X.11 VA-MD-DC Hydrogen Education for Decision Makers

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- Greg Jackson, University of Maryland, College Park, MD
- Peter B. Sunderland, University of Maryland, College Park, MD

Project Start Date: September 1, 2008
Project End Date: September 30, 2010

Objectives

The goal of the two-year project is to increase a targeted audience's understanding of hydrogen and fuel cells, including early market applications, and to provide specific examples of actions that the targeted audience – state and local government leaders – can take to support the development and use of hydrogen and fuel cell technology leading to better understanding of the community benefits that can result. The main objectives of the two-year project are to:

- Conduct a dozen in-person workshops by technical experts and professional educators.
- Produce video resources for public television, seminar use, and DOE/general public.
- Use hardware demonstrations when possible and provide real-world examples of technology.
- Produce electronic "magazine" articles on hydrogen technology demonstrations and other instructional project deliverables.

Technical Barriers

This project addresses the following technical barriers from the Education section (3.9) of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

(A) Lack of Readily Available, Objective, and Technically Accurate Information

(B) Mixed Messages

(C) Disconnect between Hydrogen Information and Dissemination Networks

(D) Lack of Educated Trainers and Training Opportunities

(E) Difficulty in Measuring Success

Contribution to Achievement of DOE Education Milestones

This project will contribute to achievement of the following DOE milestones from the Education section of the Hydrogen, Fuel Cells and Infrastructure Technologies Program Multi-Year Research, Development and Demonstration Plan:

- Milestone 17: Hold "Hydrogen 101" seminars. (4Q 2008 through 4Q, 2009)

Accomplishments

The following has been accomplished from September 2008 – July 2009 by Virginia Clean Cities and project partners:

- Conducted three "Hydrogen 101" seminars in Virginia and Maryland, four more scheduled.
- Finished shooting for and production of year one MotorWeek video "Hydrogen Update."
- Rough draft production of three "magazine" articles.
- Finishing completion of brand new Web site and special hydrogen section.
- Produced two versions of seminar curriculum, one is more general and geared towards introductory information while the other is a bit more technical. Both have been well received.
- Held ride-n-drives of Equinox fuel cell electric vehicle at two seminars.
- Fostered communication with policy-makers, and hydrogen is now large component of the energy plan of the candidate for the new Virginia's Governor.

Introduction

In order to change the way we use energy and to realize the vision of the hydrogen economy, not only will research and development need to persist by engineers and scientists, but decision makers will need to make informed public policy decisions and continue to support research and development as well as deployment activities. This project aims to raise awareness of hydrogen and fuel cell technologies, provide examples of what state and local government can do, and show how decision makers can support the development and use of hydrogen and fuel cell technologies. Our goal is to reach, by project's end, at least 50% of our target market (decision-makers and staffers at State Energy Offices, Departments of Environmental Protection, Departments of Transportation, and local government agencies) through all activities (seminars, newsletter, Web site, videos, outreach, etc.) and 20% of the target market concentrating on decision-makers and their senior staff through seminar attendance in the Virginia, Maryland and D.C. markets.

The objectives of this project are to provide hydrogen and fuel cell technology learning opportunities through seminars, multi-media and video resources, technical support, and demonstrations to local and state government and decision makers in order to help state and local government leaders become familiar with hydrogen and how it fits in the portfolio of near-term and long-term energy choices, develop an accurate understanding of hydrogen safety, recognize opportunities, and understand their part in facilitating use of hydrogen and fuel cell technologies.

Approach

Our primary approach is to host in-person seminars for our target market, state and local governments, which can be more clearly defined using the sub-groups selected for the 2004 baseline survey. Three state sub-groups were selected including State Energy Offices, Departments of Environmental Protection, and Departments of Transportation. Two local subgroups were selected including city and county local government agencies. Some activities, such as newsletters, Web sites, outreach, and videos, target these five sub-groups in a general sense and include all executives and staffers. The Hydrogen 101 seminars target decision-makers and those who inform them (i.e. executive staff).

