ENERGY TRANSITION AND ENERGY SECURITY BULLETIN

Issue 3 | July 2026 | Editor: Assoc. Prof. Basak Ozarslan

EDITOR'S NOTE — THE NEW ELECTRICITY AGE

The third issue of the Energy Transition and Energy Security Bulletin turns to a theme that has moved, within little more than a year, from a specialist concern to a defining variable in global electricity markets: the surge in electricity demand from artificial intelligence and data centres, and the strain this is placing on the grids that must deliver it. This issue is a direct continuation of the bulletin's analytical trajectory. Issue 1 (March 2026) established that global electricity demand was rising and that this trend would require the expansion and transformation of generation capacity. Issue 2 (April 2026) identified grid infrastructure as a critical and comparatively underfunded component of the energy transition, noting that transmission and distribution networks absorbed only 19 percent of global clean energy investment. Issue 3 develops both findings into a single, sharply defined story: a new category of electricity demand is now growing faster than the systems built to serve it.

According to the International Energy Agency's Energy and AI report and its subsequent 2026 update, global data centre electricity consumption is estimated at approximately 485 TWh in 2025 and is projected to reach around 945–950 TWh by 2030 — slightly more than Japan's entire current electricity consumption — before continuing to rise toward roughly 1,200 TWh by 2035. The United States and China together account for close to 80 percent of the projected growth to 2030. This is not a marginal or geographically diffuse phenomenon: in Ireland, data centres already account for 23 percent of national metered electricity consumption — more than either urban or rural households taken alone, though still less than the two combined — and EirGrid projects this could approach 30 percent by 2030.

The consequence, as this issue documents, is that the binding constraint on the energy transition is shifting. It is no longer primarily a question of how quickly clean generation can be built, but of how quickly it can be connected, and how reliably it can be supplied on demand. In the United States alone, more generation and storage capacity is currently waiting in interconnection queues — over 2,000 gigawatts — than is installed in the entire national fleet, and the typical wait from application to commercial operation has more than doubled since the early 2000s. In response, technology companies have begun contracting directly for firm, dispatchable clean power, triggering the largest wave of corporate nuclear procurement in the industry's history. This issue also situates Türkiye within this global story, examining how the country's own accelerating electricity demand and rapid capacity expansion intersect with the same structural pressures observed elsewhere.

Three headline figures frame the discussion that follows: global data centre electricity demand is set to reach 945–950 TWh by 2030 under the IEA's Base Case; 2,061 gigawatts of capacity were waiting in U.S. interconnection queues at the end of 2025; and data centres already account for 23 percent of Ireland's metered electricity consumption, the clearest live example of what this demand shock looks like at national scale.

This bulletin aims to contribute to a more informed and evidence-based discussion on these issues, drawing on the most recent available data from the International Energy Agency, Ember, BloombergNEF, the Lawrence Berkeley National Laboratory, and national statistical and grid-operator sources including Ireland's Central Statistics Office, EirGrid, and Türkiye's TEİAŞ. Readers are encouraged to consult Issue 1 (March 2026) for the foundational analysis of global electricity generation and the energy trilemma framework, and Issue 2 (April 2026) for the analysis of clean energy investment and grid infrastructure that this issue directly extends.

Assoc. Prof. Basak Ozarslan
Director, Sustainable Environment and Society Research and Application Center
Istanbul Gelisim University

THE GLOBAL DEMAND SHOCK (2015–2030)

