demand create modest upward pressure on Henry Hub prices. (For an exploration of what could happen should Russian gas return to Europe, see sidebar “Potential resumption of Russian gas flows.”)

Oil and coal prices, meanwhile, are less affected by geopolitical fragmentation because their markets are more fungible. Oil prices are projected to rise by 3 to 8 percent due to longer routes, higher insurance costs, and trade friction, while coal is projected to increase by 0 to 5 percent given its broad supplier base.

Overall, fragmentation does not create a uniform energy-cost shock. It penalizes the technologies most dependent on highly concentrated components and materials, and the regions constrained by fixed infrastructure. Many of these value chains could be rebuilt in new locations, but at the cost of higher investment and a slower, less-efficient transition.

Potential resumption of Russian gas flows

The potential reopening of European markets to Russian gas exports in the event of a future settlement of the war in Ukraine has been discussed by policymakers, market participants, and the media, including in the context of its possible implications for European energy prices and global LNG markets. At the same time, a renewed focus on European energy security has pushed current European policy firmly in the opposite direction. The European Union has adopted a legally binding framework to phase out remaining Russian gas imports, with restrictions taking effect in stages through 2027.¹

Against that backdrop, this exploration does not represent a view on the likelihood or desirability of renewed Russian energy trade, nor does it assume that a peace settlement would itself lead to a resumption of flows. Rather, it stress-tests the global energy-market implications of a hypothetical future in which geopolitical conditions change, relevant European legal and policy constraints are modified, and Russian pipeline gas becomes commercially available to European buyers again (exhibit).

This exploration is structurally distinct from the scenario deep dives in this year's *Global Energy Perspective*. It does not materially alter underlying energy demand and is instead defined primarily by a supply-side shift: the hypothetical return of 50 to 60 billion cubic meters (bcm) of Russian pipeline gas to European markets, which is still significantly below the approximate 150 bcm supplied before the war.

The consequences of such an outcome would unfold in a European gas system that has changed substantially since Russia's invasion of Ukraine in 2022. Between 2022 and 2025, Europe committed to approximately 50 bcm of new LNG import capacity, much of it in Germany, while European buyers signed nearly 25 bcm of LNG supply contracts in 2025 alone.² LNG can now reach markets across Europe, including landlocked markets in Central Europe.³

These structural changes mean that Russian pipeline gas would be unlikely to regain its historical role in the European supply mix, even under this hypothetical scenario. If 50 to 60 bcm of pipeline gas were nevertheless to return, those volumes would compete directly with spot LNG and LNG contracted following the disruption to Russian supplies. The equivalent volume of displaced European LNG demand could be redirected to other markets, including Asia, supporting supply diversification in the face of the Hormuz crisis and placing downward pressure on European gas hub and global spot LNG prices.

Combined with the impact of significant new LNG capacity entering the global market, prices in this scenario could potentially fall 60 to 70 percent from current levels of about \$18 to \$20 per million British thermal units (MMBtu). LNG suppliers without locked-in demand may potentially need to reduce or redirect volumes until the supply surplus clears. The greatest pressure would likely fall on supply sources with relatively high short-run costs, including some US LNG projects.

Beyond gas, sustained lower energy prices could reduce some of the economic incentives for efficiency and electrification investments catalyzed by the 2022–2024 energy crisis. In Europe, lower prices could partially reverse some of the structural demand reductions achieved since 2022. More broadly, lower prices could trigger additional demand, accelerate the displacement of liquid fuels in multiple sectors, and support new gas-consuming infrastructure.

The purpose of this exploration is not to anticipate a normalization of Russian energy trade, but to test the resilience of the global energy system against a consequential supply-side uncertainty and to understand how the infrastructure and contracting decisions made since 2022 could shape global market outcomes should geopolitical, legal, and commercial conditions materially change.

¹ "Russian gas imports: Council gives final green light to a stepwise ban," Council of the European Union, January 26, 2026.

