Hydrogen Education

Summary of Annual Merit Review Hydrogen Education Subprogram

Summary of Reviewer Comments on Hydrogen Education Subprogram:

Reviewers considered hydrogen education to be important to the President's Hydrogen Fuel Initiative and necessary for public acceptance of hydrogen use in daily activities. They noted that the education strategy, following a slow, multi-phased, and long-term approach, is appropriate. Reviewers also praised the hydrogen education plan for organization, understanding of barriers, coverage of target audiences, and effective coordination with key entities, particularly with state and university partners.

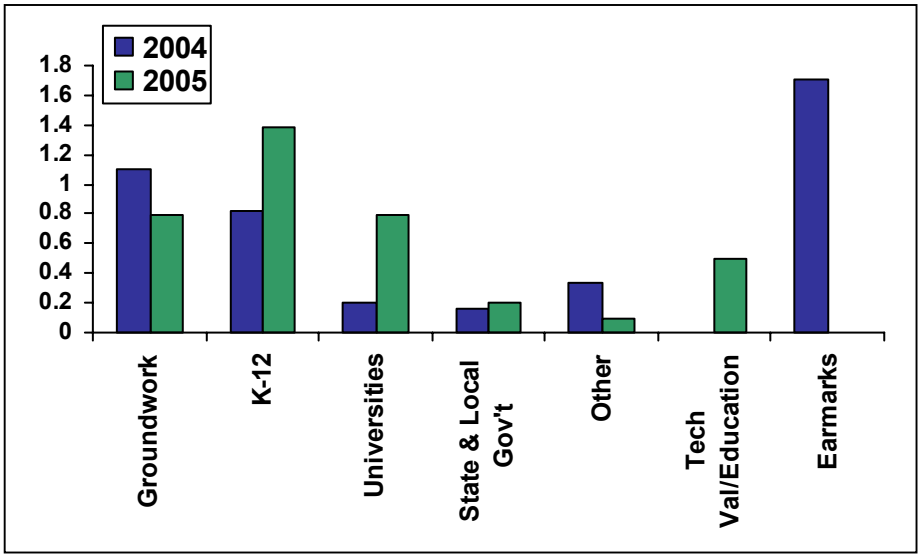
Reviewers commented on the need to coordinate education activities with technology validation projects to reach pertinent local audiences, although several commented that there is less need to focus on the general public until hydrogen fuel cell technology is closer to commercialization. It should be noted that there is coordination between the Education and Technology Validation Subprograms, although lack of funds due to Congressionally-directed projects affected this effort in FY2004.

It was also suggested that teachers participating in hydrogen education training sessions should be offered professional development credits, and that teachers representing multiple disciplines should be involved, rather than focusing on only science and math teachers. It should be noted that these points were considered in the development of the Hydrogen Education Solicitation prior to its release, and that both awards made for hydrogen curricula and teacher professional development address these issues.

There was also a request for more online learning opportunities. Several reviewers noted, however, that although the website and materials library are necessary activities, measuring their effectiveness may be difficult. The website and information center support education activities, such as workshops and training. Although their usage can provide helpful insight regarding education needs and interest, these tools are not intended to provide the primary measure of Education Subprogram effectiveness. Instead, a knowledge assessment/national survey initiated in FY2004 will measure key target audiences' understanding of the hydrogen economy. It will provide, not only information to help direct near-term education activities, but also a baseline from which the Education Subprogram can measure success over the long-term. Repeat surveys using the same methodology are planned for 2007 and 2010.

Hydrogen Education Funding:

The funding portfolio for hydrogen education addresses "groundwork" activities and development of general education materials to help lay the foundation for a long-term education campaign as called for in the President's National Energy Policy, as well as specific activities focused on several key target audiences that play a role in near-term transition activities to a hydrogen economy. The 2005 funding profile (subject to Congressional appropriation) supports projects awarded under two solicitations issued in 2004, education activities in coordination with technology validation projects, and a "phase 2" of state and local government education activities initiated in 2004.



