

### Introduction

A number of countries consider hydrogen to be a potential long-term solution to energy security, and environmental and economic concerns. However, to achieve this hydrogen future, international collaborations in all areas of hydrogen energy development, from research to technology validation to implementation, are essential. This brief sample of ongoing efforts, in both the U.S. and abroad, represents the current global commitment to hydrogen as a potential long-term solution to the world's energy needs.



### International Partnership for a Hydrogen Economy (IPHE)

#### IPHE Member Governments:

- Australia
- Brazil
- Canada
- China
- European Commission
- France
- Germany
- Iceland
- India
- Italy
- Japan
- Korea
- Norway
- Russia
- United Kingdom
- United States

In November 2003, energy ministers from 16 countries representing 85% of the world gross domestic product joined to create the IPHE, an important global effort to maximize collaborative partnerships among countries and to promote sharing of experiential and research results.

The goals of the IPHE are to: rigorously identify and promote prospective areas of bilateral and multilateral collaboration; analyze and recommend priorities for research, development, demonstration, and commercial utilization of hydrogen technologies and equipment; analyze and develop policy recommendations on technical guidance; and foster implementation of large-scale, long term public-private cooperation.

The significance of this agreement lies in its ability to coordinate and leverage resources to advance bilateral and multilateral cooperative activities and avoid duplicative efforts. It also provides a forum for addressing emerging technical, financial, legal, market, socioeconomic, environmental, and policy issues related to hydrogen technology that are not currently addressed elsewhere.

*“Through this Partnership, we have established a comprehensive framework on which to structure global hydrogen research and development. We can begin to take the concrete steps necessary to ensure that the scientific and technological work that is to come is best directed toward our ultimate goal - a secure, environmentally friendly energy future.”*

**Spencer Abraham,**  
Secretary of Energy of the  
United States of America  
(2001-2005)



## ICELAND

The City of Reykjavik, Iceland has set a goal to be the world's first hydrogen economy. In 2005, Iceland began operation of a small fleet of hydrogen fuel cell buses that run on renewably-produced hydrogen. With an abundant supply of renewable geothermal and hydroelectric power, the buses are fueled by hydrogen electrolyzed from water. The buses use fuel cell stacks to convert the hydrogen gas to electricity to drive the electric engine.

These electric buses perform much like conventional, diesel-powered buses but without the pollution and noise. A refueling station is operational in Reykjavik, and the first three hydrogen-fueled buses will replace four percent of Iceland's mass transit fleet.

## North America

The U.S. has been involved in hydrogen research, development, and demonstration (RD&D) since the late 1950s when liquid hydrogen was first used to power the National Aeronautic and Space Administration's (NASA) spacecrafts. NASA also began using fuel cells, devices that combine hydrogen with oxygen to create an electric current, to provide electricity onboard their vehicles. During the oil crisis of the 1970s, the U.S. Department of Energy (DOE) was created to focus attention on alternative energy resources, including hydrogen technologies, and thus the DOE Hydrogen Program was formed to oversee hydrogen RD&D.

These efforts have intensified in recent years. In 2002, DOE launched the FreedomCAR (Cooperative Automotive Research) Program, a partnership with the U.S. Council for Automotive Research and the energy industry. This program was intended to alleviate the nation's growing dependence on imported oil by advancing the high-technology research needed to produce hydrogen fuel cell vehicles (FCVs). To ensure that the necessary infrastructure exists to allow FCVs to successfully enter the market, the U.S. government announced a parallel development effort known as the President's Hydrogen Fuel Initiative. Over the next five years, these programs together will contribute \$1.7 billion towards the advancement of hydrogen and fuel cell-related technologies.

Canada also has extensive hydrogen RD&D efforts. The Canadian government has consistently spent around \$20 million per year on research and development with approximately another \$13 million contributed by industry. Recently, the government announced an additional \$130 million to lay the groundwork for Canada's hydrogen economy. In April 2004, the Canadian government announced funding for a Hydrogen Highway™ to be built between Vancouver and Whistler, British Columbia. An additional \$5 million will fund three other projects, including the Vancouver Fuel Cell Vehicle Project, the Hydrogen High-Pressure Valve Development Project, and the Hydrogen-Powered Delivery Van Project.

