FEATURE ARTICLE:

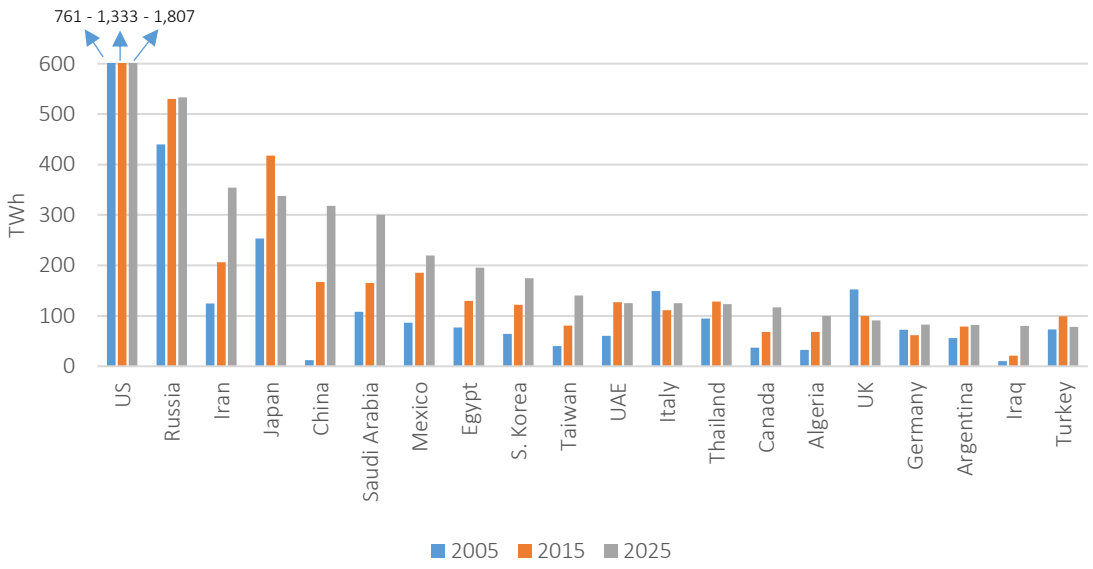
Gas-fired power generation as a growing cornerstone of modern power systems

Global electricity demand continues to increase steadily, driven by population growth, economic expansion, urbanization, electrification, and digitalization. As a result, electricity's share of global final energy consumption has risen from 18% a decade ago to 21% today, reflecting its growing importance across all sectors of the economy and its emergence as the preferred energy carrier. In response to this rising demand, global electricity generation increased by 2.8% in 2025 to a record 31,740 TWh, underscoring the central role of electricity in supporting socioeconomic development, technological advancement, and increasingly integrated energy systems worldwide.

Against this backdrop, natural gas remains a pivotal component of power systems worldwide. Gas-fired electricity generation increased from 6,880 TWh in 2024 to 6,900 TWh in 2025, enabling natural gas to maintain its position as the world's second-largest source of electricity generation with a 22% share of total output, behind only coal at 33%. At the same time, renewables continued their rapid expansion. Solar power recorded the largest increase among all generation sources, growing by 30%, or 630 TWh, to reach 2,750 TWh, while wind generation rose by 8%, or 200 TWh, to 2,710 TWh. Despite this record growth, non-hydro renewables collectively accounted for only 17% of global electricity generation in 2025, up from 15% in 2024. Hydropower and nuclear energy contributed a further 14% and 9%, respectively.

Over the longer term, gas-fired power generation has demonstrated sustained growth, increasing from 3,681 TWh in 2005, equivalent to 20% of global electricity output, to 5,540 TWh in 2015 and 6,900 TWh in 2025. Between 2005 and 2025, the largest absolute increases in gas-fired generation were recorded in the US (+1,046 TWh; from 761 TWh to 1,807 TWh), China (+306 TWh), Iran (+229 TWh), Saudi Arabia (+192 TWh), Egypt (+119 TWh), South Korea (+111 TWh), and Russia (+93 TWh) (Figure i). The US alone accounted for one-third of global growth in gas-fired electricity generation during this period, driven by abundant shale gas supplies and extensive coal-to-gas switching.

Figure i: Trend in gas-fired electricity generation by country, 2005 – 2025



Source: GECF Secretariat based on data from Ember and the Energy Institute Statistical Review of World Energy

Amid this sustained growth, the US, Russia, Iran, Japan, and China rank among the world's largest producers of gas-fired electricity. Generation remains highly concentrated geographically: although 116 countries generate electricity from natural gas, the top 10 producers account for 63% of global gas-fired power output. At the other end of the spectrum, 23 countries each generate less than 1 TWh annually. Notably, while China's gas-fired generation remains below that of the EU as a whole (318 TWh compared with 465 TWh), it exceeds the combined gas-fired output of the EU's four largest gas-fired generators: Italy, Germany, Spain, and the Netherlands.

