The Global Energy Order – 2040: Contours of an Emerging System

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Abstract
This article maps the contours of the global energy order that may emerge by 2040. It argues that global energy flows are being transformed from a price-driven commodity trade into instruments of strategic power by four simultaneous processes: an uneven low-carbon transition, the securitization of energy flows, the fragmentation of the international monetary system, and the "last wave of decolonization." By examining logistical chokepoints, the AI-driven surge in electricity demand, the nuclear renaissance, the constraints facing renewables, and contests over critical minerals and Arctic

gas, the author identifies a paradigm shift. Specifically, the petrodollar system may be yielding to an electrodollar model, in which access to reliable low-carbon electricity near data centers is becoming a critical determinant of technological power. Finally, the author assesses four scenarios for 2040—managed renewal, a Chinese-led order, fragmentation into regional blocs, and systemic rupture—ultimately concluding that regional fragmentation is the most probable outcome.

Keywords: global energy order; energy transition; energy security; geoeconomics; electrodollar; critical minerals; chokepoints; Global South; 2040 scenarios.

Will the new energy order emerge from a managed reconfiguration or a systemic rupture? The answer will be determined largely by three powers: the U.S., China, and Russia. Their decisions over the coming years—reactive and structurally formative—will define the framework within which every other actor in the world system will operate by 2040.

INTRODUCTION: THE STRUCTURAL CONDITIONS OF TRANSFORMATION

> "If a single flap of a butterfly's wing can be instrumental in generating a tornado, so also can all the previous and subsequent flaps of its wings…"
>
> Edward Lorenz, *Predictability: Does the Flap of a Butterfly's Wings in Brazil Set Off a Tornado in Texas? 1972*

By 2040, the world's energy system will have undergone changes comparable in depth only to the post-war reordering of the mid-20th century. The present transformation, however, is fundamentally different: it cannot be reduced to a single technological transition or a single geopolitical shift. We are witnessing several distinct yet interconnected processes, and it is precisely their interaction that may produce a non-linear outcome.

The ***first*** process is the transition to a low-carbon economy, proceeding unevenly and marked by reversals: the phase-out of coal has slowed, while nuclear power is experiencing a renaissance. The ***second*** is the securitization of energy flows: wars and trade conflicts are turning supplies of energy and raw materials into instruments of strategic coercion, making price a secondary consideration. The ***third*** is the fragmentation of the international monetary and financial architecture, which is driving the first significant shift of energy trade away from the dollar. The ***fourth***, marginal until recently, is the 'last wave of decolonization': demands by Global South states for reparations, greater retention of value added from raw-material extraction, revised resource rights, and redistribution of climate finance. All four processes interact, alternately reinforcing and constraining one another.

The escalation of the Russia-Ukraine conflict in 2022 catalyzed but did not cause them. The breakdown of the 'unipolar energy order of 1991–2014' was driven in part by the U.S.'s use of the dollar as an instrument of pressure, including its mounting technological rivalry with Beijing. The Ukraine conflict laid bare the accumulated contradictions and made them undeniable. The 2026 escalation in the Persian Gulf accelerated processes that had been developing since the mid-2010s.

According to Gopinath et al. (2024), the world economy is dividing into a U.S.-leaning bloc, a China-leaning bloc, and nonaligned connector countries that preserve ties with both. The notion of a 'new energy order'—one in which governments, rather than markets alone, actively reshape energy flows—was articulated by Bordoff and O'Sullivan (2022) in their essay of that name. The present analysis extends that framework into 2040. Within this framework, energy ceases to be a neutral commodity: it becomes, simultaneously, an arena of rivalry, its instrument, and its prize.

LOGISTICS HUBS AS AN ARENA OF COMPETITION

For half a century, the strategic importance of maritime chokepoints appeared to recede as free trade expanded. They have now re-emerged as instruments of strategic coercion. Roughly 20% of global oil flows

pass through the Strait of Hormuz (EIA, 2026a), while roughly two-thirds of China's oil imports transit through the Strait of Malacca (Ovannisyan, 2019; Collins, 2018). The ability to disrupt these routes confers leverage not only over prices, but also over the political alignment of importers and producers, adversaries and allies. Political constraints on whom states may buy from can become as binding as a physical blockade.

The U.S.–Iran escalation, which began in late February 2026 and soon left the Strait of Hormuz effectively closed to commercial shipping, has exceeded the 1970s oil shocks in the scale of its disruption to supply chains (IEA, 2026e). Around 1.5 million tons of LNG per week—19% of global exports—were removed from the market (Petroleum Australia, 2026). Spot prices in Asia rose above US$20 per MMBtu, reversing their discount to European benchmarks (Wood Mackenzie, 2026a). Infrastructure vulnerability was stark: the inventories of Japan's major power utilities amounted to roughly 22 days of supply (Petroleum Australia, 2026). South Korea, with more than 20% spot-market exposure, moved to increase coal and nuclear generation (Seoul Economic Daily, 2026).

The logical response to this 'southern vulnerability' has been a reorientation towards northern routes. The strategic potential of the Northern Sea Route—its capacity to cut distances between Northern Europe and Northeast Asia by up to 40%, and to open Arctic hydrocarbons to world markets—was already set out nearly two decades ago (Yenikeyeff and Krysiek, 2007). What was then a forecast for 2025–2030 is now being realized: the route is becoming a strategic hedging instrument (Mishchenko, 2026; Reilly, Yenikeyeff and Paik, 2026). For China, it offers a way out of the 'Malacca dilemma'—Beijing's long-standing strategic vulnerability arising from the concentration of its seaborne oil imports through a single chokepoint exposed to potential U.S. naval interdiction (Ovannisyan, 2019). For Japan and South Korea, it could offer access to Russian Arctic LNG that bypasses Middle Eastern instability. Yet the Northern Sea Route is largely controlled by Russia, amid a growing Chinese presence: in April 2023, the two countries' coast guards signed a memorandum

of cooperation against the backdrop of NATO enlargement and the breakdown of wider Arctic cooperation (Nilsen, 2023; Reilly, Yenikeyeff and Paik, 2026). The Arctic has thus become a new arena of geo-economic competition with a fundamentally different geometry, in which icebreaker technologies, navigational systems, and control over ports of refuge matter alongside naval power.

