

2007
Technology Validation
Summary of Annual Merit Review Technology Validation Subprogram

Summary of Reviewer Comments on Technology Validation Subprogram:

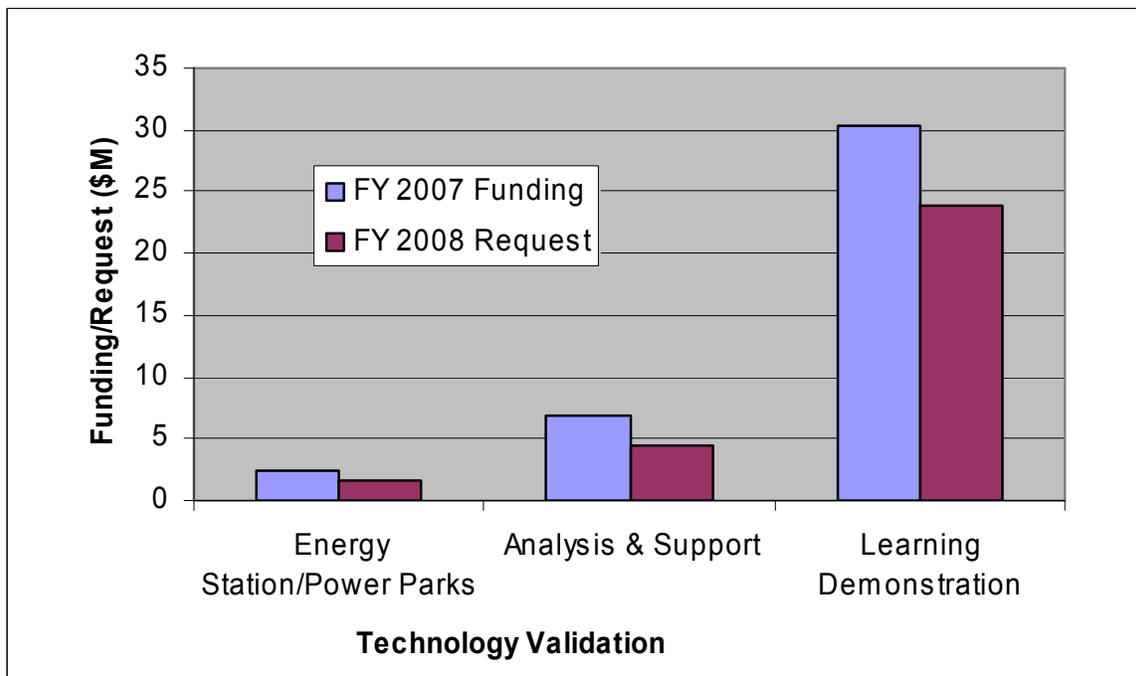
Reviewers think the learning demonstration project is an excellent match with DOE targets and the President's objectives. In addition, the learning demonstration is an important program that will provide a baseline of performance for today's PEM fuel cell powered vehicles. Gathering data on a number of vehicles in several locations and also collecting fleet experiences is important to understanding the true status of the technology in real-world applications. Good progress in getting the fueling stations operational. Several different locations with different climates are involved. Data collection is well done, focused and intelligent. The data collection and dissemination is exactly what DOE needs to have to maintain the proprietary data.

Reviewers thought that industry must open up its database and have more public disclosure because of the high profile industry and the government have given to hydrogen vehicles. More analysis on performance of the vehicle and the fuel cells would be helpful. Reviewers indicated there should be an increase in miles driven and the number of vehicles available so that stations can be more fully utilized and more information on potential improvements generated. If possible, some baseline comparisons with conventional technology in similar service would help show the progress toward commercialization.

The Integrated Hydrogen Energy Station project is excellent and very promising for very low cost hydrogen and electricity production. The greatest value of this project will come from an installed, working station generating real-world data. There should be an extended operational term with comprehensive data gathering covering efficiency, well-to-wheel emissions and energy use.

Technology Validation Funding by Technology:

The funding portfolio for Technology Validation stresses the continuation of the 6 year Learning Demonstration project as it enters its fourth year. Second generation vehicles began to be introduced in 2007 and data collection over the next few years will provide information on meeting 2009 fuel cell durability and vehicle range targets. A high temperature fuel cell Energy Station will be funded and constructed in 2008 followed by a year-long demonstration of the system. The FY2008 funding profile is subject to Congressional Appropriations.



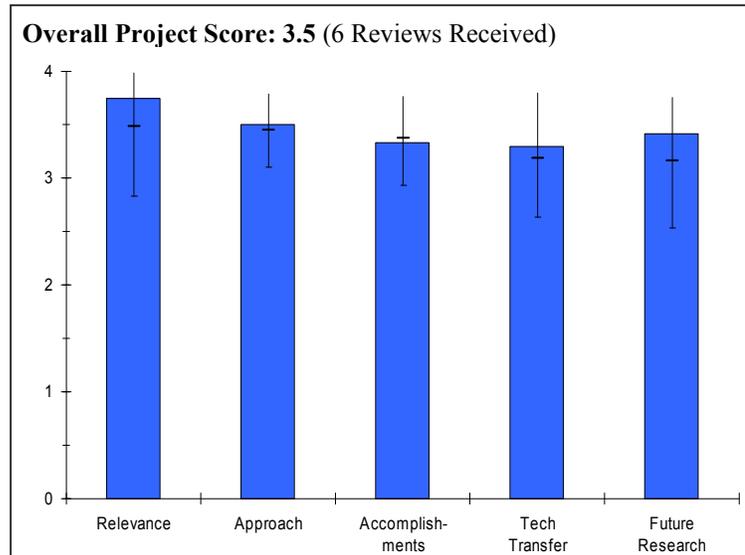
Majority of Reviewer Comments and Recommendations:

The Reviewer scores for the Technology Validation Subprogram were on average slightly higher or similar with those of other subprograms (the maximum, minimum, and average scores for Technology Validation projects were 3.8, 2.9, and 3.4 respectively. These compare to the overall maximum, minimum, and average project scores of 3.8, 1.6, and 3.1, respectively. The Technology Validation project portfolio mainly includes the Learning Demonstration in the third year of the 6 year project. In addition, an Integrated Energy Station and cryo-compressed storage tank demonstration will be funded. The major recommendations by reviewers are presented below for each of the task areas. DOE will act on reviewer recommendations as appropriate for the overall Hydrogen Technology Validation effort.

- **Learning Demonstrations** – Project is important effort to demonstrate the feasibility of fuel cell vehicles and hydrogen infrastructure. More analysis should be included on the vehicle performance and the cost of delivered hydrogen.
- **Energy Stations** – Extended operational term with comprehensive data gathering covering efficiency, well-to-wheel emissions and energy use. Work with project partners (or add partners) to fully test system capabilities by adding hydrogen vehicle fueling demonstration.
- **Storage** – A commercialization plan should be developed with suppliers. The project addresses DOE goals related to hydrogen storage aboard a vehicle.
- **Analyses** – The analyses of the Learning Demonstration should include information on lessons learned and benchmark this effort against European and Japanese initiatives.

Project # TV-01: Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project*Klaus BonHoff; DaimlerChrysler***Brief Summary of Project**

In this project, DaimlerChrysler deployed 30 Gen I fuel cell vehicles in three ecosystems to validate current status of: 1) Durability of fuel cell stack and system; 2) Range of operation with compressed H₂; 3) Cost of H₂ from various production methods; and 4) Performance degradation over life via dynamometer and on-road testing. All 30 vehicles were equipped with a customer friendly Fleet Data Acquisition (FDA) system that automatically collects statistically relevant data for submission to NREL as well as engineering analysis for technology improvement. To date, the vehicles have accumulated 130,000 miles and three driver perception surveys have been completed. Two refueling stations are in operation in Michigan (DTE and NextEnergy) with one planned for California. DaimlerChrysler, BP, DTE, and NextEnergy will also test emerging technology with the potential to meet DOE hydrogen cost target while evaluating emerging and renewable technologies to produce hydrogen and co-generation technologies to produce hydrogen and electricity. Data will be provided from Gen II vehicles under the same operating conditions as Gen I vehicles to compare technology maturity over the project duration.

**Question 1: Relevance to overall DOE objectives**

This project earned a score of **3.8** for its relevance to DOE objectives.

- The objectives were clearly stated and were consistent with DOE's MYPP.
- This is an important program that will provide a baseline of performance for today's PEM fuel cell powered vehicles.
- The difficulties establishing a hydrogen infrastructure will be established in this program.
- The project will provide data for planning of future projects by industry and the DOE.
- Directly relates to DOE goals
- Getting these fuel cell vehicle demonstrations on US highways, and doing that task correctly, is an essential step in the DOE hydrogen program.
- Very good, covers all important aspects.
- In spite of its high visibility, this project's value (especially per-dollar value) to advancing Hydrogen Initiative and bringing fuel cell technology closer to the market is not obvious.

Question 2: Approach to performing the research and development

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

- They use wireless data collection to ensure customer convenience.
- They need to raise public awareness better. This is on their radar screen to improve.
- 130 thousand miles driven.
- Three cities with good data displayed showing temperatures, different driving conditions, steep roads and stop-and-go traffic.
- Customer and perception study (49 participants) – most respondents felt safe driving the vehicles.

TECHNOLOGY VALIDATION

- The approach is well organized to obtain the technical data and the market data needed to resolve the many issues that will impact the introduction of PEM fuel cell vehicles.
- The combination of PEM fuel cell and hydrogen infrastructure in the same program properly identifies the critical technologies.
- The need for codes and standards is properly addressed in this program.
- Good approach but needs to expand variety of "customer's" needs to include full climate exposure i.e. parking and refueling.
- The program asks all the correct questions. Focus on customers and public interest is excellent.
- Good description of key parameters.
- Customer perception is good survey approach.
- Different climate testing is very good.
- Minimal technical content makes judging this approach difficult; based on available information, the approach does not appear to be particularly innovative.
- Stress on outreach and familiarizing average car buyers with fuel cell technology for automotive transportation is very useful.

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

This project was rated **3.3** based on accomplishments.

- Completed a management plan within their company and for the public.
- Driving ranges were analyzed.
- They participated in 80 events with the vehicles. They also participated in many education events.
- Good infrastructure accomplishments in LAX, Michigan with DTE, and San Francisco.
- They have developed documentation on lessons learned with NextEnergy Hydrogen Fueling Stations.
- The operation in different climates is a critical part of the program and the data presented showed the climates but did not give the data for the vehicle operation. Was the vehicle operated in all the different climates?
- The program is progressing and developing the database for high velocity and stop-and-go driving.
- Fueling data demonstrates safe operation.
- Market data collection will provide future design and system characteristics.
- Good progress demonstrated.
- Data taken in areas with two different climates. Good job done to get training for safety and other governmental officials. Excellent data set collected that includes driving patterns and personal reactions to the vehicle driving experience. Excellent effort in education, informing the public. The lessons learned are also a very interesting and worthwhile data set.
- No discussion / results on key parameters used in the approach.
- The customer survey results are good. The pool size is too small.
- Fleet data summary is good – can be further quantified with useful information.
- No data on FC performance or range.
- Very little technical information makes judging progress very difficult.
- Interesting data collected in the customer perception and acceptance study.
- Little apparent improvement to the range.

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

This project was rated **3.3** for technology transfer and collaboration.

- DTE Energy, BP and NextEnergy are business partners. Their interaction was not described very well. It is implicit that they work closely with their partners.
- Strong track record of working with government agencies, non-profit organizations and for-profit organizations.
- Outreach program providing education base for consumer and future consumers.
- Strong infrastructure is being developed in California. Infrastructure in Michigan appears to be focused around Detroit area and not the whole state.
- What about the rest of the country?