Majority of Reviewer Comments and Recommendations:

The number of education projects included in the 2004 merit review is small, and includes only the baseline knowledge assessment, State Energy Program Special Projects, and Congressionally-directed projects. Efforts related to state and local government education were included in the Education Subprogram overview. In many ways, however, the Education Subprogram effort is just starting. New projects awarded through two competitive solicitations in 2004 have created a more robust education subprogram for review in 2005.

The reviewer scores for the education projects reviewed varied from as high as 3.92 to as low as 2.08. Many projects are new and had little progress to report, and reviewers commented on the need to focus Congressionally-directed projects on hydrogen and fuel cell technologies. Also, several projects awarded through the 2003 State Energy Program experienced significant funding delays that affected their performance. To the extent possible, DOE will act on reviewer recommendations to support the overall hydrogen education effort.

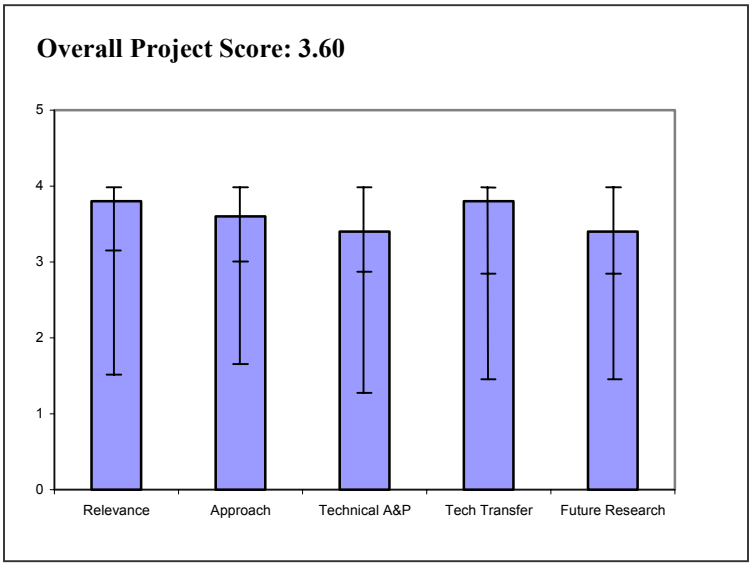
- **Baseline Knowledge Assessment:** Expand survey effort to include additional target audiences, including firefighters, local building code officials, and local community activist organizations in technology validation "test sites."
- **K-12 and University Projects –** Provide lessons learned and share results with other states interested in hydrogen education. Consider alternative funding mechanism to State Energy Program if funding delays persist.

Project # ED-1: Education Subprogram Overview

Cooper, Christy; DOE, Team Lead

Brief Summary of Presentation

The purpose of this Education Subprogram Overview is to describe subprogram goals/objectives, budgets, barriers/targets, approach, accomplishments, interactions and collaborations, solicitations and awards, and future directions. As such, it sets the stage and puts into context the education strategy and projects that will be presented in this subprogram area during the Annual Merit Review.



Question 1: Relevance to overall DOE objectives

This presentation earned a score of **3.80** for its relevance to DOE objectives.

- Education plan essential.
- Education will be necessary for acceptance of hydrogen in the public's day to day activities.
- Covers all audiences/stakeholders.

Question 2: Approach to performing the research and development

This presentation was rated **3.60** on its approach.

- Barriers clearly understood.
- Although a website and library of materials are necessary activities, measuring their effectiveness may be difficult.
- Multi-phased, over a long-term.
- Good practice to show continuous improvement.
- Good appreciation of the need for a slow, long-term education program, and need to consider feedback.

Question 3: Technical accomplishments and progress toward project and DOE goals

This presentation was rated **3.40** based on accomplishments.

- Very comprehensive plan.
- Reaching a broad audience (through hotline, internet) a challenge.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This presentation was rated **3.80** for technology transfer and collaboration.

- Interactions with many entities; well planned and coordinated.
- Continuous improvement displayed.
- Long-term approach to expand the audience.
- Networking to date appears effective.

Question 5: Approach to and relevance of proposed future research

This presentation was rated **3.40** for proposed future work.

