Technology Validation

Summary of Annual Merit Review of Technology Validation Subprogram

Summary of Reviewer Comments on Technology Validation Subprogram:

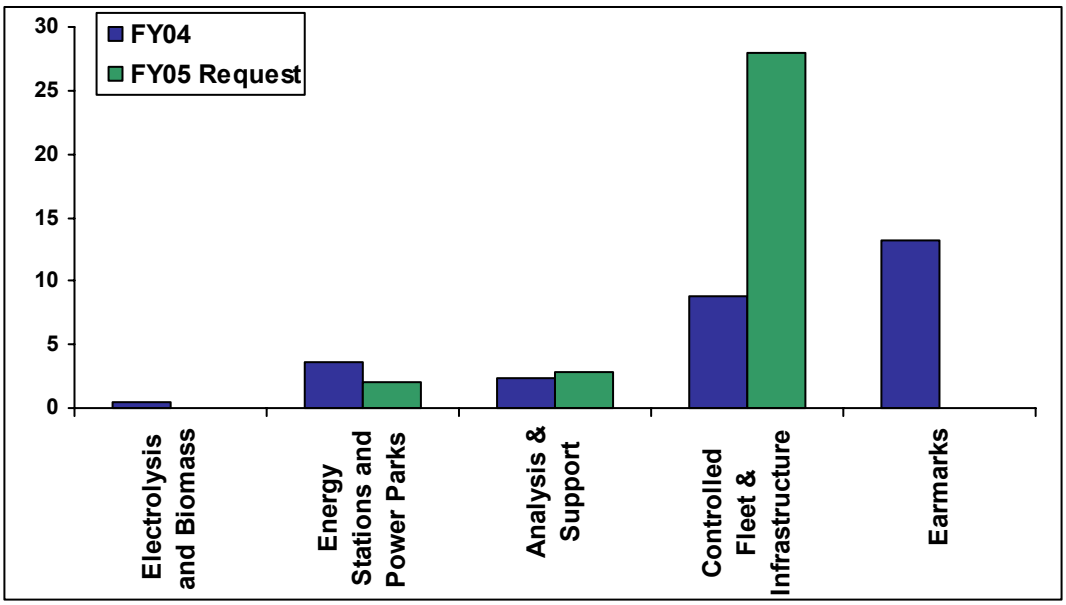
Reviewers identified the technology validation of key hydrogen energy technologies and systems to be an essential component of the Hydrogen Program mission, and critical to the President's Hydrogen Fuel Initiative. The projects were considered to be appropriately diverse and strongly focused on addressing key issues necessary to validate the technologies and/or technology durability. Reviewers noted that the projects that collected data and information and considered its applicability to future work were very valuable. The Reviewers also noted that the project Principle Investigators (PIs) should remember to consider the objectives of the HFCIT Multi-year RD&D Plan. Some of the projects initiated prior to the development of the Plan are focused on single issues; where recently initiated projects consider a broader picture.

The major criticism by the Reviewers was that the funding directed to the Congressionally-directed projects had a negative impact on the Program. As a result, the Program was unable to fund the Hydrogen Fleet Demonstration awards that were announced in 2004. The Reviewers also expressed concern that PIs did not present funding information on their projects. Reviewers found it difficult to assess the PIs' accomplishments because there was no indication of level of funding spent, and at what point in the year funding may have been received. Reviewers felt that it would be important to have specific information on the project funding level and the time-phase of funding presented by the PI or DOE management.

Reviewers thought highly of the Technology Validation Subprogram's approach of conducting ***learning demonstrations*** that emphasize co-developing hydrogen infrastructure in parallel with hydrogen fuel cell-powered vehicles that would allow a 2015 commercialization decision. Reviewers did express some concern regarding the interactions and communications between the Technology Validation and R&D activities, stating that they "are not clearly defined." Technology validation of hydrogen energy systems that crosscut into all technology R&D subprograms is an important facet of the Hydrogen Program. As such, there is a need for strong coordination between these subprogram elements and a clear feedback loop to ensure that lessons learned are translated to next generation technology designs in the shortest possible timeframe. Reviewers also expressed need for a strong linkage between the Technology Validation and the Safety, Codes, and Standards Subprograms to ensure that safety and liability issues are sufficiently linked and adequately addressed.

Technology Validation Funding by Technology:

The funding portfolio for Technology Validation addresses the need to validate integrated hydrogen and fuel cell technologies for transportation, infrastructure, and electric generation in a systems context under real-world operating conditions. The 2005 funding profile (subject to Congressional appropriation) addresses key aspects of the Hydrogen Program mission and the cross-cutting issues associated with the National Academies' Report and system integration activities.



Majority of Reviewer Comments and Recommendations:

In general, the Reviewer scores for the Technology Validation Subprogram were on average with those of the other subprograms (the maximum, minimum, and average scores for Technology Validation projects were 3.53, 2.20, and 2.92, respectively). These compare to the overall maximum, minimum and average project scores of 3.92, 1.55, and 2.91, respectively. The Technology Validation project portfolio includes a mix of well-established long running projects and new projects with little to no progress or technical accomplishments yet to report. The major recommendations for the Technology Validation Subprogram are summarized below. DOE will act on reviewer recommendations as appropriate for the overall Hydrogen Technology Validation effort.

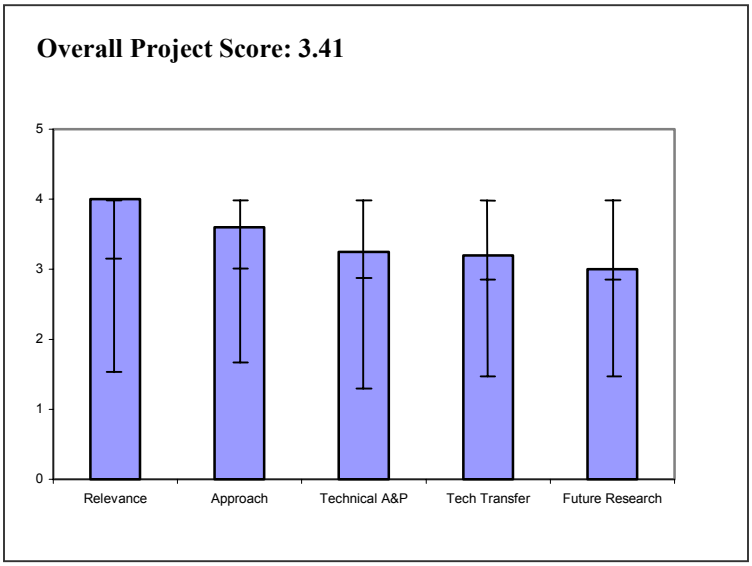
- **Power Parks Analysis** -- Focus on making available data public and expanding the analysis effort.
- **Hydrogen and Fuel Cell Demonstration/Analysis** -- Focus on reliability assessments.
- **System Analysis** – Reconsider evaluation of these projects in the Technology Validation Subprogram. Focus on increasing database of performance and reliability information.
- **Refueling Technology Development and Demonstration** -- Focus activities to ensure that lessons learned become public information. Introduce more state, local and corporate partners.
- **Vehicle Demonstrations** -- Focus on fleet assessments.

The reviewers also recommended specific projects (3) be considered for phase-out from the Technology Validation project portfolio. A general recommendation was to develop "lessons-learned" documents as technology assessment projects near completion.

Project # TV-1: Technology Validation Subprogram Overview
Gronich, Sig; DOE, Team Lead

Brief Summary of Presentation

The purpose of this Technology Validation Subprogram Overview is to describe goals/objectives, budgets, barriers/targets, approach to R&D, technical accomplishments, interactions and collaborations, solicitations and awards, and future directions. As such, it sets the stage and puts into context the R&D and analysis projects which 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 **4.00** for its relevance to DOE objectives.

- Good synergistic effect; ties up components into systems.
- Looks at H_2/electric economy with autos, utilities, and energy companies.
- Tied clearly to DOE H_2 plan.
- Validation of key technologies is clearly critical to President's Hydrogen Fuel Initiative.
- Diversity of projects provides good opportunity for comparison of technologies.
- Highly correlated to overall DOE objectives.
- Subprogram was well covered as it exists currently. Could have used a little more info on time line activities beyond the 3 fleet regions (plus NY and Washington) that are being rolled out.

Question 2: Approach to performing the research and development

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

- Good approach.
- Ties in a number of users (utility, auto companies, energy companies).
- Well planned.
- Feedback from validation activities to technology R&D to identify needs could be clearer.
- Some concern on apparent redundancy in infrastructure costs for fleet vehicle demo.
- Approach is comprehensive.
- Not convinced CNG/ H_2 mixture projects should receive much attention.
- Approach is good, and doing well with trying to incorporate with and deal with problems by earmarks.

Question 3: Technical accomplishments and progress toward project and DOE goals
This presentation was rated **3.25** based on accomplishments.

- Mine project does not fit well - hard to see commercial application widespread.
- Could use a broader approach to look at other techniques.

- Still early.
- Clear criteria of success.
- Difficult barriers - there has been good progress.
- Early stage of this program seems to be moving along as expected.

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

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

- Did not see this addressed specifically on slide - did not see communication plan.
- Right track.
- Good orientation to inclusiveness.
- More high level coordination of communication between programs may enhance use of lessons learned.
- Seems to be very broad participation among industry and universities - but not other federal agencies.

Question 5: Approach to and relevance of proposed future research

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

- Not sure of relevance of locomotive work/mine programs to consumer market.
- Task 4 - not sure of relevance of hythane vs. hydrogen fuel.
- Not yet planning for future challenges.
- Is plan realistic given realities of funding?

Strengths and weaknesses

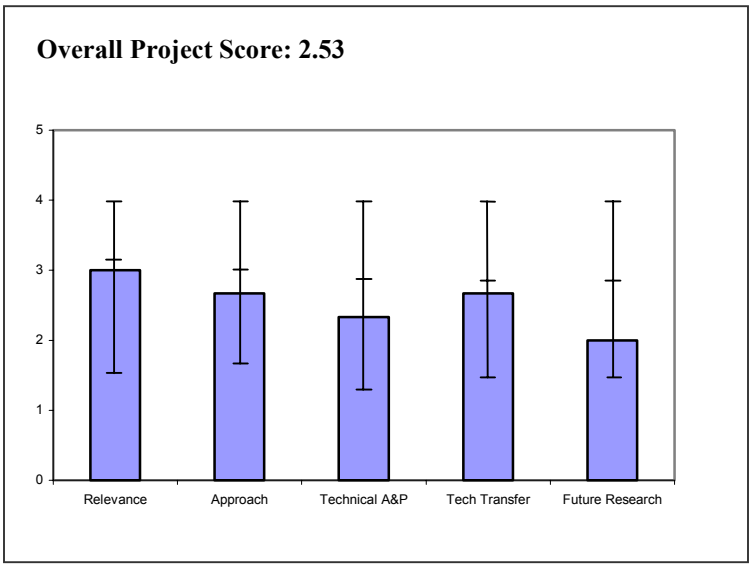
Strengths
- Program has relevance to demonstrate more "systems" concepts and less "component" approach.
- Pragmatic.
- Organized.
- Diversity of projects provides evaluations/comparisons of many different technologies.
- Good mix of organizations.
- Broad-based measured approach.
- Focused on doable near term technologies.
- Good corporate participation.

Weaknesses
- Could use more details on safety.
- Not enough supporting detail about exactly what safety issues DOE will look at.
- Task 5 only biomass pyrolysis - no other renewables?
- Would like to see timelines to see how all these projects "fit" together.
- Liability still not addressed clearly in fueling station projects.
- Availability of funding to complete projects?
- Too many fueling stations?
- Large validation projects such as fueling stations/power parks require several years for lessons learned to contribute to next generation designs.
- Planning of projects should consider this especially in light of limited funding.
- Would like to see more collaboration with other federal agencies; DOT and DOD.

Specific recommendations and additions or deletions to the work scope

- Would like to see how DOE will communicate results - "success stories" to public.
- The clear target of addressing the insurability and public access (liability management) should be added to all technology validation projects.
- Look at off-road vehicle applications such as industrial trucks, ground service equipment.
- The talk had much more info than what is in the slides, e.g. critical role of data management in Task 6. Perhaps some of these important details could be put into the slides.

Project # TV-2: Power Parks System Simulation
Lutz, Andy; Sandia National Laboratories



Brief Summary of Project

Power parks combine power generation co-located with a business, an industrial energy user, or a domestic village. In this project Sandia National Laboratories (SNL) will develop a flexible power park system model to simulate distributed power generation in energy systems that use H_2 as an energy carrier. This project will also analyze the performance of demonstration systems to examine the thermal efficiency and cost of both H_2 and power production. Deliverables include a flexible, computational tool to provide simulations of a variety of energy systems that produce H_2 and independent analysis of system performance, thermodynamic efficiency and cost of H_2/electricity.

Question 1: Relevance to overall DOE objectives

This project earned a score of **3.00** for its relevance to DOE objectives.

- Relevant to MYPP. Ties together H_2, electricity production, power parks, economics.
- Analysis such as this is critical to ensure best use of technology validation results.

Question 2: Approach to performing the research and development

This project was rated **2.67** on its approach.

- Good description about simulink s/w.
- Use of simulink provides opportunity for outside use/collaborations is valuable.

