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The new energy system: Navigating the shift from molecules to electrons


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IN A NUTSHELL

– Electricity is emerging as the central pillar of the global energy system, powering transport, buildings, industry and digital infrastructure alike

– Supported by energy security priorities, policy frameworks and the accelerated build-out of clean power generation, electrification is advancing simultaneously across multiple sectors

– As a result, demand is increasingly converging on the same underlying value chain – spanning critical minerals, electrical equipment, power generation and grids

– This convergence is exposing structural bottlenecks, particularly in networks and material processing, shaping both the pace of the transition and where investment risks and opportunities emerge along the energy value chain

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Introduction

The global energy system is undergoing a fundamental transformation. A system long dominated by fossil fuels is increasingly powered by electricity. Electricity's role as an important energy carrier is therefore permeating across multiple sectors and is becoming the backbone of energy use across large parts of the real economy.

This change is already visible across multiple sectors. Buildings are now the single largest source of electricity demand globally, while electrification in transport is accelerating, driven by the rapidly growing energy demands of the global electric vehicle fleet. Industrial processes are beginning to follow a similar path, as electrified solutions expand beyond niche applications. At the same time, the rapid growth of digital infrastructure, driven by cloud computing, data centres and artificial intelligence, is adding a new, highly concentrated source of electricity demand.

Crucially, these developments are no longer unfolding in isolation. Electrification is driving a growing convergence of demand from buildings, transport, industry and digital infrastructure onto the same underlying value chain. Critical minerals, electrical equipment, power generation and grids are increasingly shared system foundations for the multiple sectors competing for the same capacity simultaneously.

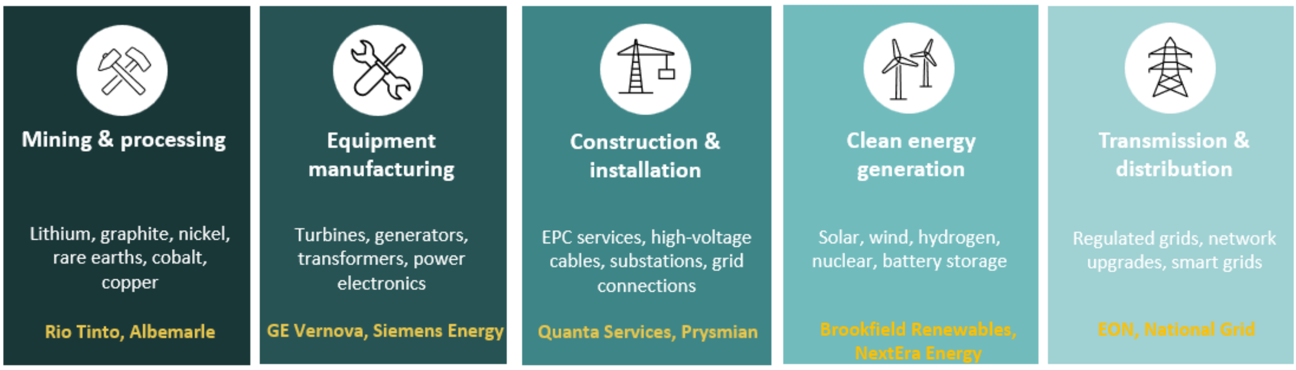
Several structural forces are reinforcing this shift. The rapid build-out of clean power generation and the continued decline in the cost of renewables and storage have improved the competitiveness of electricity across many regions. Energy security considerations have elevated electrification from a long-term decarbonisation objective to a strategic priority, particularly for countries with high reliance on imported fossil fuels. In parallel, decarbonisation policies and regulatory frameworks are reshaping the economics of energy use, supporting the transition towards electrified systems in transport, buildings and industry.

Together, these forces point to one of the most significant industrial and technological transformations of modern history. Electrification raises electricity demand structurally and, in doing so, drives sustained investment needs across the entire energy system. This includes not only power generation, but also grids, electrical equipment, enabling infrastructure and the critical materials required to build them; namely the entire energy value chain, Figure 1.

As electrification gathers pace, it increasingly exposes constraints within the system. Years of underinvestment mean that transmission and distribution networks are emerging as a key bottleneck in many regions. Electrification is also materially intensive, increasing demand for copper, lithium and other critical inputs, while processing and refining capacity remains highly concentrated geographically. These system-wide constraints play an important role in shaping the pace, cost and geography of the transition.

For investors, this matters as it represents a value build chain build-out in which pricing power and structural growth potential tend to emerge where capacity is scarce, capital-intensive or difficult to replicate. In some regions, strong policy support is accelerating capital deployment, reinforcing these dynamics and creating differentiated investment opportunities along the value chain of the emerging energy system.

Figure 1: The energy value chain



Securities mentioned are for reference only and should not be considered as investment advice
Source: DWS Investment GmbH (May 2026)

1 / The drivers of the new energy system

1.1 The electrification of the global economy

Electrification is not a new story. Rather, it is one of the longest running transformations in modern history. The first wave at the beginning of the 20th century was the build-out of power systems for lighting, industrial motors and household appliances. This wave was extended by electricity spreading deeper into buildings, industry and transport as grids expanded. But the last decade looks different because policy, technology costs, energy security, efforts to boost industrial competitiveness and new demand loads such as data centres (DC) are now reinforcing each other.

