



Nuclear Energy: Implementation and Effects

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This brief covers the role of nuclear energy in the United States, focusing on its historical development, current resurgence, and key policy challenges.

Keywords — Nuclear Energy, Electricity, Power Plants, Environment

I. EXECUTIVE SUMMARY

This brief examines the role of nuclear energy in the United States, focusing on its historical development, current resurgence, and key policy challenges. Nuclear power has consistently provided a stable, low-carbon source of electricity, contributing approximately 20% of total U.S. electricity generation. Recent growth in electricity demand, particularly driven by the expansion of the artificial intelligence (AI) industry, has renewed interest in expanding nuclear capacity and developing advanced technologies such as small modular reactors. However, significant challenges remain, including the absence of a permanent nuclear waste disposal solution and continued reliance on foreign uranium imports. This brief evaluates policy options such as deep geological storage, centralized federal management, and fuel recycling systems, drawing on international examples to assess their feasibility. Overall, it argues that while nuclear energy is a promising component of a low-carbon future, effective

policy intervention is essential to ensure its safety, sustainability, and long-term viability.

II. OVERVIEW

A. US Nuclear History

Nuclear power plant use began for electricity generation in 1958, and in 2023 the US had “93 operating commercial nuclear reactors at 54 nuclear power plants in 28 states” (“U.S. nuclear industry,” n.d.). The oldest operating plant is the Nine Mile Point Unit 1 in NY, which began operating in 1969 (“U.S. nuclear industry,” n.d.). The newest plant since 2006 is Unit 3 in Georgia, and began operating in 2023 (“U.S. nuclear industry,” n.d.). The number of operating plants decreased in 1998 from 112 to 104, with the peak summer electricity generation being 102,000 MW in 2012 (“U.S. nuclear industry,” n.d.). Nuclear power has provided “19%–20% of total annual U.S. electricity generation from 1990 through 2021” (“U.S. nuclear industry,” n.d.). Power plants are decommissioned once they are no longer used commercially, and there are 22 commercial power reactors in the process of being decommissioned (“U.S. nuclear industry,” n.d.).

B. Three Mile Island Accident

Before the Chernobyl disaster in 1986, the “Three Mile Island Unit 2 reactor, near Middletown, Pa., partially melted down on March 28, 1979” (“Backgrounder on the Three Mile Island accident,” n.d.). This would be known as “the most serious accident in U.S. commercial nuclear power plant operating history, although its small radioactive releases had no detectable health effects on plant workers or the public” (“Backgrounder on the Three Mile Island accident,” n.d.). After the incident, changes were made “involving emergency response planning, reactor operator training, human factors engineering, radiation protection, and many other areas of nuclear power plant operations” (“Backgrounder on the Three Mile Island accident,” n.d.). The accident also “caused the NRC to tighten and heighten its regulatory oversight” (“Backgrounder on the Three Mile Island accident,” n.d.).

C. AI Industry

There have been recent pushes for more nuclear energy use, largely due to the AI industry taking off. Currently, “the new Trump administration is pushing for both expansion of existing nuclear power plants and the development of small-scale reactors that are faster and cheaper to build” (Hughes, 2025). Some advocates for this energy expansion have claimed that “new nuclear generating capacity is necessary in large part to meet the growing demands of artificial intelligence computing” (Hughes, 2025).

III. IMPACT ON COMMUNITIES

Nuclear energy has posed significant environmental advantages and challenges. One of the most notable benefits includes its extremely low greenhouse gas emissions during operation, helping reduce the amount of air pollution contributing to climate change. Likewise, the International Atomic Agency highlights nuclear power’s support in “clean energy” as it produces

low carbon and continuous electricity. Nuclear power has been noted to have a relatively small land footprint compared to many renewable energy sources. However, the long-term management of radioactive waste remains a major challenge. According to the World Nuclear Association, nuclear waste remains hazardous for long periods and requires long-term storage solutions to prevent environmental contamination. There are also risks of severe accidents which can lead to devastating environmental consequences. Furthermore, nuclear power plants require substantial water for cooling, and uranium mining, necessary for fuel production, can lead to environmental degradation if not carefully regulated.