- How will this program address approval of facilities by local fire marshals?
- With a number of outside organizations involved, collaborations appear acceptable but need to include and expand to general public.
- Great team with fuel suppliers, regulators, customers, and other stakeholders.
- Very good activities and outreach events.
- 30 vehicles is a good target.
- Strong partners, seemingly well-coordinated effort.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.4** for proposed future work.

- They indicated that more miles and more data needed.
- They said they need to demonstrate refuelings for the mobile unit – yet they have already demonstrated 640 refuelings.
- Continue the site development for the Los Angeles Station. It is unclear if this is a new station.
- Well organized future work activities.
- Infrastructure work focused on California. Is the effort in Michigan finished?
- Exposure to climate extremes.
- Future plan is for more miles and more data, exactly what is needed. Moving 70 MPA tanks into the next program phase is an important task for this next effort.
- Good summary.
- It will be helpful to provide measurable qualitative goals to match with the approach.
- Much of the same – no surprises here.

Strengths and weaknesses

Strengths

- They have good data collection through a wireless data collection system which has little impact on the customer.
- They are sensitive to how the customer has reacted to driving the fuel cell vehicle and refueling the vehicle. Their perception survey provides essential feedback.
- Strong commitment to development and demonstration of technology.
- Good investment by industry to make program a success.
- "Customers" are limited to fleets (fire and police) climate exposure only during operation (not parking).
- Excellent project team. Solid base in first phase to build upon.
- Good outreach.
- FC strength of Ballard (though not emphasized/mentioned).
- Significant number of tested vehicles possibly allowing DaimlerChrysler for more reliable data collection and analysis of the strengths and weaknesses of the company's fuel cell car technology at its present state of development.

Weaknesses

- More information on the vehicle performance would be helpful.
- More analysis on performance of the vehicle and the fuel cells would be helpful.
- Data are not fully disclosed. Much of the effort looks like a press release and not technology validation.
- Industry must open up its database because of the high profile industry and the government has given to hydrogen vehicles.
- Expand customer base, widen public exposure and promotion, and add more economic evaluation.
- Provide info on utilization of refueling stations and the availability factors.
- Approach to go down to \$3.00/gge not defined/evaluated
- Virtual absence of technical information.
- Without establishing a way of unobstructed flow of technical information, this and other technology validation projects have little value to component manufacturers.

TECHNOLOGY VALIDATION

- Very high project cost, possibly at an expense of underfunding the development of critical system components (stack components in particular).

Specific recommendations and additions or deletions to the work scope

- Add more analysis of the vehicle performance.
- More information on the deployment of the new generation fuel cell vehicles. How are they going to analyze the differences between the first and second generation?
- Provide data on climate conditions.
- It would be interesting to see DCX get interested in some integrated fuel-CHP activity, rather like the home refueling projects done by other companies.
- Please provide data on the key parameters – to promote positive and beneficial features of FCV and hydrogen.
- In the future, this presentation should focus much more on strictly technical/engineering outcomes from the testing.
- The approach based on sending all data to NREL does not seem to work; among others, it does not allow to discriminate between different teams' progress – their strengths and weaknesses; test summaries, lessons learned and conclusions should be delivered by individual teams, not combined and "averaged" by NREL.
- There seems to be a need to resolve codes and standards issues before building more hydrogen filling stations.
- Per-dollar value of this and other technology validation projects should be reviewed by DOE.

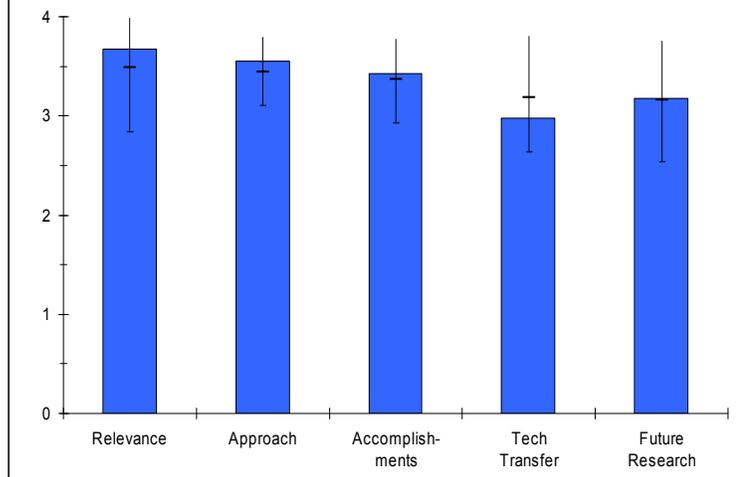
Project # TV-02: Hydrogen Fuel Cell Vehicle and Infrastructure Demonstration Program Review

Greg Frenette; Ford

Brief Summary of Project

To date in this project, Ford has placed 18 Gen I hydrogen fueled vehicles in fleet user service in three varied climatic regions to demonstrate the efficiency, reliability and durability of the fuel cell power concept, and to validate the concepts through the collection of real world data. To date, these vehicles have accumulated 274,000 miles. In parallel, hydrogen fueling stations have been sited (City of Taylor, MI, Jamestown, FL and Sacramento, CA Airport) to establish an initial hydrogen infrastructure, demonstrate alternative hydrogen production concepts, and evaluate production technologies for cost effectiveness. Emerging technologies in vehicle and hydrogen infrastructure are being validated in separate, advanced engineering vehicles (Gen II) and fuel cell system designs that demonstrate improved functionality, range, durability, economy, weight and cost.

Overall Project Score: 3.4 (4 Reviews Received)



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.7** for its relevance to DOE objectives.

- Project is important effort to demonstrate the feasibility of fuel cell vehicles and hydrogen infrastructure.
- Project is well aligned to DOE goals. Gathering data on a number of vehicles in several locations and also collecting fleet experiences is important to understand the true status of the technology in real-world applications.
- A status of cost reduction progress would improve relevance.
- Acquiring "real-world" operational data and experience is vital to making appropriate adjustments to the hydrogen R&D project mix and specific projects.
- This project is generating significant operational data.

Question 2: Approach to performing the research and development

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

- Good distribution of fueling sites with varying weather conditions.
- Good plan to demonstrate the technology and address specific issues through controlled tests and developmental prototypes.
- Crash safety studies should be included.
- Changing of an infrastructure objective was a good adjustment.
- Design of a multi-faceted gen 2 has resulted in a sound approach to addressing specific challenges that have been identified.
- Results and data from initial operations are being incorporated into next generation designs.

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

This project was rated **3.4** based on accomplishments.

TECHNOLOGY VALIDATION

- Not meeting miles driven or hour targets, but getting better.
- Good fuel cell performance.
- Fueling infrastructure issues are significant, specifically high cost and low usage.
- Excellent progress made so far. Vehicles being operated and fueled in all planned locations.
- Good list of lessons learned for infrastructure. This is important to share with industry to avoid making similar mistakes with future installations.
- Gen 2 vehicles progressing well: could go a long way to gain consumer acceptance especially by reducing the intrusion into cargo space.
- Suppliers of components should be involved with a high volume assumption to drive costs down.
- Reported on accumulation of vehicle miles versus targets.
- 8 of 18 gen 1 vehicles projected to achieve mileage and hours targets.
- Outstanding discussion of gen 2 prototype program. Excellent progress in past year on development of gen 2 vehicles.
- Outstanding attention to safety issues and concerns.

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

This project was rated **3.0** for technology transfer and collaboration.

- Data are being provided.
- Good partnership arrangement.
- Working with first responders to ensure adequate training and awareness.
- Good collaboration and coordination between team members.
- Collaborations outside the project team not apparent from presentation.
- It appears that more university and DOE lab assistance should be solicited.
- No discussion of outreach, training activities in the presentation.
- Communications on the project with other than the partners seems to be limited, based on the information provided.
- In response to a question, declined to provide any details to support conclusions/lessons learned.

Question 5: Approach to and relevance of proposed future research

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

- Continuing current effort with some improvements to vehicles and stations.
- Hybrid configuration could be interesting compromise to hydrogen storage challenges.
- Future plans include continuous improvement to vehicle design, specifically with hydrogen storage.
- Consumer research should be included.
- Discussion of future research was limited and general.

Strengths and weaknesses

Strengths

- Experienced partners.
- Project partners are continually improving vehicle design by addressing technical issues with sound R&D.
- Solid project plan – multiple vehicles in service in different climates to demonstrate technical progress.
- Showing cost reductions in new designs
- Great engineering and fabrication are evident. Results of testing are excellent.
- Getting significant miles and hours on vehicles.
- Gen 2 vehicles show promise of significant improvements.
- Attention to safety.

Weaknesses

- Results from customer feedback on performance and experience should be included in presentation.

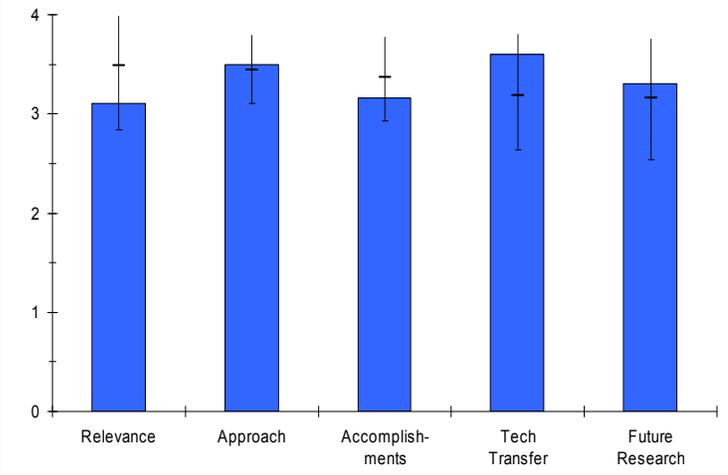
- Needs more collaboration with labs, universities, and suppliers to move toward real world, affordable products.
- Little evidence that there are education and outreach activities as important elements of this project.
- It is not clear that benefits per dollar spent are maximized, due to the dispersion of hydrogen infrastructure sites built specifically for the project and so few vehicles.

Specific recommendations and additions or deletions to the work scope

- Increase miles driven and the number of vehicles available so that stations can be more fully utilized and more information on potential improvements generated.
- If possible, some baseline comparisons with conventional technology in similar service would help show the progress toward commercialization.
- Please search for ways to make more of the data and information generated by the project publicly available. More should be shared in exchange for public (Federal) funding of \$44 million.

Project # TV-03: Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project*Dan Casey; Chevron***Brief Summary of Project**

Chevron, Hyundai-Kia Motor Co. and UTC Power are conducting a five-year demonstration and validation project designed to showcase how fuel cell vehicles (FCVs) and hydrogen infrastructure can be designed to work together to fuel vehicles of the future. The primary goal of this project is to demonstrate up to six hydrogen energy stations (primarily in Southern California, with one site elsewhere to test cold climate conditions) and up to 32 FCVs as well as inform key audiences about hydrogen as a potential vehicle fuel. Both cold- and hot-weather testing was conducted in the past year. In addition, important safety and legal codes and standards for hydrogen refueling technologies will be developed in conjunction with the federal government and other authorities. Hyundai will provide a fleet of up to 32 vehicles, powered by UTC fuel cells. Hydrogen at the refueling stations will be generated using different types of natural gas reformer technologies and electrolysis. Other collaborators include Southern California Edison, Hyundai KIA America Technical Center, Inc., Alameda Contra Costa Transit and Tank Automotive Research, Development and Engineering Center, who will serve as vehicle fleet operators and site hosts for hydrogen fueling and power generation stations.

Overall Project Score: 3.3 (5 Reviews Received)**Question 1: Relevance to overall DOE objectives**

This project earned a score of **3.1** for its relevance to DOE objectives.

