Global Energy Monitor

Energy in the BRICS 2024

CLEANER ENERGY TO ECLIPSE FOSSIL FUELS FOR HALF THE WORLD'S POPULATION

GLOBAL ENERGY MONITOR

Global Energy Monitor (GEM) develops and shares information in support of the worldwide movement for clean energy. By studying the evolving international energy landscape and creating databases, reports, and interactive tools that enhance understanding, GEM seeks to build an open guide to the world's energy system. Follow us at www.globalenergymonitor.org and on Twitter/X @GlobalEnergyMon.

ABOUT THE GLOBAL INTEGRATED POWER TRACKER

The Global Integrated Power Tracker (GIPT) is a free-to-use Creative Commons database of over 116,000 power units globally, that draws from GEM trackers for coal, gas, oil, hydropower, utility-scale solar, wind, nuclear, bioenergy, and geothermal, as well as energy ownership. Footnoted wiki pages accompany all power facilities included in the GIPT, updated biannually. For more information on the data collection process that underpins GEM's power sector trackers, please refer to the Global Integrated Power Tracker methodology page.

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ABOUT THE COVER

Coal piles near wind turbines. Image via Shutterstock.com.

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FURTHER RESOURCES

For additional data on existing and in-development capacity per country/area and region, refer to the Summary Data of the Global Integrated Power Tracker. For an interactive visualization tool of all power facilities globally, refer to the Global Integrated Power Tracker map. To obtain the underlying facility-level data from the Global Integrated Power Tracker, see Download Data.

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Energy in the BRICS

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Brazil, Russia, India, and China founded the "BRICS" group of emerging economies in 2009, and expanded membership to South Africa in 2010, and earlier this year to Iran, the United Arab Emirates (UAE), Ethiopia, and Egypt. These countries play a major role in energy and climate diplomacy and together represent 46% of the world population, 38% of GDP, and 48% of carbon dioxide (CO_2) emissions.

KEY FINDINGS

- **The share of power capacity in the BRICS group fueled by coal, oil, and gas could fall below 50% by the end of this year.** The fossil dominance of power capacity in the BRICS has fallen in recent years and is currently close to 50%. The crossover for the bloc is imminent, as non-fossil capacity additions to mid-year already outnumber coal, oil, and gas plant projects slated for commissioning in 2024. While most BRICS countries show a declining trend in their fossil share, China leads the group, with its fossil-fueled capacity share falling twice the amount of other BRICS countries over the last five years.

- **Wind and utility-scale solar capacity in development outnumber power projects fueled by coal, oil, and gas by two to one in the BRICS.** These two technologies, together with distributed solar PV, which GEM data do not cover, are set to contribute the greatest non-fossil capacity additions in the BRICS. Although this vast pipeline is significantly buoyed by China, wind and utility-scale capacity in development also outnumbers the figure for fossil-fueled power projects in five other BRICS members.

- **Despite fossil-fueled power capacity losing ground in the BRICS' power mix, virtually all members are building additional coal, oil, or gas plants.** GEM data shows all BRICS group countries, save Ethiopia, with fossil-fueled power projects in development. If built, in-development

fossil-fueled projects would increase operating coal and oil/gas capacity in the BRICS groups by 36% and 53%, respectively.

- **BRICS countries have enough renewables projects in development to nearly triple capacity by 2030.** Although the BRICS group has no collective endorsement of the global goal of tripling renewables capacity by 2030, China's recent record wind and solar capacity additions and several members' ambitious clean energy plans put a three times scale-up within reach. If the 326 GW of wind and utility-scale solar capacity additions in 2023 continued to 2030, the BRICS group would see total renewable capacity increase by more than 2.5 times. Furthermore, the sum of the BRICS' in-development renewables projects due for completion by 2030 is 2,276 GW or around 95% of the additional utility-scale renewable capacity estimated as necessary to achieve the global tripling target.

INTRODUCTION

The groups' growing role in energy and climate diplomacy within and beyond the bloc is underscored by several host nation roles for the annual UN climate summit and G20 presidency. At the same time, additional invitees to the bloc, including Saudi Arabia, present the possibility for BRICS to merge the interests of leading oil and gas producers (Saudi Arabia, UAE, Russia, Iran) with those of leading coal producers (China, India, Russia, South Africa), in effect creating a new force on the international diplomatic stage with deeply vested interests in continued fossil production.

With close to half the world's electrical power capacity and nearly half of its fossil-fueled capacity, the power sector represents the blocs' greatest source of energy-related CO_2 emissions. Power demand growth in the BRICS has averaged 5% per year in the last decade, roughly double the global average. Ahead of the annual BRICS summit in Kazan, Russia, in October 2024, this report seeks to provide a timely summary of the state of power sector transition in the nine BRICS countries. The report's analysis draws upon GEM's trackers for coal, gas, oil, hydropower, utility-scale solar, wind, nuclear, bioenergy, and geothermal, housed within the Global Integrated Power Tracker (GIPT). For a detailed analysis of each BRICS nation, see dedicated country profile sections: Brazil, Russia, India, China, South Africa, Egypt, Ethiopia, Iran, and the United Arab Emirates. See dedicated summary tables for summaries of GEM's power sector data for BRICS countries.

BRICS countries make up half the world's power capacity

Existing power capacity across all technologies in BRICS group countries totals 4.2 terawatts (TW), or just under half of the global total (9.0 TW). The capacity mix across the bloc is diverse, spanning all eight power sectors covered by GEM trackers, including the two fossil sources in coal and oil and gas, as well as six non-fossil sources, including solar, wind, hydropower, nuclear, bioenergy, and geothermal. Despite the diverse sourcing of electricity across the BRICS, each member relies heavily on a single source.

The dominant source in six BRICS group countries is fossil-powered, underscoring the importance of phasing out incumbent power sources for energy transition.

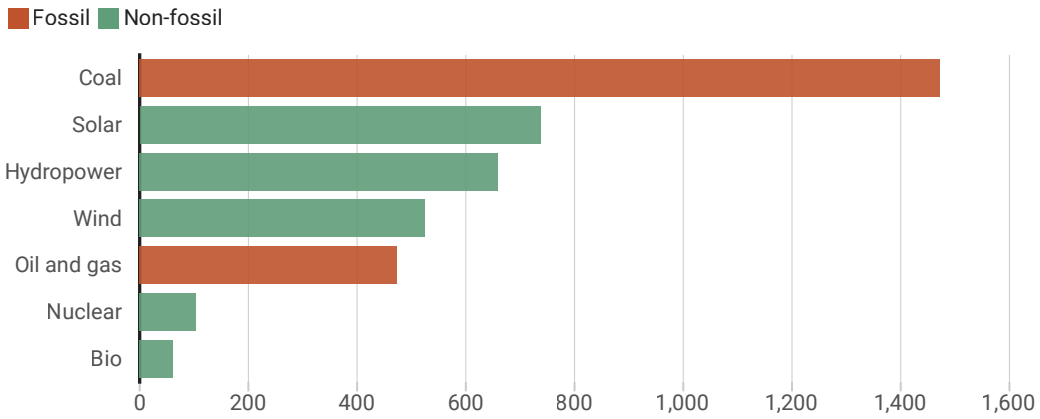
With over 70% of BRICS total power capacity, it's hard to understate the significance of China within the bloc. China's heavy reliance on coal, together with sizable shares in India, South Africa and Russia, see the BRICS countries accounting for an outsized share of the global coal fleet, some 70% of global operating coal capacity. Amongst the top ten coal producers globally, these four BRICS countries account for 99% of operating coal capacity across the bloc, some 1,469 GW. Coal has the largest share of total power capacity in three of these countries: China 41%, India 51% and South Africa 70%.

Oil and gas plants are less prominent across the group, making up 22% of the global total oil/gas plant capacity. However, this technology is an important power source for certain members, constituting the majority of operating power capacity in four BRICS countries: Russia 47%, Egypt 89%, Iran 84%, and United Arab Emirates 77%. Together these four countries account for 60% of operating oil and gas plant capacity across the BRICS group and are all amongst the top ten oil and gas producers globally. While oil and gas plants feature less prominently in the overall capacity mix of China (5% of total), the total installed capacity is the greatest amongst the BRICS (145 GW).

Hydropower is the dominant power source in Brazil and Ethiopia, accounting for 49% and 87% of total capacity, respectively. The relative abundance of rainfall in western Ethiopia coincides with the highland terrain, which creates considerable hydropower

Operating capacity in BRICS countries split between fossil fuels and non-fossil sources

Power capacity by source in BRICS countries, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor (coal, oil and gas capacity; data include units equal to or greater than specific thresholds: coal 30MW; oil and gas 50MW), IRENA (non-fossil capacity)

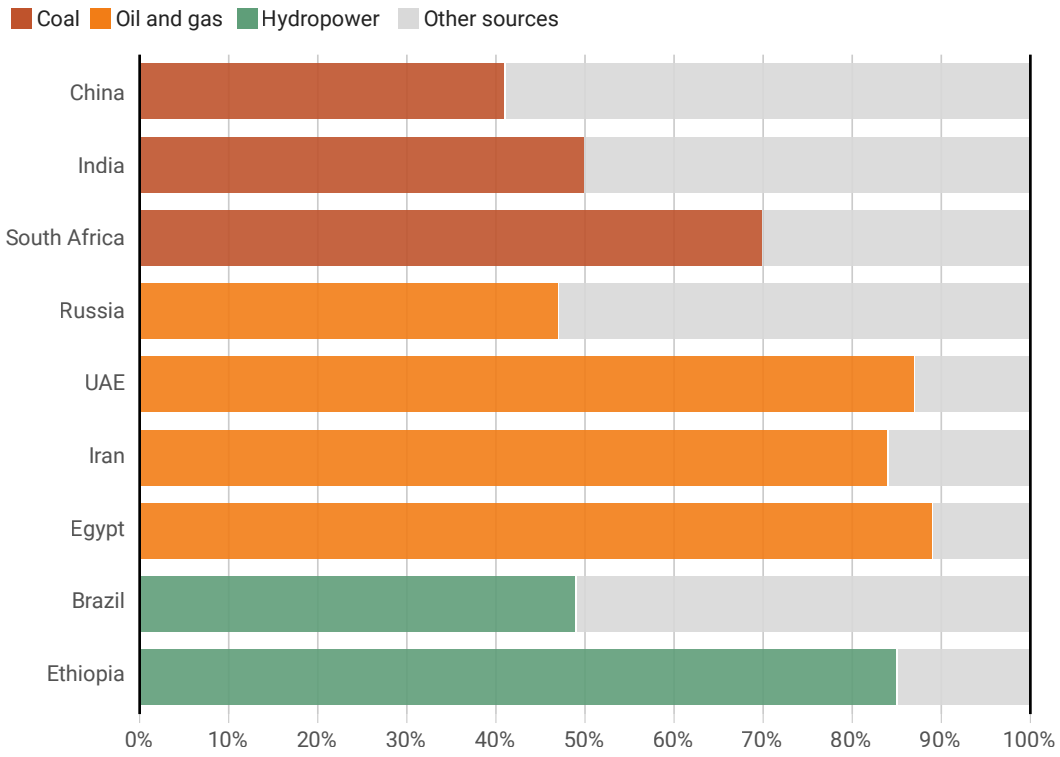
potential for conventional storage technologies. Brazil's much larger hydropower base likewise capitalizes on abundant rainfall and favorable geography, with run-of-river technologies also used on high-flow-rate rivers (notably the Madeira, São Francisco, and Paraná). China, India, and Russia also have sizable hydropower sectors, though the share of the power mix in each country is more modest, at between 10 and 20%.