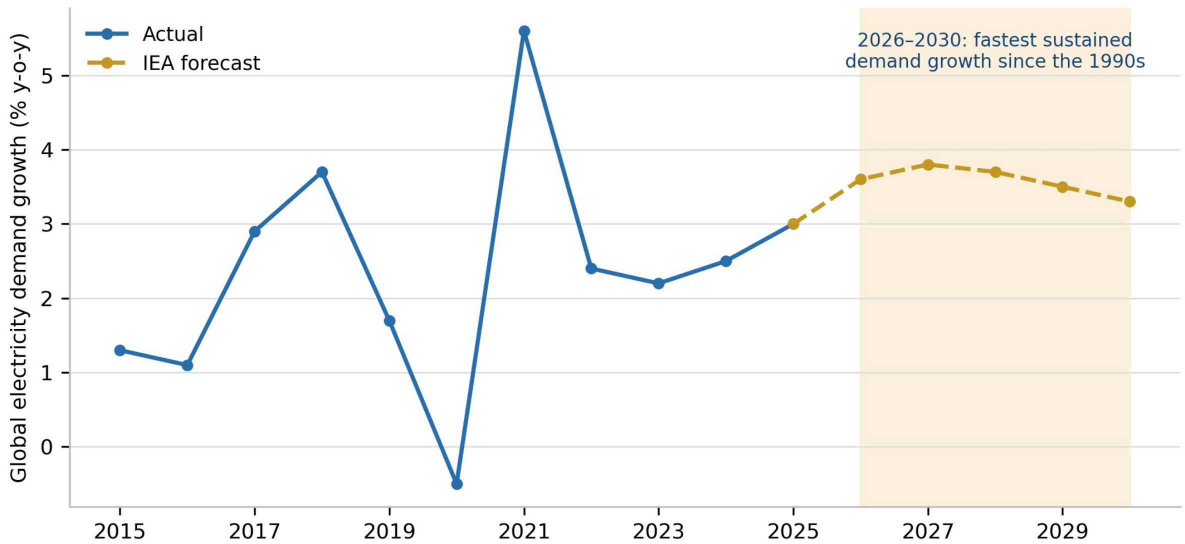

Figure 1. Global electricity demand growth, year-on-year (%), 2015–2030
Source: IEA Electricity 2026; IEA Electricity Mid-Year Update 2026

Figure 1 illustrates the reacceleration of global electricity demand growth after two decades in which, in most advanced economies, demand had grown only slowly or not at all. According to the IEA's mid-2026 update, global electricity demand grew by approximately 3 percent in 2025 and is expected to accelerate to 3.6 percent in 2026 and 3.8 percent in 2027 — among the fastest sustained rates of growth since the 1990s. Critically, the IEA now finds that global electricity demand overtook the pace of underlying economic growth for the first time in roughly three decades in 2024, a reversal of the historical pattern in which electrification of the economy grew in step with, rather than ahead of, GDP.

The sources of this growth are more diverse than in previous cycles. The IEA identifies industry, electric vehicles, air conditioning, and data centres as the principal drivers of new demand, with China and India each expected to see demand growth accelerate sharply in 2026 relative to 2025. Data centres are the newest and, proportionally, the fastest-growing component of this demand — but as later pages in this issue show, their significance lies less in their aggregate share of global electricity consumption, which remains modest, and more in their extreme geographic concentration and their requirement for continuous, high-reliability power.

Key Insights

1

Electricity demand growth has decoupled from its historical pattern

For the first time in about three decades, global electricity demand growth outpaced overall economic growth in 2024, and the acceleration is expected to continue through 2027.

2 **Demand growth is now structurally broad-based**

Industry, EVs, air conditioning, and data centres are all contributing simultaneously, unlike previous cycles driven by a single dominant factor.

3 **This reverses two decades of flat demand in advanced economies**

Countries that had planned for stagnant or slow-growing electricity demand must now revisit capacity and grid plans built on that assumption.

DATA CENTRES BY THE NUMBERS

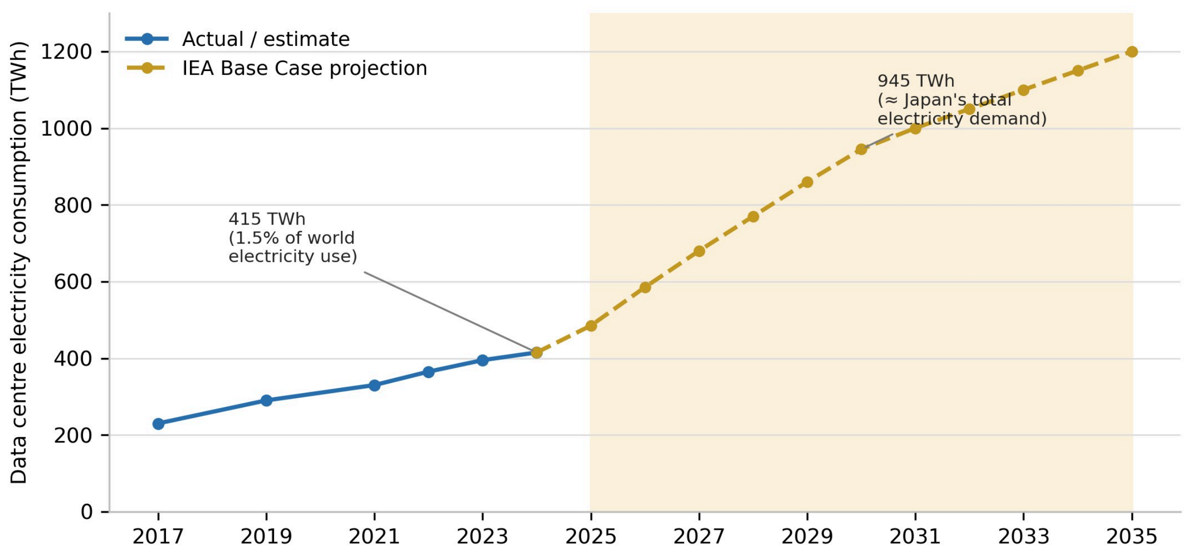

Figure 2. Global data centre electricity consumption, actual and projected, 2017–2035 (TWh)
Source: IEA Energy and AI (2025); IEA Key Questions on Energy and AI (2026 update)