- Excellent description of objectives. Very clearly stated.
- Good demonstration program but there are no R&D objectives here.
- Necessary activities to move forward with fuel cell testing coupled with fuel infrastructure development.
- Excellent match with DOE targets and President's objectives.
- This is one of several highly visible and very expensive projects that are not very likely to have a major impact on overcoming the greatest challenge of the Hydrogen Fuel Initiative.

Question 2: Approach to performing the research and development

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

- Their approach is right on target with what DOE wants.
- Impressive number of vehicle. PI needs to explain if this is Gen 1 or Gen 2 vehicles like the other automotive OEMs. PI needs to clarify if these vehicles are freezable or not.
- Chevron is doing what needs to be done. The GRI program is interesting, with an option to make either hydrogen or electricity. Excellent emphasis on training and education.
- Excellent combination of FC manufacturer, vehicle supplier, and energy provider as well as sites and users.
- Keep hydrogen capacity low to match with the anticipated FCV usage and hydrogen (keeps cost low!).
- Virtual absence of technical content in the presentation makes the approach taken difficult to assess.
- A list of milestones does not constitute an approach.

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

This project was rated **3.2** based on accomplishments.

- Good training with first responders.
- All station progress clearly explained
- GTI POGT (Gas Technology Institute Partial Oxidation Gas Turbine)
- Hot and cold weather results clearly explained. Data collection explained. Lessons learned for storage inventory calculation.
- Looks like infrastructure lags behind vehicle deployment quite a bit. It would be unreasonable to expect many miles until next year's Merit review.
- Good progress in getting the fueling stations operational. Several different locations with different climates are involved. Data collection is well done, focused and intelligent.
- Good progress towards number of vehicles and refueling stations.
- 350 bar readiness is good.
- No mention about range and benefits/challenges of 700 bar FCV.
- Please provide data on your experience for customer benefit (range, miles/kg, emissions, etc)
- For the reason of very scarce technical information, progress evaluation is extremely difficult.
- As in the case of other technology validation mega-projects the value-for-money aspect of the Chevron project continues to be unclear.
- Reporting data to NREL cannot be used as a measure of progress and accomplishments; that data should have been included in the presentation.

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

This project was rated **3.6** for technology transfer and collaboration.

- Not too many partners to drive the cars around. PI should have a slightly larger group for diverse driving patterns.
- Quality project team.
- Very good combination of stakeholders and productive outreach activity.
- Numerous, strong partners from various sectors.
- Coordination and division of effort have not been sufficiently addressed.
- Based on this presentation alone, UTC's role in the project is unclear (except for providing a winter-test venue).

Question 5: Approach to and relevance of proposed future research

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

- 32 cars in 2007.
- Pretty straight forward here what needs to be done in the next few years.
- More cars, more miles, more data – all the right direction. The GRI effort brings on-site hydrogen to the mix.
- Good plan.
- Learn about different climates.
- Validate POGT benefits.
- Proposed future research merely represents continuation of the testing; there seems to be no impact of previous research on future plans.
- Once again, the project suffers here from the lack of technical information that should have served as a base for future research.

Strengths and weaknessesStrengths

- Real world data being collected

TECHNOLOGY VALIDATION

- 6 on site generators being tested.
- Cars on road in all climatic conditions.
- Excellent team; solid planning.
- Good combination of climates and civilian vs. military sites.
- 20 vehicle deployment is an excellent progress and commitment from the team.
- In spite of the absence of specific technical information from the testing, one might assume that significant number of test data has been generated in this testing and delivered to NREL.

Weaknesses

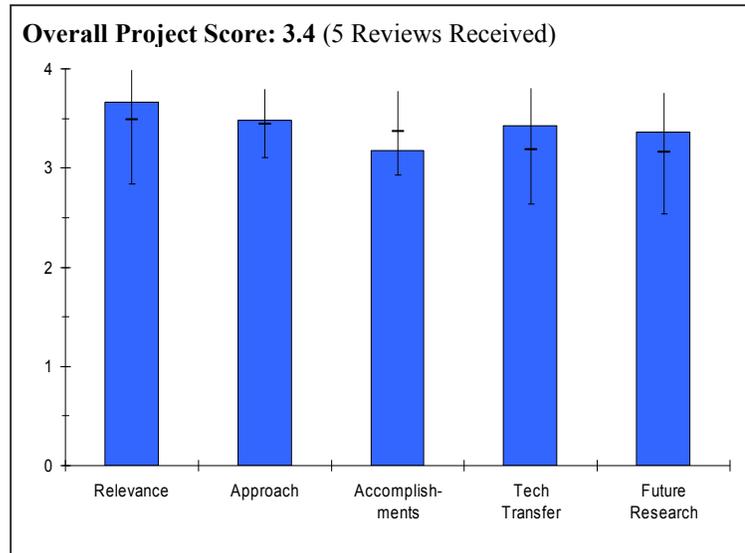
- None identified
- A little bit behind the other automotive OEMs.
- No projected performance on POGT or lab data for hydrogen.
- What is the impact on emissions due to POGT?
- Very little technical information has been made available to the community.
- Like in other technology validation projects in this group, the benefit to the manufacturers of the key fuel cell components is questionable at best.
- Approach based on sending all the technical information to NREL does not seem to have worked very well and made project evaluation virtually impossible.

Specific recommendations and additions or deletions to the work scope

- Analysis on the cost of hydrogen delivered.
- Automotive partner needs to give it to a little more diverse group of customers.
- Teams in charge of this and other technology validation mega-projects should be required to deliver real technical presentations from their work; at present, the use of NREL as an intermediary produces an average over the outcomes of all teams, with relatively little information that could be truly useful for advancing the hydrogen technology.
- Huge investments of DOE funds in technology validation projects led by Chevron, DaimlerChrysler, Ford and GM ought to be re-assessed.

Project # TV-04: Hydrogen Vehicle and Infrastructure Demonstration and Validation*Roz Sell; General Motors***Brief Summary of Project**

General Motors and energy partner Shell Hydrogen are deploying a system of hydrogen fuel cell vehicles integrated with a hydrogen refueling infrastructure to operate under real world conditions to: 1) Demonstrate progressive generations of fuel cell system technology; 2) Demonstrate multiple approaches to hydrogen generation and delivery for vehicle refueling; and collect and report operating data. Eight gen 1 vehicles have been deployed in Washington, D.C. and southern California. This project will demonstrate two generations of fuel cell technology deploying forty fuel cell vehicles (8 gen 1 and 32 gen 2) fueled with hydrogen from stations in five locations.

**Question 1: Relevance to overall DOE objectives**

This project earned a score of **3.7** for its relevance to DOE objectives.

- Vehicle OEM demo partnerships with fuel suppliers are square in the middle of the DOE Technical Validation Scope.
- Strong team with focus on meeting Hydrogen Initiative goals through well-designed vehicle and infrastructure demonstration project
- Project is in line with DOE objectives – results of real world experience is important to assess technology readiness.
- The PI addressed everything in an outstanding way.
- Acquiring "real world" operational data and experience is vital to making appropriate adjustments to the hydrogen R&D mix and specific projects.

Question 2: Approach to performing the research and development

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

- Lack of progress in deploying hardware belies an apparent weakness in approach.
- The Shell early accomplishment in getting the Benning Road station up and running was apparently out of sync with vehicle deployment.
- Incorporation of hydrogen into existing fueling sites is great way to introduce the public to the idea of hydrogen as an alternative fuel.
- Bi-coastal approach hits areas with diverse climate and large populations, in addition to strong political interest.
- Public access fueling stations are a good approach – can lead to other hydrogen vehicle partnerships that leverage limited funding and increase station use.
- Documenting C&S and permitting imperative to share success and difficulties. Can help future projects avoid the same issues.
- Suppliers should be heavily involved. A cost study trend should be developed to track progress toward reality.
- Approach results in anticipated benefits being concentrated in the latter half of the project period. Will increase the vehicles by a factor of 4, and expand fueling sites from 1 to 3.
- Placing stations at retail sites is a plus for the project.
- Project elements of outreach to students, training of first responders and showcase events are outstanding.

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

This project was rated **3.2** based on accomplishments.

- Despite high profile announcements and photo ops, real deployment of fuel cell vehicles has not occurred.
- 8 vehicles (not much used) and 1 refueler are not in keeping with initial expectations.
- Other similar projects have resulted in dozens of real, roadworthy vehicles each in service with hundreds of non-professional driver experiences.
- Making progress and expanding into new cities as planned.
- Recognize permitting issues as the longest lead item.
- Great progress made in the last year with putting vehicles in service and fueling stations on-line.
- Would like to see some general descriptions of how the vehicles are being used by each site.
- New vehicle is outstanding.
- Based on presentation information, there is no way to assess vehicle and re-fueling infrastructure performance.
- Even minimal information on vehicle miles and hours was not mentioned, and not offered in response to a question.
- Detailed information was provided on some topics, e.g., education initiatives, but not with respect to issues.
- Related to major commercialization barriers.

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

This project was rated **3.4** for technology transfer and collaboration.

- The Shell refueler at Benning Road has been a very good opportunity to show policy makers and the general public that hydrogen can be handled safely and be available conveniently.
- The addition of the State of Virginia Department of Environmental Quality and USPS as project partners has offered high profile additional opportunities to deploy vehicles.
- Well integrated partners, with complete, or nearly complete, set of skills at high level.
- Good set of recommendations/observations related to key challenges and suggested approaches for solution.
- Project team working well with other groups to transfer knowledge: training program with first responders excellent.
- More involvement of DOE labs and universities should be included.
- Outstanding number and diversity in vehicle operator partners. In gen 2, will be getting data from a variety of drivers.
- Good discussion of data design and transfer system.
- Outreach and education are important in this project.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.4** for proposed future work.

- The proposed 100 new vehicles is a promising new beginning after a slow start.
- The use of non-professional drivers in this new phase will be a welcome new opportunity.
- Expansion into other large markets fits strategy well.
- Future work planned will add data on many more vehicles in service, which will be important to help meet DOE tech targets.
- Data collection from customers and other participants are a good addition to the overall project.
- Sales and marketing research should be part of vehicle research.
- The major benefits from this project seem to lie ahead, in gen 2.

Strengths and weaknesses**Strengths**

- The Shell Hydrogen partner seems reliable
- The addition of the USPS component is a good fleet option apparently missing from the initial four FreedomCAR projects.
- The photo ops for this project have been exceptionally well advertised; a benefit to all the FreedomCAR projects.
- Experienced and committed team members.
- Larger numbers of vehicles will provide a good baseline on the current state of the technology.
- Public station access creates opportunity for collaboration with other projects and helps build public awareness for hydrogen and fuel cell technology.
- Great engineering and fabrication are evident. Results of testing are excellent.
- Outreach, training, and education.
- Gen 2 vehicles show promise of significant improvement.

Weaknesses

- GM's lack of enthusiasm for vehicle deployments.
- Need to begin transfer of fueling and some maintenance to customers to gain real acceptance.
- None.
- Relatively little operational experience to date, with one re-fueling site and 8 vehicles.
- Reluctance to provide even basic specific results and data.
- It is not clear that benefits per dollar spent are maximized, due to the dispersion of hydrogen infrastructure sites and so few vehicles.