Although the BRICS group of nations also host sizable operating fleets of other power technologies, none reach the shares of dominant power sources. For example, Brazil has the most bioenergy power capacity of any country in the world outside of China, but the share of total installed capacity is less than 10%. China is building nearly half of the world's new nuclear power plants and will overtake France within the next few years to hold the world's second-largest nuclear fleet. Yet, nuclear power would still struggle to reach a double-digit share of China's total installed power capacity.

The urgent task of phasing out dominant fossil sources from the power mix is even more stark when accounting for the generally lower capacity factors of leading renewable technologies such as wind and solar. China is a case in point, where the total installed capacity of wind and solar capacity now equals that of coal capacity. Yet, coal generation in China is over four times greater[1] than that of wind and solar combined.

Each BRICS country favors a single power source

Proportion (%) of total power capacity by major power source



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor (coal, oil and gas capacity
Data include units equal to or greater than specific thresholds: coal 30MW; oil and gas 50MW),
IRENA (non-fossil capacity)

Global Energy Monitor

1. Estimated using National Bureau of Statistics of China generation data for the last twelve months.

BRICS' wind and utility-scale solar capacity in development is double coal, oil, and gas

Across the BRICS group, in-development wind and utility-scale solar projects — those that have been announced or are in the pre-construction and construction phases — total 1,550 GW, or roughly double the figure for fossil-fueled capacity, and half of the total in-development capacity across all technologies. Adding in-development hydropower to the wind and utility solar figure sees the capacity for in-development fossil-fueled projects in the BRICS outnumbered by nearly three to one.

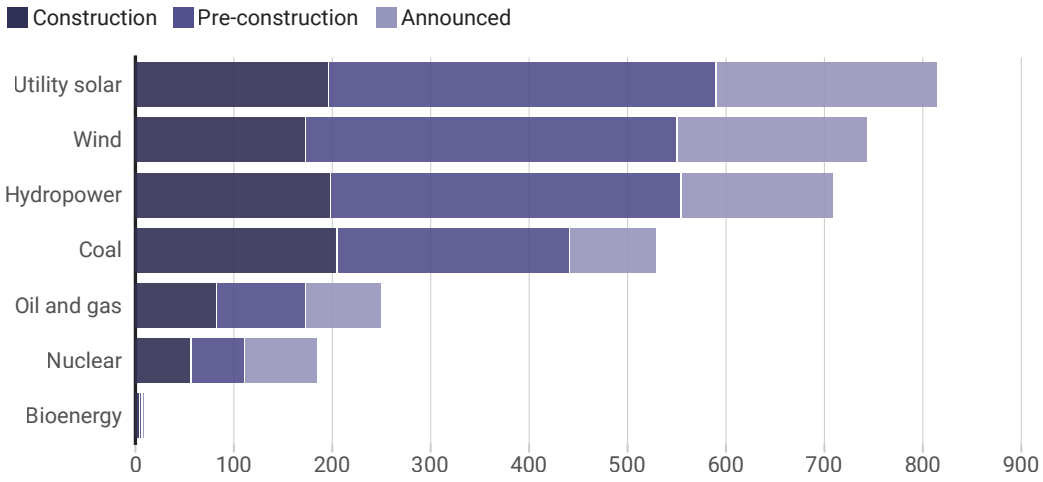
Across BRICS group countries, utility-scale solar is the leading technology for capacity in development, with 814 GW. Over 99% of this capacity comprises solar photovoltaic (PV) technologies (as opposed to solar thermal), and 70% is located in China. Naturally, the larger solar market in China corresponds with a greater proportion of the in-development figure for utility-scale solar. However, Brazil and Egypt also host sizable pipelines of in-development utility-scale solar capacity, which are ten times the level of existing operating capacity in each county.

Wind follows utility-scale solar closely with 744 GW of capacity in development across the bloc, 67% of which is located in China. Offshore wind technologies make up 27% of the in-development figure, with 67% of this segment located in Brazil and 31% in China. This strong showing for Brazil, with more in-development offshore wind capacity than any other country globally, reflects the country's vast coastline, ample wind resources, and shallow nearshore — however, uncertainty surrounding the regulatory framework for offshore wind risks stalling the buildout.

Hydropower also shows a large volume of in-development projects, some 708 GW, of which 66% is pumped storage. China and India make up 94% of in-development hydropower capacity and 99% of the pumped-storage segment. Both China and India increasingly require options for energy storage to facilitate the integration of massive wind and solar additions and ensure grid stability.

In-development wind and utility-scale solar capacity is double that for coal, oil, and gas in BRICS countries

Power capacity in development by source and status, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor
Data include phases/units equal to or greater than specific thresholds: solar 20MW; wind 10MW; hydropower 75MW; bioenergy and coal 30MW; oil and gas 50MW.

China and India together make up 82% of nuclear power plant projects in development. China alone has 118 GW of capacity in development stages, which puts the country not only first worldwide for this metric, but also surpasses the second through eighth place countries combined.

Plans for new bioenergy plants are limited compared to other technologies, with almost all in-development capacity within China and Brazil (92%). These two countries rank first and third for installed bioenergy capacity globally in 2023. Bioenergy plants in China are powered mainly by municipal waste and agricultural residues. Brazil's primary bioenergy fuel for power is bagasse — the biomass that remains from the crushing of sugarcane — for which Brazil is the world's largest producer.

Only Ethiopia is pursuing plans for new geothermal plants, with 550 MW capacity in development. Currently, the country has a single, now defunct, geothermal plant. Still, it aspires to mirror the success of neighboring Kenya, which has tapped the Eastern African Rift for over 900 MW of geothermal capacity.

The considerable pipeline of non-fossil power projects is a positive sign and, if built, will help erode the existing fossil majority used for electricity generation. However, the amount of fossil capacity in development within the BRICS is still vast in scale, with global ramifications for the energy transition.

For coal, China and India alone account for 86% of the global in-development number and 98% within the BRICS. For oil and gas power projects, BRICS' share of the global in-development number is lower, at one-third. However, all BRICS countries other than Ethiopia and India have capacity in development. If built, in-development fossil-fueled projects would increase operating coal and oil/gas capacity in the BRICS groups by 36% and 53%, respectively.

Ultimately, the size of the in-development tranche for each technology and the proportion reaching the construction phase will determine which technology wins out.

BRICS' non-fossil fueled capacity under construction exceeds that of coal, oil, and gas

All BRICS countries are building fossil-fueled power capacity, with 287 GW capacity currently in the construction phase across the group. However, the non-fossil-fueled capacity under construction is more than double this figure, at 629 GW. For comparison, the ratio of non-fossil to fossil capacity under construction in both the G7 and EU is three to one. A weighting towards non-fossil capacity additions has also been observed historically in the BRICS group, with the share of fossil-powered technologies in total power capacity falling from a peak value of around 70% in 2007 to 50% last year.[2] Should all power projects in the BRICS group get built, the fossil-powered share would drop below 50% for the first time.

This crossover may take place this year. GEM data show 72 GW of fossil capacity in the BRICS group slated for commissioning in 2024 and a further 88 GW without a known target start date, totalling 158 GW. However, non-fossil capacity additions to mid-2024 already exceed this amount, totalling 190 GW in China, India, and Brazil alone.[3] As year-end capacity statistics are collected, it is likely that the non-fossil share becomes the majority. For comparison, the European Union reached 50% non-fossil share at the start of the 2010s, and the G7 hit parity last year.

Within the bloc, the balance between fossil and non-fossil capacity varies. However, the fossil

2. Ranges between 49–51%, depending on the capacity data source (IRENA: 50%, Ember: 49%, and 51% when using official government sources).
3. Using installed capacity data to July 2024, from respective statistical authorities (China, India and Brazil).

component rarely shows signs of increasing. In hydropower-dominated Brazil and Ethiopia, robust wind and solar PV growth over the past decade has pushed Brazil's non-fossil share close to 90%, while no known coal, oil, or gas prospects in Ethiopia will maintain the near 100% non-fossil powered electricity system.

China's non-fossil contribution to the power capacity mix surpassed 50% in 2023, with massive wind and solar additions propelling this share 20 percentage points in a little over five years. Despite the unrivaled volume of fossil-powered projects under construction in China, there are hints of an impending slowdown in coal capacity additions. The country drastically reduced approvals for new coal power in the first half of 2024, granting permission to only twelve projects totaling 9.1 GW, equivalent to just 8% of the permitted amount in all of 2023. However, this slowdown in permitting may take time to work through the pipeline, and construction activities remain robust due to the substantial arrears of new coal capacity permitted in previous years. Nevertheless, accelerating non-fossil capacity additions, particularly from wind and solar, will continue to edge out coal's share.

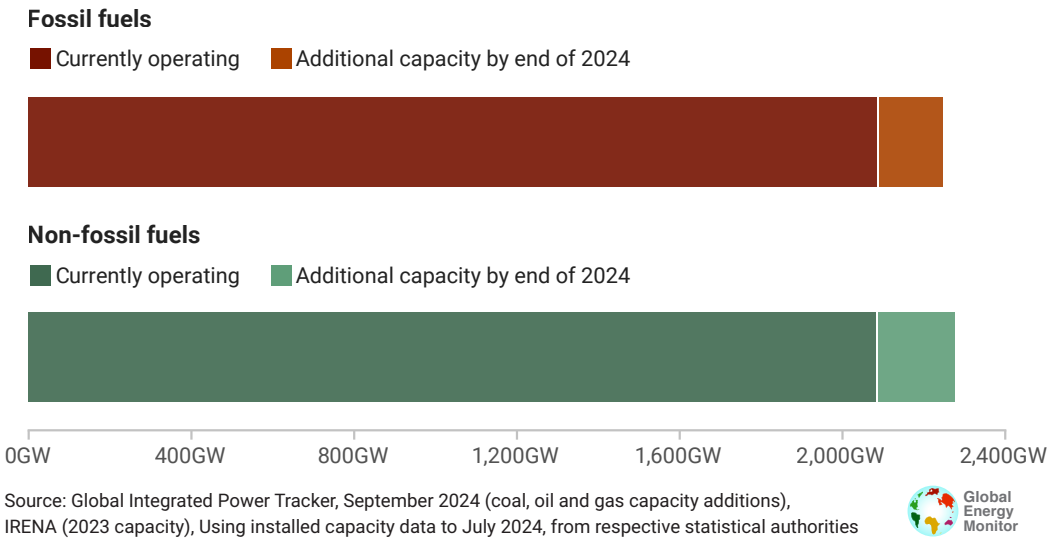
South Africa and Egypt complete this set of five BRICS countries building more non-fossil capacity than fossil. However, the absolute amount of non-fossil capacity under construction is modest compared to the total installed capacity, and the additions would change little of the current dominance of fossil power in these two countries.

GEM data for India, Iran, Russia, and the United Arab Emirates all see fossil-powered capacity in construction exceeding non-fossil. However, factoring in distributed solar PV additions in India, which GEM data does not cover, would likely see the non-fossil segment prevail in this country. This non-fossil surplus would help keep coal's share of total power capacity below 50% (a threshold passed mid-2024 for the first time since the 1960s). However, it may not be sufficient to realize the Indian Government's target of a 50% share of non-fossil capacity in the power mix by 2030, particularly given the recent spree of coal permitting.

