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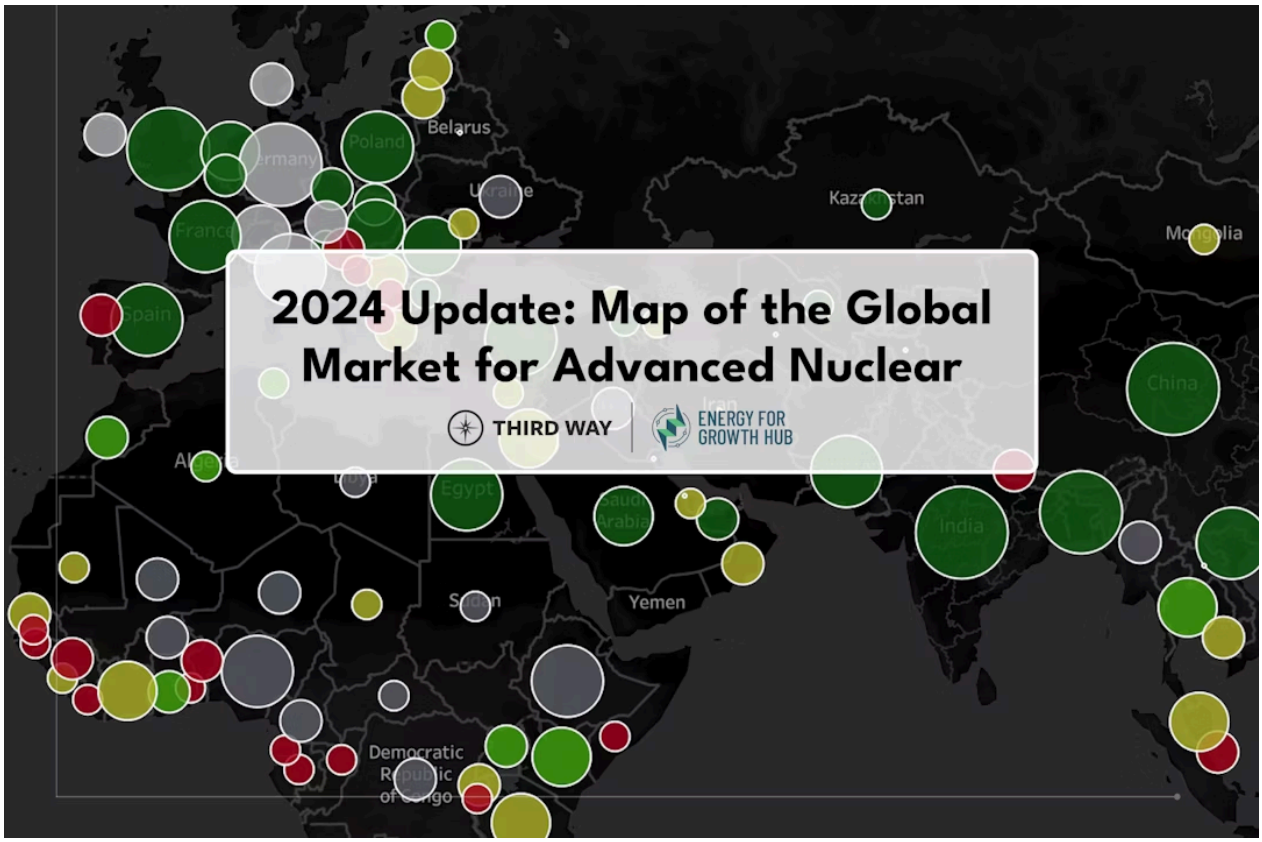
2024 Map of the Global Market for Advanced Nuclear: Future Demand is Bigger Than Ever



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Takeaways

- Third Way and the Energy for Growth Hub are releasing the latest update to its map of the global market for advanced nuclear, tracking both readiness of country markets for advanced nuclear and projected energy needs out to 2050.
- Since 2020, we've seen steady progress in international demand and readiness for nuclear energy, with the market potentially tripling by midcentury.
- New developments (e.g., artificial intelligence) that are just emerging may increase this market demand *even further*. Although long-term projections remain uncertain, global demand for advanced nuclear is poised to grow well beyond current expectations.
- For these reasons, the United States must establish a coordinated federal strategy on exports, complete advanced nuclear demonstrations, and provide enhanced tools to export financing agencies so that the US can effectively compete in a potentially massive market that has myriad implications for its national interests.