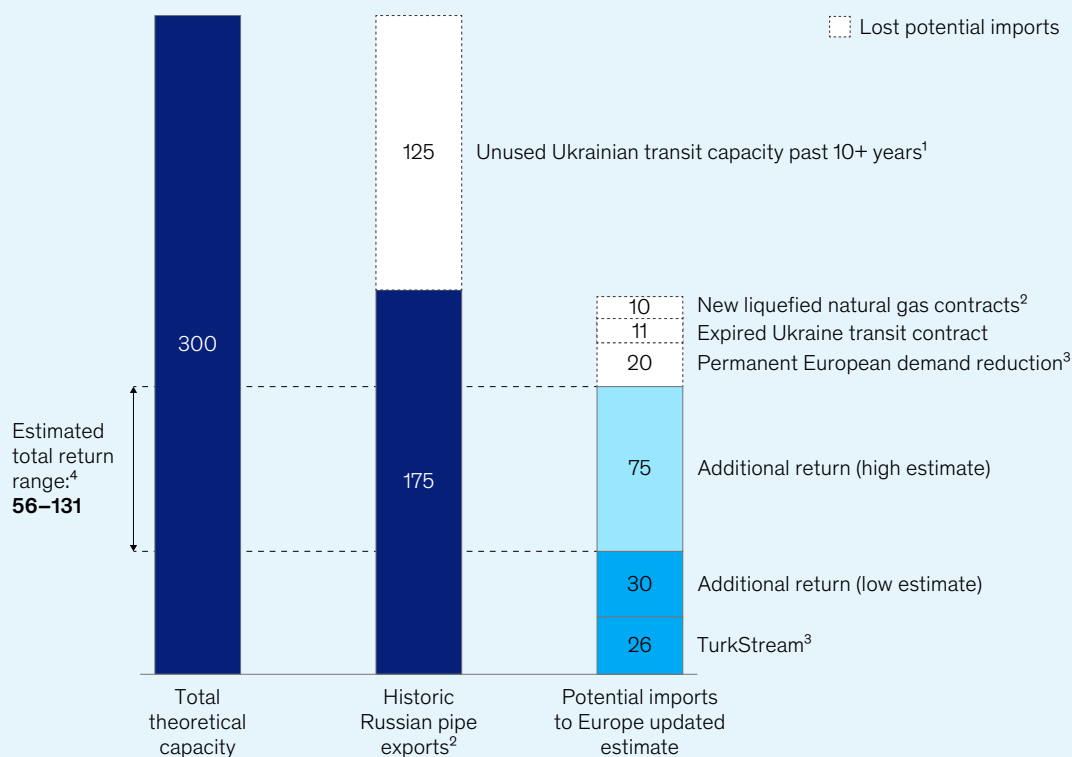
² "European LNG tracker," Institute for Energy Economics and Financial Analysis, May 2026.

³ *Analysis of the European LNG market developments*, ACER, 2024; *Gas market report, Q1–2026*, International Energy Agency, January 23, 2026.

Exhibit

Should gas from Russia return to Europe, volumes would be unlikely to reach prior levels.

Potential additional pipeline imports to Europe from Russia by flow route, billion cubic meters (bcm)



Note: Figures may not sum, because of rounding.

¹Unused capacity due to prior conflicts between Russia and Ukraine and the start-up of the Nord Stream pipeline.

²All values in bcm, based on TurkStream flows to Europe (16), Nord Stream (87.5), via Ukraine and Poland/Belarus pipelines (65), and others (2.5).

³Since 2022 based on permanent switch in power and industrial shutdowns in main Russian export markets.

⁴Full capacity of 16 bcm currently not possible due to bottlenecked flows past Bulgaria to Central Europe; based on range of one to two additional operational pipelines and buyer sentiment from McKinsey's LNG Buyers' Survey.

Source: McKinsey Energy Solutions; McKinsey Energy Solutions' Gas Intelligence Model; McKinsey EU Pipeflow

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All of the Above Energy: Utilizing every available resource to ensure reliable power

The All of the Above Energy scenario reflects a world that develops and utilizes every energy resource available to meet demand, ensure grid reliability, and keep energy costs affordable, with the net effect that all energy sources grow simultaneously. It harnesses hydrocarbon resources—oil, natural gas, and coal—alongside renewable wind, solar, geothermal, hydropower, and biofuel sources, as well as nuclear power.