This is reflected in record levels of investments and power generating capacity on the one hand and increasing supply side bottlenecks on the other. For example, last year saw an estimated USD 2.3 trillion of global investment in the clean energy transition, surpassing fossil fuel investment by over USD100 billion, with solar and wind installed capacity hitting a record high but 1,650 GW of renewables projects unable to connect to the grid,[1] Figure 2.

Figure 2: The new global energy system in numbers

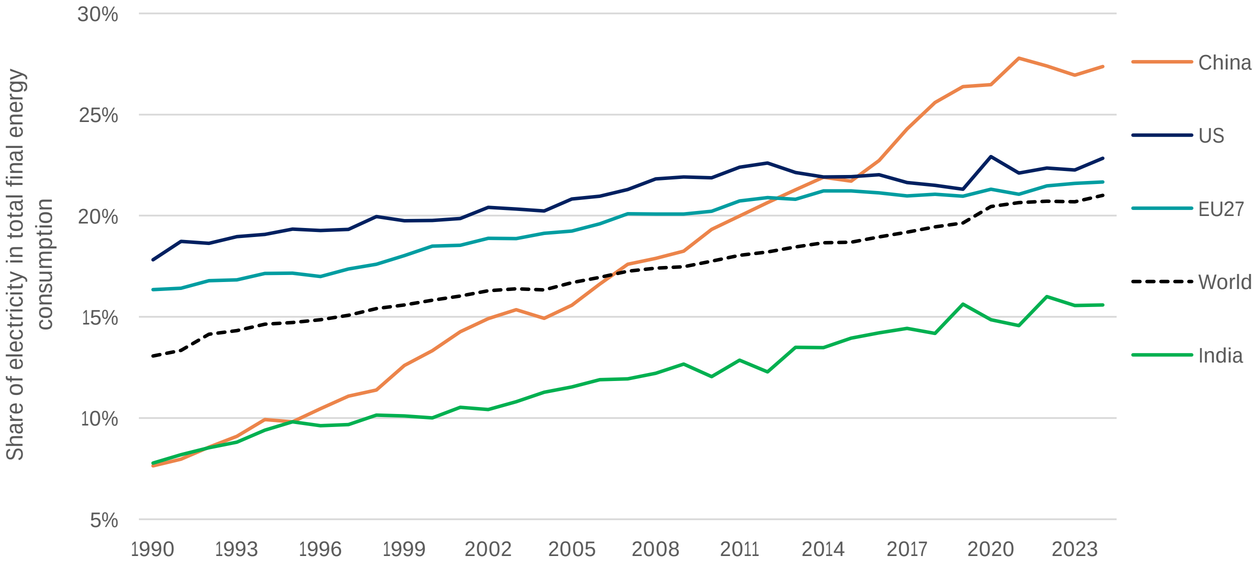
USD2.3 trillion Global investment in the clean energy transition[1]	814 GW Record high of solar and wind installed generation in 2025[2]	1,650 GW Renewable projects unable to connect to the grid[3]
+3.6% per annum Expected global electricity demand CAGR 2026-2030[4]	Doubled Solar PV capacity growth has doubled every three years since 2016[5]	+75% Real transformer and cable price increase since 2019 [6]
30% Copper supply deficit forecast by 2035[7]	Half Since 2015, grid spending has grown at less than half the pace of electricity spending[8]	20 million Electric vehicles sold in 2025, accounting for one in four new car slaes globally[9]

[1] BNEF (January 2026); [2]EMBER (March 2026); [3]IEA Renewables 2024 report attributable to mid-2024 data; [4] IEA (March 2025). Global Energy Review 2025; [5] IEA (January 2026) Electricity 2025 data; [6] IEA (February 2025). Building the future transmission grid; [7] IEA (June 2025). Global critical minerals outlook 2025; [8] IEA (October 2025). World energy outlook 2025; 9 IEA (May 2025). Global EV outlook 2025
Source: DWS investment GmbH (April 2026)

Today, electricity's share of final energy consumption reached 19.8%, up from 17% in 2015.[2] What stands out is how global electricity demand continued to decouple from total energy demand, growing around 2.3 times faster than overall energy consumption last year.[3] Electricity demand growth is increasingly an economy-wide phenomenon rather than driven by a single sector. Over the past few decades, the most dramatic rise in electricity consumption as a share of primary energy consumption has occurred in China[4] but the pace of electrification is slowly picking up in other regions, Figure 3. While the shift remains gradual on a global basis in percentage terms, the direction is unmistakable: electricity is taking on a larger role in global energy systems. Having grown by 2.7% per annum of the last decade, global power demand is forecast to reach an average annual rate of 3.6% between now and the end of the decade.[5]

[1] BNEF (January 2026); [2]EMBER (March 2026); IEA Renewables 2024 report attributable to mid-2024 data; IEA (March 2025). Global Energy Review 2025
[2] Energy Institute (February 2026). Statistical review of world energy 2025
[3] IEA (April 2026). Global Energy Review 2026
[4] For more details of the electrification pathway in Asia, please see the DWS APAC CIO View (February 2026). Charging ahead: Electrification in Asia
[5] IEA (March 2025). Global Energy Review 2025

