

FEATURE ARTICLE

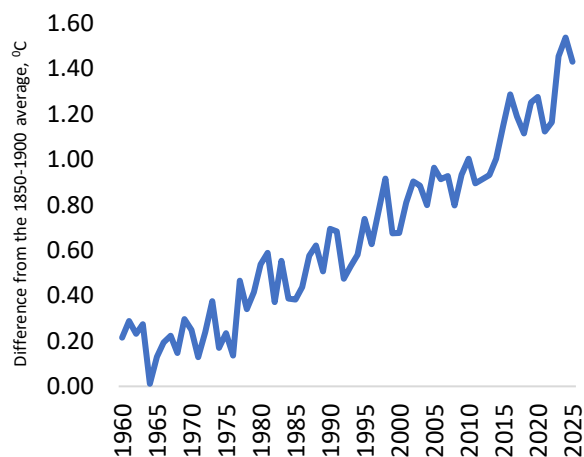
Rising cooling demand increases the need for gas-fired power generation

Intensifying climate change is driving a sustained rise in global temperatures and increasing the frequency and intensity of heatwaves across many regions. According to the World Meteorological Organization (WMO), the global average temperature in 2025 was around 1.43°C above the 1850–1900 pre-industrial average, making 2025 one of the three warmest years on record (Figure i). This long-term warming trend can be periodically amplified by El Niño events, which can bring unusually high temperatures to many parts of the world and exacerbate periods of extreme heat. Greater and more prolonged heat exposure is driving higher demand for air conditioning and placing additional pressure on electricity systems. As Singapore’s former Prime Minister Lee Kuan Yew once observed, air conditioning was “a most important invention” and one that helped make development possible in the tropics. Today, this observation is increasingly relevant as reliable cooling becomes essential not only for comfort, but also for protecting health and supporting economic activity.

A useful indicator of weather-driven cooling requirements is cooling degree days (CDD), which measure the cumulative extent to which outdoor temperatures exceed a specified reference temperature associated with the need for cooling. Higher CDD values reflect warmer conditions over longer periods and therefore indicate greater cooling requirements for buildings and other spaces. As temperatures rise and extreme heat becomes more frequent and prolonged, CDD values generally increase over time, particularly in already warm and densely populated climates. This can translate into greater use of air conditioning and higher electricity consumption during hot periods.

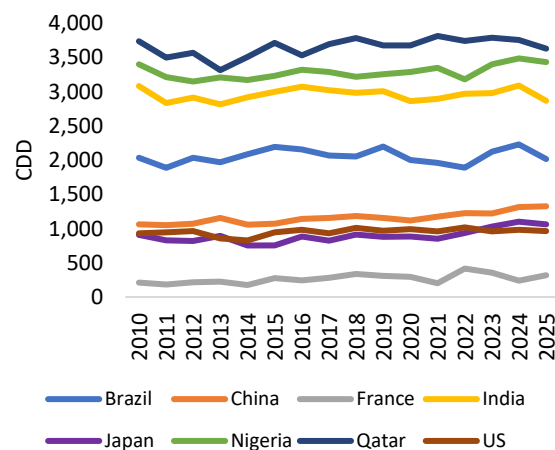
The evolution of CDD, calculated using a reference temperature of 18°C, in selected countries representing different regions between 2010 and 2025 illustrates differences in cooling needs and year-to-year weather variability (Figure ii). While annual CDD values can fluctuate considerably, many countries show an upward trend over the longer term, consistent with rising temperatures and more frequent periods of extreme heat. The highest CDD levels are generally observed in hot regions such as the Middle East, Sub-Saharan Africa, and South and Southeast Asia, where high temperatures create substantial and persistent cooling needs. By contrast, CDD levels are generally lower across Europe, but extreme heat can still sharply increase cooling needs, posing additional challenges given the relatively low air-conditioning penetration in many European countries overall.