Messaging ties to the hydrogen knowledge survey, on which the subprogram objectives and targets are based. Under DOE guidance, existing hydrogen education sub-program resources and new contributions by team members are considered. Educational content focuses primarily on a basic understanding of hydrogen properties and the energy security and environmental benefits of hydrogen and fuel cell technologies, but also focuses on more technical subjects related to fuel cells and other modes of hydrogen energy conversion. Special consideration has been given to "following the technology" and resources also concentrate on areas where hydrogen and fuel cells are publicly visible through demonstration projects or early niche market commercialization efforts, such as the Defense Distribution Depot Susquehanna, PA hydrogen fuel cell forklift project.

Key to state and local government representative education is a broad understanding of how hydrogen supports decision-making on current opportunities and laying the foundation for long-term change. Additionally, providing real-world examples and demonstrations has been a key component of each seminar when demonstrations have been available. Such demonstrations have been well received.

Results

The major achievements to date include designing curriculum for and hosting three successful, and highly received seminars, and completing a comprehensive shooting schedule and production of a seven-minute video for seminar use and broadcasting on the Public Broadcasting Service (PBS). Additionally, as part of the shooting for the video, Virginia Clean Cities interviewed individuals to gather information for three electronic technology demonstration articles, which are nearing completion.

Seminar Results

The curriculum prepared and presented by Dr. Catherine E. Grégoire Padró of Los Alamos National Laboratory at the September 17, 2008 and April 29, 2009 seminars covered the following content:

- Our current energy system.
- What is hydrogen?
- Why hydrogen?
- What is a fuel cell?
- Hydrogen production, storage, distribution, and use.
- Environmental, energy and economic implications.
- Safety.
- The future of hydrogen and fuel cells.

At the April 29, 2009 seminar, a pre- and post-workshop quiz was given by Dr. Padró. The survey consists of 11 questions that were taken directly from the original DOE survey, conducted in 2004 (see Table 1) [1]. The idea for choosing these questions was to maintain the standard set of questions to gauge learning and to compare to the 2004 baseline.

TABLE 1. Pre- and Post-Seminar Survey Results from April 29, 2009 Event held in Chesterfield County, VA and taught by Catherine E. Grégoire Padró.

Pre- and Post- Seminar Survey Question	# Responses	% Correct Before	% Correct After
1. Hydrogen Pipelines Exist Nationwide (false)	18	77.78%	88.89%
2. In a hydrogen economy, hydrogen replaces fossil fuels as the dominant form of energy (true)	18	72.22%	77.78%
3. Hydrogen gas is toxic (false)	18	50.00%	88.89%
4. Fuel cells produce electricity through hydrogen combustion (false)	18	50.00%	77.78%
5. Hydrogen is too dangerous for everyday use by the general public (false)	18	100.00%	100.00%
6. Hydrogen is lighter than air (true)	18	88.89%	94.44%
7. Hydrogen has a distinct odor (false)	18	88.89%	94.44%
8. In which state or condition can hydrogen be stored? (chemical compound and liquid)	18	61.11%	83.33%
9. When using pure hydrogen, fuel cell vehicles generate electricity, water, and what else? (heat)	18	66.67%	83.33%
10. Hydrogen can be produced using which of the following sources of energy? (natural gas, sunlight, organic matter)	18	66.67%	83.33%
11. Which of these represents a type of fuel cell? (PEM)	18	38.89%	83.33%

The curriculum presented by Dr. Gregory Jackson and Dr. Peter Sunderland at the June 5, 2009 seminar held at the University of Maryland, College Park, covered the following content:

- Overview and introduction to hydrogen and fuel cells.
- Energy today and the potential of hydrogen.
- Hydrogen safety.
- Hydrogen production, storage, distribution, and use.
- Fuel cells and other modes of H_2 energy conversion.
- Permitting process.
- Short-term prospects and long-term vision.
- Research in fuel cells and H_2 at Maryland.
- Lab tours, a showing of the MotorWeek video and a ride-n-drive were also included.