The present phase differs from the oil crises of the 1970s less in the scale of price increases than in the mechanisms of coercion: power now operates through control over energy corridors and chokepoints, not only through restrictions on commodity supply.

ARTIFICIAL INTELLIGENCE AND THE DIGITAL TRANSFORMATION OF ENERGY

AI and energy have become interdependent, and neither can be optimized in isolation.

AI sharply improves the efficiency of energy systems: it forecasts demand more accurately, balances load more effectively, and integrates intermittent renewable generation. Yet it also creates new vulnerabilities: attacks on algorithms could trigger cascading outages impossible in classical infrastructure. This is not a side-effect but a structural feature of the 'smart grid': every increment of efficiency comes at the cost of systemic fragility.

At the same time, global electricity consumption by data centers—driven increasingly by AI workloads—has grown by roughly 12% a year since 2017. In 2025 alone, it rose by 17%, compared with about 3% growth in total global electricity demand (IEA, 2025c; IEA, 2026d). In the United States, flexible gas-fired generation currently plays a central role in balancing the power system, ramping up when wind and solar output falls and helping to meet data centers' demand for reliable, round-the-clock electricity. U.S. gas is now pulled in three competing directions: towards European importers replacing Russian supply, towards Asian buyers competing for flexible cargoes, and towards a fast-growing domestic technology sector, exemplified by the Stargate AI-infrastructure program. Where a given export shipment goes is determined not by a White House directive, but by private

companies holding the cargo, whose destination-flexible contracts let them redirect volumes between markets on the basis of price arbitrage rather than state policy (Bordoff, 2025).

The emergence of the Chinese chatbot DeepSeek-R1 raised the possibility that algorithmic and architectural improvements could reduce the energy intensity of some AI workloads. Yet lower unit costs may stimulate greater use, leaving total AI electricity demand uncertain.

The AI boom's most significant effect on the energy order, however, has been felt in a different domain altogether: it has driven the largest technology corporations towards nuclear generation. 2024 marked a turning point that some analysts already rank in importance alongside the energy-policy decisions of the 1970s. Microsoft, Amazon, Google, Meta (recognized as extremist and banned in Russia), and Oracle signed or announced agreements with nuclear energy companies—from the planned restart of Three Mile Island to small modular reactors—together supporting several gigawatts of low-carbon capacity for their data centers (Mitchell, 2026; DOE, 2025). According to IEA estimates cited by Pew, nuclear power accounted for roughly 20% of the electricity consumed by U.S. data centers in 2024 (Leppert, 2025), a share that could grow.

The logic here turns on a single fundamental constraint: solar and wind generation are, for physical reasons, unable on their own to provide the continuous baseload required by hyperscalers; gas-fired generation is vulnerable to market volatility and competes with export demand. Nuclear power, whether in the form of large plants or small modular reactors, is one of the few sources combining continuity, a low carbon footprint, and the potential for predictable costs over a horizon of decades (DOE, 2025).

Russia, too, has entered the race: in November 2025, President Vladimir Putin presented the country's small modular reactors as a potential solution for powering data centers (Putin, 2025). This broader approach is already being realized on the ground: one of Russia's largest data centers has operated alongside the Kalinin nuclear plant at Udomlya since 2019.

By 2040, several competing digital-energy systems for AI are likely to emerge—Western, Chinese, and possibly Indian—each with its own configuration of generation, hardware, AI models, efficiency rules, and power-price benchmarks. The advantage will go to whoever can generate electricity, direct it into computation, and convert computational capacity into economic and political influence. This implies a structural shift to a new era in which the kilowatt-hour becomes the fundamental unit of value, and the petrodollar may give way to the electrodollar, as discussed below.

The AI boom has reinforced nuclear generation's status as a strategic resource. Access to reliable low-carbon electricity near data centers is becoming one of the determining factors in the pace of technological development.

NUCLEAR POWER'S QUIET RETURN

The AI-driven demand described above is the latest and most visible catalyst of the nuclear renaissance, but the renaissance itself has deeper roots. Three pressures are converging: the Hormuz crisis exposed the limits of relying on variable renewable generation alone; energy imports remain vulnerable; and digital infrastructure demands unprecedented amounts of power. Nuclear power addresses all three at once; it is one of the few sources that combine stability, scalability, low carbon intensity, and relative insulation from fuel-imported disruptions.

One caveat, however, is decisive: many advanced reactor designs require high-assay low-enriched uranium (HALEU): uranium with U-235 content of 5–20%, well above the 3–5% used in conventional reactor fuel (World Nuclear Association, 2026; Atomnaya energiya 2.0, 2026). At-scale HALEU production infrastructure exists today only in Russia and China, while Russia remains the only commercial supplier. The U.S. began demonstration-scale production only in late 2023. Until Centrus and other producers reach industrial scale, Western reactor programs requiring HALEU remain constrained by the lack of a viable non-Russian source.

According to the IAEA high-case projection, global nuclear capacity could more than double by 2050; in 2024–2025 new units

were commissioned in the UAE, France, the U.S., India, and China, and by mid-2026, 72 reactors were under construction worldwide (IAEA, 2026; Atomnaya energiya 2.0, 2026).