In Russia and the UAE, coal, oil, and gas plants planning retirement within the next 2–3 years would tip the balance in favor of non-fossil capacity additions. While net capacity additions would alter little of

Fossil fuels to lose majority share of total power to cleaner sources in BRICS countries by end of 2024

Power capacity by source in BRICS countries, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024 (coal, oil and gas capacity additions), IRENA (2023 capacity), Using installed capacity data to July 2024, from respective statistical authorities

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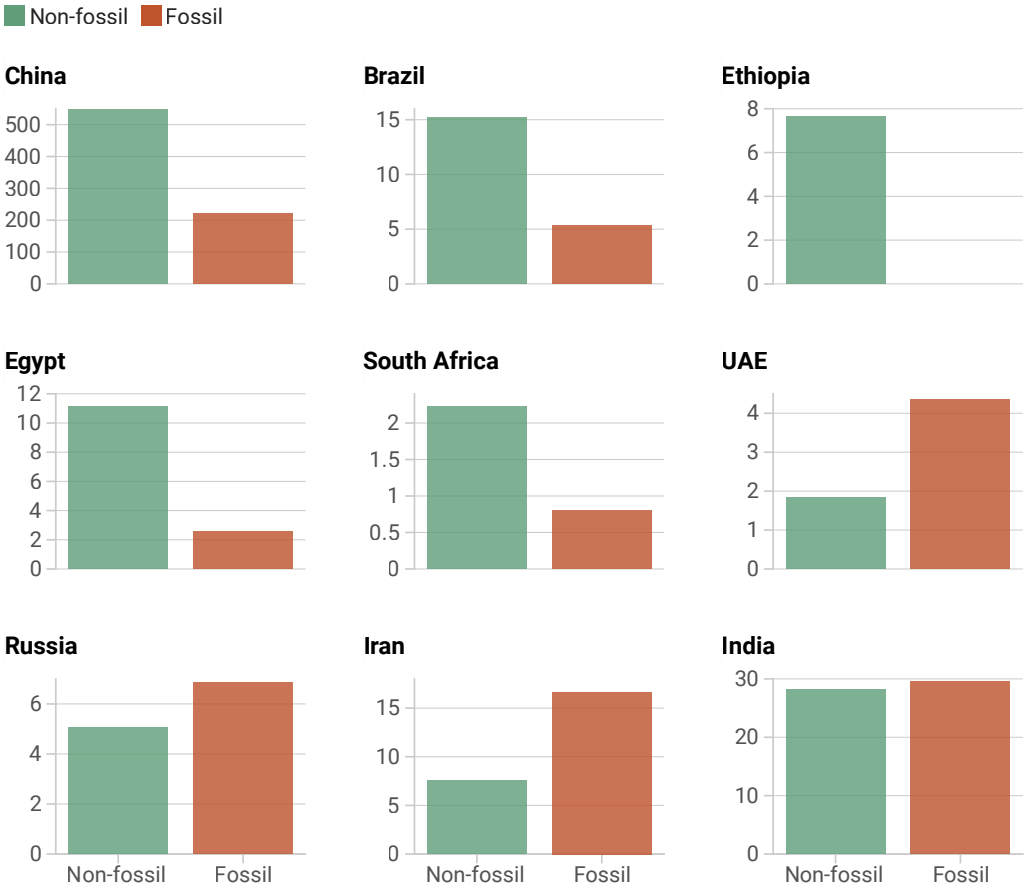
Russia's current two-thirds share of fossil fuels in the power mix, a faster pace of change is occurring in the UAE. In little over half a decade, the UAE has gone from close to zero to around a 25% non-fossil share of capacity, propelled in large part by the phased commissioning of all four units at the Barakah nuclear power plant and completion of several multi-gigawatt solar plants, including Al Dhafra solar farm, the world's largest single-phase installation. Only Iran remains with a surplus of fossil-powered capacity additions according to GEM's construction project data, virtually all of which are gas plants using domestically produced fuel supply.

More non-fossil power projects under construction than fossil in five of nine BRICS countries

Power capacity in construction, in gigawatts (GW); each country on its own scale



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor
Data include phases/units equal to or greater than specific thresholds: solar 20MW; wind 10MW; hydropower 75MW; geothermal 1 MW; bioenergy and coal 30MW; oil and gas 50MW.

Total renewable capacity in the BRICS would more than double if annual renewable additions seen in 2023 continued to 2030

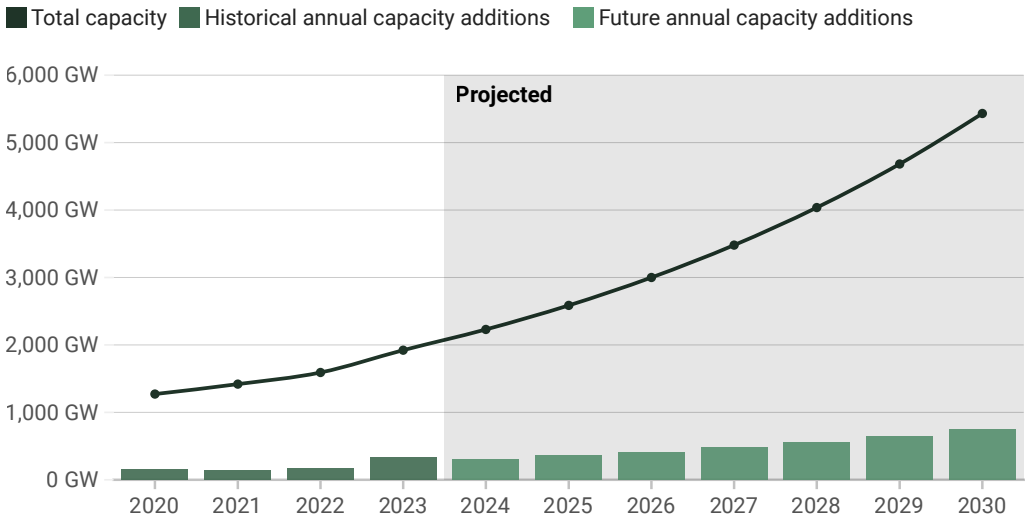
The target to triple total global renewables[4] capacity by 2030, agreed at COP28, is considered the single most important lever for reducing emissions and keeping the 1.5 degree-aligned pathway alive. Despite attracting support from more than 130 countries worldwide to date, the only signatories from the BRICS group are Brazil, Ethiopia, and the UAE. However, before COP28, a similar tripling target expressed in the G20 Leaders' Declaration, which excluded calls for coal phasedown, did attract support from China and India. China subsequently reiterated its commitment to the tripling goal along with the United States in the "Sunnylands Statement." Furthermore, the climate and energy plans of India, South Africa, and Egypt all envisage renewable capacity that is close to or exceeding three times the current level. Thus, the role of most BRICS group countries in the global tripling goal is implicit despite no formal support across the bloc.

Getting to triple the level of renewables by 2030 globally — or around 11,000 GW — would require a year-on-year growth rate of around 16%, with annual additions rising from around 600 GW in 2024 to 1,500 GW in 2030. Assuming the same 16% growth rate for the BRICS group countries over this period, total renewable installations would reach 5,430 GW in 2030, with annual additions increasing from 308 GW in 2024 to 749 GW in 2030. Although global tripling does not imply all countries increase renewables three-fold, this level of scale-up is consistent with analyses from the IEA, Climate Analytics, and the University of California, Berkeley, which all show 2030 renewables capacity in major BRICS group countries of three to three-and-a-half times 2022 levels.

Record capacity additions saw the BRICS' renewables fleet grow by 331 GW in 2023. This level of annual

Tripling renewable capacity globally requires 750 GW annual additions by 2030 in the BRICS group

Historical and projected renewable power capacity, in gigawatts (GW)



Source: IRENA (historical capacity); future capacity based on 16% year-on-year growth

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4. In this section of analysis, "renewables" refers to the same definition used by the IEA, which covers the following technologies: onshore and offshore wind, solar PV and solar thermal, hydropower (including pumped storage), bioenergy, geothermal, and ocean energy.

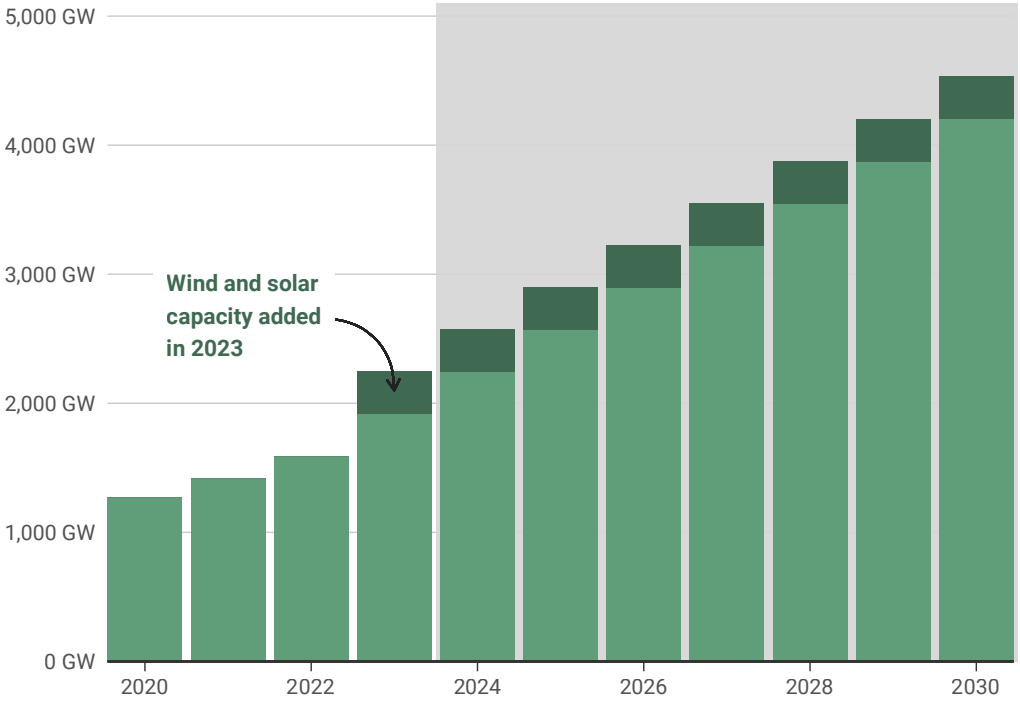
capacity additions is similar to the amount consistent with tripling for the coming years, estimated at 308 GW in 2024 and 357 GW in 2025 for BRICS group countries. Most of the recent capacity additions in BRICS group countries are from wind and solar PV technologies, making up 98% of the 2023 capacity additions or 326 GW. If annual wind and solar additions were to continue at this rate for the next seven years out to 2030, the BRICS' renewables fleet would grow to 4,200 GW of installed capacity, or 77% of the tripling value for the bloc.

GEM data tracks 2,276 GW of renewable capacity in development across BRICS group countries. This in-development figure is over 60% of the additional renewable capacity required between 2024 and 2030, consistent with tripling renewables (3,510 GW).[5] As GEM data do not cover the distributed solar PV segment of renewable capacity, the 2,276 GW of BRICS renewable capacity in development likely accounts for a larger share of additional renewable capacity required by 2030. Assuming distributed solar PV would cover around one-third of the total additional renewables capacity by 2030, the 2,276 GW of in-development renewables in the BRICS is closer to 95% of the additional capacity required by 2030 for tripling when excluding distributed solar (2,400 GW).

