



**International Partnership  
for the Hydrogen Economy**

## **EDUCATION SCOPING PAPER**

## **IPHE Education Scoping Paper**

### **Background and General Vision**

Education is crucial to the global transition to a hydrogen economy, as it provides political leaders, technical specialists, and the public with the knowledge necessary to play appropriate roles in the transition to a hydrogen-based energy infrastructure. At its third committee meeting in September 2004, the ILC agreed to form a working group on Education with representation from Brazil, the European Commission, France, Germany, Iceland, Japan, and the United States. Since that time, additional participants, including Canada and China, have also joined. The IPHE Hydrogen Education Work Group (EWG) is charged with examining the international dimensions of hydrogen education, including possibilities for collaboration among IPHE member countries.

Education efforts will achieve maximum benefit if they cut across all IPHE priority areas, both those that have been defined to date as well as those that will be defined in the future. Priority areas that have already been identified include hydrogen production, hydrogen storage, advancement of fuel cell technologies, regulations and safety codes development, infrastructure development, socio-economic research, and technology demonstration and evaluation. The EWG will work with members of other IPHE committees and groups to ensure that education efforts are appropriately integrated across program areas.

For many people, including energy specialists as well as members of the general public, hydrogen represents a dramatically new and different form of energy. Extensive education programs are needed to teach both the fundamental concepts of a hydrogen economy, with a particular emphasis on hydrogen safety, as well as the specialized information and skills that this economy will require. Cooperation among IPHE member nations will facilitate the exchange of expertise, lessons learned, materials, and ideas related to education for the hydrogen economy. Cooperation can also enhance the effectiveness and broaden the reach of individual country programs.

In order to identify target audiences, assess the needs of those audiences, and develop approaches that appropriately address those audiences, the EWG requested that IPHE Members provide a listing of the different types of educational materials and activities they had developed. The responses received to that request were instrumental in shaping the EWG's approach to future IPHE educational activities.

The EWG identifies the following distinct audience groups for educational activities:

- Policymakers and Government Officials
- Educators and Students
- Stakeholder Groups

In addition, the EWG emphasizes the following approaches:

- Virtual School / IPHE Hydrogen University
- Coordination with IEA-HIA on Education Activities

The audience groups identified each have distinct hydrogen educational needs ranging from general to technical, broad-based to narrowly-targeted. This Scoping Paper summarizes, for each audience, key educational barriers to the realization of a global hydrogen economy, specific needs of each target audience, existing resources from different IPHE Members in support of outreach and education to the targeted groups, and milestones along the path of pursuing the proposed approaches. The resources listed reflect existing materials in one or more IPHE Member countries. IPHE Members should be encouraged to continue submitting a list of existing materials. Members should also be encouraged to facilitate the translation of materials into their respective languages, should they identify these as useful to their intended domestic audiences.

## **A. Target Audiences**

### **1. Policymakers and Government Officials**

Government officials at all levels – whether in international, regional or national bodies, bureaucratic agencies, states, counties, districts, cities, or localities – will play important gatekeeper roles in facilitating the adoption of hydrogen technologies or adhering to more familiar energy technologies.

#### *Barriers and Needs*

In the case of ground-breaking and pilot projects, ensuring that regulations at various levels of government appropriately encompass hydrogen technologies presents a significant hurdle. Laying the educational groundwork among government officials is an important first step in establishing the foundations of a global hydrogen economy.

Government officials require relevant, objective, accurate information that they can rely on as part of their research to make informed decisions. This can include basic information about the fundamental concepts of a hydrogen economy, technical and cost data, and case studies on existing hydrogen projects. Most importantly, accurate information about private sector involvement in hydrogen-related activities is crucial in allowing informed policy choices.

#### *IPHE Member Existing Resources*

- Fact sheets to introduce the concept of a hydrogen economy and hydrogen technologies
- Publications on the state of hydrogen science and technology
- Print materials explaining the challenges for the successful implementation of the hydrogen economy
- Publications providing general information on transportation demonstration projects
- Blue-prints for coordinated, long-term public and private efforts required for hydrogen energy development
- Policy documents outlining national approaches to and strategies for the development of hydrogen energy

### *Milestones/Deliverable*

- Educational Materials Inventory with resources to help introduce hydrogen to policy makers and other officials who do not have a technical background.

### *Approach*

- Survey IPHE Member Countries and post their available materials in a single location on the IPHE web site, providing easy access for the intended audience.

## **2. Educators and Students**

Students are a critical source of ideas and innovation as the hydrogen economy develops, and they will emerge as leaders in the research and development, as well as the policy-making activities that will decide the future of a global hydrogen economy. Additionally, students at technical colleges and vocational schools will comprise much of the technical workforce that is needed to support the implementation and maintenance of the infrastructure of the hydrogen economy.

Today's children will be the consumers in tomorrow's hydrogen economy. As such, their understanding and acceptance of hydrogen technologies will be crucial to a successful transition to a hydrogen economy. With primary and secondary school enrollment rates very high in the countries most active in hydrogen technologies, school systems are the logical place to incorporate hydrogen literacy.

Teaching primary and secondary students about hydrogen and fuel cell technologies, as well as the fundamental principles of a hydrogen economy, will allow them to gain a general understanding of the movement toward a hydrogen economy, thereby facilitating the movement and allowing these current students to later function as informed adult consumers. Perhaps even more important, educating students on energy science and engineering, as well as on the impact that these activities may play in the global marketplace, may encourage more students to pursue further study at the university-level, thus enriching the future professional talent pool.

### *Barriers and Needs*

Given the significant issues that must still be resolved in order for a global hydrogen economy to be realized, it is important to educate students on the issues and opportunities that hydrogen presents. These students will be instrumental in determining the future direction of the world's energy solutions.