China has become the leader of the nuclear renaissance. By April 2025, China had 102 reactors in operation, under construction, or approved, with a combined 113 GW (CNEA, 2025), while its nuclear capacity under construction had ranked first globally for eighteen consecutive years. Yet nuclear power accounted for only 4.72% of its electricity generation in 2024—leaving considerable room for further growth. The strategic rationale is straightforward: in a maritime-blockade scenario, nuclear power and domestically supplied coal would provide firm generation relatively insulated from short-term disruptions in seaborne fuel imports (Reilly, Yenikeyeff and Paik, 2026). For China, the nuclear renaissance supports industrial modernization and strategic autonomy.

Russia retains its position as the world's leading exporter of nuclear power plant technology. Rosatom holds the industry's largest foreign nuclear order book in the industry, comprising 39 units in ten countries, 22 of them under construction in seven (Chaban, 2025); various estimates place its share of the global reactor export market at roughly 70–80% (Siddi and Silvan, 2024; Rosatom, n.d.). The Build-Own-Operate model is especially significant here: where it is used, as at Türkiye's Akkuyu plant, the state corporation does not merely build a plant but retains ownership, operates it, and supplies its fuel. Such arrangements can turn an export project into an instrument of long-term geopolitical influence, binding the host state to Russian fuel supplies, servicing, and technical expertise for decades.

Alongside this, small modular reactors—compact units that can serve small grids and, in some designs, operate off-grid—are advancing quickly. Their capabilities make them attractive to two very different markets: hyperscalers in the developed world (DOE, 2025) and Global South states with underdeveloped electricity infrastructure. Rosatom poured first concrete for its inaugural overseas small reactor project—a RITM-200N in Uzbekistan—in June 2026 (Rosatom, 2026). The U.S., Canada, South Korea, China, and the UK (with Rolls-Royce SMR) are

developing their own competitors (World Nuclear Association, 2026). As noted above, such choices can bind the client to a supplier for the plant's decades-long lifetime; the decisive contest of 2030–2040 will thus be for the Global South's emerging nuclear markets.

RENEWABLE ENERGY: THE LIMITS OF THE CURRENT PHASE

Over two decades, renewable energy has become one of the central stories of global transformation. However, solar and wind power have now encountered two structural constraints that investment alone has yet to overcome at scale: low power density and the lack of economically viable long-duration storage. Lithium-ion batteries are designed primarily for hours, not days; pumped-storage plants and hydrogen remain geographically and economically constrained. Bridging this storage gap would require a leap akin to that from an early-1990s floppy disk to a modern flash drive—reflecting decades of advances in architecture, materials, and manufacturing. No equivalent leap has yet occurred in electricity storage.

The energy transition rests on a tacit assumption that fluctuations in solar and wind generation can be reliably balanced. In practice this remains difficult during prolonged periods of low output. Germany and California, with some of the world's highest shares of renewable generation, already experience multi-day stretches of very low solar and wind output. The Germans call this *Dunkelflaute*, the "dark doldrums." In November–December 2024, such episodes drove German wholesale electricity prices to an 18-year high, peaking above €900 per megawatt-hour (Fortune, 2024). Under such conditions, backup gas- and coal-fired capacity appears not merely as a temporary transitional measure, but as a persistent component of the system where sufficient storage or other dispatchable capacity is unavailable. This sustains long-term demand for fossil fuels (IEA, 2025a). The Hormuz crisis of 2026 confirmed this logic: Japan and South Korea temporarily subordinated their decarbonization commitments to immediate security-of-supply concerns (Seoul Economic Daily, 2026).

By the mid-2020s, no breakthrough had yet delivered a widely deployable, affordable, and scalable means of storing energy over

long periods—whether through solid-state batteries, flow batteries, or superconducting magnetic systems. This is a techno-economic constraint, not an ideological verdict on renewables. Long-duration storage (LDES) accounted for only about 6% of global energy-storage installations in 2025, while global venture-capital investment in LDES fell by 72%—a sign that, despite expanding deployment, many of these technologies remained far from broad commercial maturity (Wood Mackenzie, 2026). The decline does not prove technological impossibility—markets respond to capital costs, regulation, and payback horizons—but it does mark a gap between early-2020s expectations and the actual pace of commercialization. Whether the breakthrough comes by 2040 belongs as much to technological forecasting as to strategic planning. Until it does, the transition will remain slow and uneven, while gas and, in some markets, coal will continue to provide backup for decades.

A principal obstacle to the energy transition is therefore technological, not merely political. Until scalable long-duration storage becomes widely available, demand for dispatchable hydrocarbons will remain structurally embedded—regardless of political declarations.

THE LAST WAVE OF DECOLONIZATION AND RESOURCE REDISTRIBUTION

What a decade ago was largely an academic and activist argument—compensation for the colonial extraction of resources—had acquired a practical dimension by the mid-2020s. Developing countries—above all in Africa, the Caribbean, and Oceania—are increasingly conditioning their participation in the climate agenda, and access to their critical minerals, on concrete concessions: direct payments, debt forgiveness, technology transfer, a greater share of the value generated by resource extraction and processing, and revised rights over natural resources (UNCTAD, 2023). The shift reflects resource geography: many key inputs of the energy transition—including cobalt, lithium, graphite, rare-earth elements—are found in developing countries, many of them former colonies (UNCTAD, 2023; USGS, 2025a). The Democratic Republic of the Congo (DRC) supplies roughly 70% of the world's

mined cobalt; Jamaica and Guinea hold some of the world's largest bauxite reserves. In the absence of systematic Western engagement with demands for reparations, resource-rich states have the alternative of turning towards China or, potentially, Russia. China is already building a 'resource network' in the DRC, Chinese-owned or controlled companies account for most of the country's cobalt production, while 'infrastructure-for-resources' agreements have further strengthened Beijing's position (USGS, 2025a; IMF, 2024).