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

This project was rated **2.33** based on accomplishments.

- Looks promising.
- Good data analysis.
- No mention of safety.
- Parametric "what if" analysis provides valuable insights.
- Results should be valuable to DOE in setting goals/research priorities.

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

This project was rated **2.67** for technology transfer and collaboration.

- Good cross section of industry and universities.
- No discussion of how results would be communicated.
- Not a clear communications or feedback to H_2 community.
- Good collaboration with Power Parks partners.
- Would like to see expanded effort to add data base /systems analysis - more money?

Question 5: Approach to and relevance of proposed future research

This project was rated **2.00** for proposed future work.

- No cost associated with future work.
- SOFC utilized/considered?
- Lessons learned were not mentioned as precursor to future work.
- Refinement of model prepared.
- Would encourage expansion of communication effort.

Strengths and weaknesses

Strengths
- Leveraged internal SNL funding.
- Excellent protocols.
- Well qualified PI.

Weaknesses
- No discussion/mention of safety.
- Questionable utility.
- Unclear on potential impact of simulation.
- Limited by resources.
- Would be even more valuable if expanded and better communication included.

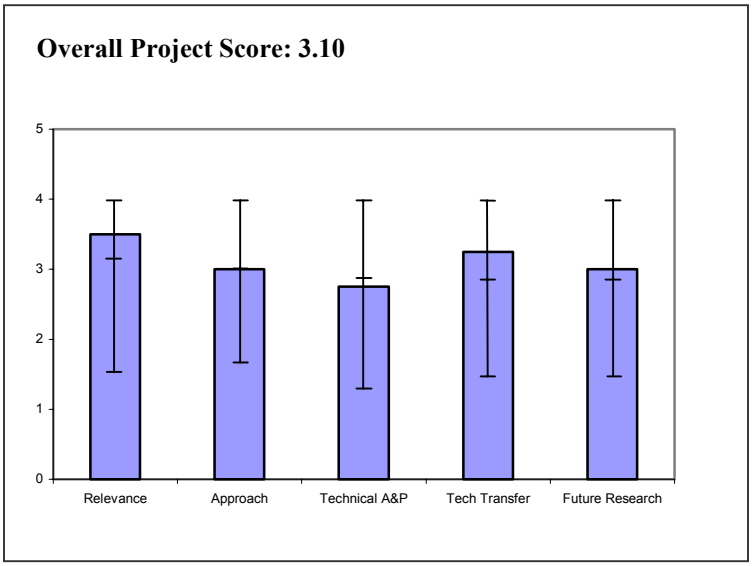
Specific recommendations and additions or deletions to the work scope

- Should be closed.
- Expansion of activities beyond Power Parks would increase data base and yield valuable analysis for DOE.

Project # TV-3: Hawaii Hydrogen Power Park
Kaya, Maurice; State of Hawaii

Brief Summary of Project

In this project, the State of Hawaii along with the University of Hawaii worked on demonstrating an integrated Hydrogen Power Park comprised of an electrolyzer powered by renewable sources, a hydrogen storage and distribution system, a PEM fuel cell and a hydrogen dispensing system for vehicles. Technical barriers as well as the economics for this project were analyzed along with gathering general public interest and support.



Question 1: Relevance to overall DOE objectives

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

- Validation of technologies developed under other DOE projects need a place to work to demonstrate their merits and receive feedback from others.
- The HI H_2 power park provides that place.
- It's versatile, has knowledgeable people and participation of diverse community partners.
- Broad-based and seems to be highly correlated to DOE objectives.

Question 2: Approach to performing the research and development

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

- Project is conducted well but individual project goals and relevancy are weak in vision.
- Open architecture philosophy.
- Excellent example of leveraging funds from state, industry and DOD sources.
- Appears to have brought local officials into safety and training exercises - excellent.
- May need to narrow technical approach.

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

This project was rated **2.75** based on accomplishments.

- Solid progress shown; meeting schedule.
- Permits and site development progressing or complete.
- Having to change from 75kWe to 5kWe PEM cells may compromise local support for viability of PEM if adequate and appropriate electrical loads are not developed.
- Appears accountable.
- Limited success to date, but reasonable for this stage of project.
- PEM fuel cell system far behind schedule; power park site design too slow.

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

This project was rated **3.25** for technology transfer and collaboration.

- Excellent use of local partners; electric and gas utilities, local government, and OEMS.
- Good outreach and education attempts.
- Good mix of industry and government collaboration.
- Need to include PEM fuel cell manufacture in project team.

Question 5: Approach to and relevance of proposed future research

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

- Future work possibilities and relationship to existing work have been thought through and planned.
- Flexibility demonstrated by changes incorporated when 75kW PEM was too expensive.
- Deliverables are not entirely clear.

Strengths and weaknesses

Strengths
- Technical knowledge and established relationships with diverse partnership base.
- Inclusive of community.
- Understanding of importance of international collaboration.
- Economically realistic.
- Good partner mix.
- Broad base technologies and approach.
- Leveraging approach to utilize U. of Hawaii personnel and facilities.

Weaknesses
- May need more focus in initial stages - or example just renewables for H_2 production instead of using reformers with multiple fuels.
- Fuel cell selection and delayed installation.
- No quantitative goals.

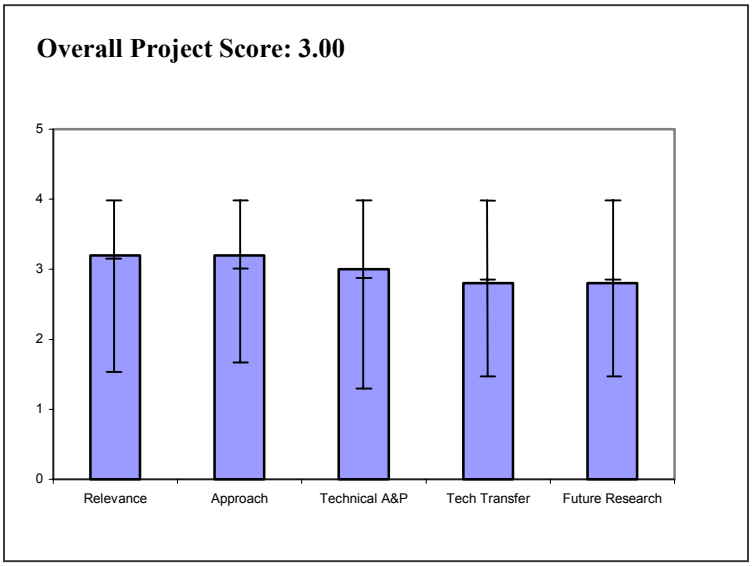
Specific recommendations and additions or deletions to the work scope

- Need to develop a staged approach with more narrow focus in early stages.
- Add fuel cell manufacturer to project team.
- Develop plans to install either multiple fuel cell modules or larger unit.
- Develop quantitative project goals and go/no go decision criteria.

Project # TV-4: DTE Energy Hydrogen Technology Park
Regan, Rob; DTE Energy

Brief Summary of Project

In this project, DTE Energy will develop and test a working prototype of a hydrogen-based energy station concept that utilizes solar & biomass power combined with electrolysis and stationary PEM fuel cell technology to take advantage of low-cost power during off-peak hours to generate hydrogen for on-peak power generation and vehicle fueling. Using state-of-the-art hydrogen generation, storage, regeneration and control technologies, the project will evaluate opportunities to reduce overall system cost and maximize performance.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.20** for its relevance to DOE objectives.

- Park is designed to support vehicle infrastructure demonstration as partner to Daimler-Chrysler.
- Seems to have a high correlation to DOE objectives.
- Key project in key location.

Question 2: Approach to performing the research and development

This project was rated **3.20** on its approach.

- Detailed system design.
- Visitor center included - very positive.
- Most of H_2 production is from electrolysis using grid electricity.
- PV fraction is relatively small.
- Like the attempt to incorporate other emerging H_2 activities.
- CaFCP fueling protocols.
- Safety approach seems comprehensive.
- Would like to see a heat integration aspect to the configuration.
- Good use of multiple H_2 feedstocks, including renewables.
- Good to have electricity production and vehicle refueling at same site.
- Excellent understanding of electric utility needs and viable approaches.

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

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

- Project in planning/permitting stage, on schedule.
- Have included existing PV collectors in system to be built.

- Emphasis on control system may be the most important aspect of this project.
- Progress with plans approved look good.
- Great to see you've procured all of the equipment needed.

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

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

- Have established collaboration with local university for data analysis.
- Very little discussion on vehicle operations applications.
- Education and outreach effort seems passive.
- Data collection plans look good with web interface for public.
- Good connections with DCX, LTU, BP, and BOC.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.80** for proposed future work.

- Concerned about pace.
- Additional of Stirling engine will be an interesting aspect of the existing design.
- Vehicle operations, H_2 purity needs, system testing and reporting not discussed in great detail.
- Good timeline.

Strengths and weaknesses

Strengths
- Good SCADA approach.
- Good safety plan.
- Good leverage of resources.
- Good life of project - 2008.
- System design is thorough and control system will provide remote access.
- Controls emphasis.
- Codes and standards.
- Safety process.
- Plans look well laid out.
- Integration with other DTE facilities (operations center) and plans to test use of fuel cell electricity for DTE grid.
- Project is valid and worthwhile.

Weaknesses
- Renewable component of the system is relatively small but leverages on existing PV arrays.
- Partners seem too limited for such a broad based project.
- Deliverables are not clear.
- Many small FC vs. a few larger FC: not representative of likely longer-term installations.
- Lack of quantitative goals.

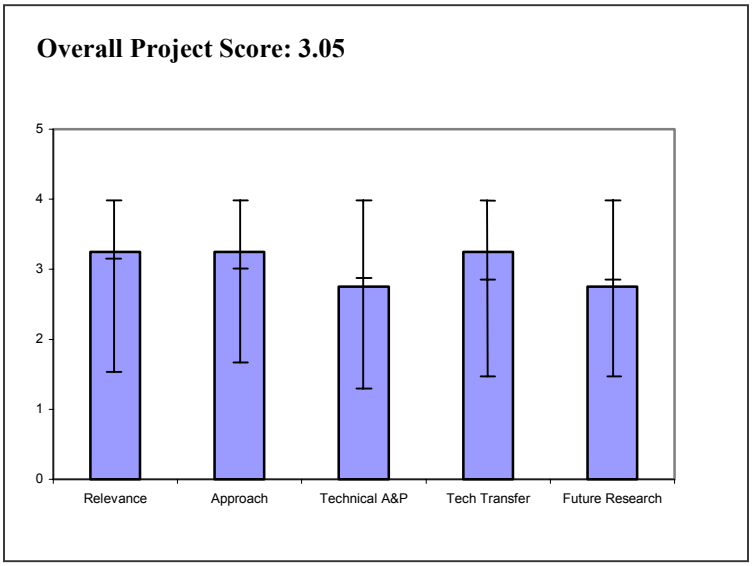
Specific recommendations and additions or deletions to the work scope

- Include discussion of data reporting to decide ahead of time what data will be released to public.
- More structured collaboration and tech transfer plan could be considered.
- Visitor center would be a good future addition, as suggested.
- Would like to see as much of the data as possible be made public (subject to agreement by your hard ware suppliers).
- Develop quantitative project goals and contingency plans if their goals are not met on schedule.

Project # TV-5: Hydrogen from Biomass for Urban Transportation
Yeboah, Yaw; Clark Atlanta University

Brief Summary of Project

Clark Atlanta University and its collaborators, focusing on producing hydrogen from biomass, produced 25 kg/day of hydrogen from peanut shells for urban transportation. This process involved pyrolysis of the biomass followed by catalytic steam reforming of the gas and bio-oil products to produce hydrogen. Successful operation of 100 hours demonstrated technical feasibility of the process, discovered agricultural uses of the carbon product, and identified economical co-product options for the bio-oils.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.25** for its relevance to DOE objectives.

- Demonstration uses entirely renewable feedstock.
- Biomass as proposed addresses critical transition/long-term need for renewable H_2.

Question 2: Approach to performing the research and development

This project was rated **3.25** on its approach.

- Peanut shells as biomass feedstock is very practical and realistic.
- Approach includes fundamental experiments on the gasification and refining processes.
- Includes economic analysis.
- Good leveraging in co-product and rural economy needs.
- Systematic engineering approach.
- Excellent use of a local waste stream with hydrogen production potential

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

This project was rated **2.75** based on accomplishments.

- Pilot unit operation (100) hrs is completed (in previous year) with successful H_2 production.
- Longer term operation is to be done at new site.
- Significant technical progress but approach to resolve them not clearly identified.

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

This project was rated **3.25** for technology transfer and collaboration.

- Good partnerships.
- Collaboration with university and industry, laboratory partners.
- Established partnership addresses key elements needed for success.
- Qualified partners.
- Good use of local and DOE resources.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.75** for proposed future work.

- Don't build a complex model.
- Will be able to process other biomass materials (beyond peanut shells).
- Scale-up will be interesting.
- At risk, should be funded.
- Not clear what new info will result from scale-up.

Strengths and weaknesses

Strengths
- Value - modest funding yields good progress.
- Intent to map project into local economic development.
- Highly focused on biomass for CO neutral H_2 production.
- Well coordinated, clearly planned program.
- Very qualified PI and partners.
- Understanding of local resources and needs.
- Specialized experience in peanut shell pyrolysis.
- Detailed cost and efficiency goals.

