

## 2011 — Education

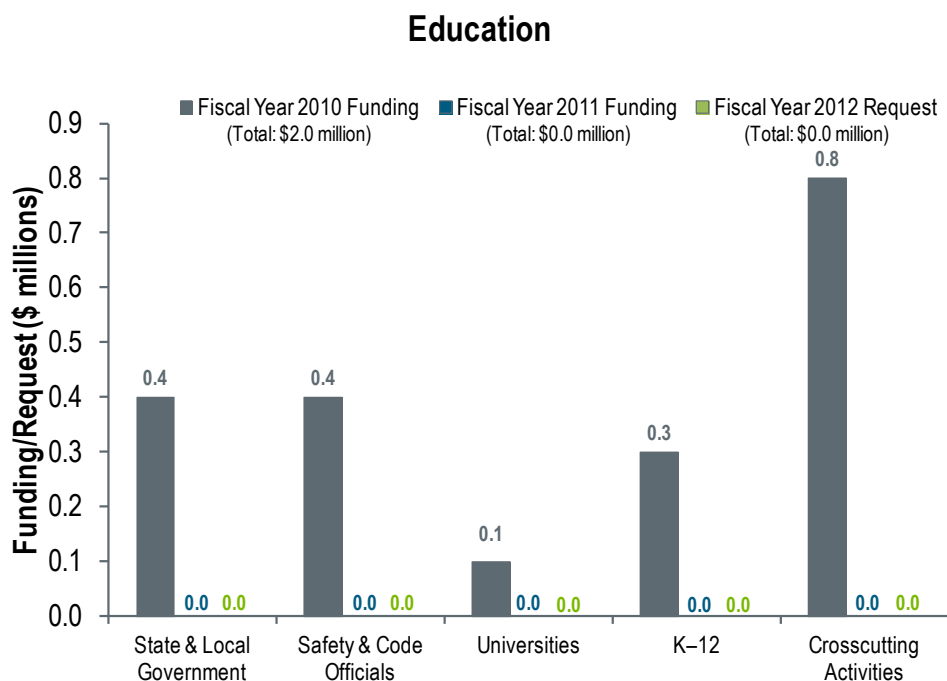
### Summary of Annual Merit Review of the Education Sub-Program

#### Summary of Reviewer Comments on the Education Sub-Program:

Reviewers considered the Education sub-program to be focused and effective. They commended the enthusiastic pursuit of project goals by the principal investigators and highlighted their dedication to getting the message out, providing credible information, and finding the best way to reach their target audiences. Reviewers expressed some concern that the sub-program is too focused on educating policy-makers and local leaders, and not enough attention is given to secondary and university students and the general public. Several reviewers mentioned that the curricula and course offerings developed by the projects were not made available to the general public, which could limit the overall effectiveness of the sub-program. One reviewer suggested that higher funding precedence be given to universities that form a curriculum that they then offer to other schools, along with training to execute it. Reviewers supported the decision to focus outreach efforts on early-market adopters, and they recommended highlighting the business case for fuel cells, including payback and investment information. Concerns about the lack of funding for Education were expressed repeatedly, and reviewers consistently encouraged continuation of efforts across all target audience projects.

#### Education Funding by Technology:

The Education sub-program efforts are prioritized to focus on the target audiences involved in facilitating the use of hydrogen and fuel cell technologies for near-term and longer term applications. While no funds were appropriated for Education in fiscal year (FY) 2011, the FY 2010 appropriation fully funded most of the sub-program's projects.



#### Majority of Reviewer Comments and Recommendations:

Fifteen Education projects were reviewed, and they were rated very highly, scoring an average of 3.4. The highest and lowest scoring projects were 3.8 and 2.8, respectively. Scores reflect the progress made over the last year and the plans for future activities.

**Universities:** Five projects in university education were reviewed, with an average score of 3.4. Reviewers recognized that workforce education is critical to the long-term success of hydrogen and fuel cells, and they commended the projects for their innovative approaches that incorporate modular lessons, online learning, laboratory coursework, and a hands-on approach to problem solving. Reviewers found the education materials to be comprehensive, well-designed, and well-reviewed, and they felt that the most significant strength of the projects was their ability to make learning accessible to the students through hands-on education. In general, collaboration with industry and other stakeholder groups was viewed as lacking, and a strong recommendation was made to increase coordination and collaboration with other institutions. Although reviewers thought the projects were successfully executed at each respective university, they perceived a lack of outreach to other universities and recommended a more proactive effort toward disseminating the curriculum materials to other educational institutions and through remote teaching. In addition, reviewers thought that performance should be tracked by measuring student information retention and collecting opinion feedback on coursework.

**Secondary Education (Grades 6–12):** Two projects in secondary education were reviewed, with an average score of 3.8. One project was praised for establishing a diverse range of partners while developing and implementing a collaborative model for others to follow. Reviewers commended another project for its approach, which addresses the challenges, both programmatic and commercial, to long-term sustainability and dissemination of hydrogen and fuel cell information. Reviewers observed that the project is focusing on critical barriers, including the need for vetted material and training of the instructors through a cost-effective train-the-trainer model.

**End Users:** One project for educating end users was reviewed, with a score of 3.5. Reviewers commended this project for providing an invaluable combination of education and direct hands-on experience through demonstrations with well-chosen lift truck users from a range of industries. Reviewers noted that the hands-on learning offered by the principal investigator was extremely successful. Reviewers also thought that incorporating first responders and local fire marshals into the process showed a further commitment and brought an even higher level of credibility to the project.

**State and Local Government Officials:** Six projects for educating state and local government officials were reviewed, with an average score of 3.3. Reviewers observed that because state and local leaders are potential technology deployment facilitators, their education is essential to the future success of hydrogen and fuel cells. Reviewers also commented that the locales of the projects were well-chosen, in states with an existing hydrogen and fuel cell presence. Key recommendations included involving different levels of government, publishing materials that lawmakers can review at their own pace, and disseminating information through online venues such as YouTube. Reviewers also suggested that additional collaboration be pursued to create programs that can be replicated across multiple states.

**First Responders and Code Officials:** Projects for educating first responders and code officials are co-funded with the Safety, Codes and Standards sub-program and they were reviewed under that sub-program at the 2011 AMR. See the Safety, Codes and Standards section of this report for reviews and comment summaries.

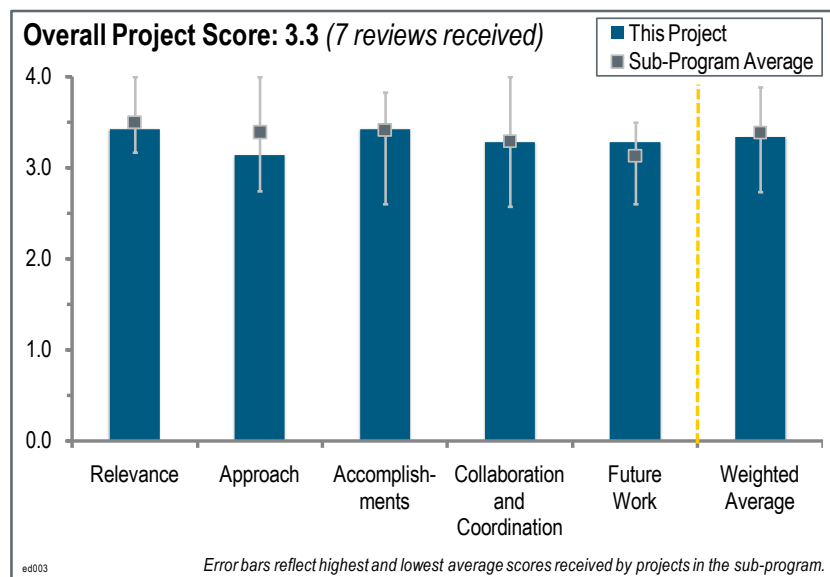
**Employment Impacts:** One project on analyzing employment impacts of hydrogen and fuel cell technologies was reviewed, receiving a score of 3.0. Reviewers believed that this project is a vital tool for influencing key decision makers, including government officials at all levels, investors, and industrial leaders. They also commented that the full economic impact of hydrogen and fuel cells projects (in terms of job creation and retention, revenues, and output) will be critical to advancing future deployments.

## Project # ED-003: Hydrogen and Fuel Cell Education at California State University, Los Angeles

David Blekhman; California State University, Los Angeles, University Auxiliary Services, Inc.

### Brief Summary of Project:

The overall objective of this project is to implement a comprehensive set of curriculum development and training activities. Specific objectives are to: (1) develop and offer several courses in fuel cell technologies, hydrogen and alternative fuel production, alternative and renewable energy technologies, and a sustainable environment; (2) establish a zero-emissions proton exchange membrane fuel cell and hydrogen laboratory supporting the curriculum and graduate students' teaching and research experiences; (3) provide engaging capstone projects for multidisciplinary teams of senior undergraduate students; and (4) foster partnerships with automotive original equipment manufacturers, energy providers, community colleges, government agencies, and other stakeholders.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.4** for its relevance to U.S. Department of Energy (DOE) objectives.

- The project is highly relevant to the DOE Hydrogen and Fuel Cells Program's objectives because it is focused on training the next generation of scientists and engineers. While much of the project is focused on traditional activities, such as adding fuel cells to power, energy, and transportation courses; providing outreach to schools; and creating laboratories, the creation of the hydrogen fueling station is innovative and is being leveraged to increase awareness of the potential for hydrogen fueling in the community. The project should also be given high marks for covering the full range of fuel cells.
- This is just the sort of project that will create and inspire the innovators needed on the hydrogen and fuel cells front. But it would be improved by specifically addressing "... networking among schools with similar programs," as stated in the project's objectives.
- Education of the new workforce is critical to the long-term success of hydrogen, fuel cell, and renewable technologies.
- This project is performing an important educational role in California, a region of early adopters for fuel cells and hydrogen.
- This project covers several fuel cell types, fuel reforming, and other topics to provide a broad knowledge base.
- In general, the project has promoted research aligned to education and outreach objectives of the Program. The project has developed and implemented a number of courses, capstone projects, and demonstrations of hydrogen fuel cell concepts and technologies. In particular, the Program has established a strong offering of courses and course sequences in fuel cell technologies, renewable energy, and sustainable environment. A number of partnerships have been created to further the efforts across a wide community of participants. The partners have engaged in the development of a range of activities. The issue has been the lack of either assessment of the individual activities or of the project. So while the activities align to the Program goals, it is difficult to evaluate the individual or programmatic impact on the participants or partners.

### Question 2: Approach to performing the work

This project was rated **3.1** for its approach.

- The work involves a well-balanced curriculum (e.g., full spectrum of fuel cells) that is being used with reasonable attendance. The principal investigator worked with all five educational elements, which is excellent. The collaboration and how it was used to develop useful, top-of-class curriculum is also notable.
- There is a broad range of activities—from curriculum development to partnership development; the fueling station; courses; laboratory development; research; and outreach for lower, upper, and graduate levels—and many collaborators are brought together to make an outstanding coherent effort. The combination of multiple courses, presentations, projects, and outreach is a very complete approach.
- The project is well-planned and the accomplishments to date are a testament to the project's feasibility. The project would benefit from more integration (i.e., beyond just collaboration) with other similar efforts.
- The barriers were discussed, outlined, and addressed very broadly. Workforce Development, for example, was framed in the context of curriculum and laboratory development without reference to specific or actual barriers addressed through a course or laboratory. Examples include laboratories that are aligned to hands-on projects related to workforce skills or curriculum that enhance professional development, and capstone projects that, while they are engaging, either reinforce certain academic knowledge or develop workforce skill sets. The overall project philosophy seems to be one of developing and implementing as many activities as possible, versus building programs based on evaluation and lessons learned.
- This project appears to not be as well-developed as other comparable projects at universities. It integrates hydrogen and fuel cell education with storage, production, photovoltaics, and the grid.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.4** for its accomplishments and progress.

- Excellent progress made. A one-year, no-cost extension was issued, but all parts of the project appear to be on track with 95% completed.
- Many courses are available through this project, which includes very targeted and focused courses offered at both graduate and undergraduate levels. The Power, Energy, and Transportation Emphasis class is a great offering. PowerPoint and video lectures help expand the reach beyond the university. The publicly accessible hydrogen station allows for education as well as fueling.
- This project is well on its way and appears to be sustainable.
- This reviewer really likes what the team has accomplished through the course of this project. The project extension is justified and was put to excellent use. The project also provides applied research opportunities.
- This project is seeking to leverage funding for the continuation of this work. It engaged high schools and offered ample hands-on opportunities for students.
- Without an activity, assessment plan, or subsequent data relevant to each activity's impact on participants and partners, it is very hard to evaluate how effective the overall project has been toward achieving measured success and progress toward the overall project's goals. Such assessment should be ongoing and integrated into the project plan and implementation. This has not been done.

### Question 4: Collaboration and coordination with other institutions

This project was rated **3.3** for its collaboration and coordination.

- The project made excellent use of its collaborations with other educational institutions to develop a well-balanced, top-of-class curriculum. It has an impressive list of collaborators and partnerships.
- This project has great collaboration with California organizations and other funding pathways, such as the National Science Foundation, to keep the project active and expanding. Offering papers, presentations, and course materials online helps promote further collaboration with other universities interested in launching similar courses.
- This project includes very good collaboration with other institutions, especially on other projects, such as the competition that engaged students from the local community college. It appears that the grantee collaborated

extensively through research opportunities, fleet optimization, workforce development activities, and public and professional education.

- The project has done a good job developing partnerships in general, but this reviewer would like to see more collaboration with other institutions and universities involved in similar projects.
- There seem to be a number of partnerships that have contributed to the activities. However, while the partners have contributed on either a project-by-project basis or as part of the overall effort, it is unclear as to the degree of participation in many cases, and the impact of the participation on either the participants and/or the partners.
- This project is perhaps not as well-developed as other comparable university projects.

### Question 5: Proposed future work

This project was rated **3.3** for its proposed future work.

- The project is very well-planned, both in the work executed and future work.
- The proposed future work is appropriate for a project that is ending.
- This project is very aggressive in securing outside funding to keep it alive and growing. Combining fuel cell and plug-in technologies helps keep fuel cells in the conversation in states such as California. Creating an educational program and courses around the hydrogen station will help develop a workforce that coincides with the maturation of the industry.
- The DOE-funded project has been successfully completed. The activity is not stopping—the project team has been successful in getting a Fulbright project and has submitted four other proposals to appropriate sponsors. Hopefully the proposals will be successful.
- The final phase of a grant must, of course, always include applying for funding to ensure sustainability, but it seemed that it was too much of a focus, instead of gathering additional partners. There were an enormous number of elite grants sought and some were already awarded. The principal investigator is very impressive.
- What has been proposed for future work is more of the same with no assessment or evaluation. Without such activities, it will be hard to quantify the impact and the program and activity improvements.

### Project strengths:

- The number of activities that were conducted under this grant is truly outstanding. A large number of partners were engaged to improve awareness of fuel cells and create an educated workforce of the future.
- The project is well-coordinated and planned, and is sustainable. Other strengths include online curriculum sharing and video lessons.
- This project was much needed, well-balanced, and used the curriculum that was developed. It also provided research opportunities for the education community and was successful in reaching more than 600 students who have been exposed to fuel cell technologies as a result of this project.
- This project is well-integrated into the southern California hydrogen “network” and the needs of the state of California.
- Strengths include numerous collaborations, proactive funding seeking, working with other colleges for student design projects, and constructing the California State University, Los Angeles, hydrogen station.
- The project includes lots of projects and activities.

### Project weaknesses:

- This is a very nice project with no obvious weaknesses. They accomplished what they set out to do.
- This project lacks embedded assessment plans.
- It appears that no one outside of the funded project partners is using the materials developed under this project. It would be great to see courseware being used more extensively. It is difficult to measure success as clear metrics were not provided. The number of students educated does not directly translate to the number of students getting jobs in the fuel cell industry.
- The project needs more substantial outreach, particularly to K–12. It also needs to collaborate and integrate more with others working on similar projects.