If several large reparations agreements were nonetheless reached—through, say, an international fund financed by a levy on 'carbon-intensive jurisdictions'—climate-finance payments could flow directly to former colonies rather than through Western corporate intermediaries. The energy transition is thus, paradoxically, becoming a catalyst of economic decolonization: by increasing the strategic importance of critical minerals, many of which are found in the Global South, it is strengthening producer states' bargaining power and reshaping established channels of Western influence—two effects that strategic analysis often treats separately.

OLD INSTITUTIONS, NEW ALIGNMENTS

By 2040, the 20th-century energy institutions will have been recast.

The International Energy Agency (IEA), created after the 1973 oil shock to coordinate cooperation among consuming countries, was built around oil security. Most recently, it coordinated the largest release of emergency oil stocks in its history: 400 million barrels during the Hormuz crisis, with the U.S. contributing 172 million (IEA, 2026f). Separately, its mandate has expanded beyond oil security to gas, electricity, the energy transition, and critical minerals (Hart, 2025). As its mandate has widened, so has criticism—from U.S. Republican lawmakers and the fossil fuel interests—of the IEA as an 'advocate for the energy transition.' The organization remains limited by the fact that the largest developing consumers—China and India as Association countries and Brazil as an accession country—do not have votes on its Governing Board.

OPEC+ faces slowing oil-demand growth and a widening divergence among its members' interests: the Gulf states, with

production costs in some fields below five dollars per barrel, have greater scope to compete for market share, whereas producers with higher costs or greater fiscal constraints, including Russia, Nigeria rely more heavily on quotas to sustain acceptable prices. Production agreements are becoming increasingly fragile as their economic basis weakens.

The most striking confirmation of this trend was the UAE's decision of 28 April 2026 to leave OPEC and OPEC+ on 1 May 2026 (Al Jazeera, 2026a), which Energy Minister Suhail al-Mazrouei described as a "sovereign national decision" (Al Jazeera, 2026b). This move has several dimensions. Materially, the UAE is OPEC's third-largest producer, with stated capacity of 4.85 million barrels a day against a production quota of roughly 3.5 million, and plans to reach 5 million by 2027 (Al Jazeera, 2026b). Institutionally, the departure of a member since 1967, without prior consultation with Riyadh (Reuters, 2026a), breaks the unwritten rule that OPEC's most important decisions are settled by agreement among its leading members. Politically, the move may indirectly align with U.S. interests, since additional Emirati production after Hormuz reopens would lower world oil prices and directly serve the Trump administration's aims. The UAE's exit came as the seven remaining participants in the voluntary production cuts agreed in early May 2026 to unwind them by a further 188,000 barrels a day (OPEC, 2026). A key member's unilateral departure nevertheless risks eroding the organization, especially if others conclude that Abu Dhabi can benefit from their efforts to prop up prices without accepting comparable constraints.

In the short term, the decision's market impact is limited. The UAE's export capacity is currently physically constrained: most of its export terminals lie inside the blocked Strait of Hormuz, while the bypass pipeline to Fujairah is already operating at its limit. In the medium term, however, the result may be a "structurally weakened OPEC" (Reuters, 2026a). The main risk lies not in the UAE's immediate volumes, but in the precedent: if a major member leaves, persistent overproducers may eventually reconsider their participation—Iraq within OPEC, Kazakhstan within OPEC+. Collective management

of supply, backed by formal monitoring but ultimately dependent on reputational and diplomatic pressure, risks being eroded.

For Russia, the immediate physical consequences are limited by the closure of Hormuz, but additional Emirati supply, no longer constrained by quotas, may reach the market just as regional flows normalize. Discounts on Russian crude could swiftly revert towards pre-crisis as it competes more intensely with Emirati grades for Asian buyers. This would weaken Moscow's pricing leverage, currently bolstered by the Hormuz-driven oil-price rally.

The SCO and BRICS+ may evolve into alternative platforms of coordination—not yet as counterweights to Western institutions, but as parallel mechanisms for settlements in national currencies, commodity pricing, and development finance. According to the IMF, the world economy is showing signs of fragmenting into U.S.- and China-aligned blocs, with a special role for non-aligned 'connector' countries (Gopinath et al., 2024). In energy, India is the paradigmatic case: it increased imports of Russian oil 22-fold in 2022, to 41 million tons (RBC, 2023) while emerging as a major exporter to Europe of petroleum products from refineries processing Russian crude (Reilly, Yenikeyeff, and Paik, 2026). It acts as a safety valve, helping to prevent fragmentation from causing a full rupture; in doing so, it captures substantial commercial gains.

By 2040, the Western bloc may be shaped by IEA norms and coordination, the EU emissions-trading system, the EU carbon border adjustment mechanism, and broader climate standards. A looser Eurasian–Global South bloc may coalesce around BRICS, the SCO, bilateral settlements in national currencies, and competing technological standards. Neither bloc would necessarily be internally cohesive: the Gulf Arab monarchies, for instance, might form a pole of their own. Between the two blocs, a buffer of intermediary states may gain economic and political weight as fragmentation deepens.

The two blocs securitize energy according to fundamentally different logics.

In Europe, securitization is built on the perception of Russia as an existential threat, which makes the severing of energy ties an end

in itself: the REPowerEU initiative, launched by Brussels in May 2022, and followed by the Commission's 2025 roadmap, envisaged a complete phase-out of Russian hydrocarbons by 2027 (European Commission, 2022; European Commission, 2025). In effect, price and technology cease to be the deciding criteria: Brussels will accept more expensive and riskier supply, so long as it is politically homogeneous.

China's energy strategy is built on supply diversification. In 2023, Xue Li of the Chinese Academy of Social Sciences proposed capping each country's share of Chinese oil imports at 20%, with a lower ceiling of 5% for the United States and each of its allies or close partners, while keeping Russia's combined share of China's pipeline-gas and LNG imports below one-third (Xue Li, 2023). Though never adopted as official policy, these thresholds capture the logic underlying Beijing's negotiations over the Power of Siberia 2 project: no single supplier, however close, should become indispensable.