To reach the vast renewable capacity buildout implied in the tripling target, pre-construction and announced projects must be built. Yet, only a quarter of the total in-development figure is currently under construction

BRICS renewable capacity would more than double by adding the same amount of wind and solar each year as in 2023

Renewable power capacity in BRICS countries if wind and solar capacity additions continue at same rate as 2023 every year from 2024 to 2030



Source: IRENA (historical capacity and 2023 additions)

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5. For comparison, additional renewable capacity required by 2030 in G7 countries is around 1,800 GW. GEM data show 617 GW of renewable capacity in development in the G7 or about 35% of the additional renewable capacity required for tripling.

(572 GW) in the BRICS region. Furthermore, China accounts for an outsized share of this construction tranche, some 90% of the BRICS total. Although the sheer size of the power sector in China implies the country will dominate the share of under-construction projects in the BRICS countries, the country is also building at a higher rate, with 32% of renewable projects in the construction phase compared to 8% among the other BRICS countries. Increasing this construction rate and continually growing the in-development pipeline is vital to all BRICS members contributing to the global goal of tripling renewables.

As all countries start from very different levels of installed renewable capacity, precisely tripling the sum of capacity across all renewable sources may not be desirable or feasible. However, this does not rule out rapid scale-up in other renewable sources. For instance, Brazil would not feasibly triple its 100 GW hydropower base by 2030. However, the country has ambitious plans for non-hydropower renewables, notably the second- and third-largest in-development pipeline globally for solar and wind, respectively. Likewise, Ethiopia currently sources virtually all electricity from hydropower. Yet, GEM data show in-development wind and hydropower projects double the current installed capacity. By contrast, Russia and Iran have comparatively small amounts of in-development renewable projects, with just 300 MW of wind and solar projects in construction between them. That said, both countries host significant wind and solar resources and ambition for these technologies should far exceed the modest levels of existing installations and in-development projects.

BRICS GROUP POWER SECTOR PROFILES

Brazil

Brazil is Latin America's largest energy producer and consumer, with roughly twice the installed capacity and annual electricity output of regional runner-up Mexico. It has distinguished itself as a global renewable energy leader, thanks to a long-established hydropower sector and burgeoning wind and solar capacity. Brazil is also a leading oil and gas producer.

Brazil generated 93% of its electricity from renewables in 2023 and has the cleanest energy mix among the G20 countries, with fossil fuels only accounting for 46% of total energy supply. In 2022, Brazil also attracted more new investment in renewables (US$25 billion) than any country except the U.S. and China.

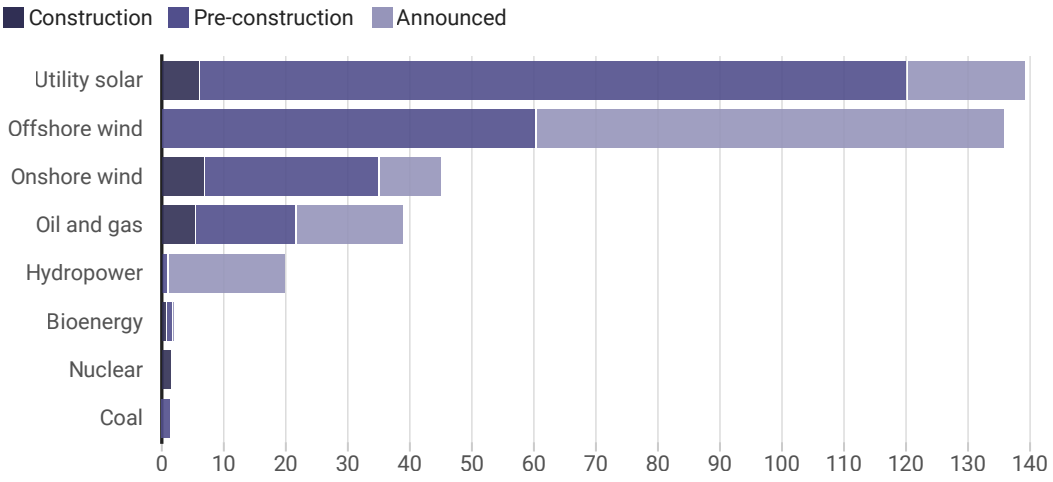
While Brazil has made great strides in leveraging its exceptional wind and solar resources to complement hydropower, transmission bottlenecks and lack of storage still hamper the realization of renewables' full potential. The government continues to actively pursue domestic oil and gas exploration and rely on fossil-fueled plants for power system balancing, posing a challenge to global net zero ambitions. Government policy has promoted gas-fired plants as a backup during drought years when hydropower is insufficient to meet national demand. Nuclear and coal-fired power plants also play a small supplemental role in Brazil's electricity matrix.

Wind and solar

Future prospects for wind and solar are especially impressive. GEM's Global Wind and Solar Trackers document 180 GW of utility-scale wind farms in announced, pre-construction, or construction status, placing the country third globally behind China and Australia. Brazil's 139 GW of prospective utility-scale solar farms ranks second globally, trailing only China. In addition to supplying green energy to the grid, these resources could allow Brazil to generate an estimated 1.8 gigatonnes of low-carbon hydrogen annually at a lower cost than any other nation, helping

Offshore wind and utility-scale solar make up almost three-quarters of all power projects in development stages in Brazil

Power capacity in development by source and status, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor
Data include phases/units equal to or greater than specific thresholds: solar 20MW; wind 10MW; hydropower 75MW; bioenergy and coal 30MW; oil and gas 50MW.

to decarbonize domestic steel production and support a new green iron industry.

Brazil's greatest wind and solar potential is found in the country's Northeast region, whereas the largest population centers and industrial users are located in the Southeast. The rapid pace of renewables growth has created transmission bottlenecks between the two regions, prompting the system operator to impose caps on wind and solar uptake into Brazil's national grid and potentially disincentivizing investment. In December 2023, Brazil held its largest ever electrical transmission auction, and in April 2024, the government awarded contracts for 4,471 km of new transmission lines and substations to facilitate nationwide renewable electricity distribution.

Brazil is a global leader in distributed solar, thanks largely to generous government incentives. As of December 2023, Brazil had 26.3 GW of distributed solar capacity. An additional 4.5 GW were installed between January and July 2024, with a cumulative total of 8.4 GW anticipated for the year as a whole. By mid-2024, Brazil had already blown past annual growth projections for rooftop and utility-scale solar combined, reaching a total installed solar capacity of 45.7 GW in July, compared to the previously predicted end-of-2024 total of 45.5 GW.

Brazil has more in-development offshore wind capacity than any other country, including 28 of the world's largest 100 proposed offshore projects. As of April 2024, Brazil's environmental agency Ibama had documented 234 GW of offshore wind projects in the licensing phase, concentrated in the Northeast, Southeast, and South. Despite industry and government support for offshore wind, Brazil's incomplete regulatory framework for offshore projects has impeded their development. The framework originally approved in 2022 has bounced back and forth between Brazil's Senate and Chamber of Deputies, and was still under debate at the time of writing, largely due to controversial extraneous provisions promoting coal plants and other unrelated energy infrastructure. The delay in approving clear guidelines has prompted concerns that wind developers may take their business elsewhere, with experts signaling that it will take at least a year after the bill's passage to establish government auctions for offshore wind.

Hydropower

Brazil generates more than 60% of its electricity from hydropower and is home to three of the world's eight largest operating hydroelectric plants: Itaipu, Belo Monte, and Tucuruí. Severe droughts in recent years have tested the country's reliance on hydropower, resulting in the contracting of several new gas plants via an emergency energy auction in 2021 and prompting calls for better integration of wind and solar into the grid to mitigate future supply disruptions.

Bioenergy

Bioenergy, primarily sourced from sugar cane residue and wood pulp, typically accounts for 7% to 8% of Brazil's electricity generation. In 2024, bioenergy is expected to represent 12% of new additions to Brazil's electrical capacity, the third-largest share after solar and wind.

Oil and Gas

Brazil ranks among the world's top ten oil producers and exporters, with offshore production accounting for more than 95%, and roughly three-quarters coming from the southeastern "pre-salt" formations. Production is expected to peak in 2029 or 2030 without development of new fields. In December 2023 the government granted drilling rights in more than 600 new locations, including environmentally sensitive areas of the Amazon basin. Petrobras also hopes to replenish Brazil's reserves through discoveries in the Equatorial Margin, a northern coastal region with production potential of up to 5 billion barrels.

Brazil's older oil-fired power plants are giving way to newer and more active plants fueled by gas. Brazil's national energy plan calls for increased gas use in electricity generation, and in 2021 gas-friendly developers and politicians successfully promoted Law 14.182/2021, obliging the government to contract 8 GW of new gas plants, including several in remote areas

requiring construction of new pipelines. Brazil has seen a recent surge in gas-to-power projects, mostly fed by new LNG import terminals, as insufficient transport infrastructure has impeded commercialization of domestic offshore gas. Among the dozen-plus pipelines proposed to bring offshore gas to Atlantic coast processing units, three (Route 1, Route 2, and Route 3) have been commissioned, with the latter only coming online in late 2024.

Brazil relies on imports for approximately 40% of its gas supply. Historically, most gas was imported from Bolivia, but production declines have prompted Brazil to consider imported LNG and fracked gas from Argentina as alternatives. Two new LNG import terminals (Sergipe and Porto do Açu) began operating in Brazil in 2020 and 2021, with four more (Barcarena, Cosan, TGS, and Suape) coming online in 2024 or 2025. Several large new gas plants have been developed in conjunction with these terminals, including Sergipe (1.6 GW), GNA I (1.3 GW), GNA II (1.7 GW), and Barcarena (2.2 GW).

Following the 2023 commissioning of Argentina's Néstor Kirchner pipeline, which relieved bottlenecks in commercializing Vaca Muerta gas, Brazil and Argentina have begun discussing potential exports of Argentine gas into Brazil. Options include sending gas through Bolivia via existing pipelines, constructing new routes through Uruguay and Paraguay, and reviving a long-dormant plan for the 594-kilometer Uruguaiana-Porto Alegre pipeline, which would transport gas from the Argentine border into Brazil's existing pipeline network at Porto Alegre.

Coal

Brazil is home to Latin America's only two remaining pre-construction coal projects. While coal only fuels a small fraction of Brazil's electricity, it remains a topic of debate in the coal-mining states of Rio Grande do Sul and Santa Catarina, where politicians have lobbied to extend the retirement date of the Jorge Lacerda power station to 2040 and lock in backup generation contracts at the Presidente Médici power station through 2050. In June 2024, Brazil's Chamber of Deputies approved the inclusion of coal-fired plants in Brazil's energy reserve auctions. However, no new coal plant has been contracted in Brazil's regular energy auctions for nearly a decade, and there is strong civil society opposition to continued use of coal.

Nuclear

Angra power station is Latin America's largest nuclear power plant, with 1990 MW currently operating and another 1405 MW under construction. The government views nuclear power as a viable component of Brazil's national energy transition plans, and has proposed small-scale nuclear as a replacement for fossil fuel-based plants in isolated Amazon basin communities.

