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**Hydrogen, Fuel Cells, and Infrastructure Technologies
Program
Education Plan Workshop Proceedings**

**Hilton Crystal City
2399 Jefferson Davis Highway
Arlington, VA 22202**

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1.0 Overview

Chapter six of The National Energy Policy directs the Secretary of Energy to “develop next generation technology—including hydrogen.” Specific recommendations include the following:

- “Focus research and development efforts on integrating current programs regarding hydrogen, fuel cells, and distributed energy.”
- “Develop an education campaign that communicates the benefits of alternative forms of energy, including hydrogen.”

On November 15, 2001, DOE convened a visioning meeting with approximately 50 leaders from industry, academia and nonprofit organizations. The vision statement that emerged is –

“Hydrogen will become America’s clean energy choice.
Hydrogen will be affordable, safe, domestically produced,
and used in all sectors of the economy and in all regions of
the country.”

In early 2002, participants in the National Hydrogen Energy Roadmap Workshop and Fuel Cell Report to Congress Workshop determined that education, in particular, is an appropriate and integral role for the Federal government to play in promoting hydrogen technologies.

Federal, state, and local governments, as well as academic, industry, and trade organizations have funded and continue to support numerous hydrogen and fuel cell education efforts. These efforts span a wide range of activities and are intended to reach a variety of audiences. Activities in schools, for example, range from distributing toys to middle school students to offering engineering curricula to graduate students. Other efforts for the general public or targeted stakeholder groups have included, but are not limited to, multi-media exhibits and presentations, websites, documentary films, training centers, demonstration programs, and newsletters. A more detailed list of organizations and their products and activities is included in the appendix to this report.

Objective of the Education Program

The overall objective of the Hydrogen, Fuel Cells, and Infrastructure Technologies Program is to educate target audiences about the long-term benefits and near-term realities of hydrogen, fuel cell systems, and related infrastructure.

Goals of the Education Program

The overall goal of the Hydrogen, Fuel Cells, and Infrastructure Technologies Program is to achieve among key audiences a level of understanding about fuel cell and hydrogen

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systems that can facilitate the commercialization and market acceptance of those technologies. If successful, the target audiences should be able to express the value of a hydrogen economy, recognize the near-term realities and opportunities of hydrogen and fuel cell technology, and understand, where appropriate, their part in facilitating the transition to the Hydrogen Age.

Specific goals of the Education Program include –

- Educate key stakeholders (see section VII of the plan) who are essential to successful commercialization of hydrogen and fuel cell technologies, and increase the teaching of curriculum including fuel cells and hydrogen technologies at all educational levels.
- Encourage local and regional hydrogen and fuel cell education initiatives and strategic partnerships with industry, government agencies, professional/trade organizations, and foundations to leverage resources in order to increase the reach, scale, and effect of education efforts.
- Build a sustainable network of businesses, environmental organizations, and educational institutions with appropriate support at the national level, and with linkages to existing institutions, to accelerate the U.S. economy toward hydrogen.

DOE, with some assistance from stakeholders, drafted a detailed outline for its 5-Year Education Program Plan. This outline expresses the objective of the education program, which is *to educate target audiences about the long-term benefits and near-term realities of hydrogen, fuel cell systems, and related infrastructure*. The detailed outline also includes specific goals of the program; barriers to the commercialization of hydrogen and fuel cells, which the program aims to overcome; key messages, target audiences, and key objectives; and plans for measuring success.

The Hydrogen, Fuel Cells, and Infrastructure Technologies (HFCIT) Education Plan Workshop was arranged to begin a serious dialogue with specialists on the content of, and issues related to, an educational program about hydrogen and fuel cells. Specific workshop objectives were to identify key education actions that DOE should support and set priorities for activities to reach the target audiences critical to realizing the hydrogen economy.

Over 60 individuals, representing industry, government, non-governmental organizations, national laboratories and universities, convened in Washington, DC on December 4th and 5th, 2002 for the workshop.

2.0 Workshop Organization

The workshop agenda and list of participants are provided in the appendix to this report.

The first day of the workshop included a plenary session in the morning, followed by breakout sessions, and a concluding plenary session.

The first plenary outlined the charge of DOE's hydrogen and fuel cell education effort (described above). The concurrent four breakout sessions that followed were based on the key audiences identified in the draft education plan. Related audiences were grouped together to maximize participants' expertise. The breakout groups were 1) Code Writing Organizations and National Regulatory Agencies, 2) State and Local Decision Makers and the General Public, 3) Professional/Trade Organizations, Large-Scale End Users, and Financial Institutions, and 4) Educators and Students. Participants received a copy of the draft education plan and other material prior to the meeting and were assigned to a working group based on their expertise. Each group had a facilitator, who promoted active discussions and, using a matrix, helped participants organize their activity recommendations and outline their priorities. (The matrix is included in Section 5.0: Reports from Breakout Groups). A scribe assisted each facilitator by keeping accurate notes of the deliberations. A spokesperson nominated by each group presented the group's information in the final plenary session on day one.

Day two was devoted to a plenary discussion of common themes and crosscutting activities, as well as overall priorities for target audiences in the context of DOE's hydrogen and fuel cell education program.