Third Way and the Energy for Growth Hub are pleased to release the latest update to the map of the global market for advanced nuclear, a collaboration between the two organizations that began with the original map in 2020 and subsequent updates in 2021 and 2022.

When Third Way and the Energy for Growth Hub began this partnership, this market was largely theoretical. However, just in the last few years, we have witnessed significant change: tangible evidence of increasing international interest in nuclear energy broadly and advanced nuclear more specifically.

Russia's aggression against Ukraine rekindled worries about energy security worldwide, driving renewed demand for nuclear energy globally and increased urgency in the US to meet this demand. Central and Eastern Europe has been at the forefront of international interest in US advanced nuclear technologies. In response, we have seen decisive actions from the Biden-Harris Administration, including Export Import Bank's recent commitment to support development of the NuScale SMR project in Romania.

Although there have been clear and visible signs of progress, what is *just emerging from beneath the surface* could greatly shape the future global market for advanced nuclear. While economic growth

and urbanization will be the primary drivers of higher energy demand in the future, we are also starting to witness the takeoff of soaring energy demand from data centers as a result of the development and expanded use of artificial intelligence and machine learning. Other energy-intensive industries, like semiconductor and chip fabrication, are also contributing to expanding interest in advanced nuclear. The real demand that we're now just seeing (see the very recent Google-Kairos and Amazon-X-energy agreements) is likely *just the tip of the iceberg*.

Moreover, as we fall further behind on climate action and face increasing climate impacts, the demand for nuclear energy will rise. We'll require clean, resilient, and abundant energy to tackle growing water stress and more severe weather phenomena.

At this point in time, it is essentially impossible to quantify or project the ultimate impact of such factors on international demand for nuclear energy out to midcentury. Nevertheless, it is undeniable that these global and technology trends will dramatically increase the size of the international nuclear market in the long term. These emerging trends mean that our projections are highly-conservative and the market is likely to be far greater than presently estimated.

Against this backdrop, near-term policy decisions in the US are crucial to ensure our industry has a competitive foothold in this potentially massive market, one in which US global leadership is absolutely critical to our climate, commercial, geopolitical, and security interests.

Topline Takeaways and 2024 Updates

The major update with the 2024 map includes all new information on nuclear readiness and revised growth projections for 146 countries out to 2050. We also include the latest additional electricity demand estimates for coal replacement, electric vehicles, desalination, and other industrial processes. (Note: country estimates for 2050 do not include data center or AI demand because no credible long term projections are available and such demand is geographically nonspecific; more details are explained in the methodology note.)

Topline Takeaways

1. Electricity demand is growing rapidly and will continue through the foreseeable future

- Total global electricity consumption in 2050 is projected to increase to over 55,000 TWh annually.

- Additional demand is 26,900 TWh – or the equivalent of adding more than six United States' worth of power consumption by 2050.

- These projections are higher than ever, and do not yet include additional demand from AI and data centers (see below).

- Around 71% of new demand will be outside of High Income Countries.

2. Advanced nuclear is well positioned to meet this new demand

- 84% of all new electricity demand will occur in countries we rate as "ready by 2030" (Green) or "potentially ready by 2030" (Light Green).

- About 95% of coal replacement needs are in Green and Light Green countries.

- A total of 98 countries could be markets for advanced nuclear power by 2050.

- 28 countries currently have commercial nuclear power while 10 countries do not but are viable markets today. An additional 10 countries are potential markets for advanced nuclear by 2030, and up to another 50 by 2050.

3. The global market for nuclear power could potentially triple by 2050

- Under our baseline assumptions (20% of new demand supplied by nuclear in Green countries, 10% in Light Green, and 5% in Yellow), we estimate that around 16% of all new electricity demand could be served by nuclear power by 2050.

- This 16% figure implies new nuclear generation of over 4,300 TWh annually, roughly correlating to a potential market size of ~$387 billion per year based on a tariff of $90/MWh.

4. Coal replacement, EVs, and other uses will increase the potential nuclear market even further.

- If just 20% of coal generation in Green and Light Green countries were replaced with nuclear, this would add another 2,150 TWh, or roughly $195 billion annually.

