

## Research and Development

### Funding Profile by Subprogram

(dollars in thousands)

	FY 2007 Current Appropriation	FY 2008 Original Appropriation	FY 2008 Adjustments	FY 2008 Current Appropriation	FY 2009 Request
<b>Research and Development</b>					
Nuclear Power 2010	80,291	135,000	-1,229	133,771	241,600
Generation IV Nuclear Energy Systems Initiative	35,214	116,000	-1,083	114,917	70,000
Nuclear Hydrogen Initiative	18,855	10,000	-91	9,909	16,600
Advanced Fuel Cycle Initiative	166,092	0	0	0	301,500
<b>Total, Research and Development</b>	<b>300,452</b>	<b>261,000</b>	<b>-2,403</b>	<b>258,597</b>	<b>629,700</b> *

**Public Law Authorizations:**

P.L. 110-5, Revised Continuing Appropriations Resolution, 2007

P.L. 110-161, The Consolidated Appropriations Act, 2008

20% = \$126M

### Mission

The mission of the Office of Nuclear Energy's (NE) Research and Development (R&D) program is to secure nuclear energy as a viable, long-term commercial energy option, providing diversity in the energy supply. In the short term, government and institutional barriers will be addressed to enable new plant deployment decisions by nuclear power plant owners and operators who wish to be among the first to license and build new nuclear facilities in the United States (U.S.). In the longer term, new nuclear technologies that can compete with advanced fossil and renewable technologies will be developed, enabling power providers to select from a diverse group of generation options that are economical, reliable, safe, secure, and environmentally acceptable. In FY 2008, the Advanced Fuel Cycle Initiative (AFCI) is included in the Fuel Cycle Research and Facilities program.

Nuclear energy has the potential to safely and reliably generate electricity for our 21st century economy, to produce economical hydrogen for transportation use without emitting greenhouse gases, and to produce heat and clean water to support growing industry and populations worldwide. NE is a key participant in on-going integrated benefits assessment activities conducted for applied R&D programs in the Department. Analyses to measure the benefits of the NE R&D portfolio compared its programs' contributions to nuclear technologies against other electricity-generating and hydrogen-producing fossil and energy efficiency and renewable energy technologies. These analyses showed that the economic benefit of the NE R&D portfolio, in terms of energy system cost saving, potentially could total \$45 billion per year by 2050, many times the cost of the government's cumulative investment. Moreover, the additional reduction in carbon dioxide emissions from nuclear technologies influenced by NE R&D could be 246 million tons of carbon equivalents per year by 2050. These projected savings show that NE R&D plays a significant role in the Energy, Science, and Environment portfolio, which, taken together, is estimated to save \$256 billion and 730 million tons of carbon equivalent per year. These results indicate substantial benefit can be derived from the Department's applied R&D portfolio investments.

At the same time the expanded use of nuclear energy domestically and globally presents challenges that must be met. Some of these challenges will be met through excellence in the use of nuclear power (e.g., nuclear safety). Others, such as nuclear waste and economic issues, can be addressed in part through advances in technology. Investment in long-term R&D could help expand the use of nuclear energy worldwide. NE focuses on much of its research on long-term, highrisk R&D that industry does not have the incentive to undertake on their own.

For the Nuclear Power 2010 (NP 2010) program, the FY 2009 budget request continues new nuclear plant licensing and reactor engineering and design activities started in previous years. In FY 2009, the NP 2010 program will cost share the work being performed by industry partners to respond to information requests from the Nuclear Regulatory Commission (NRC) as they advance their review of the two combined Construction and Operating License (COL) applications. Additionally, NP 2010 will continue to cost share the engineering and design activities of the reactor vendors for two Generation III+ advanced, light water reactors including issues related to design certification requests being reviewed by NRC. The scope of work being executed in FY 2009 will achieve progress necessary to maintain the goal of licensing and design certification decisions by NRC in FY 2010 and FY 2011, an industry decision to build in FY 2010, and completion of standardized reactor designs in FY 2011. Successful completion of these activities will lead to deployment of new nuclear plants in the next decade.