3.0 Workshop Objectives

Mrs. Christy Cooper, in her overview presentation, outlined the objectives of the workshop. Each breakout group was charged with identifying specific key education actions that DOE should support and setting priorities for activities to reach the target audiences critical to realizing the hydrogen economy.

4.0 Plenary Session - Introduction and Overview Presentations

4.1 Welcome and Overview of the DOE Program

Steven Chalk, Program Manager for the DOE Hydrogen, Fuel Cell and Infrastructure Technologies (HFCIT) Program, welcomed all the participants to the workshop and emphasized in his brief presentation the importance of the workshop to shaping the education plan.

Following his welcoming remarks, Mr. Chalk provided a brief overview of the DOE HFCIT Program and highlighted specific background information that is discussed in section 1.0 Overview, of these proceedings.

4.2 Presentation of the Education Program Plan and Workshop Process

Christy Cooper, who is responsible for the HFCIT education sub-program, discussed the background of the new education sub-program, 5-Year Education Program Plan Outline, and workshop process. She reiterated the workshop objective and encouraged participants to think creatively.

5.0 Reports from the Breakout Groups

The following section is a summary of the discussion and decisions of each of the target audience groups.

5.1 Code Writing Organizations and National Regulatory Agencies

Attendees:

Facilitator: Jim Ohi, NREL

Scribe: Erin Cready, Sentech

Karen Miller, NHA

Tony Androsky, USFCC

David Gushee, AiChe

Mary Rose de Valladares, MRS International

Neil Rossmeissl, DOE

Tom Cors, Alatram

Elizabeth Reichert, BP

Target Audiences (in no particular order):

- FIRE (Financial, Insurance, and Real Estate Companies)
- Code Officials
- Fire Marshals
- Zoning Officials
- Maintenance Repair Technicians
- Other Programs/Agencies (DOT, FEMP, EPA, FERC, OSHA, MSHA, Clean Cities, Buildings, within D
- Trade Groups/Associations (Contractors, A&E Industry, NCSL, NARUC, NASEO, STAPPA/ALAPCO
- OEMs
- OEM Technical Input (FCC, NHA, AIM)
- IEA
- UN GRPE
- PUCs
- NESCAM
- State Legislatures
- NGA
- ABA
- APA
- SDOs (Standards Development Organizations – SAE, ASME, IEEE, ISO, UL)
- CDOs (Code Development Organizations)
- Technical Associations (AIA, AICHE, ASCE)

Barriers/Challenges:

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- Excess/disorganized information
- Jurisdictional issues
- Resource availability
- Availability of hydrogen & fuel cell data
- Perception of hydrogen as unsafe
- Lack of clear message articulating “Why Hydrogen”

Needs:

- Readily available, clearly defined, consistent information – very important to have consistent, readily available information on current (and pending?) codes and standards for reference purposes.
- Awareness of jurisdictional issues – in order to facilitate this awareness, the group proposed federal agency activities in education on the status of technology and activities to address SDOs (ICC vs. NFPA) and state vs. local adoption concerns.
- Minimize the impact of resource availability – a method must be developed to address competing priorities and the allocation of limited local resources. This includes:
 - Funding
 - Access to hydrogen & fuel cell information (develop websites, education contacts, tools/videos)
 - Access to Codes & Standards – existing and in development
- Increased availability of hydrogen & fuel cell data addressing:
 - Operating experience
 - Cost
 - “Failures”
 - Open vs. intellectual property schemes
- Establishment of an accurate perception of hydrogen safety
- Development of a Safety Plan for each RD&D project
- Development of a clear message articulating the reason for switching to hydrogen & fuel cells.

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Activities/Products

Target Audience (in descending priority)	Activities/Products	Delivery Mechanism (Who, How, Where?)	When? (Short- Long Term)	Estimated Costs
<ul style="list-style-type: none"> • SDOs (SAE, ASME, ISO, MC, ICEE) • CDOs • OEMs/ Tech Input 	Develop Comprehensive Modules <ul style="list-style-type: none"> • Produce Tech. Specific modules (Generic - Code/Fire Marshall) • Produce System Modules for Training related to Model Codes • Establish Safe Working Parameters <ul style="list-style-type: none"> ○ Vehicle ○ Fueling Stations ○ Transport of Materials • Testing Performance Parameters for Stack Operation 	<ul style="list-style-type: none"> • DOE • DOE, SDO/NGOs • DOE, Other Gov't, Private, SDO/NGOs • SDO/NGOs, Private 	2002-2005	750K/yr 250K/yr 500K/yr
	Educate C&S Developers <ul style="list-style-type: none"> • Information Modules <ul style="list-style-type: none"> ○ CD ○ Website • Mobile Training Units 	DOE	2002-2007	1,150K 150K 1,000K
	“Licensing” Standards	DOE, SDO/NGOs	2002-2007	1,300K/yr
<ul style="list-style-type: none"> • Code officials • Fire Marshall • Zoning Officials • Local Officials • Regulatory Agencies (DOE, FEMP, OSHA, MSHA) 	Curriculum Development (for Enforcement Officials, OJT, Mobile Training Units) <ul style="list-style-type: none"> • Develop Checklists/Tools <ul style="list-style-type: none"> ○ Periodic ○ Installation (Certification) ○ Self • Public Database on hydrogen Technologies • Safety & Communications Plan for RD&D Project <ul style="list-style-type: none"> ○ Emergency Response Plan 	DOE, Other Gov't DOE, Private Private Private, DOE	2004-2010 2003-?	150K 100K 60K/project or 250-300K/yr 25K/project
	Establish Train the Trainer Programs for Code Officials	DOE, Other Gov't, Private, SDO/NGOs	2004-2010	450K