Figure i: Global mean temperature anomaly, 1950–2025



Source: GECF Secretariat based on data from WMO

Figure ii: CDDs in selected countries in 2010-2025



Source: GECF Secretariat based on data from Copernicus and IEA

Yet access to cooling remains highly uneven, with the regions facing some of the greatest cooling needs often having the most limited access to air conditioning. The gap is particularly pronounced across the Global South, where limited electricity access, high electricity costs and persistent energy poverty constrain the ability of households to use air conditioning despite exposure to severe and prolonged heat. As a result, many people in some of the world's hottest regions remain without adequate protection from extreme heat and its associated health risks. At the same time, the consequences of extreme heat are becoming increasingly evident even in regions with much higher levels of cooling access. Europe, for example, experienced severe heatwaves in summer 2026, with prolonged periods of exceptionally high temperatures contributing to a substantial number of heat-related deaths. These developments underscore the importance of reliable access to cooling as a means of protecting public health and enhancing resilience to extreme heat.

The scale of the challenge is reflected in the still-low penetration of air conditioning across many hot and rapidly growing markets. Around 3.5 billion people live in hot climates worldwide, yet only about 15% have access to an air conditioner, indicating substantial scope for expanding cooling access. Significant potential is concentrated in populous emerging markets across South and Southeast Asia, Sub-Saharan Africa and Latin America and the Caribbean, where exposure to high temperatures remains widespread while ownership of air conditioners is relatively low. Air-conditioner ownership is estimated at 15% of households in India, compared with 30% in Southeast Asia, 5% in Sub-Saharan Africa and 20% in Latin America and the Caribbean. The combination of large populations, high temperatures and low air-conditioning penetration therefore points to substantial unmet demand for cooling. As access to air conditioning expands, this demand will increasingly translate into higher electricity consumption and greater peak power requirements, especially during extreme heat.

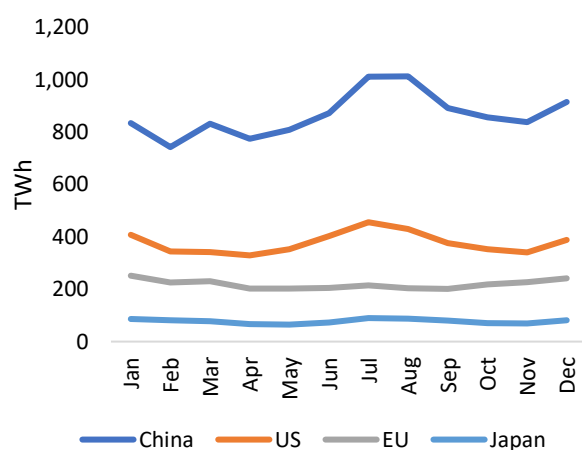
Demographic growth is further expanding the potential need for cooling, particularly in regions already exposed to high temperatures. The world's population rose from 6.1 billion in 2000 to 8.2 billion in 2025 and, according to the United Nations, is projected to reach 9.6 billion by 2050. This growth is increasingly concentrated in Africa and Asia: Africa's population increased from 0.8 billion in 2000 to 1.5 billion in 2025 and is expected to reach 2.5 billion by 2050, while Asia's population rose from 3.7 billion to 4.8 billion over the same period and is projected to reach 5.3 billion in 2050. Population growth in these regions is therefore increasing the number of people exposed to high temperatures and, consequently, the potential need for cooling, particularly across their warmer and rapidly growing areas. Moreover, continued urbanisation is reinforcing this trend, with the global urbanisation rate rising from 47% in 2000 to 57% in 2025. The concentration of population, buildings and economic activity in cities, combined with the urban heat-island effect, can further increase cooling requirements and intensify electricity demand during periods of high temperatures.