Figure 3: Electricity as a share of primary energy consumption (1990-2024)



Source: EnerData (2024 latest data as of May 2026)

1.2 Drivers of the transformation

Electricity demand growth is underpinned by powerful macroeconomic tailwinds. Population growth, urbanisation and rising per capita incomes, particularly in emerging markets, are raising baseline energy demand and increasing the role of electricity as the most scalable and flexible energy carrier. Against this backdrop, electrification is being propelled by four sector specific demand engines, reinforced by three cross-cutting accelerants that shape both the pace and the investment intensity of the transition:

Sector demand engines

- **Transportation:** Rapid growth of the global electric vehicle fleet, expansion of charging infrastructure, and the electrification of commercial and public transport are structurally increasing power demand.
- **Buildings & heat:** Accelerating adoption of heat pumps, rising cooling demand–especially in emerging markets–and energy efficiency upgrades in residential and commercial real estate are shifting energy use towards electricity.
- **Industry:** Electrification of industrial processes, including process heat and industrial power demand, is expanding through technologies such as electric arc furnaces, industrial heat pumps and advanced power electronics.
- **Digital infrastructure:** AI and cloud driven growth in data centres is creating a fast growing, highly concentrated source of electricity demand with specific requirements for reliability and grid capacity.

Cross-cutting accelerants

- **Clean energy generation build out:** The rapid expansion of low-cost renewable power, supported by storage and nuclear energy, is enabling electrification by increasing available supply while shifting investment needs towards grids, flexibility and system integration.
- **Decarbonisation policy:** Government targets and regulation, alongside corporate procurement mechanisms such as power purchase agreements and clean power commitments, are accelerating deployment by improving long-term visibility for investors.
- **Energy security and geopolitics:** Efforts to reduce fossil fuel import dependency and to strengthen domestic energy and critical material supply chains have elevated electrification from a decarbonisation objective to a strategic priority in many regions.

A defining feature of this investment cycle is infrastructure convergence. Fast-charging networks, data centres, industrial processes and electrified buildings all rely on the same core infrastructure: grids, transformers, cables and switchgear.

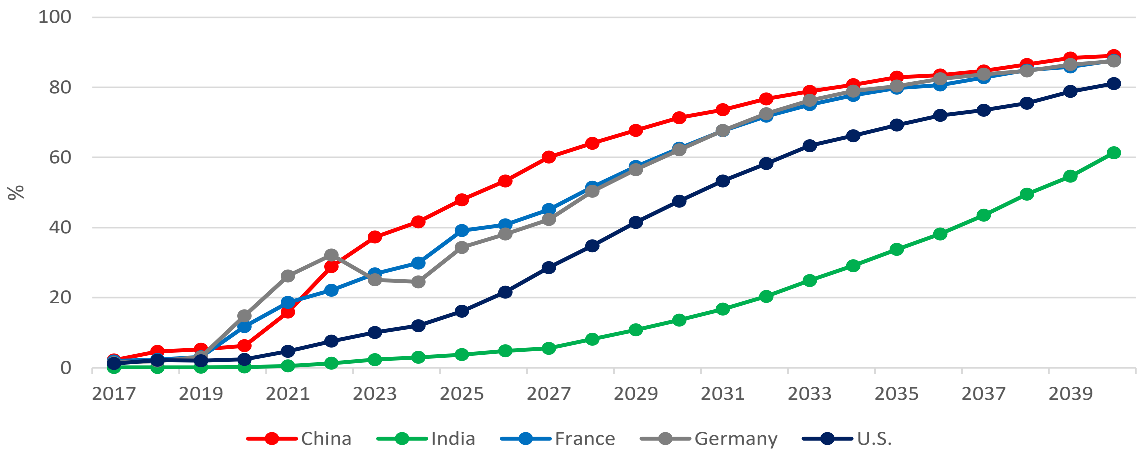
Electrification therefore results in value chain build-out, with multiple demand drivers competing for the same constrained components. We explore these demand engines in the next four sections.

1.3 Electrifying transportation

Global electric sales are expected to have exceeded 20 million in 2025, representing more than one in four cars sold worldwide.[6] Beyond passenger vehicles, electrification is spreading into commercial transport, with electric truck sales rising nearly 80% globally in 2024, reaching close to 2% of total truck sales. While the electrification of the transport sector continues, strong regional differences exist and what determines the speed, reliability and economics of fleet electrification is often the build-out of charging infrastructure.

China leads when it comes to the share of EV car sales, which reached over 50% for the first time last year,[7] meaning the conventional car is now the minority product in the world's largest car market, Figure 4. By 2030, the share of electric cars and vans is expected to reach close to 80% of total sales. Relative to the total car fleet, one in ten cars on Chinese roads is now electric rising to an expected one in three by the end of the decade.[8]

Figure 4: EV car sales as a share of total car sales



Source: Bloomberg L.P. data sourced as of April 2026

In Europe, EV sales recovered in 2025 to represent around 20% of total car sales led by Nordic countries (40%). Currently, one in 20 cars on the road in Europe are electric. By 2030, it is estimated that at least 50% of new car sales will be electric with EVs representing close to one in five of the total car fleet.[9] In comparison the U.S. is lagging as EV sales share have plateaued at around 10%, with sales potentially declining this year with just 2% of the total passenger car fleet is electric.[10]

Charging infrastructure is both a leading indicator of future EV adoption and a critical constraint on it. On a global basis, more than 1.3 million charging points were added to the global stock in 2024, up 30% from the previous year.[11] China dominates, accounting for approximately 65% of global public charging points and two-thirds of all public charging point growth since 2020.