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<ul style="list-style-type: none"> • Trade Groups/ Assn's • Technical Assn's 	Phase in appropriate Training into Designated Timelines Tools: <ul style="list-style-type: none"> • Multi-media Electronic Presentations • Mobile Training Groups • Interactive Software w/ Tests in combo w/ Practical Applications to produce interactive Training Modules on US/International Demos, etc. 	DOE, Other Gov't, Private, SDO/NGOs	2002-2012	250K/project
	Develop Curriculum: <ul style="list-style-type: none"> • Trade (both Union and Non-union members) • Tech Schools <ul style="list-style-type: none"> ○ Associate's Degree • Post Secondary (University) <ul style="list-style-type: none"> ○ Industrial Engineers ○ Civil Engineers 	DOE, Private	2002-2012	800K 500K 200K 100K
	Implement Accredited Technology Training Program <ul style="list-style-type: none"> • Key Audience Mtgs./Conferences 	DOE, Other Gov't, Private	2002-2012	1,000K 100K

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5.2 State and Local Decision Makers and the General Public

Attendees:

Facilitator: Cathy Gregoire Padro, NREL

Scribe: Jenny Mandel, Sentech

Jaimie Levin, AC Transit

Nancy Hazard, NESEA

Erin Pierce, Plug Power

Peter Alyanakian, DOE

Anne-Marie Borbely-Bartis, Battelle

Tara Sidor, Inside Washington Publishers – Inside Fuels and Vehicles

David Tuft, Breakthrough Technologies Institute

Bill Craven, Daimler Chrysler

Scott Sklar, The Stella Group, Ltd.

Bill Hoagland, Hydrogen 2000

Jeff Serfass, NHA

Maria Bellos, Breakthrough Technologies Institute

Laura Rzasa, Donley Communications

Sunita Satyapal, UTC Fuel Cells

Katie Hoffner, HydrogenWorks

Nic van Vuuren, Hampton Roads Clean Cities

DOE Role:

- Facilitate demonstration projects, with a focus on incorporating educational plans
- Provide information to various public information pipelines
- Maintain data on project results, especially successes and lessons learned
- Provide incentives and incorporate fuel cell incentives into existing renewable energy programs
- Make the provision of incentives for projects dependent on the existence of educational components
- Coordinate educational efforts with DOE's technical plan

Goals/Objectives

Near-term:

- Build support for DOE's hydrogen program
- Support existing demos with coalitions, message development, media events, and information dissemination
- Develop achievement measures (e.g. funding levels, public awareness)
- Harmonize informational messages among different stakeholders (e.g. Toyota promises FCV's next year, while DOE anticipates their availability in 2006)

Mid- to long-term:

- Build on and use hydrogen demonstration projects

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- Build a vision for a hydrogen economy
- Foster public discussion of the benefits of hydrogen

Participants drew an analogy between the creation of a hydrogen economy and development of the US space program in the 1960s, noting that the space program was able to garner public support despite the lack of a “product” to concretize the campaign.

Barriers:

- Lack of a clear vision of what a hydrogen economy would look like, with a roadmap
- Skepticism
- Fear – perception of hydrogen as unsafe
- Need for comprehensive studies and surveys, to identify other barriers
- Need to progress through four relational stages with hydrogen technologies
 - Awareness
 - Requires a consumer product, tires to kick
 - Environmental and energy security factors
 - Beyond just one product, to encompass the fuel/technologies overall
 - Knowledge and perceptions
 - Misperceptions
 - Acceptance and convenience
 - Resistance to change
 - Support
- DOE’s mission/strength may not be in running PR campaigns
- Need focus groups, market testing, opinion research, and policy analysis for FC technologies

Drivers for the adoption of hydrogen fuel cell technologies:

- Accessibility, value added, low cost of hydrogen
- Greenness
- Favorable policies – incentives, subsidies, etc.
- Pollution/urban air quality concerns
- Energy security
- Product branding (as a potential driver)
 - Branding can drive people to purchase a given product over its competitors
 - In the Netherlands, windmills represent a form of “national branding” that contribute to public support for them
 - Engenders emotional commitment
 - Requires a clear message

One participant identified three types of customers

- Those driven by environmental factors, “green consumers,” largely cost insensitive
- Those interested for value added – reliability, redundancy, etc.
- Those who are not yet customers

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The group identified immediate needs for unified, appealing message(s) for the general public, and information and data for state and local governments and other stakeholders.

Audiences

Major categories:

- Policy makers and executives
- Consumers and end users
- Commercial and business communities
- Institutions
- Media and information outlets

Audiences:

- Legislators (at all levels of government)
- State energy offices
- Local officials: public works, health and safety, fire, etc.
- Media
- Consumers
- Educators
- Non-elected city/county staff
- Utilities
- Local distribution generators
- Allied businesses (propane dealers, etc.)
- Allied organizations (including NGOs and non-profits)
- Pipelines to the public – media, manufacturers
- Environmental organizations
- Professional trade organizations (architects, building groups, etc.)
- Entertainers – can use their high visibility to convey messages
- Religiously affiliated groups – for example, the “What Would Jesus Drive?” campaign
- Green power purchasing cooperatives
- Retail transportation sector – car dealerships, bike/scooter sales points
- Hydrogen fuel cell manufacturers
- Recreation groups
- International markets – especially where they represent markets for US exports

A distinction was suggested between consumer and policy demand for hydrogen technologies, with an associated distinction in audiences.