Figure 2 traces the trajectory of global data centre electricity consumption from 2017 through the IEA's Base Case projection to 2035. Data centres consumed approximately 415 TWh of electricity in 2024, equivalent to about 1.5 percent of global electricity use, having grown at roughly 12 percent per year since 2017 — more than four times the growth rate of total global electricity consumption. The IEA's updated 2026 projections put 2025 consumption at approximately 485 TWh, rising to around 945–950 TWh by 2030, a level slightly above Japan's entire current national electricity consumption, and to approximately 1,200 TWh by 2035.

The IEA attributes almost half of the net increase in global data centre electricity consumption between 2024 and 2030 to accelerated servers — the specialised hardware used for AI training and inference — whose electricity consumption is projected to grow by around 30 percent annually, compared with about 9 percent for conventional servers. This distinction matters for policy: AI-specific demand growth is faster, less predictable, and more geographically concentrated than the general growth of cloud computing that preceded it.

Key Insights

1

Data centre demand is set to more than double this decade

From 415 TWh in 2024 to around 945–950 TWh by 2030 — a level comparable to the entire electricity consumption of Japan today.

2

AI-specific demand is growing far faster than the data centre sector overall

Accelerated-server electricity consumption is projected to grow roughly three times faster than conventional server demand through 2030.

3

In global terms, the sector's share remains modest — for now

Even at 945 TWh, data centres would represent only around 3% of global electricity demand in 2030; the challenge is concentration, not aggregate scale.

WHERE THE GROWTH IS CONCENTRATED

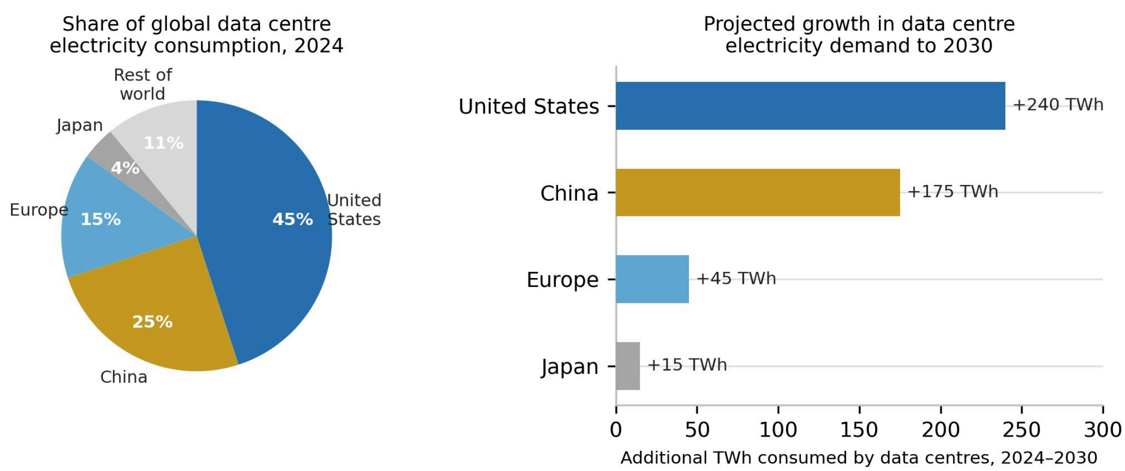

Figure 3. Regional share and projected growth in data centre electricity consumption, 2024–2030
Source: IEA Energy and AI (2025); IEA Energy Demand from AI (2026 update)

Figure 3 shows that data centre electricity demand is not evenly distributed across the global economy. The United States accounted for approximately 45 percent of global data centre electricity consumption in 2024, followed by China at around 25 percent and Europe at approximately 15 percent. Looking forward to 2030, the United States and China together account for nearly 80 percent of projected global growth: U.S. data centre electricity consumption is projected to rise by around 240 TWh (up 130 percent on 2024 levels), while China's rises by approximately 175 TWh (up 170 percent). By the end of the decade, the IEA projects that the United States will consume more electricity for data centres than for the combined production of aluminium, steel, cement, chemicals, and all other energy-intensive goods.

This concentration compounds a further structural feature of AI infrastructure: unlike traditional energy-intensive industries, which are often geographically dispersed, AI-optimised data centre capacity clusters heavily around a small number of regional hubs — nearly half of current U.S. data centre capacity sits within just five regional clusters — meaning the local grid and community impact of this growth is far more acute than national averages suggest.