In Europe, public charging infrastructure exceeded 1 million charge points in 2024, up 35% from a year earlier.[12] In the U.S. while the charging stock increased by 20% in 2024, public charging points reached no more than 200,000.[13] Currently, less than half of U.S. highways have a fast-charging station at least every 50 kilometers and the freeze on USD 5 billion of federal charging infrastructure funding following the January 2025 executive order adds uncertainty to the rollout timeline. The challenge of pre-emptively building out charging networks without clear visibility on future charging pattern preferences is

[6] Institute for Energy Research (January 2026). EV Sales Grew 20% Globally in 2025
[7] EMBER (December 2025). The EV leapfrog – how emerging markets are driving a global EV boom
[8] IEA (May 2024). Global EV Outlook 2024
[9] IEA (May 2025). Global EV Outlook 2025
[10] WRI (April 2026). For the US EV market, a more turbulent road lies ahead
[11] IEA (May 2025). Global EV Outlook 2025
[12] IEA (May 2025). Global EV Outlook 2025
[13] IEA (May 2025). Global EV Outlook 2025

something investors must navigate, just as with many other energy transition technologies. Where policy frameworks are stable and permitting/grid connection processes are clear, investment activity has increased materially in recent years.

1.4 Power hungry buildings

Buildings are powerful engines of electricity demand growth. When bundled with data centres,[14] global electricity consumption in buildings increased by more than 600TWh, or 5%, in 2024, accounting for nearly 60% of total growth in electricity consumption.[15] As a result, the buildings sector is the single largest component of electricity demand growth globally. This surge is driven largely by:

(i) The increasing adoption of heat pumps for space and water heating
(ii) The rise in air conditioning demand driven by record temperatures and growing ownership in emerging markets

These drivers converge on the same underlying requirement for reliable, reinforced power networks. Heat pumps represent the most structurally important buildings electrification technology globally and cooling-driven electrification in emerging markets has become a long-term demand growth story. The IEA estimates that by 2030, over 80% of additional electricity demand for cooling will occur in emerging and developing countries, and specifically those in Asia. In addition, data centres which we explore later, have become the buildings-sector wildcard. Collectively, these dynamics create an opportunity set spanning network reinforcement, building electrification hardware and efficiency services.

1.5 Electrification of industrial processes

Industrial electrification is the most complex and potentially the largest end-market for electricity demand, but it is progressing unevenly across sub-sectors and processes. Industry consumes approximately 37% of global final energy,[16] more than any other sector, and most of that demand is still met by fossil fuels, particularly for the high-temperature heat and chemical processes that make up heavy manufacturing. However, transition is taking place in some sub-sectors. For example, electrification technologies are being deployed in lower-temperature heat segments such as food and beverages, paper and light manufacturing.

While industrial electrification is complex, it is unfolding in certain segments. Electric arc furnace steelmakers are slowly becoming cost competitive over blast furnace rivals while the electrification of cement, chemicals and primary metals production represents a longer but potentially larger opportunity. By 2030, electricity share of global industrial process heat is projected to rise to 12%, from 4% currently.[17] This growth may be led by industrial heat pumps and electric arc furnaces across chemicals, metals and light manufacturing. For investors, the key is where electrification translates into contracted equipment demand, recurring services, and grid connection spend and which geographies can provide the power system capacity and reliability required for electrifying industrial operations.