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Activities and Products

Major categories:

- Information dissemination
- Coalitions
- Media events
- Message development
- Demonstrations.

Priority activities/products:

Activities/Products	Delivery Mechanism (Who, How, Where)	When? (short – long term)	Estimated Costs	Measurement Methods
Clearinghouse/lessons learned database/access to experts	Conferences, seminars, newsletters, websites	Short and long term	\$500k in 1 st year	Number of database accesses, number of calls
Develop messages on benefits targeted to location-specific state and local audiences	Fact sheets, speaker bureaus, newsletters, videos, web sites, training the trainer programs	Now to 5-10 years	\$700k for production, ?? for dissemination	1) 7 states in 1 st 1-2 years 2) 50 states in next 5 years
Conduct comprehensive analysis of impacts of hydrogen infrastructure (positive and negative aspects), and create educational “Hydrogen Impacts Program”	State and local authorities, technical seminars, trainings	Short term	\$200k - \$500k	Concentrate on 7 leading states
Develop positive talking points	Trainings, establish hydrogen information centers within the Clean Cities Coalition, Green Building Council, other organizations	0 – 10 years	\$200k - \$300k	1) Talking points 2) Accuracy in media portrayal
Development of a hydrogen modeling tool (incorporating economic, financial, environmental, other factors)	Seminars, meetings	0 – 2 years	\$200 k	1) Existence of tool 2) Number of stakeholders trained
Coalition of progressive/supportive utilities	Conferences, events, workshops	Immediate	\$200k in 1 st year	Database, list of contacts, members
Develop model ordinances and educate local jurisdictions	Association of state governors, mayors, city administrators, etc.	Immediate	\$150k in 1 st year	Number of jurisdictions trained/adopted
Emotionally involve the general public in a hydrogen economy	Slogan, ad campaigns	Short to medium	\$200K for message development, \$2 million + for ads (funded through	Pre- and post-campaign public awareness surveys

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			public-private partnerships)	
Public awareness surveys, to create a baseline and ongoing	Surveys, focus groups, one-on-one interviews	Immediate and ongoing	\$700K	Quantitative and qualitative metrics
Educational outreach for new and existing hydrogen demonstrations	Fact sheets, speakers bureau, etc.	Immediate and ongoing	\$10k - \$250k per year, per demo	Change in awareness levels over time

Additional activities/products:

- Information Dissemination
 - Conduct education for state/regional governments dealing with issues and benefits specific/local to them
 - Establish “Hydrogen Information Centers” within existing DOE Clean Cities coalitions (with supplemental funding, and without detracting from/conflicting with the near-term alternative fuel vehicles deployment mission)
 - Provide training on how to talk about hydrogen, alternative fuels and alternative energy, through Q&A sheets, talking points and trainer trainings
 - Develop a hydrogen impacts program to build a better understanding of environmental and other impacts of hydrogen, establish clean energy benefits, address infrastructure issues, and enhance understanding of other issues. A tool could incorporate these into a format useful to state agencies, planning commissions, etc.
 - Create a detailed “lessons learned” database, for example drawing on experiences with CNG to promote near-term gaseous handling technologies and overcome infrastructure challenges
 - Develop and disseminate model ordinances for cities and counties (these have been developed in Clark County, Las Vegas)
 - Develop and support educational packages for local code enforcement, fire, police, and health and safety officials
 - Develop contacts database of local/regional experts on fuel cells and hydrogen for media, local governments and institutional players
- Coalitions
 - Create coalition of progressive utilities to coordinate on meetings, program plans, materials development, etc.
 - Create partnerships (with state agencies, environmental organizations, OEMs, etc) to develop education tools and support commercialization efforts
 - Create coalition of state legislative advocates
 - Partner with industry to proliferate demonstrations
- Media events
 - Run public service announcements, for example of Saturday morning television and children’s channels (recognizing that children will teach their parents)
 - Develop a national awareness campaign about the potential benefits of hydrogen and fuel cells
 - Run mall events, with photos, videos and actual (hydrogen-based?) products
 - Hold “town meetings” on energy, coordinating with local media
 - Provide media support to demonstration projects to maximize visibility