- 100% coal replacement by 2050 in Green and Light Green countries would add 10,800 TWh or $970 billion.

- Poland has extremely significant coal-replacement needs. At almost 140 TWh this is about one-half of the projected demand growth in the country.

- South Africa's coal-replacement needs are even more significant. At 225 TWh, this is 130% of its additional electricity demand.

- If 50% of new demand from electric vehicles is served by nuclear in 2050, the additional demand is 2,640 TWh or $237 billion annually.

The following are some notable new findings and specific updates/changes since the 2022 map:

Readiness changes

- Estonia was upgraded to "potentially ready by 2030" (Light Green).

- Eswatini entered into the "potentially ready by 2050" (Yellow) category for the first time.

Regional aggregates

- Electricity demand in East Asia and the Pacific will more than double by 2050, accounting for 36% of the total global increase.

- Electricity demand in South Asia will increase about 3x in 2050, from 2100 TWh in 2022 to 8260 TWh in 2050, accounting for 22% of the total global increase.

- Africa will account for approximately 7% of total additional demand in 2050 or 1950 TWh.

Emerging Factors to Significantly Affect Future Global Demand for Advanced Nuclear

Our projections are highly-conservative because they do not include additional demand from new technologies. As detailed in the methodology note, this map update is based on the latest economic growth projections and does not account for the additional impact of artificial intelligence and data center infrastructure on electricity demand out to 2050.

But with the milestone commercial agreements between Google and Kairos Power and Amazon's announcement to invest in X-energy and spur advanced reactor deployment around the US, it appears that we are now observing the beginnings of a potential tidal wave of demand for advanced nuclear caused by AI and data centers.

Beyond uncertainties in the future geographical distribution of data center infrastructure, the unprecedented nature of the AI power boom means that there are currently no credible long-term projections. The International Energy Agency (IEA), in its high-case scenario, projects that global

electricity demand from artificial intelligence and data centers will rise to 800 TWh by 2026, up 75% from 460 TWh in 2022.

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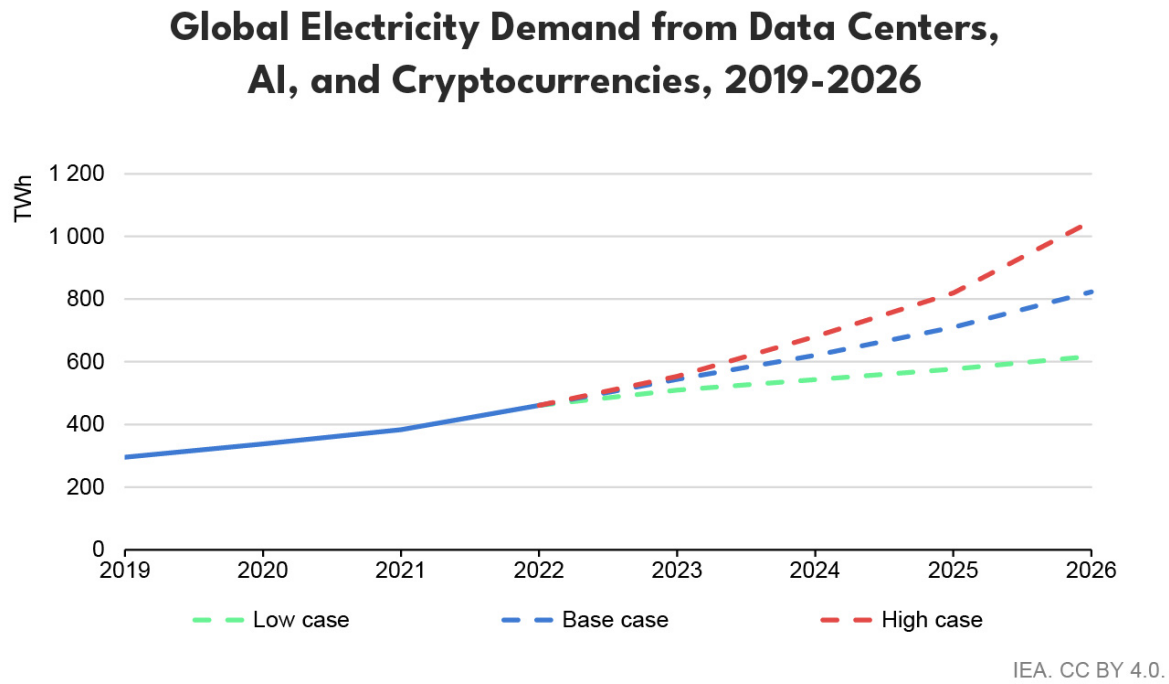

Notes: Includes traditional data centres, dedicated AI data centres, and cryptocurrency consumption; excludes demand from data transmission networks. The base case scenario has been used in the overall forecast in this report. Low and high case scenarios reflect the uncertainties in the pace of deployment and efficiency gains amid future technological developments.