On the positive side, rising incomes are contributing to improved living standards and enabling more households to meet this growing demand for cooling. Economic growth has increased GDP per capita, supporting higher household incomes and purchasing power across many regions of the world. According to the World Bank, between 2000 and 2025, GDP per capita in PPP (current international \$) increased from \$8,000 to \$25,700 globally, from \$35,600 to \$87,500 in North America, from \$22,100 to \$65,500 in the EU, from \$5,800 to \$25,000 in East Asia and Pacific, and from \$2,300 to \$5,800 in Sub-Saharan Africa. Higher incomes allow more households to afford air-conditioning equipment and the electricity needed to operate it, particularly in warmer regions where cooling requirements are greater. As living standards improve further, wider adoption of air conditioning can help address currently unmet cooling needs, particularly in emerging and developing markets, and become an increasingly important driver of electricity demand.

Global electricity consumption for space cooling, driven predominantly by air conditioning, reached 2,900 TWh in 2025, accounting for 10% of electricity demand, according to the International Energy Agency (IEA). Cooling demand is increasing across residential, commercial and industrial sectors, driven by rising air-conditioning ownership in households, expanding commercial buildings such as offices and shops, and cooling needs in factories for both air conditioning and industrial processes.

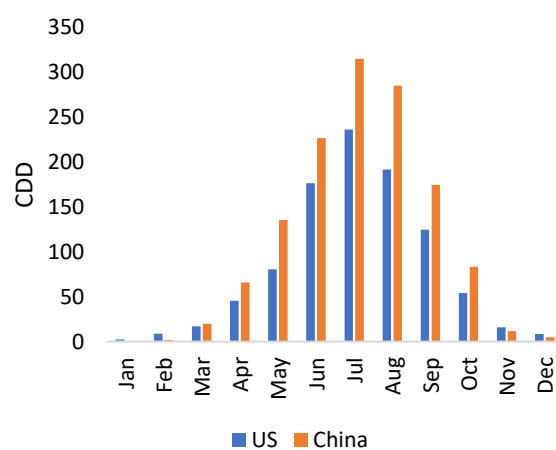
The impact of cooling demand on power systems is disproportionately large because cooling needs are concentrated during hot periods and often coincide across large areas, contributing to pronounced increases in electricity demand during summer months. This seasonal pattern is evident in major electricity markets, where higher cooling demand during the summer contributes to substantial increases in electricity generation. From April 2025 to July 2025, electricity generation increased from 775 to 1,012 TWh in China, from 329 to 456 TWh in the US, from 202 to 215 TWh in the EU and from 66 to 90 TWh in Japan, reflecting differences in climate patterns and air-conditioner penetration (Figure iii). The relationship is particularly clear in China and the US, the world's two largest electricity markets, where CDD values peak in July and air-conditioner ownership reaches 80% and 90%, respectively (Figure iv). As cooling demand becomes increasingly concentrated during hot periods, space cooling is an important driver of peak-load requirements, placing additional pressure on power-system flexibility and reliability. During periods of peak demand in 2025, space cooling accounted for around 30% of total global peak electricity demand, with cooling systems collectively drawing 1,400 GW from power grids.

Figure iii: Electricity output in selected countries in 2025



Source: GECF Secretariat based on data from Ember

Figure iv: CDDs in US and China in 2025



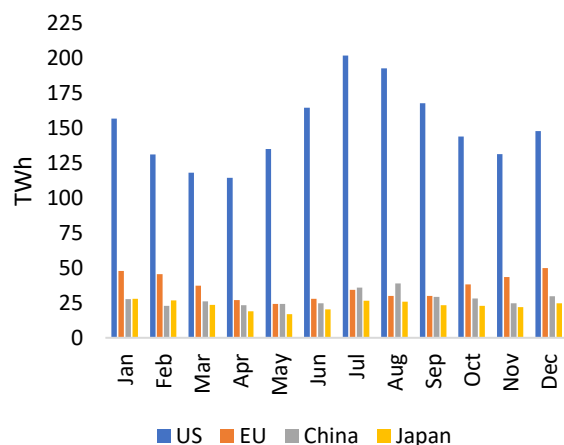
Source: GECF Secretariat based on data from Copernicus and IEA

