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# Energy in the Era of the New Geopolitics

By **Laura Cozzi** and **Thomas Spencer**

**Laura Cozzi** is Director of Sustainability, Technology and Outlooks at the International Energy Agency.

**Thomas Spencer** is a Senior Energy Analyst at the International Energy Agency.

The global energy system is constantly changing: rising consumption in developing countries, the growing role of electricity, vulnerabilities in supply chains, and the environmental implications of energy policy choices. The security of the system and the substantial investments required in the future can only be ensured through international cooperation, as exemplified, among other mechanisms, by the International Energy Agency.

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The world remains hungry for energy. It is a crucial input to modern economies and fuels welfare improvements for the billions of people in developing countries. The secure, affordable and sustainable flow of energy is a core concern of national policymakers everywhere. At the international level, policymakers recognize that energy security requires cooperation. For this reason, they have invested in international organizations like the International Energy Agency (IEA), which was established in 1974 after the first oil shock with a mandate to support the energy security of its member countries. However, the energy system is changing, and with this change, the nature of energy security is also shifting. Four major trends are restructuring the global energy system.

Firstly, emerging markets and developing economies have become a larger share of global energy consumption. In 2000, they accounted for less than half of global energy demand. Today, they account for two-thirds, and more than half of global consumption of both oil and natural gas.

Secondly, electricity is becoming more important both to the energy system and to the global economy –a trend the IEA has dubbed the emerging "Age of Electricity". Today, electricity accounts for around 20% of global energy consumption, with the remainder being made up of oil products, natural gas, coal use in industry, and direct use of renewables such as bioenergy. However, electricity disproportionately powers high value-added service sectors and advanced manufacturing, and is a critical enabler of communications and public services. For this reason, electricity directly powers sectors accounting for around 40% of the global economy and indirectly enables almost all economic activity through its role in communication networks. Electricity security has therefore moved the center of energy security.

Thirdly, energy security concerns are broadening from fuels to energy technologies. Historically, energy security largely meant maintaining affordable and secure flows of oil and natural gas. As this article discusses, this remains an essential component of energy security. However, with the increasing diversification of energy sources and the growing sophistication of energy technologies, supply chains for raw material inputs, intermediate components, and final energy technologies have become important vectors for energy security. The most salient example of this trend is the concern that has arisen around the security of supply chains for critical minerals: their production and refining is highly concentrated and tools such as export controls have been deployed as instruments of geopolitical leverage.

Fourthly, the global environmental consequences of energy production and consumption have clear international dimensions. The energy sector is responsible for about three-quarters of the greenhouse gas emissions that cause global climate change. Climate change requires international cooperation, which is becoming harder in today's fragmented and fractious geopolitical environment. The impacts of climate change also affect the energy sector, and wildfires, droughts and extreme heat have caused significant disruptions to energy systems. But other issues also bear mentioning as well. Today, more than 700 million people globally lack access to electricity, and nearly 2 billion still cook using polluting fuels such as wood and waste. This saps development opportunities at the macroeconomic level, and impacts the education, health and productive work of hundreds of millions of people.

The geopolitical context is also growing more contested than at any time since the Cold War. In recent years, armed conflicts have broken out in major energy-producing regions. The global energy shock of 2022 was the worst crisis in energy markets since the 1970s, and while energy markets subsequently stabilized, they remain volatile and at risk of disruption, as the current conflict in Iran attests. Beyond physical risks to pipelines, tankers, and power plants, geopolitical and trade conflicts have led to a growing use of economic measures such as export controls, financial sanctions, and industrial policy, as policymakers probe for leverage across supply chains and seek to enhance national economic resilience.

In this context, the task of ensuring energy security is more complex than ever before. Policymakers need a clear map of these shifting risks, an understanding of how they interact, and a roadmap for how to manage them. In such a complex environment, trade-offs are inevitable and must be balanced. This article aims to set out an overview of this "new map" of energy security in today's more complex and dangerous world.