Key Insights

1 **The U.S. and China will drive nearly 80% of global growth to 2030**
Europe and Japan see meaningful but comparatively modest absolute growth over the same period.

2 **By 2030, U.S. data centres could out-consume its entire heavy industry sector**
More electricity for data centres than for aluminium, steel, cement, and chemicals combined — a striking reallocation of industrial-scale demand.

3 **Demand is hyper-concentrated at the local level**
Nearly half of U.S. data centre capacity sits in just five regional clusters, magnifying local grid strain well beyond what national figures suggest.

THE GRID QUEUE CRISIS

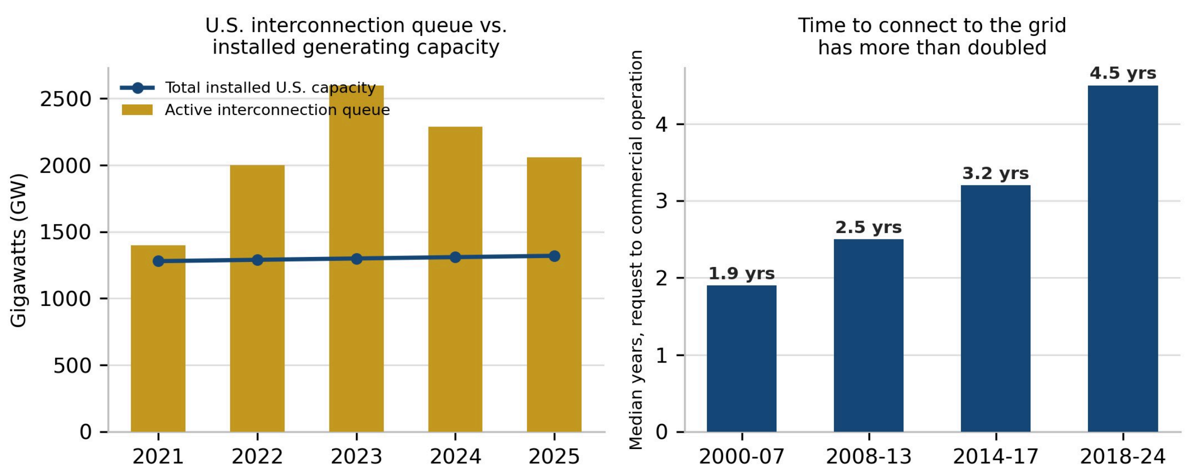

Figure 4. U.S. interconnection queue capacity vs. installed capacity, and time to connect, by period
Source: Lawrence Berkeley National Laboratory, "Queued Up" (2024, 2025, 2026 editions)

Figure 4 extends the grid-bottleneck finding introduced in Issue 2, where grid infrastructure was shown to absorb only 19 percent of global clean energy investment despite emerging as a critical constraint. New data from Lawrence Berkeley National Laboratory shows the scale of that constraint in the United States: as of the end of 2025, approximately 2,061 gigawatts of generation and storage capacity were actively seeking grid interconnection — down from a peak of roughly 2,600 GW in 2023, but still comfortably exceeding the entirety of installed U.S. generating capacity. The typical project reaching commercial operation now spends more than four years in the interconnection queue, more than double the waiting time recorded for projects built in the 2000s.

The recent decline in queue volume reflects record project withdrawals — over 750 GW withdrew from queues in 2025 alone — rather than a resolution of the underlying bottleneck; withdrawals were concentrated among speculative or under-financed projects, while natural gas capacity in the queue rose sharply as developers sought firmer, faster-to-permit alternatives to intermittent renewables in markets facing acute, near-term load growth from data centres.

Key Insights

1 **More capacity is waiting to connect than is currently operating**
At 2,061 GW, the active U.S. interconnection queue still exceeds total installed national generating capacity.

2 **Connection times have more than doubled since the 2000s**
The median project now takes over four years from application to commercial operation, up from under two years two decades ago.

3 **Urgency is shifting developers toward gas, not away from the queue**
Active natural gas capacity in the queue rose sharply in 2025 as data-centre-driven urgency favoured faster, firmer generation options.