- Proposed plan very well laid out.
- More planning related as opposed to research.
- Too diffuse and scattered not consistent with "go slow approach."

Strengths and weaknesses

Strengths
- Outstanding organization, accomplishments, and goals.
- Coordinating with key organizations.
- Great work!
- Good outreach to state energy agencies and universities.

Weaknesses
- No coordination with Technology Validation Subprogram to reach pertinent local audience at project sites.

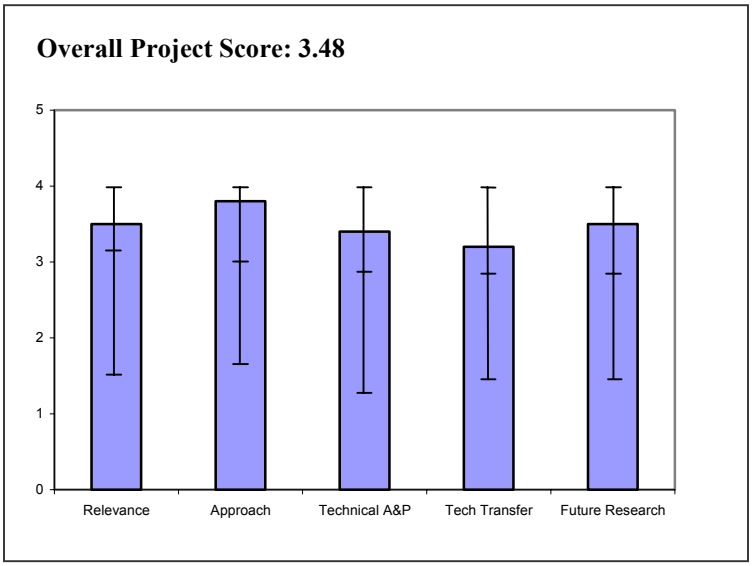
Specific recommendations and additions or deletions to the work scope

- Consider/confirm that any teacher attending the "train the teacher" sessions will receive a continuing education credit. (As a former teacher, this would raise my interest level.)
- Confirm scope of teacher involvement for all teaching fields, not limited to science and/or math.
- Title needs to be specific regarding scope.
- Develop more online learning possibilities.
- Share successful approaches among funded and future projects.
- Coordinate with Technology Validation Subprogram to identify most pertinent target audiences.
- Interact with professional engineering societies; ask them what would be helpful for their memberships.
- Cut back on education to general public, until we are closer to commercialization.

Project # ED-2: Baseline Knowledge Assessment
Truett, Tykey; Oak Ridge National Laboratory

Brief Summary of Project

Oak Ridge National Laboratory's (ORNL) project is to measure the current level of awareness and understanding of hydrogen and fuel cell technologies and the hydrogen economy in four target populations – general public, students and educators, state and local government agencies, potential large-scale users – and to establish a baseline for comparison of future evaluations of public awareness, knowledge, and opinion.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.50** for its relevance to DOE objectives.

- Important project.
- Project is critically relevant but very difficult to implement.
- Necessary to guide developments of education program - also will monitor effectiveness of education program.
- Very important work to assess current knowledge base.
- Capture of identified groups is a good practice for continued improvement.

Question 2: Approach to performing the research and development

This project was rated **3.80** on its approach.

- Very effective approach to obtain level of "awareness."
- 1000 adults + 1000 students + 100-150 educators + 100 S&L agencies + 50 large scale users = 2250-2300 total interviews?
- $270,000 investment for 2300 interviews?
- Confirm number of surveys planned will provide a statistically significant result for the overall population and minimize standard deviation and variance.
- Excellent approach - very well thought out.

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **3.40** based on accomplishments.

- Commendable effort.
- Project still in initial stages - difficult to assess.
- 1000 people survey is a good start.
- Bureaucracy appears to slow progress.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **3.20** for technology transfer and collaboration.

- Limited "collaboration" other labs etc. but is nature of project.
- Too early in project to assess.
- In presentation, need to be more explicit with collaborations with other education organizations.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.50** for proposed future work.