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- Find a champion who is not politically affiliated to keep hydrogen in the public eye
- Prepare “ad slicks” on fuel cells and hydrogen, for publication in local papers
- Message development
 - Conduct public opinion research on hydrogen, among both general public and decision makers, using focus groups, surveys and one-on-one interviews
 - Focus on a hydrogen safety message
 - Develop a slogan/branding for hydrogen
 - Educate 1 million 4th grade kids (“the real customers for the hydrogen economy”), use supportive branding, and research the responses
 - Work with networks (e.g. Nickelodeon) to develop a cartoon featuring a hydrogen character
- Demonstrations
 - Fund *focused* activities such as demonstration programs, film festivals, etc, that will help educate peers, decision makers, the general public, business communities and young people
 - Support cost-shared demonstrations that put products before the public through competitive, incentivized offerings
 - Put a project on the ground where the public can experience hydrogen, i.e. a ski lift
- Other
 - Promote incentives for making hydrogen fueling stations public
 - Get hydrogen education into the classroom, train teachers about the issues and the educational resources available to them
 - Make available factual information for textbook authors and other writers of educational materials
 - Identify barriers and be upfront about the obstacles that hydrogen faces
 - College campus outreach, to mobilize those who might be excited but unorganized, urging involvement/activism
 - Create a list of demonstrations by state or region, divided into electricity and transportation
 - Fund demonstration projects and coordinate education based on a *sustained* media campaign, with coverage of the whole project from conception to completion (not just the ribbon cutting)
 - Provide policy leadership through federal procurement
 - Embrace utilities’ natural gas facilities to leverage for hydrogen infrastructure, to establish economies of scale faster
 - Make hydrogen “renewable”
 - Develop plans and messages for a “hydrogen incident” that adequately deals with safety
 - Link up with sustainable development organizations/interests
 - Establish and coordinate state-level hydrogen discussion and promotion forums
 - Develop web-based marketing/capture techniques to deliver messages, publicize demonstration projects, and capture interested citizens’ emails for future communications

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5.3 Large Scale End Users, Financial Institutions and Professional/Trade Organizations

Attendees:

Facilitator: Mark Crowdis, Sentech

Scribe: Matt Johnson, Sentech

Ken Cameron, GM

Atul Deshmane, ENRG, Inc.

Doug Wheeler, UTC Fuel Cells

Ed Bless, H2 Solutions

Susan Leach, Hydrogen 2000

Bernie Geyer, USFCC

Larry Liles, IBEW

Paul Galatowitsch, EcoHydrogen

LARGE SCALE END USERS

Types

- Real Estate Development/Architects
- Healthcare
- Utilities
- Telecommunications
- Educational Institutions
- Financial Sector
- Manufacturing
- Government Buildings
- Transit Agencies
- Transportation Fleets
- Overnight/Package Delivery
- Military
- Space Program
- Semiconductors
- Network Security

Target Audiences

- Cultural Leaders/Celebrities
- Information/Security Managers
- CFO
- Facility Managers
- CEO/Agency Leaders

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Barriers

- Identification and gaining access
- Resistance to change
- Aversion to risk
- Comparative life-cycle cost
- Lack of knowledge of incentives
- Capital cost/payback
- Lack of technical knowledge
- Inertia of the current system
- Acceptance of hydrogen as a fuel
- Balance between building excitement and overselling
- Focusing on fuel cells ignores interim technologies

Priority Activities/Products

- Short courses
 - Classes at
 - National workshops
 - Colleges and secondary schools
 - Attach to existing conferences
 - Target
 - Facility managers
 - Fleet managers
 - Long term planners
 - Courses on introductory topics
 - Start at high level – move towards more detail
 - Target predisposed markets
 - Measurement
 - Number of people taking courses
 - Knowledge gained by participants
 - Courses should be realistic in building expectations
 - Collaborate with industry to determine realistic time frame
 - Teach course on current non-fuel applications of hydrogen
 - Begin in 2003 – 5-10 year effort
 - Cost is proportional to size of target audience
 - Start with one pilot course – expand as necessary
 - Cover
 - Hydrogen
 - Fuel cells
 - Infrastructure
 - Information provided should be above layperson level, but not too technical
- Case studies and reports
 - Evaluation and case study done by independent group, not DOE
 - Starting in 2003
 - Broken out by activity
 - Target hydrogen applications independent of fuel cells

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- Case study is an analysis of the success of a project
- Measurement
 - Website downloads
 - Number of case studies
 - People viewing case studies
 - References to the case studies in other studies
- Generate case studies from ongoing DOE studies
- Three per year (one per commercial area)
- Independent evaluation reduces bias
- Tailor case studies to audience
- Provide true stories of cost saving and cost comparisons for CEOs
- Life cycle costs
- Concentrate on reliability issues

Other Activities/Products:

Activity/Product	Delivery	When	Estimated Cost	Measurement
Educational Short Courses	(See above)			
Reports and Case Studies	(See above)			
In-house educational presentations to facilities staff, organizational mgrs/leaders	Science and technology leaders make presentations	2003 forward		Pre/post survey of knowledge
Develop articles for submission to trade journals of target audiences – utility, transit, architect	Professional and trade publications	Now	\$50k	Number of publications/circulation/membership
Incentives – set up DOE website to coordinate incentives available – target CFO/facility mgr	Website or brochure			
Educate utilities/PUC	Brochures, travel shows, personal contact, demonstrations	2 years	\$250k \$10m demos	Implementation of technology, contacts /calls
Develop hydrogen and CNG blend-fired generators	Environmentally conscious users	2003-2008	\$1.5m	Measure number of units installed and volume of pollution prevented
Co-market and encourage available fuel cell products in brochures/presentations	Brochures and presentations	2003 forward		Product sales
Demonstration of hydrogen use for cooking in fast food restaurant	Advertising at fast food restaurants			
Testimonials of individuals with fuel cell experience – target CEOs				
Develop hydrogen application primer – industry applications and potential for success – target IPPs, utilities				
Write educational book on hydrogen evolution to date and what is being developed	Book			
Use the “fire and brimstone”				