- This project’s metrics for how many students have been “touched” do not seem to be as well-documented as those for similar university projects.

### Recommendations for additions/deletions to project scope:

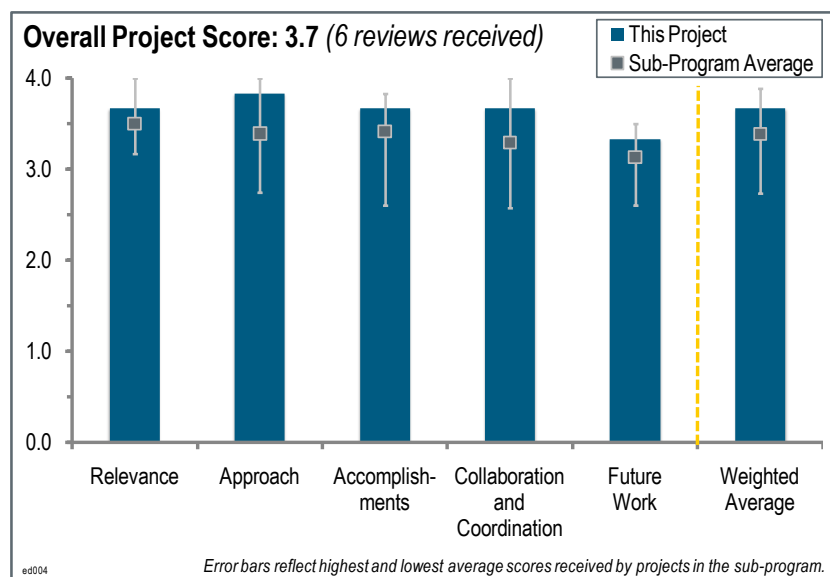
- Add an activity level, partnership, and programmatic assessment process.
- It may be too late, but please add some outcomes and metrics for measuring the outcomes.
- The project was completed successfully.
- This reviewer suggests adding a formal K–12 outreach component with three major parts:
  - A K–6 student program
  - A 7–12 student program
  - A 7–12 teacher program
- Continue this funding.

## Project # ED-004: Hydrogen Energy in Engineering Education (H2E3)

Peter Lehman; Humboldt State University Sponsored Programs Foundation

### Brief Summary of Project:

The objectives of this project are to: (1) deliver effective, hands-on hydrogen energy and fuel cell learning experiences to a large number of undergraduate engineering students at multiple campuses of the California State University and University of California; (2) provide follow-on internship opportunities for students at hydrogen and fuel cell companies; and (3) develop hydrogen teaching tools suitable for commercialization, including a basic fuel cell test station and a fuel cell/electrolyzer experiment kit appropriate for use in university engineering laboratory classes.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.7** for its relevance to the U.S. Department of Energy (DOE) objectives.

- This project is highly relevant to the project's mission of providing hydrogen and fuel cell education and exposure to a large number of students.
- The project is 90% complete. Activities include hands-on experiences, courses, internships, experimental kits, and instructor training. The program targets experiential activities for students in hydrogen and fuel cell technologies and provides related industry internships. The program is very well-organized and executed with depth and breadth of potential educational activities aligned to delivery, assessment, and training. The project team has identified projects that target a range of student grade levels from pre-college to college level and has also included instructor and teacher training. Finally, the program is developing commercially viable kits that align to the sustainability and dissemination objectives of DOE.
- This is just the sort of project that will create and inspire the innovators needed on the hydrogen and fuel cell front.
- Education of the future workforce in fuel cell and hydrogen technologies is critical to the success of these technologies.
- This project is creating a curriculum and kits to help fill a void.
- The project is seeking to develop an effective hands-on curriculum, internships, and teaching tools that can be commercialized. In so doing, it aims to address the lack of trained educators and regional differences. Project deliverables and the objectives they are seeking to address seem mismatched.

### Question 2: Approach to performing the work

This project was rated **3.8** for its approach.

- The iterative approach to developing curriculum should be applauded. The team used focus groups and also pilot tested, actively monitored, and refined the curriculum under development. Bravo!
- This project has made very good progress against performance goals, with a range of embedded assessment and evaluation processes to ensure not only programmatic but also individual project and activity achievement aligns with goals.



- This reviewer really likes the “plug-and-play” concept, which includes modules that “drop” into more classical subjects, such as thermodynamics. This reviewer also really likes the “hands-on kits” developed by this project. The industrial internship tops off the hands-on approach of this project. This approach is particularly important for an undergraduate course curriculum.
- The project provides ample hands-on experience to a large number of university students across many institutions by making fuel cell kits available to teaching laboratories. The curriculum is well-integrated into the engineering focus at Humboldt State University. The project has developed a strategy of incorporating feedback from students to improve its courses.
- This project is easily replicated and doesn’t add to the instructional burden. Developing kits and testing stations allows for hands-on experiments and study. Providing internships helps foster interest and long-term commitment from students in hydrogen and fuel cell fields. Adding videos and a website to help promote the program to others will help expand its reach.
- The project is well-planned and its accomplishments to date are a testament to the project’s feasibility. Although barriers were identified, it was not always clear how project actions and strategies were connected, if at all, to addressing these barriers.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.7** for its accomplishments and progress.

- The project is moving at a rapid pace and is completing tasks. It is also incorporating a few tasks that go above and beyond, such as translating the materials into Spanish and teaching students in El Salvador.
- This project is well on its way and appears to be sustainable.
- The list of concrete accomplishments and the expansion to other educational campuses is very good and is a statement of the project’s success.
- The project team developed a simple bench-scale fuel cell test station to enable students to have a hands-on experience with fuel cell operation and make measurements that were incorporated into coursework. The team also developed an assessment strategy to gauge the impact on students’ knowledge and methods for course improvements. There is excellent collaboration with the University of California, Berkeley, (UCB) that includes sharing and developing curriculum.
- This project has identified and is addressing specific barriers. There is ongoing evaluation of the project. The project team has developed a user-manual approach and created nine instructional videos to address the barrier of the lack of educated trainers. The team has also developed and implemented pre- and post-assessments, as well as the use of focus groups, including interviewing instructors. The project uses students to improve the bench-top kits, which is not only an important approach to improve the kits, but also a good opportunity to engage the students to learn and practice what they have learned.
- The project is 90% complete with no extension requested.

### Question 4: Collaboration and coordination with other institutions

This project was rated **3.7** for its collaboration and coordination.

- This project includes substantial sharing of course materials, experience, and fuel cell kits across a number of institutions.
- This project has strong partnerships with industry, private partners, and a number of different campuses.
- This project includes good collaboration with California universities and several industry partners. There is lots of potential for further collaboration with many other campuses around the state.
- A reviewer was concerned that the strength of collaborators was weak, but that concern was addressed by the increase in involved institutions. The reduction of some of their funding to provide stipends to students was very good, as evidenced by an increase in industrial participation.
- The project has partnerships with industry for internships. Because the project team has identified regional issues as barriers, more emphasis could be focused on addressing those barriers through partnerships.
- Project leadership collaborated with educational institutions and industry partners, but the collaboration seemed fairly limited to California. This is especially true if “regional differences” was one of the barriers the grant was hoping to address.



### Question 5: Proposed future work

This project was rated **3.3** for its proposed future work.

- This project has a good approach to expanding to other campuses by recruiting faculty. Commercializing kits and test stations could lead to a revenue stream that could keep the project robust.
- This project is very well-planned both to date and for the future.
- The DOE project performed very well, and the proposed work beyond the current project is good.
- The proposed future work is appropriate for the short time remaining.
- The future effort seems to be concentrated on California; some effort could be directed as a more national dissemination process, as the team has developed a number of online modules and training processes. Also, the kits could be nationally distributed.
- The project still seems very limited in scope. It would be nice if the project extended beyond California to really address regional issues.

#### Project strengths:

- Excellent work. Two things that really struck this reviewer were the quantified self-evaluations and the iteration on the project output for continual improvement. UCB took a kit to learn what worked and what did not and then engaged UCB students to engineer improvements. That was really cool. This reviewer assumed that those at UCB were indeed part of this project.
- This project has excellent collaborations. Sharing and supplying fuel cell kits enables fuel cell education across a broader range of institutions, and has a high impact on the approach. The project has enthusiastic and passionate faculty.
- Strengths include strong assessment processes, processes to train instructors, and the development of kits.
- One strength of the project is the iterative process for curriculum development. Another is the linking of internships to education, even if that was challenging to initiate. The team has done excellent work to demonstrate measurable change through monitoring and assessment.
- The project has excellent collaboration and potential expansion opportunities at other California campuses.
- The project's expansion to a number of campuses is a strength. It is well-coordinated and planned and is also sustainable. The online curriculum sharing deserves praise.

#### Project weaknesses:

- This project needs more partners to address regional issues, as well as a national dissemination plan.
- The project does not contain a lot of plans for next steps. It is not entirely clear to this reviewer how the project will address a lack of trainers and regional differences in developing undergraduate engineering students with a project that does not reach much beyond California.
- This project needs more substantial outreach, particularly to K–12.
- A reviewer was not impressed with the video that showed students working in a laboratory with safety glasses sitting on the tops of their heads, while another student had his glasses on. “Safety first” should be something students learn in the hydrogen laboratory.

#### Recommendations for additions/deletions to project scope:

- Adjust the dissemination plan to become more national.
- A reviewer suggests adding a formal K–12 outreach component with three major parts:
  - A K–6 student program
  - A 7–12 student program
  - A 7–12 teacher program
- Continue funding.

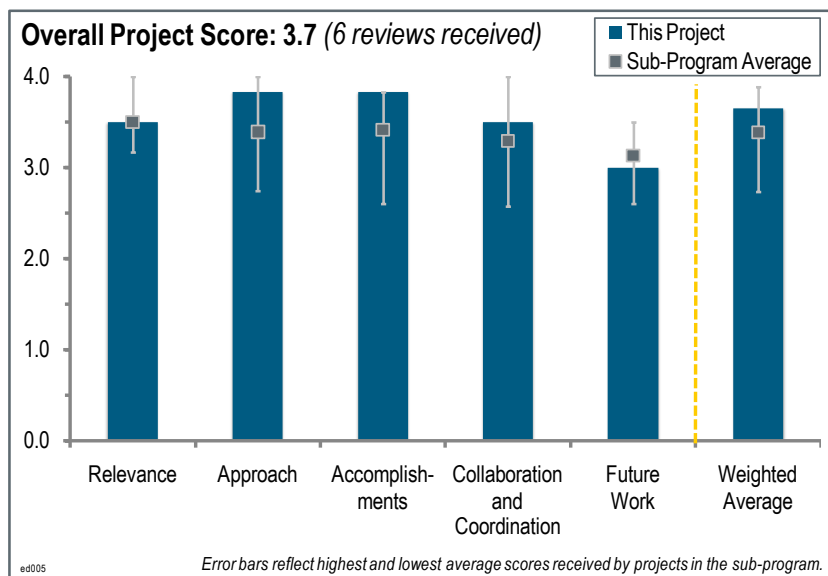
## Project # ED-005: Hydrogen Education Curriculum Path at Michigan Technological University

Jason Keith; Michigan Technological University

### Brief Summary of Project:

The overall objective of this project is to expand existing university programs in fuel cell and hydrogen technologies. Specific objectives are to develop: (1) courses in hydrogen technology; (2) curriculum programs in hydrogen technology; (3) hydrogen technology-related modules for core and elective engineering courses; and (4) hydrogen technology modules to supplement commonly used chemical engineering texts.

### Question 1: Relevance to overall U.S. Department of Energy objectives



This project was rated **3.5** for its relevance to U.S. Department of Energy (DOE) objectives.

- This reviewer is a very strong supporter of education activities to make sure the future workforce understands and is trained in this field. This project clearly addresses this point.
- This project is highly relevant to DOE goals of getting fuel cell and hydrogen education to a national student audience.
- It is good to see this project not only meeting education needs for university students, but also training them for future careers in vehicles and other hydrogen and fuel cell applications.
- Project leaders have set the laudable goal of trying to attract tomorrow's energy leaders by expanding the existing university programs that teach fuel cell and hydrogen technology. The approach of using hands-on teaching tools is appropriate for today's students and using a web site is a great way to help disseminate material. However, it is not clear that the web site has been designed to attract the eyeballs it deserves, but the potential is there. The minor in hydrogen technology and the graduate certificate program help round out the offerings of this grant.
- The expansion in the teaching of hydrogen and fuel cell technologies to a larger number of universities is relevant to DOE goals.
- The narrow scope of the project somewhat limits its ability to meet the objectives.

### Question 2: Approach to performing the work

This project was rated **3.8** for its approach.

- Adapting teaching materials and methods to the new style of active learning this generation practices is a tremendous approach. As the presenter stated, his students are not learning engineering, they are doing engineering. That is brilliant. The project's module approach can be adapted to a number of widely used engineering textbooks and is a powerful way to disseminate this approach and have it readily adopted. That is a great idea.
- This project has a good approach. The curriculum is tested with industry, which is excellent. The project received excellent evaluations for its hands-on modules. The project team also engaged in typical academic activities,

such as giving presentations. The team connected with a wide number of external reviewers and took the program to a national level.

- The module approach for insertion into already established curricula and courses is a very good one. Textbook modules were also developed.
- National distribution and testing at institutions are key parts of this project's approach. It is good to see that the project seeks to develop a minor as a result of this work. The hands-on approach to learning is a key strength of this project. It is good to see that the principal investigator (PI) has recognized how the students like to learn and has capitalized on that with this project.
- For a more applied curriculum, hands-on activities and applied problems are critical because they provide practice opportunities to solve problems. This is critically important and is a core feature of this work. Making these "modules" compatible and interfacing with traditional textbooks for the discipline of choice is a very good way to get this material out to the education community.
- Existing aspects of the project are very well-designed, but integration with other efforts is weak.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.8** for its accomplishments and progress.

- The self evaluations (student course evaluations) are all very impressive—so this project is clearly well-liked. This approach has the potential of reaching an enormous number of students. The list of concrete accomplishments is very impressive.
- This project developed a curriculum based on a new style of learning favored by this generation of students. It developed course materials in modules that are readily adapted to widely used engineering textbooks; this enables rapid dissemination of this approach. It also developed a corresponding laboratory-based learning approach to problem solving. Another accomplishment is the active dissemination of the approach and results at American Society for Engineering Education meetings and to national engineering organizations.
- There has been a great deal accomplished on this project.
- A very large amount of coursework and modules have been created. It is unfortunate to hear that interest in some of the courses and the minor has been reduced as a result of recent emphasis on battery vehicles over fuel cell vehicles. The PI is commended for finding ways to retain interest in the face of such adversity.
- This project is on course to accomplish what was proposed.

### Question 4: Collaboration and coordination with other institutions

This project was rated **3.5** for its collaboration and coordination.

- This project facilitated excellent interaction between external reviewers across a wide cross-section of stakeholders in education and encouraged them to review, improve, and likely to help adopt this approach and these course materials.
- A very significant effort has been made to disseminate materials produced by this project to academic institutions throughout the United States.
- This project employed good collaboration with publishers of the textbooks and professional societies to spread the use of the coursework and modules developed.
- This project did not seem to solicit "collaborators" in the manner this reviewer would have defined. However, the list of relevant external reviewers clearly demonstrates that the project enlisted the advice and review of appropriate stakeholders from relevant academic, end user, and developer industries.
- It is unclear how much collaboration actually took place, but it seems like a lot. It should be written up a bit better. A large number of external reviewers were engaged in the creation of the curriculum. Reviewers were told that industry approved the curriculum, but the reviewers from industry were not listed. It seems like there was a lot of collaboration and coordination but it was not documented.
- Collaboration and coordination seems largely limited to presentations and discussions.