- Very much in line to assess "progress" of getting the word out and evaluating public feedback in future.
- Survey will be done.
- Will 2007 survey be funded separately?
- Is there any value in using the internet as a vehicle for surveys?
- Baseline survey is necessary to measure progress of education program.

Strengths and weaknesses

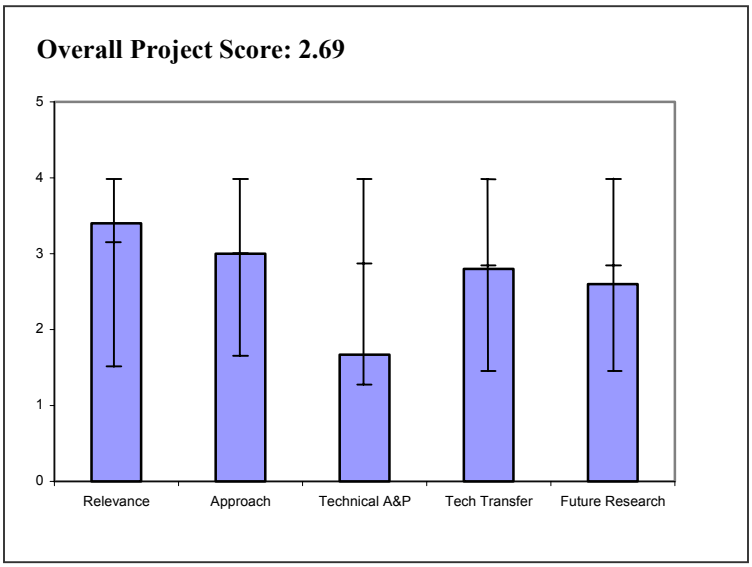
Strengths
- Survey results/analysis will be very interesting.
- Look forward to analysis and project report next year.
- Good concept and organized.
- Good identification of targeted groups.
- Good survey sampling methods.
- Good analysis plans.

Weaknesses
- Assumed 50% success rates for calls seem high.
- Trying to reach too broad a population.
- Should focus on key users, regulators, and community activists.
- Telephone surveys can be negative as many people are on the do not call list.

Specific recommendations and additions or deletions to the work scope

- Evaluate automated survey options for 2007 survey- might be more cost effective.
- A suggestion would be to go to schools, college campuses, earth day, fairs, etc. to do surveys.
- Survey firefighters and local building code officials.
- Survey local community activist organizations at future technology validation test sites.

Project # ED-P1: Demonstration of a PEM Fuel Cell with On-Site Generation of Hydrogen
Turner, Tim; North Carolina State University



Brief Summary of Project

This North Carolina State University (NCSU) project will support hydrogen education and outreach through a baseline demonstration of hydrogen fuel with zero emissions from source to point of use, supplemental and backup electrical power for operational purposes, and establishment of a core facility for hydrogen-related research at the university.

Question 1: Relevance to overall DOE objectives

This project earned a score of **3.40** for its relevance to DOE objectives.

- New project - not much data.
- Some barriers identified.
- Proposed project will enhance public awareness.
- SEP H_2 Education Project.

Question 2: Approach to performing the research and development

This project was rated **3.00** on its approach.

- Needs to think through education process - what level of kids (can't do all K-12, too expensive).
- Barriers clearly understood.
- Project will utilize PV electrolysis to produce H_2. Short term H_2 will produce electricity through FC but long term plans to use as transportation fuel.
- Safety plan not yet addressed.

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **1.67** based on accomplishments.

- New project.
- N/A, project not approved yet.
- Accomplishments and progress have been inhibited by funding process challenges. Too many layers to transfer the funding through. FY03 still not awarded to grant recipient. This is a problem.
- No accomplishments as work has not yet started - will not judge.
- Budget may be insufficient to meet objectives.
- Concept described may be difficult to reach target audience (K-12).

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **2.80** for technology transfer and collaboration.

- Not determined from posters.
- Collaboration proposed is appropriate.
- This is rated as a good plan. Once the project is implemented a real assessment can be done to determine the degree of success.
- Work is done through a university, but does not appear to be coordinated.
- Good fusion at site with multiple alternate fuels.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.60** for proposed future work.