By 2024, Russia already accounted for roughly 20% of China's oil imports—the very ceiling Xue Li had prescribed. The same diversification principle explains Beijing's caution towards Russian pipeline gas, and its markedly different posture on liquefied natural gas (LNG). Xue Li's framework specified no comparable caps on LNG imports from the U.S. or Australia; indeed, it recommended increasing them. The logic is structural rather than political: a wider supplier network and larger traded volumes reinforce China's bargaining position in the Asian gas market, giving Beijing leverage over regional pricing and a broader base for yuan-denominated settlements (Shi, 2024).

By 2040, Europe's push for 'geopolitically acceptable' supply, and China's model of 'diversified leverage,' may redefine the global gas market.

In the energy sector, global fragmentation is unfolding along two parallel tracks: the securitization of supply, where geopolitical acceptability takes priority over price, as in Europe; and an intensifying contest for low-cost resources as a source of competitive advantage, as in the U.S., China, and India.

FROM THE PETRODOLLAR TO THE KILOWATT-HOUR

The linkage of oil to the dollar—the 'petrodollar' system, reinforced by U.S.–Saudi financial and security arrangements of the 1970s—underpinned demand for the American currency for nearly half a century. But the mechanism is now being progressively eroded. Some Gulf states have begun accepting yuan and rupees in payment for oil, and central-bank digital currencies (CBDCs) may accelerate the trend. Their momentum, however, slowed in 2025–2026, partly under competitive pressure from dollar-linked stablecoins: in 2025, the U.S. opted against a state CBDC, and instead promoted privately issued digital tokens backed by the dollar (White House, 2025).

The petroyuan has a genuine chance of becoming a partial alternative: China is the world's largest oil importer, and yuan-denominated oil transactions involving Russia, Iran, and Venezuela as well as LNG deals, already occur. The institutional groundwork is already in place: yuan-denominated crude-oil futures have traded on the Shanghai International Energy Exchange since March 2018 (INE, n.d.). Should Beijing succeed in creating a Northeast Asian gas hub with yuan-denominated pricing, the dollar's dominance in energy trading would be substantially undermined.

Behind the CBDC and the petroyuan, however, lies what several analysts already call the transition from the petrodollar to the electrodollar (Jakati, 2025; Kim, 2026). This transition reflects a deeper structural change in the global economy: in an increasingly electric, AI-driven system, the kilowatt-hour is becoming a fundamental measure of productive capacity, displacing the barrel of oil from its former central position. Every computation, performed by a neural network, has an energy cost. Unlike fiat money, which can be issued at will, and unlike cryptocurrencies, which are detached from the real economy, the kilowatt-hour is tied directly to productivity—measurable, divisible, universal, and resistant to politically-driven inflation: its value is set by physics, not politics (Kim, 2026).

The electrodollar does not require the wholesale electrification of transport and industry, where hydrocarbons will play a supporting role for decades. Rather, it relies on powering the 'compute economy'

with electricity from stable nuclear, gas, hydrological, and geothermal sources, and thus does not hinge on breakthroughs in renewables or battery storage.

China was the first to begin building the state architecture of this system (Jakati, 2025; Girishankar, 2025). The average industrial power price in China is about $0.09 per kilowatt-hour—lower than in most major economies (China Briefing, 2025). Yet Beijing's real advantage lies not in absolute price, but in differentiated pricing and subsidies that make electricity an instrument of industrial policy. Some energy-intensive, low-technology industries pay elevated rates, while data centers running domestic AI chips (Huawei, Cambricon) receive electricity-cost subsidies of up to 50%. In late 2025, these subsidies were expanded to help technology giants, such as Alibaba and Tencent, offset the higher power draw of still-less-efficient domestic accelerators (Wu, 2025). In effect, China spends its 'electro-currency' to fund its own AI industry and cut its dependence on foreign technology. By end-2025, China's installed wind and solar capacity had reached 1.84 TW (NEA, 2026). It has created the infrastructure for an 'electro-currency mint' at an unprecedented pace.

The emerging Compute-Energy Standard is the AI era's functional counterpart to Bretton Woods (Kim, 2026). In this scheme, the strategic reserves of states will be measured not in gold and Treasury bonds, but in gigawatts of constant, dispatchable-at-will generating capacity. The next step could be energy-backed stablecoins, in which the tokenized kilowatt-hour—produced by small reactors sited next to data centers—replaces Treasury bonds as the low-risk anchor of digital liquidity. McKinsey puts investment in data centers at $6.7 trillion by 2030, $5.2 trillion for capacity supporting AI workloads (McKinsey, 2025). This is no longer infrastructure spending in the classical sense but the construction of new electricity-intensive computational infrastructure as the material basis of economic power.

The geopolitical consequences invert those of the petrodollar. Petro-states exported dependence on the U.S.: to pay for oil, importers had to accumulate dollars. Electro-states offer the opposite: China already exports solar panels and wind turbines that turn buyers into 'mini

electro-states,' reducing their dependence on imported fuels. The result is a contest among three models: an Atlantic 'electrodollar,' built on AI infrastructure and the prospective deployment of American SMRs; a Eurasian system coalescing around Russian nuclear projects, pipeline supply, and the Chinese market; and a Chinese model of 'electro-states' that exports above all the technological capacity to generate power. Which prevails remains open. Global energy flows will follow this new monetary geography, reinforcing the fragmentation of the international financial system.

This is not a rhetorical flourish but a structural shift: in the AI economy, the kilowatt-hour becomes the real base currency, because it is a measurable input directly underpinning productivity. Whoever shapes the cost of electricity for global computation will hold leverage comparable to OPEC's in the oil era. States that control cheap, reliable electricity gain monetary sovereignty of a new kind, whether or not they possess hydrocarbon resources.