Weaknesses
- Economic and community development.
- Economics depends on co-producing fertilizer which uses 30% of the H_2 produced.
- Funding-biomass may be the only near-term renewable H_2 option.
- Good program should be adequately funded.
- Limited systems safety and experience.
- Limited experience with hydrogen fueled vehicle.

Specific recommendations and additions or deletions to the work scope

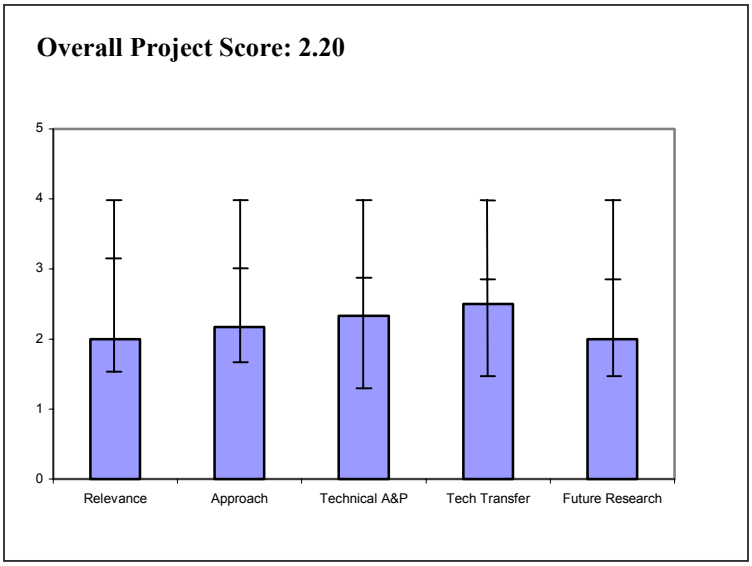
- Do not make an analysis project - the strength is in empirical nature.
- External design review to insure all issues have been addressed before moving to scale-up.
- Develop contingency plans if 1000 hours of operation introduces new reliability or safety issues.
- Do detailed reliability assessment based on 1000 hour operating experience.

Project # TV-6: Alkaline Fuel Cell-Battery Hybrid Systems with Ammonia or Methanol as H_2-Supply

Robert, R.; Apollo Energy Systems Inc.

Brief Summary of Project

Apollo Energy Systems Inc. is working to design an Alkaline Fuel Cell (AFC) system with circulating electrolyte for vehicles in intermittent duty service and small units for uninterruptible hybrid power supplies; develop a low cost ammonia cracker; optimize system performance and life; and reduce cost for accessories. The project is focusing on Pt-catalyst reduction and use of silver catalyst.



Question 1: Relevance to overall DOE objectives

This project earned a score of **2.00** for its relevance to DOE objectives.

- Appears to be a good concept - ammonia as feedstock.
- But while meeting stated program goals, it's hard to imagine place of these specific products in program vision.
- Storing H_2 as ammonia is not relevant to the DOE objectives.
- Project does not describe economic relation to DOE targets.
- Lack of focus in the presentation made it difficult to assess relevance or accomplishments.
- NH_3 fuel for AFC technology appears to be a niche application technology.
- It's not clear how this project directly supports the President's Hydrogen Initiative.

Question 2: Approach to performing the research and development

This project was rated **2.17** on its approach.

- Identification of barriers.
- Integrates deep and continuing electrochemistry knowledge into applications.
- Ammonia cracker is a distraction from fuel cell development.
- Circulating KOH is a concept of questionable value.
- Unfocused.
- I couldn't determine what their key objective/approach was.
- Very little discussion on project technical process or safety procedures.
- AFC and ammonia advantages were described well.
- Disadvantages were not discussed.
- The overall approach was not clearly laid out.

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

This project was rated **2.33** based on accomplishments.

- Hard to follow from presentation.
- Real progress among direct demo seems elusive.
- Improved capacity of electrodes.
- Accomplishments in line in funding but can't tell what else may have contributed to the program.
- Technical accomplishments were not clear.
- Looks like the project has accomplished most of what it set out to do. But, what was really learned?

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

This project was rated **2.50** for technology transfer and collaboration.

- Did not get this from presentation.
- NH_3 "cracker" may be good reference work for small H_2 generations in future.
- Collaboration with U. of Graz.
- Some industry, university collaboration.
- Program would benefit from broader partnership/collaboration.
- Commercial applications or partners not mentioned.
- Interactions appear to be limited to the Technical University of Graz.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.00** for proposed future work.

- While demos are potentially continuing, upside progress is not really produced.
- Pathway for future development not clear.
- Future steps not clear.
- It's not clear what steps will be taken next after the end of this project later this year.

Strengths and weaknesses

Strengths

- In depth knowledge of AFC's and battery chemistry.
- AFC technology has clear advantages over PEM or SOFC for some applications and some funding should probably continue to be directed towards it.

Weaknesses

- Talked about "problems" with handling and storage of hydrogen - should not describe in this way - these "problems" are being worked on by others and are not problems within the hydrogen community.
- Using alkaline does not give this company the ability to not look at handling of hydrogen.
- I don't see this work being picked up by others for continued development.
- This project seems to be only weakly related to the DOE program plan.
- Needs to be better focused.
- Relevance/fit to DOE objectives not clear.
- AFC is currently outside mainstream work in H_2 and fuel cell technology development.

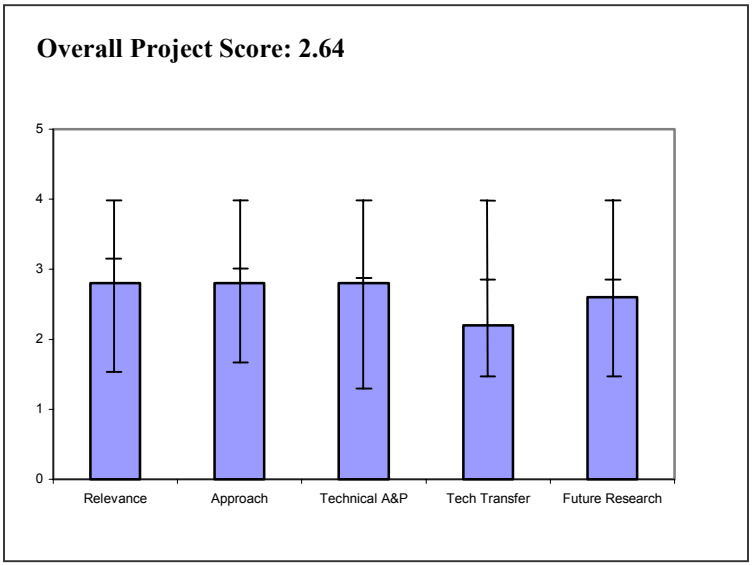
Specific recommendations and additions or deletions to the work scope

- Ran out of time - should use better time management - description of project.
- Need a clear definition of path to commercialization.
- Otherwise project looks like pure research and not suited to technology validation.

Project # TV-7: UNIGEN® Regenerative Fuel Cell for Uninterruptible Power Supply
Porter, Stephen; Proton Energy Systems

Brief Summary of Project

In this project, a team of Distributed Energy System and Proton Energy Systems will demonstrate a hydrogen fuel cell-based uninterruptible power supply with economic viability, real-world applicability, and regulatory code compliance. Performance goals include power output of 3+kW, storage capacity of 50 hours, instantaneous operation upon grid failure, and maintenance of digital equipment.



Question 1: Relevance to overall DOE objectives

This project earned a score of **2.80** for its relevance to DOE objectives.

- 3kW range.
- Goals: technology validation, education, codes & standards.
- Backup system may well provide a niche market for profitable development through the commercialization "Valley of Death."
- Application of the system seems more like a niche application than for widespread use.
- Not aimed at DOE cost targets.
- Makes significant contribution to tech validation objectives.
- Good demonstration of use of fuel cells.
- While this is an example of an application for fuel cells, it is not clear how this advances the technology.

Question 2: Approach to performing the research and development

This project was rated **2.80** on its approach.

- Appears to be well thought through including safety aspects.
- Well thought out and exciting so far.
- Not clear if interconnection hardware, software, and controls are suitable to the task. (Not really a H_2 question but critical to mission).
- Design of system is good.
- Project benefit to DOE would be enhanced if approach included data release and analysis.
- Clear objectives and well-defined pathway to get there.
- Project focus seems to be on control systems and component integration - not clear.
- Little discussion of safety or project decision making.

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

This project was rated **2.80** based on accomplishments.

- On track for Sept. 2004 end date.
- Good application at Mohegan Energy.
- Good back-up applications.
- I like development of high pressure generation of H_2, but role of this component in system is not clear.
- The need to supply steel (ASME?) storage vessels is potentially a significant feedback from society.
- A "sounding" of public fear of "plastic" tankage may lead to a better hydrogen and fuel cell program.
- Completed assembly and installation of FC system on site.
- The presentation did not present any performance data.
- Meeting objectives in a timely manner.

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

This project was rated **2.20** for technology transfer and collaboration.

- State and Mohegan - what about DOE?
- What are plans for communicating outcomes?
- Work with community partners is good.
- Project solves a problem that Casino has with existing PC-25's, that's good.
- Interact with local government agencies.
- Education to visitors.
- No data release or analysis by outside academic partners.
- Sufficient to meet all objectives.
- Limited partners.
- Not clear on training and outreach benefits.

Question 5: Approach to and relevance of proposed future research

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

- What are plans for operation?
- Project nearing completion.
- Calls for completion of all milestones on schedule.
- Project is near completion.
- Monitoring and testing?

Strengths and weaknesses

Strengths

- Good ID of safety aspects - release of H_2.
- Putting tanks on roofs may be a general solution to many siting problems.
- System is apparently complete and ready for demo phase.
- High cost share ratio.
- Clear plan.
- Example of application and controls design.

Weaknesses

- Slides seemed out of order- accomplishments on several different slides throughout presentation.
- No apparent weaknesses.
- Needs more potential for training and outreach.
- Limited scope.
- No apparent heat application.

Specific recommendations and additions or deletions to the work scope

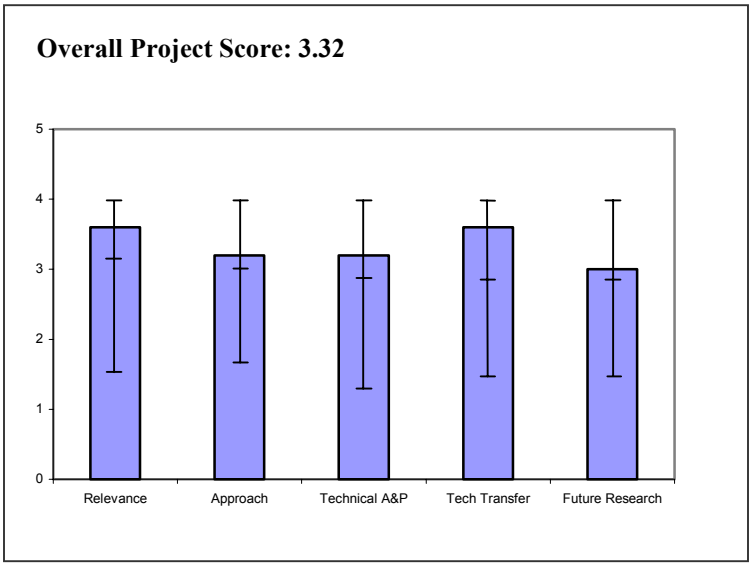
- Has the demonstration been collecting performance data?
- Complete project as proposed.

Project # TV-8: Controlled H_2 Fleet & Infrastructure Analysis

Wipke, Keith; National Renewable Energy Laboratory

Brief Summary of Project

Under this multi-year validation project the National Renewable Energy Laboratory (NREL) will assist DOE in demonstrating use of fuel cell vehicles and H_2 infrastructure under real-world conditions, using multiple sites, varying climates, and a variety of sources for hydrogen, including renewables. The primary activity over the last year was to support the DOE solicitation process and prepare for post-award work, while future activities will include analyzing data from vehicles and infrastructure to obtain maximum value for DOE and industry from this "learning demonstration. "



Question 1: Relevance to overall DOE objectives

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

- Fits with the DOE Multiyear RD&D Plan.
- Good speaker.
- Good slide to define tech validation.
- New project.
- Involvement of strong programmatic and technical expertise from a National Lab is imperative for public acceptance of the overall Hydrogen Program.
- NREL is providing a confidence building role.
- Target calibration.
- Appropriate plan/analysis is critical if multimillion dollar investment in fleet vehicle program is to benefit community at large. This project is attempting to do that.

Question 2: Approach to performing the research and development

This project was rated **3.20** on its approach.

- Good ID of technical barriers and targets.
- Good upfront thinking/planning.
- Emphasis on safety.
- Launch of program and completion of solicitation activities through the award phase looks good.
- Time now to begin assessment of data and progress of successful projects.
- Composite data on "non-secure" side of firewall may reduce effectiveness/value of data.
- Factors identified for analysis seem well thought out.

Question 3: Technical accomplishments and progress toward project and DOE goals
This project was rated **3.20** based on accomplishments.

- Good description.
- Have met schedule so far.
- This is excellent, but a little early to predict success on FC fleets.
- NREL supports the DOE conduct of program.
- Major objective - tech support for RFP process completed.
- Met schedule/deliverable.