Specific recommendations and additions or deletions to the work scope

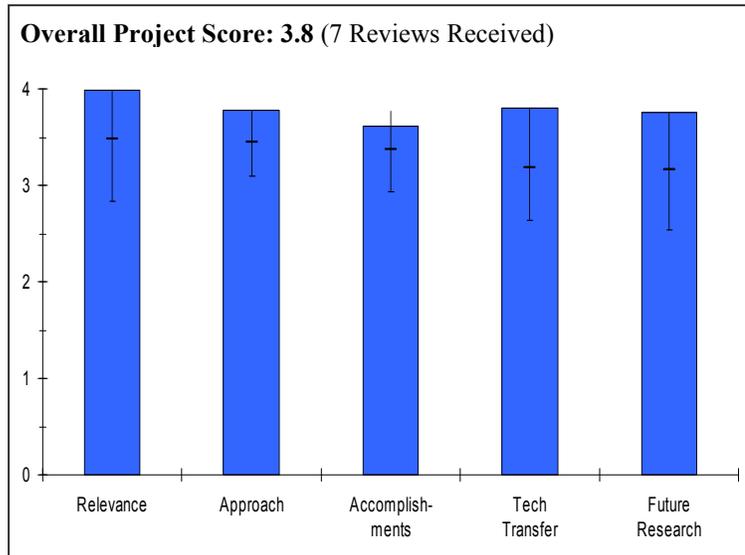
- Need to ensure that C&S efforts are fully integrated into the other Program activities in this area.
- Please search for ways to make more of the data and information generated by the project publicly available. More should be shared in exchange for public (Federal) funding of \$44 million.

Project # TV-05: Controlled Hydrogen Fleet and Infrastructure Analysis

Keith Wipke; NREL

Brief Summary of Project

Under this multi-year validation project the National Renewable Energy Laboratory is assisting DOE in demonstrating use of fuel cell vehicles and H2 infrastructure under real-world conditions, using multiple sites, varying climates, and a variety of sources for hydrogen, including renewables. The objectives of this project include: 1) Validation of hydrogen fuel cell vehicles and infrastructure in parallel; 2) Identification of current status of technology and its evolution; 3) Re-focusing hydrogen research and development; and 4) Supporting the technology readiness milestone in 2015. This project takes data from all the controlled hydrogen vehicle and infrastructure fleet tests, analyzes it, and prepares reports.



Question 1: Relevance to overall DOE objectives

This project earned a score of **4.0** for its relevance to DOE objectives.

- This project is exactly what DOE EERE needs to maintain the proprietary data.
- Excellent work to gather all TV [Technology Validation] information
- We finally can look objectively at the claims being made by GM, Ford, DC, and Hyundai.
- Critical effort to collect, organize, and distribute the fuel cell vehicle fleet data. Absolutely necessary to do this and do it very well because so many resources are being spent to do these demonstrations.
- Analysis of FCV fleets and utilization of hydrogen.
- Infrastructure is very important. The project address that well.
- Objectives are well defined and measurable.
- This oversight project is essential to assessing the status of hydrogen vehicle progress.
- This is the conduit to some of HFCIT's most important projects. It is very relevant.

Question 2: Approach to performing the research and development

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

- This project approach was designed in close coordination with DOE staff and is being conducted in a professional manner.
- Secure and analyze the data. HSDC (Hydrogen Secure Data Center). 114,000 individual trips analyzed.
- Interact with companies.
- Would like to see more public disclosure as soon as available.
- Excellent.
- An impressive activity by NREL, doing exactly what is needed. Intelligent plan. Proprietary concerns managed correctly.
- Good strategy for data collection and analysis.
- Need to identify key parameters to showcase the benefits of FCV and hydrogen (miles/kg, impact of operating conditions, maintenance, emissions, etc).

- Refueling time, amount, capacity factors, and availability factor should be analyzed for greater value of the data.
- The data presentation is comprehensive and thorough, considering the field experience in the program.
- Many database systems are used by industry to manage larger and more complex databases. It is not obvious that a custom database was necessary. It may have been more cost effective to use a commercial database rather than developing a DOE proprietary database for this single task.
- Putting the data on a website is an excellent improvement.
- “Mean Time between Failure” and “Mean Time between Repair and Availability” data would be good to add to the data set.
- “Fueling Station Fuel Delivery Capacity Factor” (capacity served as a percentage of available capacity) would be good to add to the data set.
- Some indication of stack life or stack changes would be good to add to the data set.
- This task is difficult. NREL uses a good approach, using the secure data center.
- NREL did not mention one of the key steps of their approach – gaining the trust of the four project teams. Good job!
- The series of publications is a good component.

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

This project was rated **3.6** based on accomplishments.

- Fleet analysis Toolkit FAT is used.
- All methods are documented in quarterly reports. These have been delivered on time and have been presented at key conferences. 30 composite data have been published.
- Developed a more responsive website for easier access to users. This was in response to the previous annual program review feedback.
- They have determined the fuel cell stack hours accumulated through December 2006. Extrapolation was used to determine fuel cell stack degradation. They can determine the DOE target of 1000 hours degradation of 10%.
- Their safety reports provide some documentation of safety incidents.
- Infrastructure maintenance is important in identifying future maintenance requirements.
- Excellent.
- Excellent.
- NREL has done a great job during the first phase, and has built a quality team for continuing forward.
- Too many details, little substance, please focus on key results.
- On-road data is most important for customer acceptance.
- Please use graphics that are more legible.
- Progress is consistent with project progress and up to date – this is a strength.
- I think we're seeing good progress now. It was difficult for this project earlier before much data had been transferred, and there appeared to be some skepticism as to if they would obtain sufficient data.
- While there is certainly much sensitive data, it is unclear why the PI does not differentiate between data that is sensitive and cannot be reported and data which simply hasn't been analyzed. I sensed a hesitation to differentiate between the two. Reviewers can still get a feeling that the project is headed in the right direction if we are told that the analysis has been performed, but the result has not been cleared (or even won't be cleared).

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

This project was rated **3.8** for technology transfer and collaboration.

- They collect data from industry successfully and disseminate data via website very successfully.
- They compute a range from several sources based on their input.
- They can put the pieces together and determine a range histogram per company.
- Vehicle range factors analyzed include on road, window sticker and dyno (dynamometer) range.
- Great job of cooperation with teams and publishing results.
- Need to collaborate more with universities.

- Excellent cooperation with industrial, governmental and other (public) stakeholders. Excellent record of getting data distributed.
- Good interactions with stakeholders.
- FC [fuel cell] and refueling station should be separately addressed and analyzed.
- Data dissemination using a website is an excellent improvement.
- The listed collaborations with other projects are excellent.
- The reports and website are a real plus.
- Interfacing is by definition controlled.
- Safety Panel interaction is very important.

Question 5: Approach to and relevance of proposed future research

This project was rated **3.8** for proposed future work.

- Stack degradation data will improve as more hours are reported per stack.
- Radio histogram of refueling.
- Feedback for future R&D.
- Encourage expansion to include MTBF [mean time between failures] and FMEA [failure mode and effects analysis] information as more data is collected.
- Excellent.
- One hopes for the same quality as NREL gave for gen 1 plus even more.
- Fuel cell degradation under hybrid vs. non-hybrid (more demanding conditions) should be analyzed. This will help R&D to better focus on the duty cycles.
- Compare with others in non-DOE environment if possible.
- Next phase plans are appropriate and timely.
- Exactly what it needs to be.
- Compilation of lessons learned, especially in the safety area would be welcomed.

Strengths and weaknesses

Strengths

- Provides DOE with a means to analyze collect data and analyze it in a methodic way. Excellent dissemination of data.
- Great analytical capability great data handling capability.
- Data collection algorithms and comprehensive analysis.
- Good summary of progress made, overall status.
- Web-access of reports is great progress.
- Breadth of data.
- Lessons learned.
- Customer data (time to refuel).
- A very tough job, done well.

Weaknesses

- None
- Inhibited by need for confidentiality.
- Need to filter out the "noise" and "bias" of the data input. A question of veracity.
- Please minimize the introductory slides that do not contribute to the project message (e.g. slides no. 11, 12, 13, 14, 15, 27-28, etc).
- No comparison with other international projects.
- Some programs are not tracked (APS for one).
- See second bullet under technical accomplishments. [While there is certainly much sensitive data, it is unclear why the PI does not differentiate between data that is sensitive and cannot be reported and data which simply hasn't been analyzed. I sensed a hesitation to differentiate between the two. Reviewers can still get a feeling that

the project is headed in the right direction if we are told that the analysis has been performed, but the result have not been cleared (or even won't be cleared).]

Specific recommendations and additions or deletions to the work scope

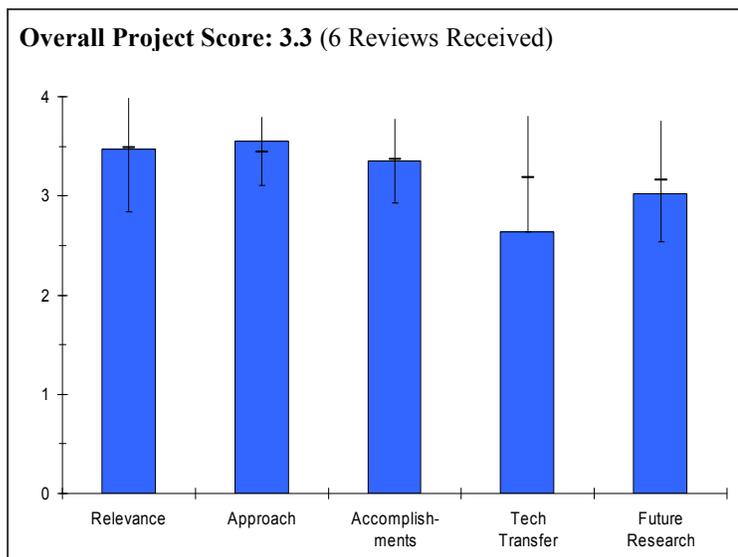
- 40 slides in this venue are a bit much to absorb.
- Suggest policy options to assist car manufacturers and energy providers to commercialize vehicles and establish critical infrastructure.
- Lessons learned would be helpful as a published report.
- Other countries (i.e. Asia and Europe) have somewhat similar fleet operations underway. It would be interesting to build a global record of fuel cell vehicle demonstration results. At least, NREL might add some web links so those reports are easy to find.
- Focus on lessons learned – identify positive attributes for good value – highlight them.
- Capacity factor at each site is important for cost reduction.
- Benchmark against European and Japanese initiatives
- Try to include more projects, even those not in the DOE program.
- Compilation of lessons learned.

Project # TV-06: Validation of an Integrated Hydrogen Energy Station

Dan Tyndall; Air Products

Brief Summary of Project

Air Products and Chemicals, Inc. is conducting a project to demonstrate the technical and economic viability of a hydrogen energy station using a high-temperature fuel cell to produce hydrogen and electricity. A total system design and engineering development effort has been completed with the goal to economically recover hydrogen from the anode of a high temperature fuel cell. Design and construction of the energy station is in progress. The project will conclude in a year-long demonstration of the system at a suitable site. Safety is the top priority in the system design and operation.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.5** for its relevance to DOE objectives.

- Excellent concept for pursuing energy-generating infrastructure.
- Reduced hydrogen cost and improved efficiency extremely beneficial.
- This project is advancing capability on the supply side.
- Production of heat, power and fuel from waste streams could provide environmental benefits with respect to both the elimination of waste and production of useful energy products.
- Project addresses the lack of hydrogen infrastructure for hydrogen which fits into DOE objectives.
- Need to indicate how much of these sources are available in a practical manner. (Is digester gas a potential to supply 1% or 10% or 50% of U. S. needs?) Without this info the relevance is very hard to access.
- Demonstrating the viability of using a variety of biomass feedstock materials to produce hydrogen at commercial prices.