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approach – create awareness of risk. Target CFO, CEO				
Case study on agricultural green waste biofuel – targets facility electrical generation	Agricultural companies and food processors collect green waste left behind in fields and processing facilities	2003-2030	\$5m/year	Measure kWh produced via green waste biofuel and \$ saved over grid costs
Educate financial sector on secure/clean/six 9's power = target facility managers				
Roundtable discussions between fuel cell and hydrogen developers and end users – focus on issues developers must be aware of	Workshops	Short term	3 or 4 roundtables @ \$50k each	Greater understanding by FC developers of what their future customers needs are
Hydrogen fuel cell quarterly updates on technology development status, sales volume.	Newsletter/web (to believers), trade group meetings/analysts (to uninitiated)			
Literature tailored to financial services and healthcare sector	Brochures			
Video/DVD on hydrogen and fuel cells	Direct mail, DOE reps, conferences	Now	\$350k	Number reached; conferences attended, in which markets?, number of viewers
Develop dual fuel vehicle demonstrations – target fleet owners	Presentation materials delivered to fleet owners	2003-2010	\$750k	Number of vehicles running on hydrogen blended fuels in the US
DOE develop retrofit kits for hydrogen fueled cars				
Promote hydrogen as a choice over natural gas				

PROFESSIONAL/TRADE GROUPS

Types

- Transportation
- Stationary Generation
- Fuel
- Utility/Energy
- Infrastructure
- Trade Unions
- Associations of Associations

Target Audiences

- President
- Chapter heads
- Public relations
- Program chair

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- Conference planning
- Member services

Barriers

- Relevance
- The group noted that the barriers listed for large-scale end users are also relevant for professional and trade groups.

Priority Products/Activities

1. Video/DVD
 - a. Focus on utility groups, building groups, architects
 - b. Make one to start – alter it as the technical status of the technologies changes
 - c. Measure success by audience size, telephone surveys
 - d. Targeted towards specific applications and groups
 - e. Long term project – at least five years
2. DOE public service announcements
 - a. Hire an ad firm
 - b. Target all associations
 - c. Use one full time employee
 - d. Measurement – PSAs placed, number of readers

Other Activities/Products:

Activities/Products	Delivery	When	Estimated Cost	Measurement
DOE advertisements/PSAs	(see above)			
Videos and DVDs providing information on H2 and fuel cells	(see above)			
Develop a financial template with: Cost benefit analysis Feasibility data	Project cost and performance data presented to 10% of the largest trade organizations	2003-2005	\$600k	% of trade organization leaders who listened to presentation
Write articles tailored to target audience publications	Publications	Now	\$50k	Number of publications, circulation, membership
Sideshow demonstration of small novelty uses for hydrogen	Industry trade shows			
Presentations at conferences or chapter meetings	In person, DOE, all over country	Short term (1-5 years)	If you can get group to pay travel / lodging, then only staff time. Otherwise, \$2k/trip	How many presentations in a year
Advertise environmental stewardship factor through video/DVD/brochures				
Target lay members to identify	Website and technical	2004 -	\$1m	Fuel cell test center

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technical challenges that need to be addressed	paper			results
Technology presentations	National meetings	Now	\$250k	Contacts to DOE
Trade show booths	Demos, literature, videos at trade shows	Now	\$1m to develop trade show demo	Contacts, feedback from questionnaires
Develop incentives – awards for hydrogen achievement	Financial aid, national awards	1 year		Number of competitors for awards/incentives
Website that lists information for people to get started	Internet (links on assoc. sites, etc.)	Now		Hits to site
Short courses on relevance of fuel cells and hydrogen to trade groups. Teach fundamentals	Tack onto trade shows of target group.	Short term 1-5 years	\$50k each – could charge registration fee	Number of courses, registrants

FINANCIAL SECTOR

Types

- Venture capitalists
- World Bank
- Investment banks
- USAID
- Banks
- Insurance companies
- Foundations

Target Audiences

- Analysts
- Fund Managers
- Program Directors at Foundations (Energy and Environmental areas)
- Risk Analysts
- Technology Managers
- Start-ups
- Business Development Managers

Barriers

- They've been burned before
- Big competition for funding
- Inability to quantify externalities
- Not adequate on due diligence

Priority Products/Activities:

- Meetings with investment community
 - Ongoing – starting now for approximately next ten years

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- DOE educates investment community on hydrogen and fuel cells
- Requires one full time employee
- Discontinue when 5% of audience has been educated – this should be critical mass
- Conduct survey of fuel cell companies to collect information – summarize that information for investment community
- Target investment bankers, analysts
- Workshops targeted to investor groups
 - As part of an investor conference
 - Starting now, five year length
 - Frequency – one per year for each target group (total of 6 –8 per year)
 - Success measures – number of attendees at workshop
 - DOE invites investment bankers to hear presentations on DOE projects

Other Products/Activities:

Activities/Products	Delivery	When	Estimated Cost	Measurement
Meetings with investment community	(See above)			
Workshops targeted to investor groups	(See above)			
Face to face meetings with World Bank and USAID	Meetings	Short term	\$5-\$10k	Will world bank and USAID give \$ for fuel cell demonstrations
Perform analysis of market and customer requirements and associated company efforts	Prepare report	2003-2005	\$100k	Comparability with associated company efforts
Workshops for insurance companies and risk analysts	Workshops	Short term	\$50k (but can charge registration fee)	Number of registrants, willingness to insure fuel cell and hydrogen projects
Public service ads in professional publications – direct people to DOE website	Advertisements/ website			