POWERING THE HYPERSCALERS: THE NUCLEAR PROCUREMENT WAVE

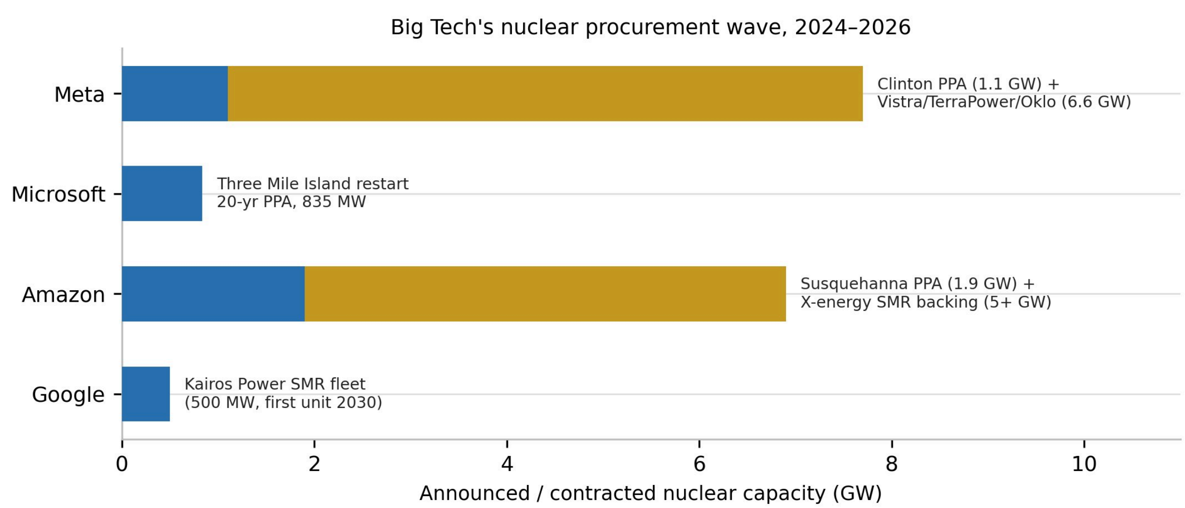

Figure 5. Announced or contracted nuclear capacity secured by major technology companies, 2024–2026
Source: Company disclosures as reported by Reuters, Financial Times, and industry trade press

Facing grid connection delays measured in years and a requirement for continuous, carbon-free power, leading technology companies have turned to nuclear energy at a scale without recent precedent. Microsoft signed a 20-year power purchase agreement with Constellation Energy to restart the 835-megawatt Three Mile Island Unit 1 reactor — the first major U.S. nuclear restart in decades — with output dedicated to its AI infrastructure. Amazon secured a long-term agreement for 1.9 GW of output from the Susquehanna nuclear plant and has separately backed the development of new small modular reactor (SMR) capacity with X-energy. Google became the first technology company to directly commission new nuclear capacity, ordering a fleet of small modular reactors from Kairos Power with a first unit expected online by 2030. Meta has combined a power purchase agreement for an existing Illinois nuclear plant with separate agreements targeting up to 6.6 gigawatts of additional nuclear and clean capacity by 2035.

Collectively, these four companies' commitments amount to more than 10 gigawatts of contracted or targeted nuclear capacity announced over roughly two years — a volume that, cumulatively, approaches the scale of a mid-sized national nuclear fleet, procured not by utilities or governments but by four private technology companies seeking firm, round-the-clock power.

Key Insights

1 **A single-customer model is reshaping nuclear economics**
Corporate PPAs, rather than utility procurement, are now driving nuclear restarts and new SMR orders in the United States.

2 **Big Tech has become the industry's largest new nuclear buyer**
Four companies have collectively announced or targeted more than 10 GW of nuclear capacity since late 2024.

3 **SMR deployment timelines remain the key uncertainty**
Most new small modular reactor capacity is not expected online before 2030, leaving a multi-year gap that gas and existing nuclear assets are filling in the interim.