Russia

Fossil resources are crucial for Russia's energy system and economy, with coal, oil, and gas making up 90% of the total energy supply and the oil and gas sector contributing 20% of GDP. A major reconfiguration of fossil fuel exports has taken place since Russia's invasion of Ukraine in 2022 and the Western-imposed sanctions that ensued. Oil exports have largely been redirected to eastern markets, while the impact on the gas sector was more pronounced, with gas exports to the EU dropping by around 75–80% compared to levels in 2021. Russia's reshaped gas export strategy has so far relied on maximizing pipeline flows to Central Asia, Turkey, and China, notably via the Power of Siberia pipeline. Further expansion of the exports to China through the construction of the Power of Siberia 2 Gas Pipeline has been Russia's ambition to compensate for the loss of gas exports to the EU. Still, as of July 2024, Moscow and Beijing could not reach an agreement.

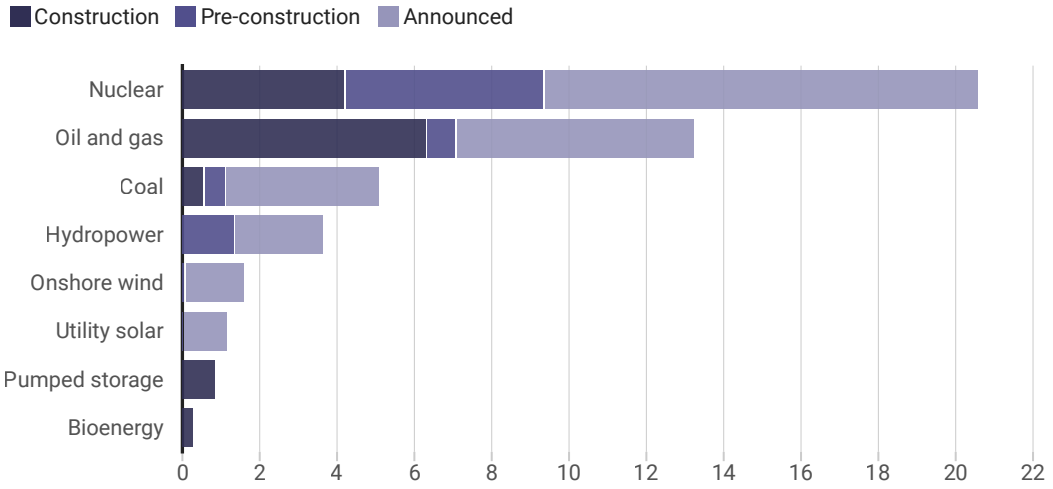
Gas has long been Russia's primary source for electricity generation, accounting for 46.3% of the total in 2023, with coal's share at 16.6%. Demand growth in the past 20 years has been met mostly by increased gas and nuclear generation. With continuing growth in power demand and aging power plant equipment (GEM data show Russia's thermal plants to average 41 years in age), Russia is faced with the task of modernizing existing infrastructure and introducing new generating capacities.

Gas

Russia continues to expand gas-fired capacities, with a total of 13.2 GW in development, of which 6.3 GW is in construction, and of which 2.8 GW will replace existing coal units. The largest project in construction is the Kashirskaya power station in the Moscow oblast, where two 900 MW gas units will replace about 1.9 GW of gas and coal units retired in 2019–2021. A number of proposed gas-fired plants have been delayed due to the sanctions, especially those involving large gas turbines (e.g. the proposed Unit CC 1 of 850 MW at Zainsk GRES power station). However, Russia is ramping up its manufacturing. In 2023, Rostec United Engine Corporation manufactured its first serial gas turbine GTD-110M for the Udarnaya power station (Unit 3 of 110 MW), to be installed in 2024. It is the first domestic high-power turbine to reach mass production.

Nuclear accounts for nearly half of all power capacity in development stages in Russia

Power capacity in development by source and status, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor
Data include phases/units equal to or greater than specific thresholds: solar 20MW; wind 10MW; hydropower/pumped storage 75MW; bioenergy and coal 30MW; oil and gas 50MW.

Likewise, the role of foreign manufacturers in servicing gas turbines has become a challenge for the sector. Domestic energy companies are contending with a considerable variety of foreign turbines. At the same time, the Ministry of Energy has set the task of developing maintenance procedures and manufacturing parts in Russia. In 2024, several stations requested to decommission the operating foreign turbines due to inability to service them. Meanwhile, several plants (Yuzhno-Sakhalinskaya-1 power station) had to replace the turbines with the Russian stock of lower capacity.

Faced with the sanctions and decreased volumes of gas export, Russia has been turning its focus to the gasification of its territory, including the most remote regions (Siberia and the Far East), as part of the "Gasification of Russia 2021–2025" program launched by Gazprom. Also, the planned development of the gas transit system for exports to China will expand the gasification of Siberia and the Far East. It should alleviate the existing restrictions on available gas in the city of Khabarovsk and Primorsky Krai, for example, at the Khabarovsk-4 power station, which is in construction and the Vladivostok-2 power station, which has been gradually converting to gas. Several pipelines are planned to supply gas to new territories (for example, Volodino-Krasnoyarsk Gas Pipeline), which will later become part of the Power of Siberia 2 Gas Pipeline to China.

Coal

Most of the coal fleet is located in Siberia and the Far East, close to hydropower plants, which allows coal generation to complement hydropower's seasonality. Coal production and export volumes have not been significantly affected by sanctions imposed in 2022, as exports reorient coal exports to the East despite significant logistical and transportation challenges. Russia's total coal plant capacity has shown small decreases in the last two decades, as 7.7 GW was retired or converted to gas. Over 5,000 MW of coal capacity is in the planning, but only 565 MW is in construction as of June 2024, including Unit 2 with 185 MW at Krasnoyarsk CHP-3 in Siberia and two units with 280 MW at Partizanskaya power station.

Nuclear

Russia has eleven existing nuclear power plants and plans to build 12 more by 2035, totalling 20.6 GW. Of these in-development nuclear projects, 4.2 GW are already in construction and 80% target commissioning by 2035. The Akademik Lomonosov plant became Russia's and the world's first floating nuclear facility in the world when commissioned in 2020. An additional 400 MW floating nuclear plant (Cape Nagloynyn plant) is under construction. Four more plants are in the construction phase, with three replacing the existing older plants.

Wind and solar

With a combined installed capacity of 4.7 GW, the wind and solar share of electricity generation is less than 0.5%, falling short of the government's target of a 4.5% share by 2024. However, in the southern power grid, where renewable energy installations are concentrated, the share of renewable generation has exceeded 12%. Russia had previously announced at COP28 plans to increase renewables to 12 GW by 2030 (excluding large hydropower). Though GEM data shows 2,733 MW combined wind and utility-scale solar capacity in development, virtually all these projects are at the announcement stage, with none in construction.

Foreign firms have led some of the largest renewable energy projects, with Enel completing the Azov wind farm in 2021 and Kolskaya wind farm in 2022, and Finland's Fortum involved in the Kalmykia solar farm, commissioned in 2022. The departure of foreign investors has affected the investor landscape as well as equipment suppliers, such as Vestas, that had previously opened two manufacturing facilities in Russia. Finnish group Fortum — formerly the largest renewable energy player in Russia — with 3.4 GW of wind and solar farms at various development stages, had its assets seized by presidential decree in April 2023.

India

India is currently the third-largest energy-consuming country in the world, with 89% of its total energy supply met by fossil fuels. India's buoyant economy is anticipated to become the third-largest globally by 2030, driving the greatest increase in energy needs of any country globally over the next decade. Squaring this increase with India's goal of reaching net zero emissions by 2070 will require a major overhaul of the energy sector, particularly within the power sector. India aims to install 500 GW of non-fossil fuel capacity by financial year 2031–32, mainly comprising solar PV and wind technologies. Expediting these installations is key to limiting the role of coal-fired generation in meeting pronounced increases in electricity demand, estimated to hit 8% year on year in 2024.

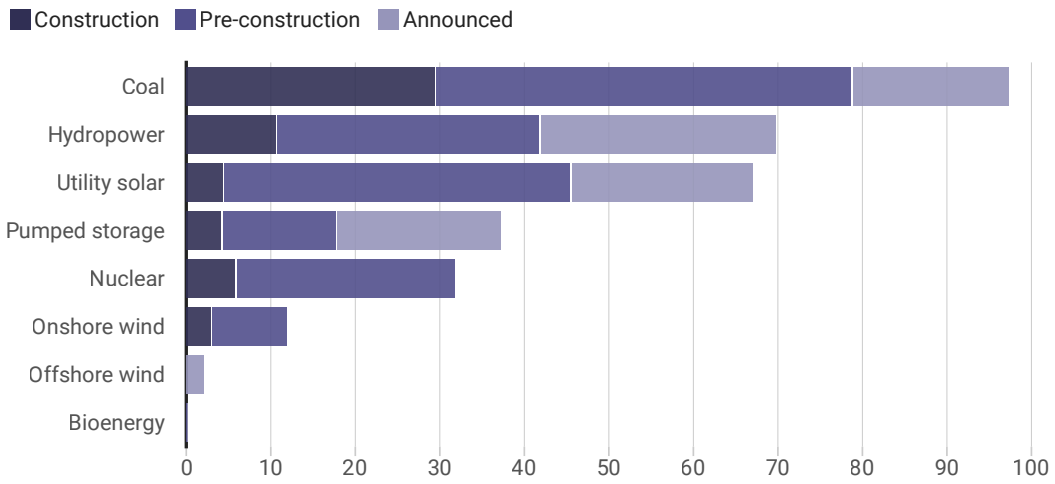
Coal-fired generation reached historic highs during extreme heatwave conditions in May of 2024, as Indian authorities implemented emergency measures to maximize coal plant output. Despite record-high auction results for utility-scale renewable energy projects this financial year, the country faces multiple hurdles to realizing the government's ambitious renewables target. Chief amongst these are weak enforcement of renewables purchasing obligation targets, import barriers on solar modules, and indebted power distribution companies unable to make sufficient grid investments.

Coal

Despite the declining share of coal in India's generation mix, the country's vast coal fleet is second only to China globally, with 239.6 GW of operating coal plant capacity. Year-on-year coal capacity additions have slowed from peak installation rates seen in the mid-2010s, though the total fleet and pipeline of new coal plant proposals continues to grow. In the first half of 2024 alone, the capacity of new and revived coal plant proposals (23.5 GW) already surpassed all of 2023 (13.6 GW), increasing the total capacity in development from 76.7 GW in 2023 to 97.3 GW. As part of efforts to meet rising power demand, the Indian government has redoubled support and fast-tracked the development of large coal plants, led by publicly financed, state-owned undertakings. Private Indian firms have also expressed interest in constructing 10 GW of coal-fired power capacity over the coming decade, ending a six-year period of scant private involvement in coal power. Largest amongst these players is Adani power with several large proposed expansion projects, including at Kawai power station, which would add a

More coal power under construction than all other power projects in India combined

Power capacity in development by source and status, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor
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Global Energy Monitor

substantial 3.2 GW to the existing 1.3 GW plant, and the Mahan Super Thermal power project, with two expansion units beginning construction and two additional units granted preliminary permits in 2024, bringing plant operating capacity to 4.4 GW.

Solar

Solar PV capacity additions in India have outpaced all other sources over the last five years, reaching a cumulative installed figure of 84.3GW as of May 2024. The total includes 66.5 GW of ground-mounted, 12.9 GW rooftop, 2.6 GW hybrid solar (combined with a wind farm), and 3.4 GW off-grid installations. The significant capacity additions saw India become the world's third-largest solar power generator last year, behind China and the U.S.