For the Generation IV Nuclear Energy Systems Initiative (Gen IV) program, the FY 2009 budget request continues critical gas reactor R&D that will help achieve desired goals of sustainability, economics, and proliferation resistance to ready the technology for commercial deployment in the 2030 timeframe. In FY 2009, Gen IV R&D focuses specifically on component and material aging and degradation where results will directly benefit existing nuclear plants by extending their current operating licensing period and designing advanced reactor concept plants with a longer operating life. Continued investigation of technical and economical challenges and risks are needed to support NGNP design and licensing basis development. In FY 2009, NGNP R&D includes broader activities conducted in support of the VHTR concept and benchmarking methodologies in conjunction with the Generation IV International Forum (GIF). Successful completion of these activities is necessary to support the 2011 decision to proceed with the demonstration of an NGNP by 2021, as directed by EPAct. Key to the strategy for conducting R&D under the Gen IV Nuclear Energy Systems Initiative is the multiplication effect on investment derived from international collaboration. By coordinating U.S. efforts with those of the GIF partner nations, our funding is leveraged by a factor of two to ten, depending on the reactor concept involved.

For the Nuclear Hydrogen Initiative (NHI) program, the FY 2009 budget request continues integrated laboratory-scale (ILS) experiments begun in FY 2008 on two baseline nuclear hydrogen production technologies. It also completes the design of an ILS experiment for the Hybrid Sulfur thermochemical cycle. These experiments are being conducted in order to provide the necessary information needed to make a recommendation of the hydrogen production technology to be coupled with the NGNP as required by the Energy Policy Act of 2005 (EPAct 2005). Additional NHI activities planned in FY 2009 are targeted at improving the efficiency and economics of advanced, high temperature hydrogen production technologies. Successful completion of these activities will represent tangible progress toward demonstrating nuclear hydrogen production at a cost competitive with other hydrogen production technologies.

For the Advanced Fuel Cycle Initiative (AFCI) program, which is focused on implementing the Global Nuclear Energy Partnership (GNEP), the FY 2009 budget request continues to develop methods to reduce the volume and long-term toxicity of high-level waste from spent nuclear fuel, reduce the long-term proliferation threat posed by civilian inventories of plutonium in spent fuel, and provide for proliferation-resistant technologies to recover the energy content in spent nuclear fuel. These activities continue R&D to develop advanced recycling technologies capable of extracting highly radioactive elements from commercial spent nuclear fuel and using that material as fuel in nuclear reactors to generate additional electricity. The FY 2009 request also supports continuation of conceptual design activities for the AFCF, ABR and CFTC, necessary to support the GNEP vision of a closed fuel cycle. Successful achievement of these activities will improve the way spent nuclear fuel is managed, and will facilitate the expansion of civilian nuclear power in the United States and encourage civilian nuclear power internationally to evolve in a more proliferation-resistant manner.

In FY 2009, NE will continue to support R&D activities at university and research institutions through competitive awards focused on advancing nuclear energy technologies. Through its Nuclear Energy Research Initiative process, NE will designate at least 20 percent of funds appropriated to its R&D programs for work to be performed at university and research institutions. This commitment to strengthening the nation's nuclear education infrastructure directly supports the goals of the America Competes Act of 2007, which specifically highlighted the need for increased support of the U.S. nuclear science and engineering education enterprise, as well as the President's American Competitiveness Initiative. These funds will support investigator-initiated basic research and mission-specific applied R&D activities; human capital development activities such as fellowships and young faculty awards; and, infrastructure and equipment upgrades for university-based research reactors and laboratories. This mutually beneficial arrangement will help university and research institutions bolster their R&D capabilities and help strengthen the U.S. educational infrastructure necessary to support the nuclear renaissance envisioned by this budget request.

### Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility and management excellence), plus 16 Strategic Goals that tie to the Strategic Themes. The NE R&D program supports the following goals:

Strategic Theme 1, Energy Security: Promoting America's energy security through reliable, clean, and affordable energy

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

The NE R&D program has one GPRA Unit Program goal which contributes to Strategic Goal 1.2 in the "goal cascade":

GPRA Unit Program Goal 1.2.14.00: Develop New Nuclear Generation Technologies - By 2015, enable industry to construct and operate new nuclear power plants, promoting safe, reliable and carbon-free energy production, through the standardization of Generation III+ plant designs, the successful demonstration of nuclear plant permitting and licensing processes, the advancement of Gen IV plant