Source: International Energy Agency. Electricity 2024. Organisation for Economic Co-operation and Development (OECD). January 2024. https://www.iea.org/reports/electricity-2024. Accessed October 2024.

Projecting these trend lines out to midcentury will result in *highly* divergent results. Presently, it appears that the growth of artificial intelligence and data centers is pushing the boundaries of our capacity to build generation and transmission infrastructure, and long-term global electricity consumption from these sources will ultimately be determined by our ability to rapidly mobilize capital and supply chains towards clean energy deployment.

However, to provide some indication as to the scale of potential impact from AI and data centers, we are already seeing that the global power consumption from these sources is on par with the total electricity use of *entire countries*. The 460 TWh of total power consumption from AI/data centers in 2022 would have ranked it the *11th largest country in the world in terms of electricity usage*, right under France.

AI Consumption (TWh) (2022)

Countries	Total Consumption
China	8,849
United States	4,277
India	1,852
Russia	1,119
Japan	1,036
Brazil	679
Canada	636
Korea, Rep.	607
Germany	561
France	470
AI/Data center/Crypto	460
Saudi Arabia	399
Mexico	348
Indonesia	332
United Kingdom	326

Source: International Energy Agency. Electricity 2024. Organisation for Economic Co-operation and Development (OECD). January 2024. https://www.iea.org/reports/electricity-2024. Accessed October 2024.

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Then, assuming the high-case scenario to 2026, AI/data centers are projected to be the *6th largest country* in the world in total power consumption:

AI Consumption (TWh) (2026)

Countries	Total Consumption
China	9,231
United States	4,591
India	2,113
Japan	1,083
Russia	1,064
AI/Data center/Crypto	800
Brazil	706
Germany	640
Canada	628
Korea, Rep.	603
France	527
Indonesia	438
Saudi Arabia	415
United Kingdom	414
Mexico	397

Source: International Energy Agency. Electricity 2024. Organisation for Economic Co-operation and Development (OECD). January 2024. https://www.iea.org/reports/electricity-2024. Accessed October 2024.

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Therefore, although the exact long-term impact of AI and data centers is difficult to pin down at present, current trends suggest a potentially outsized effect on global power consumption in 2050 and hence also, the size of the future global market for advanced nuclear.

Outside of power, innovations in advanced nuclear are now opening the possibility of new uses and applications for nuclear, which will grow the global market *even further*. Given their smaller sizes, many advanced nuclear designs are optimal alternatives to replace retiring coal generation assets. Energy-intensive users are now looking to deploy advanced nuclear technologies for high-temperature steam to drive a variety of industrial applications. In the future, advanced nuclear could potentially also power large-scale direct air capture systems or play a significant role in clean hydrogen production.

And as we increasingly feel the effects of a changing climate, the ability of advanced nuclear to serve these nontraditional applications will become more and more valuable over time. For

example, desalination demand projections were included in this map update, and climate-induced water stresses may increase this demand to new levels around the world. Although the exact effect of climate on these demand projections is challenging to quantify with any accuracy, it is yet another factor that has uncertain but potentially dramatic impacts on the future global demand for advanced nuclear.

The Time to Act is Now

We're now witnessing a surging global market—critical to core US national interests—that may be even larger than we can currently imagine.

While it will take years for the full story to play out, what is abundantly clear is that decisions we make today will significantly affect the trajectory of US competitiveness and leadership in this market for decades to come.

Here are the policy steps we must take in the near term:

Enable a cohesive, coordinated federal strategy on US nuclear exports by...