1.6 The digital infrastructure revolution

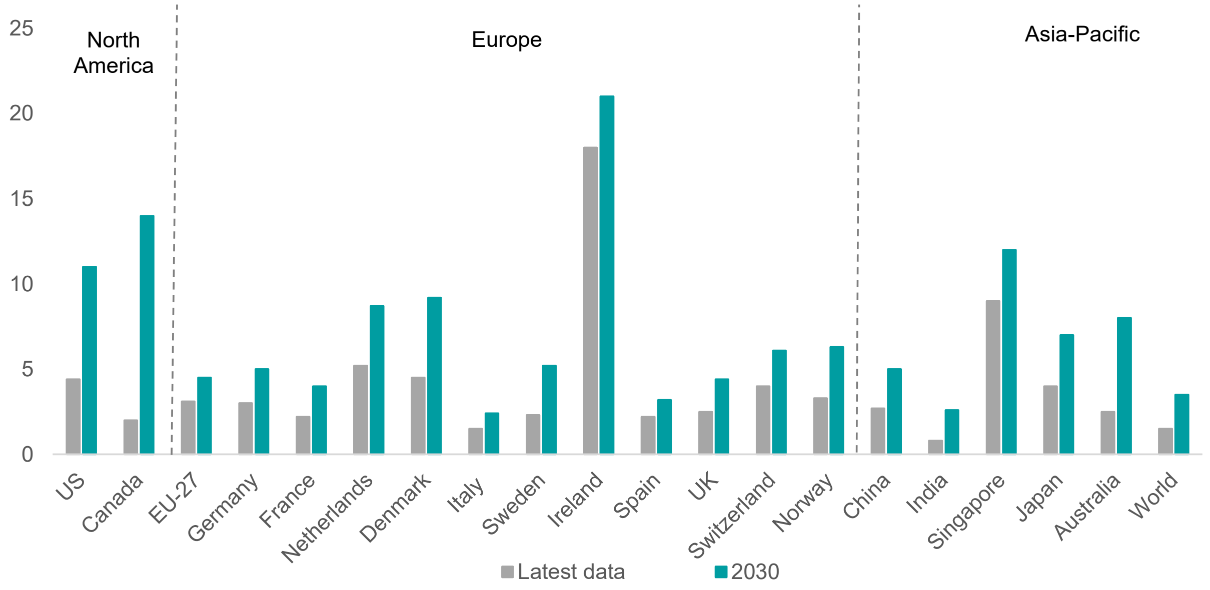
DCs exist to power the world's digital ecosystem. Their purpose is to store data, hosts apps, run analytics, train AI models and maintain online services. They are designed never to go offline and consequently require reliable power sources which are concentrated geographically. For example, one hyperscale data centre can consume as much electricity as 50,000 homes.[18] When a cluster forms in one location, the effect is considerable and localized and can make their integration into the grid potentially more challenging.

For example, in certain U.S. states, data centre clusters can account for as much as 20% of a state's power consumption which can strain local grid infrastructure. Where renewables and grid access are limited, some operators are deploying natural gas-based generation and exploring small modular reactors for future low-carbon baseload reliability. Projections for 2030 reveal that DCs may become a large share of total power consumption particularly in the U.S., Canada, Netherlands, Denmark, Ireland, Singapore and Australia, Figure 5. These highlight why DCs could become the marginal driver of grid upgrades in specific regions even when their share of total power consumption at as national level appears modest. For

[14] According to the IEA, data centres contributed roughly 8% of the 600TWh increase in electricity consumption growth
[15] IEA (April 2025). Global Energy Review 2026
[16] IEA (July 2023). Tracking clean energy process 2023
[17] IEA (October 2025). Renewables 2025: Analysis and forecasts to 2030
[18] IAEI (January 2026). How much electricity does a data center use? Complete 2025 analysis

investors, this concentration effect is crucial: it can drive long connection queues, accelerate investment in local grid reinforcement and increase demand for reliability solutions.

Figure 5: Current and projected data centre power demand as a share of national power demand by country



Source: ICIS (May 2025). Data centres: Hungry for power

1.7 Accelerants to the electrification investment cycle

We have explored the structural drivers underpinning the shift to electricity as the dominant energy carrier. In this section, we assess three possible accelerants which may determine how fast electrification happens. The difference between a gradual transition and a genuine super-cycle depends on whether these accelerants fire simultaneously. These encompass policy, technology and market and financial accelerants, which we examine in turn.

- **Policy:** This encompasses energy security, carbon pricing, decarbonization mandates and permitting reform for grid infrastructure and renewable energy projects. We would view energy security as potentially the most resilient to the ebb and flow of political ambition since unlike climate commitments which are contested across the political spectrum, the desire to reduce dependence on imported fossil fuels commands broad cross-party support. In Europe, the European Commission has launched a coordinated wave of electrification focused legislation. These include the EU's Clean Industrial Deal which targets the electricity share of final energy consumption reaching 32% by 2030. In China, the 15th Five Year Plan has embedded electrification targets for example in nuclear, gird transmission and non-fossil fuel energy share.

- **Technology:** Falling cost curves as well as increasing deployment, for example in solar power generation, illustrate how technology can be a powerful accelerant to electrification and specifically the clean energy build-out. Other technologies such as green hydrogen, heat pumps, battery storage, vehicle-to-grid technology have the potential to accelerate electrification rates across the industrial, buildings and transportation sectors.

- **Market and financial dynamics**: China's manufacturing dominance is also creating a global cost deflation dynamic that draws even fiscally constrained economies into electrification. This suggests that there is strong possibility that parts of the developing world will bypass centralized fossil fuel grid infrastructure and leapfrog directly to distributed clean energy systems. Compressing costs of capital are also compounding falling technology costs, while corporate power purchase agreements are providing long-duration revenue certainty that is enabling project financing without government support.

If it materialises, an electrification super-cycle may have important implications across the energy value chain such as tightening market fundamentals across key minerals. To assess the investment landscape, the next section explores the bottlenecks, investment gaps and structural opportunities that may exist along the entire energy value chain from mining and processing to generation and transmission.

2 / Converging demand across the energy value chain

2.1 Bottlenecks across the energy value chain

A defining feature of this investment cycle is infrastructure convergence. As transport, buildings, industry and digital infrastructure electrify and scale in parallel, electricity is becoming the backbone of energy use across the real economy. This simultaneous build-out is driving demand to converge on the same underlying value chain: Clean power generation, grids, electrical equipment, construction and critical materials. The resulting concentration of demand is exposing structural bottlenecks, particularly in networks and material processing, which in turn shapes the pace of the transition, pricing dynamics and where investment opportunities emerge along the energy value chain. We therefore frame the investable universe through five interconnected pillars - mining & processing, equipment manufacturing, construction & installation, clean power generation & storage, and transmission & distribution including smart grids, as outlined in Figure 1. Each pillar with distinct risk and return characteristics.