The states of Rajasthan and Gujarat have led solar capacity additions in recent years and together account for over 40% of cumulative solar PV capacity nationwide. By contrast, eastern and northeastern states host less than 2% of total solar PV capacity, hindered by a combination of factors including less accessible development sites, less favorable policy conditions, competition with agriculture for land, lower solar resource, a large incumbent coal sector, and a high population density.

GEM data shows 67 GW of utility scale solar projects in development, comprising 21.5 GW announced, 41 GW pre-construction, and 4.4 GW construction projects. Half of this in-development figure (39 GW) is accounted for by 24 large projects over 500 MW in capacity. Such large projects receive support through the Indian Government's Ultra Mega Renewable Energy Power Parks scheme, which facilitates land acquisition, supporting infrastructure, and economies of scale for solar farm developments.

Wind

Globally, India ranks fourth for total wind installations, with 46.4 GW of installed onshore wind as of May 2024. Installations have languished in recent years, though a recovery in FY 2023/24 saw the highest deployment (3.4 GW) since the record year of FY 2016/17 (5.5 GW). Current installations of onshore wind in India are largely constrained within the seven so-called "windy states" that span the western stretch of the nation, with Gujarat and Tamil Nadu accounting for 25% and 23% of total installed wind capacity, respectively. The generally lower wind resources in the eastern and north eastern regions limits the potential rollout of onshore wind.

GEM data shows 14 GW of wind projects in development, comprising 2.1 GW announced, 8.9 GW pre-construction, and 3.0 GW construction projects. Of this in-development wind capacity, 85% is onshore and 55% located within two states (Karnataka 5 GW and Tamil Nadu 2.7 GW). Several recent policies targeting the sector are anticipated to support expanded rollout of wind technologies in the coming years, namely, more ambitious renewable purchase obligations for power distribution companies and wind capacity tenders targeting 10 GW per year for the next five years. A revised strategy for incentivizing the replacement of older generation turbines of less than 2 MW rated capacity with state-of-the-art models is expected to boost wind generation. And in February 2024, seabed leasing commenced for 4 GW capacity around the southern coast of Tamil Nadu, inline with an offshore wind strategy targeting 37 GW by 2030.

Hydropower

Hydropower capacity in India stands at 51.9 GW as of June 2024, with approximately 95% of the total comprising equal shares of run-of-river and dam technologies, and the remainder made up of pumped storage. Hydropower installations cluster in the mountainous Himalayan foothills (~45% of total capacity) and Western Ghats range (~25% of total capacity). Hydropower is a particularly important power source in certain states, with shares of over 82–97% of total capacity in five northern states. GEM data shows 104 GW of hydropower projects in development, comprising 47 GW announced, 42 GW pre-construction, and 15 GW construction projects. Of these in-development projects, 65% are in northern and northeastern states and 35% use pumped storage technology. Hydropower generation hit a five-year low in 2023 when the lowest annual rainfall volumes since 2018 reduced streamflow and water levels in reservoirs. Hydropower generation in India is vulnerable to the effects of a changing climate, which is thought to be driving an increase in hazards related to melting glaciers and extreme rainfall.

China

China remains the world's largest power producer and consumer, with a total installed capacity of 2,920 GW and 94,564 TWh of power consumption in 2023.[6] In 2023, the country consumed more than twice as much power as the United States, the world's second-largest power consumer. The industrial and manufacturing sectors accounted for 63% and 48% of China's total power consumption, respectively, reflecting the country's role as the world's factory.

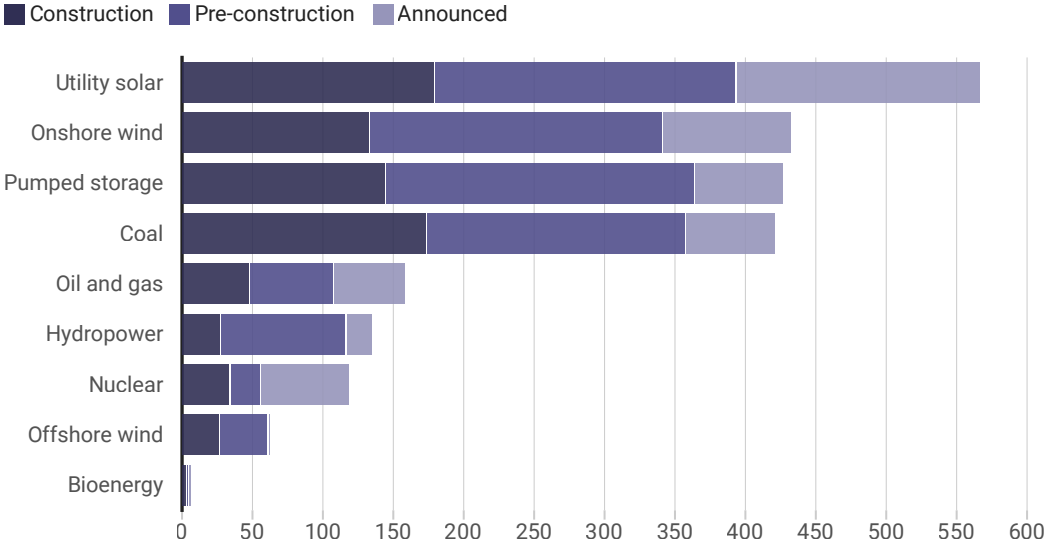
Wind and solar capacity reached 38.4% of China's total power capacity in mid-2024, surpassing coal's share of 38.1% and jointly becoming the largest source of power in the country. However, coal still accounted for nearly 60% of the country's power generation in 2023, while wind and solar power made up 15.5%.

In 2020, China pledged that its carbon emissions will peak before 2030 and reach carbon neutrality by 2060. China's Nationally Determined Contribution under the Paris Agreement, updated in 2021, commits to reaching 1,200 GW of wind and solar installed capacity by 2030. This goal was reached in July 2024, six and a half years earlier than the promised year. However, other commitments, including strictly limiting coal consumption growth, strictly controlling new coal power, reducing energy intensity, and reducing carbon intensity by 2025, got severely off track when approvals of new coal power plants increased fourfold in 2022–23, compared with the previous five-year period of 2016–20, as detailed in a joint analysis by GEM and the Centre for Research on Energy and Clean Air.

On a positive note, the rapid expansion of wind and solar capacity continued in the first half of 2024. Power generation from renewable sources exceeded China's power demand growth for the first time in history during this period. As a result, China may have reached peak carbon emissions in 2023, six years ahead of its commitment.

Over two-thirds of capacity under construction in China is from non-fossil sources

Power capacity in development by source and status, in gigawatts (GW)



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Global Energy Monitor

6. Statistical Communiqué of the People's Republic of China on National Economic and Social Development in 2023

Coal

China operates the largest coal power fleet in the world, with 1,147 GW operating capacity surpassing the rest of the world combined. Since 2015 and the adoption of the Paris Agreement, the country has added 267 GW of new coal power, more than the entire operating coal capacity in India, which has the second-largest coal fleet in the world.

Since the beginning of 2022, an estimated 225 GW of new coal power plants have been permitted. According to GEMs data, 173 GW of coal capacity are currently under construction, which amounts to 76% of the world's total. China also has two-thirds of the world's coal capacity in pre-construction stages.

China's coal fleet is the world's youngest, with an average[7] unit age of 13 years, compared to 42 years for coal units in the G7. China's relatively modern coal fleet uses more advanced supercritical or ultra-supercritical combustion technologies, which can significantly increase efficiency and reduce pollution compared to other combustion types. For comparison, only 3.2% of the capacity in India uses such technologies. The young age and more advanced technology may present a hurdle for the energy transition due to the concern of investment loss and the reluctance to retire such plants.

Since 2016, China's coal plants have gone through a massive flexibility retrofit, aiming to assist wind and solar in mitigating their intermittency. However, despite the rhetoric of coal power playing a "supporting" role, and the pledge to "strictly control" coal consumption growth, power generation from coal increased approximately 12% from 2020 to 2023. Almost half (46%) of the growth in energy use in 2023 came from coal and 70% from fossil fuels, against a target of getting more than 50% of the growth from renewable energy.

Meeting the carbon emission intensity target remains a significant challenge. To achieve this goal, an annual carbon intensity reduction of 7% and energy intensity reduction of 6% are necessary during the 2024–2025 period. The continued construction of coal power plants and their increased power generation will undermine China's efforts to achieve its goal.

In the first half of 2024, China's coal power industry appears to be undergoing a transformation driven by the rapid development of clean energy. China abruptly curtailed approvals for new coal power plants, approving just twelve projects totaling 9.1 GW, equivalent to 8% of what was permitted in all of 2023.

Wind and solar

In 2023, China added 293 GW of new wind and solar power capacity, almost twice as much as in any previous year. The rapid growth trend continued in the first half of 2024, with 102 GW of new solar and 26 GW of new wind power capacity being added. Total wind and solar power capacity reached 1180 GW in mid-2024, for the first time exceeding the country's coal power capacity of 1170 GW.

With 180 GW of utility-scale solar and 159 GW of wind power under construction, which, according to GEM data, is nearly twice as much as the rest of the world combined, China is cementing its position as the global leader in renewable energy development. The 339 GW of utility-scale solar and wind capacity that have reached the construction stage accounts for one-third of all proposed wind and solar capacity in China, far surpassing the global construction rate of just 7%.

How China's coal-centered grid can absorb the rapid growth of wind and solar power presents a big challenge for the continued expansion of renewable energy. Utility-scale solar and wind power are largely generated in the country's north and northwestern regions. Due to the limited transmission and intermittency mitigation capacity, curtailment in the renewable power sector resurfaced after some years of calm. In March 2024, the curtailment rate for solar power exceeded 5% nationwide, a threshold set by the government in 2018. In the East China region, where distributed solar is widespread, the regional

7. Capacity-weighted median of coal unit age

grid and power distribution network are unprepared for the distributed solar boom. Since late 2023, the curtailment and temporary suspension of distributed solar applications has risen significantly in several eastern provinces, which could constrain future distributed solar installations if the ability to absorb solar power is not improved quickly.

Hydropower

By the end of June 2024, China's hydropower capacity reached 427 GW, including 373 GW of conventional hydropower and 54 GW of pumped storage, the highest figures for both technologies globally. During 2021–2023, China experienced a severe drought, causing a 7% drop in hydropower production compared to 2020. Generation bounced back in the first half of 2024, when hydropower, along with other non-fossil sources, helped meet 84% of power demand growth in China.

GEM data tracks a vast pipeline of hydropower projects in development in China, 562 GW or 52% of the global total. Three-quarters of in-development hydropower capacity in China is pumped storage, compared to its 12% share of total operating hydropower capacity. The increasing buildout of pumped storage is in line with the goal of China's National Energy Administration to reach 120 GW capacity by 2030 and can facilitate the integration of China's massive wind and solar additions by providing energy storage and grid stability.

Nuclear

With a capacity of 58 GW, China operates the world's third-largest nuclear fleet. These nuclear installations generated 5% of China's power in 2023 despite having only 2% of the total power capacity. According to Global Energy Monitor, nearly half of the world's nuclear power under construction is located in China. And despite a moratorium on inland nuclear plants imposed after the Fukushima disaster, China is building enough capacity to overtake France within the next few years to become the country with the second-largest nuclear fleet after the U.S.

Gas

Gas generated about 3.3% of power in 2023, playing a relatively minor role in China's power landscape. Gas power accounts for 17% of the country's total gas consumption, of which 42% relies on imports. Although China only accounts for 7.3% of global gas power capacity, over 30% of the world's gas plant capacity under construction is in China, the largest share of all countries, according to GEM.

