

A Split-Second Look at Nuclear Energy in the U.S. and Around the World

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Despite growing energy demand and concerns over climate change, nuclear energy capacity in the U.S. and around the world is on the decline. This executive briefing explores global nuclear energy capacity, public policies related to nuclear power generation, and challenges facing the industry including nuclear waste and public perception.

Nuclear Power Generation and Nuclear Waste

Nuclear power is a low carbon source of energy and produces nearly one-third of the world's green energy. This primarily occurs through a process called nuclear fission. Nuclear fission is a reaction that occurs when the nucleus of an atom (commonly uranium-235) splits into two or more smaller nuclei, releasing energy in the form of heat and radiation. In a nuclear power plant, the heat produced from nuclear fission warms a reactor's cooling agent (usually water) producing steam that is channeled to spin turbines and activate an electric generator. The ensuing spent reactor fuel generates high-level radioactive waste (HLW) which can be toxic to human health for thousands of years.¹ As a result, nuclear power plant operators must dispose of HLW in safe and successful ways according to its risk to human health and the environment. In the United States, HLW is stored in geologic repositories after a process called vitrification where HLW is mixed with silica sand and glass-forming chemicals which is then heated until it melts. Next, the molten material is poured into stainless steel canisters where it cools to form a glass. Finally, the vitrified HLW is stored in one of three sites in Georgia, New York, and Washington.²

Nuclear Power Capacity in the United States

The United States houses 93 operational nuclear reactors in 28 states with a capacity of 95.8 GWe in 2023, representing 18.2 percent of total U.S. electricity generation. The average age of these reactors was 41 years in 2021.³ Plant Vogtle Nuclear Units 3 and 4 located in Georgia are the first newly constructed nuclear units in the United States in more than three decades.⁴ Public opinion on nuclear energy within the United States has steadily shifted from 2020 to 2023 with a majority of Americans now viewing nuclear energy positively due to increased oil prices and environmental concerns.⁵ Despite this change in public opinion, the share of commercial energy generated by nuclear power declined to the lowest level in 25 years as of 2023.⁶ Twelve nuclear reactors, with a combined capacity of 10 GWe, have been retired since 2012, with three other reactors scheduled to be retired by 2025.⁷ These reactors were prematurely retired for a variety of reasons, but most were shut down due to competition with low cost energy alternatives, such as oil and coal, and high operating costs.⁸ In deregulated markets, nuclear power plants must compete on an open market with other forms of energy generation, which has led to a majority of the premature retirements.⁹

¹ Nuclear power plants produce high-level and low-level waste. High-level waste accounts for 3 percent of waste.

² Disposal of HLW is regulated by the U.S. Department of Energy. U.S. Nuclear Waste Technical Review Board, "[Vitrified High-Level Radioactive Waste](#)," November 2017.

³ The lifespan of a nuclear power plant is between 40 to 80 years. In the United States, the Atomic Energy Act authorizes the Nuclear Regulatory Commission to issue licenses for commercial nuclear reactors to operate for up to 40 years, and licenses can be extended for 20 years at a time. Sweeney and Duquiatan, "[As power plant fleet age holds at 28, US nuclear fleet hits middle-age milestone](#)," October 26, 2022. USNRC, "[Backgrounder on Reactor License Renewal](#)," accessed March 2024.

⁴ Vogtle 3 began operation on July 31, 2023, and Vogtle 4 is scheduled to come online in 2024. Southern Company, "[Clean energy for a bright future](#)," accessed December 2023.

⁵ Leppert and Kennedy, "[Growing share of Americans favor more nuclear power](#)," August 18, 2023.

⁶ Park, "[Global nuclear power faces unprecedented challenges](#)," December 11, 2023.

⁷ Gilbert, "[Economics and Retirements of Existing Nuclear Power Reactors](#)," accessed December 2023.

⁸ Nuclear Energy Institute, "[Decommissioning Status for Shutdown U.S. Nuclear Plants](#)," accessed December 2023

⁹ Clifford, "[Why the U.S. government plans to spend billions to keep money-losing nuclear plants open](#)," February 17, 2022.