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5.4 Educators and Students

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Scribe: Sherry Marin, Sentech

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Jodi Theut, GM, Public Policy
Kaye Kamp, Albert Einstein Educator Fellowship / DOE
Linda Norman, General Atomics
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Joel Berry, Kettering University
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Lara Neer, National Hydrogen Association
Jim Boyd, National Joint Apprentice Training Committee
Dan Sperling, UC Davis, Institute of Transportation Studies
Martha Calahan, NEED
Rick Jones, HS Physics Teacher, Albert Einstein Educator Fellow
Marsha Zalbowitz, Los Alamos National Laboratory
Bryan Garcia, CT Clean Energy Fund
Liz Pfeifer, BMW
Bob Hayden, CA Fuel Cell Partnership

Target Audience:

- Teachers
 - Alpha: Already interested
 - Beta: Uninterested; teach to the requirements
- Students
- Elementary: these students are the future consumers of these technologies, and they can influence their parents.
 - Middle
 - High School
 - Technical/Vocational
 - Pre-service Teachers
 - Continuing Education
- School Administrators: Boards, Principals, etc.
- National Standards Developers

Barriers

- Lack of Resources – Insufficient time and money are the overarching barriers.
- Packed curriculum – There is little time/space for fuel cells, especially in high school curriculum. Can we get more than an hour dedicated to hydrogen and fuel cell education?

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- Getting into the required curriculum – There is enough flexibility for interested teachers to add alternative energy to their classes; but how do we get the “Beta” (uninterested) teachers, who teach only to the tests/requirements. How can we get fuel cells into “the book?”
- Lack of knowledge about basic energy – There needs to be a base of knowledge about energy before we can start talking about hydrogen and fuel cells.
- Resistance to Change - Use of, and comfort with, old materials and textbooks.
- Getting to the most appropriate, most effective audience
- Delivery - Getting the information to the targets where they live; face-to-face interaction
- Lack of a national standard/policy on future education requirements (for alternative energy)
- Getting teachers to use the tools and curricular once they are developed; motivating teachers.
- Students often know more about hydrogen and fuel cells than their teachers.
- Lack of cooperation across Federal agencies

Needs:

- Products/tools must be engaging.
- We also need to get outside the classroom – to reach students in libraries and museums, at science bowls, etc.
- Focus on hands-on education.
- Get into the “good” textbooks.
- Keep it simple.
- Include benefits and realities (manage expectations).

Priority Activities/Products:

Activities/Products	Delivery Mechanism (Who, How, Where?)	When? (Short-Long Term)	Estimated Costs
Establish coordinating bodies: <ul style="list-style-type: none"> • Core Education Group 	<ul style="list-style-type: none"> • Industry, Educators, & Gov’t; full-time 	Short-term (< 3 months)	<ul style="list-style-type: none"> • \$0.5 MM/yr

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Activities/Products	Delivery Mechanism (Who, How, Where?)	When? (Short-Long Term)	Estimated Costs
<ul style="list-style-type: none"> Teacher Advisory Board 	<ul style="list-style-type: none"> All Grades/levels; including vocational 		
<p><i>Information clearinghouse:</i></p> <ul style="list-style-type: none"> Network of info – who’s doing what: existing programs, activities, internships, funds, etc. <p>Also combining existing fuel cell and hydrogen educational sites into a network or web-ring.</p>	<p>Begin with existing databases and websites</p> <ul style="list-style-type: none"> Catalog programs, activities, etc. Improve EREN website (upgrade search engine) EIA Kids Page as Student Hub and repository SciLinks as Teacher Hub 	Near term	
<p>Training and equipping teachers</p> <p>Develop curricula: K-12 and university/grad</p> <ul style="list-style-type: none"> Provide teachers kits/free loan trunks Workshops at teachers’ conferences Require for State curricula, ABET, and National Science Education Stds 	<p>The Core Education Group (Coordinating Body)</p> <ul style="list-style-type: none"> Build into existing alternative energy curricula 	<ul style="list-style-type: none"> Mid-term (2 years) Near term (within 1 yr) Mid-term Long-term (5-years) 	
Traveling/museum exhibit(s)	<ul style="list-style-type: none"> Begin with research of existing exhibits Museum consortium 		
<p>Outside the classroom (hands-on learning)</p> <ul style="list-style-type: none"> Develop and build tomorrow’s energy center Nat’l competition and expos Summer camp/workshop Student build fuel cell 			
Increasing presence at educators’ conferences			
<p>Providing funding to teachers and students</p> <ul style="list-style-type: none"> Fund collegiate education – Graduate and Post Doc. 			
IMAX movie			
Fuel cell demos in school buildings			

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Other Activities/Products:

- Fund collegiate education – Graduate and Post Doc.
- Add FCGP to DOE Science Bowl Resources List
- Add hydrogen fuel cells to DOE DER Roadshow (Anne-Marie Borbely-Bartis) for classroom education.
- Team with appropriate technologies
- Work with future technologies to develop curriculum now
- School-wide assemblies with hands-on follow-up activities
- Presence (tables/exhibits, talks, etc.) at National, State, and local conferences – K-14 and vocational; coordinate with NSTA, etc.

