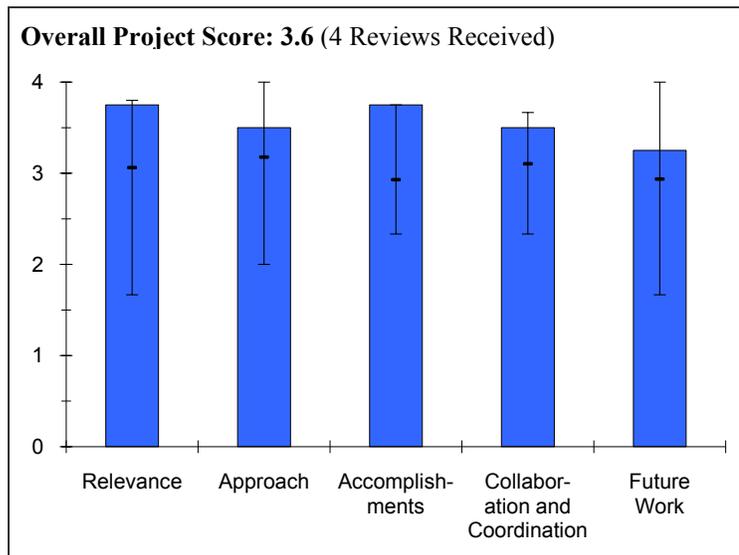


**Project # TV-01: Controlled Hydrogen Fleet and Infrastructure Analysis***Keith Wipke; National Renewable Energy Laboratory***Brief Summary of Project**

The objectives of this project are to: 1) provide facility and staff for securing and analyzing industry sensitive data at the National Renewable Energy Laboratory's (NREL) Hydrogen Secure Data Center (HSDC); 2) perform analysis using detailed data in HSDC to: a) evaluate current status and progress toward targets, b) provide feedback on current technical challenges and opportunities into the Department of Energy (DOE) hydrogen research and development program, c) provide analytical results to originating companies on their own data (detailed data products), and d) collaborate with industry partners on new and more detailed analyses; and 3) publish/present progress of the project to the public and stakeholders (composite data products).

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

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

- This project is very relevant to the DOE Hydrogen and Fuel Cell Technologies Program (FCT). The data collected and reported in this project is vital to measuring the progress of the programs and to glean information that is critically important to guiding future directions of the technical work.
- This project is well defined and relates directly to DOE technical targets.
- This project performs analysis and reporting of crucial testing of vehicles and fueling.
- This work is very relevant to DOE fuel cell objectives of conducting independent assessment and dissemination of fuel cell vehicle (FCV) information and providing real-world feedback to researchers and partners to improve technology. The information gathered will help improve technology readiness for FCVs and lead to successful market introduction. This project validated DOE targets in real-world conditions.

**Question 2: Approach to performing the research and development**

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

- The approach focuses on the collection of actual, in-the-field operating and performance data in a self-reporting format. Then, the information is disseminated in a comprehensive compilation that allows proprietary information provided by suppliers and users to be protected. The approach is a solid and sound type of data collection and reporting, and its value has been validated by the large number of references to the project, coupled with acceptance by the reporting organizations.
- Although there are only two of the original four original equipment manufacturers (OEM) left to validate the last few objectives. That is a sufficient amount for this project.
- The detailed products that NREL has published have been helpful to the OEMs and all parties involved in the analysis of the results.
- The approach for this project was right from the beginning, and it continues to be right.
- The project is well-designed to address technical barriers set by industry and DOE. The scope of testing covers all of the bases.

## TECHNOLOGY VALIDATION

- The approach is very reasonable for providing real-world analysis, data collection, and information dissemination efforts, while protecting sensitive information. Composite data products are a good way to provide summaries without revealing any company-sensitive information. (This has been an area of concern for partners). This approach was focused on addressing the key areas of interest to the DOE FCT Program.