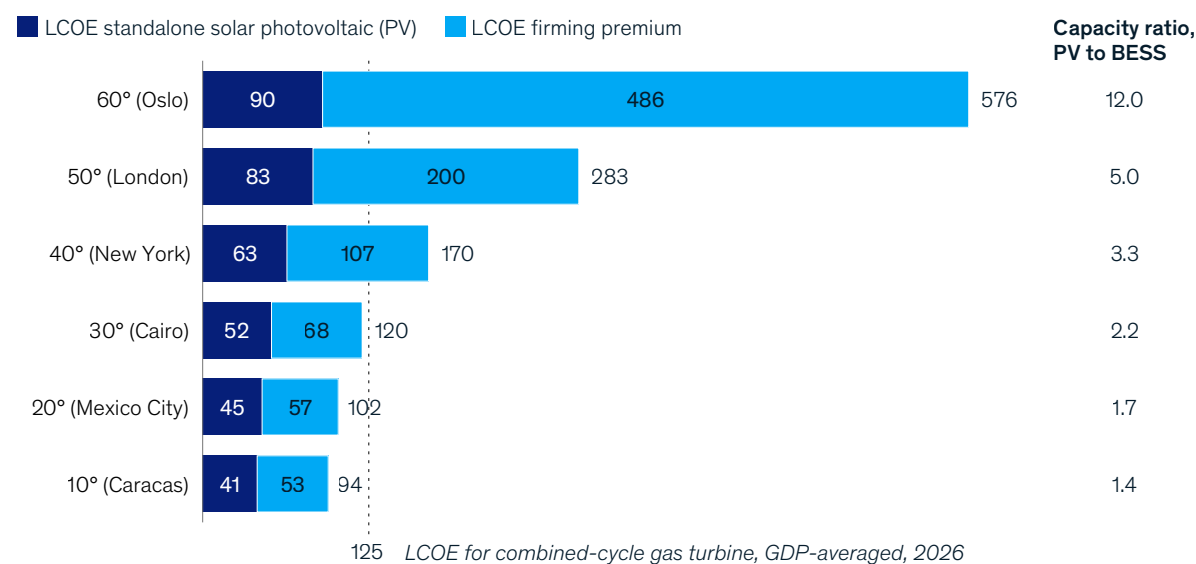
All of the Above Energy assumes the same strong demand as the Hydrocarbon Resilience and Decarbonization Delivers scenarios, underpinned by robust GDP growth, rapid AI and data center expansion, and continued emerging market development. However, it does not presuppose which supply pathway prevails. Where Decarbonization Delivers assumes that electrification and low-carbon cost declines outrun everything else, and Hydrocarbon Resilience assumes that incumbent fuels remain the path of least resistance, All of the Above Energy assumes both hold at once: policy, capital, and infrastructure back every resource class in parallel. The organizing principle of this scenario is that no single technology is cheapest everywhere once reliability is priced in, so the lowest-cost path to firm, affordable power differs by geography and the energy system expands across all carriers.

The economics of firm-solar-plus-storage help illustrate the case. Standalone solar PV is already the cheapest source of generation across much of the world, and its raw cost is competitive at every latitude. But solar delivers a variable, daytime-weighted output profile that must be firmed to serve around-the-clock demand. The cost of that firming rises sharply with latitude as the amount of available sunlight declines. For example, adding enough storage to reach a 90 percent reliability target leaves firmed solar well below the cost of gas-fired generation at low latitudes: roughly \$94 per MWh in Caracas and \$102 per MWh in Mexico City, against a global gas benchmark near \$165 per MWh. But the premium grows as the solar resource becomes more seasonal (Exhibit 16). By New York's latitude, firmed solar reaches \$170 per MWh, becoming more expensive than gas; by London's latitude it climbs to \$283 per MWh, and by Oslo's it reaches \$576 per MWh—more than three times the cost of gas, because a winter-scarce solar profile requires a substantial storage overbuild to deliver flat, reliable output.

Exhibit 16

Firm solar-plus-storage undercuts gas at lower latitudes, while the firming premium doubles at higher latitudes.

Firm solar-plus-storage LCOE¹ at different latitudes, 2026,² \$ per megawatt hour



¹Levelized cost of electricity.

²Assuming a 90% reliability target, PV capital expenditure of \$800,000 at \$25 per megawatt hour, and battery energy storage system (BESS) capital expenditure of \$250,000 at \$25 per megawatt hour.