- New project – not identified.
- Future pathway is clear.
- Again the project has not begun due to funding problems but, there is a plan to expand from PV to add wind electrolysis which is promising.
- Planning appears to be minimal at present.

Strengths and weaknesses

Strengths
- A good plan in place.
- Good ideas.

Weaknesses
- Although this is a new project, need to state clearly or think through aspects.
- All funding to project was not identified, although it was stated there was additional money.
- Safety plan needs to be better thought through and not left up to the state to administer.
- Funding process is a critical problem.
- Experience needed.
- Appearance of lack of planning (might be too early in the process).

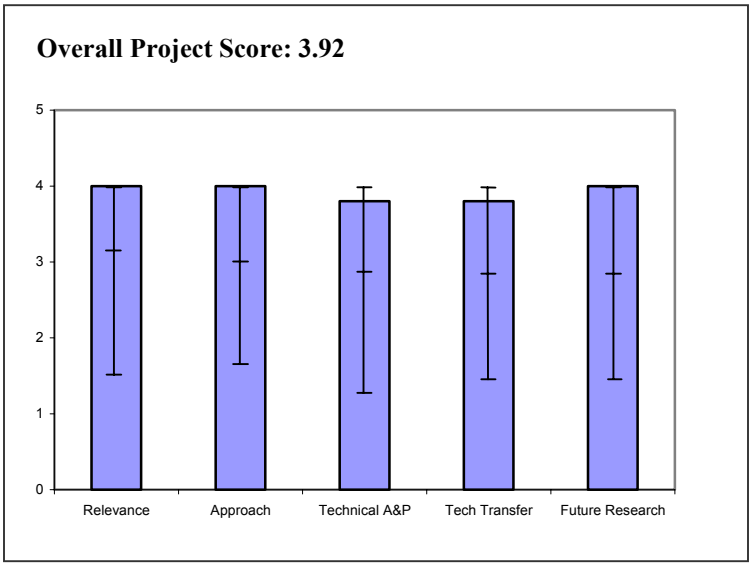
Specific recommendations and additions or deletions to the work scope

- Identify funding issues and correct.
- Use different funding mechanism in the future.

Project # ED-P2: Washington State Fuel Cell Education and Demonstration Program
Vowles, Mira; Central Washington University

Brief Summary of Project

Central Washington University created a tool and process to educate K-12 students about hydrogen and fuel cells. It used a fuel cell curriculum and car kits, held hands-on workshops for 200 teachers, installed a PEM fuel cell at the university, offered additional fuel cell educational resources, and held four press conferences to increase public awareness. It will have educated 18,000 Washington students by 9/30/04 and measured impacts through pre- and post- quizzes.



Question 1: Relevance to overall DOE objectives

This project earned a score of **4.00** for its relevance to DOE objectives.

- Aggressive objectives - hope they achieve.
- Good idea for documentation of how well students learned.
- Very important education project.
- Project appears to be very successful.
- 200 teachers->18,000 students in 1 year.
- Very relevant - education initiative.

Question 2: Approach to performing the research and development

This project was rated **4.00** on its approach.

- Excellent combination of partners and participants…Army, industry, universities, etc.
- Barriers well understood and the means to overcome them clearly addressed.
- Project had great partners and cost share.
- Many of the project barriers had been identified in the planning stages so they were addressed, allowing for a very successful project.

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **3.80** based on accomplishments.

- Accomplished all goals.
- Progress is well underway to achieve goals.
- Successful project in the 1st year and it appears it will continue for another year.
- Already "trained 200 trainers."
- Good practice to network through teachers.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **3.80** for technology transfer and collaboration.

- Very good partnerships.
- Very broad-based interactions with other entities.
- Good documentation process for teachers and students reached.
- Excellent use of negotiation skills to obtain FC kits and teacher access.
- Good practice to provide kits for hands-on experience.

Question 5: Approach to and relevance of proposed future research

This project was rated **4.00** for proposed future work.