CONTROL OVER CRITICAL MINERALS

By 2040, the geopolitics of the energy transition will be determined primarily by access to lithium, cobalt, nickel, graphite, and rare-earth elements. Such access is already highly concentrated. China dominates the global supply chain, controlling roughly 60% of rare-earth mining and 91% of the processing of magnet-grade rare earths—essential for EVs, wind turbines, and precision weapons. It also leads the processing of nineteen of the twenty critical minerals (IEA, 2026a; 2025b; USGS, 2025b). While the DRC supplies roughly 70% of global cobalt (USGS, 2025a), most of it is still processed in China (Kholodov, 2025). The West, in other words, has steadily exchanged oil dependence on OPEC for mineral dependence on Beijing; the new dependence is concentrated in a single power and spans the entire value chain, not merely the raw-material segment.

ARCTIC GAS AND THE NORTHERN SEA ROUTE

A new resource frontier is also opening: Arctic natural gas. Russia produced roughly 33 million tons of LNG in 2022 (OSW, 2023); a

2021 target had envisaged up to 140 million tons by 2035 (PortNews, 2021), but the *Energy Strategy to 2050*, approved in April 2025, revised the target down to a range of 110–130 million tons by 2036 (Interfax, 2025). The EU's twentieth sanctions package went further than any one before it: for the first time, it barred the servicing of LNG tankers and icebreakers, targeting the existing fleet rather than merely future construction (Gijs, 2026). This compounded existing constraints. The South Korean shipyard Hanwha Ocean (formerly DSME) canceled its ice-class carrier contract for 'Arctic LNG 2', and fleet construction at the Zvezda shipyard has stalled due to shortages of key components (Reilly, Yenikeyeff and Paik, 2026). By mid-2026, sanctions and technical problems kept Arctic LNG 2's annualized commercial deliveries near one-sixth of its full 19.8 mtpa design capacity; two trains had been completed, while the third was on hold (IEA, 2026b; Reuters, 2026b).

Russian Arctic LNG continues to flow to China, which is investing in Northern Sea Route infrastructure and seeking access to icebreaker technologies and Arctic navigation expertise as part of an emerging Russia–China Arctic axis. The White House's high-profile 2025 effort to acquire Greenland attests to Washington's understanding of the strategic value of Arctic positions. Greater American control over Greenland would strengthen Washington's position along emerging Arctic shipping routes and its ability to counter China's growing role as Russia's principal Arctic partner.

Taken together, these trends point to a broader American effort to shape China's access to energy along key overland and maritime routes through pressure applied across multiple theatres below the threshold of open conflict—an effort visible less in public declarations than in force posture and defense planning (The White House, 2025; DoD, 2026). The underlying blockade scenario remains contested in American strategic literature: Collins argues that such an operation would have to be sustained for at least a year, while disruption to world trade and pressure from allies and neutrals would force Washington to lift it long before then (Collins, 2018).

With a comprehensive blockade difficult to sustain, pressure shifts to specific corridors.

The first corridor is the Northern Sea Route (Mishchenko, 2026; Reilly, Yenikeyeff and Paik, 2026). Following the 2014 sanctions, ExxonMobil suspended its Arctic offshore cooperation with Rosneft and withdrew from the joint projects in 2018, depriving the United States of a channel for applying its engineering expertise and influencing shelf-development standards. Although Beijing did not automatically fill the vacuum, the Western withdrawal made China a more important source of financing and equipment for Russian Arctic projects, as well as a market for their oil and gas; in 2018, Beijing also incorporated Arctic routes into its 'Polar Silk Road' concept. The second node is the Kuril Islands: an escalation of the dispute over them would threaten access routes from the Sea of Okhotsk. The third is the Baltic region, whose ports provide an alternative maritime route for trade with China, easing pressure on the overburdened Far Eastern railways. The fourth is Central Asia, where vulnerability lies less in infrastructure than in the stability of the transit states: destabilization in Kazakhstan, Turkmenistan, or Uzbekistan could severely disrupt pipelines flows to China without a direct blockade.

In response to such distributed pressure, Beijing and Moscow are already expanding their maritime security cooperation in the Arctic and their joint naval activity in the western Pacific. Should the Northern Sea Route become the principal corridor of the Sino-Russian energy axis, the U.S. would likely extend its strategic focus to the Russian Arctic theatre—a direction in which NATO is already moving by strengthening its presence in the High North.

Paradoxically, pressure meant to restrict China's energy access may instead accelerate the militarization of the Arctic and the securitization of Central Asian routes. These routes are critical to the contest for the Northeast Asian gas market.

THE BATTLE FOR THE NORTHEAST ASIAN GAS MARKET

The Northeast Asian gas market illustrates all the trends described above. Here four leading suppliers—the U.S., Qatar, Australia, and Russia—compete for sales to Japan, China, and South Korea, which together account for almost half of the world's LNG (Petroleum

Australia, 2026; Reilly, Yenikeyeff and Paik, 2026). The market is large enough to support a regional gas hub of a new type, with pricing decoupled from oil and some settlements conducted in yuan. Whoever establishes leadership in this market will acquire energy leverage over the world's largest manufacturing economies, as well as substantial regional influence.

China's position is twofold. On the one hand, Beijing is seeking to reduce its dependence on seaborne supplies through Malacca and Hormuz, to which end it needs gas from Central Asia, Russian pipeline gas, and Arctic LNG. On the other hand, China views Russian and Central Asian gas both as a benchmark for LNG contract negotiations and as a basis for establishing itself as a regional pricing and trading hub, potentially intermediating LNG sales to Japan and South Korea. For Moscow, such intermediation may weaken its direct access to these markets and risk relegating it to second-tier supplier status.