Nuclear energy plays a significant role in economic development, particularly through job creation and industrial growth. The nuclear sector supports a range of high-paying jobs including engineering, plant operations, and construction. Reports from OCED Nuclear Energy Agency show how power plants also create long term employment opportunities. Although building these nuclear power plants requires extremely high upfront investment, and projects often face delays and cost overruns. These financial risks can fall on governments, investors, or taxpayers.

The rapid growth of AI, or artificial intelligence, has significantly increased global energy demands. Data centers that power AI systems require large amounts of electricity and water for cooling. According to UNU-EHS, energy demand from AI and data centers is rising quickly. Nuclear energy can be viewed as a potential solution to this issue. Because it provides stable, 24/7 low-carbon electricity, nuclear power can support the continuous energy needs of AI systems without increasing reliance on fossil fuels and reducing the carbon footprint. However,

even when powered by nuclear energy, these facilities can strain regional infrastructure. The effectiveness depends on how efficiently both technologies are managed.

IV. POLICY PROBLEM

Many recent bills that fund nuclear energy include recent U.S. policies that have increased support for nuclear energy through the Bipartisan Infrastructure Law, the Inflation Reduction Act, and the ADVANCE Act. These laws provide major federal investments, tax incentives for nuclear projects, support for keeping existing reactors open, help for restarting retired reactors, and regulatory changes to make new reactor development easier. According to the DOE, these policies support the national goal of adding 200 gigawatts of new nuclear capacity by 2050, with 35 GW by 2050. Some supporters argue that funding nuclear energy can help address climate change in ways, such as producing carbon-free electricity, providing steady power, and reducing greenhouse emissions. The DOE says that nuclear power can help prevent more than 470 million metric tons of carbon dioxide emissions per year.

However, the focus on nuclear energy has other sides. These include deviating attention from other climate solutions policies including renewable energy and energy efficiency. Nuclear power plants are also extremely expensive and take years to construct. Taking into account the timeline of the construction and utilization, they do not reduce emissions immediately. Nuclear energy also raises concerns over radioactive waste, safety risks, and possibility of accidents. Therefore, having policies that rely too heavily on nuclear power could reduce the investment in faster and cheaper solutions. While nuclear energy does play an important role in reducing carbon emissions, it should not replace broader efforts in investing in cleaner and more efficient energy systems.

V. POLICY OPTIONS

Due to the recent nuclear expansion, the issue of the management of spent nuclear fuel arises as it remains radioactive for thousands of years, possibly leading to contamination. Currently, the U.S. has no permanent disposal site, leaving waste stored in temporary facilities across the states. This creates a fragmented disposal system prone to misalignment between state and federal decisions, and inconsistent safety standards. Federal policymakers could potentially solve these issues by prioritizing investments in deep geological repositories, which bury waste in stable rock formations below the surface. Currently, the U.S. operates only one of these facilities, the Waste Isolation Pilot Plant in New Mexico, but establishing more is possible. To solve the intrastate issues, it would be beneficial to have more centralized management under the federal government to create a more efficient system. Finland offers an effective model with its Onkalo repository which is nearly operational and is seen as one of the most advanced permanent nuclear waste solutions globally. This safe disposal infrastructure would also help to keep nuclear energy a clean energy source and stop negative impacts on polluted ecosystems, organisms, and groundwater. A second solution to this issue involves an analysis on the specific process the U.S. uses in managing nuclear fuel. Right now, the country relies on foreign uranium imports for energy production, which poses significant security risks. There's also a buildup in spent fuel which has its own negative impacts. Investing in fuel recycling and reprocessing programs would help to address these problems as it could get usable material from spent fuel and reduce the total waste volume. In relation to the current administration, President Trump's executive orders have touched on this topic but a greater emphasis is necessary. Additionally, the expansion of domestic uranium

mining and reuse of materials would help create a more sustainable nuclear waste cycle, which creates a foundation for energy independence. Another country we can look at is France. It is proof of how these solutions can work as they have been successfully reprocessing a large amount of their nuclear fuel which the U.S. hasn't done since the 70s. Although, with these sustainable methods come increased concerns around proliferation and nuclear material theft, which circles back to the need for centralized federal oversight. Ultimately, this fuel cycle is a great option that can help to use resources efficiently and decrease the waste burden.