**Question 5: Proposed future work**

This project was rated **3.0** for its proposed future work.

- The PI plans to continue to develop student projects in alternative fuels, produce more module developments, and continue dissemination of curriculum. A GATE proposal is in the works.
- The proposed future work is appropriate for the short time remaining.
- Future emphasis should continue to be on disseminating project educational materials.
- This project is practically finished. It would be good to get feedback from the students on how they have been impacted as a result of this work and also from any other professors who have used the coursework for their students in other schools.
- The project needs to focus more on additions to the project scope.

**Project strengths:**

- National dissemination through the American Institute of Chemical Engineers, the American Society of Mechanical Engineers, and the American Society for Engineering Education is a terrific idea.
- The coursework and classroom-based elements are well-developed and appear to be useful and sustainable.
- This reviewer really likes the “practicing problem solving approach.” Designing these “modules” to be suitable for use with contemporary traditional texts is an excellent approach that clearly has the potential to reach a very large number of students.
- The active learning approach is appropriate for today’s students and matches how they learn. Other strengths include readily integrated modules for widely used engineering textbooks and producing a comprehensive set of modules. This project is the best of the university projects.
- This project had an excellent approach and a dedicated PI.
- This is a large, comprehensive volume of work. The hands-on approach to learning is emphasized by the coursework and it sounds like it is really appreciated by the students.

**Project weaknesses:**

- The reviewer felt there were no weaknesses, other than it is unfortunately coming to an end.
- There is a small one: the lack of information on how other schools are using, or not using, the coursework. The true success for this project would be to see use in other classrooms outside of the PI’s school.
- This project is too focused on the classroom (e.g., modules and problem sets). It needs more substantial outreach, particularly to K–12, and to collaborate and integrate more with others working on similar projects.

**Recommendations for additions/deletions to project scope:**

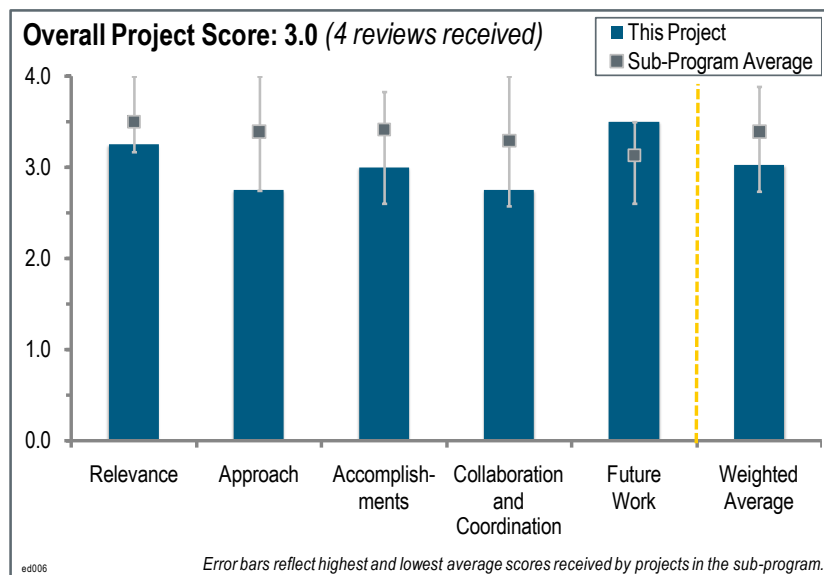
- Keep this activity funded.
- This reviewer would strongly encourage the PI to work with other universities, professional societies, or with industry—not just for adoption of the curriculum but for adoption of the graduate certificate model.
- Develop more non-classroom aspects to the project—for example, students participating in community outreach, competitions, special projects and research, collaborations, and internships. The project should significantly expand its work on what is referred to as “Hands-on Project Work.”

## Project # ED-006: Hydrogen and Fuel Cell Technology Education Program (HFCT)

David Block; University of Central Florida

### Brief Summary of Project:

The overall objectives of this project are to: (1) develop and sustain an education concentration in Hydrogen and Fuel Cell Technology (HFCT); (2) offer HFCT courses and associated labs; (3) develop industry and educational collaborations; (4) prepare students who can successfully work as HFCT professionals in government, industry, and academia; and (5) produce program graduates who will demonstrate knowledge, techniques, skills, and modern tools related to HFCT and who will be able to apply current knowledge and adapt to emerging HFCT applications.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.3** for its relevance to U.S. Department of Energy (DOE) objectives.

- This project supports understanding of hydrogen technology and also trains workers for the industry—both are supportive of the objectives.
- The goal of this project is highly relevant to the DOE Hydrogen and Fuel Cells Program’s education mission.
- Education of students in hydrogen and fuel cell technologies is very important to the Program.
- This is just the sort of project that will create and inspire the innovators we need on the hydrogen and fuel cell front, but it would be improved by specifically addressing “... networking among schools with similar programs,” as stated in the DOE goals and objectives.

### Question 2: Approach to performing the work

This project was rated **2.8** for its approach.

- The approach has involved the development of HFCT courses and curricula at the University of Central Florida (UCF) and the University of North Carolina (UNC).
- This project is well-planned and its accomplishments to date are a testament to its feasibility. The project would benefit from more integration (i.e., beyond just collaboration) with similar efforts.
- A college curriculum for these technologies was developed. This project does not seem to prepare students prior to college or after, nor is there wide distribution. This makes the impact inherently limited. Potential posting of all materials and community college outreach diversifies the effect somewhat, but the impact is still very limited compared with what might have been accomplished.
- This project is not well-described and, as such, does not have a well-developed approach to curriculum generation compared with other university projects.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.0** for its accomplishments and progress.

- This project has appropriate curriculum and student participation. Visits to community colleges help disseminate the concepts. The project also developed several new classes, including a senior project class with good hands-on content.
- Significant technical progress has been made.
- The project appears to have survived the transition from UCF to UNC-Chapel Hill; however, because of the move it probably lost some productive time. It has not shown as much progress as comparable university programs.

### Question 4: Collaboration and coordination with other institutions

This project was rated **2.8** for its collaboration and coordination.

- The project has done a good job developing partnerships in general, but would benefit from more collaboration with other institutions and universities involved in similar projects.
- This project has good partners for the students, but partnerships are mostly directed inward. The project could improve by increasing outward partners—partners who benefit preferentially from the association with the project.
- This project has good industrial collaboration to direct student research; however, it is not clear how this input helps direct improvements in curricula. This project's approach to working with other academic institutions, especially UNC-Chapel Hill, to develop curricula is weak. The mechanism for distributing curricula and materials to others in the fuel cell and hydrogen educational "network" is not as well-developed as other comparable university projects.
- It would be beneficial if some of the educational materials developed could be distributed more widely than just to UCF and UNC.

### Question 5: Proposed future work

This project was rated **3.5** for its proposed future work.

- The project is very well-planned, both in the work executed and the future work.
- Expanding the curriculum to the Master's program and the research and development program is very good.
- The proposed future work is appropriate for the time remaining on a project that is concluding.
- The HFCT courses and curricula will continue for at least five years after this project ends.

### Project strengths:

- The project is well-coordinated and planned and is sustainable.
- The significant indigenous funding shows commitment and makes the odds of continuation after the program ends much higher. A ratio of 4:1 students interested to students in the concentration ensures that the word gets out to students beyond those majoring in the field.
- Strengths include the involvement of two large universities and dedicated principal investigators.
- Data on student assessments of courses are apparently available, but were not shown; an example of how such input is used to improve courses would have been a strength.

### Project weaknesses:

- Weaknesses include the lack of networking among schools with similar programs, integration (i.e., beyond just collaboration) with other similar efforts in general, and the lack of significant K–12 and community outreach.
- This project provides little benefit outside the 70+ students in the program or sampling the classes. It would be much better if it was spread through the whole UNC program. It is unclear why \$160,000 per year was required to accomplish this; that figure seems high relative to other programs in the portfolio.

- There is no Chemical Engineering division at UNC-Chapel Hill. Chemical Engineering is essential to fuel cell and hydrogen technologies, so this is a major shortcoming if it is not covered by the energy technology department. The project does not offer much regarding transferring the curricula developed to other institutions, or efforts to share what the project team has learned with others who are interested in hydrogen and fuel cell education.

**Recommendations for additions/deletions to project scope:**

- Address weaknesses.
- Give, or at least sell, the curriculum to other North Carolina colleges, and preferably other schools in the Southeast. Encouraging the distribution of the materials to other universities would greatly increase the value of the project to the DOE mission.

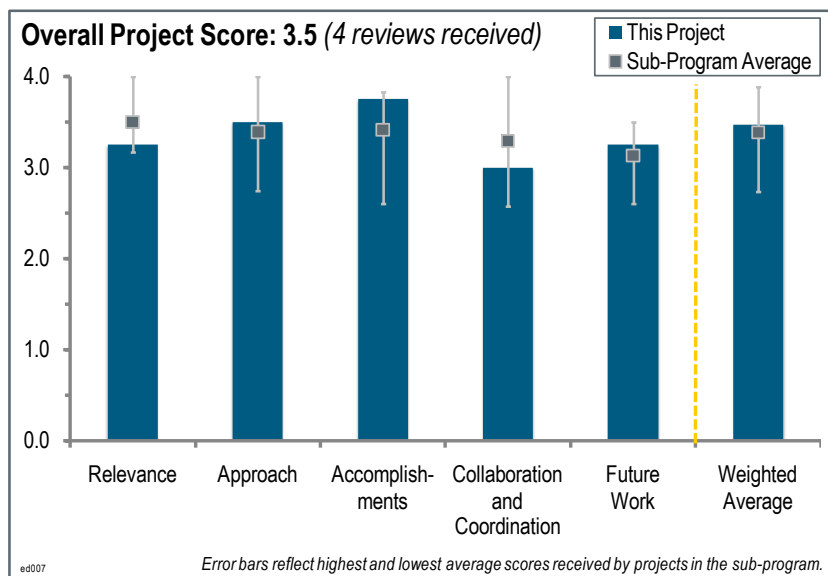


## Project # ED-007: Development of a Renewable Hydrogen Production and Fuel Cell Education Program

Michael Mann; University of North Dakota

### Brief Summary of Project:

The primary objective of this project is to provide formal multidisciplinary renewable hydrogen production and fuel cell training to undergraduate and graduate level engineers and scientists. The project includes training at three levels to maximize program benefits: (1) a broad overview to expose a large number of students to the basics of hydrogen technologies; (2) a “mid-level” training for a moderate number of students; and (3) detailed training for a smaller subset of students with interest and potential to make significant contributions to technology development.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.3** for its relevance to U.S. Department of Energy (DOE) objectives.

- This is just the sort of project that will create and inspire the innovators we need on the hydrogen/fuel cell front, but it would be improved by specifically addressing “... networking among schools with similar programs,” as stated in the DOE Hydrogen and Fuel Cells Program’s goals and objectives.
- This project provides education to a large number of students and training to a moderate number of students so that hydrogen is better accepted and there is a workforce ready to drive it forward.
- Undergraduate and graduate student hydrogen and fuel cell educational opportunities are highly relevant to the Program.
- Educating students from middle school to graduate school is important in furthering an appreciation for the clean energy potential of hydrogen and fuel cells. There is limited Program funding for education and allocating \$300,000 for dissemination within just one of the hundreds of universities will not have much impact unless the information transitions beyond the University of North Dakota (UND), which does not appear to be planned.

### Question 2: Approach to performing the work

This project was rated **3.5** for its approach.

- The multi-task approach adopted in this project is well-conceived.
- For what the principal investigator (PI) proposed, the approach seems logical. The six tasks appear to target a wide range of UND teachers and students. This approach will not remove education barriers in a way that goes beyond UND and the surrounding community.
- The multilevel approach and widespread coverage is very good. Better availability for out-of-state entities should be considered. It was a good idea to make the work sustainable despite the loss of key faculty and the end of DOE funding. The desire to have every student exposed is nice, too. A mix of laboratory activities and lectures is desirable for good engagement. This reviewer liked how the project integrated the Master’s program students into the process, too—which is good for all involved.

- Existing aspects of the project are very well-designed, but integration with other efforts is weak.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.8** for its accomplishments and progress.

- This project is well on its way and appears to be sustainable.
- This project has made good progress on course modules and case studies. It had good attendance in three new classes and also in new laboratory courses. There are two post-graduates teaching, which helps bring in new instructors. The project also has a good summer placement rate, and a much wider impact due to the PowerOn! program.
- Approximately 200 students at the University of North Dakota have been positively impacted by the project.
- The PI is accomplishing much of what was proposed. Posting new case studies on the National Science Foundation web site has not even started. The EE 522 Renewable Energy Systems course will focus on an important area: renewable hydrogen production. The Renewable Energy Systems course seems limited to electrolysis, and perhaps something on gasification. The reviewer questioned whether other subjects would be included, such as landfill gas, waste water treatment plant gas, and hydrogen energy storage in smart grids. The PI has delivered training to the three levels of education that he proposed. More than 200 students have been impacted by the project. Two hundred students divided by \$300,000 comes out to \$1,500 per student educated. Fuel cell technology education dollars are too limited at this rate to make a significant difference nationwide. These dollars should have educated half the state.

### Question 4: Collaboration and coordination with other institutions

This project was rated **3.0** for its collaboration and coordination.

- The project has very good collaboration with other institutions that can benefit and has suitable connection with institutions that help their project.
- The project has done a good job developing its current partnerships, but it would benefit from developing more, particularly by collaborating with other institutions and universities involved in similar projects.
- Collaborations have been good, but could have been extended to a larger number of hydrogen and fuel-cell-related organizations.
- This project did not feature much collaboration outside of UND and the neighboring communities. No work was done with industries or key stakeholders in North Dakota. Working with the National Renewable Energy Laboratory, the Energy & Environmental Research Center at UND, and Proton on site is a good way to leverage expertise.

### Question 5: Proposed future work

This project was rated **3.3** for its proposed future work.

- The project is very well-planned, both in the work already executed and future work.
- Given that the funds are expended, this is a reasonable plan.
- Getting information on the National Science Foundation web site will help with broader dissemination. The presentation did not contain a future work slide, but one can decipher from other slides that the project team will complete the work that was proposed.
- Efforts should be made to continue providing this exposure to future students at the University of North Dakota.

### Project strengths:

- This project is well-coordinated and planned, and is also sustainable. The outreach to middle schools, such as that done through PowerOn!, is a strength.
- This project has a broad, sustainable impact at several levels and several locations.
- This is a well-conceived and executed project.

- Project strengths include the achievement of an educational focus across three levels of students and instructors, and building fuel cell awareness into the education curriculum for engineers.

### **Project weaknesses:**

- This project needs to collaborate and integrate more with others working on similar projects.
- This project needs to expand the number of college-level students reached.
- Weaknesses include a lack of breadth beyond UND and the surrounding community, and a lack of education efforts beyond the academic community.

### **Recommendations for additions/deletions to project scope:**

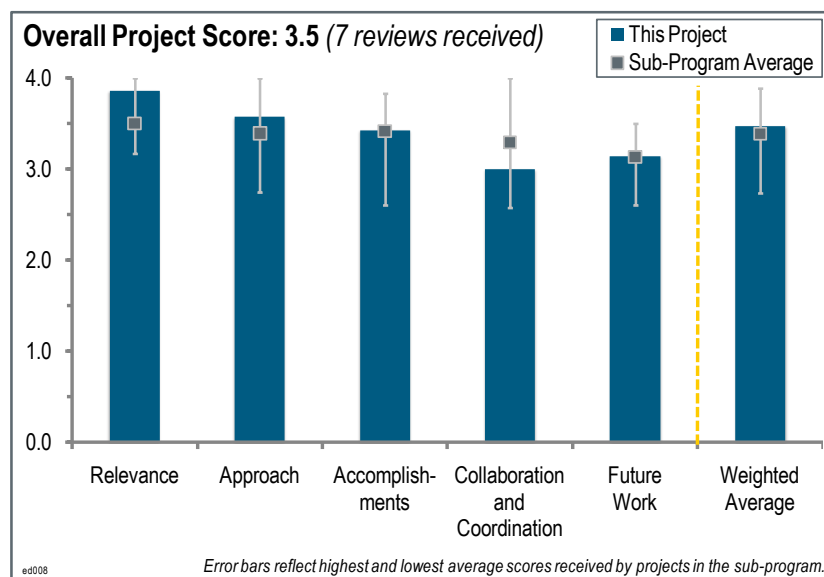
- A reviewer would like to see the curriculum taught to other teachers to bring back to their own colleges. However, this project has done excellent work—keep it up.