Question 2: Approach to performing the research and development

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

- Thorough project design.
- Appropriate correlation with natural gas pricing – cost reduction should be focused on improvement of conventional storage, clean up, compression, balance of plant, and dispensing systems.
- Further explanation of cost saving opportunities is needed, if any, of new PSA technology/design.
- Project has many parts to it, and appears organized to adequately handle all parts.
- Right-sized for the streams of interest.
- Flexibility of the system allows it to be used with a variety of feedstocks that are not necessarily available in huge quantities.
- Good approach for station capable of producing hydrogen fuel and providing electric power.
- Allowing for multiple feedstocks makes the system more flexible for use at varying geographic locations.
- Excellent plan and execution to date.
- In his presentation, and response to questions, Mr. Tyndall clarified the importance and challenge of: (1) integrating equipment included in the overall system design; and (2) design of the sub-system for hydrogen purification.

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

This project was rated **3.4** based on accomplishments.

- Excellent design and planning; timeline for completion looks good.
- Permitting is critical, further discussion of progress to completion needed to verify timeline.
- Project schedule moving a little slower than expected relative to state of project presented last year; e.g., Advanced PSA H₂ recovery was already done last year, so intervening time has only produced bid specs and some (very important) gas clean-up work.
- Progress would likely have been more advanced if DOE funding had been more available.
- Making good technical progress.
- Site selection for Phase 3 facility.
- Project appears to be on track.
- Excellent choice of sites: having a motivated partner will greatly improve chance of a successful demonstration.
- Early days yet, but looks very promising.
- Has taken quite a while for the project to hit its stride (only 20% of the budget so far). But preliminary work prior to final design and construction has been thorough, resulting in well-supported decisions which should set the stage for a successful demonstration.

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

This project was rated **2.6** for technology transfer and collaboration.

- Partnership with FCE appears positive and ideal.
- Interfacing with potential users (OEMs) is unclear.
- With the several elements in the project and public demonstration, this is an excellent opportunity to build new working relationships and capability among important supplier and user groups.
- With the selection of the site for Phase 3, relevant partners are being identified.
- Technology transfer not apparent from presentation.
- Need more industry, universities, and DOE labs involved to address design refinement opportunities and reduce cost.
- Based on the presentation, there is no evidence of collaboration or communication with organizations other than the project participants.

Question 5: Approach to and relevance of proposed future research

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

- On paper the numbers (e.g. efficiencies, production, power, etc.) are incredibly promising – real-world performance data are critical to project success.
- Data collection and real-time performance analysis plan is unclear.
- The group is identifying and solving issues as presented.
- This project is revealing work needed in gas clean-up.
- This project is revealing relative value to production of H₂ vs. electricity.
- Future design progress for the selected site will focus the work on this specific feedstream, and will allow APCI to optimize the process design and operation.
- Need to document the experiences and lessons learned, including user perspective.
- Need to work with user to include hydrogen vehicle fueling as part of project. System can't be fully demonstrated without testing that aspect along with power generation.
- Study total long term potential for significant percentage of H₂ and electricity for total country needs.
- Plans for completing Phase 3 and later phases follow logically from the planning, design work and studies accomplished during the earlier phases of the project.

Strengths and weaknesses

Strengths

- Excellent and needed project concept: energy + hydrogen + heat + bio-waste energy.
- Potential to fill real-world data needs for energy stations and bio-waste energy/hydrogen production.
- Waste-to-energy projects are very desirable at the community level. This project provides a renewable energy hydrogen production application while showing how technology can truly help solve the burdensome problems of waste disposal.
- Good progress on operation of PSA for dilute hydrogen feed.
- Multiple feedstocks make the system more flexible.
- Very promising for very low cost H₂ and electricity production.
- Builds on technology for power production that is becoming more widely used, and for which there is a growing experience base.

Weaknesses

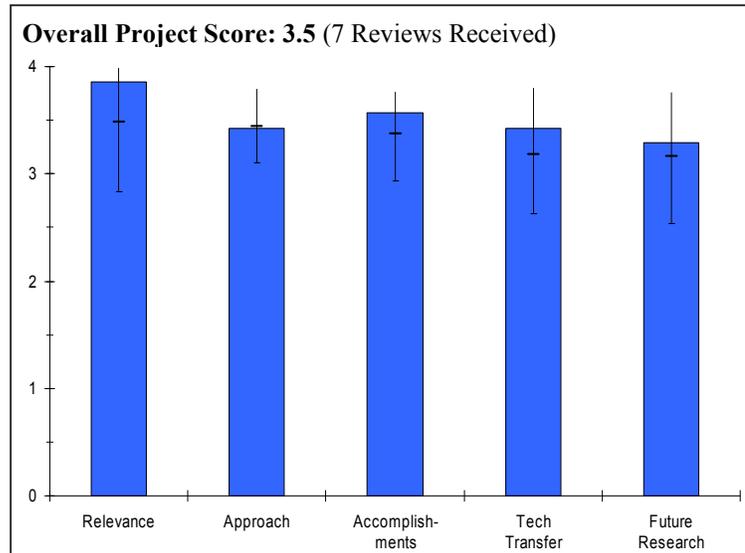
- High project complexity including added new technologies with unclear cost advantages (e.g. new PSA).
- Greatest value to come from installed, working station generating real-world data – permitting and other external factors will greatly influence timeline (real-world operation less than one-half of overall timeline).
- This project seems to be going a little slower than I expected. Perhaps I'm just too anxious to see this integrated project get going.
- Need to transfer lessons learned and document process of gaining permits to build station. This will be important for the industry and others interested in implementing the technology in the future.
- Acronyms are excessive. (I missed some info I'm sure.) Concerned if all this effort has potential for a significant amount of H₂ and electricity on a total country percentage effect basis.
- Evidently the project budget will be increasing, in order to allow completion of work currently planned for Phase 3 and beyond.

Specific recommendations and additions or deletions to the work scope

- Extended operational term with comprehensive data gathering covering efficiency, well-to-wheel emissions and energy use.
- Lessons learned and barrier identification for future commercial infrastructure.
- Based on my experience with trying to develop similar projects in Sacramento, I have difficulty accepting the economics as presented. Maybe this project needs to disclose actual project costs for components as well as projected future costs.
- Work with project partners (or add partners) to fully test system capabilities by adding hydrogen vehicle fueling demonstration.
- Calculate how much total energy (%) the USA could get long term!
- A statement was made indicating there is some interest in adding a hydrogen fueling station to the project. If that happens, it is recommended that DOE not participate in funding such an addition to the scope, since DOE is already supporting a number of demonstration hydrogen stations.

Project # TV-07: California Hydrogen Infrastructure Project*Ed Heydorn; Air Products***Brief Summary of Project**

This project is focused on demonstrating a cost-effective hydrogen infrastructure model in California for possible nationwide implementation. It includes the design, construction and operation of seven hydrogen fueling stations; collection and reporting of operational data; documentation of permitting requirements and experiences; and validation of expected performance, cost, reliability, maintenance, and environmental impacts. In this project Air Products is also deploying a novel hydrogen compressor they have designed with capital costs potentially 50-75% less than conventional systems. This project will also implement a variety of additional new technologies with the objective of lowering the cost of delivered hydrogen.

**Question 1: Relevance to overall DOE objectives**

This project earned a score of **3.9** for its relevance to DOE objectives.

- Most relevant aspects include fuel station footprint reduction and infrastructure capital cost reduction.
- Learning and value gained by increasing vehicle usage and infrastructure learning through the creation of a working "network".
- Additional value generated through innovative, new technology developments – greatest DOE value gained if learning is shared.
- 7 fueling stations are targeted. Results are being compared to NREL's data. This project helps DOE determine a transition pathway for establishing hydrogen fueling stations from several different sources.
- Very relevant to the DOE objectives for H₂ cost and delivery.
- Understanding the cost associated with development of a hydrogen delivery infrastructure is important to the future of hydrogen vehicles.
- Validation of the technology is on the critical path to establishing a hydrogen energy structure in the U.S.
- Direct application to immediate use for H₂ fleet. Excellent transient filling stations.
- The DOE emphasis on testing and evaluation of hydrogen vehicles requires the deployment of a hydrogen infrastructure. This project is a part of this emphasis.
- Hydrogen refueling stations are vital to the president's initiative – this is a very important contribution towards that goal.

Question 2: Approach to performing the research and development

This project was rated **3.4** on its approach.

- Excellent work with OEMs in coordinating fuel demand vs. location vs. timing and fueling requirements
- Reliance on mobile and temporary stations may limit extrapolation and learning for future commercial infrastructure deployment, cost and footprint reduction as well as reducing the "retail"-feel for near-term customers – future work and presentations should clearly show linkage of mobile application learnings to future commercial situation
- Work with OEM's and station operators.

TECHNOLOGY VALIDATION

- Design, permits, and installation are detailed.
- Specific status relative to technical/cost barriers was not sufficiently addressed.
- Unclear if sufficient detailed information will be provided to DOE to help guide R&D.
- Project should benefit Program by involving OEMs not currently involved in the learning demos.
- Criteria for success, cost targets, milestones, etc., are unclear.
- The approach is well organized and addresses many of the critical features to making the hydrogen station a commercial enterprise.
- The collection of data and feedback for the station operations is an important aspect for the next generation of hydrogen delivery systems.
- Very focused effort on new compressor may be diluting effort by inclusion due to development required.
- Main emphasis is validation of performance. Most of this project seems a conventional business activity, selling and installing commercial hardware; in this role Air Products serves more like a vendor.
- Working with all stakeholders including OEMs and energy companies.
- Is a great approach – from planning through execution stages.
- Selection of low-cost alternate designs to reduce the cost of hydrogen.

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

This project was rated **3.6** based on accomplishments.

- Progress to date is impressive, particularly for the new UCI station with 700 bar fueling and a more "retail"-like setup – further developments of this kind should be pursued.
- Progress on novel compressor appears promising – reduced capital costs clear, however, the operating costs and electricity usage (energy use) need to be better explained.
- UCI has 300 fills and have met all performance targets.
- This is a public station. Opened in February 2007.
- Torrance station based on Air Products pipeline as a source of hydrogen. Completion should be ready by the end of 2007.
- Hydrogen Fuelers (HF-150) mobile fuelers. This is being held in Long Beach, CA. The station should be online in the next 30-60 days.
- New delivery concept – trailer delivered with gaseous delivery on demand. Testing is completed. Hydrogen Base Unit (HBU) hydrogen fueler without wheels. Discussing the HBU with station operators to help in the transition. Novel compressor system is being integrated with these stations.
- Good technical progress since last year.
- Progress in site selection has been slow.
- Some unique delivery concepts and a compressor are included that should benefit the Program and help support near-term activities by OEMs.
- Program progressing well. Start up of fueling stations at UCI is important milestone.
- The presentation did not discuss the database that was developed but rather reported the event: reads somewhat like a press release not a technical program sponsored by the DOE.
- Novel compressor is interesting but is an adaptation of older technology. This should be identified by Air Products.
- Good implementation progress. Good scale up to 700 bar.
- Progress is evident in the UCI filling station. The pipeline project (Torrance) will be interesting to monitor. The portable tube trailers must be thought of as just a stop-gap activity.
- UCI stations with 350 and 700 bar capability show excellent progress.
- Mobile fuelers with liquid and gaseous hydrogen is a highly innovative low-cost option.
- Single stage [compression from] 100 psi to 14000 psi without external cooling has a potential of cost reduction.
- Good use of APCI's (Air Products and Chemicals, Inc) experience in high pressure H₂ in other areas.
- Considering the funding used so far, excellent progress has been made in all seven stations.

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

This project was rated **3.4** for technology transfer and collaboration.