Despite the memorandum signed by Gazprom and CNPC in September 2025, the key commercial parameters of Power of Siberia 2, above all, the pricing formula, remain unsettled (Wong, 2026). Having lost most of its European market, Gazprom can no longer leverage competition between European and Asian buyers, sharply weakening its negotiating position. Even so, in March 2026, the draft of China's 15th Five-Year Plan (2026–2030) called for "preparatory work" on the central route of the China–Russian pipeline—widely interpreted as *Power of Siberia 2*—signaling political will to move forward, but not to pay any price.

Since the start of the Hormuz crisis, Japan and South Korea, key U.S. allies in urgent need of cheap gas, have faced a choice between alternative LNG at substantially higher prices and arrangements involving Russian Arctic LNG supplied via the Northern Sea Route, potentially through Chinese intermediaries. Despite pressure from Washington, Tokyo retains the Mitsui and Mitsubishi stakes in Sakhalin-2 and continues to import its LNG under a U.S. sanctions waiver that the Treasury renews every six months (The Japan Times, 2025). The situation exposes a genuine conflict of interests and could strain U.S. alliances with Japan and South Korea and complicate their cooperation with the Quad and AUKUS (Reilly, Yenikeyeff and Paik, 2026).

As recently as early 2025, the market outlook to 2040 appeared benign: a wave of new U.S. and Qatari liquefaction capacity by 2030 suggested moderate oversupply, lower prices, and a gradual globalization of gas trade following the oil-market model, with regional price indices converging (IEA, 2026g; PwC, 2025).

Two events of 2025–2026 radically altered that trajectory. First, sanctions led the IEA to exclude Arctic LNG 2's 27 bcm of annual capacity from its baseline global supply forecast (IEA, 2026c).

Second, Iran's 2 March 2026 attack on Qatar's Ras Laffan terminal prompted QatarEnergy to declare force majeure and suspend loadings. Further strikes on 18–19 March seriously damaged two of its fourteen liquefaction trains, with a combined annual capacity of 12.8 million tons, or 17.4 bcm. Repairs may take three to five years, while the North Field East expansion is expected to be delayed by more than a year (IEA, 2026c). The IEA now puts Middle East crisis-related supply losses in 2026–2030 at roughly 140 bcm—excluding constrained Arctic LNG 2 volumes and with the estimate still being revised upward. Together, these shocks have delayed the global LNG supply wave by at least two years.

The shift has structural geo-economic consequences. As of 12 June 2026, all LNG liquefaction FIDs taken that year were for U.S. projects (IEA, 2026b). The U.S. is moving from supplier of last resort to systemically important exporter, with all the political leverage that entails. Constraints on Russian and Qatari supply create a window of opportunity for producers in Canada, Mozambique, and Australia, yet none can compensate for the shortfall in the foreseeable future. American dominance brings its own tension: Henry Hub prices rose by more than half in a single year, to $3.52 per MMBtu in 2025, and the EIA expects a further rise from 2027 as domestic demand for data-center power climbs (EIA, 2026b). Following the post-2022 pivot to Europe, 2026 brought Europe and Asia into direct competition for flexible U.S. cargoes.

However, U.S. energy-intensive industries and consumer groups are pressuring the White House to limit exports—through supply restrictions, political conditions on buyers, or direct quotas. In January 2024, the Biden Administration suspended decisions on new licenses for LNG export authorizations to countries lacking free-trade agreements with the U.S.,

citing climate and economic concerns. Trump rescinded the pause in January 2025, but the precedent showed how swiftly politics can redirect the export model. Such intervention risks undermining the American market model—and the buyer trust on which U.S. energy dominance rests. For Japan, South Korea, and Taiwan the emerging outcome is not a 'surplus of cheap LNG' but 'expensive, predominantly U.S.-origin LNG,' with Washington's bargaining power over all three buyers sharply increased.

It is in this context that China's strategy of establishing its own gas hub in Northeast Asia takes on particular weight. The contest is already intense: after China imposed a 15% tariff in February 2025, U.S. LNG deliveries to China fell to zero in March; the tariff rose to 125% in April (Bloomberg, 2025).

If the global supply architecture shifts decisively towards American dominance by 2030 while the Russian and Qatari alternatives remain constrained, a regional hub with yuan-denominated pricing could become increasingly important. It would serve not merely as a means of currency diversification, but as a channel through which Asian consumers could preserve some market autonomy from a U.S.-centered *Henry Hub* system.

By 2040, competition in Northeast Asia will therefore be not only among suppliers, but also between pricing models: the American 'globalized' model and the Chinese 'regionally yuanized' one.

On balance, the market may split into an Atlantic basin centered on *Henry Hub* and Europe, and a China-centered Asian bloc combining Russian pipeline gas, Arctic LNG, and settlements in yuan.

SCENARIOS FOR THE ENERGY ORDER OF 2040

> "If you can look into the seeds of time,
> And say which grain will grow and which will not,
> Speak then to me."
>
> William Shakespeare, *Macbeth, 1605*

Based on the trends set out above, four scenarios for 2040 may be distinguished, using the established two-axis tradition of energy-order scenario analysis: the degree of international cooperation and the role

of the state in markets (Andrews-Speed, van der Linde and Keramidas, 2014). The axes derive from the POLINARES model; the names and content of the scenarios, and the probability estimates, are the author's own. The four quadrants are recast here in the terms of the 2020s—the electrodollar, AI, the nuclear renaissance, critical minerals—and each is assigned a probability of becoming the dominant configuration as of early August 2026 (Table 1). Elements of the scenarios are not mutually exclusive: reality will likely combine features of several.

Table 1.

Four scenarios across two axes: estimated probability of becoming dominant by 2040 (%)

	Integrated / multilateral order	**Fragmented into national blocs**
Market economy	1. Managed Renewal (10–15%)	3. Fragmentation into Regional Blocs (35–40%)
Strategic (state) economy	2. A Chinese Energy Order (25–30%)	4. Systemic Rupture (25–30%)

Note: The ranges express uncertainty; any point estimates selected from them should collectively sum to 100%. Elements of different scenarios may coexist.