- No further funding- project is essentially complete.
- Proposed future work sharply focused and should substantially "get the word out."
- Very good use of funds and partner collaboration.

Strengths and weaknesses

Strengths
- Well thought out project plan.
- Excellent collaboration with sponsors as well as teacher community.
- One of the most comprehensive H_2 training courses from K-12 & above.
- Share good and successful practices with other educational programs.
- Great job.

Weaknesses
- None provided.

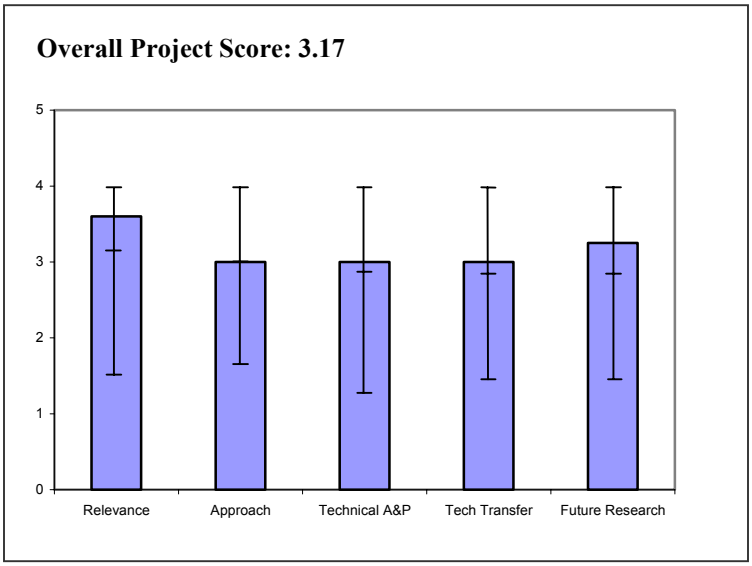
Specific recommendations and additions or deletions to the work scope

- Would be good to put "Lessons Learned" out for others who are considering similar K-12 projects.
- Keep up the good work!

Project # ED-P3: Development and Dissemination of PEM Fuel Cell Educational Modules
Peters, Andrew; University of North Dakota

Brief Summary of Project

The University of North Dakota (UND) education project involves the development and assessment of PEM fuel cell educational units for use in middle schools and junior high schools, implementation of energy-related courses in campus curricula and middle school teacher education, and support to the campus Chapter of the Society for Energy Alternatives and its efforts to develop a PEM fuel cell-powered vehicle for demonstrations, racing, and outreach with schools, the community, and governmental leaders.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.60** for its relevance to DOE objectives.

- New project.
- Good concept.
- Impressive plan "tasks 1-4."
- The project as described is very relevant.

Question 2: Approach to performing the research and development

This project was rated **3.00** on its approach.

- Assessments to monitor progress - good.
- Need to focus more on safety of fuel cell car kit for students.
- Focused on critical areas for accomplishment.
- The teacher access appears to be fairly limited. 20 teachers.
- A secondary information dissemination plan might be helpful, i.e. make curriculum available to other teachers.
- Fuel cell race car is a good concept, but may be an unrealistic goal on a small budget.
- There are many safety systems built into a FC that have been tried out through certification tests.
- Race car implies that a vehicle is to go fast: without a certain amount of safety engineering. I would strongly recommend against such a endeavor unless a FCV manufacturer or FC technology company is involved. The budget and timing do not appear to account for this.
- Teacher training appears successful.
- Obtaining fuel cell has caused delays.

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **3.00** based on accomplishments.

- New project.
- Availability of PEM FC car holding up project.
- There appears to be several issues that have caused delays in the progress of this project.
- Difficulty moving forward due to not being able to obtain fuel cell.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **3.00** for technology transfer and collaboration.

- Did not identify fuel cell company - do not know how this will work.
- Work confined to UND participants.
- Very good cost share with UND.
- Innovative plan to reach across the state using the modified solar car.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.25** for proposed future work.

- New project.
- Future work hidden in text. Needs to be brought forward to track.
- This is difficult to assess as this project is in its early stages.

