Methodology

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ENERGY FOR GROWTH HUB

Estimating Future Nuclear "Readiness"

We use a basic 6-stage scale to describe a country's relative preparedness and motivation for the development of advanced nuclear power. A country that is "ready" for advanced nuclear power could reasonably be seen as a potential export market by a nuclear corporation.

- **Green** - Countries that already own and operate nuclear power reactors, have begun construction already, or are actively accepting bids to construct reactors with a reasonable probability of success. These countries have completed the IAEA Milestones process. **Ready by 2030.**
- **Light Green** - Countries with significant demonstrated interest and capacities. This includes governments with formal regulatory and policy authorities in charge of nuclear energy development or that are significantly advanced in the IAEA Milestones process or have signed "hard" MOUs with supplier countries to develop technical capacity with the explicit goal of eventually constructing a reactor. **Potentially ready by 2030, likely ready by 2050.**
- **Yellow** - Countries that have shown some interest in developing nuclear power or have taken some fundamental first steps toward building the necessary capacities. This includes strategy development, formal regulatory authorities, significant IAEA engagement, or signing "soft" educational or exploratory MOUs with supplier countries. **Not ready by 2030, potentially by 2050.**
- **Red** - Countries with low need, no demonstrable interest, or very low capacity. **Unlikely ready by 2050.**
- **Grey** - Countries that explicitly prohibit nuclear power or are planning a full phase-out. These countries are non-markets in any foreseeable future.
- **Black** - Countries that are listed as "Conflict-Affected States" by the World Bank or are under international sanctions related to their nuclear program or for aggressive actions against another country. These countries are non-markets in the foreseeable future.

Some Notable New Findings and Specific Updates/Changes Since 2024

Readiness changes

- Ghana was upgraded to "potentially ready by 2030" (*Green*) following the launch of a formal nuclear construction bidding process.
- Singapore entered into the "potentially ready by 2050" (*Yellow*) category after signing a Section 123 agreement with the United States.

- Togo advanced to "potentially ready by 2050" (*Yellow*) after signing a nuclear cooperation MoU with US-based advanced reactor company Nano Nuclear.
- Italy has reentered the readiness framework as "ready by 2030" (*Green*) as a result of officially initiating nuclear policy discussions following a 25-year ban.

Regional aggregates

- Electricity demand in East Asia and the Pacific will nearly double by 2050, accounting for 32% of the total global increase.
- Electricity demand in South Asia will more than double in 2050, accounting for 14% of the total global increase.
- Africa is projected to contribute approximately 8% of global additional demand in 2050. Latin America and the Caribbean will account for 9%.

Projecting Electricity Demand

Our model draws on six data points from four sources:

- Our World in Data:
  - *Electric power consumption (kWh per capita)* which is originally sourced from Ember and generally available 1985-2024. Total consumption is calculated by multiplying *kWh per capita per person* by *population*.
- World Bank's *World Development Indicators*:
  - *GNI, Atlas Method (current US$)*, is sourced from the World Bank, and is available up to 2024.
  - *GNI per capita* is calculated by dividing GNI, Atlas Method (Current US$) by population.
- United Nations *World Population Prospects 2024*
  - *Population, total* in 2023 and medium variant projects for 2030 and 2050.
- IMF, *World Economic Outlook Database*, October 2025
  - *Gross domestic product, constant prices, % change* is available from 2023-30. The 2030 growth rate forecast is treated as the long-term projection for a given country.

Our model to project the growth in country-level electricity demand in 2030 and 2050 consists of several parts:

1. **Characterizing the relationship between income and electric power consumption.** We use per capita electricity consumption and GNI per capita for all years 1985-2022, creating a large sample size (n = 1053) and strong correlation (R^2 = 0.71). The analysis treats every Country/Year data point as the average person in that given country in a given year. For data availability

reasons, the sample starts in 1985. With this data, we can use the trend to estimate per capita electricity consumption based on income.