6.0 Day 2 Plenary: Discussion of Integrating Activities

Rajat Sen facilitated a discussion among all workshop participants on target audiences, the role of DOE, and priority activities and products.

Target Audiences

Participants identified and discussed a range of audiences to target, including: the US Congress and other national-level decision makers; codes and standards groups, including insurance companies and the real estate industry; financial institutions; federal agencies aside from DOE; state and local officials who impact on the acceptance of hydrogen projects; large-scale end users and their employees; educators and students; and the general public.

In discussion, participants agreed on the following audience prioritization:

- High
 - Codes and standards organizations
 - To overcome immediate barriers to implementation of hydrogen projects
 - State and local decision makers
 - To overcome immediate barriers to implementation of hydrogen projects
 - Students and educators
 - Slower education process, so need to start now
 - Potential to further disseminate knowledge to the general public
 - Prospective markets for hydrogen fuel cell technologies
 - Need to build population with technical expertise for future labor pool
- Medium
 - General public, special focus on:
 - Large-scale end users
 - Market “pull” for hydrogen FC technologies
 - US Congress
 - Policy “push” for hydrogen FC technologies
- Low
 - Financial institutions
 - Will be mobilized by market mechanisms as appropriate

DOE Role

In discussion of DOE’s educational role, participants identified niches in objectively and reliably gathering information. Some felt that DOE should engage through the educational system via activities such as teacher trainings on a hydrogen curriculum, articulating future

educational and training needs for hydrogen technologies, and forming a paid teachers' council on hydrogen fuel cell technologies. Many people supported a DOE role in stimulating a high-visibility media campaign to raise awareness of hydrogen technologies, through which DOE could develop a message and ad campaign and work with the private sector to secure funding for media publicity.

Discussants concluded with agreement on DOE roles in:

- Provision of objective and reliable information
- Coordination of hydrogen-related activities underway both within and outside of DOE
- Development of public/private partnerships for public education
- Support for hydrogen education in classrooms
- Articulation, at the highest possible level, of a clear vision and goal

Activities and Products

Introducing the group discussion on activities and projects, Rajat Sen highlighted five crosscutting themes to emerge from the breakout groups: information dissemination activities; leverage of demonstrations for educational purposes; fostering of coalitions and partnerships; information gathering and management of case studies; and expectation management.

The ensuing discussion focused on the need for a vision and leadership role at a high level, recalling the US space program and mobilizing effects of President Kennedy's promise to put a man on the moon. Participants noted that such a vision must grow from partnerships in order to be widely embraced and politically saleable.

The group agreed on the following priorities for activities and products:

- Information management, to include information gathering and dissemination and expectation management
- Coalition and partnership building
- Demonstration-oriented educational activities

APPENDIX A

Hydrogen, Fuel Cells, and Infrastructure Technologies Program Education Plan Workshop

**Hilton Crystal City
2399 Jefferson Davis Highway
Arlington, VA 22202**

December 4-5, 2002

AGENDA

Wednesday, December 4, 2002

- | | |
|---------------------------|---|
| 7:30 – 8:30 AM | Registration & Continental Breakfast |
| 8:30 – 8:45 AM | Introductory Remarks – Steve Chalk, U.S. DOE
(Purpose, Objective, Drivers, Audience) |
| 8:45 – 9:30 AM | Presentation of the Education Program Plan and Workshop Process
– Christy Cooper, U.S. DOE |
| 9:30 – 9:45 AM | BREAK |
| 9:45 AM – 12:00 PM | Break Out Groups (by Target Audience, NOT in priority order):

(1) Code Writing Organizations and National Regulatory Agencies - Red
(2) State and Local Decision Makers and the General Public - Blue
(3) Professional/Trade Organizations, Large-Scale End Users, and
Financial Institutions - Green
(4) Educators and Students - Yellow |
| 12:00 – 1:00 PM | LUNCH (Facilitator conference) |
| 1:00 – 3:15 PM | Break Out Groups (continued with wrap-up) |
| 3:15 – 3:30 PM | BREAK |
| 3:30 – 5:00 PM | Plenary Session – Christy Cooper: Group Presentations
(10 minutes presentation/5 – 10 minutes discussion each) |
| 5:00 PM | ADJOURN |
| 5:30-6:30 PM | RECEPTION |

**Hydrogen, Fuel Cells, and Infrastructure Technologies Program
Education Program Plan Workshop**

**Hilton Crystal City
2399 Jefferson Davis Highway
Arlington, VA 22202**

December 4-5, 2002

AGENDA

Thursday, December 5, 2002

7:30 – 8:30 AM	Registration & Continental Breakfast
8:30 – 8:45 AM	Overview of the Day – Christy Cooper
8:45 – 10:15 AM	Discussion of Integrating Activities – Rajat Sen, Sentech
10:15 – 10:30 AM	BREAK
10:15 – 11:00 AM	Discussion of Integrating Activities - continued
11:00 AM – 12: 30 PM	Analysis and “Voting” on Priorities
12:30 – 1:00 PM	Schedule for Plan Development and Submission
1:00 PM	ADJOURN

**APPENDIX B
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