## Oil and Natural Gas Security

Oil and natural gas still make up over half of global primary energy demand. Oil is the primary fuel for transport but is also an important input into the production of petrochemical products. The use of natural gas is more diverse, with the fuel important in electricity generation, industrial production, cooking and heating in residential and commercial buildings. It is also a crucial input to agriculture, as almost all nitrogenous fertilizers are made with natural gas. In 2025, global oil demand reached around 100 million barrels per day (mb/d), up around 7% on the 2015 level. Global natural gas demand was 4,300 billion cubic meters (bcm) in 2025, up over 20% from the 2015 level.

Three major trends have influenced oil and gas markets in recent years. The first is the rise of producers outside of the Organization of Petroleum Exporting Countries (OPEC). In 2010, the so-called "OPEC+" countries[1] accounted for 60% of global oil production and 40% of global natural gas production. That has now fallen to 50% and 34% respectively, thanks notably to the rise of unconventional oil and natural gas production in the United States (US). Today, the US accounts for 20% of global oil production, ahead of Saudi Arabia, and 25% of global natural gas production, ahead of Russia. Despite this, the key chokepoints such as the Strait of Hormuz, the Bab El Mandeb Strait and Suez Canal, and the Strait of Malacca remain critical thoroughfares for global energy trade.

1. OPEC+ is an expanded alliance of oil-exporting countries that includes all OPEC members plus a group of major non-OPEC producers such as Russia, Kazakhstan, Mexico, and Oman.

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The second trend is the rise of liquified natural gas (LNG) as an increasingly important share of global long-distance natural gas trade. In 2010, pipeline trade accounted for 60% of global long-distance natural gas trade; by 2025, this had fallen to 43%. The global LNG market now reaches 470 bcm, up from 275 bcm in 2010. This has led to the emergence of an increasingly liquid international gas market, with growing convergence between regional price benchmarks (although substantial price differences remain). The emergence of LNG was accelerated by the energy shock unleashed by Russia's war in Ukraine, as Europe sharply decreased its pipeline imports from Russia and increased its imports of LNG from alternative suppliers.

The third trend is the emergence of substitutes for the use of these fuels in some sectors. In electricity generation, renewables have grown rapidly. Wind and solar photovoltaic (PV) increased from 25% of global electricity generation in 2015 to around 35% in 2025. In the case of oil, electric vehicles (EV) have taken a growing share of annual car sales, accounting for about one-in-four sales globally in 2025. Electric cars still account for a small share of cars on the road, as only part of the operating fleet is replaced every year. Despite this, EVs have contributed to the sluggish growth of oil demand for road transport since the Covid-19 pandemic.

These three trends influence how the dynamics of energy security for oil and gas may play out in the years and decades to come. It is to this topic that we now turn, focusing on investment in new supplies; the outlook for midstream assets such as LNG terminals; and import dependencies.

### *Outlook for Demand in The Context of Energy Transitions*

A significant uncertainty impacting oil and gas markets is the pace of energy transitions. Projections vary considerably, even among scenarios that do not presume substantial changes in energy or climate policies. Variations arise due to differing assumptions regarding economic growth, international collaboration, commodity pricing, technological costs, the effectiveness of energy policies, competition between fuels and technologies across sectors, and innovation rates. Consequently, market outlooks exhibit marked differences, even in scenarios that do not assume a step-change in the stringency of climate policies around the world.

In the case of oil, demand growth is slowing as EVs increasingly penetrate the market. Most scenarios envisage a peak in oil demand by around 2030, with consumption then plateauing or falling slightly. The outlook for natural gas is more nuanced. Within the electricity sector (40% of global natural gas demand), renewables are competitive and growing rapidly, although gas-fired power plants will be important for balancing and electricity security. In the buildings sector, heat pumps can cost-effectively substitute for natural gas heating, but their deployment is capital-intensive and requires coordination of numerous economic actors. There are currently no economically competitive substitutes for natural gas use for high-temperature heat in industry or as a feedstock for fertilizers. For this reason, scenarios tend to see a substitution of natural gas in electricity generation, alongside continued growth in industry and buildings, leading to overall growth of the fuel. There is, nonetheless, a wide divergence in the projected level of global natural gas demand in different scenarios.