## Project # ED-008: Dedicated to the Continued Education, Training, and Demonstration of Polymer Electrolyte Membrane Fuel Cell Powered Lift Trucks in Real-World Applications

Tom Dever; Carolina Tractor and Equipment Co. Inc.

### Brief Summary of Project:

Project objectives are to: (1) educate a broad group of stakeholders regarding the benefits of fuel cell and hydrogen technology by conducting “H<sub>2</sub> Education Seminars,” many of which have taken place over the past year at various locations; (2) demonstrate clean energy through a series of one-month deployments of two hydrogen-fuel-cell-powered lift trucks for use by strategically selected, large electric fleet users; and (3) assist in the commercialization of fuel cell and hydrogen technology through longer and geographically diverse deployments in real-world applications.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.9** for its relevance to U.S. Department of Energy (DOE) objectives.

- It is very relevant to educate potential users and customers about fuel cell forklifts, hydrogen, and hydrogen safety. Allowing a two-month trial is a very effective way to help garner more customers. Fuel cell forklifts are being purchased by big name customers that are, in many cases, repeat customers. This project helps keep the spark from American Recovery and Reinvestment Act funding toward fuel cell forklifts alive.
- This and other near-market deployment projects are critical to the growth and deployment of fuel cell technologies. Material handling is one of those market pull opportunities that will help accelerate and mature the production of fuel cells along the path to large-scale mass production. The education of potential fuel cell users in the material-handling industry will clearly help accelerate the use in this marketplace.
- This project makes an important contribution by getting fuel cells and hydrogen out in front of a relatively non-technical audience of adopters and workers. LiftOne is making a good contribution to hydrogen education and market transformation within its region and is allowing this audience to see first-hand the opportunities and advantages provided by hydrogen-powered electric vehicles versus battery-powered electric vehicles.
- This project is effective for educating, demonstrating, and applying alternative lift vehicles with project outcomes of reducing energy costs, improving environmental performance, and increasing business productivity.
- This project educates key audiences and offers a clear message to users.
- Educating many groups of potential customers is key to deploying more fuel cells, especially in the material-handling sector.
- Material-handling equipment (MHE) is probably the most successful early market for fuel cells.

### Question 2: Approach to performing the work

This project was rated **3.6** for its approach.

- The hands-on approach is extremely effective. The educational sessions seem to be held at good intervals and live demonstrations allow users to see, touch, and feel the technology at work.
- The approach is excellent. The principal investigators (PIs) condensed their presentations from a full-day discussion to one that fits into the customer's time window. This clearly increased the willingness of the operators or businesses to engage. The PIs also engaged first responders and local fire marshals. This project absolutely has a necessary and correct approach.
- This project has a very hands-on approach, which is probably the best, if not the only, way to reach the customers in this market. This reviewer doubts if webinars would have been successful.
- LiftOne's communication with a broad cross-section of largely non-technical stakeholders is carried out well, using a "hands-on, kick-the-tires, look-under-the-hood" approach rather than a lecture-based sales approach. The joint market transformation, communication, and education approach appears effective with this important audience for this specific hydrogen and fuel cell application.
- The project team took the message, including the truck, on the road, and condensed the message to fit in the appropriate time slot. Six deployments have been completed.
- It is good to see the frequency of these educational sessions within the LiftOne facilities. The outreach to other companies such as AGI is fabulous. It would be good to see more outreach to other similar groups to spread the education further, even if funding does not exist for a deployment. It is good to see outreach to fire and other emergency response personnel to make sure there are no gaps of knowledge. Combining deployments and education is an important part of this project's success, as the users could also experience the equipment firsthand.
- The project is appropriately focused on cost, convenience, and refueling time. The cost barrier is problematic, but long-term lease arrangements might have been considered for the revised business plan.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.4** for its accomplishments and progress.

- The successful trials, exposition participation, and educational sessions all contribute to a very well-rounded project.
- Moving from the nominal one-day presentation to site visits clearly increased the visibility of the technology. That was a very good change in approach and it clearly shows in the accomplishments and progress demonstrated. This reviewer also really prefers conducting the hands-on "visits" instead of holding conferences. The accomplishments speak for themselves.
- This project features good progress reported in an honest way, with great candor in describing problems and working with original equipment manufacturers (OEMs). The project is gathering very useful comparison data on fuel cell working times in a battery-dominated sector. The project team also made a difficult down select decision on the OEM of fuel cells by switching/adding a new supplier late in the project, exhibiting a drive to complete the project with good momentum.
- Deployments have been completed. The project includes a nice presentation of demonstration results. Hydrogenics products proved to be expensive, so the team moved to another OEM. Business solutions, expos, and other venues provided good outreach.
- MHE is probably the most successful early market for fuel cells.
- Progress was good, but the geographic scope could have been evaluated through sensitivity analysis to consider higher energy cost states. Also, long-term lease arrangements might prove interesting as a business model for deployment. Identification or extrapolation of 10-year, long-term operations and maintenance (O&M) would also have been of value.
- It was good to see six different deployments at companies with recognizable names—this is important for outreach. It would be good to see more results from these deployments in terms of how the customers reacted.

#### Question 4: Collaboration and coordination with other institutions

This project was rated **3.0** for its collaboration and coordination.

- Good collaboration is required to succeed in their business, and they appear to be succeeding.
- This project provided good reason to consider, use, and change partners, including fuel cell vendors. The collaboration with end users appeared adequate and reasonable.
- The PIs did a good job of changing the team when one company was not as dedicated as originally planned. The strength of this project seems to be its ability to make business-to-business connections, so larger teams may not be appropriate.
- There are several manufacturers working on fuel cells for forklifts. The project team could have tried to incorporate one or two others in the project to date, but it is now moving toward working with additional OEMs. This will only build upon the project's success so far. Incorporating local fire department officials was a very good component of this project.
- This project was designed around a fairly small handful of collaborators. The project might have been even more successful if it had a few more partners to help broaden the scope.
- Hydrogenics delivered as a business partner in phase 1. Additional collaboration would be helpful.

#### Question 5: Proposed future work

This project was rated **3.1** for its proposed future work.

- Continue all education efforts. Add another demonstration with new OEM (fuel cell provider).
- Adding another OEM and potential new sites is a good direction. More educational seminars and media outreach will help increase hydrogen awareness and make the technology more accessible.
- There appears to be great promise for more work with refined business plans, leasing arrangements, sensitivity analysis for higher cost locations, and longer term operation for analysis and confirmation of O&M and durability costs for fuel cell lifts as compared with conventional lifts.
- This project is finishing up—the plans presented will accomplish a well-structured closure.
- The project is complete.
- The proposed future work is appropriate for the small amount of time left on the project.
- This project is mostly finished so there is not much future work, but it would be great to continue this education and deployment model in other areas of the United States where the cost of electricity and labor is higher. It would be nice to see outreach with more customers for the last part of this project, rather than large conferences, as the unique value of this team seems to be its ability to explain the “nitty gritty” of implementing a fuel cell material handling vehicle project.

#### Project strengths:

- The hands-on approach and direct contact with the audience were strengths of this project. The fact that BMW made an award after a presentation by the awardee is direct evidence of the project's success.
- This project's strengths include how it addresses education in an important segment of fuel cell early adopters in a battery-dominated market sector. The team conducts market transformation in parallel with its education role.
- The hands-on, kick-the-tires approach works.
- This is the kind of industrial outreach to potential users that is needed. The hands-on demonstration of hardware on site is good.
- The individualized educational outreach was very effective in increasing awareness of this technology and disseminating its potential to the industry.
- One strength of this project is the fact that it supports its educational material by showing the customers the equipment and allowing them to use it.
- This is an excellent opportunity for market application with pressing drivers including cost, safety, air quality, refueling time, and operation downtime.

**Project weaknesses:**

- The project's only partner is Hydrogenics, who is not a leader in this market. The awardee acknowledges this weakness and is now partnering with Plug Power.
- The cost justification model is not yet available.
- The project appears to be at the end of analysis, but opportunity exists for refined business plans, leasing arrangements, sensitivity analysis, and confirmation of long-term O&M and durability costs as compared with conventional lifts. A more detailed economic analysis may have addressed these questions.
- There is a need to develop a benefit calculator that could be used elsewhere.

**Recommendations for additions/deletions to project scope:**

- A reviewer thinks this project could be duplicated in other regions. This reviewer believes this message could be delivered to conferences of users in other parts of the country. This is a success story that is ready for a major public outreach effort.
- Recommendations include expanding to other states and working with other OEMs, refuelers, and sites.
- Recommendations include continuing project demonstration with refined business plans, leasing arrangements, sensitivity analysis at difference locations, and confirmation of long-term O&M and durability costs.
- An additional demonstration is recommended.
- Recommendations include expanding to more customers either in this region or other regions and identifying customers who are willing to speak to others about their experiences.
- This project is coming to close, so this question is not applicable.

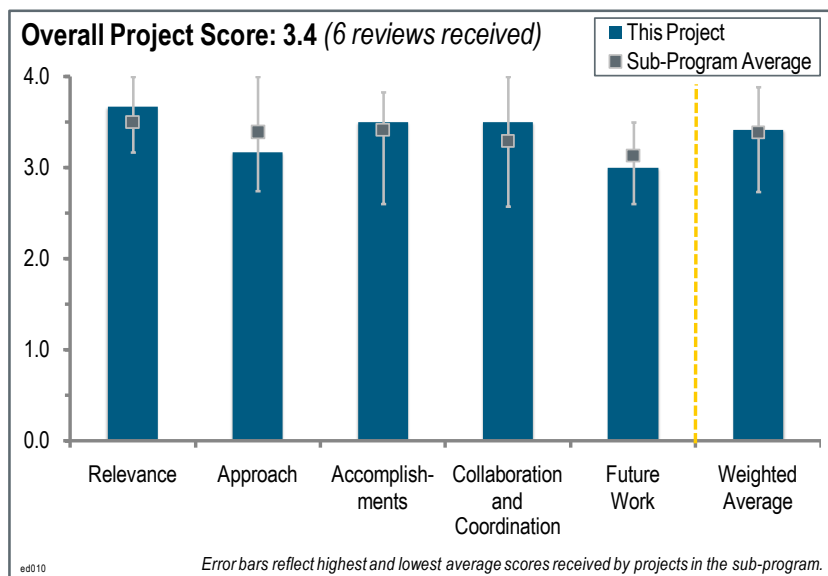


## Project # ED-010: Development of Hydrogen Education Programs for Government Officials

Shannon Baxter-Clemmons; South Carolina Hydrogen and Fuel Cell Alliance

### Brief Summary of Project:

The goal of this project is to accelerate the ongoing integration of hydrogen and fuel cells as an energy solution into South Carolina and the Southeast by providing accurate and reliable information to state and local decision makers. Objectives for the project are to: (1) identify key messages for decision makers; (2) develop varying presentation formats based on time available and audience interest and technical level; (3) develop webinars for state and local government officials; (4) give “H<sub>2</sub> 101” presentations to a variety of stakeholders; (5) offer monthly webinars for interested stakeholders; and (6) collect feedback and improve presentations.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.7** for its relevance to U.S. Department of Energy (DOE) objectives.

- This project addresses DOE Hydrogen and Fuel Cells Program’s educational and outreach objectives for fuel cell technologies.
- This project has clear goals that are relevant to DOE objectives.
- There is a very important need to educate government officials. Connecting with solar and wind is a very important near-term opportunity.
- The development and delivery of hydrogen education material is an important activity to support the growth of the hydrogen and fuel cell industry. The objective of the present project is to educate decision makers in South Carolina.
- A reviewer particularly likes the principal investigator’s (PI’s) reminder to broaden the definition of “decision maker” to include more than just government officials.
- A whole-state approach to putting South Carolina on the map as a leader in hydrogen and fuel cells is very relevant to the needs of the education sub-program. This includes speaking to industry, government policy makers, and the general public. Using limited DOE funds in both a broad and targeted manner provides maximum effectiveness and outcomes, as has clearly been demonstrated here. The PI has shown flexibility in looking at multiple markets and educating stakeholders on the benefits of each, down to facility-specific consultation.

### Question 2: Approach to performing the work

This project was rated **3.2** for its approach.

- This project has a focused and aggressive approach to providing information and promoting economic development of the fuel cell industry in South Carolina.
- The project team took a very good approach in developing relationships with solar, wind, and biomass groups. The team also had a good, logical approach to target key stakeholders.

- The project team employs a strong set of tenets for its approach: assess, design, develop, deploy, and evaluate. Going after a wider set of stakeholders (e.g., every congressional member and governor's office, as well as accountants who do business cases for fuel cell projects) appears to have paid off in terms of projects undertaken and general support. Supply chain mapping by North American Industry Classification System code is a novel approach.
- The project team assesses, deploys, and designs a program that will maximize audience participation. The team took advantage of all opportunities and exceeded its targeted audience. The team is limited to South Carolina only. The team takes advantage of other outreach programs and streamlines the approach for South Carolina's unique circumstances.
- The approach, as laid out in the presentation, appears to lack focus. That is, the team appears to have met with many "stakeholders," but the message being delivered to the stakeholders was not well-described.
- The project seems like it places a lot of emphasis on producing materials and brochures that DOE and manufacturers also produce. This reviewer would like to see South Carolina Hydrogen and Fuel Cell Alliance develop a toolbox more like what Rocky Mountain Institute did for Project Get Ready rather than create reports and brochures.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.5** for its accomplishments and progress.

- The BMW forklift project is a good one. Using YouTube video clips is a new and effective tool. Leaders from GE and other states were engaged—Scott Greenway's work is very productive.
- The project team has held many in-person meetings and webinars that have reached more than 1,700 stakeholders. The team managed to get fuel cells and hydrogen added to a 35% solar tax credit in the South Carolina legislature. Early market case studies are very useful for promoting fuel cell technologies. Extending proven successes to other southeastern states is positive.
- The project met or surpassed all of its goals.
- The team has worked with the legislature to establish a law that helps with the permitting process for hydrogen technologies in the United States. The team is working with state legislators, universities, and architects and has had many individual meetings with national, state, and local candidates. The team also conducted case studies and developed some models to show how municipalities can save money using hydrogen fuel cell buses. Lift truck analysis conclusions based on a model is a helpful tool. The model helps a decision maker determine the value proposition for various applications such as combined heat and power and forklifts.
- Specific metrics were given on outreach. The project reached 1,744 stakeholders in the last 12 months, and exceeded metrics in meetings/presentations, having done 30 versus the four that were planned. The PI appears well on the way to completing tasks before the end of the grant period on July 31, 2011. Fuel cell lift truck analysis as well as telecommunications and combined heat and power fuel cell studies give potential adopters an easy-to-understand view of the value proposition.
- The team did not identify any metrics for which progress was evaluated. For example, there was no mention if surveys or similar were used to evaluate the effectiveness of the educational material. One notable accomplishment was that South Carolina is the only state that has a state code for hydrogen permitting.

### Question 4: Collaboration and coordination with other institutions

This project was rated **3.5** for its collaboration and coordination.