South Africa

South Africa is the largest energy user on the African continent, with 94% of its total energy supply met by fossil fuels. Coal is the backbone of the South African power sector. With the sixth-largest coal fleet in the world, the country is the most coal-reliant economy among the G20. Longstanding issues with intermittent electricity supply, caused by aging power infrastructure and poor maintenance, culminated in a record year for rolling blackouts in 2023. The situation has driven record installations in small-scale wind and solar PV projects, as households and businesses seek improved energy security. Together with limited growth in electricity demand, the greater generation has seen a marked reduction in rolling blackouts so far this year. However, the power supply position remains precarious, with the South African electricity public utility, Eskom, standing by forecasted supply shortages for the forthcoming winter season.

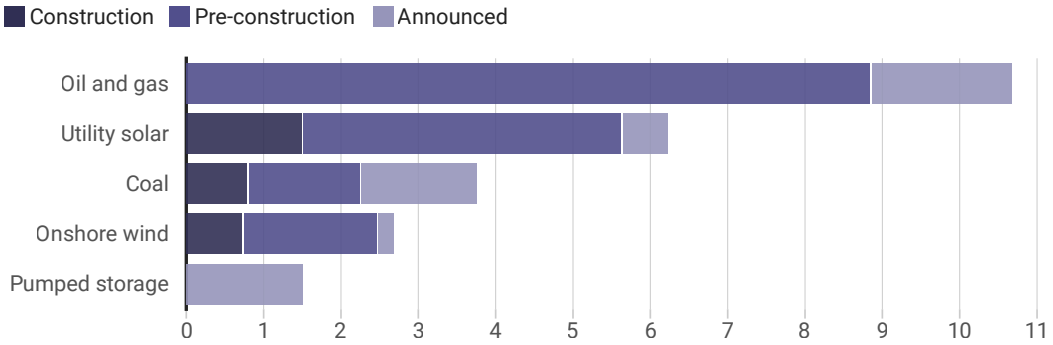
Coal

South Africa hosts 85% of the total coal capacity on the African continent and has the most coal plant capacity in construction or pre-construction phases of any other African country (2.26 GW). The total capacity of South Africa's coal fleet increased by 600 MW in the first half of 2024, with the fifth unit of the Kusile power station completed in April and the mothballing of a 200 MW unit at the Hendrina power station. An additional 800 MW unit at Kusile is expected to join the fleet next year.

Coal phaseout was the cornerstone of the Just Energy Transition Partnership established between South Africa and wealthy nations during COP26, which committed the mobilization of US$8.5 billion in financing to accelerate the nation's decarbonization. However, Eskom approved a plan in May 2024 to allow three coal plants (Hendrina, Grootvlei and Camden) initially scheduled for retirement before 2027 to continue running until 2030, putting $2.6 billion of the climate financing at risk. Furthermore, the updated Integrated Resource Plan (IRP), released in draft by the South African government in early 2024, envisages continued coal use, double the rollout of gas-fired power by 2030 compared to the previous IRP, and less than half the capacity of wind and solar. Energy analysts heavily criticized the draft IRP, and the Energy Minister has since acknowledged the need to rework the plan in light of substantive public comment, also hinting at a revised renewables target with greater ambition.

Three times more wind and utility-scale solar capacity than coal under construction in South Africa

Power capacity in development by source and status, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor
Data include phases/units equal to or greater than specific thresholds: solar 20MW; wind 10MW; hydropower/pumped storage 75MW; coal 30MW; oil and gas 50MW.

Wind and solar

South Africa's wind farms tend towards the higher wind speeds in the southwestern cape provinces, and with 3.7 GW installed capacity nationwide, represents the largest wind fleet on the African continent. The transmission grid in this region is now at capacity and has limited further wind installations, with no bids for wind projects registered in the last public capacity auction out of a 3.2 GW allocation. However, the upcoming public auction targets additional wind capacity. GEM data shows 2.7 GW of wind projects in development, comprising 0.2 GW announced, 1.7 GW pre-construction, and 0.7 GW construction projects. Approximately 2.2 GW of this in-development capacity is targeted for commissioning by 2025, and it will increase the current operating wind fleet by 60% if built.

Distributed solar capacity in South Africa has seen rapid uptake in recent years, helped by power market reform, increasing demand for energy security, and environmental requirements of large energy users. Most new installations are for the commercial and agricultural sectors and exploit a change to licensing rules for private systems with less than 100 MW capacity. This segment of solar PV installations in South Africa now constitutes close to 6 GW capacity, with close to half of that figure added in the last 18 months. GEM data tracks prospective solar projects greater than 20 MW in South Africa, showing 6.2 GW of solar projects in development, comprising 0.6 GW announced, 4.1 GW pre-construction, and 1.5 GW construction projects. Existing grid-connected solar PV capacity in South Africa would double if in-development capacity targeting commissioning by 2025 were built on time.

Nuclear

The 1.9-GW Koeberg plant, which began its first commercial operation in 1984 near Cape Town, is the country's and the continent's only nuclear plant. In July 2024, the National Nuclear Regulator approved a plan to extend the operation of the 930-MW Unit 1 for another 20 years while the extension of Unit 2 is under consideration. The South African Minister of Electricity and Energy announced in July 2024 a plan to procure 2,500 MW new nuclear capacity with approval from the National Treasury ongoing.

Egypt

Egypt's electricity consumption has more than doubled in the last twenty years. Greater fossil gas and oil generation has largely fulfilled this growing demand and now makes up 88% of the country's electricity generation. However, the Egyptian government plans a significant change in the power mix, setting an ambitious target for renewable energy to account for 42% of total electricity production by 2035, mainly comprising wind and solar PV.

Oil and gas

Egypt occupies a vital role in the global crude oil and natural gas trade due to its management of the Suez Canal and the Suez-Mediterranean (SUMED) Pipeline, both essential to the global energy trade network. Despite the significant discovery of the Zohr offshore gas field in 2015, Egypt's journey to becoming Africa's top natural gas producer has been challenging. The increase in natural gas production was impeded in the 2020s due to a combination of technical challenges and a lack of new fields. As a result, Egypt has had to navigate a complex energy landscape, relying more on LNG imports to meet the growing demand, particularly during the cooling seasons. GEM tracks 2,675 GW of new gas plant capacity across three projects in Egypt. However, two of these projects, representing 2,250 GW, appear stalled, as this development capacity is no longer listed in the annual reports of respective developers.

Hydropower

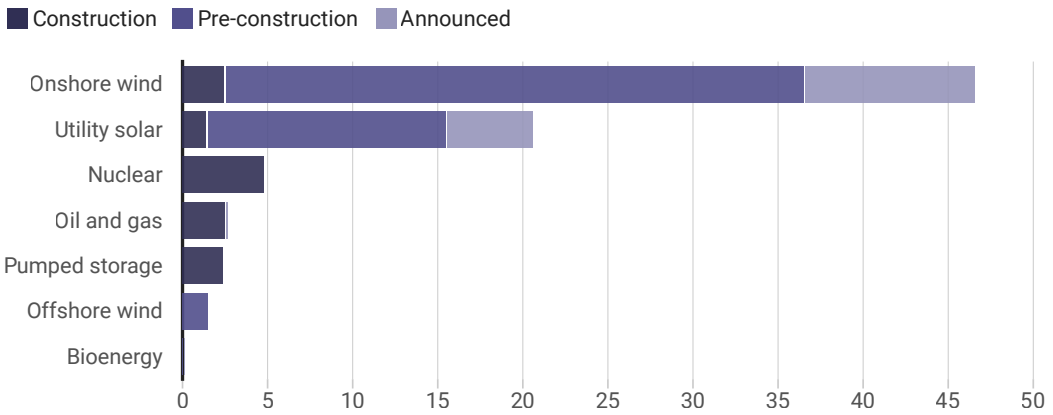
Located on the River Nile, Egypt's 2,778 MW Aswan hydroelectric power plant provided nearly half of its electricity in the decades following its commissioning in the late 1960s. With the rise of thermal power stations, the share of electricity generated from hydro resources has decreased to 6% today. However, with 13,500 MW capacity, it remains Egypt's largest source of clean electricity. Egypt has a single hydropower project currently in development: the 2,400 MW Gabal Ataqah hydroelectric plant, launched in collaboration with the Chinese company Sinohydro in 2019. It will be Egypt's first power plant to generate electricity using water storage and pumping during peak times, with commissioning scheduled for 2024.

Solar and wind

Egypt hosts ample solar and wind resources, yet onshore wind and solar PV account for little over 5% of electricity generation. Fulfilling the government's 2035 Integrated Sustainable Energy Strategy will require a significant rollout of renewables, particularly from

Four times more non-fossil power than oil and gas capacity under construction in Egypt

Power capacity in development by source and status, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor
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wind and solar, which are foreseen to make up 14 and 21% of power generation, respectively. GEM's data on renewable projects in development shows Egypt with the fourth largest amount in the BRICS, with wind and solar comprising 91% of its 76 GW pipeline. Although the proportion of wind and solar projects in construction is relatively low at 6%, there are signs of several major projects progressing through the pipeline. Two of the largest wind projects in development, one led by the UAE's Masdar and the second by Norwegian Scatec, acquired land access agreement with the Egyptian government, and the 500 MW Kom Ombo Al Nowais solar farm has progressed ahead of schedule, potentially seeing operation later this year.

Nuclear

Egypt's first nuclear power plant, located in El Dabaa on the Mediterranean coast, is currently under construction. The plant will feature four reactors, each with a capacity of 1,200 MW. Construction work began on the fourth reactor in January 2024. The first reactor is scheduled for commissioning in 2026, with all four reactors expected to be fully operational by 2030. The Russian State Atomic Energy Corporation (ROSATOM) is developing the project. Egypt's Nuclear Power Plant Authority (NPPA) will own and operate the facility.

Ethiopia

Ethiopia is Africa's second most populous country and one of the region's fastest-growing economies. Despite a robust economy, much of the population remains vulnerable to climate-related hazards, laid bare most recently during the 2022 drought in Ethiopia's eastern Somali Region, which was the most severe in 40 years. Inadequate infrastructure contributes to this vulnerability, including deficient access to reliable electricity, affecting half of the country's 123 million inhabitants.

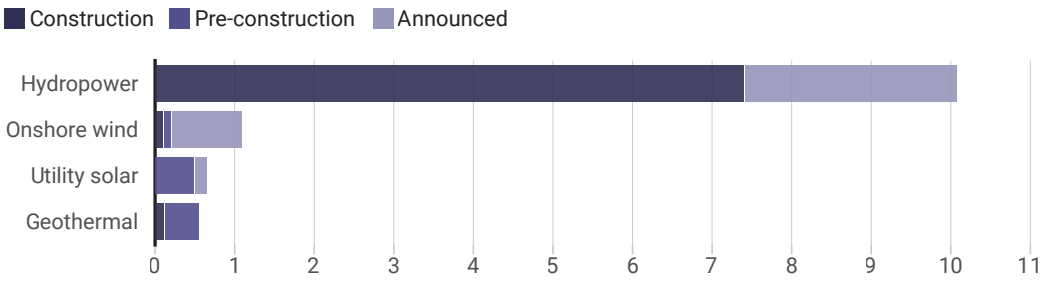
Ethiopia's National Electrification Program targets universal electricity access by 2030, underpinned by grid expansion and increases in generating capacity from 5 GW to 19.9 GW, as envisaged in the Ten-Year Development Plan. The additional capacity includes expansion of hydropower, which currently supplies over 90% of total generation, as well as wind, solar, and geothermal sources. Ethiopia's power utility expects capacity to reach 9 GW total generation capacity by 2025 with the addition of under-construction hydropower, wind, and solar plants.