### *Investment in New Supplies*

Even if demand does not grow, investment in oil and gas is still needed. It is not widely understood that most investment in oil and natural gas production is to offset declines from existing fields rather than meet new demand. Without investment in new and existing fields, oil production would fall by around 8% per year and natural gas by 9% per year. This is often referred to as the "natural decline rate". Since 2019, 90 cents out of every dollar of investment in oil and natural gas production has gone to offsetting production declines rather than to meet demand growth.

In reality, investment is set to continue in existing oil and gas fields, and approved projects currently under development are expected to ramp up. This helps to slow, but not halt, the natural decline rate. Therefore, new conventional oil and gas projects are still needed to offset decline rates and ensure adequate supplies to meet demand. By 2035, around 20-25 mb/d of new oil and 1,200-1,500 bcm of new gas production is needed to meet demand trajectories consistent with today's policy settings. Today's level of upstream investment is broadly consistent with delivering the lower end of these ranges but would need to rise by around 10% to meet the upper end.

### *Outlook for LNG*

LNG liquefaction capacity is set to expand substantially to 2030, rising by about 265 bcm, as a wave of new projects comes online, notably in the US. How this large LNG supply growth is absorbed by markets depends on the outlook for demand. If demand growth is at the lower end of ranges consistent with today's policy settings, IEA projections indicate a surplus of LNG export capacity emerging in the next few years, with the possible consequence of downward pressure on prices (although the market would still be at risk of short-term disturbances, as is currently occurring with the crisis in the Middle East. The duration and intensity of the conflict with Iran will determine its impact on the outlook for LNG supplies from the region for the next few years). On the other hand, if LNG demand is higher, then the supply growth would be absorbed faster and new LNG export facilities would be needed by the early 2030s.

### *Import Dependency and Maritime Chokepoints*

The major trend in the global trade of oil and gas is the growing role of emerging markets and developing countries in Asia. Already today, China and India account for nearly half of the shipments of crude oil through the Strait of Hormuz (all markets in Asia account for more than 85%). Similar numbers hold for LNG shipped via the Strait of Hormuz.

Looking forward, this dependency is set to increase. The share of developing Asia in global oil and gas imports increases from 45% today to around 60% by 2035. The two major import regions –Europe and Asia– see diverging trajectories in the mid-term. In Europe, slower economic growth, stagnant energy demand, and progress in energy transitions push down oil and gas imports by around 20% by 2035. By contrast, rapid economic growth, growing energy demand, and declining domestic production push up gas imports by more than 120% to 2035 in developing Asia, driven in part by the shift of Southeast Asia from net exports to net imports across this timeframe. Oil imports grow by around 15% across the same period. This shift of the geographical balance in energy trade is set to be a major structural trend in the years to come.

## Electricity Security

Electricity systems are among the most complex systems in human societies. Demand and supply must be balanced in real-time across all points of the network. Four trends add to the complexity of maintaining electricity security. Firstly, electricity supply is becoming more weather-dependent and variable, as the share of renewables increases. Secondly, the electrification of end-uses increases the reliance on electricity across the energy sector and economy more broadly, while also introducing growing variability on the demand side. Thirdly, the rise of distributed energy resources such as batteries and rooftop solar PV is challenging the paradigm of centralized generation and one-way flows from generators to consumers. Fourthly, widely dispersed, above-ground transmission and distribution networks are particularly exposed to growing threats of extreme weather and physical disruption by malicious actors, while the increasing digitalization of electricity systems increases the "attack space" for cyberattacks.

### *Entering the Age of Electricity*

Since 2019, global electricity demand has grown at more than 3% per year, which is faster than the expansion of global Gross Domestic Product (GDP) across the same period. By contrast, global energy demand grew by only 1.4% per year across this timeframe. Global electricity demand rises by about 1,000 terawatt-hours (TWh) annually to 2035 in IEA scenarios, equivalent to adding the consumption of Japan to global demand every year. This growth stems mainly from increased use of appliances, cooling systems, industrial electrification, and transport. Data centers have attracted a lot of attention recently, but account for only around 10% of global electricity demand growth to 2035, although their share is higher in some regions, such as the US.

In such complex systems, electricity security is a multifaceted concept. However, at its simplest, it can be expressed as having adequate generation and network capacity to meet peak demand; a system that is sufficiently flexible to balance demand and supply; and sufficiently resilient to absorb and recover from disruptions.