CASE STUDY: IRELAND'S GRID UNDER STRAIN

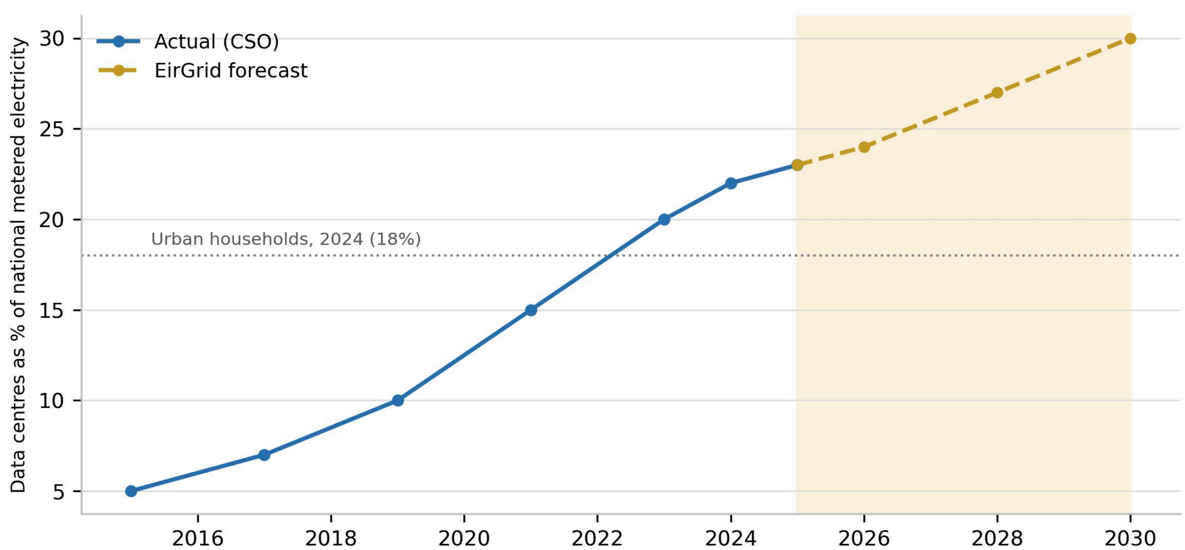

Figure 6. Data centres as a share of Ireland's total metered electricity consumption, 2015–2030
Source: Central Statistics Office of Ireland (2026); EirGrid forecasts

Ireland offers the clearest illustration available today of what unconstrained data centre growth can mean for a national grid. According to Ireland's Central Statistics Office, data centres accounted for 23 percent of the country's total metered electricity consumption in 2025, up from 22 percent in 2024 and just 5 percent in 2015 — a near-fivefold increase in relative share over a decade. That 23 percent share already exceeds either urban households (18 percent) or rural households (9 percent) taken individually, although combined residential consumption (27–28 percent) still remains somewhat higher than the data centre share. EirGrid, the national transmission system operator, projects that data centres and other large new energy users could account for as much as 30 percent of total electricity demand by the early 2030s.

This growth has already produced concrete policy responses. Ireland's energy regulator introduced a new connection policy requiring large data centres to source at least 80 percent of their annual energy demand from new renewable projects they help to develop, while also requiring some to provide generation or storage capacity back to the grid. Development in the Dublin area, where grid capacity is most constrained, was effectively paused for new large-scale projects for much of 2025 before the regulator lifted the de facto moratorium in December 2025 under the new framework. Ireland's experience is not an isolated case; it is a preview of pressures now emerging in Virginia, the Netherlands, and Singapore.

Key Insights

1 **Data centres now outconsume either urban or rural households on their own**

At 23% of national electricity use in 2025, data centres exceed urban households (18%) and rural households (9%) individually, though combined residential consumption (27–28%) remains somewhat higher.

2 **The share has grown nearly fivefold in a decade**

From 5% in 2015 to 23% in 2025, with EirGrid projecting up to 30% by the early 2030s.

3 **Regulation is shifting the burden back onto developers**

New rules require large data centres to fund and connect their own renewable supply, and in some cases return power to the grid.