- Good interfacing with OEM project partners.
- Unclear interface with other DOE TechVal (TV) programs – project managers should show linkage with TV programs and, if not already, develop appropriate systems to increase the overall network, vehicle usage, and learning generation.
- Well-to-wheels analysis to be conducted by UCI is a critical program feature.
- Many good collaborations are included in this project.
- Works closely with OEMs and fueling station operators especially Orange County and Los Angeles County in and around their pipelines.
- Very good collaboration with state and local entities in California.
- Program collaboration is within the program. I did not see much on outreach efforts.
- Will Air Products make station performance data available to all of industry or is this company private?
- The pipeline approach is unique to Air Products and should provide valuable information that could move the hydrogen infrastructure forward.
- Appears to have excellent communications with automobile people as well as station operators.
- AP has sought siting input from vehicle manufacturers. It would have been better to contact local agencies for a parallel input.
- Involving UC Irvine as outreach and study partner is an excellent idea.

Question 5: Approach to and relevance of proposed future research

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

- Novel compression shows excellent capital cost reduction. Operating costs and energy usage need better explanation.
- Learnings from mobile fueler and new delivery concept deployments need to show clearer application to impacting future fully commercial infrastructure design.
- Novel compressor development – complete operating program (what about cost?).
- Their slide of future work was comprehensive and provided a good summary for each of the technologies.
- Report the costs and technical challenges of establishing a fueling station that uses an existing pipeline as the source.
- Future work will contribute to the Program with multiple operating H₂ delivery concepts and a novel compressor.
- More emphasis should be placed on addressing specific barriers and targets.
- Program planning is well organized and addresses the high points of the objectives.
- A commitment to share more data with the public would be a beneficial addition.
- Expanded installations excellent. Suggest new 14,000 psi compressor development effort be separated into its own project.
- Installation of hydrogen dispensing at other sites is an obvious follow-on, but was not mentioned.
- 700 bar vehicle support is important to increase the range. UCI station is ready for that.
- NDC (new delivery concept) and HBU (hydrogen based unit) testing is likely to provide a new low-cost option.

Strengths and weaknesses

Strengths

- Flexible and (relatively) short turnaround on infrastructure deployment concepts.
- Cost and footprint reducing technologies.
- 700 bar fueling for next generation vehicles.
- Well-to-wheels analysis of various deployment approaches.
- Integrates previously funded projects such as the novel compressor.
- Beneficial project as part of the initial H₂ transition.
- Strong technical capabilities.
- Well organized approach by a strong company.
- Pipeline approach is very important to resolving delivery of hydrogen issues.

TECHNOLOGY VALIDATION

- Strong, workable equipment developed experience with installation. Experience with installation. Experience with a variety of fueling options.
- Working with all stakeholders and building on APCI's (Air Products and Chemicals, Inc).
- Technology strength is very important.

Weaknesses

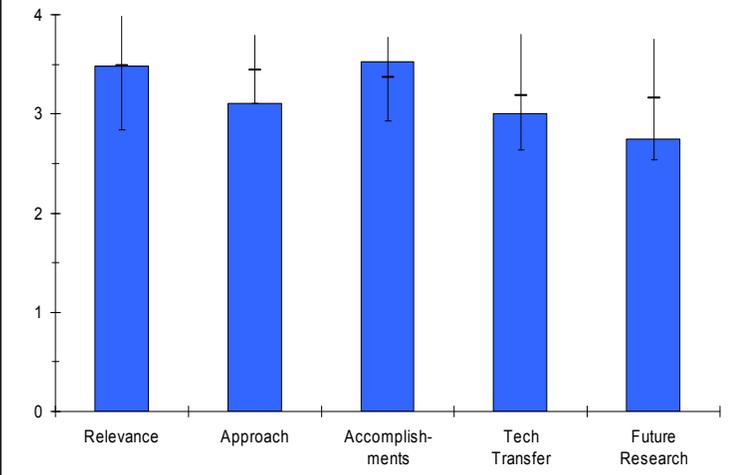
- Heavy reliance on mobile and temporary station design may prohibit learning transfer to future commercial situation and may limit near-term development of a true FCV fueling network including a "retail"-feel for near/mid-term customers.
- None.
- Unclear if there will be sufficient dissemination of detailed results (such as costs) as input to the DOE technical targets to help guide future R&D.
- Program does not report like a DOE Technical Validation program. The same information was available to the press and the data exchange appears to be a press release. DOE programs should strive for a higher level of quality than a press release.
- Limited to distribution of gaseous and liquid hydrogen; no on-site generation options.
- Others have previously built and deployed compressed and liquid hydrogen portable hardware (fed by liquid hydrogen); so the N in the Air Products New Delivery Concept is not "new". It takes considerable energy and diesel fuel to haul hydrogen around southern California, especially in tube trailers. There should have been a consideration of emissions resulting from the distribution of "clean" hydrogen.
- Perhaps beyond the scope – how to increase the capacity factor for the refueling stations.
- Identify transition strategy.

Specific recommendations and additions or deletions to the work scope

- Regular reporting of deployment lessons learned and critical barriers identification.
- Improvement of "retail"-likeness of future stations, customer friendliness.
- Cost of integrating the novel compressor.
- Detailed cost and lessons learned report on establishing the fueling station associated with pipeline. Also the potential opportunities should be documented including a detailed forecast of potential stations that could be converted between 2012 and 2015 if the demand exists.
- Adjust program to provide more technical exchange.
- Add on-site generation i.e. reformer and/or electrolysis options.
- California is making quite good progress in building hydrogen fueling stations i.e. the Hydrogen Highway. The DOE needs to be well integrated with this larger activity. Emphasis needs to be on standardization of systems and codes and standards so that costs can come down, and then on the building of a competitive commercial industry that builds the same station over and over again in many locations. One way this could happen is to set subsidies for these filling stations, and then lower those subsidies as the total number in place increases. This shot-gun approach, different technologies that include component development (that long, long promised AP hydrogen compressor), is not a route on the pathway towards a cost effective hydrogen infrastructure.

Project # TV-08: Cryogenic Capable Pressure Vessels for Vehicular Hydrogen Storage*Salvador Aceves; LLNL***Brief Summary of Project**

The objective of this Lawrence Livermore National Laboratory (LLNL) project is to demonstrate long range (200 to 500 mile) hydrogen hybrid vehicle with an insulated pressure vessel. Insulated hydrogen pressure vessels have lower cost and safety advantages relative to compressed and liquefied hydrogen storage (e.g., no boil-off losses). The second generation insulated pressure vessels built by LLNL filled with liquid hydrogen can meet the 2007 volume and 2010 weight DOE targets (neglecting accessories). Future work will include development of improved insulated pressure vessels that can meet the DOE 2010 volume goal using liquid hydrogen.

Overall Project Score: 3.3 (4 Reviews Received)**Question 1: Relevance to overall DOE objectives**

This project earned a score of **3.5** for its relevance to DOE objectives.

- Uses science to crack existing paradigms with a good outcome!
- Strong relevance to DOE targets for storage volume and weight.
- Interesting strategy to increase vehicle range.
- Extremely relevant and very worthwhile.
- The project addresses DOE goals related to hydrogen storage aboard a vehicle.
- The work demonstrates the potential for significant improvement in range between re-fuelings for hydrogen vehicles.

Question 2: Approach to performing the research and development

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

- Uses the tremendous capabilities of the LLNL facilities to inexpensively explore with prototypical hardware the practicality of their theoretically based storage concept.
- Overall technical approach appears to be sound.
- It is still unclear if the system will be practical or cost-effective.
- Insufficient attention to cost/feasibility analyses.
- Not clear (even though better than 700 bar) that it can ever be affordable at long-term, high-volume. A road map of potential ways to get to affordability needs to be constructed.
- The scientific inquiry by LLNL, including use of phase diagrams, resulted in some potentially very important results. It supported well a decision to move into design, fabrication and demonstration of a cryogenic storage system.

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

This project was rated **3.5** based on accomplishments.

- They have successfully accomplished what they set out to do.
- I rate the dollar/accomplishment very high for this project.

TECHNOLOGY VALIDATION

- Good technical progress is being accomplished on the system.
- Very good results and excellent technical progress. Low-cost, high-volume manufacturing technology needs to be added.
- Outstanding amount and variety of work accomplished with limited funds.

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

This project was rated **3.0** for technology transfer and collaboration.

- Project scope and short schedule did not encourage multiple parties; quite acceptable for this project
- Collaboration to date appears to be limited and insufficient.
- There is potential future collaboration with OEMs.
- Need more production manufacturing knowledge input to design.
- Based on the presentation, there is no evidence of collaboration or communication with organizations other than the project participants.

Question 5: Approach to and relevance of proposed future research

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

- Work identified with this successful start is leading to new deployments in the future. This will present vehicle integration challenges because the concept really breaks the existing design and use paradigms for vehicle fueling.
- Two important technical issues were identified for future work.
- There is no apparent effort to consider costs, weight, volume, etc., and make a realistic assessment of system viability.
- Lacking vision on moving to reality of mass production.
- Identified and discussed the limited work to be accomplished during the remainder of the present project.
- No specific information provided about potential future research or demonstration activity.

Strengths and weaknesses

Strengths

- Science-based breakthrough in really new capability for storage options available to consumers for "not always liquid or gas" vehicle fuels.
- Relatively fast and inexpensive project!
- Strong technical team.
- Excellent ideas with test hardware well built and tested.
- Significant work was accomplished for a relatively small public expenditure.
- Work accomplished ranges from scientific inquiry/analysis through practical application in a vehicle. Few projects have such a range of activity.

Weaknesses

- Relies on vacuum for much of its practical configuration.
- The need to describe this really interesting and useful concept to policy makers.
- May introduce a new and unanticipated dimension to vehicle safety.
- Insufficient attention has been provided to costs and/or realistic assessment of system viability.
- How to commercialize?
- System-wide (well-to-wheels) linkage is not established. Specifically: (1) no evidence that availability of liquid hydrogen re-fueling is considered; and (2) energy implications of liquefying hydrogen for use as an energy carrier.

Specific recommendations and additions or deletions to the work scope

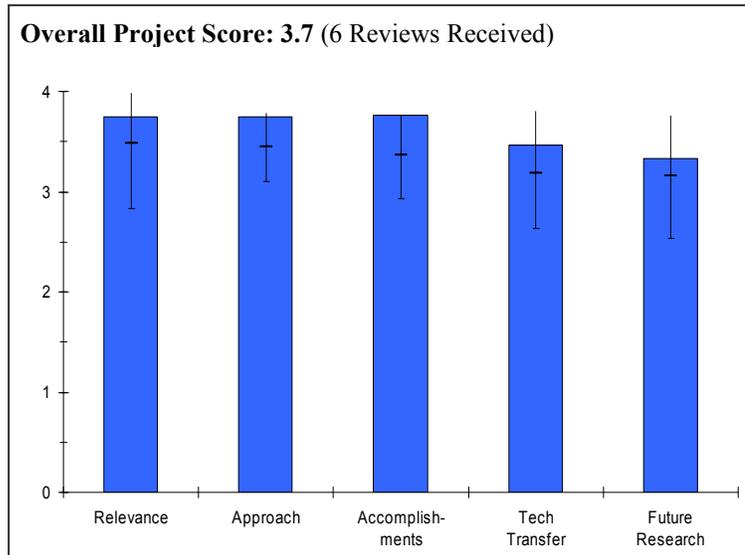
- Add (or initiate new project) to investigate possible new hydrogen release dynamics in a post failure mode. We know how gaseous hydrogen tanks behave in failure and we know how low pressure liquid behaves in tank failure. How would the spectrum of liquid/gaseous hydrogen behave? Describe the possible results in language appropriate for first responders.
- Project team should carefully examine potential costs and viability of system and include a go/no-go decision point before proceeding much further.
- Develop commercialization plan with suppliers.
- Before funding any further work on this system for storing hydrogen on board a vehicle, it is recommended that DOE perform analyses to address issues identified in the "Project Weaknesses" section above.

