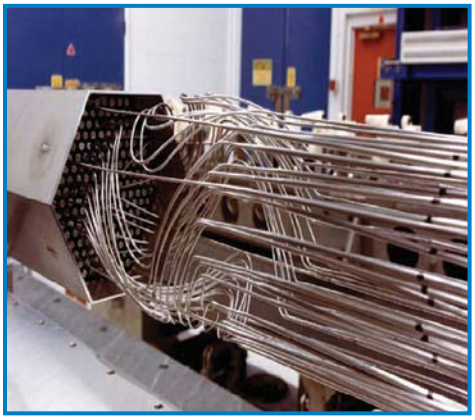
Recycling Spent Nuclear Fuel

The U.S. Department of Energy's Office of Nuclear Energy

Finding ways to close the nuclear fuel cycle will provide greater energy security in a safer, cleaner world.



The Advanced Fuel Cycle Initiative (AFCI) provides technologies for the Global Nuclear Energy Partnership (GNEP) that enable wide-scale use of nuclear energy in a manner that reduces the risk of proliferation and improves the management of nuclear waste.

The mission of the AFCI is to develop fuel cycle technologies that will support the economic and sustained production of nuclear energy while satisfying requirements for a controlled, proliferation-resistant nuclear materials management system.

The AFCI is the U.S. research and development component of the Global Nuclear Energy Partnership. GNEP was introduced in February 2006 as an element of the President's Advanced Energy Initiative to promote safe, secure, and sustainable use of nuclear energy worldwide. AFCI is consistent with the National Energy Policy of 2001 and the Energy Policy Act of 2005.

Addressing Future Energy Needs

The Energy Information Administration projects that U.S. electricity demand will grow almost 50 percent by 2030. World electricity demand is expected to almost double by 2030. Much of this increase in energy demand is driven by economic growth in developing nations. Nuclear power can provide a plentiful, reliable supply of energy without the emission of greenhouse gases that result from burning fossil fuels.

In the United States, nuclear power provides approximately one-fifth of the electricity used to power factories, office buildings, homes, and schools. One hundred and four operating nuclear power plants, located at 65 sites in 31 states,

The United States "will build the Global Nuclear Energy Partnership to work with other nations to develop and deploy advanced nuclear recycling and reactor technologies. This initiative will help provide reliable, emission-free energy with less of the waste burden of older technologies and without making available separated plutonium that could be used by rogue states or terrorists for nuclear weapons. These new technologies will make possible a dramatic expansion of safe, clean nuclear energy to help meet the growing global energy demand."

— National Security Strategy of the United States, March 16, 2006

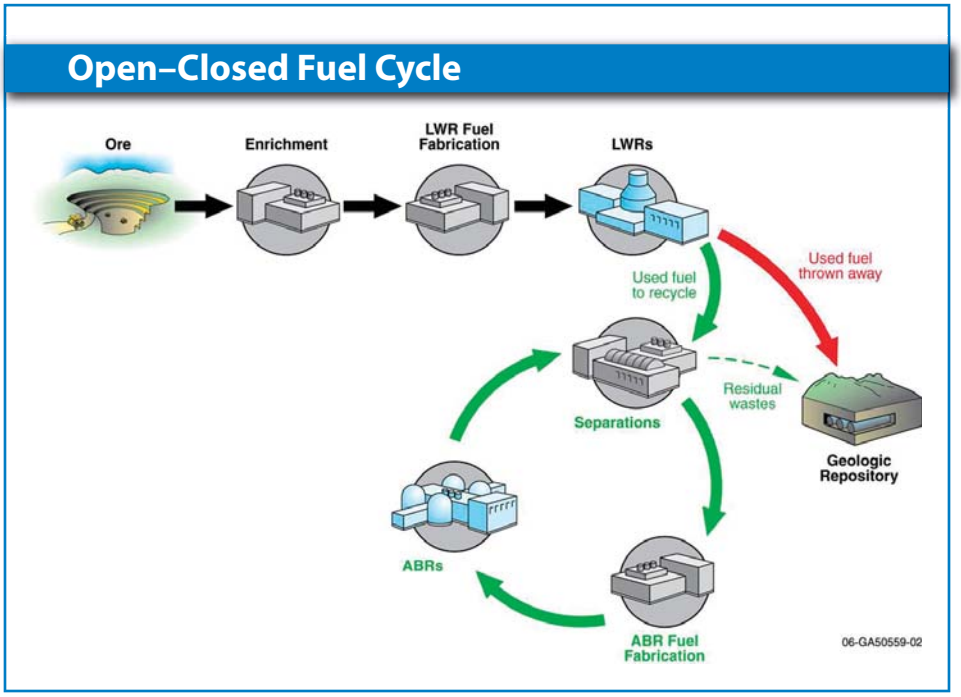
constitute the second-largest source of electricity generation. Historically, the United States has used a 'once through' or 'open' fuel cycle in which nuclear fuel is used a single time in the reactor prior to disposal. AFCI will develop and demonstrate new technologies to enable beneficial recycling of spent nuclear fuel (SNF). This would allow the United States to ultimately move to a 'closed' fuel cycle, where SNF is recycled and re-used as fuel to produce additional energy.