- This project includes many useful collaborations with South Carolina organizations, both private and public.
- This project's private industry and solar alliances are excellent. Boeing and Bosch are also good candidates. City planners and developers are good candidates that would benefit from fuel cells. The South Carolina Secretary of Commerce, formerly employed at BMW, is a good person to engage. This project features a good list of politicians before and after elections—the project team should keep up this strategy.
- The team is trying to leverage its activities with similar activities and organizations in other states and with other renewable energy activities, such as solar activities.
- The PI clearly has a passion for this subject, which shows from the positive response received by the education collaboration activities. This project features a nice mix of e-education tools such as webinars and YouTube

postings, along with many public briefings, newsletters, and stakeholder meetings. The slide on feedback showed the importance of having the PI consider the impact of past events to develop better future plans. The plan to collaborate with Florida, Tennessee, and North Carolina is good, but this reviewer is not sure how much was really accomplished here. The South Carolina Hydrogen and Fuel Cell Alliance is a very strong collaboration.

- BMW is an important collaborator. Forklifts are important to BMW, as are other hydrogen vehicles—BMW’s H-series burns hydrogen in an internal combustion engine and has a cryogenic tank in the trunk of the car. There is no renewable portfolio standard in South Carolina—they want to start a clean energy standard instead.

### Question 5: Proposed future work

This project was rated **3.0** for its proposed future work.

- Continued updating of materials and presentations is appropriate for completion of this project.
- Bosch is also a potential collaborator. There are big plans to get more collaborators involved, including setting up a women’s leadership module that will teach hydrogen technologies. The model they have developed will help to show the value proposition to potential clientele.
- The project team has developed a good plan to complete the work as planned. They will be working on policy input in terms of tax breaks.
- Funding expires in July 2011. Proposed future work includes updating material and continuing to pursue collaborations with similar activities and organizations in other states.
- No slide was provided on future work; however, there was enough in the other slides to recognize what the PI will do in the time remaining on this project.

### Project strengths:

- This project is led by a strong and active project team and has a strong approach.
- Shannon Baxter-Clemmons brings a high level of energy and leadership to this project.
- The forklift scenario analysis is very well-organized.
- The energy and enthusiasm of the team is an apparent strength. It is also a strength that key members of the team are local and have strong contacts in the local community.
- This project’s strengths include a good knowledge of the local market, the ability to reach beyond traditional stakeholders, and using real-world examples in the messaging. It was very good to show fuel cells as consumer products, not environmental tools.
- One strength was that this project engaged with almost every key stakeholder in South Carolina. Efforts have produced real results, as evidenced by the public industrial hydrogen refueling station, adoption of fuel cells by many industries in South Carolina, and widespread recognition of South Carolina as a leader in this area. Focusing on key stakeholders—both in industry and government—has paid off.

### Project weaknesses:

- It would be nice to provide a summary of key policy input for stationary fuel cells as well as transportation.
- The focus of the project came across as diffuse in the presentation. There were no clear metrics used to identify progress.
- Most of the information provided to stakeholders is anecdotal. This project needs data to back up the case studies and marketing materials.
- This project has mostly a hydrogen/fuel cell transportation (vehicle and lift truck) focus. There is little on stationary fuel cell power, although some progress was shown in this area since the last Annual Merit Review.

### Recommendations for additions/deletions to project scope:

- This project needs to coordinate with the utilities, especially nuclear power plant operators.
- This project should connect fuel cells with wind and waste biomass. Working with biomass groups to promote fuel cells and hydrogen is a good near-term opportunity.
- This project should undertake a more focused and systematic approach.

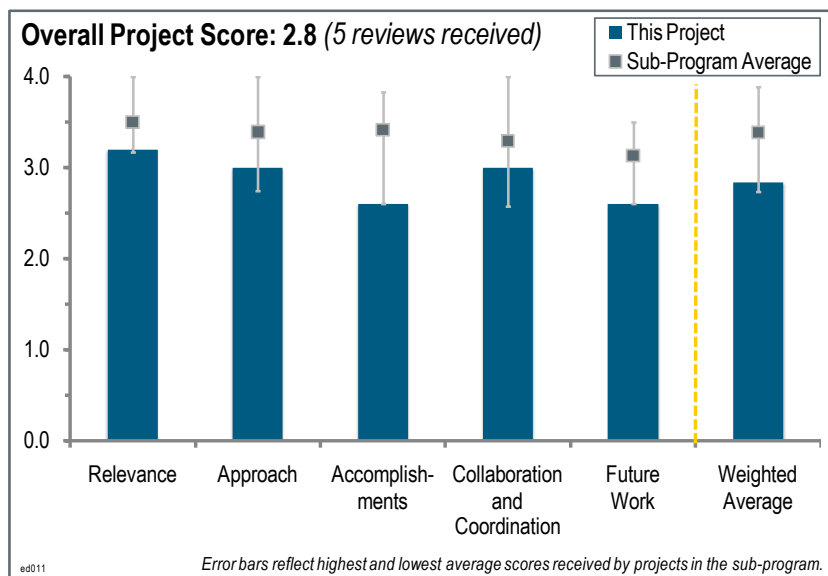
## Project # ED-011: Virginia, Maryland, and Washington, D.C. Hydrogen Education for Decision Makers

Chelsea Jenkins; Commonwealth of Virginia, Virginia Clean Cities

### Brief Summary of Project:

The goals of the project are to increase state and local government leaders' understanding of hydrogen and fuel cells, including early market applications, and to provide specific examples of actions they can take to support the development and use of hydrogen and fuel cell technology which will lead to better understanding of the resulting community benefits.

Objectives are to: (1) hold up to 12 in-person workshops led by technical experts and professional educators; (2) produce video resources for public television, seminars, the U.S. Department of Energy (DOE), and the general public; (3) use hardware demonstrations when possible and provide real-world examples of the technology; and (4) produce electronic "magazine" articles on hydrogen technology demonstrations and other instructional project deliverables.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.2** for its relevance to DOE objectives.

- This project supports the DOE Hydrogen and Fuel Cells Program's goals and objectives by targeting state energy offices.
- This project meets the objective of getting the message out, especially through the use of videos and webinars. The project also targets diverse audiences.
- The project team is the Clean Cities coalition for Virginia. The team is accomplishing much more than the Clean Cities objectives of getting clean alternative fuel vehicles on the road. It is also educating at the university level. However, this project does not hit the goal hard enough.
- The National Capitol Area is arguably one of the most important parts of the country to have an education project. There has been little accomplished to suggest that, despite being relevant, a lot of progress was made to advance Washington, D.C./Maryland/Virginia on this front.

### Question 2: Approach to performing the work

This project was rated **3.0** for its approach.

- This project features a fairly standard approach involving in-person meetings and presentations, media, and the development of educational materials.
- The approach focuses on barriers to getting the message out. The project team made a good move to webinars when the budget for travel to meetings was constrained.
- The project team builds on past partnerships with universities. However, the universities seem to be limited to the state of Virginia, such as James Madison University and the University of Richmond. The targeted audiences are local and state decision makers, including state energy offices. The project team has a targeted list of the individuals.

- This project accomplished very little in the way of engaging key stakeholders on hydrogen and fuel cells. Working on the MotorWeek video was a good approach that reached vast audiences. The presentation did not include a barrier slide or problem statement that the approach is trying to address. The approach is not very strategic, but seems to be just a laundry list of intended actions. Seminars are good, but they should be balanced with one-on-one meetings with key stakeholders. A lot of key people do not show up to group training events.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **2.6** for its accomplishments and progress.

- This project has many diverse activities, including seminars, writing articles, web products, web casting, and curriculum development. The project team also publishes newsletters and produces videos such as the one produced by MotorWeek. The team also plans on conducting evaluations of a survey it will circulate.
- Video resources and other outreach and instruction are excellent. Using new social media is a good diversification of outreach. The team was not clear about reaching policy makers.
- Targeting potential end users could have helped get more attention from state and local officials.
- There was very poor attendance at the University of Maryland seminar. There are no metrics on the number of stakeholders reached, people trained, etc. The MotorWeek videos proved to be a hit. The principal investigator (PI) appeared not to understand the importance of maintaining or replacing the Benning Road, Washington, D.C., hydrogen station so that there is at least one public refueling station in the National Capitol Region. Granted, this was not the proposed scope, but one would think the project team would latch on to this issue to some degree.

### Question 4: Collaboration and coordination with other institutions

This project was rated **3.0** for its collaboration and coordination.

- Many collaborations were noted—the work with MotorWeek in promotional videos was outstanding.
- The long list of collaborations is impressive. It shows they have been busy reaching out; however, they can do more.
- There is a long list of collaborations, but it's not clear what activity goes with each collaboration. This represents more than 2011 work.
- There was a wide list of collaborations made to date, but it was difficult to see exactly what these collaborations were about and what they accomplished. This project has a nice collaboration with James Madison University, but little else in this university-rich area. Having subcontracts to the Washington, D.C. and Maryland energy offices helps education efforts in those areas. The economic recession and a lack of local examples of emerging markets are weak excuses for the lack of overall support in collaboration attempts. Clean energy has been a major topic of late, especially among public policy makers in the area.

### Question 5: Proposed future work

This project was rated **2.6** for its proposed future work.

- The project will be completed in the next few months; the completion of planned seminars and webinars is appropriate. The planned first responder training is good.
- There are four remaining seminars and webinars, including the first responder training.
- There is much to accomplish in education efforts, including a lot to do in 2011.
- There was very little to go by from the slides, and not much was discussed in the presentation either. The reviewer pointed out the slide bullet "Follow-up and Evaluation" as an example. It appears that other than doing four more webinars, not much is going to occur in the future.

### Project strengths:

- The MotorWeek educational videos were a strength.
- The MotorWeek segments were positive.
- The MotorWeek video was a hit.

- This project has very nice information output, especially the video.
- The project team is reaching out to universities in an effective way.

### Project weaknesses:

- The targeted audience is too restrictive.
- The Clean Cities goals confuse this project direction and get mixed with the progress of this project.
- There is a lack of metrics to assess success of this effort.
- There are not enough outcomes from state policy makers.
- Weaknesses include the lack of demonstrated advances in education in the Washington, D.C./Maryland/Virginia area; overreliance on electronic media; a lack of any passion/strategic engagement for hydrogen and fuel cells evidenced by the PI; and a lack of achievements or significant progress against metrics.

### Recommendations for additions/deletions to project scope:

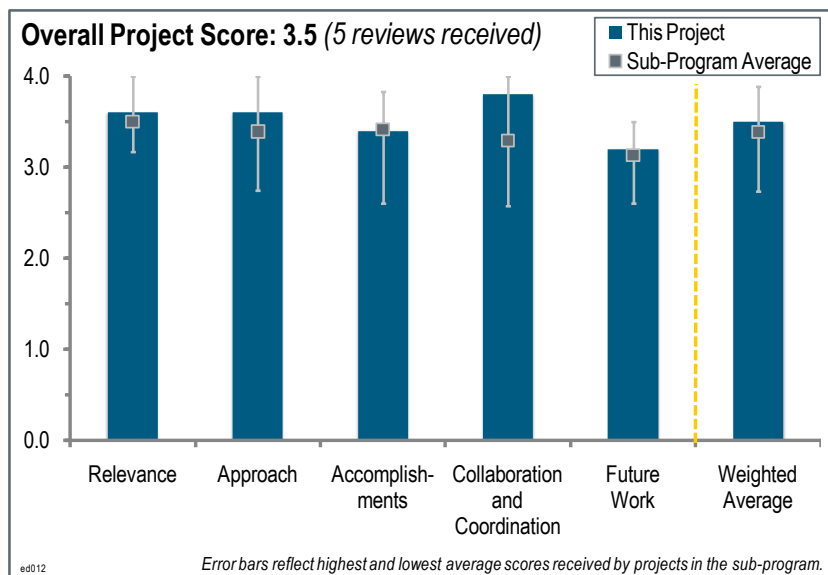
- Reach out to more universities in all three states. Hold a university conference on the future of hydrogen and renewable energy.
- Continue to drive meeting and webinar attendance.

## Project # ED-012: State and Local Government Partnership

Joel Rinebold; Connecticut Center for Advanced Technology, Inc.

### Brief Summary of Project:

The primary objective of this project is to build and strengthen partnerships between the hydrogen community and state and local governments. The partnership building project has five components: (1) identify key stakeholders and expand and strengthen partnerships; (2) develop resources to analyze potential sites for hydrogen and fuel cell deployment; (3) educate state and local decision makers and other key stakeholders; (4) integrate state and local development plans with federal/U.S. Department of Energy (DOE) objectives; and (5) identify financial and investment opportunities.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.6** for its relevance to DOE objectives.

- This project supports DOE Hydrogen and Fuel Cells Program's objectives by emphasizing early market deployment of fuel cell technologies.
- The project team explains the economic impact first to its potential clientele, and this makes it immediately relevant. The roadmap includes an explanation of the strengths, weaknesses, and economic impacts for each technology. This project is helping the Program to achieve its education goals in the New England region.
- This project is directed toward the critical goal of getting state leaders comfortable with and informed about hydrogen as a fuel in economic, technical, and ecological aspects, and helping states develop plans to implement the technology. Both goals are key to the rapid roll out of hydrogen. This, in turn, is critical to achieving an economically viable system in a short enough time frame so that businesses can become profitable before operating cash is consumed.
- Partnerships with state and local decision makers are a great idea. This project has made very nice progress through proper use of tool, models, and analysis.
- This type of effort is a model for the education sub-program to follow. It begins with the strong in-state effectiveness of the Connecticut Center for Advanced Technology, Inc. (CCAT) in Connecticut, and continues outside those borders to the Northeast. The principal investigator (PI) stresses the need to engage key stakeholders, whether they are first responders, economic growth agencies, transportation departments, potential users of fuel cells, or students. Coordination with state and local planners is critical in developing hydrogen refueling stations, stationary fuel cell power, and broader initiatives.

### Question 2: Approach to performing the work

This project was rated **3.6** for its approach.

- The development of individual state roadmaps to identify and analyze potential sites for hydrogen and fuel cell deployment is a positive approach.



- The project team is working with eight state market assessments. The team has defined models and asked the right people for feedback. This is the right approach because it is very practical, realistic, and economically based. The project team's approach is realistic and measurable.
- The roadmap for the Northeast and its component items are quite comprehensive. Involving lawmakers is very productive and timely.
- A regional approach, especially among smaller states such as those in the Northeast, makes a lot of sense as they have more interdependence and can expand their respective supply chains more effectively. However, it does appear that outside of Connecticut it has been hard for the PI to get significant traction, with the possible exceptions of Massachusetts and New York. Targeting all major fuel cell applications (i.e., stationary, transportation, and portable) is a very good approach.
- The education and information provision activities are well-done. The organization's "matchmaking" and specific state plans are good. This reviewer would like to see more proactive promotion and guidance of officials, especially in regard to planning of infrastructure and creating cohesive networks of stations and implementations, but the current developments are still very good.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.4** for its accomplishments and progress.

- The multi-state market assessment that includes jobs created, total revenue, and the number of companies is an impressive accomplishment.
- The project team has set up good meetings to identify market drivers. The progress in roadmap development is impressive. The project team is asking all the right questions at the state level.
- The project is almost complete, with only one ongoing item, but several new activities are progressing. This project is making some progress towards educating people. The roadmap is developed although not yet implemented, but the plan sounds good.
- This project has good milestones and has made excellent progress in most of them. The economic impact and business case analysis work is very focused on making successful introductions of fuel cells and hydrogen vehicles. The early market deployment strategy beginning with Connecticut is a concrete and effective step. Connecting with the waste biomass industry is a very important near-term opportunity.
- CCAT has demonstrated good progress against a far-reaching set of objectives. The PI has discussed providing tools to decision makers and is following through with market studies, roadmaps, and surveys on hydrogen and fuel cell knowledge. With only four months remaining, there is still a lot of work to be done in the areas of high-level market assessment (25% complete), mapping target fuel cell locations (35%), training on models (20%), and educating state and local officials (25%). This reviewer is not sure about the impact of models—no feedback from stakeholders was discussed. Two operational hydrogen stations (plus a third on the way and a fourth in the concept/planning stage) in Connecticut is partly due to CCAT's good work. There were no statistics provided on those educated. Expanding the database to include key stakeholders in the eight-state region is good.