Project # TV-10: Technology Validation: Fuel Cell Bus Evaluations

Leslie Eudy; NREL

Brief Summary of Project

The overall objective of this project is to validate fuel cell and hydrogen technologies in transit applications by 1) showing progress of the technology toward commercialization, 2) providing “lessons learned” on implementing next generation fuel cell systems in transit operations, and 3) harmonizing data collection efforts with other fuel cell bus demonstrations worldwide (in coordination with the Federal Transit Administration (FTA) and other U.S. and international partners). To date, this project has collected operational, performance, and cost data on eight hydrogen fueled buses in real-world service at three transit agencies.



Question 1: Relevance to overall DOE objectives

This project earned a score of **3.8** for its relevance to DOE objectives.

- Addresses fuel cell performance and durability data, infrastructure maintenance and training facilities.
- Validate fuel cell and hydrogen technologies in transit applications.
- Harmonizes data collection.
- Very relevant to the DOE objectives regarding cost, fuel cell durability, etc.
- Will help identify R&D needs.
- Good work and well-focused.
- This is needed for bus evaluations.
- The project objectives support DOE's objectives for gaining data and experience in fuel cells and infrastructure operations in a mass transit application. Key barriers are being addressed.
- Essential work gathering data on fuel cell bus operations. Critical that the data is collected and distributed by an "honest broker"; NREL fills this roll.
- Excellent summary of data generated from three bus projects in California.
- Buses provide the most important opportunity to commercialize hydrogen fuel cells.

Question 2: Approach to performing the research and development

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

- Two-pronged approach with data collection – analyze miles driven and performance of fuel cells.
- The project is well-integrated and supportive of other technology validation efforts.
- Very good.
- The approach is well thought out and comprehensive and will certainly lead to accomplishing the objectives.
- The direct comparison to diesel buses is well done and appropriate.
- Built using the same procedures that NREL is using for FCV projects. Work seems to be relevant and timely.
- Very good focus on key parameters – miles/kg, \$/mile, maintenance costs, etc.
- Fleet data collection has many advantages to promote/focus FCV technology.

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

This project was rated **3.8** based on accomplishments.

- Data collected is well analyzed and disseminated.
- Good progress during past year to collect data from multiple sites.
- While data is still being gathered, present analysis is good.
- Many excellent results have been obtained so far, particularly the complete final report for the VTA [Valley Transit Authority] demonstration.
- The project appears to be on track and progressing well.
- Project collects, organizes and reports data from bus operations. Hard to know how NREL could do this better.
- Very good charts showing performance of buses at three different sites.
- Highlights the benefits of hybrid design for fuel cell bus.

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

This project was rated **3.5** for technology transfer and collaboration.

- Works closely and successfully with transit authorities.
- 4 fleets analyzed.
- Both diesel and fuel cell are analyzed side by side which provide excellent analysis for transit authorities.
- Excellent international collaboration through the IPHE.
- Good collaboration with transit agencies.
- Some international collaboration, with more planned.
- Excellent coordination with 4 fleets.
- International collaboration questionable.
- The extent of collaborations with domestic fuel cell and infrastructure providers was not fully discussed in the presentation. The international collaboration is good.
- Great interactions with international partners working on the same problem. A global strategy for data reporting is a useful outcome.
- Provide current status – where are they doing better on cost and performance?

Question 5: Approach to and relevance of proposed future research

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

- How to reduce the fuel cell economy?
- Project does not appear to have well-defined, long-term objectives with milestones and a clear end-point.
- More data will obviously increase work.
- Suggest international work be separated into its own project.
- Suggest future inclusion of other fleets.
- The proposed future work is appropriate to continue progress toward the project objectives. The potential for evaluating more fleets is being considered.
- NREL simply proposes more of the same. Makes sense to continue gathering these data. Others could do it, but NREL does it very well.
- Good plan.
- Please include data from previous cold climate bus operation (e.g., Chicago and Vancouver) if resources permit.

Strengths and weaknesses**Strengths**

- Excellent collaboration with transit companies and international partners, reporting of results and dissemination.
- Qualified PI at NREL.
- Excellent analysis capability.

TECHNOLOGY VALIDATION

- Experience with handling confidential data.
- The evaluation is fairly comprehensive, including both vehicle and infrastructure data. Various fueling systems (hybrid, ice, fuel cells, etc.) are included. The baseline using diesel buses is appropriate.
- Good collection of key parameters – data evaluation and comparisons.
- Benefits of hybrid and CNG designs are important lessons learned.

Weaknesses

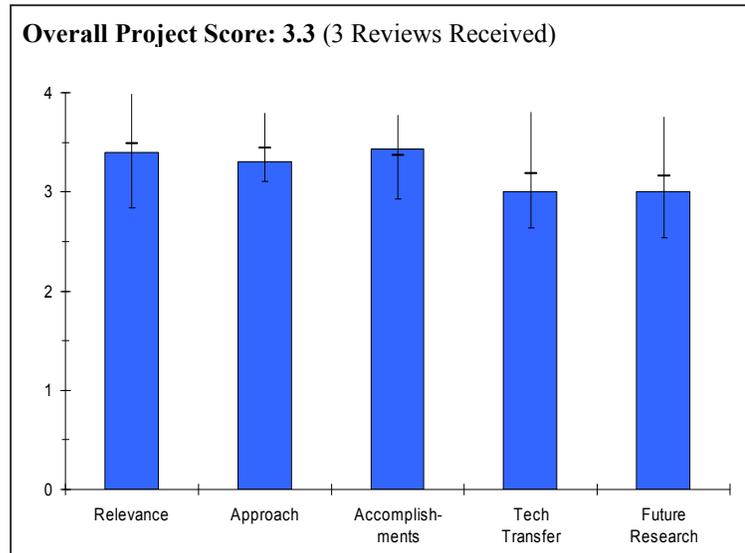
- Warm weather geographic performance of buses only.
- Project would benefit from clearer milestones and longer-term planning.
- Lack of data so far.
- One facet that hasn't been evaluated yet is climate variation. All evaluations done so far have been in warm to moderate climates.
- Identify opportunities for further improvements in fuel cell fund and system performance, life, and cost.
- Please include environmental benefits (SO_x, NO_x, and noise).

Specific recommendations and additions or deletions to the work scope

- Analyze the cost variations in more detail.
- Include cold climate performance such as Chicago and NYC if possible.
- None.
- Delete international component.
- Add more fleets in the future.
- Data from a cold weather climate would be valuable if added to the scope.
- Would be timely to hire a crew to make a documentary which describes these U.S. fuel cell buses. That needs to include rider interactions, maintenance experiences, and other stakeholder inputs. That DVD could be very timely data as other cities consider transit options.
- Compare U.S. data with European and Japanese counterparts. Rationalize the differences and identify the opportunities.

Project # TVP-02: Geographically Based Hydrogen Infrastructure Scenario Analysis*Margo Melendez; NREL***Brief Summary of Project**

The overall objective of this project is to identify the best infrastructure scenarios to meet key transition scenarios and to identify implementation issues in the 2015-2025 timeframe. Two of the scenarios being looked at in 2025 are: 5 million vehicles and 4,000 refueling stations in 2025, and 10 million vehicles and 8,000 refueling stations. Several urban areas have been analyzed to determine the number of hydrogen refueling stations needed and the percent of the population that would be served.

Question 1: Relevance to overall DOE objectives

This project earned a score of **3.4** for its relevance to DOE objectives.

- Supplies DOE with information on size of minimum societal effort needed to support assumed projected H2 vehicle penetrations.
- This project supports DOE's goals for infrastructure development.
- This shows the feasibility and one possible scenario for establishing a hydrogen fueling infrastructure to support the hydrogen economy.
- This analysis, when combined with other analytical initiatives, will provide valuable insights for consideration during development of Federal policies to support hydrogen commercialization.

Question 2: Approach to performing the research and development

This project was rated **3.3** on its approach.

- Good use of data from existing gasoline infrastructure, vehicle use, and lifestyles; all evaluated with GIS overlays.
- This project uses the HyTrans model to develop estimates for the number of hydrogen stations needed for early adoption in a phased approach.
- Well integrated with other DOE-funded modeling and analysis activities.
- Existing databases are utilized in a logical and readily understandable manner.
- Is not R&D.

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

This project was rated **3.4** based on accomplishments.

- Project is nearing completion with lots of useable information for policy makers and business planners on refueling infrastructure needs.
- The sources of data and transparency of assumptions and technique will be helpful as others begin to use this data.
- The technical value has been accomplished at reasonable cost.
- Provides a limited rollout plan by state.
- The results are laid out in a methodic and easy to understand manner.

TECHNOLOGY VALIDATION

- Provided sound underpinning and results for a required DOE report to Congress.
- Work has essentially been completed in a timely manner.

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

This project was rated **3.0** for technology transfer and collaboration.

- Capabilities of ORNL and NREL investigators appear to have been successfully paired.
- N/A – no information available to determine this category.
- I know there has been collaboration but nothing is shown.
- Results of analysis shared with many parties of interest at multiple workshops.

Question 5: Approach to and relevance of proposed future research

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

- Work exposes the need to consider different refueler deployment patterns for different metropolitan areas; e.g. LA has demand for more even distribution compared to major radial corridors found in NY and Chicago.
- None.

Strengths and weaknesses

Strengths

- Uses publicly available Government held data as its basis and is used in an open transparent analysis. This is useful as a comparison to projections made by oil companies in prior years.
- The data output from this project offers considerably greater information about the needs and the land use changes (options) needed to introduce such a pervasive new infrastructure.
- Good phased approach which supports the DOE MYPP goals and targets for infrastructure.

Weaknesses

- Attempts to project minimum required infrastructure using data developed and responsive to the highly developed I.C. engine and gasoline delivery methods.
- FCV introduction and initial uses may differ markedly from the spectrum of vehicle needs serviced by existing fueling infrastructure. Therefore, reliance on existing data may not be as solid as is typical.

Specific recommendations and additions or deletions to the work scope

- Here's a test: would this methodology, if used to show gasoline station growth, have predicted multiple gas stations on busy intersections?
- Compare oil company projections for minimum needed infrastructure with these results; do they show agreement?
- Use this information to project potential impact on existing energy infrastructure needed to supply these energy intensive users; i.e., impacts on local natural gas and/or electricity supplies and physical distribution assets.
- More information should be provided on how the data was developed. What was the methodology?
- Similar work to update these results should be undertaken in two or three years.

Project # TVP-04: Policy Options for Hydrogen Vehicles and Infrastructure*Steve Lasher; TIAX***Brief Summary of Project**

The objective of this project is to identify and evaluate policy options to support the introduction of hydrogen vehicles and infrastructure. Policy options were grouped according to whether they were early-transition, late-transition, or commercial stage. They will next consider:

1. Could it be legislated and implemented?
2. Does the magnitude of the incentive make a difference?
3. How would the incentive affect other fuels and industries?

Question 1: Relevance to overall DOE objectives

This project earned a score of **3.3** for its relevance to DOE objectives.

- Evaluation of potential impact of a variety of policies to accelerate adoption of hydrogen-fueled vehicles is a useful exercise.
- This supports DOE's goals.
- Useful for a review of policy options for acceleration of fuel cell vehicle markets.

Question 2: Approach to performing the research and development

This project was rated **3.3** on its approach.

- Reasonable evaluation of conventional policy options.
- Analyzed DOE's phased approach as outlined in the MYPP.
- Short duration and small project, but with considerable output.
- Is not R&D.