2.2 Mine supply and processing chokepoints

The energy value chain starts with mining and processing. These deliver the metals and materials which are becoming strategically important inputs for electromobility, renewables, power grids, semiconductors, data centers and defense applications. As a result, demand for key minerals is forecast to grow rapidly across multiple markets. This includes an estimated fivefold increase in lithium demand by 2040, graphite and nickel demand doubling and cobalt and rare earths increasing by up to 60%.19 In the case of copper, the rapid expansion of grid infrastructure in China has been the single largest contributor to copper demand growth over the past two years.20

From an investment perspective, one of the main characteristics of mine supply is the lead times required to build new mining productive capacity. For example, mine development timelines now average 17 years from discovery to production, on top of which copper ores grades have declined 40% since 1991, and only 14 new copper deposits have been discovered in the past decade, compared with 225 in the previous 23 years.[21] According to the IEA, copper is forecast to have market deficit of 35% by 2035.[22] In addition, of the USD360 billion to USD450 billion needed to ensure copper supply by 2030, as much as USD270 billion is still lacking, with copper alone accounting for 36% of the total critical minerals' investment gap.[23] For lithium, while the market is well supplied in the near-term, rapidly growing demand is projected to turn market balances into deficits as early as 2028.[24]

In addition to the constraints on new mine supply, potentially severe bottlenecks exist in the refining, separation and processing parts of the value chain. Over several decades China has built a dominant position in precisely these segments. This dominance is based less on geological monopolies and more on long-term industrial policy aimed at processing capacity, technological learning curves and economies of scale. This geographic concentration of refining supply is another dimension of the investment case not least given the risk of export controls on critical minerals. For copper, lithium, nickel, cobalt graphite and rare earths, the average market share of the top three refining nations rose to 86% in 2024, with almost all supply growth coming from the single top supplier: Indonesia for nickel and China for all others.[25]

The choke point is largely in midstream processing. China refines around 70% of global lithium and cobalt, and over 90% of rare earths and graphite.[26] This issue became clear following Chinese export restrictions during 2024–25 on gallium, antimony and rare earths, which produced sharp price spikes before being temporarily suspended late last year. Western policymakers responded with the EU Critical Raw Materials Act, the U.S. Section 45X production credit, and the U.S.

[19] IEA (June 2025). Global critical minerals outlook 2025
[20] IEA (June 2025). Global critical minerals outlook 2025
[21] Crux Investor (June 2025). How copper supply deficits are reshaping the critical minerals landscape
[22] IEA (June 2025). Global critical minerals outlook 2025
[23] Ecofin Agency (May 2025). Copper deficit could reach 30% by 2035, warns IEA
[24] Wood Mackensie (March 2026). Lithium demand could exceed 13 million tonnes by 2050 as energy transition accelerates
[25] IEA (June 2025). Global critical minerals outlook 2025
[26] EIA (May 2025). China dominates global trade of battery minerals

Department of Defense's strategic partnership with MP Materials at a guaranteed price floor, attempting to establish a parallel 'Western premium' supply architecture. For investors, these dynamics may favor integrated miners with secure jurisdictional access (Rio Tinto, BHP, Freeport-McMoRan, Glencore), Western rare-earth and lithium players with policy support (MP Materials, Lynas, Albemarle), and increasingly the recyclers.

Consequently, investors may wish to consider looking beyond broad commodity price trends and focusing on where bottlenecks and pricing power sit along the value chain. In that framing, mining and processing firms with secure access to strategic resources, technological capability and credible counterparties could be relatively better positioned to capture long-term demand, even if the path is volatile.27

2.3 Constraints on manufacturing and construction

The equipment manufacturing and construction and installation pillars spans the making of turbines, generators, transformers, and power electronics to EPC services, high voltage cables to cover three broad categories: first, the companies that produce solar panels, wind turbines, power transformers, high voltage cables, substations and grid connections.

In many instances, many segments within this part of the energy value chain are subject to supply side bottlenecks. For example, the manufacturers of transformers and cables have been faced with years of underinvestment. Global demand for high-voltage cables which are essential for connecting offshore wind farms, cross-border interconnectors and reinforced onshore grids, have led to delivery lead times of as much as three years in some segments.[28] Power transformer manufactures face a structurally similar dynamic. This is compounded by the AI data centre build-out which is competing for the same physical components: high voltage cables, large power transformers and substation equipment.

For investors, this is the part of the value chain where the bottleneck thesis has most clearly translated into financial results. Lead times for large power transformers now exceed two years and high-voltage cable orders are booked up to five years out. This scarcity has shown up in record order books and meaningful margin expansion at leading equipment makers including Hitachi Energy, Siemens Energy and GE Vernova, with comparable dynamics at cable manufacturers such as Prysmian and Nexans. Although capacity is being added, Hitachi Energy alone has announced billions in new investment.[29] The most specialized segments such as HVDC cable, large power transformers and high-voltage switchgear should retain pricing power for longest given their long build-out cycles. EPC contractors and installers, like Quanta Services and Mas Tech Inc., capture a complementary slice of the same opportunity.