The role of natural gas in national electricity systems varies considerably, reflecting differences in resource availability, energy policies, market structures, and power sector development. The world's top 10 gas-fired power generators can be broadly grouped into three categories based on the share of natural gas in their electricity mix. The first group exhibits high dependence on natural gas, with gas accounting for more than 60% of electricity generation, including Iran (90%), Egypt (80%), Saudi Arabia (63%), and Mexico (62%). The second group demonstrates moderate reliance, with gas shares ranging from 30% to 60%, including Taiwan (49%), Russia (45%), the US (40%), and Japan (33%). The third group comprises countries where natural gas plays a more limited role, accounting for less than 30% of electricity generation, notably South Korea (28%) and China (3%).

Looking ahead, while traditional drivers such as economic and industrial growth will continue to support rising electricity demand, emerging structural trends are expected to underpin the expansion of gas-fired power generation, including its role in backing up variable renewable energy and meeting growing electricity needs from data centers and space cooling.

Amid expanding wind and solar capacity in some regions, the role of natural gas in power systems is evolving from a primarily baseload function toward an increasingly important dispatchable role that facilitates renewable energy integration. As weather-dependent renewables increase variability in electricity supply, system operators face growing challenges in balancing generation and demand across time horizons. Gas-fired generation helps manage low wind and solar output, particularly during peak demand, while providing flexibility to respond quickly to changing system conditions. Its fast-ramping capability and ability to sustain output over extended periods make it well suited to supporting grid reliability during short-term imbalances and system stress.

The rapid expansion of global data centers, particularly those optimized for AI, has emerged as a major driver of rising electricity demand. According to the IEA, global data center electricity consumption reached 485 TWh in 2025, representing a 17% y-o-y increase, far exceeding the 2.8% rise in overall global electricity demand. Within this total, electricity use by AI-focused data centers expanded even more rapidly, surging by 50% in 2025. Looking ahead, demand from data centers is expected to continue rising, with global electricity consumption projected to double to 950 TWh by 2030. Data centers require a reliable, large-scale electricity supply, as they cannot tolerate interruptions or fluctuations. In this context, gas-fired generation has emerged as one of the most suitable power sources for supporting digital infrastructure growth. Unlike renewable energy sources, whose output depends on weather conditions, gas-fired power plants provide reliable baseload electricity. The widespread availability of natural gas infrastructure and shorter construction timelines further enhance its attractiveness. As a result, gas-fired generation is expected to play a major role in meeting rising data center electricity demand. In the US, the world's largest data center market, natural gas is projected to supply 60% of the additional power required for data center expansion through the end of the decade.

Climate change, manifested through more frequent, intense, and prolonged heatwaves, together with rising living standards, is driving an unprecedented surge in space cooling demand, making it one of the fastest-growing segments of global electricity consumption. According to IEA estimates, electricity consumption for space cooling reached around 2,400 TWh in 2025, accounting for about 8% of global electricity demand, and is projected to exceed 3,000 TWh by 2030. Today, around 3.5 billion people live in tropical regions, yet fewer than 15% of households own an air conditioner, with ownership expected to rise significantly as incomes increase across Asia and Africa. Cooling loads are concentrated during periods of extreme heat, increasing demand for dispatchable and fast-ramping electricity. Against this backdrop, gas-fired generation is emerging as a key source of system flexibility for highly seasonal and weather-dependent cooling demand, responding to short-term demand spikes and multi-day heatwaves.

Moreover, the upcoming El Niño event, with the World Meteorological Organization indicating a 90% probability that El Niño conditions will persist and intensify through the 2026 summer, is expected to contribute to elevated global temperatures and drive cooling demand to exceptionally high levels, placing significant stress on electricity systems. At the same time, persistent heat domes can reduce wind speeds and increase cloud cover, lowering wind and solar generation, while associated drought conditions may reduce inflows to major hydropower reservoirs across Asia and South America. In this context, natural gas is expected to play an important role as a dispatchable energy source, with its fast-ramping capability helping to compensate for renewable generation shortfalls and support grid reliability during periods of extreme heat.

To support these emerging structural trends, many countries are positioning gas-fired power generation as a cornerstone of their long-term energy strategies, given its high efficiency, operational flexibility, and lower emissions compared with oil- and coal-fired generation. This is reflected in the substantial global pipeline of gas-fired capacity under development, including projects at the construction, pre-construction, and announcement stages. Globally, the pipeline totals 930 GW, of which more than 500 GW is expected to be commissioned by 2030, supplementing nearly 2,000 GW of existing operating capacity (Figure ii).