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

This project was rated **3.60** for technology transfer and collaboration.

- Good use of coordination with systems integration group.
- Great slide on collaborations and interactions.
- A clear need to have public entity at nexus of program technical evaluation; NREL appears to be doing well at this job.
- Tech transfer process is well thought out but more detail on how data is handled would be interesting.

Question 5: Approach to and relevance of proposed future research

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

- Good slide.
- Detail is not readily available.
- Good feedback mechanisms.
- Procedures/process to insure feedback to technology/component development is very important.

Strengths and weaknesses

Strengths
- Good speaker.
- Brings trusted public technical oversight to overall program that to some would otherwise appear to be government subsidy of private development.
- Better at this than say NETL or LBNL or ORNL which might appear to general public as not as trustworthy for development of a "scary" new technology.
- Well planned.
- Technology gap identification important.
- Well thought out, well articulated plan.
- Qualified PI.
- Excellent, well designed program management process.

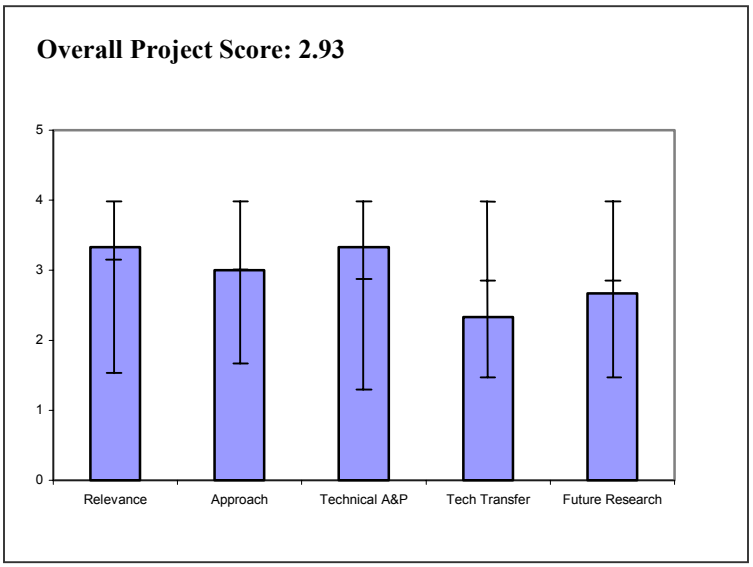
Weaknesses
- Slides should have been updated to show firewalls.
- Editorial and interpretive techniques used behind firewalls unclear and seemingly subjective.
- Will reporting of composite data only dilute value to rest of community of the largest of all the H_2/FC projects?

Specific recommendations and additions or deletions to the work scope

- Focus on analysis from fleet.
- Is GIS assessment critical at this time given funding constraints?
- What are contingencies for incomplete data, unresponsive program participants, equipment failures, etc?

Project # TV-9: Development of a Turnkey H_2 Refueling Station

Guro, David; Air Products and Chemicals, Inc.



Brief Summary of Project

Air Products and Chemicals, Inc. is working on a project to demonstrate the economic and technical viability of a stand-alone, fully integrated H_2 fueling Station based on the reforming of natural gas. Building on the learnings from the Las Vegas H_2 Fueling Energy Station program, the project seeks to optimize the system, advance the technology, and lower the cost of H_2. The demonstration will be done through the operation of a fueling station at Penn State University with the purpose of obtaining adequate operational data to provide the basis for future commercial fueling stations. The top priority of the fueling station is the maintaining of its safety standards in its design and operation.

Question 1: Relevance to overall DOE objectives

This project earned a score of **3.33** for its relevance to DOE objectives.

- Build on learnings of Las Vegas system.
- High correlation with DOE objectives.

Question 2: Approach to performing the research and development

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

- Good approach.
- Well thought through.
- Project seems very proprietary to Air Products.
- Would be nice to see more heat integration in system design.

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

This project was rated **3.33** based on accomplishments.

- Looks like good progress from last year.
- Hardware chosen and developed.
- Good development based on lessons learned from previous projects.
- Improved pressure.
- Improved instrumentation.
- Good discussion of purification technology component and dispenser.
- Early in project so results are understandably limited.

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

This project was rated **2.33** for technology transfer and collaboration.

- Tech transfer plan is not clear.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.67** for proposed future work.

- Looks like on track.
- The next phase plan seems conservative and funding driven to the detriment of achieving functionality.
- Vehicle operations should be discussed – "not part of the work scope" is not an adequate response.

Strengths and weaknesses

Strengths
- Good safety slide.
- Good safety plan and codes & standards input.
- Good focus on component technology, i.e., dispenser and purification.
- Systems in integration well designed.

Weaknesses
- Slide "Approach for O_2" - colors hard to see.
- Unclear on how the hydrogen community gets any input or help from this project.
- Work tech transfer and collaboration plan.

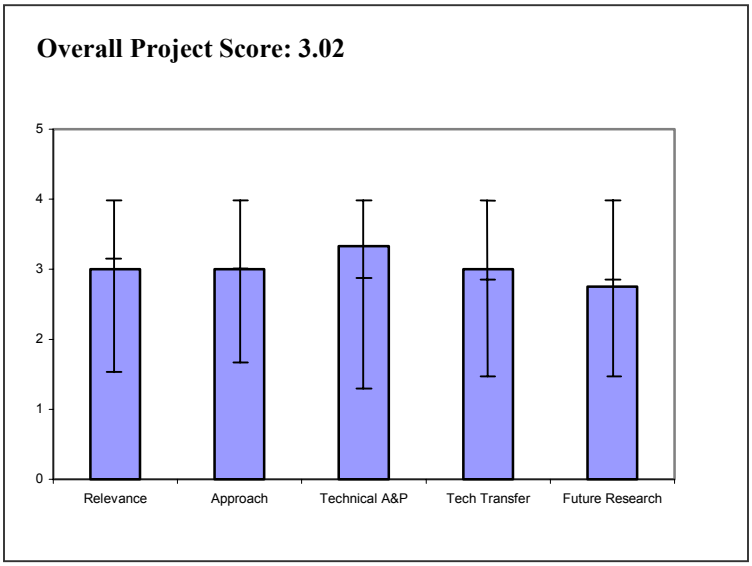
Specific recommendations and additions or deletions to the work scope

- A mechanism should be incorporated in this and other fueling stations to report the "self-insured" aspect to a real operator.
- Is there a way to introduce more state, local or corporate partners?

Project # TV-10: Development of a Natural Gas-to-Hydrogen Fueling System
Liss, Bill; GTI

Brief Summary of Project

GTI is designing a competitive, fast-fill natural gas-to-hydrogen fueling system with 40-60kg/day delivery capacity that meets DOE cost goals of $2.50/kg of H_2 or less. GTI will undertake system design and analysis to identify potential pathways, conduct development and lab testing to confirm subsystem operation, integrate the system and incorporate controls, and conduct lab and field testing to validate performance and reliability.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.00** for its relevance to DOE objectives.

- Developed to reduce cost of H_2 - fits DOE's goals.
- Development of on-site hydrogen production and refueling stations is critical to program, but there is competition in the arena already.
- Distributed reforming at higher efficiency and lower cost is a primary goal of DOE program.
- NG-> H_2 fuel station is an important approach that needs to be fully investigated.

Question 2: Approach to performing the research and development

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

- Appears to be well thought out, could use timeline to explain.
- Module development has progressed with significant milestones and evolutions.
- Cast of characters is impressive but perhaps hard to herd.
- Fast fill development does good job of combining experimental/modeling programs.

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

This project was rated **3.33** based on accomplishments.

- Good list of accomplishments.
- Tech accomplish is good but have fallen behind on schedule.
- Should have finished phase 2.
- Good progress in developing components of the system.
- Meet 75% processor efficiency for future goal in compact system.
- Great compact design on your 50-80 kg/day H_2 generator.
- Excellent work on H_2 cylinder filling and dispenser validation.

Question 4: Technology transfer/collaborations with industry, universities and other laboratories
This project was rated **3.00** for technology transfer and collaboration.

- Good list.
- Presenting capabilities at several public meetings.
- Industrial partnerships are not clear.
- Is the "confidential" work on a new PSA part of the DOE project?
- Would be nice to know more about this.
- Good interactions with others.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.75** for proposed future work.

- Slide was for "next steps"- but not for future research.
- Good so far but how well they deal with project delays will be critical in next 6 months.
- Look forward to completion of the refueling facility.

Strengths and weaknesses

Strengths
- Bounded, directed, important scope and goals.
- Good tech team.
- Providing competition for Air Products' effort.

Weaknesses
- I'm seeing modules that will probably work together but I don't really get the feel that the whole system has come together yet and has a whole system persona yet.

Specific recommendations and additions or deletions to the work scope

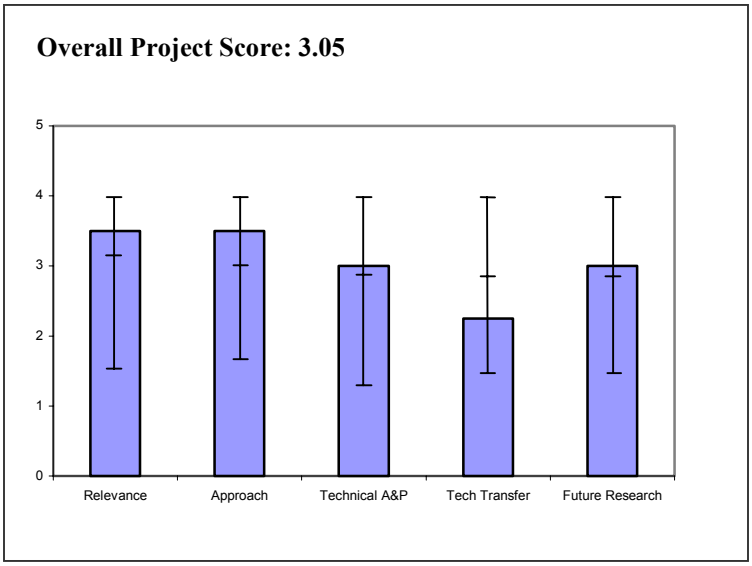
- How will "dispenser" be field tested before compression and PSA?
- Project plan needs to be adjusted for current progress and rethought for how whole system will operate.
- Present operating data for components in system (ex: reforming efficiency).
- Recommend that you work with Air Products, since they only appear to be = +/- 8% accurate on H_2 dispensing accuracy.

Project # TV-11: Novel Compression and Fueling Apparatus to Meet Hydrogen Vehicle Range Requirements

Carlson, Todd; Air Products and Chemicals, Inc.

Brief Summary of Project

The objective of this project by Air Products and Chemicals, Inc. (APCI) is to develop a novel compression and fueling apparatus to meet hydrogen vehicle range requirements. An isothermal compressor concept was designed, simulated and tested. High pressure automatic valves, 900 bar storage valves for cascade, flow meter, dispensing equipment and other instruments were also investigated for achieving this objective.



Question 1: Relevance to overall DOE objectives

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

- A good idea that is being rapidly checked out.
- H_2 compression and fueling are directly relevant to the H_2 Fuel Initiative and Multi-year RD&D plan.
- Project aimed at meeting compression cost and efficiency targets.
- Near isothermal operation is good concept.
- Project is targeted at useful application.

Question 2: Approach to performing the research and development

This project was rated **3.50** on its approach.

- Identified both technical issues as well as status and impact of parallel development of codes & standards.
- Identified need and desire to participate in codes & standards development.
- Combines fundamental tests to understand H_2-liquid solubility with dynamic modeling.
- How does compressor interact with storage and dispensing systems?
- Is controls design for system integration part of this project?

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

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

- Haven't seen hardware yet.
- Project plan is very focused with specific objectives that have been accomplished.
- Although there were initial funding issues, technical accomplishments are successful.
- Solubility tests were instructive.
- Dynamic modeling is showing design parameters that need to be optimized.
- Technical gains appear to be incremental.
- One might expect more tangible gains at this point in the project.

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

This project was rated **2.25** for technology transfer and collaboration.

- Because of patent or commercial proprietary information they are not sharing with others.
- This area was not addressed.
- Assumes the products developed in this project would be made available to market - good collaboration being done.
- Collaboration with groups inside APCI.
- Not much evidence of tech transfer plan.
- Appears to be strictly an internally focused project for APCI.

Question 5: Approach to and relevance of proposed future research

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

- A bit early for future work.
- Future plans are in line as second year of the project plan.
- On schedule to build prototype of the novel compressor.
- Plan to use prototype in service at refueling station.
- Reasonable time frame is key element.

Strengths and weaknesses

Strengths
- Novel; maybe it will work.
- It addresses compression to meet the 700 bar desires of the automotive OEM's.
- I see no show stoppers.
- Excellent project plan and implementation.
- Excellent safety experience and planning and testing evaluation.
- Project has a good combination of tests and modeling to develop a novel design.
- Targeted project on needed technology gap.

Weaknesses
- Liquid/gas interface is troublesome for contamination of H_2.
- Tech transfer not as defined as I would like to see.
- IP was discussed - it is not clear what will be available to the public vs. what Air Products will retain.
- Presentation did not show a schematic to explain how the novel process works.
- Tech transfer.
- Limited progress to date.