Source: McKinsey Energy Solutions

The implication of this latitude-related variance is at the core of the All of the Above Energy scenario. In equatorial and mid-latitude markets, firmed renewables are the reliable lowest-cost option; at higher latitudes, dispatchable sources such as gas and nuclear remain economically essential to hold the system together. No single technology is the lowest-cost across the entire curve, which is precisely why, in this scenario, every resource class continues to grow.

Executives planning exclusively against the Continued Momentum baseline could be materially under-resourced across all asset classes in this world.

Decarbonization Delivers: The scenario where everything accelerates

Decarbonization Delivers is the scenario in which the energy system delivers simultaneously on affordability, security, and decarbonization. The mechanism by which this happens is economic rather than policy based: When low-carbon technology costs fall fast enough that clean energy is the cheapest available option across the majority of applications, markets drive deployment without requiring sustained policy support (see sidebar “Scenario triggers and key drivers”).

The technology cost trajectory is this scenario's load-bearing assumption. Solar PV learning rates have been consistently underestimated across every previous edition of the *Global Energy Perspective*. Under Decarbonization Delivers, AI-accelerated materials discovery shortens the development cycle for next-generation perovskite solar cells and solid-state batteries. Here, the substitution that policy has been trying to mandate for a decade arrives instead through the market. The key leader in this scenario would be China, accounting for 41 percent of total solar PV additions between 2025 and 2050 (Exhibit 17).

Decarbonization Delivers is also the scenario in which firm low-carbon power broadens the transition toolkit: Nuclear costs decline, SMRs become repeatable rather than experimental, and credible nuclear fusion milestones begin to reshape expectations for the post-2035 power system, providing additional firm low-carbon capacity. Early signals of such a trajectory are already visible today. Ontario province in Canada has authorized the construction of an SMR at Darlington, and Amazon is backing X-energy with the ambition to support more than 5 GW of new nuclear capacity in the United States by 2039.³³

³³ “Commission authorizes Ontario Power Generation Inc. to construct 1 BWRX-300 reactor at the Darlington New Nuclear Project site,” Canadian Nuclear Safety Commission, April 4, 2025; “Amazon continues to be one of the world’s leading corporate purchasers of carbon-free energy,” Amazon News, February 19, 2026.

Scenario triggers and key drivers

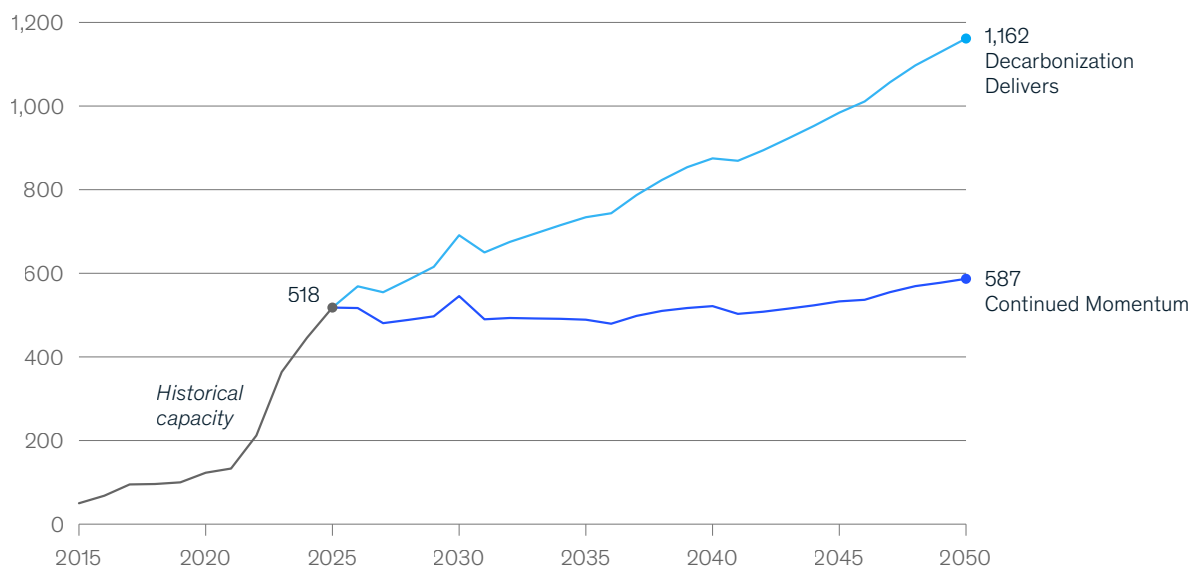
Decarbonization Delivers moves three levers from the Continued Momentum baseline simultaneously:

1. Low-carbon technology cost declines accelerate sharply. Solar LCOE falls below \$20/MWh, battery storage is sub-\$50 per kilowatt-hour (kWh), and green hydrogen approaches cost parity before 2030.
2. Policy ambition rises materially, catalyzed by severe and widely observed climate-related implications that shift public perception faster than incremental policy processes could achieve.
3. AI productivity gains increase economic output without proportionate energy-intensity growth. Energy efficiency also improves more rapidly through AI-optimized industrial processes, building management, and grid operations.

Exhibit 17

AI-accelerated materials discovery shortens the development cycle, driving solar photovoltaic installation globally.

Annual solar photovoltaic installation projection, global,¹ gigawatts per year



¹On a direct current (DC) basis. Historical capacity is end of year and projections are mid-year (due to modeling constraints).
Source: McKinsey Energy Solutions

McKinsey & Company

Nuclear fusion remains further from commercialization, although the industry attracted record funding in the 12 months to July 2026, suggesting that expectations for post-2035 clean firm power are beginning to change.³⁴ This acceleration could translate into a material step-up in nuclear buildout. Between 2025 and 2050, average annual net nuclear capacity additions rise from about 18 GW in the Continued Momentum baseline to 40 GW in Decarbonization Delivers, more than doubling the pace of deployment and reversing the sharp slowdown observed over the past two decades (Exhibit 18).

This is not a low-demand scenario, however. GDP grows at about 3 percent a year, driven by genuine AI-led productivity gains. Many emerging markets continue to electrify at pace and data centers expand, but at a lower energy intensity because advances in AI chip efficiency reduce the load per unit of compute. Total energy demand continues to rise but is met predominantly by new-energy technologies.

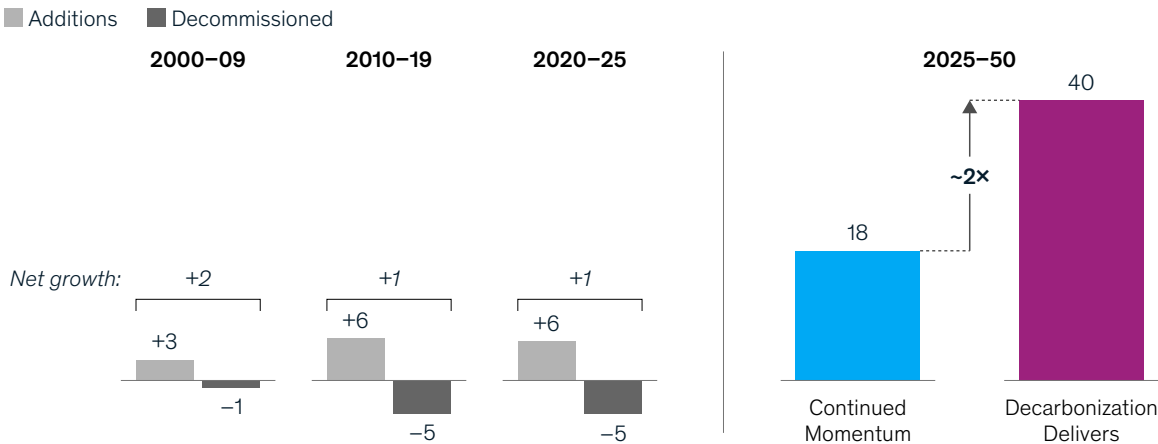
The investment profile is the most capital-intensive across the scenarios, not because fossil fuel investment continues, but because the deployment of new technologies requires unprecedented parallel investment in grids, storage, and grid management software. Transmission investment would need to grow approximately threefold. The companies that position early for this potential infrastructure buildout could face the largest addressable market of any scenario.