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

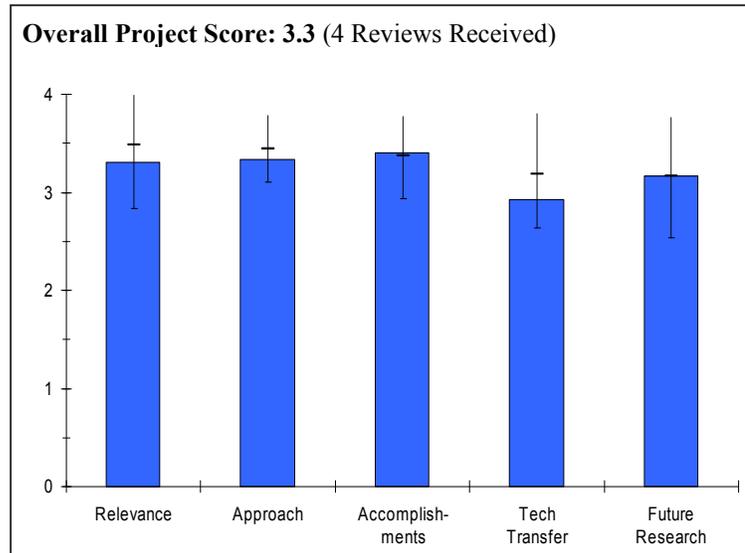
This project was rated **3.4** based on accomplishments.

- Completed work as planned.
- Clearly reported results.
- Hood analysis reported in an easy to understand way.
- Completed study.
- This low-budget task was completed quickly. It contributed to scenario analysis activity led by NREL, and to establishing a baseline perspective on policy options.

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

This project was rated **2.9** for technology transfer and collaboration.

- Incorporation of additional experts from the financial industry would have enhanced the project (recognizing that the funding was so small that this is probably not a practical suggestion).



TECHNOLOGY VALIDATION

- Unclear how collaboration occurred.
- Project supports DOE, with little other collaboration.
- The work used and contributed to other analytical initiatives and models.
- Results of this work were shared with many parties of interest at multiple scenario analysis workshops.

Question 5: Approach to and relevance of proposed future research

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

- More creative incentives, rather than rehashing former (and mostly failed) incentive programs for other fuels, should be proposed.
- None.
- Work was completed.
- No future plans were discussed.
- Work completed. No follow-on proposal.

Strengths and weaknesses

Strengths

- Easy to understand results provided supports DOE's phased approach to infrastructure development.

Weaknesses

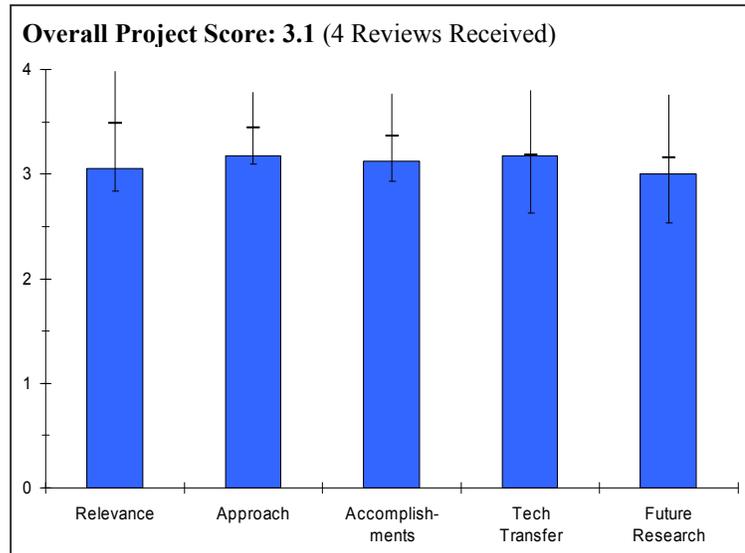
- Depth of the analysis is insufficient (but so was the funding).
- Suggested that model used for ethanol could be useful for fuel cell infrastructure. Results are qualitative. Little discussion about previous vehicle mandates such as earlier US CAFE mandates or the CA ZEV mandates. No discussion about subsidies for customers, which might be a better option than continued OEM subsidies. Should include comparisons with the multibillion subsidies recently given to nuclear industry and other subsidies (including liability insurance) by the Congress. Also, a study of total subsidies including State and Federal that the auto industry receives today would be of interest, with the idea that fuel cell systems would require only a small fraction of such benevolence.

Specific recommendations and additions or deletions to the work scope

- None.

Project # TVP-08: Hydrogen Filling Station*Rick Hurt and Yitung Chen; UNLV***Brief Summary of Project**

As a first step in the development of a hydrogen utilization network, the University of Nevada-Las Vegas Research Foundation is installing and analyzing the performance of a hydrogen generating and fueling system powered by solar energy. Objectives include development of generation and fueling system requirements, survey of potential sites for the filling station and determining favorable/unfavorable characteristics of each, selection of the site with site plan and support to the site permitting process, design of the system layout, construction of the filling station in Las Vegas, monitoring operation of the system, and characterizing its performance. In the second step of the process, the filling station is being supplemented with a high-pressure electrolyzer that was developed for this project. Two utility vehicles are being converted to use hydrogen as fuel. One of these is an electric vehicle that will function as a hybrid full cell vehicle; the second is a hydrogen-fueled internal combustion engine system converted from a gasoline-fueled ICE system. Finally, engineering and performance demonstration of tandem solar cell systems is taking place as well as some basic science studies.

**Question 1: Relevance to overall DOE objectives**

This project earned a score of **3.0** for its relevance to DOE objectives.

- This project is introducing hydrogen and renewable resources safely and with many personal interfaces to a broad spectrum of the community.
- Project covers many aspects of the Hydrogen Program's portfolio
- Direct application to H₂ generation and refueling.
- This project is useful; however it does not support the DOE's large effort to demonstrate fuel cell vehicles and infrastructure fueling.

Question 2: Approach to performing the research and development

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

- Using a university associated team as a basis for broader collaboration with the local community to introduce hydrogen applications is an approach trusted by society.
- The project is designed to be both flexible and inclusive of new community partnerships.
- Large overall program with many small projects – need better coordination/integration.
- Good focus on high pressure electrolysis.
- Good focus on vehicle conversion and demonstration.
- The emphasis on renewable energy sources is interesting. The hydrogen production capacity is far larger than the projected demand.

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

This project was rated **3.1** based on accomplishments.

TECHNOLOGY VALIDATION

- Community involvement and enthusiasm is proof of the positive accomplishments produced by this project.
- Consider that the project has already successfully engaged the local water district (who now offers use of their land, as well as management capabilities), a local developer of a photochemical water splitting technology, a local automotive and marine service company, the local power company (who provided the design and hardware for the generator electrical interconnection), and others.
- The amount of local resource support for this project far exceeds the nominal 20% cost share officially ascribed to this project.
- All projects seem to be making progress, but hard to tell if they are on target.
- Coordination/integration is not clear.
- Should focus more on photoelectrochemical progress and scale ups.
- The electrolysis system is operational. Good effort to educate UNLV students, professors, school teachers, and others. Useful website up with all production data available.

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

This project was rated **3.2** for technology transfer and collaboration.

- This project is bringing hydrogen applications out of the protected environs of structured "projects" and into the everyday lives of various members of the community, and doing so in a safe, technically supervised manner.
- Good project partners.
- Should coordinate with large auto and DOE groups.
- Biggest collaboration appears with a vendor.

Question 5: Approach to and relevance of proposed future research

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

- Once technology opportunities are guided into the hands of the everyday community, innovation will certainly result.
- Should focus on completing hardware and then refueling demos.
- Project appears to be in final phases and future plans are not clear.

Strengths and weaknesses

Strengths

- Solid core of technically competent sponsors.
- Visible solar energy user and producer of hydrogen in a solar rich resource area.
- Multiple community access points.
- Project is sufficiently stable and trusted to have attracted additional local resources; e.g., the water department enthusiasm and resources.
- Team appears to have strong R&D technology capability for areas under investigation.

Weaknesses

- Hard to tell if individual projects are contributing.
- Overall integration of all the projects is not clearly portrayed.
- Team is weak in established manufacturing capability.
- UNLV needs to get some hydrogen consumption to match their production capacity.

Specific recommendations and additions or deletions to the work scope

- Far too much material presented.
- Presentation/poster much longer than "allowed" and still does not provide sufficient detail on most projects.
- Should be multiple presentations, including one that specifically addresses how all the others are integrated into a sensible, focused program.
- Add main auto company to team.
- Seems an obvious site for a Federal fuel cell bus demo project.

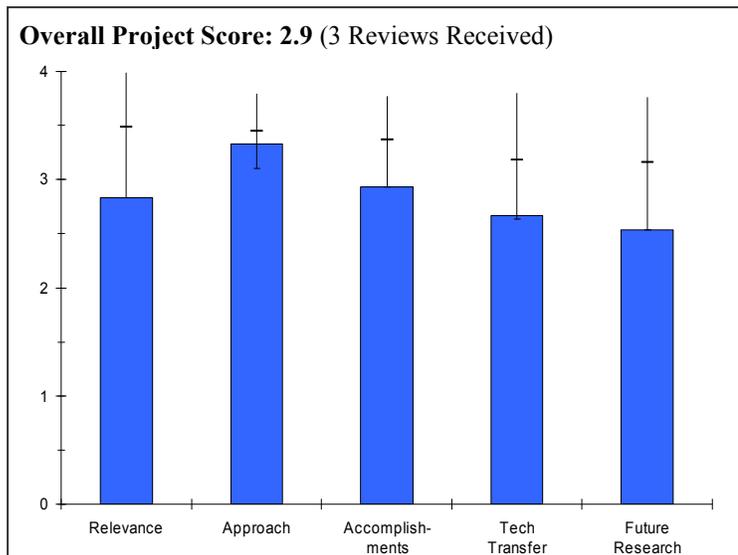
Project # TVP-11: Florida Hydrogen Initiative

Ed Levine; Florida Hydrogen Initiative

Brief Summary of Project

The Florida Hydrogen Initiative (FHI) is a non-profit organization incorporated under the laws of the State of Florida to move Florida to the forefront of the nation's hydrogen economy. The Florida Hydrogen Initiative uses its resources to aid the development of a robust Florida-based hydrogen industry thereby establishing Florida as the cornerstone of a southeastern hydrogen hub. The non-profit corporation is comprised of public leaders, university researchers, citizens, and industry representatives. The Florida Hydrogen Initiative, Inc. develops Florida's Hydrogen Infrastructure by:

- Brokering partnerships for applied technology demonstration projects throughout the state;
- Sponsoring research in the production, storage and use of hydrogen fuels;
- Facilitating technology transfers between the public and private sectors to create, build and strengthen high-growth potential, technology companies.



Question 1: Relevance to overall DOE objectives

This project earned a score of **2.8** for its relevance to DOE objectives.

- Set of small focused projects that address specific barriers to a hydrogen economy
- This is 3 unrelated projects with some more relevant than others. Distinctions need to be clearer.

Question 2: Approach to performing the research and development

This project was rated **3.3** on its approach.

- Each project has a reasonable plan.
- Approach on citrus residue conversion should investigate use of bad crops and weather damaged crops, as well as peels.

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

This project was rated **2.9** based on accomplishments.

- All projects are making progress.
- Project timing versus status of development wasn't clear.

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

This project was rated **2.7** for technology transfer and collaboration.

- Good teaming effort.
- Creative outreach efforts.
- No evidence was noted.

Question 5: Approach to and relevance of proposed future research

This project was rated **2.5** for proposed future work.

- Plans are logical.
- Mr. Levine plans to follow up with DOE staff and managers of other DOE projects. It is clear that he desires to accomplish the tasks in this project so that they contribute as much as possible to helping achieve goals and objectives established for the DOE hydrogen program.

Strengths and weaknesses

Strengths

- Three good ideas are evident.

Weaknesses

- Completion of all three projects is totally independent and basically unrelated.

Specific recommendations and additions or deletions to the work scope

- The traveling museum should tie the other projects into one story with ties to the general topic of hydrogen.