

## Hydrogen Technologies Group

### Highlights

The NREL Hydrogen Technologies and Systems Center and its Hydrogen Technologies Group take a systems engineering and integration approach to matching hydrogen R&D needs and opportunities with NREL's expertise in renewable energy.

Research in the Hydrogen Technologies Group runs the gamut from photoelectrochemical hydrogen production to controlling corrosion of fuel cell materials to developing hydrogen codes and standards and collaborating with the international research community.



Photoelectrochemical water splitting: Using a photovoltaic cell/electrolyzer submerged in an alkaline aqueous solution to produce hydrogen. Richard Peterson/PIX12958

**Hydrogen-powered fuel cells can be highly efficient and emit only water. Hydrogen can be produced domestically, stored for later use, and possibly shipped via pipeline. What can we do to make the potential of hydrogen a reality?**

All energy resources, from fossil fuels to renewable fuels like wind, solar, and biomass, can be used to produce hydrogen. Hydrogen can be used in fuel cells to power vehicles and provide electricity and heat for homes and offices. This flexibility, combined with our increasing demand for energy, opens the door for hydrogen power systems and their associated benefits. But there are several key barriers to hydrogen becoming America's clean and secure energy option. Hydrogen technology must be flexible, affordable, safe, and available to all regions of the country. And to truly be sustainable, it must be produced from domestic renewable resources.

The Hydrogen Technologies Group within NREL's Hydrogen Technologies and Systems Center is working to meet these challenges and to facilitate the transition to a hydrogen economy.

### Hydrogen Technologies and Systems Center

The Hydrogen Technologies and Systems Center works to integrate hydrogen production, storage, and distribution systems. By integrating these systems, we hope to ensure that hydrogen technologies are successfully deployed. The center also develops advanced technologies and systems that deliver multiple products and services from renewable resources. We partner not only with other programs at NREL, but also with the U.S. Department of Energy (DOE), government agencies, industry, communities, universities, and other national laboratories to implement the National Hydrogen Energy Vision for a clean and secure energy future.

Researchers in the center use a systems engineering and integration approach to match hydrogen research and development (R&D) with NREL's expertise in renewable energy.



**NREL**

**National Renewable Energy Laboratory**

*Innovation for Our Energy Future*

The center provides strategic support to DOE's Hydrogen, Fuel Cells & Infrastructure Technologies Program. It is responsible for coordinating research priorities across multiple NREL research centers, and advising DOE on innovation pathways.

The Hydrogen Technologies Group advances the Hydrogen Technologies and Systems Center's mission by researching a variety of hydrogen production and use technologies. The group also examines infrastructure issues that will one day facilitate hydrogen production and use.

## Hydrogen Production and Use

### Hydrogen from Renewable Resources

Although renewable resources can provide hydrogen for electricity generation, grid stability and intermittency issues are major barriers. By combining renewable generation technologies with hydrogen production and storage, renewable sources could potentially capture a larger share of the power-production market without major upgrades to the existing grid. The hydrogen produced from renewables can also be used for transportation fuel. The Hydrogen Technologies Group is researching storage and production technologies that can make hydrogen production more cost effective and reliable.

### Photoelectrochemical Water Splitting

Photoelectrochemical water splitting is a one-step process for producing hydrogen using solar irradiation of

semiconductor devices. Hydrogen Technologies Group researchers are testing new materials and structures that can collect the required energy and are stable in the reaction environment. NREL holds the world record—12.4%—for efficiency in direct water splitting.

### Advanced Fuel Cell R&D

Manufacturing challenges are one of the major obstacles to widespread use of fuel cell technology. Component material properties, manufacturability, and overall fuel cell operation are key research areas. Currently, the Hydrogen Technologies group is researching opportunities to understand and control the corrosion mechanisms in bipolar plates. Researchers are also investigating in-line sensors for use with high-speed fuel cell manufacturing equipment. The Hydrogen Technologies Group is working with other technology centers at NREL to integrate fuel cell systems with renewable energy conversion technologies.

## Safety, Codes, and Standards

Safety codes and standards must be developed and accepted before hydrogen can become a significant part of the U.S. energy supply. The Hydrogen Technologies Group is working with standards development organizations, code developers, and regulatory agencies to develop hydrogen codes and standards as part of a national program sponsored by DOE. The group is also assembling a hydrogen sensor laboratory to assist in developing codes and standards for placing hydrogen sensors.

## Partnerships and Collaboration

### Education

An understanding of the long-term benefits and near-term realities of hydrogen, fuel cell systems, and related infrastructure is an essential part of public and market acceptance. The Hydrogen Technologies Group provides target audiences with information about fuel cell and hydrogen systems. Our researchers also conduct workshops for codes and standards officials and have developed Web-based training modules for first responders and state and local officials.

### International Collaboration

Internationally, hydrogen energy technologies offer an important potential alternative to fossil fuels. The Hydrogen Technologies Group works with experts from around the world to address many of the technical challenges and long-term research needs that face the hydrogen community. The work is conducted through the International Partnership for the Hydrogen Economy, International Energy Agency, International Gas Union, and related forums.

## For More Information

The work of the Hydrogen Technologies Group directly supports the goals of the DOE's Hydrogen, Fuel Cells & Infrastructure Technologies Program R&D activities. To learn more about this work, visit <http://www.eere.energy.gov/hydrogenandfuelcells>.

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