### Question 4: Collaboration and coordination with other institutions

This project was rated **3.8** for its collaboration and coordination.

- This project features good collaborations with a large number of organizations at federal, state, regional, and local levels.
- This project has done an excellent job of raising the level of awareness at all levels of government and industry. Constituents are increasing in numbers.
- The project team has made connections with key groups to get its job done. Also, it would be good to make several technical resource connections, such as with a university or a key research and development center, such as United Technologies Research Center (UTRC).
- All major stakeholders have been included as partners. Involving legal and other biofuels companies is a very positive strategy. The fleet guidance document is an excellent source of information on stations and alternate vehicles.
- Expanding the market assessments from just Connecticut to eight states in the Northeast was good. The PI discussed a large number of collaborations across the Northeast (e.g., state, regional, local partners, and utilities).

### Question 5: Proposed future work

This project was rated **3.2** for its proposed future work.

- This project should continue focused activities through project completion in August 2011.
- The project team has a well-thought-out plan that will build on its past accomplishments. The team's state and regional partners are growing.
- The plans to complete the work are good, but this reviewer is pleased to see the work will continue after this funding ends.
- This project should include the policy decisions that have worked to promote fuel cells. Stationary fuel cells and transportation fuel cells involve different policy suggestions.
- Finishing up target maps and roadmaps builds on prior work. The percentage of completed work on the remaining tasks in some areas makes it appear that the project team has a lot of catching up to do. Linking the team's work with DOE models will provide customers with a more robust set of models from which to use.

#### Project strengths:

- This project has a strong regional approach.
- The project team has set up a good network that includes utilities and local and state level decision makers. The team is helping to increase awareness.
- This project seems to be reducing the number of people who know nothing and increasing the number who know something. The project has produced good tools for others to use. This project is also sensitive to where programs would fail and resisted the temptation to undertake them even if there was customer pull for them.
- This project features a good team and partnership with stakeholders, and good connection with job growth. Lawmakers' engagement is very important. The cash flow analysis approach is great.
- Strengths include the overall approach and breadth of scope. Another strength is that collaborations with state and local institutions will include road mapping.

#### Project weaknesses:

- This project is not making much progress on making people feel well-informed. It needs more funding to truly implement these programs in a more meaningful scale and with coordination between adjoining states. The roll out of the roadmap data to states seems a bit late in the game for this project, but that may be due to the funding level.
- It would be nice to include some success stories and lessons learned from other deployments.
- This project perhaps tried to take on too much with limited DOE resources (\$295,000) at hand. This reviewer is not sure how well the other states will pay attention to a roadmap developed by CCAT.

#### Recommendations for additions/deletions to project scope:

- Keep at it and focus more on bringing the technology to the people who can use it, rather than those who call.
- Continue the partnership strategy with actual deployments and develop data to share with local and state governments. Consider how to engage the energy and budget committee chairpersons.

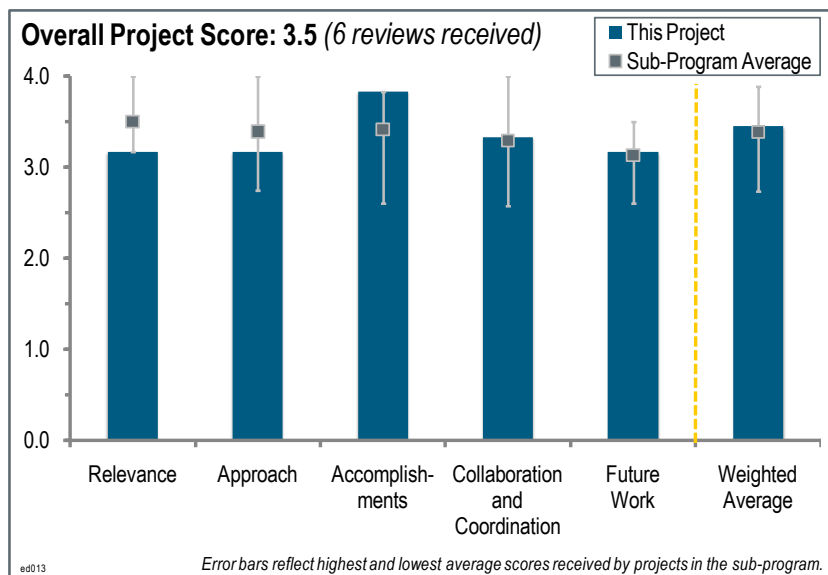
## Project # ED-013: Raising Hydrogen and Fuel Cell Awareness in Ohio

Pat Valente; Ohio Fuel Cell Coalition

### Brief Summary of Project:

The overall objective of the project is to increase the awareness and understanding of state and local government officials in Ohio concerning hydrogen and fuel cell technology, with the goal of accelerating the deployment of clean energy solutions. Achieving this objective will improve the environment, decrease U.S. dependence on foreign energy, and bolster the manufacturing sector. An increase in the awareness and understanding directly contributes to the following U.S. Department of Energy (DOE), Hydrogen and Fuel Cells Program, Hydrogen Education sub-program objectives:

(1) by 2010, increase understanding of hydrogen and fuel cell technologies among state and local governments by 10% compared to 2004 baseline and (2) by 2012, increase knowledge of hydrogen and fuel cell technologies among key target populations (state and local governments) by 20% compared to 2004 baseline.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.2** for its relevance to DOE objectives.

- This project meets DOE objectives by educating and promoting fuel cell technologies in both the private and public sectors at the state level.
- This project is focused on meeting DOE objectives.
- This project is relevant to DOE objectives because it involves educating key audiences, including community leaders, officials, and others.
- The development and delivery of hydrogen education is an important activity to support the growth of a hydrogen economy. The target audience for this proposal was state energy officials.
- This reviewer would like to see this project do more with business leaders, but Ohio might be doing that outside of the scope of this grant.
- The development and delivery of hydrogen education material to local and state government officials is an important activity to support the growth of a hydrogen economy. This particular project targeted officials in Ohio.

### Question 2: Approach to performing the work

This project was rated **3.2** for its approach.

- The approach, which is based on a regional emphasis, appears to be effective. The approach has been effective at reaching elected officials.
- The inclusion of companies from the region is a good approach.
- The project team found a way to reach elected officials and went straight to the legislature. Hydrogen 101 and Fuel Cells 101 were always included as part of a seminar. The statewide and regional approach is good. The project team added alternative and clean energy to the forum. The project uses a steering committee and has a local and regional flavor.

- The approach to tailor the “message” to a particular audience is excellent. However, migrating the delivery medium only to webinars is likely not the most effective approach. A combination of face-to-face meetings, which allow the message to be modified on the fly, and webinars would have been better. The approach to “talk with” and “not to” is more easily accomplished this way.
- The approach is very well-thought-out and accounts for the audience’s needs. The project has a good focus on regional issues. There is no way a biannual newsletter provides “timely” information.
- The approach was systematic and well-thought-out. The target audience was clearly identified and the forums used for material dissemination were effective. In particular, the inclusion of regional partners in the regional forums was an excellent approach to connect with local communities.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.8** for its accomplishments and progress.

- One accomplishment is creating the surveys that indicate the hydrogen/fuel cell knowledge level.
- This project features an excellent regional perspective without losing statewide messaging. Another accomplishment is working with other clean technologies to promote relevance of fuel cells to supplement the benefits of these other technologies.
- This project conducted a large number of conferences.
- This project conducted lots of forums, and the matchmaking has been successful. Other accomplishments include the tracking for coalition and networking. The portal and database will be beneficial to future work or partnerships and keep the momentum going beyond this immediate project.
- The student competition and the U.S. market report are both extremely valuable accomplishments. In particular, the U.S. market report is a great educational reference.
- The team completed 19 regional forums on hydrogen, and the effectiveness of the forums was evaluated by surveys. A state database of hydrogen projects has been developed and is continuously updated. The Ohio Fuel Cell Coalition (OFCC) has also facilitated partnerships between fuel cell companies and end users.
- This project featured good work on the follow up to measure success.

### Question 4: Collaboration and coordination with other institutions

This project was rated **3.3** for its collaboration and coordination.

- The coalition has benefited from strong participation by the state-based companies that are developing fuel cell products and from customers of fuel cell products.
- This project features a variety of collaborators in Ohio.
- The project team has lots of partners—it is good to see suppliers emphasized. The main focus is on jobs.
- Many collaborators were listed, but it was not clear how extensive the interactions were. The major collaboration was with the two organizations that helped prepare and review materials and with regional forums.
- The collaborations with the National Association of State Energy Officials and California are a good start, but groups outside of California should also be targeted.
- The OFCC has a lengthy and substantive list of collaborators.

### Question 5: Proposed future work

This project was rated **3.2** for its proposed future work.

- Extending the project for another year will allow the continuation of the work beyond the project’s period of performance.
- There are additional seminars scheduled. A DOE grant has seeded this effort, which is to continue beyond the end of the DOE project.
- There is a good plan for completing the work, which includes a few forums and a newsletter that will continue after the project ends.

- The OFCC proposed holding five to seven additional forums and will use survey results collected over the duration of the project to assess the overall effectiveness of the project.
- Dissemination of information only via webinar is likely not the ideal approach.

### Project strengths:

- This project features a strong coalition of concerned, dedicated, and involved participants. The focus on job creation is positive. The funding by multiple sources, including the state, is also positive.
- The coalition has benefited from strong participation by the state-based companies that are developing fuel cell products and from customers of fuel cell products.
- There is a good set of collaborators that range from universities to industry.
- This project has a lot of momentum and has made very good use of DOE money.
- This is a strong project and the accomplishments with respect to the student competition and U.S. market report are commendable.
- The systematic approach to identify target audiences and include regional partners is a major strength of the OFCC.
- The forums were very well-thought-out and planned. It is good that this project can continue after the grant expires.

### Project weaknesses:

- The presentation would have been greatly improved if some of the actual content of seminars were provided.
- The metrics used to evaluate progress are not well-described.
- Consider moving to a short monthly update instead of a twice-a-year newsletter.

### Recommendations for additions/deletions to project scope:

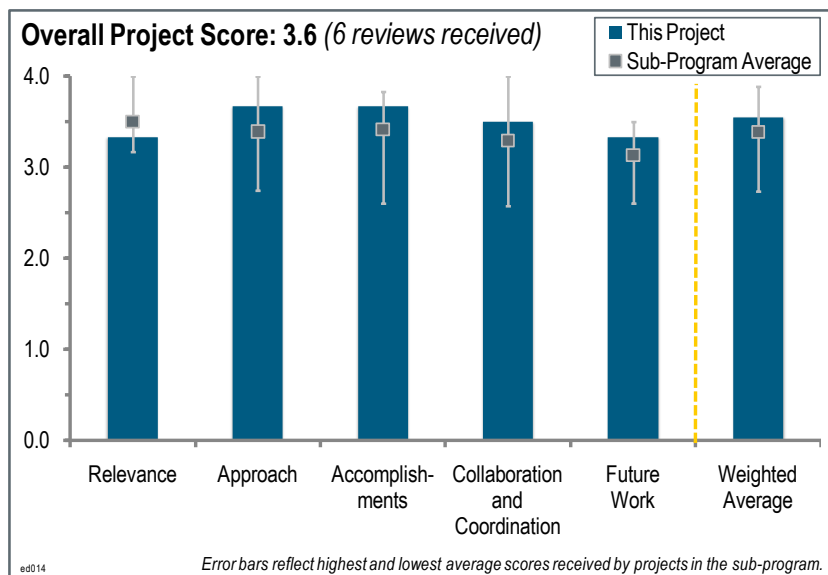
- Publicize the database or create a public portal for state users.
- Consider annual updates to the U.S. market report.

## Project # ED-014: H2L3: Hydrogen Learning for Local Leaders

Patrick Serfass; Technology Transition Corporation

### Brief Summary of Project:

The objectives of this project are to: (1) create presentation materials tailored to state and local government leaders by relating hydrogen to their interests and spheres of responsibility; (2) establish pathways for working with national associations of state and local officials as a route for disseminating information about hydrogen, thereby establishing a pattern for ongoing information flow; and (3) launch learning sessions by conducting initial workshops for local and state officials at national gatherings in an effort to achieve a nationwide reach.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.3** for its relevance to U.S. Department of Energy (DOE) objectives.

- The project addresses the DOE objectives of providing learning opportunities and information for local leaders, including detailed market analyses. Thus, it is relevant to the DOE Hydrogen and Fuel Cells Program's goals and objectives in this area.
- This project is effectively addressing goals set by the Program.
- This project is relevant to the key objective of educating key audiences.
- This project addresses an audience that is hard to reach and engage.

### Question 2: Approach to performing the work

This project was rated **3.7** for its approach.

- The approach focuses on providing pertinent educational opportunities to local leaders in their own environments and minimizing travel requirements by using Internet tools such as webinars. The approach also incorporates the use of the existing Schatz curriculum rather than developing a new one.
- The project team adapted its strategy to be more webinar-based to attract more of an audience, and increased its focus to include an "outside the choir" audience.
- This project features good collaborations and leveraging of resources with a wide spectrum of stakeholders and experts. Using webinars is a cost-effective way to disseminate information.
- The move to webinars allows this project to reach more partners. The market report is very good. The student contest has been a successful activity for several years, and provides good publicity and good experience for the students.
- The market report is an excellent idea for communicating data and real-world information in a short, attractive, and easy-to-read format.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.7** for its accomplishments and progress.

- Accomplishments include achieving more than 100 individual contacts and considerably more group sessions at various national meetings of local leaders. In addition, the project team coordinated a highly successful design contest for college-level students.
- The project is receiving good feedback from attendees. The student design contest should be continued.
- The Hydrogen 101 curriculum evolution and other outreach are very good. The feedback following the seminars is very good—the project team is collecting survey data. The move to webinars allows the project to reach more partners. Local leaders are talking to each other—peer-to-peer communication is very good. The market report located on the Technology Transition Corporation web site is very good. The student contest has been a successful activity for several years and provides good publicity and good experience for the students.
- The team completed 19 regional forums on hydrogen, and the effectiveness of the forums was evaluated by surveys. A state database of hydrogen projects has been developed and is continuously updated. The Ohio Fuel Cell Coalition (OFCC) has also facilitated partnerships between fuel cell companies and end users.
- Accomplishments are difficult to quantify because the project has been in a position of “pushing” the message, with low potential to benefit from the “pull” that may result from the introduction of successful products.

### Question 4: Collaboration and coordination with other institutions

This project was rated **3.5** for its collaboration and coordination.

- This project features collaborations with partner organizations in preparing and disseminating hydrogen and fuel cell information, and with organizations that assist in providing the learning opportunities for local leaders and the general public.
- The prime partner has increased collaborators to increase the potential audience, and they are actively seeking more partners.
- The events are designed to enhance interactions. The list of collaborators continues to grow.
- This project has excellent collaborations and is looking for more partners.
- This reviewer would have liked to see Connecticut, South Carolina, and Ohio more involved in the local leader outreach. The project team should make sure that the webinars are coordinated with other groups, such as the Clean Energy States Alliance and the South Carolina Hydrogen and Fuel Cell Alliance.

### Question 5: Proposed future work

This project was rated **3.3** for its proposed future work.