### *Generation Adequacy*

Electricity supply must always match demand, so system operators require sufficient resources to cover peak usage –generation, transmission, storage, and flexible demand are all essential. Meeting rising peak demand is increasingly complex due to electrification, climate change, and evolving consumption patterns. Globally, the IEA projects that peak electricity demand will increase by 40% from 2024 levels by 2035, with EV adoption and heating boosting demand in advanced economies, while more air conditioners and appliances raise demand in developing regions.

Today, peak demand is largely met by running dispatchable plants such as nuclear, hydro and fossil fuels at close to their maximum capacity and building power plants, often natural gas-fired ones, specifically to be on stand-by to meet peak demand. While these strategies remain critical, the picture is set to change with the growing importance of storage technologies and demand response. In 2025, global capacity additions of battery storage reached around 110 gigawatts (GW), more than the largest ever capacity addition of natural gas-fired power plants. By 2035, the IEA projects that around 1,600 GW of storage capacity will be operating, more than today’s entire installed capacity of hydropower.

### *Electricity System Flexibility*

Electricity systems must not only have enough resources to handle peak demand but also need to be adaptable to fluctuations in both supply and consumption, maintaining grid stability at every moment throughout the year. As more renewable energy sources are integrated and electrification increases, power system flexibility faces growing and complex challenges. By 2035, the IEA projects that the need for electricity system flexibility is set to rise by two to seven times, depending on the electricity market in question.

Power grids and interconnections help mitigate supply and demand swings by linking generators over broad geographic areas within and between countries and regions. This connectivity eases the pressure on other sources of flexibility and brings additional providers into the mix. However, aging transmission and distribution networks increasingly threaten system reliability and resilience. Ensuring electricity security will depend on targeted strategies to modernize and digitalize the grid. However, long permitting times, connection queues and grid congestion are challenges that will require focused policy attention.

By 2035, batteries and demand response measures will play a significant role in making electricity systems more flexible. Batteries are especially effective alongside solar PV, charging during times of high solar output and discharging during evening peaks. Demand response is a cost-efficient way to shift usage away from peak hours –using tools like flexible EV charging, smart air conditioners, and heat pumps–, though it relies on consumer incentives such as time-variable tariffs.

Traditional technologies will continue to provide crucial flexibility. Dispatchable hydropower remains a major low-emissions option, though its success depends on careful water management amid rising drought risks. Thermal power plants, meanwhile, retain an essential role in ramping and seasonal flexibility, but their main function is transitioning from bulk electricity production to delivering secure capacity, particularly as renewables take a larger share.

### *Resilience to Extreme Events*

Extreme weather disrupts energy supply and raises costs due to damage, losses, higher insurance, and the need for resilient infrastructure. According to new IEA data, nearly 300 extreme events in 2023 affected critical energy operations, with about 95% impacting the electricity sector and causing supply outages to over 200 million households globally. This disproportionate exposure of the electricity sector is due to its widely distributed, overhead infrastructure.

Electricity system peak demand is increasing, driven in large part by an increase in cooling demand. However, peak temperatures occasionally exceed the usual maximum of a region, and changes in the climate are driving an increase in the frequency and intensity of these extreme peak temperatures. IEA analysis indicates that growing incidence of extreme heat may erode safety margins of spare capacity in electricity systems. Planning for growing incidences of extreme temperatures will be critical going forward.

## Technology Security

### *Critical Minerals*

Minerals like rare earths, copper, nickel, lithium, and others are critical inputs for energy technologies. However, security risks in the supply chains of these minerals have increased. Three issues emerge: market concentration, increasing use of coercive instruments such as export controls, and mid-term supply adequacy.

The IEA has analyzed a set of 20 energy-related minerals, which, in addition to their role in energy technologies, also underpin a range of strategic industries, including information technology, aerospace, defense and advanced manufacturing industries. While their individual market sizes may remain modest, disruptions in supply can generate disproportionate economic ripple effects across multiple sectors.