2. **Estimating GNI per capita in 2030 and 2050.** Using World Bank GNI data from 2023 and IMF GDP growth projections between 2023 and 2030 (GDP growth is assumed to mirror GNI growth). GNI was inflated by the given growth rate for each country between 2023 and 2050. All dates after 2030 assume the same medium-term growth rate given for 2030. GNI per capita is then determined by dividing this projection by the medium variant population projection from the UN.
3. **Estimating electricity consumption per capita.** While a trend is not itself strictly predictive, this basic model makes the assumption that over the long run, countries will regress toward the historical global mean. By applying the equation from our characterization in (1), we estimate the future level of electricity consumption per capita for each country in 2030 and 2050 based on their projected income per capita. [Note: The model assumes full regression to the historical global mean for 2050 which makes more sense for a long-run estimate. For 2030, we use a model adjusted for more limited convergence as appropriate for shorter-run estimates because of lags and economic structures that change over decades not year-to-year.]

   We apply the global trend to all countries up to $27,690 per capita or twice the World Bank's FY24 threshold for High Income Countries (HICs). For all 2xHIC countries above $27,690 per capita, the model utilizes a trendline based on

2xHIC data points only because (a) the vast majority of data influencing the trend is from non-HICs, (b) we have no historical precedent for projecting electricity at the very high income levels projected for many HICs in 2050, and (c) electricity consumption trends tend to level off at higher incomes.

4. **Estimating total electricity gaps.** Total electricity consumption growth in 2030 and 2050 is straightforward to calculate. We use population data to determine total projected electricity consumption, and calculate the difference from 2023 electricity production data from Our World in Data.

Data Notes:

1. *No adjustment for technology.* We also assume that efficiency gains are, on average, canceled out by increased electrification (e.g., cooking, heating, etc).
2. *Data Availability:* World Bank and/or IMF data is unavailable for a small subset of countries such as Afghanistan, Lebanon, South Sudan, Syria, Yemen, Sri Lanka, Eritrea, Venezuela, and North Korea.
3. *Country Coverage*: The exercise is limited to countries with a population above 1 million in 2023. This excludes mostly small island nations such as Cabo Verde and low-population wealthy countries such as Luxembourg that primarily import electricity, or we assess wouldn't have serious needs for nuclear technology anyway.

Important Note: Our Future Electricity Demand Does Not Cover Data Centers and Artificial Intelligence

The projections in this model explicitly DO NOT include estimates for additional demand from data centers serving artificial intelligence, cryptocurrency mining, or other new technologies. In its 2024 Electricity Report (pg 31), the IEA projects global electricity demand from AI, data centers, and crypto to rise to 800 TWh in 2026 in its base case scenario, a nearly 75% increase from 460 TWh in 2022. The 2025 IEA Electricity Report estimates that China's data center electricity consumption alone could reach 180-340 TWh by 2027. So, while additional electricity demand from these sources will likely be very significant, they are excluded here because (a) we could find no credible third party global projections beyond 2026, (b) specific data center geography is hard to assume since end-use is often delinked from data center locations, and (c) we have no historical precedent to draw on for correlations with income or other variables.

Bringing it Together

The final step of the analysis is to estimate a theoretical total potential market size for advanced nuclear technology under a range of different assumptions by comparing net electricity needs with relative readiness of a country at the given year benchmark.

While ultimately a version that allows the user to adjust based on their own assumptions, we use a baseline benchmark for 2050 of:

- **20%** new demand supplied by nuclear power in **Green** countries.
- **10%** new demand supplied by nuclear power in **Light Green** countries.
- **5%** new demand supplied by nuclear power in **Yellow** countries.

This is meant to be a very basic assumption just to give a relative size of the potential market, not specific country-level projections.

Additional Demand Drivers for 2050

Our projections for future electricity demand are based on historical trends and relationships between income and electricity consumption. This means that certain drivers of future electricity demand are not explicitly included in these projections. To understand the potential additional scale of these sectors, we chose four major drivers of electrification that are particularly relevant to nuclear power and estimated the potential market size in each country for which data was available.