Strengths and weaknesses

Strengths
- Good cost share for the project.
- Innovative plan to reach public in the state.
- Good plan for education program.

Weaknesses
- Future work hidden in text. Needs to be brought forward to track.
- Building a fuel cell race car plan not defined well enough.

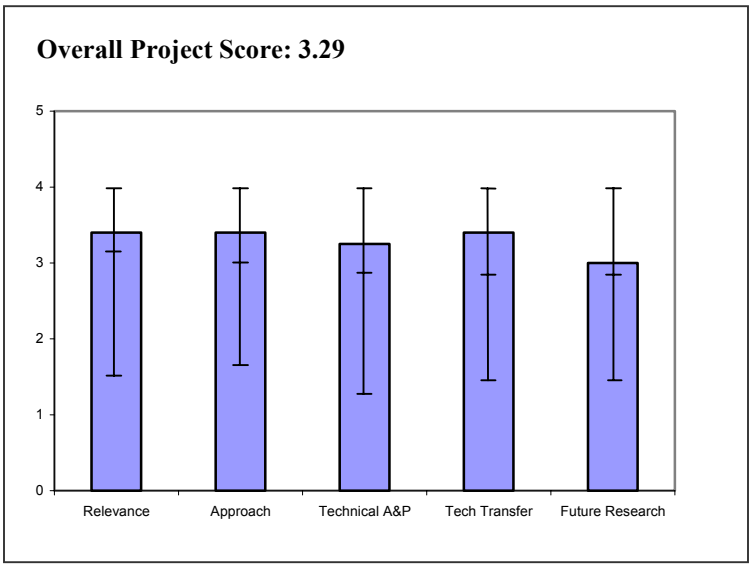
Specific recommendations and additions or deletions to the work scope

- Recommended use of existing information from the DOE H_2 website basics i.e., how a fuel cell works. These can be easily used in this project.
- Develop more detailed safety proposal needed for a fuel cell vehicle race car.

Project # ED-P4: Lansing Community College Alternative Energy Center
Borger, Ruth; Lansing Community College

Brief Summary of Project

Lansing Community College (LCC) will increase awareness and knowledge, and prepare for the deployment of renewable energy technologies, including hydrogen fuel cells, by creating an integrated, educational, technical training program.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.40** for its relevance to DOE objectives.

- New project - excellent speaker.
- Well thought through - takes advantage of other hardware.
- Very interesting project.
- The project activities are in support of alternate fuels which is great. There does not appear to be emphasis on H_2.

Question 2: Approach to performing the research and development

This project was rated **3.40** on its approach.

- Community college angle is a great idea.
- "Barriers" very well identified and solutions are clear and realistic.
- Approach is well thought out.
- Good approach - many different sources of funding. It is not obvious what the DOE is supporting. (about $1M).
- Good target audience - adults.
- Job retraining opportunities a best practice.

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **3.25** based on accomplishments.

- New project.
- Project in early phase but the potential is enormous.
- The project is in early stages and cannot be adequately assessed.
- Project has not yet begun.
- Proximity of Cadillac plants a positive interaction.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **3.40** for technology transfer and collaboration.

- Good mix of partners and funding.
- Very broad interaction is proposed.
- A good plan for alternative energy been developed.
- Again it is too early in the project to do an adequate assessment.
- No detailed plan regarding technology transfer, etc.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.00** for proposed future work.

- Very effective plan proposed.
- The funding has not been received yet so it is difficult to assess future work.

Strengths and weaknesses

Strengths
- Great idea to use community college.
- Very professional.
- The enthusiasm is tremendous.
- Good alternative energy plan.
- Positive ownership of project.