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

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

- This project continues to make excellent progress. Reported progress includes more than 100,000 vehicles hours and 2,500,000 vehicles miles. The project has resulted in more than 80 public data publications with new results and updates published every six months, which is truly outstanding. The depth of technical analysis and interpretation of collected data is excellent.
- The vehicles tested in this project have been phenomenal. The project continues to relentlessly pursue the technical targets and to improve vehicle fuel cell performance and fueling infrastructure. This is an excellent use of public funds and the statistics speak for themselves (e.g., 2.5 million miles driven).
- The products developed by NREL in response to OEM data needs and public needs have been fantastic (e.g., 80 composite data products published, 20 of which are new this last year).
- There has been good progress in durability for the stack for Generation 2 over Generation 1.
- The project is meeting DOE goals.
- They greatly reduced transients, making durability goals easier to achieve.
- The refueling information is very important, especially in comparison to battery charging.
- Toyota's 431 mile driving range is extremely useful.
- There is a significant number of vehicles (almost 150 vehicles total, over 100,000 hours) and stations (23 total) in data collection effort. It is good to see vehicles with higher hours/miles included. The project continues to track key stations that serve as backbones for hydrogen efforts.
- There are a significant number of composite data products (20 new, 52 updated) in the last year. It is good to keep information up to date, and presented at key venues.
- Careful analysis of key aspects of vehicle operation (hydrogen cost, stack efficiency and durability, and driving range) demonstrates improvements in all aspects. (Hydrogen cost projections are not so optimistic.) The analysis of transient operation improvements of particular interest demonstrates the technical depth of the program and helps feed information back to manufacturers and researchers.

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

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

- The basic nature and approach of this project requires extensive collaborative interactions with suppliers and users. Numerous publications and presentations have been accomplished in this review period. There have been collaborative interactions with automotive and energy industry partners, FreedomCAR and Fuel Tech Team, industry and state government organizations, and federal government agencies including the Department of Defense (DoD).
- Everyone is engaged and loves these projects.
- They are collaborating with all the right partners – car companies, industry associations and state groups. They need better marketing and promotion of the program and results to the media, both public and government.
- They are collaborating with industry partners and major constituents of interest to discuss results and methodology. New collaboration with DoD Defense Logistics Agency should be beneficial to both parties.

### **Question 5: Approach to and relevance of proposed future research**

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

- The future work plan includes continuing the work already underway to establish operational and performance trends and improvements. Added emphasis with OEMs and infrastructure developers on supporting early market introductions is vital to timely deployment of hydrogen and fuel cell technologies.

- This is an outstanding real-time, real-world learning project that should be fully supported by the DOE through the end of the budget and funding cycle.
- They are a very crucial partner to help facilitate the automaker goal of commercialization in the 2014-2015 timeframe. Data will help educate consumers and local officials where stations and vehicles will be deployed.
- The project is nearly complete, but closeout activities appear to be appropriate to finish up the work (i.e., final report and leveraging of past experience to assist future deployment and validation projects).

### **Strengths and weaknesses**

#### Strengths

- They employed a proven and tested approach to data collection and information dissemination.
- They made extensive use of analytical multivariate techniques.
- The results are essential for the auto OEMs and the entire value chain, including hydrogen suppliers, refilling stations and carbon manufacturers.
- They have a very comprehensive data collection.
- They enacted a thorough and careful analysis of important aspects of vehicle and station operation.
- There was a wide variety of data products presented, which have been updated to reflect current information.
- There was good partnership with key constituents.

#### Weaknesses

- No weaknesses noted.
- None.
- They need to promote findings and activities more. If the public and/or government knew of the scope of this project and results and data found, it would greatly help industry fight critics and skeptics who write off FCVs. A website is not enough because most people would not know to look there.
- No significant weaknesses observed as the program is well defined and successful.

### **Specific recommendations and additions or deletions to the work scope**

- Keep up the good work!
- A final project report dissemination plan should be developed. The plan should include a presentation at the International Partnership for the Hydrogen Economy (IPHE) and the International Energy Agency (IEA).
- The battery analysis could be improved. The life-cycle cost analysis should be looked at and analyzed.
- There should be an expanded presentation of results from primarily fuel cell events to broader auto events, government conferences, etc.
- No additions or deletions identified as the project is nearly complete.