THE TÜRKİYE ANGLE: A NEW DEMAND LAYER

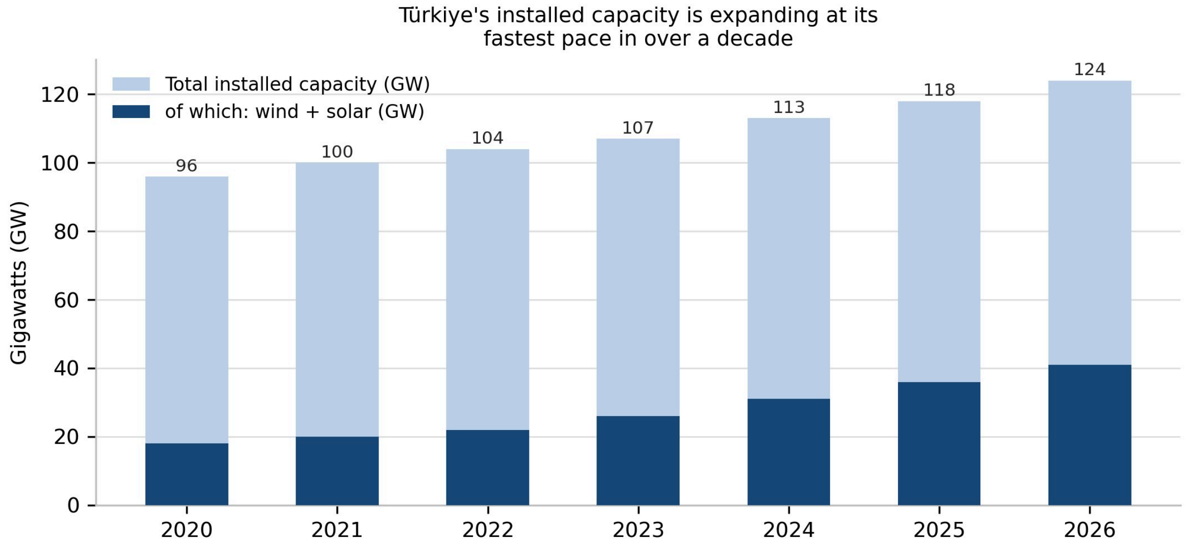

Figure 7. Türkiye's total installed electricity generation capacity and wind + solar capacity, 2020–2026 (GW)
Source: TEİAŞ / Ministry of Energy and Natural Resources; ICCI Türkiye Energy Outlook 2026

Türkiye's electricity system is expanding at its fastest pace in more than a decade, reaching an estimated 123–126 GW of total installed capacity by 2026, of which wind and solar together now exceed 40 GW — up from under 18 GW in 2020. This buildout is occurring against the backdrop of the same structural demand pressures documented globally in this issue: Issue 1 of this bulletin already showed Türkiye's electricity consumption per capita nearly doubling between 2000 and 2024, and national electricity demand continues to track among the strongest in the OECD. Türkiye's storage-connected project pipeline has separately surpassed 30 GW, reflecting early efforts to manage the variability that a rapidly growing renewable share introduces into the system.

Türkiye is also positioning itself as a prospective regional hub for digital infrastructure, citing its transcontinental connectivity, developing renewable base, and strategic location between European and Middle Eastern data markets. Should this ambition materialise at scale, it would add a new, concentrated demand layer of the kind already reshaping grid planning in Ireland and the United States — reinforcing the case, made in Issue 2, for accelerating investment in transmission capacity ahead of, rather than in response to, demand growth.

Key Insights

1 **Türkiye's capacity buildout is the fastest in over a decade**
Installed capacity has grown from roughly 96 GW in 2020 to an estimated 123–126 GW in 2026, with wind and solar more than doubling their share.

2 **A storage market is emerging alongside renewable growth**
Storage-connected project pipelines have surpassed 30 GW, an early domestic response to rising variability in the generation mix.

3 **Digital infrastructure ambitions could add a new demand layer**
If Türkiye's data centre ambitions materialise at scale, grid and generation planning will need to anticipate this demand rather than react to it.

POLICY AND INVESTMENT RESPONSES

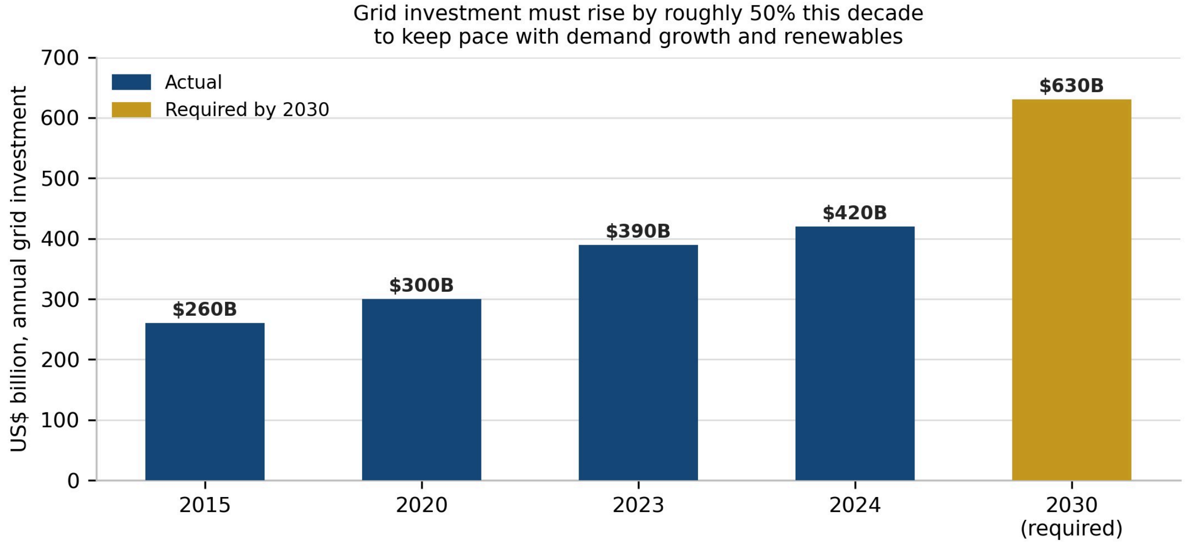

Figure 8. Global grid investment, actual (2015–2024) and required annual level by 2030 (US$ billion)
Source: IEA World Energy Investment (2025); IEA Electricity Grids and Secure Energy Transitions (updated 2025)