Refined supply is quite concentrated across them, with China accounting for an average of 70% of global refining capacity across 19 of the 20 minerals assessed. Its share is much higher in some cases: China accounts for around 90% of the refined supply of rare earths, for example. Overall, the top three refining nations controlled an average of 82% of the market share in 2020, rising to 86% by 2024. Despite announced refining projects in new countries, supply chain diversification is expected to progress slowly, with the share of the top three refining countries only dropping back to 82% by 2035. IEA analysis therefore indicates that while governments and companies are making efforts to diversify supply, change will not come overnight, and market forces alone will not be sufficient to ensure resilient and diverse supply chains for critical minerals.

Another question relates to the overall adequacy of supply relative to demand. Supply-demand balances for most critical minerals are improving through 2035, with nickel, cobalt, graphite, and rare earths expected to meet demand if planned projects stay on track. However, copper faces a possible 30% supply shortfall by 2035 due to declining ore quality, rising costs, and slow project development. Lithium may also see shortages from rapid demand growth, though new project prospects are brighter than for copper. Addressing these gaps will require new investments, reduced lead times, material efficiency, substitution, and expanded recycling.

Although supply balances for many minerals have improved, elevated market concentration introduces considerable risk of substantial supply deficits if production from the leading supplier is disrupted. For instance, by 2035, IEA projections indicate that without the supply of the largest producer, the rest of the world would be able to meet less than half of its own demand for battery metals and rare earths. This emphasizes that, even in adequately supplied markets, critical mineral supply chains remain highly susceptible to supply shocks arising from extreme weather events, technical failures, or trade disruptions.

Instruments such as export controls have been used to gain leverage in the context of geopolitical tensions. For example, on April 4, 2025, China imposed export controls on 7 heavy rare earths and related products, leading to sharp drops in exports and forcing some automakers worldwide to reduce production or temporarily shut factories. On October 9, 2025, China expanded export controls to 5 more materials and introduced licensing requirements for foreign firms exporting goods containing Chinese rare earths. Out of the 20 critical minerals the IEA tracks, 11 are subject to some form of export control.

### *Energy Technology Supply Chains*

In 2024, the combined market size for 6 principal clean energy technologies –batteries, heat pumps, electrolysers, PV, wind power, and EVs– reached approximately USD 900 billion. EVs constituted the largest proportion of this total, followed by solar PV, batteries intended for stationary storage applications, and wind power. Monitoring the diversification of manufacturing capacity across these technologies serves as a key indicator of energy security; excessive geographical concentration can increase the risk of supply chain disruptions arising from natural disasters, accidents, geopolitical tensions, or deliberate attempts to manipulate supply or pricing.

Manufacturing capacity for these technologies remains significantly concentrated, especially in China. In 2024, China represented over 80% of installed capacity throughout the solar PV value chain, almost 80% for wind turbine nacelles, and more than 70% for blades. China's dominance

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in battery manufacturing is even more pronounced, accounting for at least 85% of global production across all segments and exceeding 95% for battery anodes.

### Human Security: Climate Change and Energy Access

#### *Global Energy Sector Emissions*

In 2025, the global energy sector emitted 38 billion tons of $CO_2$ and another 4 billion tons of $CO_2$-equivalent of methane emissions. This makes the energy sector the largest contributor to global climate change, accounting for around three-quarters of total global greenhouse gas emissions. Energy sector emissions have yet to peak: in 2025, they rose by around 0.4%, continuing the slowdown in emissions growth that has been seen in recent years.

In terms of regions, China is the largest emitter of energy-related emissions (one-third of the global total), followed by the US (12%), India (8%) and the European Union (EU) (6%). Overall, emerging markets and developing economies accounted for two-thirds of global emissions and advanced economies for one-third. *Per capita* emissions are widely distributed: *per capita* emissions in the US are around three times the global average, while those of the EU are only just above the global average. China's *per capita* emissions are two times the global average (and above the EU's), while India's are less than half.

Although global emissions have not yet peaked, clean energy technologies and climate policies are starting to put a dent in the growth trend of global emissions. The growth rate of global emissions over the past decade is half that of the previous decade. Numerous countries have demonstrated that decoupling economic growth and emissions is possible. In advanced economies, emissions are 20% below their 2007 peak, while GDP is 33% higher.