³⁴ "Fusion industry attracts record annual funding of \$4.48bn, raising total to \$14.24bn," Fusion Industry Association, July 13, 2026.

Exhibit 18

Decarbonization Delivers sees a significant step-up in global nuclear capacity.

Global nuclear yearly net capacity growth, average, gigawatts



Source: International Atomic Energy Agency Power Reactor Information System; McKinsey Energy Solutions

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Implications for executives: Scenario thinking at the core of strategy

The *Global Energy Perspective 2026* depicts an uncertain future across several dimensions at once: demand growth, AI-driven power load, geopolitics, infrastructure delivery, technology cost declines, and the balance between affordability, security, and decarbonization. The question for executives now is how to build a strategy that can sustain performance across a wider range of plausible energy-system outcomes. Such questions are relevant not only for executives of energy companies and the organizations in their supply chains, but are increasingly important, even crucial, for all sectors. Affordable, reliable energy supply is a fundamental condition for sustained socioeconomic growth and development.

Scenario planning amid the current levels of disruption and uncertainty is an essential, if imperfect, risk-mitigation tool. While the COVID-19 pandemic—and the world's response—was unprecedented in modern times, the Hormuz disruption is an example of a shock that could have been better anticipated outside of the region and its potential impacts modeled. Such modeling can reveal the critical chokepoints at which a strategy begins to fail. Tracking these signposts and understanding their implications is where executives can begin to translate scenarios into strategic action.

Of course, some scenarios may offer executives few practical options. There is little that oil executives can do to sustain traditional operations in a world where the price of oil falls below \$40 per barrel, for example. In these cases, executive teams may need to take a broader view of the futures they believe are likely to unfold to avoid decision paralysis today. In some instances, the only choice may be to explore new sources of growth.

Ultimately, the answer to what to do next will look different for every organization, depending on how exposed it is to energy system dynamics, its geographic location and the markets it serves, and its place in the value chain. A sustained focus on key market signals and how they translate into best- or worst-case outcomes can help executives stay clear-eyed about which bets they can hedge and which they can't as they plan the way forward.

Moving from scenarios to strategic action

Scenario planning alone is not enough. Executive teams may also need to develop a view on which future they believe is most likely to unfold to avoid decision paralysis today. Energy executives specifically can draw on the insights in *Global Energy Perspective 2026* to test whether their organization is tracking the right set of market signals, has a firm-wide view of its posture in a geopolitically fragmented world, and is adequately adapting its short-term shock responses into long-term resilience. Such considerations can also reveal whether and how operating models may need to change to maximize efficiency. Executives can ask several probing questions to begin pressure-testing their strategies:

- **Do our energy system forecasts explore different scenarios, and do we understand the core drivers of energy system change and their potential effects on our organization?** To understand the extent and limitations of forecasting methodology, executives can ask questions such as: “Under which scenarios do new opportunities present themselves?”, “In which scenarios does our continued market participation become unviable?”, and “How quickly can we pivot when the next crisis hits?”
- **Do we have a firm-wide view on our critical signposts?** In areas of extreme uncertainty or unpredictability, organizations, at the very least, need to be clear-eyed about the critical signposts that would trigger structural changes for the business. The most important of these can be identified for regular monitoring at the board and business-unit levels. A focus on the most business-critical or market-critical energy system signposts, rather than on all variables, can help executives avoid falling into a “scenario trap,” where the question of which future will unfold overshadows the work of building resilience today.
- **What have we learned and how have we evolved since 2020 in response to three consecutive gray swan events? Have our existing resilience measures worked, and are we building sufficient long-term resilience from our short-term crisis response?** The COVID-19 pandemic and the Russia–Ukraine war forced many organizations to rewrite their business continuity plans and operational playbooks overnight. However, the lessons from such crises are not always sufficiently translated into long-term strategic and operational changes that embed organizational resilience against unknown future shocks. A good place for executives to start is by asking whether their organization proved resilient in the wake of the Hormuz crisis, and what they could have done differently in terms of preparation and response.
- **Are we breaking down organizational silos and making business continuity planning a shared responsibility across key operating functions such as finance, strategy, IT, operations, and risk?** Given the frequency and scale of energy-system shocks, and the increasing levels of scenario planning required by boards, CEOs, and leadership teams, organizations may need to reconsider decision-making responsibilities to ensure mitigation plans account for a fuller range of knock-on implications.
- **Are we proactively adapting our organization at the structural level, where doing so already makes sense?** The reality is that many organizations have not yet committed to long-term, structural changes across many areas that are largely within their control: manufacturing footprint, supply chains and sourcing, sources of labor, use of technology, and operating models. Some energy organizations are already shifting toward more decentralized operating models to support greater operational agility.
- **Are we agile enough in our decision-making and organizational capacity to implement changes quickly when needed?** Agility includes the flexibility to reallocate capital, secure permits, and reprioritize projects as signals change—for example, pausing renewables buildout if grid connection queues become binding, accelerating firm power or storage if AI load grows faster than expected, or shifting LNG and gas portfolios if geopolitical supply risks intensify.
- **Are we engaging the right set of ecosystem partners to address supply security?** In a geopolitically fragmented world, energy security concerns can supersede any single organization’s strategy or response.

