Updated May 15, 2024

Nuclear Energy in a Climate Change Context: Current Appropriations for Nuclear Energy Development

The potential role of nuclear energy in mitigating climate change has been a significant element of recent congressional discussions about energy and environmental policy. For example, Senate Environment and Public Works Committee Chairman Tom Carper at a committee hearing in April 2023 stated, "As many of you know, I believe that safe nuclear power plays an essential role in our efforts to address the greatest challenge of our time, the climate crisis." Other Members of Congress have expressed opposition to nuclear power over concerns that include safety, cost, and the risk of storage of spent nuclear fuel.

The Consolidated Appropriations Act, 2024 (P.L. 118-42) includes more than $5 billion in new funding and transfers for advanced reactors and fuel, as well as support for existing civilian nuclear power. Nuclear energy is also included as a consideration in the Biden Administration's Long-Term Strategy for the United States on climate change.

U.S. Climate Strategy

Human-caused emissions increase the levels of greenhouse gases (GHGs) in the atmosphere, causing global average temperature increases, with a corresponding increase in the net negative effects of climate change. Average global temperatures have increased by approximately 1.0° C since the preindustrial period, with corresponding identified climate-driven impacts.

A scientific consensus exists that reducing net global GHG emissions to zero (net zero) by 2050 is consistent with a greater than 50% chance of limiting global temperature increases to 1.5° C. The Long-Term Strategy includes a goal of reducing U.S. GHG emissions to net zero by 2050, as a contribution to limiting climate-driven impacts.

As a party to the United Nations Framework Convention on Climate Change (UNFCCC), the United States submitted a Nationally Determined Contribution (NDC) document with the goal of reducing U.S. GHG emissions by 50%-52% by 2030 compared with 2005. All pathways described in the Long-Term Strategy that achieve net-zero U.S. GHG emissions by 2050 incorporate achieving the 2030 U.S. NDC GHG emissions reduction goal.

Many factors contribute to the U.S. emission of GHGs. The pace of U.S. GHG emissions reduction has not occurred, and is not currently projected to occur, at a rate that some experts assess is in line with meeting these stated climate goals. Emissions reductions in industrial processes, transportation, and other sectors have proven challenging. Replacement of certain fossil fuels with low-carbon electrification and alternative energy sources has been seen as a mechanism for GHG emissions reduction.

Rising U.S. electricity demand could pose additional challenges. Some stakeholders in the electricity sector have raised concerns that increases in electricity demand, including those of data centers, and the effects of a transition to lower carbon electricity generation could affect electric grid reliability.

Potential Role of Nuclear Power

Supporters of nuclear energy contend that nuclear energy could contribute to bringing the United States onto a decarbonization trajectory consistent with its 2050 net-zero GHG emissions goal. Proponents say this could be accomplished, for example, by increasing nuclear-generated electricity and using nuclear reactor heat for industrial processes, such as the production of hydrogen, replacing equivalent energy from fossil fuels.

Increasing the role of nuclear power would likely involve building new nuclear generating capacity both to replace existing, aging nuclear reactors and to create a net increase in nuclear generating capacity. Some nuclear power advocates state that such efforts would be facilitated by

- using standardized reactor designs, such as small modular reactors (SMRs), that could be built in series to achieve construction economies of scale;
- increasing the capability and capacity of the nuclear workforce and supply chains;
- developing advanced reactors that could be smaller, safer, and less expensive than existing nuclear technology; and
- using nuclear fuel developed for enhanced safety and requiring less frequent reactor refueling.

Some environmental advocates have questioned the use of nuclear energy to contribute to mitigating climate change. Such groups raise concerns about nuclear energy that include cost, timing, safety, whether nuclear power's life-cycle carbon emissions are as low as those from renewable energy technologies, and nuclear weapons proliferation.

The construction of nuclear power plants often has been subject to large cost overruns and schedule delays, sometimes leading to the abandonment of a project. Recently completed (and proposed) U.S. nuclear projects have relied at least partly on tax credits, government grants, and other assistance to be economically viable. Concerns have been raised about the cost-effective construction of nuclear energy projects and whether financing other efforts to reduce GHG emissions might be more effective.

Proponents of funding for nuclear energy point to the operating characteristics of nuclear power plants that can contribute to electric reliability, including their ability to operate constantly and support voltage and frequency levels on the grid. Some lower cost non-emitting resources, such as wind and solar electricity generation, do not inherently operate this way, potentially limiting their ability to supply large shares of electricity generation without the use of additional technologies such as large-scale energy storage.