- The project is nearly complete (82%). Remaining activities include offering the most popular webinars in the remaining time available and continuing to collect feedback from participants regarding the effectiveness of these learning experiences.
- Ideas for proposed future work include increasing the focus on jobs and incorporating the “voice of the customer” for fuel cell users.
- Testing subjects for future webinars on target audiences is a good approach to addressing issues of interest.
- The project team is hoping to repeat this student project next year, but the reviewer wonders if funding will be available. There are four upcoming webinars covering topics such as: (1) where the jobs are, (2) maximizing local renewable resources, (3) case studies of actual activities concerning customers and local leaders, and (4) local planning issues.
- It seems like the project team is winding the project down just by finishing what it started.

### Project strengths:

- This project’s strengths include its diversity of collaborators and ability to get industry sponsorships.
- The project team is very experienced in outreach and is energetic and innovative.



- Strengths include this project's clear vision, ability to adapt to changing times, and expansion of the student design contest.
- Strengths of the project include a validated approach and good collaborations. The market report continues to be a valuable tool. It would be useful to try to establish industry trends, as the report currently covers several generations.

**Project weaknesses:**

- The reviewer felt there were no weaknesses. Keep up the good work.
- Attracting people to webinars is tough! This reviewer is concerned about TTC keeping the passion for hydrogen with the National Hydrogen Association not being part of everyday life.
- The education of local leaders is good, but there could be more resources for education at school levels.

**Recommendations for additions/deletions to project scope:**

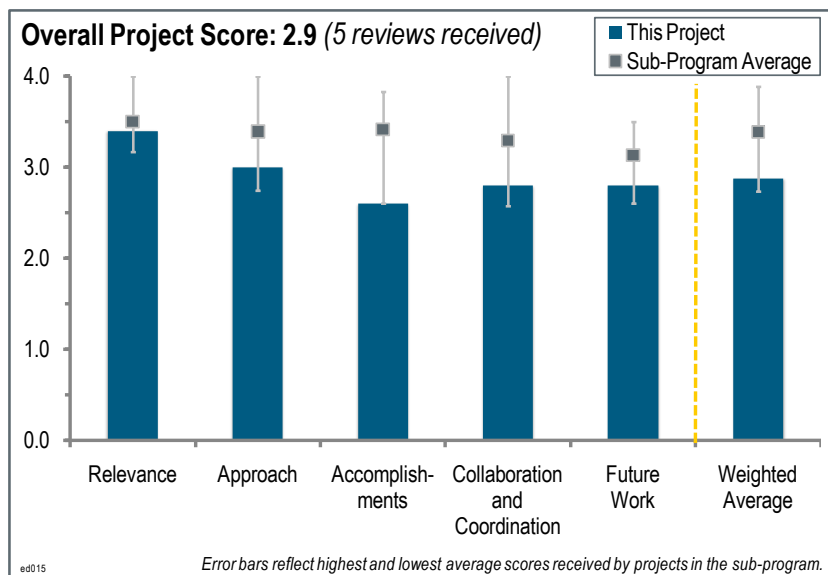
- The student design contest should be continued if at all possible!
- The student design content should continue, and an appropriate venue should be identified.
- Continue the student contest!
- This reviewer recommends more activities with customers, and possibly bringing customer groups into the coalition of partners.
- Update the U.S. market report.

## Project # ED-015: Hydrogen Education State Partnership Program

Warren Leon; Clean Energy States Alliance

### Brief Summary of Project:

The objectives of this project are to: (1) identify best practices and policies of state hydrogen programs; (2) develop strategies and information to overcome many state policy makers' resistance to support fuel cells; (3) provide information and technical assistance to state policy leaders and state renewable energy programs to foster development of effective fuel cell programs; and (4) promote strategic opportunities for states and the U.S. Department of Energy (DOE) to advance fuel cell deployment through partnerships, collaboration, and targeted activities.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.4** for its relevance to DOE objectives.

- This project is relevant in that it addresses the DOE Hydrogen and Fuel Cells Program's objectives of improving public awareness and acceptance of fuel cell and hydrogen technologies.
- The project team has made its publications and conference calls relevant. The team helps DOE get states involved by asking other states to share their success stories. This project is helping DOE educate all state-level employees.
- It is important to have a public education and outreach effort that focuses on coordinating state policies to leverage federal policies.
- Engaging lawmakers is very important. Positive messaging to them can provide a sustainable path to development of the fuel cell industry.
- Involving an entity such as the Clean Energy States Alliance (CESA) to further hydrogen education is important and relevant to this area. A multi-state alliance can leverage resources and provide tools for other states to use without those states having to develop the tools individually. One downside to this CESA-type activity is that there are very few "boots on the ground" talking to and educating people on hydrogen and fuel cells.

### Question 2: Approach to performing the work

This project was rated **3.0** for its approach.

- CESA is uniquely qualified to undertake the work as presented. Listening to lawmakers in both supporting and non-supporting states is a very productive approach. The policy input and models used are good tools to reach the goals. This project contains a good list of publications.
- The project team produces publications, seminars, LISTSERVs, and conference calls for its outreach. It also attends conferences and gives presentations. This approach has worked well for several years.
- The approach is focused on providing learning opportunities through targeted publications and online webinars directed primarily toward state officials, including state energy offices and policy decision makers. The focus of this project is the promotion of stationary fuel cell power systems.

- This effort has struggled from the beginning and had too far to go to turn it around completely. There did appear to be some regrouping on the part of CESA after the principal investigator's (PI's) passing, but also after reflecting on the poor performance in the previous two years. Focusing on supermarkets, performance monitoring, and the inclusion of fuel cells in renewable portfolio standards is a restart in the right direction. Limited engagement with individuals continues to handicap the impact that this approach will have.
- This project appears to have missed some opportunities, such as ensuring fuel cells were included in the Recovery Act State Energy Program grants. They were also late to recognize the opportunity to focus the message on the benefits of fuel cell products to certain early adopters, such as grocery stores and material-handling equipment (MHE). This group also coordinated a policy-maker panel that included a person representing New York who actually spoke negatively about fuel cells in front of an important audience.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **2.6** for its accomplishments and progress.

- The project team has published four publications with wide dissemination and has helped many states learn from other states' successes. The monthly calls among states sounds like a winning combination.
- This project had success with seminars and briefing papers.
- Progress seems to continue to be slow, but some publications and case studies have been completed. Several presentations were made at national meetings of state policy makers.
- The PI described very few vignettes on the effectiveness of the approach and was pretty much just reading the slides. The case study on Gills Onions is a good accomplishment. That story needs to be spread across the states to show how waste-to-energy can be produced using fuel cells. Some supermarkets contacted the New York State Energy Research and Development Authority after the CESA-hosted webinar. It is hard to discern the impact the refocused effort has had, as the PI did not offer much in that regard.
- This project appears to have missed some opportunities, such as making sure fuel cells were included in the Recovery Act State Energy Program grants. They were also late to recognize the opportunity to focus the message on the benefits of fuel cell products to certain early adopters, such as grocery stores and MHE. This group also coordinated a policy-maker panel that included a person representing New York who actually spoke negatively about fuel cells in front of an important audience. The reviewer believes this may have hurt progress, and this could have been avoided with some simple screening of the messaging before the panel presentation.

### Question 4: Collaboration and coordination with other institutions

This project was rated **2.8** for its collaboration and coordination.

- Grocery stores have been very helpful in explaining their successes, and this has helped the project team coordinate and collaborate better. The project team coordinates DOE grantees each month with a conference call. This activity alone helps DOE to achieve its goals of reaching state-level decision makers. The project team has been engaging many stakeholders for many years, and it has had success in doing so.
- Involving key state entities is a good idea.
- Outside collaborations are primarily with the National Conference of State Legislatures. Contacts with DOE and the Technology Transition Corporation do not count as meaningful collaborations. More collaboration with organizations that represent potential users, customers, and/or providers is needed.
- The emphasis on distance learning tools (e.g., webinars, conference calls, LISTSERVs, web sites) limits the ability to have the best impact with groups such as first responders, which is better done in face-to-face forums. Upon regrouping, the PI stated that he did not want to hear from academics, but end users instead. This is a good basis for building an education and outreach program. This is one of the only nationally based education programs funded by DOE (most were regional), and was an overall disappointment in terms of the expectations one would have of the collaboration potential. The project team could have tried to get state block grant funds to consider fuel cells. The funding was recently received from Recovery Act provisions, and precisely what technologies would be employed was not made definite in advance.
- Poor collaboration was recognized at last year's review. This project has tried to respond to this over the past year.

### Question 5: Proposed future work

This project was rated **2.8** for its proposed future work.

- In working with stationary fuel cells, a Gills Onion-type success story is good to promote.
- The project team is winding down the contract and should be allowed to finish its work.
- Increasing the focus on highlighting the benefits of fuel cell products to early-market customers should be quite helpful in advancing these markets.
- Future plans seem to continue the same sort of activities that have not worked well in the past. The project is nearly complete (85% complete), but it is advisable to try a different approach in the time remaining.
- There is not enough time to turn things around for this project, as there is nothing to build upon from the first two years of work. This is essentially a new start. The PI does appear to be more focused on outcome than in the past.

### Project strengths:

- This project involves all states.
- This is a national approach to educating states via CESA.
- This project engages energy professionals in a productive way.

### Project weaknesses:

- Involving key committee chairs for energy, environment, finance, and budget will lead to even more productivity.
- There was a lack of clear objectives and metrics from the beginning, and the turnover of the PI caused a setback. The lack of progress for the first two years severely handicapped the potential for turning this program around.
- Weaknesses include the failure to collaborate and coordinate messaging to the fullest extent, and the failure to capture opportunities such as the inclusion of fuel cells in state plans through the Recovery Act State Energy Program.

### Recommendations for additions/deletions to project scope:

- This project should continue building on successful case stories, such as stationary fuel cells, and complete a survey to measure the effectiveness of webinars.
- Perhaps they could get the National Association for State Energy Officials more involved.
- The project team should focus on relaying the benefits of fuel cell products to customers, such as distribution warehouses, combined heat and power, and backup power.

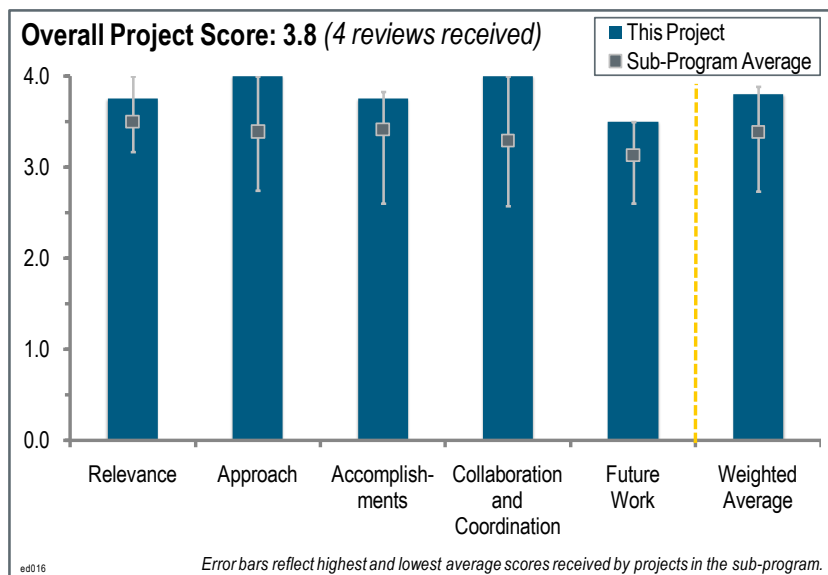
## Project # ED-016: Hydrogen Technology and Energy Curriculum (HyTEC)

Barbara Nagle; Lawrence Hall of Science at University of California, Berkeley

### Brief Summary of Project:

The overall project goal is to educate a diverse group of high school students and teachers about: (1) the scientific and technological basis for hydrogen and fuel cells; (2) research and development currently underway to implement safe and effective hydrogen and fuel cell transportation demonstration programs; and (3) current challenges and potential benefits of hydrogen and fuel cells in the broader context of energy use and resources. Project objectives are to: (1) develop, field test in national centers, revise, publish, and disseminate a hydrogen and fuel cell curriculum module for

varied high school science settings; (2) develop and implement a professional development plan for teachers who will use and help disseminate the materials; (3) develop a model for collaboration among school districts, informal science centers, university scientists, local transportation agencies, and other leaders in the field; (4) disseminate the materials to a broad national audience; and (5) evaluate the quality and effectiveness of the curriculum materials and professional development strategies.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.8** for its relevance to U.S. Department of Energy (DOE) objectives.

- This project targets a diverse base of students including varying grade levels and demographics and addresses important DOE barriers such as the lack of educated trainers. This project features a solid process to develop, field test, modify, and assess a hydrogen fuel cell curriculum that can be financially sustainable after DOE funding is no longer available. The project has a strong range of partners, including secondary and higher education organizations, video and dissemination companies, and others. The project has also developed a collaboration model that can be extended to other institutions, including museums.
- This is just the sort of program that will create and inspire the innovators that are needed on the hydrogen and fuel cell front.
- Exposing high school students to the technology of hydrogen and fuel cells is highly relevant to the DOE Hydrogen and Fuel Cells Program.
- Educating young people in hydrogen and fuel cells is critical to ensuring a successful future for hydrogen.

### Question 2: Approach to performing the work

This project was rated **4.0** for its approach.

- The approach features a well-developed understanding of the barriers, both programmatic and commercial, to long-term sustainability and dissemination. The project is addressing critical barriers, including the need for vetted material and training of the instructors through a cost-effective train-the-trainer model. The project has progressed nicely, even though funding has been uneven and not to the recommended level. Overall, the project has made significant progress toward its goals through well-planned and executed strategies. The project has very good breadth and depth of partners representing educational and commercial institutions.

- The project is well-planned and the accomplishments to date are a testament to the project's feasibility.
- Development and implementation of a high-school curriculum that is easy to integrate into the high-school educational setting and relatively inexpensive to access is an excellent approach.
- Developing a product that can be disseminated nationally gives DOE "more bang for its buck."

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.8** for its accomplishments and progress.

- Even with sub-par funding, the team has achieved many of its initial objectives through innovative partners and programs, including a curriculum that can be disseminated to a broad scope of national users. The team has made significant progress in addressing regional differences that might be barriers to broad dissemination of the curriculum. The team has also established good practices to train the trainer and demonstrated the effectiveness of its curriculum and training practices.
- This project is well on its way and appears to be sustainable.
- A two-week curriculum module has been developed and published so that it is commercially available to high schools.
- The iterative process of having teachers use the module and provide feedback will result in a stronger product. Since this phase was completed by June 2010, more information on what changes resulted from the iterative process would have been helpful.

### Question 4: Collaboration and coordination with other institutions

This project was rated **4.0** for its collaboration and coordination.

- Collaboration has been very good, including work with commercial partners.
- Partnerships have been strategically chosen to further project goals, i.e. , Lab-Aids, Inc. and Chabot Space & Science Center.
- There has been excellent outreach to high school teachers about the hydrogen and fuel cell curriculum module.
- Having the industry partner, Lab-Aids, Inc., provide cost share is very good. Additionally, having AC Transit provide support to teachers and fund production of the video materials is good.

### Question 5: Proposed future work

This project was rated **3.5** for its proposed future work.

- The project is very well-planned, both in the work executed and for future work.
- Proposed future work includes a solid plan and strategy to complete the commercialization process and to publish the curriculum, an online strategy for content delivery to students, and online training of teachers and instructors.
- Continued exposure of the project output to high school science teachers should be the future objective.
- Completing and disseminating the materials is the logical next step to conclude the project.

### Project strengths:

- Project strengths include the iterative cycles of curriculum development and revision that were used, the strong commercialization strategy, the field tested materials, and the training processes.
- Strengths of this project include its partnerships, planning, and overall strategic plan. The student impact or number of students reached is another positive.
- This is a very well-planned and executed project.
- Targeting high school teachers and providing a product that should be self-sustaining after the end of the work are strengths of this project.

**Project weaknesses:**

- The reviewer felt there were no weaknesses.
- The lack of funding.
- Ideally, more curriculum material would be available online to teachers for free.