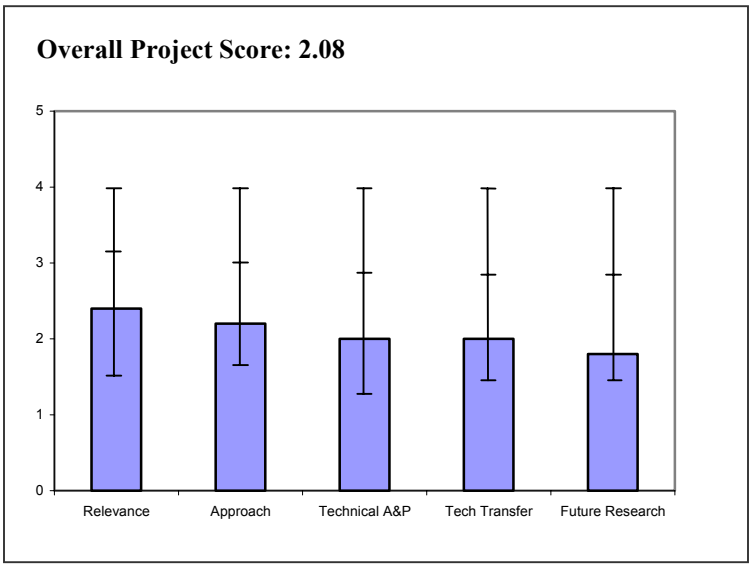
Weaknesses
- May be taking on a lot of varied activities - be careful not to dilute focus.
- Not enough emphasis on H_2 and fuel cells.
- Presentation very vague - more detail required for plan and goals.

Specific recommendations and additions or deletions to the work scope

- Increase focus on H_2 and fuel cell activities.

Project # ED-P5: Shared Technology Transfer Project
Griffin, John; Nicholls State University

Brief Summary of Project



Nicholls State University (NSU) is to establish a collaborative process with domestic industries for the purpose of sharing Navy-developed technology. The purpose is to educate private business sectors to increase the awareness of these businesses to the vast amount of technologies that are available. The key objectives include cataloging NAVSEA-Carderock unclassified technologies, rating the level of readiness for each hydrogen program-related technology, developing and implementing an Educational Outreach program to increase awareness within hydrogen-related industries, identifying and matching hydrogen-related businesses that might benefit from the technologies, and launching an Educational Technology Showcase and website featuring the initial set of technologies that have been identified as being hydrogen related.

Question 1: Relevance to overall DOE objectives

This project earned a score of **2.40** for its relevance to DOE objectives.

- Hard to understand concepts.
- Objective not clear.
- Seems generalistic.
- The relevance to the DOE HFCIT Multi Year Plan could not be determined.
- Directly supports NAVSEA- Carderock. NAVSEA- Carderock was not defined.
- Presenter not available.

Question 2: Approach to performing the research and development

This project was rated **2.20** on its approach.

- Did not get idea of "how."
- "NAVSEA- Carderock" What is it?
- What is intended relationship (specific) to DOE program?
- Approach was interesting but not relevant to DOE HFCIT MYRD&D plan and objectives.

Question 3: Technical accomplishments and progress toward project and DOE goals

This project was rated **2.00** based on accomplishments.

- Start date unknown?
- Very generic charts.

- Not relevant to President's H_2 Fuel Initiative.
- Catalog template looks like a valuable tool.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories

This project was rated **2.00** for technology transfer and collaboration.

- No explanation.
- Very limited as discussed in the text.
- Who is "FHPL?"
- Ref: "Relationship of Programs" How do they contribute?
- Some interesting partners: HARC could possibly provide some opportunity of identifying some relevant projects/technologies.
- No detailed plan regarding technology transfer, etc.

Question 5: Approach to and relevance of proposed future research

This project was rated **1.80** for proposed future work.

- No explanation.
- Future work not identified.
- Not applicable as it is a new project.

Strengths and weaknesses

Strengths
- Good structure of project.

Weaknesses
- Difficult to obtain details without presentation.
- More detail required regarding technology transfer and collaboration.
- Not relevant to President's Hydrogen Fuel Initiative.
- Source of funding not clear.
- Referenced DOE barriers and targets but project does not identify its "own."
- Project timeline is one year?
- What is the advantage of using turbines to produce liquid hydrogen?
- Budget information was incomplete.
- No safety issues identified.
- No one available to explain the poster!

Specific recommendations and additions or deletions to the work scope

- Can't recommend additions/deletions as scope is not defined/unclear.