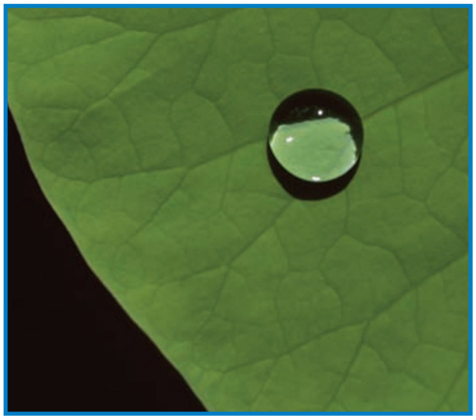
# Hydrogen for Transportation

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



*The Nuclear Hydrogen Initiative could lead to the production of a completely emissions-free transportation fuel.*

**Hydrogen is the most common element in the universe. Its increased use in transportation would benefit the environment and reduce U.S. dependence on foreign sources of petroleum.**

Significant progress in hydrogen combustion engines and fuel cells is bringing hydrogen-powered transportation closer to reality. Hydrogen may also be used in bio-fuel production, to boost the energy value of existing fossil fuels, making them burn much cleaner, and in the recovery of liquid fuels from our vast domestic resources of coal, tar oil sands, and oil shale. The primary challenge to the increased use of hydrogen as part of the Nation's overall energy infrastructure is the cost associated with its production, storage, and delivery. While hydrogen can be produced from readily available sources such as natural gas and water, existing hydrogen production methods are either inefficient or produce greenhouse gases, defeating a primary advantage of using hydrogen—its environmental benefits.

Nuclear energy has the potential to efficiently produce large quantities of hydrogen without producing greenhouse gases and could play a significant role in hydrogen production. The goal of the Nuclear Hydrogen Initiative (NHI) is to demonstrate the economic, commercial-scale production of hydrogen using nuclear energy. If successful, this research could lead to a large-scale, emissions-free, domestic hydrogen production capability to fuel the evolution of a future hydrogen economy.

## Developing an Integrated Program

The President's Hydrogen Fuel Initiative (HFI), of which the NHI is a component, is a research and development (R&D) effort to reverse America's growing dependence on foreign oil and expand the availability of clean, abundant energy. Hydrogen is produced today on an industrial scale in the petrochemical industry by a process of steam reforming, using natural gas as both source material and heat source.

A potentially better option for the future could be the use of advanced nuclear technology to produce hydrogen. High-temperature heat from an advanced nuclear system could be supplied to a hydrogen-producing thermochemical or high-temperature electrolysis (HTE) plant to support high efficiency hydrogen production and avoid the use of carbon fuels.

The Office of Nuclear Energy (NE) has developed a Nuclear Hydrogen R&D plan that defines the objectives and goals of the NHI and identifies the R&D required to deploy the most promising technologies.

As part of the President's HFI, the NHI is being implemented in close cooperation with programs in other Department of Energy offices that are conducting hydrogen R&D—the Offices of Energy Efficiency and Renewable Energy, Fossil Energy, and Science. This cooperation eliminates redundancy while ensuring that R&D is complementary. NE has also established substantial cooperation in this area with its international research partners.

## Planned Program Targets

The NHI addresses the need for greater utilization of our energy resources by developing energy conversion systems to economically produce hydrogen for use in our national transportation system. Program targets include:

- FY 2008: Begin testing of integrated laboratory-scale thermochemical and high-temperature electrolysis hydrogen production systems.
- FY 2011: Select technologies to be demonstrated in a pilot-scale hydrogen production experiment.
- FY 2013: Begin operation of a pilot-scale hydrogen production system experiment.

## Planned Program Accomplishments

### FY 2008

- Conduct integrated laboratory-scale experiments on sulfur-iodine thermochemical system to confirm the technical viability of the integrated system.
- Conduct tests of multi-cell electrolyzers for the Hybrid Sulfur thermochemical cycle.
- Operate the HTE integrated laboratory-scale experiment at normal operating temperatures and full rated power to confirm efficiency and demonstrate structural integrity.

### FY 2009

- Continue operation and testing on the Sulfur-Iodine integrated laboratory-scale thermochemical experiment to assess long-term process stability and component durability.
- Evaluate the effect of process improvements, such as membranes and improved catalysts, on thermochemical cycle efficiency.
- Design an integrated laboratory-scale experiment for the Hybrid Sulfur cycle at the Savannah River National Laboratory in preparation for construction in FY 2010.
- Continue HTE experiments begun in FY 2008 to investigate long-term cell operability and thermal cycling issues.
- Incorporate the results from the integrated laboratory scale experiments into the hydrogen production economic analysis model to identify cost drivers and, by 2011, support the hydrogen technology selection required by the Energy Policy Act of 2005 in 2011.

**Program Budget**

**Nuclear Hydrogen Initiative ($ in Millions)**

| | FY 2008 Request | FY2008 Actual | FY 2009 Request |
|---|---|---|---|
| **NHI** | $22.6 | $9.9 | $16.6 |