Education efforts should focus on engaging university students studying science, engineering, and public policy through research opportunities and expanded course offerings; training mechanics, autoworkers, HVAC technicians, and other industry specialists through appropriate instruction at technical and vocational schools; and enhancing primary and secondary hydrogen education through teacher education and curriculum revision and development. IPHE member

countries can benefit from sharing training and age-appropriate hydrogen curriculum materials, as well as by sharing experiences and best practices from the use of such materials.

#### *IPHE Member Existing Resources*

- Print resources on the basic facts of hydrogen and fuel cells
- Online discussion of socioeconomics of hydrogen, including employment opportunities, and online exercises for students
- University curricula on the basic aspects of fuel cell technology; renewable energy systems; thermodynamics for fuel cells; detailed description of different types of fuel cells

#### *Milestones/Deliverables*

- Database of resources for technical colleges and universities in IPHE member countries.
- Database of resources for primary and secondary teachers and students in IPHE member countries.
- Plan for establishing Master Classes and the IPHE Virtual School.

#### *Approach*

- Establishment of the IPHE Virtual School

### **3. Stakeholder Groups**

IPHE recognizes that non-governmental stakeholders will play important roles in the development and adoption of a hydrogen economy. The IPHE Implementation – Liaison Committee adopted an organizational approach to the involvement of stakeholder groups. In order to support and deepen these efforts, the EWG can best use its resources in the development of materials to be used in outreach activities with stakeholder groups. Below is a listing of hydrogen economy stakeholders that are not represented in other sections of this Scoping Paper.

- Private industrial and commercial enterprises
- Non-governmental civil society groups, such as community organizations
- Large-scale end users such as utilities, transit agencies, fleet operators and residential associations

Numerous organizations and groups exist that cut across organizational and interest lines, through which stakeholders in a hydrogen economy can organize themselves and share information. The IPHE can support stakeholders by fostering productive discussion and facilitating the flow of information, which can sustain the momentum for pursuing the vision of a global hydrogen economy. Active communication among the stakeholders involved can shape the direction and content of educational efforts and obtain greater benefit for IPHE educational activities.

### *Barriers and Needs*

The large number and diversity of potential global stakeholders presents logistical challenges to the efficient sharing of information with the IPHE. Such information sharing must take place in two directions: both from the IPHE to stakeholders and from these active and interested parties to the IPHE.

The internet presents a powerful tool for communicating and disseminating information and IPHE must take advantage of its potential in order to effectively manage communications with stakeholders. In addition, information partnerships should be established with existing organizations and groupings to channel communications effectively.

### *Existing Resources*

For communities hosting hydrogen demonstration projects:

- Introductory materials on demonstration projects and fueling stations
- Brochures for children and adults on environmental issues; fuel cell vehicles; and hydrogen
- Public relations video on fuel cell vehicles
- Website with resources on fuel cell vehicles
- Animation of functioning of PEM fuel cells

### *Milestones/Deliverables*

- Database of resources for stakeholders in IPHE member countries

### *Approaches*

- Utilize the existing Liaison Group of Stakeholder Association to promote educational activities
- Establish IPHE Virtual School
- Make IPHE Member country materials available on the IPHE website

## **B. Educational Approaches**

### **1. Virtual School**

In the August 2005 Reykjavik Education Work Group meeting, EWG members expressed interest in the creation of an IPHE Virtual School. Through this School, IPHE would offer short online courses in basic topics of hydrogen and fuel cell technology, in both technical and socioeconomic areas. The basic concept of the School involves information-sharing among

universities and technical colleges with hydrogen education programs in IPHE member countries. Other project areas that the team identified as important or of interest include policymaker education and training, technician training, and competitions to engage universities as well as younger students.

#### *Audience*

The audience for which the courses are intended is broad, ranging from university-level students to researchers and a “young professional” class, which could include local-level policymakers. The courses should be taught at a level that is accessible across these groups. The EWG could consider adding more specialized courses in the future as appropriate.

#### *Structure*

One way to structure the School would be around a partnership with universities housing significant hydrogen and fuel cell research. The EWG should determine selection criteria for the participating universities and researchers; establishment of criteria for desired courses; incentives to individual professors and to their universities; and the creation of what could be structured as an “Institutional Faculty Club” to administer the School.

#### *Technologies*

A range of technologies are available for use in such a project, including “downloadable” audio/visual technology that would allow the offering of classes 30-40 minutes in length.

## **2. Coordination with IEA**

The IEA Hydrogen Implementing Agreement has identified education in its strategic planning process. This will be addressed fully in the coming year, and strategies for coordinating educational activities with IPHE will be developed.

## **C. Additional Responsibilities**

In the Beijing Action Plan, the IPHE Steering Committee mandated the development of a communication and outreach package that would include “educational materials designed to build public confidence,” and an enhanced IPHE website “to convey messages that address the benefits, issues of public perception, and risks of the hydrogen economy.”

In the absence of an education working group, the Steering Committee managed the development of the requested communication and outreach package. The Office of the Secretariat developed the requested materials, and in January 2005, the Steering Committee approved the following hydrogen education materials:

- Interactive Hydrogen Demonstration Atlas (Internet-based)
- IPHE Fact Sheets (5)
  - Hydrogen: An Overview
  - Hydrogen Storage

- Hydrogen Production and Delivery
- Fuel Cells: A Hydrogen Enabling Technology
- Hydrogen Safety Codes & Standards

*Proposed Approach*

- Provide technical assistance as requested by IPHE Steering Committee in development of IPHE hydrogen education products

**Action Requested from the ILC**

At the June 2006 meeting, the ILC is requested to review and approve the Hydrogen Education Work Group Scoping Paper.

**END OF EDUCATION SCOPING PAPER**