Hydropower

With over 5 GW in operation, Ethiopia hosts the most hydropower capacity of any African country. It uses this power source to supply over 90% of its electricity needs. Constructed between 2011 and 2023, the Grand

Hydropower makes up almost all power capacity underconstruction in Ethiopia

Power capacity in development by source and status, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor
Data includephases/units equal to or greater than specific thresholds: solar 20MW; wind 10MW; hydropower 75MW;geothermal 1MW.

Ethiopian Renaissance Dam (GERD) currently contributes most of this operating capacity. As of March 2024, the dam's construction was 95% complete.

According to GEM data, Ethiopia has 10,078 MW hydropower capacity in development. The largest project is the Koysha Hydropower Dam on the Omo River, which will be the country's second-largest, after the GERD, with a capacity of 2,170 MW.

Despite the considerable potential for hydropower expansion, the sector faces several controversies and challenges. Notably, the construction of the GERD has sparked tensions with Egypt and Sudan, who are concerned that the dam could affect their water supply (the dam sits on the Blue Nile, a tributary that supplies 85% of the River Nile's water flow). Furthermore, the vulnerability of Ethiopia's hydropower generation to lower water availability is a concern in the drought-prone region, prompting renewed focus on diversifying the energy mix.

Geothermal

Ethiopia sits at the northern end of the Eastern Africa Rift, an area of tectonic activity with substantial potential for geothermal electricity generation. However, Kenya is the only country in the region to have exploited the resource, with over 900 MW installed capacity. By comparison, Ethiopia's single 7.3 MW Aluto Langano geothermal power plant, now 20 years old, is nonoperational. Expansion and recommissioning of the Aluto Langano site is expected to lift capacity to 70 MW, and GEM data tracks an additional 480 MW of geothermal capacity in development stages across a further three projects. However, ambitious plans to tap into this underutilized resource are hampered by an incomplete policy framework and a labored approval process for new exploration licenses.

Wind and Solar

With around 500 MW installed wind capacity, Ethiopia hosts the fourth-largest wind fleet on the African continent. Wind energy generation has increased fivefold over the past three years, driven by large-scale projects like the 120 MW Ashegoda Wind Farm. By contrast, grid-connected solar technologies are limited. Ethiopia possesses significant wind resources, particularly to the country's east, and receives nearly 3,000 hours of sunshine annually, making wind and solar leading candidates for non-hydropower capacity additions.

According to GEM data, 1,086 MW of wind projects and 650 MW of solar projects are currently under development, accounting for 74.8% of the non-hydropower capacity under development. However, only the first phase (100 MW) of the Assela wind farm is under construction. Other significant projects are in the development pipeline, including one of the 300 MW Aysha Wind Project, set to be the country's largest, for which UAE's AMEA Power signed a Power Purchase Agreement with Ethiopian Electric Power in August 2024. In January 2023, Ethiopia's minister of finance signed an MoU Ethiopia with Abu Dhabi Future Energy Company, or Masdar, to develop a 500 MW solar project.

Iran

Iran holds some of the world's largest proven oil and natural gas reserves, ranking third in oil and second in gas in 2021. This significant fossil endowment has enabled a power sector dependent on gas and oil for over 90% of generation, which ranks amongst the top ten globally for the emissions intensity of power and contributes to Iran's position as the world's eighth-largest greenhouse gas emitter in 2023. Despite the energy abundance, rapidly rising electricity consumption outstrips supply, driven by subsidies, population growth and rising temperatures (boosting cooling demand). Increasingly frequent droughts add to the worsening electricity crisis during which hydropower and pumped storage facilities underproduce, leaving substantial power shortfalls during peak demand in summer, which has recently necessitated managed restrictions on supply to industrial users. Recent capacity additions have fallen far short of plans for 10,000 MW of renewable capacity by the end of the current government's administration (August 2025). Meanwhile, GEM data show a robust pipeline of oil and gas power plant projects that risk further entrenchment of fossil power and new requirements for imported gas.

Oil and gas

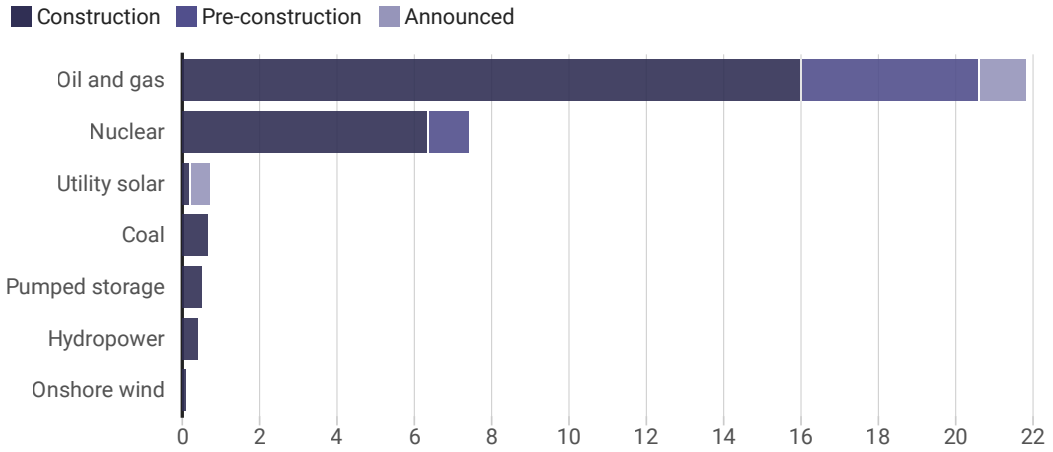
Despite being the top natural gas producer in the Middle East, Iran faces a gas shortage, particularly during winter, with a peak daily shortfall of 300 million cubic meters in recent years (about one-third of domestic daily demand). Losses during extraction and transport exacerbate the supply situation, with up to a quarter of production lost. Only substantial investments can stem the imminent decline in productivity at the South Pars field (three-quarters of Iran's gas production). Despite the National Iranian Oil Company penning a $40 billion memorandum of understanding on energy cooperation with Russia's Gazprom in July 2022, contracts for new production have yet to materialize. Nevertheless, according to GEM data, Iran has 21.8 GW of oil and gas plants under development, with 73% of this capacity already in the construction phase.

Nuclear

Iran currently has a single nuclear power plant, Bushehr 1, with a capacity of 915 MW, which was first connected to the grid in 2011. In 2023, nuclear energy contributed less than 2% of the country's total electricity generation. However, the Iranian leadership has

Two-thirds of Iran's power capacity in development is oil & gas

Power capacity in development by source and status, in gigawatts (GW)



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signaled plans for a significant scale-up, some 20,000 MW of nuclear energy by 2041. These plans include an additional two units at the Bushehr site, the smaller 300 WM Darkhovain plant near the country's western border with Iraq, and up to four units in the Southern Hormozgan Province. These plants under construction total 6,357 MW according to GEM data.

Wind and solar

Iran's modest wind and solar installations belie substantial domestic wind and solar resources, particularly its ample 300 days of sunshine annually. Last year, policymakers set ambitious targets of 20 GW of total renewable capacity by 2027 (including hydropower) and 10 GW of solar capacity by 2030, increasing to 50 GW of renewable energy by 2031. Yet, in the past fiscal year, less than 75 MW of renewable energy capacity was added, falling far short of an initial projection of 2,500 MW. GEM's data show that only 200 MW of solar and 100 MW of wind capacity are under construction in Iran, with no further projects in development. Hindering future growth prospects are international sanctions that dampen foreign investment, restrict access to global financial markets, and limit technology transfer.

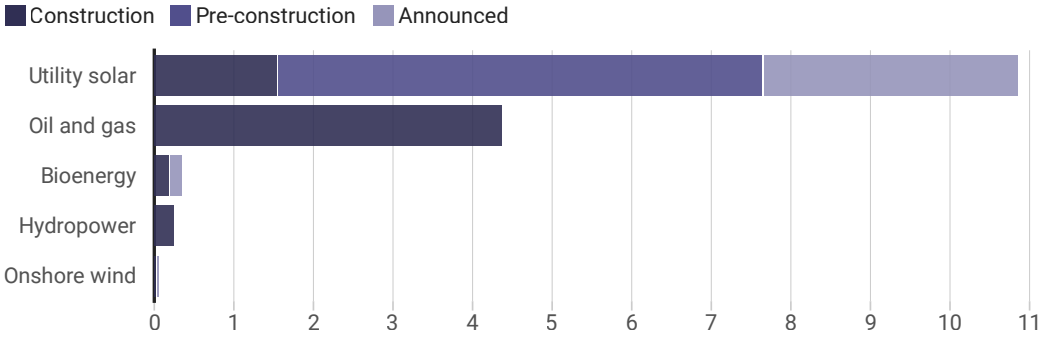
The United Arab Emirates

The UAE is a leading natural gas and oil producer, amongst the top ten globally for total liquid fuels, and the third largest in the Organization of Petroleum Exporting Countries (OPEC). These resources make up the bulk of its total energy supply and are a major component of the value of its total exports. The UAE national oil company has investments in place to achieve 5 million barrels per day of crude oil production capacity by 2027 and become self-sufficient in gas supply by 2030 (currently reliant on gas imports from Qatar for one-fifth of total supply). The planned gas growth will require costly development and expansion of several new gas fields.

Despite its reliance on fossil fuels, which have, until recent years, powered all electricity generation, the country plans to diversify its energy sources and reduce emissions. Underpinning these ambitions is a commitment to reach net zero emissions by 2050 and an updated National Energy Strategy, targeting triple renewable power-generation capacity and a 30% clean energy share in the power mix by 2030. Given its geographical constraints, which limit hydropower and wind deployment, the UAE is focusing on further developing nuclear and solar energy to diversify its power generation mix and reduce emissions.

Two-thirds of the UAE's power capacity under construction is oil & gas

Power capacity in development by source and status, in gigawatts (GW)



Source: Global Integrated Power Tracker, September 2024, Global Energy Monitor
Data include phases/units equal to or greater than specific thresholds: solar 20MW; wind 10MW; hydropower 75MW; bioenergy 30MW; oil and gas 50MW.

Gas

The power sector in the UAE is dominated by gas plants, which covered virtually all electricity generation five years ago. This share of generation has now dropped to close to 70% as nuclear and solar capacity generation has picked up. GEM tracks 4.4 GW gas plant capacity in construction in the UAE across five projects, the largest of which is the 2.4 GW Fujairah F3 Integrated Water and Power plant. However, the new capacity will mainly replace older gas plant capacity due for retirement (3.3 GW by 2027) and add new desalination capacity.

Nuclear

The Barakah Nuclear Power Plant became the country's and region's first nuclear power station when the first of four APR-1400 reactors commenced operation in 2021. The fourth unit came online in September 2024 and, with a total output of 5,600 MW, aims to supply around 25% of the UAE's electricity.

Solar

Virtually all of the UAE's solar projects consist of large utility-scale projects, including the 2 GW Al Dhafra and 1.2 GW Noor Abu Dhabi solar farms, amongst the largest single-phase installations in the world. The planned completion of the Al Ajban and Mohammed Bin Rashid Al Maktoum solar parks in 2026 would increase total installed solar capacity by 60%.