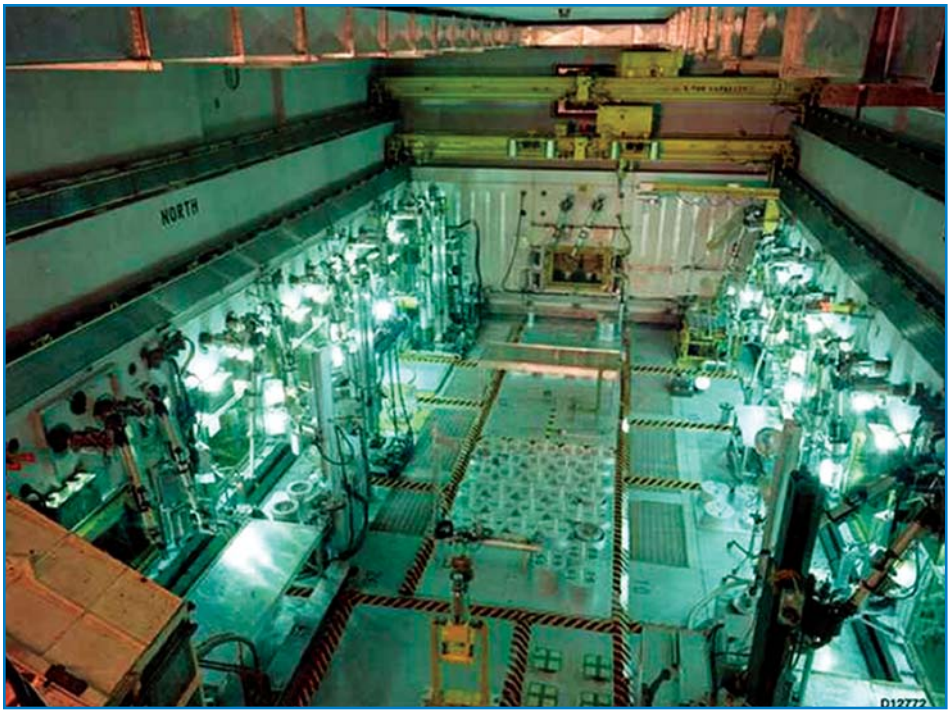
Benefits of AFCI — AFCI will reduce the risk of nuclear proliferation worldwide by promoting more proliferation-resistant technologies to reduce the stockpile of plutonium and expanding the use of nuclear power. AFCI will support U.S. international non-proliferation goals by demonstrating advanced materials accountability and control, monitoring, and safeguards systems that will reduce the threat of diversion or misuse.

AFCI also offers the potential for more efficient nuclear waste disposal. Advanced fuel cycle technologies can significantly reduce the volume, thermal output, and radiotoxicity of waste requiring permanent disposal at the Yucca Mountain geologic repository. By reducing the volume of waste, reducing the heat that is generated from the waste, and reducing the potential radiation exposure, the amount of waste that can potentially be disposed of at Yucca Mountain can be increased. The expanded physical waste disposal capacity would potentially accommodate all of the spent fuel generated in the United States this century. The ability to transmute, destroy, or burn transuranics in a fast reactor is the principal long-term waste management benefit of GNEP.

Recycling fuel can also satisfy growing energy needs while reducing waste and improving the environment. For example, the energy content available from recycling one year's production of U.S. spent nuclear fuel is approximately the same as that from oil provided by the Alaska Pipeline in that year.

AFCI is also expected to be a major stimulant to the revitalization of the domestic nuclear industry and our related nuclear infrastructure,





Hot Fuel Facility

providing U.S. technical leadership and improving U.S. global economic competitiveness.

Goals of AFCI — In cooperation with the international community, the United States seeks to:

- Expand nuclear power to help meet growing energy demand in an environmentally sustainable manner.
- Develop, demonstrate, and deploy advanced technologies for recycling spent nuclear fuel that do not separate pure plutonium.
- Develop, demonstrate, and deploy advanced reactors that consume transuranic elements from spent light water reactor fuel and spent fast reactor fuel.
- Establish supply arrangements among fuel supplier nations to provide reliable fuel services worldwide for generating nuclear energy by providing nuclear fuel and taking back spent fuel for recycling.
- Develop, demonstrate, and deploy advanced, proliferation-resistant nuclear power reactors appropriate for the power grids of developing countries and regions.
- Develop enhanced nuclear safeguards to effectively and efficiently monitor nuclear materials and facilities, to ensure commercial nuclear energy systems are used only for peaceful purposes.