Scenario 1: Managed Renewal. The major powers agree on a new architecture encompassing standards for critical minerals, climate finance, rules for trade in clean-energy technologies. Its probability of becoming dominant is low, around 10–15%, given U.S.–China mistrust and persistent hybrid pressure; only repeated large-scale crises might bring the major powers back to the negotiating table.

Scenario 2: A Chinese Energy Order. China consolidates its dominance in critical-mineral processing and the manufacture of clean-energy technologies, including nuclear reactors, while most developing countries become dependent on Chinese standards and finance. Unlike Scenario 3, this is a single, China-centered order rather than a balance among competing blocs. Western countermeasures reduce its probability of becoming dominant, but China's structural advantage in key value chains keeps it significant, at around 25-30%.

Scenario 3: Fragmentation into Regional Blocs. The world fragments into competing energy blocs—a Western bloc comprising the U.S., Europe, Japan, South Korea, and Australia, and an Eastern one comprising Russia, China, Iran, and parts of Central Asia—with the transitions proceeding at different paces and by different rules. Between them lies a buffer perimeter of India, Türkiye, the Gulf states, and others that retain ties with both sides and extract rent by mediating between them, distinguishing this order from a bipolar 'Cold War 2.0'. This currently appears the most probable outcome, with a 35–40% probability of becoming dominant: it requires neither a grand compromise nor systemic rupture, but represents the inertial continuation of current trends. India exports to Europe petroleum products refined from Russian crude; Türkiye buys Russian gas and nuclear technology alongside American LNG.

Scenario 4: Systemic Rupture. Overlapping crises—the closure of Hormuz, a clash over Taiwan, sabotage on the Northern Sea Route, destabilization in Central Asia, the cascading disintegration of both OPEC and OPEC+ after the UAE's departure—fracture global energy supply chains. The low-carbon transition initially slows, even as highly exposed fossil-fuel importers gain a strong incentive to accelerate it later, and the international system enters a period of extreme uncertainty. The scenario's probability of becoming dominant—around 25–30%, significantly higher than in early 2025—will rise further if hybrid pressure persists: each individual crisis may remain below the threshold of rupture, their cumulative effect may cross it. So far, however, the Gulf conflict has done more to accelerate fragmentation than to bring systemic rupture closer.

Table 2.

Four scenarios by energy sector

	1. Managed Renewal	**2. Chinese Order**	**3. Fragmentation**	**4. Systemic Rupture**
Oil	Managed decline; moderate prices; OPEC+/consumer compromise	Strategic control; high intra-bloc demand; national oil company dominance	Regionalization; intra-bloc trade; oil as leverage	Minimal investment; enclave production; extreme volatility

	1. Managed Renewal	2. Chinese Order	3. Fragmentation	4. Systemic Rupture
Gas	Global bridge fuel; transparent LNG spot trade	Strategic imports; long-term contracts; yuan settlements	Bloc-partitioned flows; regional hubs	Shrinking LNG trade; local survival and barter
Nuclear	Regulated renaissance; international standards	State strategy; Hualong One; exports to allies	Competing national technologies; proliferation risk	Stalled construction; life extension for aging plants
Renewables	Global breakthrough; storage and smart grids	Chinese value-chain dominance; deployment under Chinese standards	Duplicated supply chains; green protectionism	Sporadic local generation; no economies of scale

Which of the four prevails will depend less on technology, markets, or climate than on a handful of decisions made in Moscow, Beijing, and Washington over the next three to five years—above all, the pricing formula agreed for *Power of Siberia 2*, how assertively Beijing uses its critical-minerals leverage, and whether Washington politicizes its LNG exports.

CONCLUSION: AN ORDER IN THE MAKING

Technology alone will not determine the global energy order of 2040: many of the necessary technologies already exist, while others may emerge in the foreseeable future. The order will be shaped by political decisions made today. Which states will be able to build an icebreaker fleet; through which straits tankers will pass; whether a gas hub with settlements in non-Western currencies can be launched; which nuclear platform will assume a dominant position in the Global South; whether an industrially scalable solution for long-duration energy storage will be found—these questions will be decided not only in technological laboratories but also in the offices of policymakers. The key question is how far the parties are prepared to go: whether they will use blockades of energy routes as an instrument of coercion or refrain from such escalation.

Energy has become one of the central arenas of strategic rivalry. Each principal player now operates under a constraint examined

by this article. Russia, having lost Europe, relies on Asian markets even as the UAE's exit from OPEC and OPEC+ threatens direct competition for the same buyers by 2027–2030. The U.S. must balance LNG exports against its own compute economy, as no previous administration has had to. China remains dependent on seaborne imports through Malacca despite gains in Arctic infrastructure, mineral processing, and nuclear construction. Japan and South Korea balance their alliance commitments and energy security. Africa and Latin America wield their resource leverage as the last wave of decolonization gathers force.

Restricting China's access to energy resources may backfire, prompting Beijing to securitize its energy routes: expand its icebreaker fleet, strengthen its security presence in Central Asia, increase joint patrols with Russia in the Arctic, and deepen strategic ties with countries purchasing nuclear technology from Rosatom. This will not immediately terminate globalization, but it may consolidate a new Cold War with potential flashpoints in the Arctic, the Baltic, and Central Asia.

Ultimately, the outcome of this confrontation will be determined not by military force or volume of resources alone, but by countries' capacity to build durable institutions, alliances, technological systems, and, above all, trust. Today, trust is becoming scarcer than any mineral or energy source. Every major player must find points of accommodation that make the new energy order viable rather than allow it to be fractured by conflict. The contours of this order are already emerging—unevenly and in fragments, but clearly enough to reveal the principal fault lines.

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