- **Desalination** is at the heart of the energy-water nexus, and could grow dramatically in a water-stressed world. Economically running desalination plants requires large quantities of consistent (and cheap) power supply, making nuclear power well-suited.
    1. *Water consumption in 2050* - We held per capita water consumption constant and projected usage in 2050 using medium variant population projections. In some extreme cases, it is fair to assume a country could dramatically alter its water consumption patterns, but there is no basis for assuming this.
    2. *Water Supply in 2050* - Free water supply is determined by subtracting environmental flow requirements from renewable water resources.
    3. *Water Stress* - Calculated as a % by dividing total water consumption by total free water supply. The UN through SDG 6 defines 0-25% as No Stress, 25-50% as Low, 50-75% as Medium, 75-100% as High, and 100%+ as Critically water-stressed.
    4. *Shortfall potentially met by desalination* - Using real-world desalination statistics, we roughly assuming a laddered pattern to consumption:
        a. 1% of total water needs met by desalination for countries above 50%, 5% of total for countries above 75%, and 10% of all water needs for countries above 100% water stress. Based on current patterns of usage in the Middle East, Spain, and Australia, we assess that this would result in a conservative total estimate of the potential desalination market.

5. *Total electricity demand potential* - While the energy requirements of desalination can vary widely, we chose a conservative medium point of 3kWh per cubic meter required by a reverse osmosis facility.
   a. Data sources used: *Aqueduct Projected Water Stress Country Rankings by the World Resources Institute; FAO-AQUASTAT; UN-World Population Prospects; Public academic sources.*

- **Industrial non-electric energy.** Significant energy is consumed in the industrial sector outside of direct electricity inputs. This will be one of the most difficult sectors to decarbonize as large quantities of energy are needed for industrial heating and other activities. Globally, industrial energy is three times the total electricity used in an economy. By projecting this ratio forward, we can estimate the total industrial energy that could be electrified or otherwise decarbonized by 2050.
  a. Nuclear power can be used either directly as an input of heat or electricity, or indirectly as an ideal energy source for producing green hydrogen and other fuels that may be useful in decarbonizing industrial processes.
  b. Data Sources Used: *IEA World Balances 2025.*
- **Coal Replacement.** As a source of reliable and clean power, nuclear plants are excellent candidates for direct replacement of existing coal facilities. Our model projects *additional* electricity demand, but doesn't account for the potential to outright replace existing high-carbon assets such as coal plants. This is particularly relevant in countries like South Africa where electricity demand isn't expected to grow, but nearly all of the existing assets will need to be replaced in order to reach net zero.
  a. We used the latest data from Global Energy Monitor's Coal Tracker to determine the entire fleet of coal plants that are either operating or under construction today. We assumed that on average coal plants operate at a 55% capacity factor, and from this can determine the total quantity of power that would need to be replaced. This was checked for accuracy against other sources.
  b. Data Sources Used: *Global Energy Monitor.*
- **Electric Vehicles**. While EVs don't have unique relevance to nuclear power, they represent a potentially significant new source of electricity demand. We calculated projected demand in our focus countries under the Bloomberg New Energy Finance's Economic Transition Case (60% fleet electrification) and a reference case:
  1. *Project vehicle ownership* using a simplified version of our GNI projection model, which calculates vehicle ownership on a country basis in 2050 based on the projected GNI of each country. There is a tight correlation here historically (R^2=0.7).

2. *Annual kilometers traveled* is calculated by taking a vehicular average of 13,500km annually (latest US average taken as global average) and multiplying it by the total volume of vehicles in the country.
3. *Total electric demand* determined by the total vehicle miles traveled multiplied by the market share of EVs and average efficiency of EVs available today.

a. Data Sources Used: *Our World in Data, EV-Database, World Bank Indicators, US DOT Transportation Statistics Annual Report, BNEF Electric Vehicle Outlook 2021, UNEP, St. Louis Fed.*