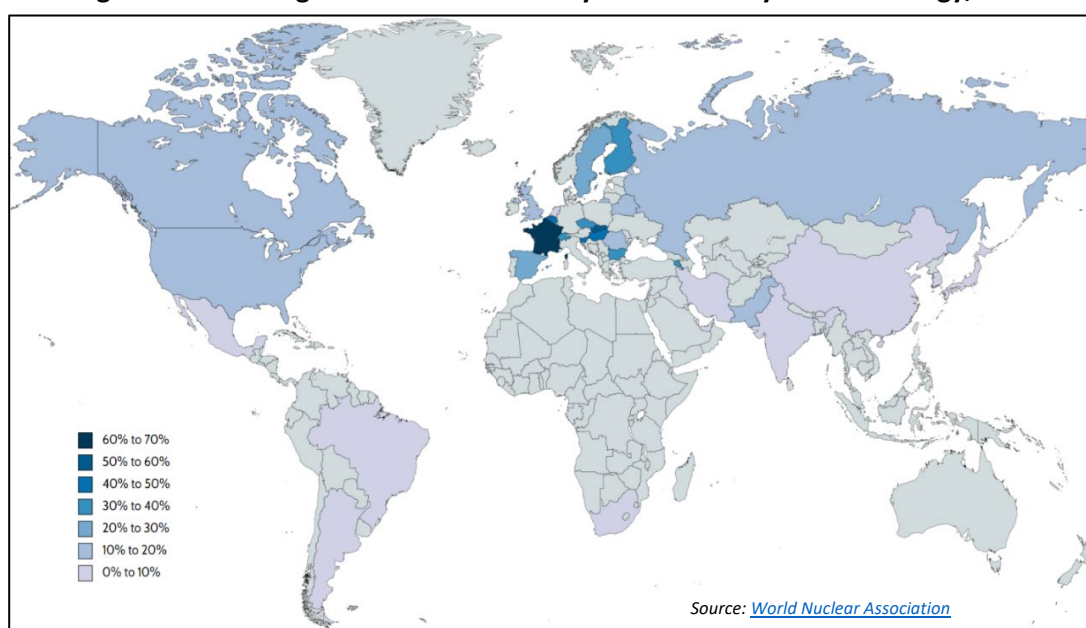
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To help counter this reduction in nuclear energy, the U.S. government has committed to investing in its current nuclear infrastructure to keep plants open. In November 2021, the U.S. government passed the Infrastructure Investment and Jobs Act which created the Civil Nuclear Credit Program (CNCP).¹⁰ The CNCP allows for nuclear power plants to bid on credits to support their continued operations if they project an early retirement leading to increased air pollutants from less utilization of low-carbon energy. The Inflation Reduction Act (passed in August 2022) created the Zero-Emission Nuclear Power Production Tax Credit which will be available to existing nuclear power plants in operation from 2024 to 2032.¹¹

Global Nuclear Power Capacity: Challenges and Development

The overall share of global electricity generated by nuclear energy has declined from 17.0 percent in 2000 to 9.2 percent in 2020.¹² Between 2013 and 2023, China more than tripled its nuclear energy capacity with a 10-year annual growth rate of 15.6 percent due to concerns over energy independence and air pollution.¹³ France leads the world in national percentage of electricity generated through nuclear power at 62.5 percent in 2022 followed by Slovakia (59.2 percent), Hungary (47.0 percent), Belgium (46.4 percent), and Slovenia (42.6 percent) (figure 1).¹⁴ In contrast, following the Fukushima Daiichi accident in 2011, many countries planned to completely phase out nuclear energy production due to safety concerns. Germany, Spain, and Switzerland all plan to complete their phase out by 2030, with Germany completing its phaseout this year.¹⁵ However, Belgium and Japan have reversed previous phaseout plans and are revitalizing their nuclear power plants over climate concerns and energy independence.¹⁶

Figure 1: Percentage of National Electricity Generation by Nuclear Energy, 2022



¹⁰ [Public Law No: 117-58](#).

¹¹ [Public Law No: 117-169](#); Downing et. al., "[A Preliminary Examination of the Trade Competitiveness and Climate Objectives in the Inflation Reduction Act of 2022](#)," February 2022.

¹² Chestney, "[Nuclear share in energy generation falls to lowest in four decades-report](#)," October 5, 2022.

¹³ China is the second largest producer of nuclear energy in the world. Clifford, "[How China became the king of new nuclear power, and how the U.S. is trying to stage a comeback](#)," August 30, 2023.

¹⁴ Globally, major developers and utility companies involved in nuclear energy include NextEra Energy (United States), Duke Energy Corporation (United States), Electricité de France (France), Engie (France), Constellation Energy Corporation (United States), and Rosatom (Russia). King, "[Top 10: Nuclear Energy Companies](#)," November 15, 2023.

¹⁵ Deschenes, "[Out of phase: The costs and benefits of Germany's nuclear phase-out](#)," May 3, 2022.

¹⁶ Nuclear Newswire, "[Countries change nuclear policies in response to Ukraine war](#)," January 6, 2023.

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