2.4 The clean energy power generation build-out

In 2025, 692 GW of renewable capacity was added globally, or four times the capacity additions that occurred ten years earlier.[30] This brings total installed renewable capacity to 5,149 GW and renewables accounting for 86% of all new power capacity added globally. From a regional perspective, China dominates as it is adding more renewables capacity annually than the rest of the world combined. Solar energy has remained the primary growth driver, contributing to nearly 75% of total renewable additions in 2025. Wind energy followed with 159GW, bringing the combined share of solar and wind to 97% of all renewable capacity.

Between now and 2030, global renewable capacity is expected to almost double again increasing by 4,600 GW, roughly the equivalent of adding China, the EU and Japan's combined power generation capacity to the global energy mix, with solar PV alone accounting for almost 80% of the increase.[31] This surge reflects the fact that solar and wind are now the cheapest sources of new electricity generation in the world.

A key feature of this investment theme is the breadth of the clean energy build-out: In more than 80% of countries worldwide, renewable power capacity is set to grow faster between 2025 and 2030 than it did over the previous five-year

[27] DWS CIO View (April 2026). Critical minerals – the power factor in commodities
[28] Gardiner (February 2025). Exploring the future of HVDC interconnectors
[29] Securities are provided for reference and should not be treated as investment advice
[30] IRENA (April 2026). Near-700 GW surge in 2025 proves renewable energy resilience
[31] IEA (October 2025). Renewables 2025: Analysis and forecasts to 2030

period.[32] In addition, there are growing corporate commitments towards clean energy such that more than 400 companies from over 150 markets, with a combined annual power demand requirement of over 500 TWh, have committed to 100% renewable power consumption under the RE100 initiative.[33]

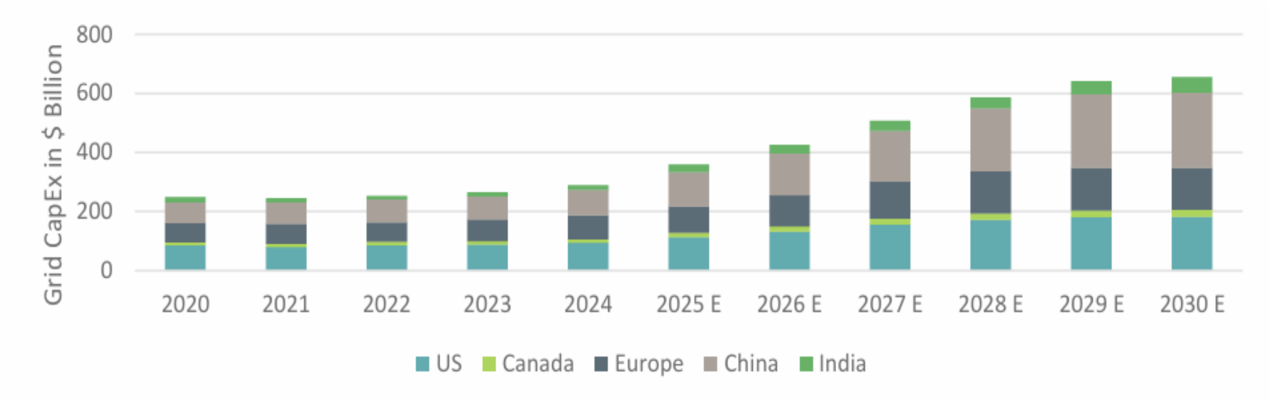
Another part of the clean energy build-out is the nuclear revival. This is being led by China such that it is estimated the country will account for half of all capacity additions to 2050 and its nuclear fleet could overtake that of the U.S. by 2030.[34] In the U.S., small modular reactors (SMRs) are also increasingly filling the power needs of hyperscalers. Globally, SMRs could account for as much as one quarter of new capacity added between now and 2050.[35]

For investors the cleanest exposure may sit with diversified utilities such as NextEra, Iberdrola, Southern Company and Duke Energy that carry multi-year regulated investment plans, and with independent power producers holding nuclear or contracted gas assets near data center developments. Pure-play renewable developers remain part of the opportunity but warrant caution given their cost-of-capital sensitivity. The nuclear revival is investable today through operating fleets and uranium producers; small modular reactors offer longer-dated optionality but, in our view, require patience.

2.5 Transmission and distribution

Transmission and distribution is the connective tissue of the electrification system and one of the most diverse opportunity sets, encompassing physical infrastructure, digital technology, energy services and integrated solutions. While the past decade has seen strong investment in power generation, there has been underinvestment in the infrastructure needed to connect and use it. As a result, grid expansion and modernisation have become binding constraints in many markets. A significant step-up in grid investment is required. The IEA[36] estimates that grid investment needs to double by 2030 to more than USD600 billion per annum, after over a decade of stagnation at a global level, Figure 6. For investors, the critical point is that rising load (EVs, heat, industry, data centres) and rising renewable penetration both increase network capex requirements, while equipment lead times can make the supply response slower than demand.