Governments and regulators are beginning to treat grid capacity with the strategic urgency once reserved almost exclusively for generation. The IEA estimates that global grid investment needs to rise by roughly 50 percent this decade — from around $400–420 billion annually in the mid-2020s to over $600 billion per year by 2030 — simply to keep pace with electrification, renewable integration, and new large-load demand from data centres and industry. In the United States, several regional grid operators and federal regulators have introduced expedited or "fast-track" interconnection pathways for large flexible loads willing to curtail consumption during system stress, while the European Union's Grid Action Plan seeks to accelerate permitting and mobilise financing for cross-border transmission expansion.

Despite this momentum, the scale of the required response continues to outstrip current delivery — a pattern consistent with the "structurally insufficient" investment gap this bulletin identified with respect to clean energy financing in Issue 2. Permitting reform, in particular, remains politically and administratively difficult, and most grid reinforcement projects still take years longer to complete than the generation or demand growth they are intended to accommodate.

Key Insights

1 **Grid investment must rise by around 50% this decade**
From roughly $420 billion annually today to over $600 billion by 2030, according to IEA estimates.

2 **Flexible-load and fast-track programmes are an emerging tool**

Regulators are increasingly offering faster grid connection to large consumers willing to curtail demand at peak stress moments.

3 **Delivery still lags the scale of the challenge**

As with clean energy investment in Issue 2, the direction of travel is positive, but the pace remains structurally behind what is required.

SYNTHESIS: THE TRILEMMA UNDER A NEW KIND OF PRESSURE

The evidence assembled in this issue shows that the AI- and data-centre-driven demand surge is testing all three dimensions of the energy trilemma introduced in Issue 1 simultaneously, rather than sequentially. On energy security, new large, concentrated loads are straining grid reliability in specific regions even as national supply adequacy remains intact — a form of localised security risk distinct from the import-dependency risk examined in Issue 2. On affordability, rising system costs associated with grid reinforcement and, in some markets, the use of new gas capacity to meet urgent demand, raise the question of who ultimately bears the cost of serving this new class of consumer. On environmental sustainability, the picture is genuinely double-edged: data centre operators are among the world's largest corporate purchasers of both renewable power and, increasingly, nuclear capacity, yet near-term supply gaps are in places being filled by additional natural gas and, in some regions, coal-fired generation.

Taken together with Issues 1 and 2, this bulletin's first three issues now form a coherent analytical arc: from the description of a transforming global electricity system, to the quantification of its investment and security trade-offs, to the identification of the specific new demand shock now testing the system's physical limits. The next issue in this series will build on the grid and flexibility themes introduced here to examine how battery and long-duration storage economics are evolving to help resolve the intermittency and reliability challenges this issue has documented.

DATA SOURCES

DATA SOURCES

[1] IEA (2025). Energy and AI. IEA, Paris. https://www.iea.org/reports/energy-and-ai
[2] IEA (2026). Key Questions on Energy and AI, executive summary update. https://www.iea.org/reports/key-questions-on-energy-and-ai
[3] IEA (2026). Electricity 2026 — Analysis and Forecast. https://www.iea.org/reports/electricity-2026
[4] IEA. Electricity Mid-Year Update 2026. https://www.iea.org
[5] IEA. Electricity Grids and Secure Energy Transitions (updated 2025). https://www.iea.org/reports/electricity-grids-and-secure-energy-transitions
[6] IEA (2025). World Energy Investment 2025. https://www.iea.org/reports/world-energy-investment-2025
[7] Lawrence Berkeley National Laboratory. Queued Up, 2024, 2025 and 2026 editions. https://emp.lbl.gov/queues
[8] Central Statistics Office of Ireland (2025, 2026). Data Centres Metered Electricity Consumption.
[9] EirGrid. Generation capacity and demand forecasts.
[10] TEİAŞ (Türkiye Elektrik İletim A.Ş.). Installed capacity and generation-consumption statistics.
[11] ICCI — International Energy and Environment Exhibition and Conference (2026). Türkiye Energy Outlook.

[12] Company disclosures: Microsoft/Constellation Energy; Amazon/Talen Energy/X-energy; Google/Kairos Power; Meta/Constellation Energy, Vistra, TerraPower, Oklo.

NEWS SOURCES

[–] Reuters — Energy & Commodities
[–] Financial Times — Energy
[–] Carbon Brief
[–] Data Centre Dynamics
[–] Central Statistics Office / RTÉ / Irish Examiner (Ireland data centre coverage)

Istanbul Gelisim University — Sustainable Environment and Society Research and Application Center