The time required to site, build, permit, test, and operationalize nuclear plants—more than 14 years by one environmental group's estimate—may be too long for nuclear power to make a meaningful contribution to climate change mitigation. Proposed changes, such as standardized designs, aim to shorten these timelines.

In the wake of incidents at nuclear power plants at Three Mile Island, Chernobyl, and Fukushima, some environmental groups have raised concerns about the safety of nuclear energy and its expansion. Concerns have also been raised about the safety of the long-term storage of the spent nuclear fuel produced by nuclear reactors.

Life-cycle analysis has been used to compare GHG emissions from nuclear energy production with emissions from renewable energy sources. The life-cycle emissions from nuclear energy production include mining, milling, and transporting nuclear fuel, as well as the emissions associated with waste management and the construction of nuclear facilities. A National Renewable Energy Laboratory study found that life-cycle GHG estimates for nuclear power were similar to those for most renewable energy sources and a fraction of those for fossil fuels.

Nuclear Energy Current Appropriations

The U.S. Department of Energy (DOE) is the primary agency that carries out federal civilian nuclear energy programs (see **Table 1**). Major nuclear energy programs include advanced reactor research, development, and demonstration; nuclear production of hydrogen; advanced nuclear fuel availability; and research on the operation and safety of existing reactors.

Funding for those activities is included in DOE's Nuclear Energy appropriations account, which received $1.685 billion in the FY2024 Consolidated Appropriations Act, which also included a major transfer of previously appropriated nuclear funding as described below. The nuclear energy account increased by $212 million (14%) over the FY2023 amount.

Congress has provided additional funding for DOE nuclear energy activities through supplemental appropriations bills and advance appropriations in the Infrastructure Investment and Jobs Act (IIJA; P.L. 117-58). Through IIJA, Congress appropriated $2.477 billion for the DOE Advanced Reactor Demonstration Program from FY2022 to FY2026. Under that program, DOE is paying up to 50% of the costs of two advanced reactor demonstrations, one each in Wyoming and Texas. In addition, through IIJA, Congress appropriated $6 billion over the same period for Civil Nuclear Credits to support existing nuclear power plants at risk of closing for financial reasons. Most of the Civil Nuclear Credit funding was not used for that purpose due to a number of factors, including rising wholesale electricity prices, state support, and federal tax credits provided to nuclear plants in the Inflation Reduction Act (IRA; P.L. 117-169).

Table 1. FY2024 Nuclear Energy Appropriations

Funding Source	$ (in millions)
P.L. 118-42 Nuclear Energy Account	1,685
P.L. 118-42 Transfer to SMRs	950
P.L. 118-42 Transfer to Nuclear Fuel Programs	2,720
P.L. 117-58 IIJA Advanced Reactor Demonstration Program	600
P.L. 117-169 IRA Advanced Nuclear Fuel Program for FY2022-FY2026	700

Sources: Consolidated Appropriations Act, 2024 (P.L. 118-42); IRA (P.L. 117-169); and IIJA (P.L. 117-58).

Notes: Nuclear fuel transfers are subject to implementation of nuclear fuel import sanctions on Russia, which were subsequently imposed by the Prohibiting Russian Uranium Imports Act (P.L. 118-62). SMR = small modular reactor.

The FY2024 Consolidated Appropriations Act transferred $950 million from IIJA's Civil Nuclear Credit program to support SMR deployment and university reactor safety training. The FY2024 act also transferred $2.72 billion from the Civil Nuclear Credit program to a DOE program to support domestic production of enriched uranium to fuel existing and advanced reactors, contingent on sanctions on Russian nuclear fuel imports, which were subsequently imposed by the Prohibiting Russian Uranium Imports Act (P.L. 118-62). The transferred funding is in addition to $700 million for nuclear reactor fuel provided in the IRA for FY2022-FY2026.

DOE nuclear energy funding supports the development of some of the components, particularly advanced reactor technology and fuel, that might be used to increase nuclear power capacity above current levels. Successful demonstration projects could contribute to the U.S. achievement of net-zero GHG emissions by 2050, although nuclear energy expansion also raises other policy concerns.

Jonathan D. Haskett, Analyst in Environmental Policy
Mark Holt, Specialist in Energy Policy

IF12636

Disclaimer