The seasonal and weather-dependent nature of cooling demand increases the need for dispatchable generation capable of responding rapidly to peak demand, presenting challenges for several major generation technologies. Wind and solar generation are intermittent and weather-dependent and cannot be relied upon to provide electricity whenever cooling demand reaches its highest levels. Although battery storage can help address this variability by storing surplus renewable electricity for later use, its limited discharge duration and dependence on prior charging constrain its ability to sustain supply during prolonged periods of high cooling demand. Scaling up battery storage also entails lifecycle environmental impacts associated with mineral extraction, manufacturing and end-of-life management. Nuclear and hydropower are often operated to provide baseload electricity and may have limited capacity to respond to short-term spikes in demand, depending on plant characteristics and operating conditions. While coal-fired generation can provide dispatchable electricity, its higher greenhouse gas emissions make it less attractive environmentally.

Against this backdrop, gas-fired generation is particularly well suited to supporting cooling-driven peaks, combining dispatchability and operational flexibility with relatively low emissions. Gas-fired power plants can be ramped up rapidly to meet sudden increases in electricity demand and can complement variable renewable generation during periods when solar and wind output is insufficient. At the same time, gas-fired generation has a significantly lower carbon intensity than coal, with modern combined-cycle gas turbine plants typically emitting around 350–400 gCO₂/kWh, compared with around 800–1,000 gCO₂/kWh for conventional coal-fired generation. As a result, gas-fired generation plays a crucial role in major electricity markets, where higher cooling demand during the summer contributes to substantial increases in electricity generation. From April 2025 to July 2025, gas-fired generation increased from 115 to 202 TWh in the US, from 27 to 34 TWh in the EU, from 23 to 36 TWh in China and from 19 to 27 TWh in Japan (Figure v).

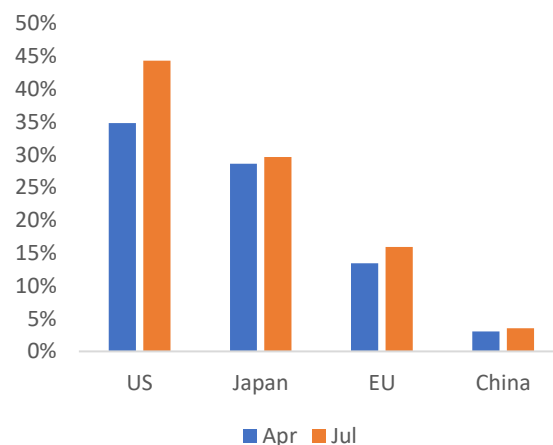
The critical role of gas-fired generation in meeting cooling demand is also illustrated by its growing share of total generation during periods of higher electricity demand. In the major markets, the share of gas-fired generation increases from April, when cooling requirements are generally lower, to July, when cooling demand typically reaches its seasonal peak (Figure vi). This seasonal increase reflects the ability of gas-fired power plants to respond flexibly to higher electricity demand associated with rising temperatures and increased air-conditioning use. The pattern is particularly relevant in power systems where gas-fired generation provides a significant share of dispatchable capacity and can be adjusted to complement other generation sources, including variable renewable generation. As cooling demand becomes increasingly concentrated during periods of high temperatures, flexible gas-fired capacity can therefore help power systems accommodate seasonal increases in electricity demand while maintaining reliability during peak periods.

Figure v: Gas-fired generation in selected countries in 2025



Source: GECF Secretariat based on data from Ember

Figure vi: Gas-fired generation share in 2025



Source: GECF Secretariat based on data from Copernicus and IEA

Looking ahead, rising incomes and living standards, combined with higher temperatures and more frequent heatwaves, are expected to drive further growth in cooling demand across many regions. According to the IEA, global electricity demand for space cooling is projected to reach 4,500–5,200 TWh by 2035, depending partly on the occurrence of strong El Niño events and their influence on extreme temperatures. Ensuring reliable electricity supply during periods of peak cooling demand will require sufficient firm and flexible generation capacity. Gas-fired generation can play a crucial role by providing dispatchable capacity that responds rapidly to fluctuations in electricity demand, thereby helping maintain power-system reliability during periods of high temperatures.