#### *Outlook for Climate Change*

Even with immediate and rapid emissions reductions, all IEA scenarios highlight that it is no longer possible to prevent warming from exceeding 1.5 degrees C in the near-term. Only atmospheric carbon dioxide removal, based on technologies that have not been proven at scale, could –theoretically– bring warming to below 1.5 degrees towards the end of this century. These trends make adaptation and energy sector resilience to a changing climate an imperative for energy security.

Uncertainty about Earth's response to future emissions means higher temperature outcomes remain possible, stressing the need to limit extreme risks. Whatever its level may be, future warming from current levels is inevitable in all IEA scenarios and carries with it risks, including the risk that crucial tipping points in planetary systems will be reached. Those risks become extreme at the upper end of the levels of warming possible if today's policies are not strengthened.

### *Outlook for Energy Access*

Recently, progress in expanding access to clean cooking has slowed. In 2019, nearly 120 million people worldwide gained access, but by 2023, this number had dropped to 100 million. Asian countries that once led improvements are now seeing slower advances as they near universal access. However, some of this slowdown is balanced by notable gains in Pakistan, Cambodia, and Myanmar, each reaching record numbers of households gaining access in 2023. In Latin America and the Caribbean, recent improvements have been modest and mostly limited to Central American nations.

Electricity access has improved significantly in recent decades, with a billion fewer people lacking electricity since 2000 and 40 countries nearing universal access. After pandemic-related setbacks, progress resumed but remains slower than before Covid-19. In 2024, access improved by 11 million, well below the 2010-2019 average of 65 million per year.

Although clean cooking access remains limited in sub-Saharan Africa, conditions for expansion are improving. Private sector involvement and innovative solutions are helping broaden access cost-effectively. Nonetheless, IEA projections estimate that 1.7 billion people will still lack access to clean cooking fuels by 2030 –thanks to improvements in Asia and efforts in sub-Saharan Africa. By 2030, about 710 million people are expected to lack electricity access.

## Outlook: Towards a Holistic View of Energy Security

The challenge of energy security is more complex and important than ever before. A spate of shocks –from the global energy crisis in 2022 to trade disputes centered on critical minerals, to extreme heat events pushing electricity systems to breaking point– highlight the range of risk factors and their interrelation. A key principle for policymakers going forward is the need to take a holistic view of the risks and opportunities, because focusing on a single aspect of the challenge will create risks of trade-offs in others. Three principles can guide policymakers going forward: diversification, predictability, and international cooperation.

Diversification means diversification of sources, technologies, and supply chains. By broadening the range of energy sources, technologies, and supply chains, countries can reduce their reliance on any single fuel, supplier, or route, thereby mitigating the risks associated with supply disruptions, price volatility, or geopolitical tensions. Ensuring diversification not only helps stabilize energy supply and prices but also supports the resilience of national and global energy systems in a rapidly changing world.

Strategies of diversification often require long-term investments in infrastructure and energy facilities. For these investments to be made, investors need predictability in policy frameworks. For example, achieving a diversification of critical minerals supplies requires long-term investments in mining and refining capacities, in the context of markets that have historically been volatile (and subject to non-market distortions). For these to happen, governments will have to step in to provide investible frameworks: market incentives alone will not suffice.

Finally, no country is an energy island: all are exposed to international prices, trade flows and global environmental change. Cooperation will therefore be a critical principle to improving energy security. Managing the complexities related to energy security, trade, supply chain stability, and energy transitions will remain a critical challenge in the future. Another significant challenge concerns securing investment for costly energy infrastructure. Despite representing 20% of the global population, Africa receives just 2% of worldwide clean energy funding. Addressing this gap is difficult, as many economies face strained fiscal conditions, higher interest rates, and decreased private sector enthusiasm for sustainable finance. To boost clean energy investment in emerging and developing markets, it will be necessary to attract international finance while also strengthening local capital markets.

Today’s energy policy makers are confronted with pressing energy security concerns. Their strategies must weigh how these challenges overlap and interact with other priorities, such as affordability, access, competitiveness, and addressing climate change. IEA analysis highlights crucial decision points ahead and collectively provide a foundation for evidence-based, data-driven policy about future direction.