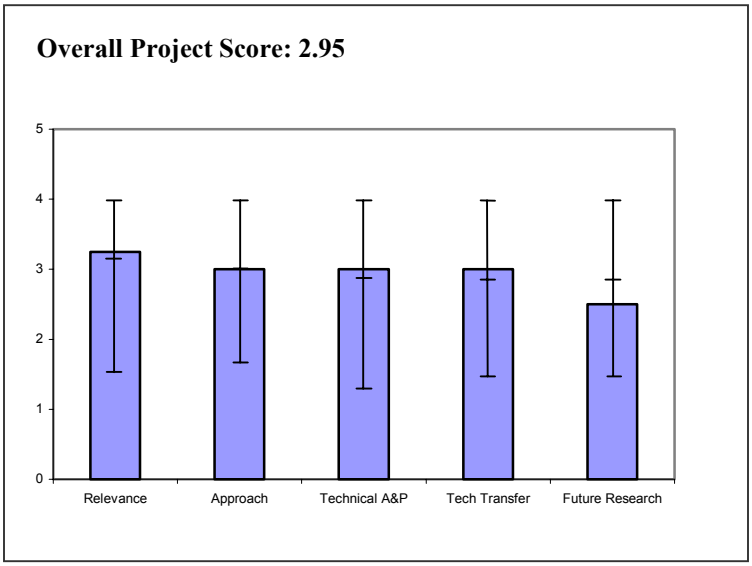
Specific recommendations and additions or deletions to the work scope

- Having a fluid system that is not all liquid or gas phase may present safety challenges that are different than either an all gas or all liquid system. Need to address.
- Public disclosure of these safety (and operational) cautions is the right thing to do.
- Fueling station location coordination with program goals would add value.
- I hope APCI will publish a paper on the performance of the prototype when data is available.
- Broaden collaboration.

Project # TV-12: Auto-Thermal Reforming Based Refueling Station at SunLine
Anderson, Lance; Hydradix/SunLine

Brief Summary of Project

Hyradix and SunLine are working together to develop an on-site natural gas autothermal reforming system for vehicle refueling. This reformer will advance sulfur removal technology, purify the fuel stream through pressure swing adsorption, compress and store hydrogen at 5000 psi, and demonstrate the refueling of fuel cell & HCNG buses, street sweepers, and cars.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.25** for its relevance to DOE objectives.

- It's still early in development of on-site H_2 generation for refueling.
- Parallel development of concepts is very appropriate.
- NG reforming is directly relevant to the President's H_2 Fuel Initiative.
- H_2 production is produced compressed and stored for use - H_2 ICE vehicles currently used for HCNG buses.
- Future FC buses and specialized FCV currently.
- Demonstration of reformer is an important part of tech validation program.
- Relevant DOE cost goals for distributed reforming.

Question 2: Approach to performing the research and development

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

- Meeting current production objectives.
- Autothermal reformer is interesting technical approach.
- Demonstration at SunLine provides real world experience.
- No discussion of budget.
- Little discussion of safety protocols.
- What advantages led toward use of ATR vs. SMR?

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

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

- Achievement of operating hardware in the field.
- Successfully producing H_2 from NG reforming at below 2008 cost objectives.
- Current cost ~$2.60/kg H_2 2008 target $3.00/kg H_2.
- Unit is in operation and initial testing at SunLine.
- Presentation did not show any performance data.

- Have not shown reformer efficiency.
- What steps are taken to validate H_2 specs for auto OEM's.
- Cycling and unit operation was discussed minimally.

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

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

- Working with SunLine is an open pathway to getting broader feedback from local operations and public acceptance.
- Working well with SunLine in training and public education.
- Collaboration with SunLine Transit Agency.
- Little discussion of tech transfer or partner collaboration.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.50** for proposed future work.

- Remote monitoring is appropriate.
- Future market plans not discussed.
- Presentation did not show plans for releasing performance data.
- Ongoing testing and reporting?
- How will learnings from this station impact future designs?

Strengths and weaknesses

Strengths
- Technology in demonstration phase - early commercial market introduction.
- Demonstration is important at a real transit agency.
- Supports multiple vehicle applications.

Weaknesses
- Potential for degradation of H_2 purity.
- Are emissions acceptable for wide-spread deployment in urban areas?
- Not clear how this technology will be introduced in the expansion of H_2 infrastructure.
- Presentation did not mention energy efficiency of the H_2 generation.
- Budget.
- Tech transfers.

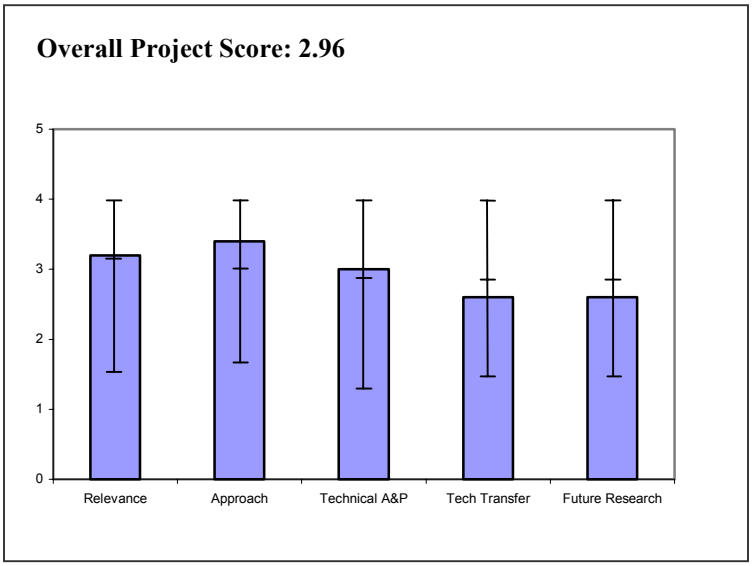
Specific recommendations and additions or deletions to the work scope

- Identify market introduction of this technology - not in business sensitive detail but in relevance to President's H_2 Fuel Initiative.
- I hope as project proceeds that Hyradix or SunLine will collect and publish performance data for the generator.
- Include more info on operations and future development.

Project # TV-13: R&D of a PEM Fuel Cell, Hydrogen Reformer, and Vehicle Refueling Facility
Wait, Mark; Air Products and Chemicals, Inc.

Brief Summary of Project

A team of Air Products and Chemicals, Inc. and Plug Power will: demonstrate small on-site H_2 production for fuel cell power generation and H_2 fueling stations; demonstrate a multipurpose vehicle refueling station to dispense H_2/CNG blends and pure H_2, demonstrate a H_2-fueled stationary 50kW fuel cell; evaluate operability/reliability/economic feasibility; certify integrated power generation and vehicle refueling designs; and expand the current facility to serve as the first commercial facility when sufficient hydrogen demand develops.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.20** for its relevance to DOE objectives.

- Technically relevant to the President's H_2 Fuel Initiative.
- NG reforming is a critical transition technology for H_2.
- Organization/link to MYPP clear.
- This station concept seems to have focused on technology without giving sufficient thought to how and by whom it would be applied in an operating environment.

Question 2: Approach to performing the research and development

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

- Project plan for fueling station focused and aggressive.
- Unfortunately FCV availability is limited - great model for working with local officials for permitting.
- Interesting "Power Park" design (FC).
- $13M program.
- 50 % cost share 5 yr project.
- Proven 3 stage approach.
- Work followed plan.
- A lot of money was spent without an adequate follow through with how the station should be used.
- Project approach was good from a technical perspective.

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

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

- Tech accomplishments - FC testing not completed as a direct result of funding reduction low project scope.
- Undergone DOE safety review 3/04.
- Integrates stationary and mobile H_2 systems.
- Good summary of H generation performance fuel station performer dependent on fleet establishment.
- 50 kW Plug Power fuel cell.
- Excellent progress toward DOE goals.
- Lessons learned valuable to H_2 community.
- Technical progress and learning has been impaired by lack of operational use/applications.

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

This project was rated **2.60** for technology transfer and collaboration.

- Fleet availability is necessary for successful outcome of this project.
- Good collaboration with code and 1st responders (permitting).
- Looks like a proprietary pilot project which is hesitant to put information into the hydrogen community.
- With the exception of visitor traffic and interaction with PSU, not enough discussion in play of tech transfer/collaboration.
- Partnership demonstrated integration of fuel company with fuel cell company.
- How has this station influenced code development?
- Fueling protocols?

Question 5: Approach to and relevance of proposed future research

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

- Working towards H_2 fleet.
- Seems like this project has matured to be commercial.
- Besides continued operation and note that the site has potential for long term usage in cooperation with DOE longer term plan for R&D its continued operation is not clear.
- Good use of DOE investment to support future work.
- Project will be enhanced if it is integrated into DOE validation program but it is unclear how that will happen.

Strengths and weaknesses

Strengths

- Fueling station technologies- H_2 production and dispensing excellent.
- Utilize operating performance data with technology validation H_2 Fleet and Infrastructure projects and C&S activities.
- Plug Power teammate appears frank.
- Very objective discussion of development barriers and technical challenges - for both H_2 generation system and 50 kW FC.

- Well qualified team.
- Use of results for PSU design.
- This project was well run and provided valuable lessons which are being used in next generation design.
- Good 1st example of energy station concept.

Weaknesses

- Air Products had no representation about how it leverages other EERE projects to support this project.
- Additional discussion of how project overcame regulatory challenges - e.g., grid connection, local permitting, would be useful.
- Need better articulation on how this project can be positioned to help achieve MYPP - use the investment already made to take advantage of future RD&D needs.
- Poor application planning-especially for vehicles.
- Projects at this cost level need a high hurdle for planning and application relevance.

Specific recommendations and additions or deletions to the work scope

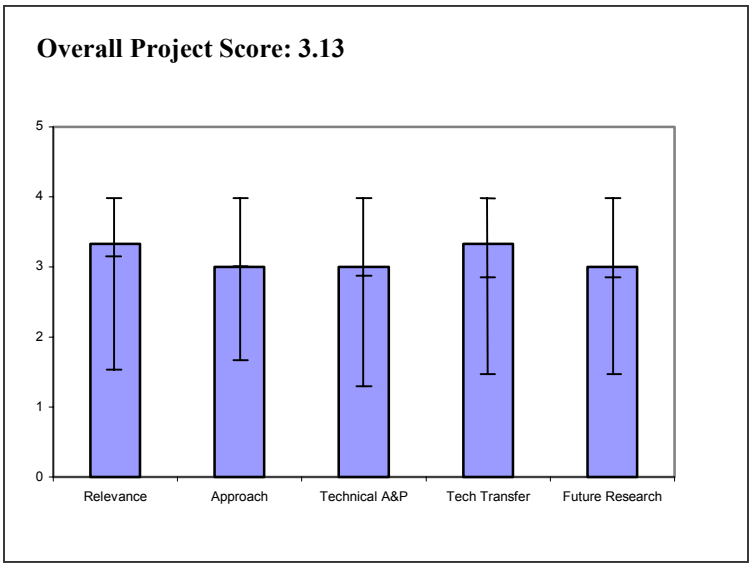
- Pursue HFCV opportunities to use.
- Vendors who have multiple projects should discuss the complimentary nature of the work vs. overlaps and double dips - which this project seems to include for Air Products.
- Much can be gained from tech transfer of experience gained from this project. Recommend more attention to tech transfer collaborations.
- Need to focus on application and expanding operations.

Project # TV-14: LAX Airport Hydrogen Fueling Station - Small Footprint H_2 Capability at the Corner Filling Station

Rachlin, Aaron; Praxair

Brief Summary of Project

In this two year project, Praxair will design, develop, install, and operate a H_2 fueling station that features integration and packaging of existing technologies electrolysis based on-site production, up to five light-duty vehicles per day, five minute "fast fills," growth flexibility to meet demand, and enabled for heavy-duty fills. Praxair will also provide a demonstration of a hydrogen based fueling infrastructure capable of supporting a small fleet of hydrogen fueled vehicles in order to meet the California Fuel Cell Partnership's goal to introduce up to 60 HFCVs by 2003 and that is compatible with other fueling stations.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.33** for its relevance to DOE objectives.

- Distributed H_2 fueling stations.
- Fueling technologies.
- Real-world demonstration is important.
- Small station and focused application is appropriate for this stage of H_2 technology.

Question 2: Approach to performing the research and development

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

- Important location and small size station.
- Electrolysis technology is interesting.
- Economics will be an important outcome of this project.
- Small foot print design allows for installation in airport site.
- Station configuration seems to have been well thought out considering: safety, operations, training and outreach.

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

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

- Early in project - difficult to assess tech accomplishments.
- Project design is on track despite delays beyond the control of presenter.
- Front end project activities seem to have taken a long time.
- Most meaningful accomplishments are contract and financial rather than technical.

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

This project was rated **3.33** for technology transfer and collaboration.

- Excellent partnership collaboration and cost share.
- Working with agencies to get project demonstration ready for construction.
- OEM's will be included to bring vehicles.
- Does not seem to advance any new technology installation designs.
- Strong collaboration and partner potential.

Question 5: Approach to and relevance of proposed future research

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

- Plans include expansion of H_2 dispensing opportunities beyond original plan.
- Will provide practical experience in fuel station construction and operation.
- Primary future research seems to be on supported vehicle technologies - not actual fueling station.