## Europe

Governments and industries throughout Europe have been actively involved in hydrogen and fuel cell development for some time, acknowledging the importance of fuel cell research as far back as 1988 when €8 million (\$9.6 million) was made available for such research over a four year period.

Recently, the European Commission President, Romano Prodi, unveiled a €2 billion (\$2.4 billion) hydrogen vision designed to bring hydrogen technologies, including fuel cells, closer to large-scale commercial viability. He also pledged that by 2050, Europe's hydrogen supply would be based on renewable resources. In November 2003, the European Commission launched the European Initiative for Growth to accelerate the European Union's (EU) economic recovery. The initiative includes a Quick Start Programme, with approximately €2.8 billion (\$3.4 billion) of public and private funding; a ten-year program for hydrogen-related research, production, and use is anticipated. It also includes the European Hydrogen and Fuel Cell Technology Platform.

Currently, the EU has more than 70 on-going research and development projects conducted by governments, universities, and industry. In particular, the EU has committed to supporting the Clean Urban Transport for Europe (CUTE) demonstration project. As one of the world's largest hydrogen fuel cell technology projects, CUTE operates a fleet of 27 hydrogen-powered buses serving nine cities in Europe. This project has also required the development and maintenance of an accompanying hydrogen distribution infrastructure to support the fleet. Madrid, Spain hosts the first operational CUTE bus, which began service in June 2003. It has traveled more than 6,000 miles and transported more than 30,000 passengers.



## Asia-Pacific

In anticipation of the 2008 Olympic Games in Beijing, China, the U.S. Secretary of Energy, China's Science and Technology Minister, and Beijing's Vice Mayor created the Green Olympic Protocol, an agreement focusing on the utilization of clean energy technologies. As part of this agreement, hydrogen buses will be used in Beijing during the 2008 Olympic Games.

As a leader in hydrogen and fuel cell research and development, Japan has researched hydrogen fuel cell technologies since the early 1980s. In 1992, Japan created the International Clean Energy Network Using Hydrogen Conversion (WE-NET in Japanese), a ten-year program designed to focus R&D efforts on core hydrogen technologies. Today, the WE-NET program has been replaced by the Ministry of Economy, Trade and Industry's (METI) New Hydrogen Project (NHP). Their goal is to facilitate the commercialization of hydrogen fuel cells.

## Asia-Pacific Economic Cooperation (APEC):

APEC, which has 21 members including Australia, U.S., Philippines, Malaysia, and Japan, has recently begun to consider hydrogen as a potential long-term solution to its growing collective energy demand. APEC members represent more than a third of the world's population (2.6 billion people), approximately 60% of world GDP (US\$19,254 billion) and about 47% of world trade. Among its latest actions on hydrogen, the APEC Energy Working Group (EWG) held a workshop to develop an Interim Framework Document on hydrogen and fuel cells. This document identifies opportunities for APEC to work with the IEA and the IPHE to advance hydrogen energy; to develop a program for capacity building assistance on policy and regulatory issues; and to work in a long-view toward harmonized codes, standards, and regulations.

## Interested in Learning More?

U.S. Department of Energy  
[www.eere.energy.gov/hydrogenandfuelcells](http://www.eere.energy.gov/hydrogenandfuelcells)

National  
Hydrogen Association  
[www.hydrogenassociation.org](http://www.hydrogenassociation.org)

U.S. Fuel Cell Council  
[www.usfcc.com](http://www.usfcc.com)

International  
Partnership for the  
Hydrogen Economy (IPHE)  
[www.iphe.net](http://www.iphe.net)

## South America

In the greater São Paulo metropolitan area, the Brazilian government is stimulating the development of fuel cell buses by supporting a significant operational test of these buses. The project, in collaboration with industry partners, assists the Brazilian government and the Empresa Metropolitana de Transportes Urbanos de São Paulo S/A in acquiring eight fuel cell buses, to provide operational feedback to hydrogen fuel cell technology developers. The Brazilian government hopes that this fuel cell bus project will provide valuable experience and increase the demand for fuel cell buses. They also hope it will pave the way to making hydrogen technology commercially viable throughout Brazil. Brazil has a large-scale, modern, well-equipped and competitive bus industry served by bus manufacturers Mercedes-Benz, Volvo, and Scania. Brazil also currently utilizes natural gas and ethanol technologies for many of their public transportation needs.

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