

## IX.14 H<sub>2</sub> Educate! Hydrogen Education for Middle Schools

Mary Spruill

The National Energy Education Development (NEED) Project  
8408 Kao Circle  
Manassas, VA 20110  
Phone: (703) 257-1117  
E-mail: mspruill@need.org

DOE Manager

GO: Reg Tyler  
Phone: (720) 356-1805  
E-mail: Reginald.Tyler@go.doe.gov

Contract Number: DE-FG36-04GO14278

Subcontractors:

- Sentech, Inc., Bethesda, MD
- Los Alamos National Laboratory, Los Alamos, NM

Project Start Date: August 1, 2004

Project End Date: October 31, 2011

### Fiscal Year (FY) 2011 Objectives

- Collaborate to develop, design, and deliver a first-class, comprehensive middle school hydrogen education program that includes: training, classroom materials, technical and best-practices exchange, and evaluation.
- Design a program to link hydrogen science and technology and the concept of a hydrogen economy to the classroom.
- Educate the 4-12<sup>th</sup> grade audience about hydrogen and fuel cell technologies to facilitate market acceptance and understanding.

### Technical Barriers

This project addresses the following barriers from the Education chapter of the 2009 Fuel Cell Technologies Multi-Year Program Plan:

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

As awareness of hydrogen increases with increased media activity and inclusion in many state and local energy plans, there continues to be a lack of information that is readily available, accurate, and objective. Many hydrogen advocacy groups have produced educational information that in some areas would be considered more public relations information than education. This project addresses the need for educational materials that are available, objective, and accurate. Based on NEED's core principle of delivery of objective energy information, the H<sub>2</sub> Educate materials are reviewed by

subject matter experts, are made readily available via the Web, are delivered to educators at workshops, and are compared and contrasted with other hydrogen materials on a regular basis. This project's materials will continue to adapt as the need for additional and more robust materials becomes apparent.

#### (B) Mixed Messages

This project was created and continues with the intent to provide cornerstone materials that address misconceptions, provide clarity of information, and link to accurate and available information when necessary and possible. The hydrogen community continues to have disparate views on certain subjects and the key messaging to use. NEED, with review from DOE, national labs, and subject matter experts, works to provide this project with common, clear language and messaging that students, teachers, and their families find useful and appropriate for age and knowledge level. NEED works to mitigate the misinformation from the diverse messages and provide a concise message for the intended audience.

#### (C) Disconnect between Hydrogen Information and Dissemination Networks

NEED has capitalized on this disconnect and continues to work with various groups and organizations to become a stronger dissemination network – using local energy and education networks to deliver training and information about hydrogen to the intended audience. NEED – acting as a dissemination network – provides a conduit for valuable and accurate hydrogen information for the 4<sup>th</sup>–12<sup>th</sup> grade community. In addition, NEED has created its own information and dissemination network of 4<sup>th</sup>–12<sup>th</sup> grade educators and the education community to deliver quality hydrogen education materials and training.

#### (D) Lack of Educated Trainers and Training Opportunities

This project addresses the lack of educated trainers by providing professional development opportunities for teachers and energy professionals. These training opportunities provide participants with general background, foundation knowledge, and expansion information for more technically advanced audiences. NEED trains a network of trainers to deliver the information in local communities as well.

#### (E) Regional Differences

This project is adapted – in training methods and messaging – for local and regional differences – including proximity to hydrogen use and production. NEED's programming is locally based, with local needs – both economic and educational – considered as programs are created. Regional differences in attitudes are addressed and discussed in training programs. In

addition, regional access to hydrogen infrastructure is part of the program. Should hydrogen fueling stations, vehicles or fuel cells be nearby, the infrastructure is included in the programming.

#### (F) **Difficulty in Measuring Success**

The project is measuring knowledge gain among its target audience and finding good results. Educational programs often have longer term impacts that are not easily measurable in the course of a month or year. True attitude change takes a longer period of time than information gain. In all cases, educators report a minimum of a 40% knowledge increase in hydrogen knowledge upon completion of the H<sub>2</sub> Educate workshop. NEED is in the process of analyzing the results from a survey conducted of all educators who have participated in professional development since the beginning of the program to provide additional results for review.

#### **Contribution to Achievement of DOE Education Milestones**

This project contributes to achievement of the following DOE education milestones from the Education section of the 2009 Fuel Cell Technologies Program Multi-Year Research, Development and Demonstration Plan – Task Six: Facilitate Development and Expansion Hydrogen Technology Education for Middle and High Schools

- **Milestone 6.22:** Develop curriculum for middle schools (2Q, 2006)
- **Milestone 6.23:** Hold teacher workshops. (2Q, 2007 – 1Q, FY2012)
- **Milestone 6.24 and 25:** Revise curriculum materials (2008 and 2011)
- **Milestone 6.26 and 27:** Materials developed are in use in high schools and training is also provided to high school educators.