The curriculum was changed considerably for the June 5, 2009 seminar and did not specifically address the topics included in the 2004 baseline survey. Therefore, a survey that focused more on qualitative information related to seminar effectiveness and participant reception was administered. The results of this survey are seen in Table 2. Note only ten remained at the end of seminar, although 19 originally were accounted for.

TABLE 2. Results of University of Maryland, June 5, 2009, Seminar Survey

i. Overview and Introduction to Hydrogen & Fuel Cells		
Very Useful	Useful	Not Useful
8	2	0
ii. Our Current Energy System and the Potential of Hydrogen		
Very Useful	Useful	Not Useful
6	4	0
iii. Lab Tours		
Very Useful	Useful	Not Useful
6	3	1
iv. Hydrogen Safety		
Very Useful	Useful	Not Useful
9	1	0
v. MotorWeek Video		
Very Useful	Useful	Not Useful
7	3	0
vi. Ride-N-Drive		
Very Useful	Useful	Not Useful
7	3	0
vii. Hydrogen Production, Storage, Distribution and Use		
Very Useful	Useful	Not Useful
7	3	0
viii. Fuel Cells and their Relationship to H2		
Very Useful	Useful	Not Useful
5	5	0
ix. Permitting Process		
Very Useful	Useful	Not Useful
0	8	1
x. Short-Term Prospects and Long-term Vision		
Very Useful	Useful	Not Useful
4	6	0
xi. Research in Maryland and Other Institutions		
Very Useful	Useful	Not Useful
5	5	0
xii. Closing Open Discussion		
Very Useful	Useful	Not Useful
2	7	0

TABLE 2. Results of University of Maryland, June 5, 2009, Seminar Survey (Continued)

xiii. Overall Event		
Very Useful	Useful	Not Useful
6	4	0
Why did you attend today's seminar?		
• Learn about hydrogen as a motor fuel. • Our office is the state regulator of motor fuel. We wanted to learn about what the future may be for hydrogen. • To develop greater understanding about current and future developments in use of hydrogen fuel cells. • To learn more about the industry since I just started working in it. • Interest in fuel cell technology in relation to commercial use in the transportation sector. • To gain more information on hydrogen. • Listen to active professors, drive GM Equinox, see Ballard laboratory. • To see program, potential use in training. • To see if this technology can be applied in our business now or within next 2 years.		
What was the most interesting part of today's seminar?		
• Vehicle ride-n-drive. • We started with no real knowledge of hydrogen fuel cells. I feel as though I have a fair understanding of how they work, what their limitations are today, and the challenges they face. • Lab on safety and combustion. • The lab tours and seeing the Equinox because it's one thing to hear about fuel cells but actually seeing them in person was so valuable. • Driving the fuel cell vehicle and visiting the research labs. • All. • The lab tours and the overviews from those very knowledgeable professors. • Permitting – as I have not seen any presentations on this. • Everything. • How hydrogen is produced, different types of fuel cells, safety considerations.		
What did we NOT cover today that you desired? How can we improve?		
• It was would nice for the professor to have more time. • More on safety, website, supplemental information; need more time for safety. • Perhaps a little more on cost of operating on fossil fuel versus hydrogen.		
Other comments?		
• From a regulatory standpoint, I would be interested as this becomes a more viable fuel in terms of fuel quality (consumer getting what they pay for) and the ability to retain a fair portion of the use to fund the transportation trust fund. • Great event for making industry contacts. • Excellent presentation of issues, problems and solutions regarding use of hydrogen fuel cells as energy source. • Technical presentation was excellent from Greg Jackson; better detail for different sectors and research.		