**Recommendations for additions/deletions to project scope:**

- Obtain more funding, a good model for other groups.

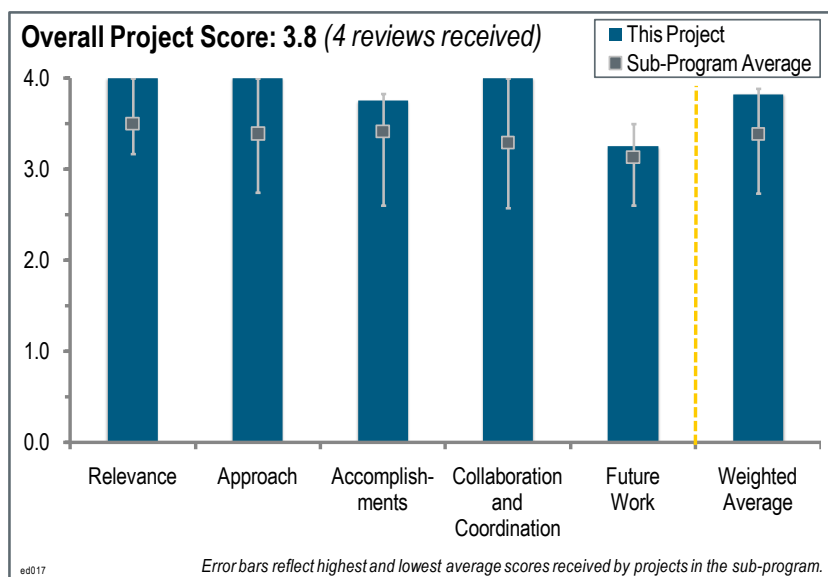


## Project # ED-017: H2 Educate! Hydrogen Education for Middle Schools

Mary Spruill; National Energy Education Development Project (NEED)

### Brief Summary of Project:

Project objectives were to: (1) collaborate to develop, design, and deliver a first-class, comprehensive middle school hydrogen education program, including training, classroom materials, technical and best-practices exchange, and evaluation; (2) design a program to link hydrogen science and technology to the classroom; (3) deploy materials via teacher training and other professional development outreach opportunities; (4) provide technical support for schools that entered the program in its first two years and collect and evaluate data for revisions in the second year; (5) work to expand the reach of the program with new partners able to support training workshops at the local level; (6) expand the program for new localities and workshops; (7) continue to evaluate effectiveness and usability of materials; and 8) expand financial resources for workshops.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **4.0** for its relevance to U.S. Department of Energy (DOE) objectives.

- This is a well-established project that has reached nearly 8,000 teachers to date. The project and team effort has accomplished much with a relatively limited amount of funding since 2004 through its workshops. This project has included the cyclical development, revision, and evaluation of curriculum, classroom materials, and training aligned to hydrogen and fuel cells in the classroom. There has been strong development of partners and collaboration between the partners to support the broad expansion of the project. The project team recognizes the importance of assessment and evaluation on a continual basis.
- This is just the sort of project that will create and inspire the innovators that are needed on the hydrogen and fuel cell front.
- This is a really broad project that will help with public acceptance.
- This is a wonderful project, but this reviewer would have liked to have seen the standard slide that identifies the barriers that were being addressed.

### Question 2: Approach to performing the work

This project was rated **4.0** for its approach.

- The project team created a demand for its work that exceeds available resources. The project continues to expand through partnerships. Evaluation is embedded into the project through its delivery, training, and dissemination aspects.
- The project is extremely well-planned and accomplishments to date are a testament to its feasibility.
- The workshops and materials are helpful to the target teaching audience. The fact that they were created by the user peer group ensures proper usage and good acceptance.
- Training teachers to teach students increases the number of people educated exponentially.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.8** for its accomplishments and progress.

- Reaching 8,500 teachers is an outstanding accomplishment.
- Each year the project team has continued to build and expand the project while maintaining a structured delivery and evaluation process.
- This project is well on its way and appears to be sustainable.
- Evaluations show that the project had strong education impact. Modules were created in less time than anticipated. The project trained an amazing 8,500 teachers and may have touched nearly one million students.

### Question 4: Collaboration and coordination with other institutions

This project was rated **4.0** for its collaboration and coordination.

- The collaborations seem suitable and broad enough to cover all aspects of the technology. This project featured lots of collaboration.
- This project has a strong range of partners and collaborators. The project team has established and implemented a collaborative model for others. Through partnerships, the project team has obtained limited funding to continue the project on a regional or local basis.
- This project features an impressive listing of collaborators, although it is not always clear what each collaborator did.

### Question 5: Proposed future work

This project was rated **3.3** for its proposed future work.

- The project is very well-planned, both in the work already executed and the work still to be completed.
- The project team intends to continue past the project's end.
- The most important aspects of the future work are where it goes from here and how it will be funded.
- There is no clear information on proposed future work, but the project is over and it does appear as though plans are in place to continue the outreach activities.

#### Project strengths:

- This project's strengths include its strong partnerships, demonstrated effectiveness, and strong model to develop materials and training processes.
- This is a fantastic project. Keep up the good work.
- This project has strong co-funding—clearly the project team cares about this work. Other strengths include materials that are free to anyone and very good reach to teachers and students. The project is teacher developed, so teacher needs should be covered well.
- Targeting elementary and middle schools promises to have the most impact in the future.

#### Project weaknesses:

- This is a wonderful project, but the project team's failure to follow the DOE guidelines for presentations makes locating information much more difficult.
- This project lacks a clear pathway to continue beyond DOE support.

**Recommendations for additions/deletions to project scope:**

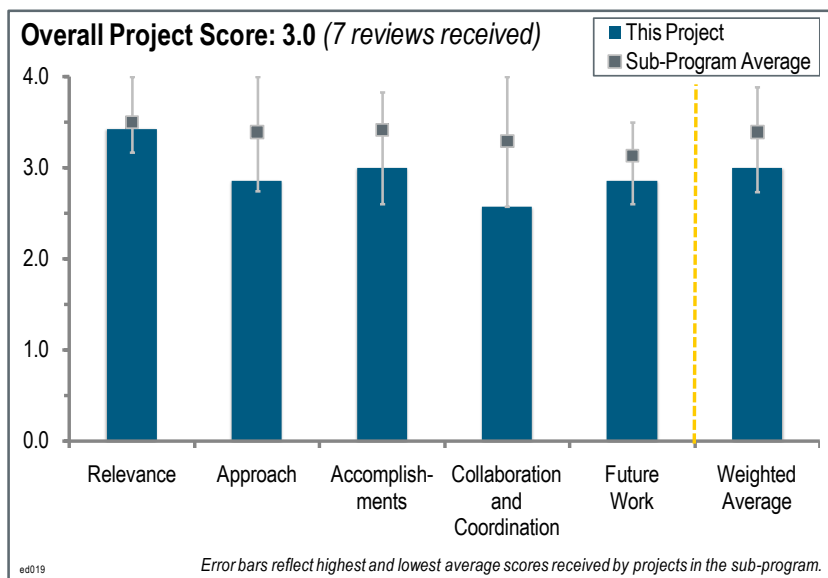
- This reviewer had not much to add, other than to say “great job.”
- This project is currently at the “sunset” timing of its funding, and this reviewer is not sure that it will be continued. The project team needs to continue efforts to either obtain continuation funding or leverage lessons learned to the benefit of other projects.

## Project # ED-019: Employment Impacts of Early Markets for Hydrogen and Fuel Cell Technologies

Marianne Mintz; Argonne National Laboratory

### Brief Summary of Project:

The objective of this project is to facilitate early-market deployment of fuel cells in stationary, backup power, and material-handling applications by developing a user-friendly tool to calculate economic impacts. The tool will be designed to meet U.S. Department of Energy (DOE) and stakeholder needs by: (1) identifying industry sectors benefiting most from increased fuel cell production; (2) determining the impact of constructing new facilities to achieve target levels of production; and (3) identifying indirect and induced effects of fuel cell deployment on state, regional, and national economies.



### Question 1: Relevance to overall U.S. Department of Energy objectives

This project was rated **3.4** for its relevance to DOE objectives.

- This project has lots of focus on job creation, so it is a vital tool for influencing decision makers at all levels, as well as investors and other industries. The tool shows various supply chain sectors, many of which are not familiar to decision makers and others outside of the fuel cell industry. It helps relay how other industries (e.g., plumbing; heating, ventilation, and air conditioning, etc.) can adapt to service the fuel cell industry.
- The economic impact will be critical to advance industry deployment with a full understanding of job creation and retention, revenues, and output.
- This project is meeting objectives of both the education and analysis sub-programs. An overview of the goals, the modeling approach, and output design are conceptually very good.
- Identifying the jobs and economic impacts of early-market deployment of fuel cells is relevant to every area in the DOE Hydrogen and Fuel Cells Program.
- A web-based, user-friendly tool to calculate potential economic impacts of hydrogen and fuel cell technology deployment is an extremely valuable tool to spur commercialization of hydrogen-based technologies.
- Having a tool that companies can use to model jobs is vital to moving hydrogen and fuel cells forward at a state level. However, without Recovery Act-type funding, there is a very slim chance that any company will build a new fuel cell manufacturing facility. This reviewer would like to see more emphasis on the jobs created by deploying fuel cells.

### Question 2: Approach to performing the work

This project was rated **2.9** for its approach.

- The user input fields are very descriptive and inclusive of what a user might need. Having a tool that is unique to each user's requirements and situation is much needed in the industry. Showing economic impacts will help ease red tape when putting in new facilities and convincing investors and government officials.
- It is clear that the team working on this project is clearly focused on the key areas of job generation and dollar flow. This focused approach is good because there is a danger if the project is not focused and tries to be

something different for a variety of different audiences. The focus on the flow of dollars over processes is also important, and it is good that this distinction was made in the presentation.

- It is great to have a tool that businesses use themselves instead of a report that provides an analysis of numbers.
- The existing work to address manufacturing facilities is important, but limited. Future work would serve the public well by addressing the economic impact of individual installations of products for end users.
- Apparently, this is an established approach. The tool is hard to understand. The reviewer wonders who uses the tool. It is hard to tell if the regional IMPLAN (Impact analysis for PLANning) economic statistics model used is a good platform. The presentation is generic, hard to follow, and incomplete.
- Near-term commercialization growth of hydrogen technologies is likely to occur in niche applications and markets. The current focus on large-scale manufacturing and product penetration does not address the economic impacts of these niche or site-specific markets. Also, there is no discussion of uncertainty in the model or a parametric study of various scenarios depending on model assumptions.

### Question 3: Accomplishments and progress towards overall project and DOE goals

This project was rated **3.0** for its accomplishments and progress.

- The project team is making good progress with the model and reaching each goal at a good pace. The project's direction is focused and targeted. The project has just begun, so it is hard to point to significant accomplishments.
- The project team has made lots of progress on the tool in a very short amount of time.
- The only reason this reviewer did not rate this project a "four" (outstanding) is because it is very early in the project and hard to tell whether the group is ahead of where it should be or on schedule. The progress so far is impressive, but it is also not done. From what this reviewer has seen so far, it looks like this will turn out to be a fabulous tool. Hopefully it keeps progressing along these lines.
- Work appears to be complete or near complete for polymer electrolyte membrane (PEM) manufacturing facilities, but other technologies, including solid oxide fuel cells, phosphoric acid fuel cells, molten carbonate fuel cells, and hydrogen generation facilities may be further away from completion.
- The PEM fuel cell work is underway. The results are in an interesting form, and preliminary results seem unexpected. The stakeholder webinar is a good idea.
- The focus on large-scale deployments is not aligned with current market needs. Moreover, any model requires parametric studies of model assumptions on outcomes.

### Question 4: Collaboration and coordination with other institutions

This project was rated **2.6** for its collaboration and coordination.

- Working with Connecticut, California, and South Carolina helps reinforce regional job development and identify companies and opportunities to add more detail to the model.
- This reviewer thinks that it is too early to judge this project. It is clear that this group is working with some others on the project and is seeking input from others, but the time for collaboration is probably a little further down the road, when more of the project is finished and it needs to be tested and shared with potential users.
- The collaboration appears adequate, but confirmation of the model results with original equipment manufacturers (OEM) partners may be a reasonable action before the final launch of the model.
- The project team has done a good job collaborating with its partner organizations, but this reviewer is just not sure if they are the right partners. The project needs the Clean Energy States Alliance and the National Fuel Cell Research Center to be involved instead of the California Fuel Cell Partnership.
- It is important to vet the statistics with the key inputs, such as the fuel supply companies and the OEMs to make sure the data can hold up to analysis. It is also important to benchmark the data versus other economic impact or jobs impact studies.
- The presentation simply provides a list of stakeholders. The project needs more stakeholders and someone to verify outputs.
- Although the primary stakeholders are fuel cell manufacturers and hydrogen suppliers, there does not appear to be any direct collaboration with these stakeholders.

### Question 5: Proposed future work

This project was rated **2.9** for its proposed future work.

- This project is on track to provide a much-needed tool for the fuel cell industry. Proposed future work includes adding modules that will further advance progress in persuading decision makers to make investments in the fuel cell industry.
- This reviewer is looking forward to seeing the national net job and economic impacts that will be developed in future work.
- The project team has a good idea of what it wants as the output.
- This project has confirmed future work to address other technologies and end-use applications, but it is not clear if the work will be completed in time for project conclusion.
- The reviewer wondered how this project will add stakeholders and address some of the other plans discussed if it is ending.
- The proposed work to address site-specific economic impacts is good and more aligned with market needs. However, there is no mention of how this will be achieved, or if it is even possible using the IMPLAN platform.

#### Project strengths:

- There is nothing like it out there and it is vital to help make a case for the industry.
- This project highlights the importance of relating jobs to the fuel cell industry.
- This is a user-friendly tool that delivers valuable economic impact information to increase manufacturing and end-use deployment.
- This is an important project for DOE and users who want to say that there will be jobs.
- This project comprehensively addresses the flow of dollars at an appropriate, very detailed level. The fact that it is well-focused on jobs and dollars is a project strength. This project will result in a very useful tool that can meet a variety of needs in private and public sectors.
- The tool itself is a good piece and the data acquisition is also a strength. This reviewer knows that is hard to do!

#### Project weaknesses:

- The reviewer felt there were no weaknesses.
- The principal investigator says the tool will be used by DOE and stakeholders, but the tool needs to be made available for many others to use, too.
- This project would have additional usefulness if it were to add other technologies including hydrogen generation, transportation applications, and end-use applications for individual technology deployment, as well as to confirm model operation confidence with verification at known test sites where conclusions have been proven.
- There is a need to calibrate or validate the model with actual data or give credibility to the results somehow.
- One weakness is the lack of focus on niche markets that are more aligned with current market needs.
- This project has the wrong collaborators at this point, assuming that the “low-hanging fruit” is a factory to manufacture fuel cells.

#### Recommendations for additions/deletions to project scope:

- This reviewer thinks the site-specific information is vital to include, as soon as possible. It will help sell fuel cells now.
- While this project is clearly focused on the analysis (and that is a good thing), part of the utility of this tool for people other than those who will use the model directly will come in creating outreach tools for those for whom the model itself is too complex to understand. Using some of the existing partners or other organizations that are not yet a part of the team, more work should be done to make sure the results of this tool can be shared widely with others who will not use the tool directly.
- The project team needs to make this tool available to developers, urban planners, state and local officials, and Congress, among others, to show the viability of investing in fuel cells and manufacturing facilities. The project could expand to add the environmental impacts that manufactured fuel cells could provide.

- An amendment of the project schedule may be needed to add other technologies including hydrogen generation, transportation applications, and end-use applications for individual technology deployment, as well as to confirm model confidence.
- If this project is looking only at fuel cells, the project team also needs production technologies such as electrolyzers. The project team should also add an element to validate the output.