#### **FY 2011 Accomplishments**

- In 50% of the time estimated, the team created the middle school H<sub>2</sub> Educate learning module. In spite of resource constraints, the project is 100% complete with its revised scope and now is in replication and outreach to more communities. The project is scalable and can be deployed incrementally with additional resources.
- The effort has garnered additional support from a variety of partners – state energy offices, Clean Cities organizations, utilities, energy companies and others.
- Over 8,800 teachers trained.
- Training programs completed in 35 states with additional training in 2011 with extension of DOE funding.
- On average, pre-workshop survey scores were 5 out of 15 correct on the survey of hydrogen knowledge. After completing the workshop the average score was 13 out of 15 correct demonstrating a significant improvement in hydrogen knowledge as the result of the workshops.

- Preliminary survey results indicate that over 90 percent of survey participants felt that the resources made it possible to teach hydrogen more often and in more detail and that the materials increased student knowledge and understanding of hydrogen.



#### **Introduction**

In 2004, NEED and DOE launched the H<sub>2</sub> Educate Program for middle school and high school educators. The program included extensive curriculum development, hands-on kits for classrooms and teacher training. Using partner support from state energy offices, private industry, and trade associations, NEED extended the reach of the program to reach more teachers than originally planned.

#### **Approach**

The NEED Project brings its 30+ year history in energy education, curriculum development, teacher training, and networking efforts to H<sub>2</sub> Educate for middle school curriculum development, teacher training, and the expansion of hydrogen understanding and knowledge in classrooms throughout the country. NEED, with SENTECH, Inc. of Bethesda, Maryland as a key partner, launched a bold effort to exceed the DOE's expectations for a hydrogen education program in 2004 and have exceeded development calendar and outreach targets.

H<sub>2</sub> Educate and the activities undertaken as part of this project are the result of a collaborative effort among teachers, students, advisors, technical specialists, federal employees and professional educators. This effort brings together resources from NEED and its national partners and the DOE, to capitalize on success, resources, networking opportunities, and curriculum development and delivery capabilities. Key elements of this program are NEED's national network, a strong relationship with the National Association of State Energy Officials, and an annual budget capable of doubling the resources provided by this cooperative agreement. Making up this network are a conservatively estimated 65,000 classrooms touched by NEED materials and training each year.

#### **Results**

Results of the project continue to show success with pre-training survey results showing a 5 out of 15 correct successful response and a post-training survey result showing a 13 out of 15 correct successful response.

Workshop outreach expanded from six training programs and several hundred teachers trained in the first year of the program with over 8,800 teachers trained by 2011. NEED works to deliver the H<sub>2</sub> Educate curriculum

throughout the network of NEED schools and the schools they reach with educational outreach.

- Curriculum materials are available live on the NEED and DOE websites. Website statistics indicated substantial download activity. For example, hydrogen information has been added to the EIA Kid's Page [www.eia.doe.gov/kids](http://www.eia.doe.gov/kids) and statistics indicate 350,000 users per month.
- Addition of hydrogen information and activities to the Energy Information Association Kid's Page [www.eia.doe.gov/kids](http://www.eia.doe.gov/kids) (350,000 users per month).
- H<sub>2</sub> Educate materials have been included in NEED's curriculum redesign to provide a fresh, graphic look to the materials.
- Students and teachers show knowledge gain and deeper understanding of hydrogen knowledge.
- On post-workshop surveys, teachers indicate feeling prepared to teach the materials in their classrooms.
- Preliminary results from a survey of all educators that have participated in the program indicate that over 90 percent of educators had improved hydrogen knowledge and were more aware of hydrogen technology after the unit.

## Conclusions and Future Directions

H<sub>2</sub> Educate programs this year continued to expand the reach of the program to middle schools throughout the country. Additional outreach via state energy offices has allowed additional programs to be delivered outside of the programs within the DOE funding for this program. NEED continues to provide hydrogen materials through the National Energy Conference for Educators, the National Science Teachers Association annual conference and a number of state science conferences throughout the country.

The Virginia Department of Mines, Minerals and Energy and the Virginia General Assembly appropriated funding to provide teacher workshops and curriculum kits and materials to schools in Virginia in execution of the Virginia Hydrogen Roundtable recommendations.

## Future Directions

- An H<sub>2</sub> Educate session will be hosted at NEED's National Energy Conferences for Educators in July 2011.
- H<sub>2</sub> Educate materials will be presented at 650 local teacher workshops.
- Work with other hydrogen partners to maximize reach of programs and materials – i.e. working with infrastructure grantees to provide educational resources.
- Continue incorporation of materials and programming into NEED's existing training initiatives.
- Annually update materials with new data and provide major changes to educational community.
- The addition of H<sub>2</sub> Educate website for materials, links and additional information.

Deliver maximum number of hands-on resources to classrooms leveraging resources to do so. Expand partnerships with infrastructure grant recipients to provide outreach and education programming to additional communities.