MotorWeek "Hydrogen Update" Video

Virginia Clean Cities worked with MotorWeek over several months to shoot footage for the first year video. Footage included several hydrogen dispensing stations on the east coast, many of current original equipment manufacturer hydrogen fuel cell electric vehicles, and several early market hydrogen fuel cell pilot projects.

The video runs seven minutes and twenty seconds, and covers an introduction to hydrogen fuel cells as they relate to transportation and current research, development, and early market deployment activities.

The video was completed on June 1, 2009 and was shown at the June 5, 2009 seminar. The video will be cut to a few minutes and aired on MotorWeek in August 2009. MotorWeek is available on PBS and the SPEED channel. The video is also available for viewing on the Virginia Clean Cities Web site at www.hrccc.org.

Conclusions and Future Directions

The seminars that have been held to date have been very well received and the participants' knowledge of hydrogen and fuel cell technology has increased as indicated by the surveys. The next year of this project will focus on the following outputs described below, as well as continuous improvement.

Future Project Outputs

Over the next year, Virginia Clean Cities and partners will:

- Host an additional seven to nine in-person seminars and Webinars will be held in Virginia, Maryland and D.C. and work with the National Energy Education Development Project to co-host teacher training seminars.
- Complete eight "technology profiles"/case studies. The first three that are under development include: University of Maryland and Ballard Power Systems research and development, South Carolina's hydrogen and fuel cell work, and the Defense Depot Susquehanna Pennsylvania fuel cell forklift demonstration.
- Finish shooting and produce a second MotorWeek video.
- Conduct follow-up surveys of participants from past seminars.
- Record and pod-cast several of the seminars to be linked from the Web site.
- Finish completion on new interactive Web site to include all content produced from project and other resources from education awards.
- Attend events to discuss and promote project and project outputs.

Planning and Improvements

A meeting between the past instructors and other key stakeholders will be held during the second week of November 2009 to discuss blending the two sets of

curricula developed, and other key project components. DOE project managers will be included in the discussion to ensure future curriculum improvement includes current and key DOE messaging.

Key partnerships have been developed over the last year with organizations such as the Local Governments for Sustainability, the National Association of Counties, the Virginia Association of Counties, the Virginia Municipal League, and climate communities. Virginia Clean Cities is working with these partners to host upcoming events specifically targeting their members, who represent the target audience for this project. This will also aide in increasing participation at the events. Due to extreme travel restrictions, attendance has been lower than hoped for at the past two seminars.

A discussion about extracting the key information from curricula will take place at the project development meeting in order to determine an agenda for the Webinar series. Webinars will begin in early 2010 in order to increase audience reach and allow for travel-restricted audience to attend.

Surveys for future seminars will include both qualitative and quantitative metrics to gauge participating learning, as well as reception and seminar deficiencies.

Key Issues

The main issues relate to Virginia Clean Cities undergoing some major organizational and staff changes, as well as the Recovery Act placing extra demands on current staff and requiring a shifting of focus to respond to extremely tight timelines. The project manager for the day-to-day management of this project transitioned to a new position and Virginia Clean Cities has been working to fast-track reorganization and the hiring of a new project manager. The position will be filled by early September 2009.

FY 2009 Publications/Presentations

1. Catherine Padro PowerPoint for 9/17/2008 seminar.
2. Al Christopher PowerPoint for 9/17/2008 seminar.
3. Catherine Padro PowerPoint for 4/29/09 seminar.
4. Chelsea Jenkins PowerPoint for 4/29/09 seminar.
5. Dr. Gregory Jackson PowerPoint for 6/5 seminar.
6. Dr. Peter Sunderland PowerPoint for 6/5 seminar.

All presentations available at http://www.hrccc.org/hydrogen/hydrogenseminars.html.

References

1. Hydrogen Knowledge and Opinions Survey, 2004. “Results: State and Local Government Survey” pps. 47-65. Available online at http://www1.eere.energy.gov/hydrogenandfuelcells/pdfs/survey_main_report.pdf.