Facilities Required

Three facilities are proposed to accomplish the AFCI objectives:

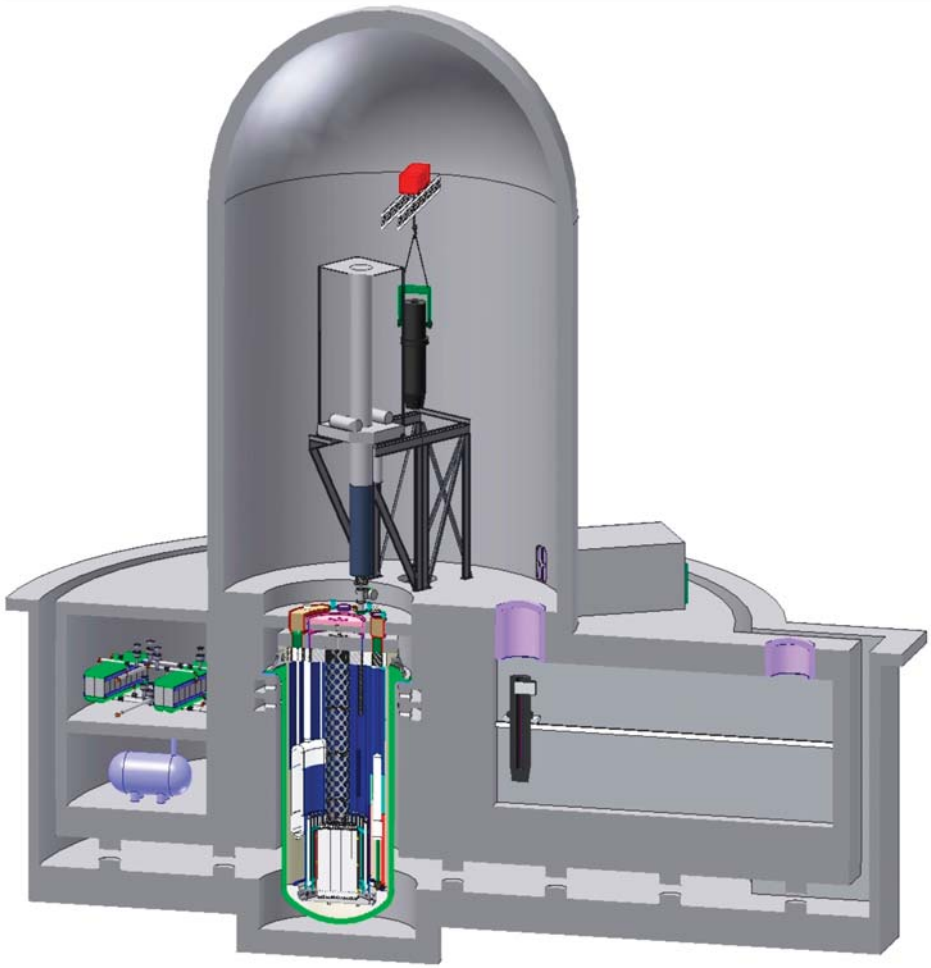
- A nuclear fuel recycling center: for the separation of light water reactor SNF and fast reactor SNF into their reusable and non-reusable constituents, and for the fabrication of transmutation fuel for the fast reactor (the advanced recycling reactor).
- An advanced recycling reactor: a fast neutron spectrum reactor that would be capable of converting long-lived radioactive elements (e.g., plutonium and other transuranics) into shorter-lived radioactive elements while producing electricity.
- An advanced fuel cycle research facility: a research and technology development facility that the Department of Energy would design, build, and operate to develop transmutation fuels and improve fuel cycle technology.

Planned Program Accomplishments

FY 2008

- Complete the GNEP Programmatic Environmental Impact Statement and issue a Record of Decision.
- Develop a detailed GNEP technology roadmap for demonstrating solutions to address outstanding technical issues and programmatic risks.
- Provide a decision package to the Secretary of Energy to address the path toward a government-industry partnership to build a nuclear fuel-recycling center and a prototype advanced recycling reactor.
- Complete bilateral agreement with France on global nuclear cooperation.
- Initiate work on proliferation-resistant reactors sized to match the electrical distribution systems of reactor-user nations suitable for potential U.S. manufacture and export to reactor-user nations with lower capacity electrical distribution systems.
- Continue expansion of the international GNEP organization of 20 Partner and 21 Observer and Candidate nations to achieve non-proliferation and nuclear energy expansion goals.

Advanced Recycling Reactor



- Complete a review of existing DOE facilities to determine what capability upgrades are possible in order to meet the nuclear fuel cycle development needs through the 2020-2025 timeframe.

FY 2009

- Establish formal tri-lateral agreement with Japan and France to support joint sodium fast reactor prototype development and supporting infrastructure, and advanced recycling research and development.
- Continue irradiation and testing of metal and oxide transmutation fuels in the Advanced Test Reactor; complete design and initiate fabrication of instrumented transmutation fuel tests for irradiation in the Advanced Test Reactor.
- Complete two coupled end-to-end tests of aqueous separations processes, evaluating gaseous collection systems and providing material for test fuel and waste form fabrication.
- Complete draft advanced fuel cycle research facility user facility strategy for GNEP partner and stakeholder review.

Program Budget

AFCI-GNEP
($ in Millions)

	FY 2008 Request	FY 2008 Actual	FY 2009 Request
AFCI-GNEP	$405.0*	$179.4	$301.5

*** $10.0 million requested by the National Nuclear Security Administration**