Including the *International Nuclear Energy Act* amendment in FY25 NDAA: Our primary competitors in the global arena are vertically-integrated, state-owned enterprises. US private industry is essentially competing against national governments, which means the federal government has a vital role to play in leveling the playing field. The *International Nuclear Energy Act of 2024* (S.A. 3197 in the Senate FY25 NDAA) would facilitate a more holistic, whole-of-government strategy on US civil nuclear exports. The amendment would encourage the establishment of a civil nuclear coordination and strategy office within the White House, and would provide authorities to the State Department on advance engagement and capacity building activities with prospective partner countries—something our rivals have been quite adept at doing.

Ensure we have advanced nuclear solutions to serve the international market by...

Securing robust funding for advanced nuclear demonstrations in FY25 Appropriations: The enhanced flexibility, economics, and passive safety characteristics of US advanced nuclear technologies are poised to give American industry a competitive edge and prepare it to meet the diverse needs and demands of the future international market. Hence, it is absolutely vital that we meet the remaining needs of our vanguard advanced reactor demonstrations, such as those initiated by the US Department of Energy's Advanced Reactor Demonstration Program (ARDP). A strong funding mark in the FY25 Appropriations Bill will be needed to get our demonstrations on

track to completion and start operations. Starting with FY25 appropriations, sustained and robust federal support will be imperative so that our advanced reactor projects can get across the finish line. In June, Third Way and a coalition of NGOs and labor unions recommended redirecting the remaining funds within the Civil Nuclear Credit Program (CNCP) towards the ARDP in the FY25 Energy and Water Development Appropriations Bill.

Enhance our ability to provide competitive financing packages by…

Providing the needed authorities and tools to US export financing agencies, including within the upcoming reauthorizations for DFC and EXIM: Financing is a crucial component of the US nuclear sector's competitiveness in overseas markets. Thus, it is essential that we provide our export financing agencies—Export-Import Bank (EXIM), US International Development Finance Corporation (DFC), US Trade and Development Agency (USTDA), etc.—the necessary authorities and tools to enable our industry to win deals abroad and deploy US advanced nuclear technologies at scale. For example, the *Civil Nuclear Export Act* proposes an explicit inclusion of nuclear energy in EXIM's list of Transformational Export Areas, affording US nuclear exporters access to preferential rates and terms, including when they are in direct competition with entities associated with the People's Republic of China. Highlighting the importance of such provisions will be critical so that they are included in the upcoming reauthorization bills for both EXIM and DFC.

How To Use This Map

Our map includes several features that will make it easy for policymakers and advocates to find useful information on potential advanced nuclear markets around the world. On the map, every country included in our analysis is marked with a circle. The size of each circle represents the magnitude of the projected increase in energy demand for the corresponding country. The color of each circle illustrates a country's ranking on our 6-stage scale that assesses relative preparedness and motivation for the development of advanced nuclear power. You can find the complete dataset for our analysis here. The map contains seven filters that show:

- A 6-stage scale describing each country's relative preparedness and motivation for the development of advanced nuclear power.
- Projected percentage growth in national electricity demand from 2018-2050.
- Projected additional electricity demand in TWh for each country in 2050.

- Projected demand from additional demand drivers that are currently nascent markets, or would not be included in the baseline model, including Coal Replacement, Desalination, EV Transition, and electrification of Industry.

- The World Bank's four Income Groupings: low, lower-middle, upper-middle, and high.

- The NTI Nuclear Security Index ratings that assess actions related to supporting global nuclear security efforts.

- The NTI Nuclear Security Index rankings of 46 countries with nuclear facilities to assess actions to protect those facilities against sabotage.

In order to understand the potential global market for advanced nuclear technologies, we set out to determine two things: Where is the opportunity (using new energy demand), and where can nuclear power contribute in a meaningful way (using our "readiness" score)?

We define a country as "ready" for nuclear by considering if it could be a customer for an advanced nuclear supplier and credibly negotiate a purchase agreement with an international supplier country over the timeframe given. We determine this by using a 10-point checklist covering internal institutions and controls such as policy and regulatory agencies, as well as external signals of interest such as engagement with supplier countries and international institutions like the International Atomic Energy Agency. More information on the scoring methodology can be found here.

To estimate future electricity consumption, we use historical data to establish a trend based on income correlations. We then extrapolate this relationship to 2030 and 2050 for each country, using data and forecasts from the United Nations, International Energy Agency, International Monetary Fund, and the World Bank. More information on the electricity projection methodology is available here.