Figure 6: Grid capital expenditure regional comparison forecast (2020-2030)



Source: Bloomberg LP (January 2026). Forecasts are based on assumptions, estimates, views and hypothetical models or analyses, which might prove inaccurate or incorrect

The most acute pressure point is likely to be data center grid connection lines, with wait times in major U.S. markets now exceeding eight years in some regions. Recent regulatory reform, including FERC's late-2025 order on co-location, is enabling behind-the-meter and co-located generation arrangements. This creates opportunities for independent power producers and for engineering and EPC firms able to deliver integrated grid solutions, even as it modestly dampens the upside for traditional regulated utilities.

[32] IEA (October 2025). Renewables 2025: Analysis and forecasts to 2030
[33] RE100 website
[34] IEA (January 2025). Path to a new era of nuclear energy
[35] IAEA (September 2024). IAEA outlook for nuclear power increases for fourth straight year, adding to global momentum for nuclear expansion
[36] IEA (November 2023). Electricity grids and secure energy transitions

2.6 Risks to the energy value chain build-out

The global energy system is undergoing a fundamental transformation, driving a large-scale buildout across the energy value chain and creating attractive opportunities for investors. However, the pace, sequencing and geographic distribution of this expansion remain uneven. The following risk themes highlight where constraints, concentration and execution challenges may materialize.

- **Permitting and grid connection delays**: Grid build-out is lagging generation and demand growth, with permitting delays and connection queues deferring revenues across the value chain, particularly for renewable energy producers.
- **Processing concentration:** The energy value chain remains structurally dependent on a narrow set of geographies for metals refining and processing capacity. This concentration exposes the value chain to export controls, geopolitical tensions and supply disruptions.
- **Slow adoption rates of electrification for end-use sectors:** While electrification is already scaling across transport and buildings, and digital infrastructure continues to expand rapidly, progress in industry remains slower, with certain segments relying on technologies, such as green hydrogen, that are not yet fully commercially viable.
- **Digital infrastructure:** Across many markets, DC projects face a web of constraints from land and water availability to permitting and access to computer chips. Typically, utility generation or transmission capacity is often viewed as the biggest source of DC project delay[37] followed by permitting issues and fibre availability all of which could slow the pace of the digital revolution.[38]
- **Policy frameworks:** The build-out of the new energy system depends on aligned policy across energy, infrastructure and industry. Policy shifts can delay or reprice investment and increase execution risk. However, clean energy's cost competitiveness and largely policy-independent demand from AI and data centres provide structural support.

[37] Schneider Electric, AlpaStruxure and Data Centre Frontier (April 2025). Before AI, after AI energy crunch survey

[38] For more details see DWS Research Institute (February 2026). Hunger games: The data centre race for power, land and water

3 / Conclusion

Key findings

1. Electricity is becoming the backbone of the global energy system: Electricity is gaining share across transport, buildings, industry and digital infrastructure, with demand increasingly converging on the same power-generation, grid and equipment value chain.
2. Four demand engines are driving the transition at different speeds: Electric vehicles, heat pumps and cooling, industrial electrification, and data centres are all increasing electricity demand, though adoption is fastest in transport, buildings and digital infrastructure, and more uneven in heavy industry.
3. Clean power buildout is enabling electrification, but grids are becoming the binding constraint: Renewable capacity additions are scaling rapidly, yet transmission and distribution infrastructure has not kept pace, creating connection delays and reinforcing the need for higher grid investment.
4. Data centres have become the new marginal load in several power markets: AI and cloud demand are creating concentrated electricity loads that can strain local grids, lengthen connection queues and increase demand for reliability solutions, including co-located generation.
5. The energy transition is increasingly material-intensive: Electrification raises demand for copper, lithium, nickel, cobalt, graphite and rare earths, while long mine-development timelines and concentrated refining capacity create potential supply-side chokepoints.
6. Geopolitics and energy security are reinforcing the electrification theme: The desire to reduce fossil-fuel import dependency and secure critical-material supply chains has elevated electrification from a decarbonisation objective to a strategic industrial-policy priority

Investor implications

1. Focus on bottlenecks, not just headline demand growth: The most attractive opportunities may emerge where capacity is scarce, capital-intensive or difficult to replicate – particularly grids, transformers, high-voltage cables, switchgear, critical minerals and refining.
2. Grid infrastructure is a core investment theme: Utilities, transmission operators, equipment manufacturers and EPC providers may benefit from the need to reinforce, expand and digitise power networks after years of under-investment.
3. Critical minerals require a selective approach: Long-term demand appears structurally supported, but investors should distinguish between upstream mining exposure, midstream processing bottlenecks, geopolitical risk and recycling opportunities.
4. Electrical equipment manufacturers may retain pricing power: Long lead times for transformers, high-voltage cables and substation equipment suggest that specialised suppliers could continue to benefit from strong order books and constrained capacity.
5. Clean-power exposure should favour resilient business models: Diversified utilities, contracted power assets and companies with credible multi-year capex plans may offer cleaner exposure than highly levered renewable pure plays that remain sensitive to financing costs.
6. Data-centre power demand creates opportunities beyond technology stocks: Rising AI-related electricity needs may support investment opportunities in power generation, grid connections, reliability solutions, co-located generation, cables, transformers and engineering services.

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