Strengths and weaknesses

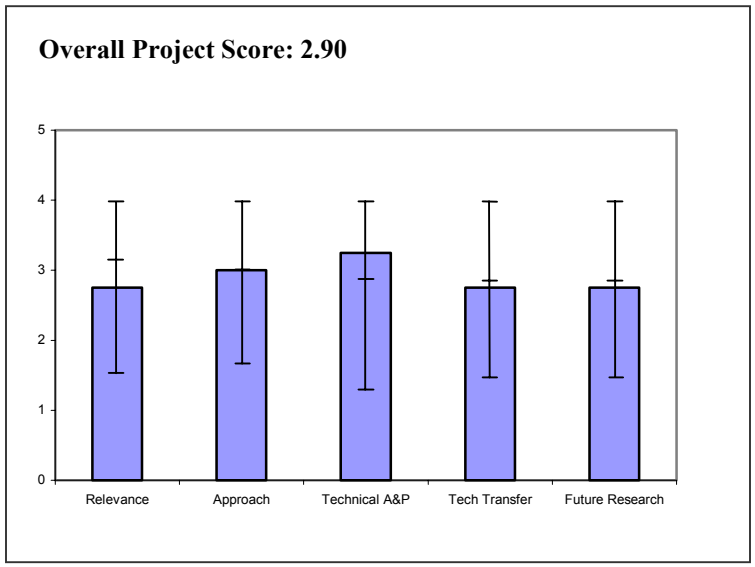
Strengths
- Great collaboration.
- Participation in CA H_2 Highway Program.
- Visibility.
- Size - appropriate for application.
- Education and outreach potential.

Weaknesses
- Uses little or no new technology.

Specific recommendations and additions or deletions to the work scope

- Plan to provide data on cost of H_2 and the electric-to- H_2 efficiency in the system.
- Include air traffic off road (ground service equipment) vehicles.

Project # TV-15: Hydrogen and Natural Gas Blends: Converting Light and Heavy Duty Vehicles
Collier, Kirk; Collier Technologies



Brief Summary of Project

Collier Technologies is developing a low-emissions, heavy-duty vehicle engine package to seamlessly repower today's buses and trucks with existing natural gas and diesel engines that will exceed DOE's goal of reducing 1998 emission standards and maintain or enhance vehicle drivability. This will be accomplished through the addition of hydrogen to the natural gas fuel mixture.

Question 1: Relevance to overall DOE objectives

This project earned a score of **2.75** for its relevance to DOE objectives.

- This program continues to provide a valuable bridge to a H_2 future.
- Introducing a use for H_2 that can reduce emissions and introduce H_2 familiarity to broader society will help justify H_2 generators while we wait for more FCV's.
- Important work to provide vehicles and H_2 demand in transition to H_2 economy.
- Emission targets align with goals.
- A very good idea.
- Was there any consideration of going to synthetic diesels from natural gas?
- What is the efficiency gains/loss compared to the hydrogen and natural gas blends.
- What are the compression pressure benefits?
- HCNG offers incremental improvements over CNG on emissions but at a reasonable cost?

Question 2: Approach to performing the research and development

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

- Exhaust gas recirculation is the best way to control emissions with H_2 combustion.
- Super charging recovers power density that clean/dilute mixtures produce.
- What about the issue of cost of fuel?
- What is the compression benefit of this mix?
- Technical approach seems sound but overall cost/benefits of HCNG should be part of project.
- Staged approach is good.
- Safety plan is not well defined.

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

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

- Results are consistently high at low cost.
- Demonstrated success in LDV conversions.
- Achieved emissions reductions for CO and NOx with good efficiency.
- Project would be stronger if hybrid configuration was used.
- Progress seems to be consistent with overall project goals.

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

This project was rated **2.75** for technology transfer and collaboration.

- This project reaches a segment of society that is larger and different from other technology validation activities.
- Conversion "kit" is available for commercial sale.
- Industrial partners with OEM.
- Tech transfer plan is not clear.
- Limited collaboration.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.75** for proposed future work.

- Designed system for future bus conversions.
- Should try to get it into the hands of normal users and not just fleet users.
- Specific future targets are good (many other projects only have general future plans).

Strengths and weaknesses

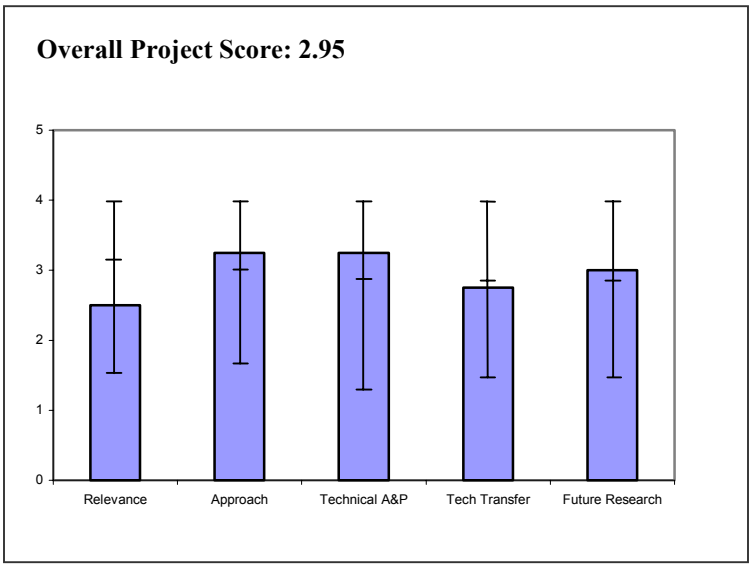
Strengths
- Practicality with real world application in every community.
- This is vital work for helping to promote the growing fleet of H_2 fueled vehicles.
- Good idea. Should expand users to get a better understanding of approach.
- Targeted, focused scope.

Weaknesses
- It's viewed as low tech or only transitional.
- Project relevance to DOE objectives.

Specific recommendations and additions or deletions to the work scope

- Hybrid technology would make this a more interesting, relevant project.
- Consider using customers to really understand the benefits of this application.
- It would be good if normal customers can be used to really understand the benefits of this application.

Project # TV-16: Fuel Cell Powered Underground Mine Loader Vehicle
Barnes, David; Vehicle Projects, LLC



Brief Summary of Project

Vehicle Projects LLC is developing a zero-emissions, fuel cell-powered metal-mining locomotive that operates on a 14 kW fuel cell power plant. Hydrogen will be stored in metal-hydrides. Vehicle Projects will evaluate the locomotive's safety and performance, primarily in surface tests, and evaluate its productivity in an underground mine in Canada.

Question 1: Relevance to overall DOE objectives

This project earned a score of **2.50** for its relevance to DOE objectives.

- Application seems poor choice for demonstrating fuel cells.
- Interesting project with lots of technical challenges.
- Application seems good one for demonstrating metal-hydride storage, but even if successful will have limited public visibility.
- Niche application, but one where unique economics make sense.
- There are more cost effective ways to demonstrate the integrated storage/fuel cell system.
- Good focus on specific applications.

Question 2: Approach to performing the research and development

This project was rated **3.25** on its approach.

- Design follows success of previous program.
- Hybrid vehicle design is good.
- Removable hybrid storage is unique idea for this application.
- Multiple sites add to cost- why?
- Sound approach that considered specific application, economics, focused technical configuration, and safety.

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

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

- FC procured and in bench scale testing.
- Not clear how lessons learned will transfer to community at large.
- Technical design is very appropriate for the application.
- Progress seems appropriate for this stage of project.

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

This project was rated **2.75** for technology transfer and collaboration.

- Collaboration is good on this complex system.
- Due to limited operational environment it's not clear that much valuable feedback can be recycled into broad market products.
- Industry/OEM partners suggest a good team is in place.
- Would like there to be adequate testing of storage/FC system prior to installation.
- Good mix of collaborators and partners.
- Tech transfer plan is not clear.

Question 5: Approach to and relevance of proposed future research

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

- Strong integrated team.

Strengths and weaknesses

Strengths
- Good metal hydride storage application.
- $5 million of DOE funds for 1000 hrs demonstration is costly.
- Bench testing (more) could address many issues addressed by costly mine vehicle and prevent problems onsite.
- Well thought out design configuration for a specific application.

Weaknesses
- Limited market.
- Project seems more focused on vehicle system design, while H_2 storage and FC performance are secondary.
- Narrow application - project should spend some resources on considering this technology configuration for other applications.

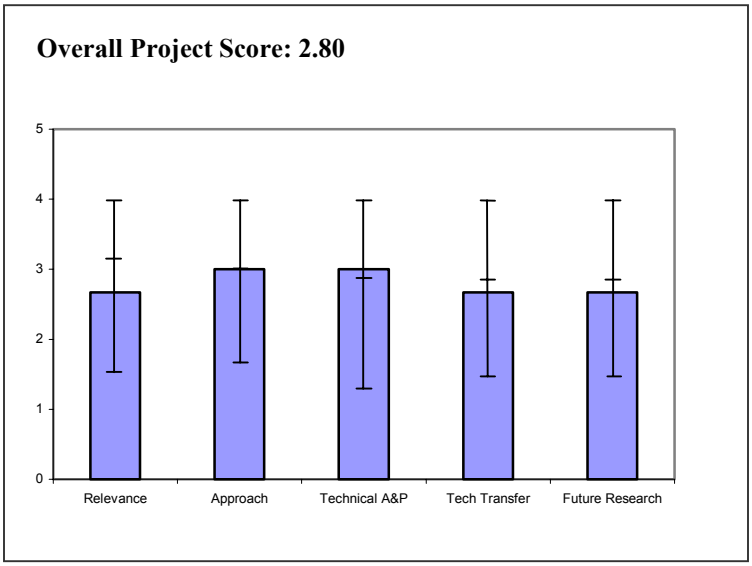
Specific recommendations and additions or deletions to the work scope

- Would like to see data from the bench-scale tests on the FC stack.
- Future performance of vehicle (H_2 mileage) should be compared to the conventional alternative.
- Should consider other applications for this technology configuration such as ground service equipment or industrial off-road trucks.

Project # TV-P1: Validation of an Integrated System for a Hydrogen-Fueled Power Park
Keenan, Greg; Air Products & Chemicals, Inc.

Brief Summary of Project

Air Products and Chemicals, Inc. is conducting a project to complete a feasibility, technical, and economic analysis to determine the optimal fuel cell system for the co-production of power and hydrogen from natural gas (power park) with a reformer / PEM System, High Temperature Fuel Cell (HTFC). They will optimize the system for lowest total energy cost, and develop a cost estimate to demonstrate a prototype natural gas based power park at a suitable site.



Question 1: Relevance to overall DOE objectives

This project earned a score of **2.67** for its relevance to DOE objectives.

- Commercial understanding applied.
- Co-production is a method that strongly supports the President's Initiative by making the technology economically viable sooner.

Question 2: Approach to performing the research and development

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

- Good use of previous data. Started as PEM FC but economics led to change of scope.
- Simplistic.
- Very focused on DOE's technical barriers of cost.
- Should more fully address how H_2 off-gas would be recovered from high-temp FC.

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

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

- Good recognized new goals.
- Unclear milestones.
- Technology combination looks very promising.

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

This project was rated **2.67** for technology transfer and collaboration.

- None provided

Question 5: Approach to and relevance of proposed future research

This project was rated **2.67** for proposed future work.

- Excellent.

Strengths and weaknesses

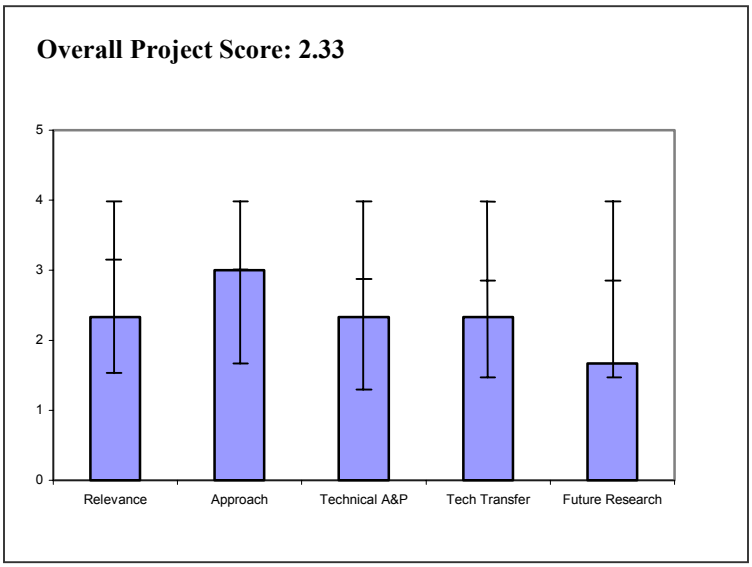
Strengths
- Good redirect of project ideas and learning to using SOFC/MCFC.
- Good identification of safety aspects.
- APCI understands topic.
- Focuses on economics.

Weaknesses
- Communications products.
- Feedback to community.
- Doesn't get into enough technical detail on how this would be done.

Specific recommendations and additions or deletions to the work scope

- Not worthy of continuing.
- Include a technical demonstration on the next phase.
- People may see this can't be done economically. Show that they are wrong.