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VII. CONCLUSIONS

Nuclear energy presents a complex but important opportunity in the transition toward a low-carbon energy system. While it offers reliable electricity generation and reduced greenhouse gas emissions, unresolved issues surrounding waste management, environmental risk, and energy security continue to limit its full potential. The lack of a permanent disposal solution and dependence on foreign resources highlight the need for stronger and more coordinated policy action. By investing in long-term waste storage solutions, improving federal oversight, and advancing fuel recycling technologies, policymakers can address these structural challenges. Ultimately, the future of nuclear energy in the United States will depend not only on technological advancement but also on the ability to implement effective, sustainable, and socially responsible policies that balance environmental protection with growing energy demands.

VIII. REFERENCES

- “Advantages and Challenges of Nuclear Energy.” 2024. Department of Energy.
<https://www.energy.gov/ne/articles/advantages-and-challenges-nuclear-energy>.
- “Backgrounder on the Three Mile Island Accident.” 2022. Nuclear Regulatory Commission.
<https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/3mile-isle>.
- Dalban, Lauren. 2026. “Hochul Wants More Nuclear Power in New York.” Inside Climate News.
<https://insideclimatenews.org/news/14012026/new-york-gov-hochul-highlights-nuclear-power-in-state-address>.
- “DOE's Office of Nuclear Energy Awards \$19 Million to Advance Recycling of Used Nuclear Fuel.” 2026. Department of Energy.
<https://www.energy.gov/ne/articles/does-office-nuclear-energy-awards-19-million-advance-recycling-used-nuclear-fuel>.
- “Energy demand from AI – Energy and AI – Analysis.” n.d. IEA. Accessed April 26, 2026.
<https://www.iea.org/reports/energy-and-ai/energy-demand-from-ai>.
- Hughes, Trevor. 2025. “Nuclear power roars back, thanks to Trump administration push.” USA Today.
<https://www.usatoday.com/story/news/politics/2025/08/08/nuclear-power-getting-major-push-trump-administration/85516824007/>.
- Kerr, Dara. 2024. “Google and Microsoft report growing emissions as they double-down on AI.” NPR.

<https://www.npr.org/2024/07/12/g-s1-9545/ai-brings-soaring-emissions-for-google-and-microsoft-a-major-contributor-to-climate-change>.

“Nuclear power and climate change: Decarbonization.” n.d. IAEA.
<http://www.iaea.org/topics/nuclear-power-and-climate-change>.

“Nuclear Waste Disposal | U.S.” n.d. GAO. Accessed April 26, 2026.
<https://www.gao.gov/nuclear-waste-disposal>.

OECD Nuclear Energy Agency and International Atomic Energy Agency. 2018. “Measuring Employment Generated by the Nuclear Power Generator.” Organisation for Economic Co-Operation and Development.
<https://www.oecd-nea.org/upload/docs/application/pdf/2019-12/7204-employment-nps.pdf>.

“Radioactive Waste Management.” 2025. World Nuclear Association.
<https://world-nuclear.org/information-library/nuclear-fuel-cycle/nuclear-waste/radioactive-waste-management>.

Shekhar, Himanshu, and Soenke Kreft. 2024. “Artificial Intelligence - Help or Harm for the Climate?” UNU EHS.
<https://unu.edu/ehs/commentary/artificial-intelligence-help-or-harm-climate>.

“U.S. Department of Energy Awards \$2.7 Billion to Restore American Uranium Enrichment.” 2026. Department of Energy.
<https://www.energy.gov/articles/us-depart>

[ment-energy-awards-27-billion-restore-american-uranium-enrichment](https://www.energy.gov/articles/us-department-energy-awards-27-billion-restore-american-uranium-enrichment).

“U.S. nuclear industry - U.S. Energy Information Administration.” 2023. EIA.
<https://www.eia.gov/energyexplained/nuclear/us-nuclear-industry.php>.

“U.S. Sets Targets to Triple Nuclear Energy Capacity by 2050.” 2024. Department of Energy.
<https://www.energy.gov/ne/articles/us-sets-targets-triple-nuclear-energy-capacity-2050>.