Figure ii: Global gas-fired power capacity expansion outlook, 2026–2030

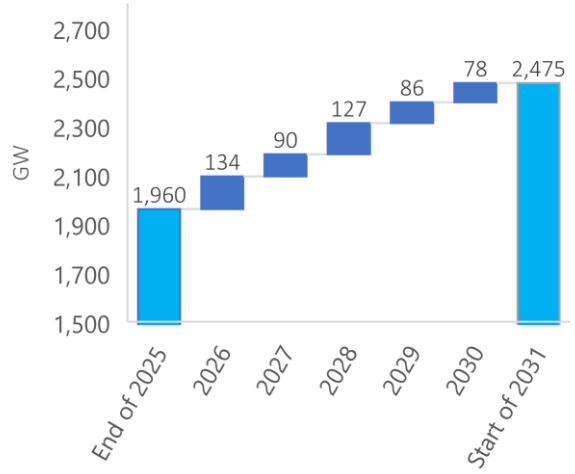
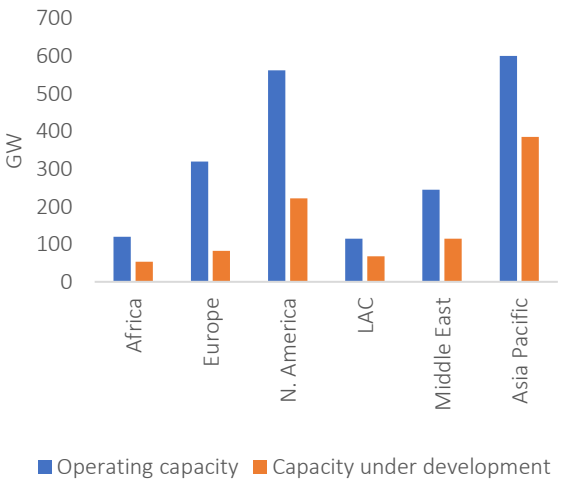


Figure iii: Regional distribution of operating and under-development gas-fired power capacity



Source: GECF Secretariat based on data from Global Energy Monitor

Regionally, Asia Pacific is the world's largest gas-fired power market, with 600 GW of operating capacity and 385 GW under development, reflecting strong electricity demand growth driven by industrialization and economic expansion (Figure iii). North America follows with 560 GW of operating capacity and 220 GW under development, supported by rising demand from data centers. Europe ranks third; however, excluding Russia, it has only 210 GW of operating capacity and 65 GW under development. At the national level, the largest development pipelines are concentrated in the US (210 GW), China (150 GW), Vietnam (55 GW), and Saudi Arabia (30 GW), underscoring the growing role of gas-fired generation across both mature and emerging power markets.

The expansion of gas-fired generation faces some structural challenges across the value chain, spanning equipment manufacturing, natural gas affordability, and grid infrastructure adequacy.

The critical challenge for expanding gas-fired generation capacity lies in scaling gas turbine manufacturing fast enough to support the construction of new power plants. Strong demand for gas turbines has resulted in a cumulative global order backlog exceeding 110 GW, against an annual manufacturing capacity of only 60–70 GW. This imbalance has created a multi-year delivery queue, extending commissioning timelines and requiring developers to adopt longer-term planning horizons. In response, manufacturers are investing in capacity expansions, optimizing production lines, and strengthening supply chain coordination to increase throughput.

Another key challenge relates to the affordability of natural gas. This is particularly important given that, among the top 20 gas-fired generating countries, six are net gas exporters, one is not involved in global gas trade, and the remaining 13 are net importers, leaving most systems exposed to international price volatility and import availability. In this context, the 2026 blockade of the Strait of Hormuz temporarily weakened the competitiveness of natural gas, although the subsequent easing of tensions is expected to support a normalization of spot gas prices and a recovery in gas-fired generation across multiple regions, particularly in Asia.

A further constraint is the need to expand and modernize electricity grid infrastructure. While new gas-fired power plants can often be developed relatively quickly, their integration depends on sufficient transmission and distribution capacity to deliver electricity reliably to consumers. In many countries, aging and underinvested grid networks have become a major bottleneck, requiring extensive upgrades, reinforcement, and expansion. Such projects are typically capital-intensive and time-consuming, involving lengthy permitting procedures, land acquisition challenges, and complex construction requirements. As electricity demand continues to grow and power systems become increasingly interconnected, grid expansion and modernization will remain essential prerequisites for realizing the full potential of new gas-fired generation capacity.

Despite these challenges, gas-fired generation is reinforcing its role as a reliable source of baseload electricity across a wide range of demand segments, including data centers and space cooling. It is also strengthening its role as a key dispatchable resource for integrating variable renewable output and supporting electricity system balance. In addition, it plays a critical role in ensuring system adequacy during peak demand periods, when the margin between supply and demand tightens, and in providing firm capacity to maintain reliability under constrained operating conditions.