Project # TV-P2: Fuel Cell Installation and Demonstration Project In Gallatin County, Montana
Nelson, Bruce; Zoot Enterprises Inc.



Brief Summary of Project

This project by Zoot Enterprises Inc. is intended to demonstrate operation of a fully integrated distributed generation system consisting of a fuel cell generation plant, interconnection equipment and microgrid to provide the hydrogen industry and the general public with a real world application of such a system. Additional goals are to determine the degradation rate of the fuel cells and the point at which it becomes economically necessary to "restack" by essentially replacing the fuel cells themselves; provide operational data to Montana State University to assist in the development of control equipment to optimize fuel cell performance when combined with other electrical sources; and maximize efficiency of the heat recovery (cogeneration) system.

Question 1: Relevance to overall DOE objectives

This project earned a score of **2.33** for its relevance to DOE objectives.

- Project looks at fuel cells in a "credit-processing" application.
- Molten carbonate fuel cell from Fuel Cell Energy.

Question 2: Approach to performing the research and development

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

- Oversized fuel cells with grid system - intent to "build up" system as new tenants go into facilities - seems like an uneconomic way.
- System is not economically optimized - extra redundancy.
- Great to see fuel cell being used in a high reliability situation.
- Will give fuel cell a good name in the premium power sector.

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

This project was rated **2.33** based on accomplishments.

- Not specific in posters.
- Some communication with outside communities.
- Functional system.
- Strong progress appears to have been made to date.
- Amazing decrease in electric grid utilization.

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

This project was rated **2.33** for technology transfer and collaboration.

- Not identified.
- Very simple approach to communications.

Question 5: Approach to and relevance of proposed future research

This project was rated **1.67** for proposed future work.

- Good idea but seems like bad upfront engineering.
- Future work seems focused on operational details.
- Focus on bigger issues of more importance to DOE if possible, such as performance data.

Strengths and weaknesses

Strengths
- Practical application.

Weaknesses
- Fuel cell tripped over 2 dozen times the first year.
- Presentation was simply too long - 39 slides in total.
- Be more concise.

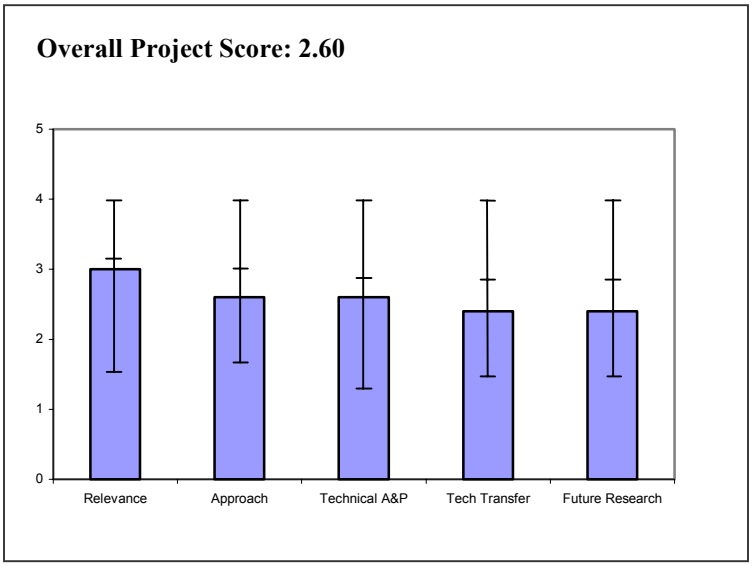
Specific recommendations and additions or deletions to the work scope

- Only continue with very high commercial cost share! Microgrid for "local" service augmentation.
- This is a sales gimmick for FCE and unworthy of additional taxpayer input.

Project # TV-P3: Global Assessment of Hydrogen Based Technologies
Fouad, Fouad; University of Alabama, Birmingham

Brief Summary of Project

The University of Alabama, Birmingham and Argonne National Laboratory (ANL) team will evaluate performance and emissions characteristics of hydrogen-fueled vehicles; assess impacts of hydrogen vehicle deployment on Southeast regional air quality; evaluate the use of hydrogen fuel cells for stationary power generation; and assess infrastructure needs and costs for production and distribution of hydrogen in the Southeast.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.00** for its relevance to DOE objectives.

- This project is growing the H_2 knowledge base in an area with environmental challenges and an as yet undeveloped mitigation strategy.
- Project is regional.
- Engine emissions are relevant to use of H_2 in vehicles at practical cost in near term.
- The regional focus of this project (Southeast US). Contributes to the relevance of this project which otherwise might not be as great.
- I don't see how this project differs from previous HCNG engine performance studies, nor do I see how this will promote hydrogen technology acceptance.

Question 2: Approach to performing the research and development

This project was rated **2.60** on its approach.

- Well-focused and on track.
- Using Argonne as source is a great transfer mechanism.
- Very dependent on ANL.
- Project tasks are not tightly related.
- The regional analysis and stationary power tasks are a bit of a stretch from the vehicle testing.
- PI recognizes that they need assistance from established H_2 program participants.
- By using only a single blend composition (30% H_2, 70% CNG), project will not necessarily evaluate optimism conditions for HCNG use.

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

This project was rated **2.60** based on accomplishments.

- Not a lot of original technical work, but growing the knowledge base is the real focus new projects will come.
- Project is making progress on tasks 1 and 2.
- Others are scheduled for future year.
- Project is early in its implementation and has understandably not made a large amount of progress.
- New fuel supply system installed, and some test data collected.

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

This project was rated **2.40** for technology transfer and collaboration.

- Effective model use and tweaking with ANL.
- Collaboration with ANL is allowing tests and modeling the university could not do.
- There appears to be a lack of collaboration with the engine conversion people.
- PI knows that interaction with others is needed but has not yet made progress in this area.
- Fuel delivery system was designed and built by ANL but no private sector collaboration.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.40** for proposed future work.

- Project has a clear but limited scope that's achievable, and a schedule that's reasonable.
- It faces a decision on where to go from here, and could use interaction with other centers like ITS Davis or Hawaii.
- Poorly planned.
- Proposed tasks on regional infrastructure seem unrelated to the vehicle work.
- PI has plans for expanding program to a broader partner base.
- Success in this area is key.
- Too many ANL analytical tools, should develop methodology and priorities pertinent to southeast concerns.
- Need more focus on validating new technology and new infrastructure.

Strengths and weaknesses

Strengths
- Embedded in educational infrastructure, uses link to ANL.
- H_2 use will positively impact air quality.
- Clean cities connection sought.
- Focus on H_2- combustion for vehicles is an important part of H_2 transition strategy.
- Introduces H_2 and fuel cell technology in geographic region where little work has been done and little public exposure.
- Pragmatic evaluation of hydrogen/CNG blends for light duty vehicle ICEs.

Weaknesses
- Undeveloped future vision.
- Question is whether timing is right to try to develop an education/knowledge center without near term access to fuel cell vehicles.
- Fleet which is going to be associated with established H_2/Transportation centers in FL, CA, & MI.

- Seems to be "sample oriented" in that the empirical testing of equipment based on incomplete selection criteria.
- The 5 tasks are not strongly related.
- The emissions testing are not coupled to the people doing the engine conversion.
- Repeats technical work that has been done by others.
- Modeling focuses on CNG/ H_2 mixture fuels which appear to only have transitional benefits.
- No new or innovative technology is being validated.

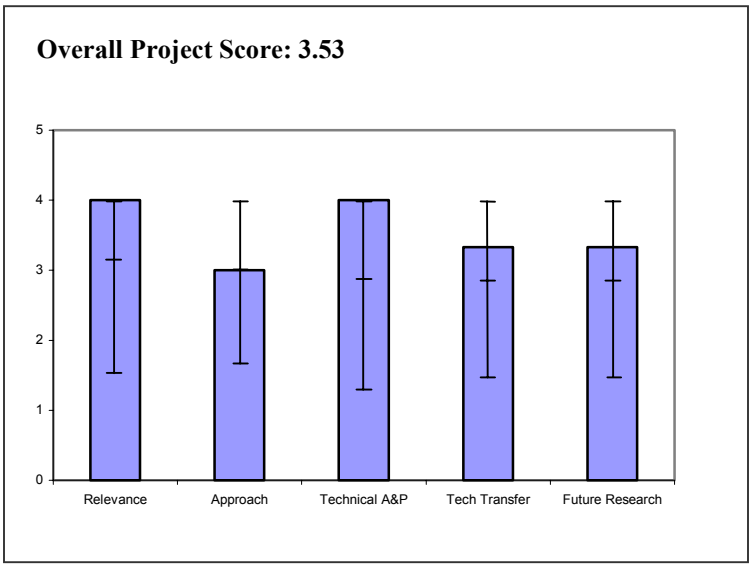
Specific recommendations and additions or deletions to the work scope

- I suggest the emissions testing program be coupled to engine experts to explain the results.
- Focus on educational and consortium building activities.
- Bring in industrial partners which can introduce commercial application potential to the project.
- Just focus on PEM fuel cells vehicle performance and power generation potential for southeast region of US.
- Close project.

Project # TV-P4: Hydrogen Power Park Business Opportunities Concept Project
Hobbs, Raymond; Pinnacle West Capital Corporation

Brief Summary of Project

In this project, Pinnacle West Capital Corporation conducted studies on economic hydrogen production, renewable energy opportunities, integration of distributed generation and transportation fuel production, incorporation with existing energy assets, scalability, integrated business opportunities, identification of technical barriers, and identification of market opportunities. Under the economic production of hydrogen, the options investigated were (i) solar reforming of natural gas, (ii) low cost electrolysis, (iii) hydrogen purity requirements (iv) heat energy recovery, and (iv) chemical by-product value.



Question 1: Relevance to overall DOE objectives

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

- Project well thought through.
- Dramatic development H_2: $2.25/kg pure product - open to public.
- Great to have data collected on performance testing of H_2 components.

Question 2: Approach to performing the research and development

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

- Good use of management buy-in.
- Good iterative process. Iterations make adjustments.
- Self insured.

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

This project was rated **4.00** based on accomplishments.

- Good use of program funding.
- Website (real time) is good idea for communication.
- Very safe design of station.
- Strong regulatory relations.
- Amazing to see how low the marginal cost of electricity (to produce H_2) is for APS-this should be expected now.

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

This project was rated **3.33** for technology transfer and collaboration.

- Good connections with others in collaborations (ex. BC Hydro)
- Good licensing prospect with fueling station.
- Decent interactions with others.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.33** for proposed future work.

- Understands work needed be to accomplished.
- It would be excellent if you could add another fuel cell to be tested such as Ball and Nexa/Airgen.

Strengths and weaknesses

Strengths
- Excellent safety identification leading to patentable ideas.
- APS strong internal support for establishing H_2.
- Website has performance data in real time.
- Real world testing of H_2 components.

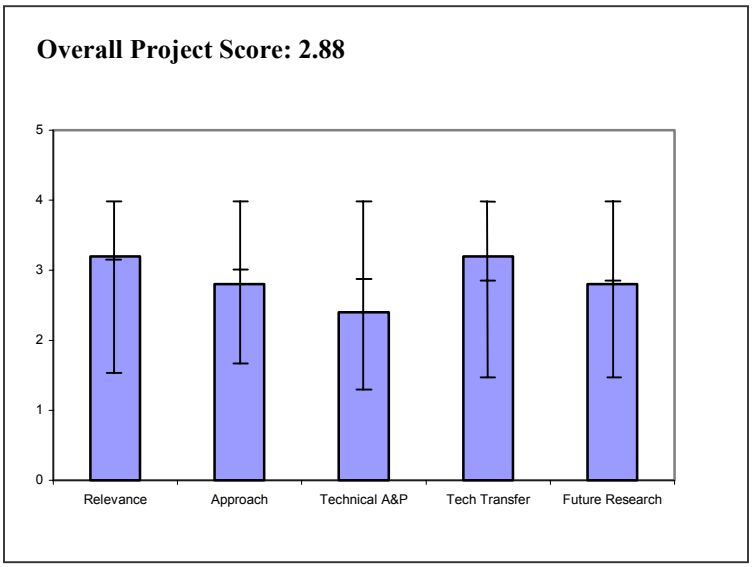
Weaknesses
- None provided

Specific recommendations and additions or deletions to the work scope

- Continue project.
- Provide details. Are all the components hooked into the system at once? How would they interact if they were?

Project # TV-P5: NextEnergy Microgrid and Hydrogen Fueling Facility
Quah, Michael; NextEnergy

Brief Summary of Project



NextEnergy's project objectives are to support the DOE "Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project" in the Detroit area, collect and analyze data with existing codes and standards, establish a "Best Practices" training, educational program, integrate critical hydrogen infrastructure components and systems for multi-use operations within a core urban environment, optimize system solutions/integration to advance the hydrogen infrastructure for vehicular and stationary use, provide hydrogen to vehicles at 3,600 psig and 5,000 psig (for demos in the Detroit area), and study the system interactions/integration for power generation (~ 1 MW) in a Microgrid with fuel cells, ICE generators, Stirling engines, and solar PV.

Question 1: Relevance to overall DOE objectives

This project earned a score of **3.20** for its relevance to DOE objectives.