Stakeholder collaboration can prove an effective mitigation lever for ensuring stable energy supply—waste-stream optimization, collective purchasing power, and demand-side response are all examples of solutions that require ecosystem-level coordination.

Taken together, these questions are intended as a provocation for executives operating under uncertainty: How well do you understand the points at which your business survives, thrives, or fails in its market?

The *Global Energy Perspective* is not intended to be used as a static set of scenarios that define a single strategic path, but rather as a strategy-management system that helps executives explore plausible futures in order to decide which bets to make now, which options to preserve, and which signals would justify changing course.

About this report

The *Global Energy Perspective 2026* is McKinsey's 11th annual assessment of how the global energy system may evolve to 2050. It is intended to serve as a fact base to help stakeholders navigate the opportunities and challenges of today's energy landscape—not to prescribe a preferred scenario or pathway.

McKinsey's *Global Energy Perspective* model integrates bottom-up asset-level data across oil, gas, coal, power, and low-carbon technologies with macroeconomic, policy, and technology assumptions, covering more than 140 countries. Scenarios are built on nine dimensions spanning macroeconomic conditions, policy ambition, and technology evolution. No probabilities are assigned to any scenario.

Three core historical *Global Energy Perspective* scenarios—Slow Evolution, Continued Momentum, and Sustainable Transformation—are available as full quantitative datasets through McKinsey Energy Solutions. Featured scenarios in this report describe directional outcomes; full model outputs for these scenarios are available to subscribers.

The data for these scenarios come from a variety of sources, including the International Energy Agency (IEA), the Energy Institute, Eurostat, the Intergovernmental Panel on Climate Change (IPCC), Oxford Economics, the United Nations, the US Department of Agriculture (USDA), and the US Energy Information Administration, among others. These sources were used as input for McKinsey's proprietary modeling.

The *Global Energy Perspective* is produced by [Energy Solutions by McKinsey](#), which is part of [McKinsey's Global Energy and Materials Practice](#), in close collaboration with the firm's [Industrials and Electronics](#) and [Sustainability](#) practices. McKinsey is committed to the position that the world requires a major course correction to reach climate goals aligned with the Paris Agreement, and our research is focused on helping global stakeholders meet those targets.

About [Energy Solutions by McKinsey](#): Energy Solutions is McKinsey's global market intelligence and analytics group focused on the energy sector. The group enables organizations to make well-informed strategic, tactical, and operational decisions by using an integrated suite of market models, proprietary industry data, leading industry benchmarks, advanced analytical tools, and a global network of industry experts. It helps leading companies across the entire energy value chain manage risk, optimize organization, and improve performance.

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About the Global [Energy and Materials Practice](#): McKinsey's Global Energy and Materials Practice deploys deep insights, functional capabilities, and proprietary benchmark and data solutions across the converging energy, materials, and natural resource supply chains to help create substantial and long-lasting value for stakeholders. Guided by AI and the power of a global team, it brings distinctive industry perspectives across sectors that support today's critical infrastructure ecosystems. The practice is proud to have partnered with hundreds of major industry players as the leading and most integrated adviser on strategic and functional transformations, enabling clients to accelerate decarbonization and realize transitions across energy, food, and materials.

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