- Program focus on integration of prime movers (powered by H_2 and other sources of energy) with a local interconnection is an essential component of the program.
- Danger is that H_2 program is diluted with too many other technologies.
- Downtown Detroit site.
- Open architecture.
- Facility emphasizes power generation and some components do not utilize H_2.
- Project will produce useful data on cost of electricity from fuel cells and engines.
- Approach focuses on proving a power system with many components controlled to match grid electronics.
- Good overall logic to the plan.
- Should be a very good demonstration of technology gains and benefits as a fueling station.
- Ambitious goals and scope, particularly because it is intended for a densely populated urban area with high Big 3 vehicle manufacturer visibility.

Question 2: Approach to performing the research and development

This project was rated **2.80** on its approach.

- They are making very good progress, but scope is ambitious and keeping costs within range that will allow the technical aspects to move forward is going to be a challenge.
- Inclusive philosophy.
- Good leverage on state support.

- Approach focuses on proving a power system with many components can be controlled to match grid electronics.
- Focused on problems that need to be resolved.
- Choice of basement storage creates extra barriers that will inevitably delay completion and increase cost.

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

This project was rated **2.40** based on accomplishments.

- Site prep on a brownfield.
- Team recruitment.
- Project is new so progress is in planning, design, and overcoming regulatory barriers phase.
- Could go faster but current rules and regulations prevents it.
- Only preliminary conceptual design completed to date.

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

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

- Project building hand-in-hand with Wayne State and development of H_2 and DER curriculum for MI colleges is great.
- Intent is stated to use web.
- Project plans to make data available on website, so public will have rapid, convenient access to performance data.
- Could improve on collaboration but the process is good.
- Many important collaborators.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.80** for proposed future work.

- Project is just starting and needs to stay focused but plans for adding biomass fuels show interest.
- Future plan to produce H_2 by reforming makes the project align better with DOE goals for tech validation.
- Should provide a good set of data for all to see regarding the benefits of the various power generation systems.

Strengths and weaknesses

Strengths
- Projects are high profile and interactive with educational infrastructure providers.
- Premises are sound.
- Spin-off envisioned.
- Scada system will put unedited data on web.
- The project is ambitious regarding producing real world data and demonstrating power technologies from a variety of fuels.
- Should provide a good service to all Michigan related activities.
- This is heavily needed.

- The project site is as real world operating conditions as one can get.
- There is a good mix of different hydrogen uses in the DTE H_2 microgrid.
- Scope okay.

Weaknesses

- Tough initial cost barriers.
- Need to develop workforce with right skill sets. (Challenges not really weaknesses).
- Potential for dilution of focus and emphasis on H_2.
- Technical layout issues, including basement.
- Not online yet.
- Basement site for liquid H_2 tank and associated vaporizer and piping.

Specific recommendations and additions or deletions to the work scope

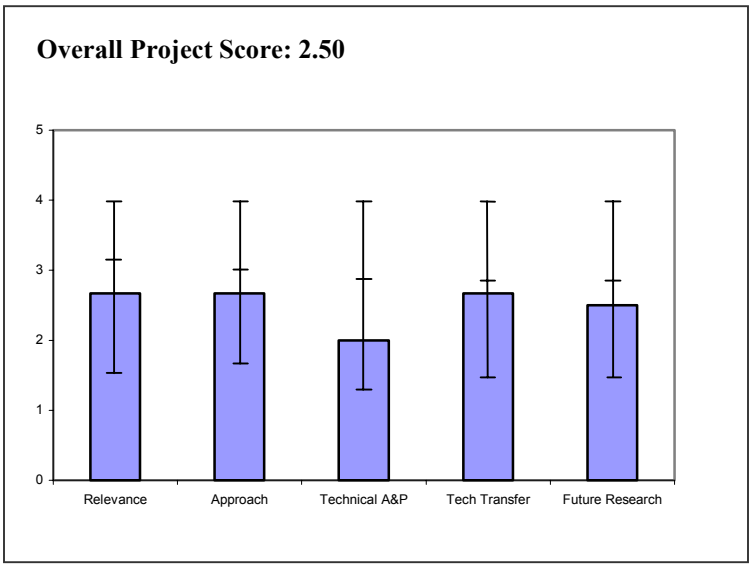
- Make implementation of H_2 production by reforming a priority in acquiring components.
- Expand the partnership to build greater strengths.
- Employ a hydrogen safety specialist to conduct in-depth safety analysis to address Detroit Fire Department questions and concerns.
- Conduct risk analysis with quantitative results and uncertainty analysis to compare risk of alternative tank locations.

Project # TV-P7: Hydrogen Fuel Project

Morse, Derick; Regional Transportation Commission of Washoe County, Nevada

Brief Summary of Project

The Regional Transportation Commission of Washoe County, Nevada is to develop integrated, geothermal energy powered fuel production and use a cycle that has essentially zero criteria emissions, zero green house gas emissions, scalability, and reliability comparable to today's mature fossil fuel technologies. A companion objective is to foster public and regulatory agency acceptance of hydrogen fuel technology as a safe, effective and desirable path. This R&D effort should contribute significantly to the commercialization of hydrogen fuel technologies for mass transit applications.



Question 1: Relevance to overall DOE objectives

This project earned a score of **2.67** for its relevance to DOE objectives.

- Renewable geothermal production of H_2 is directly relevant.

Question 2: Approach to performing the research and development

This project was rated **2.67** on its approach.

- Project is still in project planning process.
- No clear rationale on why and how geothermal energy is suited for H_2 production.

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

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

- Too early in the project to assess.

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

This project was rated **2.67** for technology transfer and collaboration.

- Again too early to assess.
- Need to collaborate with at least other Nevada fueling stations.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.50** for proposed future work.

- None provided

Strengths and weaknesses

Strengths

- Connection to community.
- Good mix of experienced hydrogen companies and key local government agencies and potential hydrogen users.

Weaknesses

- Project does not appear to have collaborative efforts with other DOE H_2 program projects.
- The Nevada fueling stations appear to be stand-alone projects.
- Public education component is poor.
- No articulated cost goals and go/no-go decision criteria.

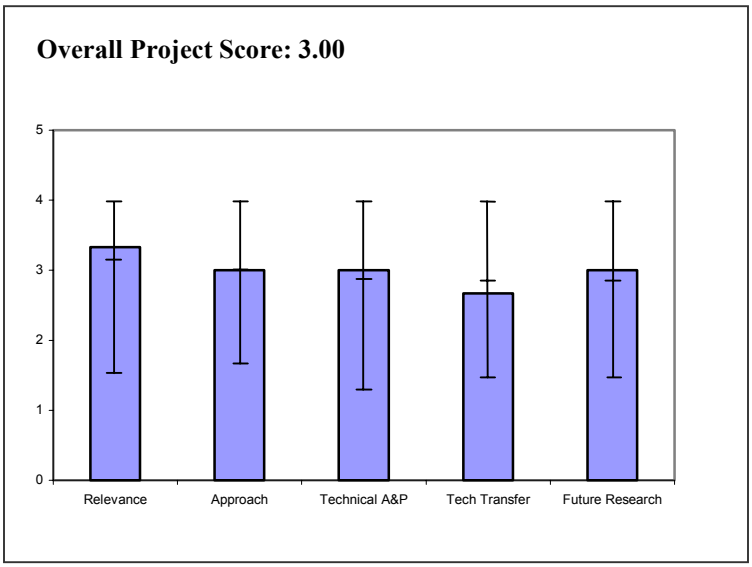
Specific recommendations and additions or deletions to the work scope

- Projects in Nevada should begin collaboration.
- Continue with cost share.
- Abandon para transit vehicle application.
- Focus on hydrogen production system design and economic analysis.

Project # TV-P9: Renewable Hydrogen Fueling Station System
Boehm, Robert; University of Nevada-Las Vegas (UNLV) Research Foundation

Brief Summary of Project

As a first step in the development of a hydrogen utilization network, University of Nevada-Las Vegas (UNLV) Research Foundation will install and analyze the performance of a hydrogen fueling system powered by the solar energy. Objectives include development of the requirements for the fueling system, survey of potential sites and determining favorable/unfavorable characteristics of each, selection of the site with site plan and support to the site permitting process, design of the fueling system layout, installation of the fueling station in Las Vegas, monitoring operation of the fueling system and characterizing performance.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.33** for its relevance to DOE objectives.

- Looks at renewable aspect.
- Electrolysis is directly relevant to the Presidents H_2 Fuel Initiative.
- Cost share strength.

Question 2: Approach to performing the research and development

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

- "Chicken and egg" process-also building/using utility vehicles as well as building station.
- Good concept.
- Project is in initial stages of implementation.
- Interesting renewable production of H_2 technologies, PV, and wind.
- Focus on codes & standards participation.
- Permitting engaged.

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

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

- Could use more detail on poster.
- Better photographs showing entire site.
- Flow chart detailing process would be useful to explain concept.
- Technical aspects of this project have not yet been started.
- Most activities have been site review and coordination.

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

This project was rated **2.67** for technology transfer and collaboration.

- Didn't see a lot of collaborative efforts.
- Could use more integration.
- Tech transfer and education activities have been included in the project plan.
- Las Vegas water district engaged.

Question 5: Approach to and relevance of proposed future research

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

- Looks good-funding appears adequate.
- Fairly new project future research not clear.

Strengths and weaknesses

Strengths
- Renewable H_2 production.
- Proton self insured the site.
- Warranty for 1 year/7 year stack life.

Weaknesses
- Better detail on poster to explain concepts.
- Three H_2 fueling stations in Nevada-all seem stand alone projects.
- Doesn't know the context of solar H_2.

Specific recommendations and additions or deletions to the work scope

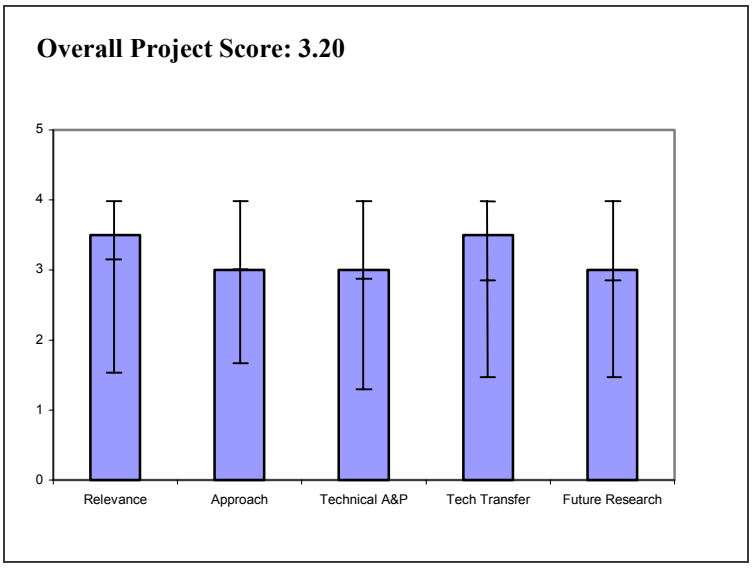
- Increased coordination with other Nevada fueling station.
- Continue this-good value.

Project # TV-P11: Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems

Rocheleau, Richard; Hawaii Natural Energy Institute

Brief Summary of Project

On this project Hawaii Natural Energy Institute (HNEI) will: (1) produce an integrated program for the development and deployment of hydrogen based distributed energy systems, and (2) advance key technologies, consistent with DOE plan, to advance hydrogen production technologies and infrastructure research and testing.



Question 1: Relevance to overall DOE objectives

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

- The program is bringing (has brought) together diverse H_2 supplier technologies and applications and demonstrating them in close association with local and civil and infrastructure stakeholders.
- Project plan is still being developed and finalized.
- Fuel purity.
- H_2 from biomass.

Question 2: Approach to performing the research and development

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

- Project planning is striving to collaborate/partner with DOE H_2 program activities.
- Responsive.

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

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

- For most projects within program, measurement of results against goals in relatively easy and is embedded in funding requests from project sponsors.
- Too early in project to assess technical accomplishments.
- Facilities functioning and taking data.
- Training and learning underway.

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

This project was rated **3.50** for technology transfer and collaboration.

- This is a critical function for this program.
- Keeping the website current, though important, is only one aspect.
- They could use a PR department; not to blow their horn but to let others (especially the public outside HI) know about their work.
- Again project plan is still being developed.
- Good collaboration with Hawaiian utilities and sugar companies.

Question 5: Approach to and relevance of proposed future research

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

- They seem to have a good pipeline of projects and are not dependent on a single project for success.
- Cannot be assessed.
- Renewable H_2 pertinence.
- Testing may overlap with industry.
- Good local source of biomass, good plans for hydrogen use in Honolulu.

Strengths and weaknesses

Strengths
- Good quality technical work with physical systems.
- Diverse disciplines are brought together.
- Great leverage on other government investments.
- Experienced PI and project team.
- Realistic understanding of potential hydrogen renewable sources and relevant applications in Hawaii.

Weaknesses
- Communicating success and failure with outside.
- Not clear what DOE funding will support.
- Need to choose specific goals and focus rather than just opportunistic.
- Need to transport biomass hydrogen from other lands to Oahu.

Specific recommendations and additions or deletions to the work scope

- Continue to develop collaboration and partnerships with DOE H_2 program.
- Focus on Energy Park.
- Defocus on testing generally and define mission more tightly.
- Develop quantitative phased goals and go/no-go decision criteria and contingency plans.