2015 — Market Transformation
Summary of Annual Merit Review of the Market Transformation Sub-Program

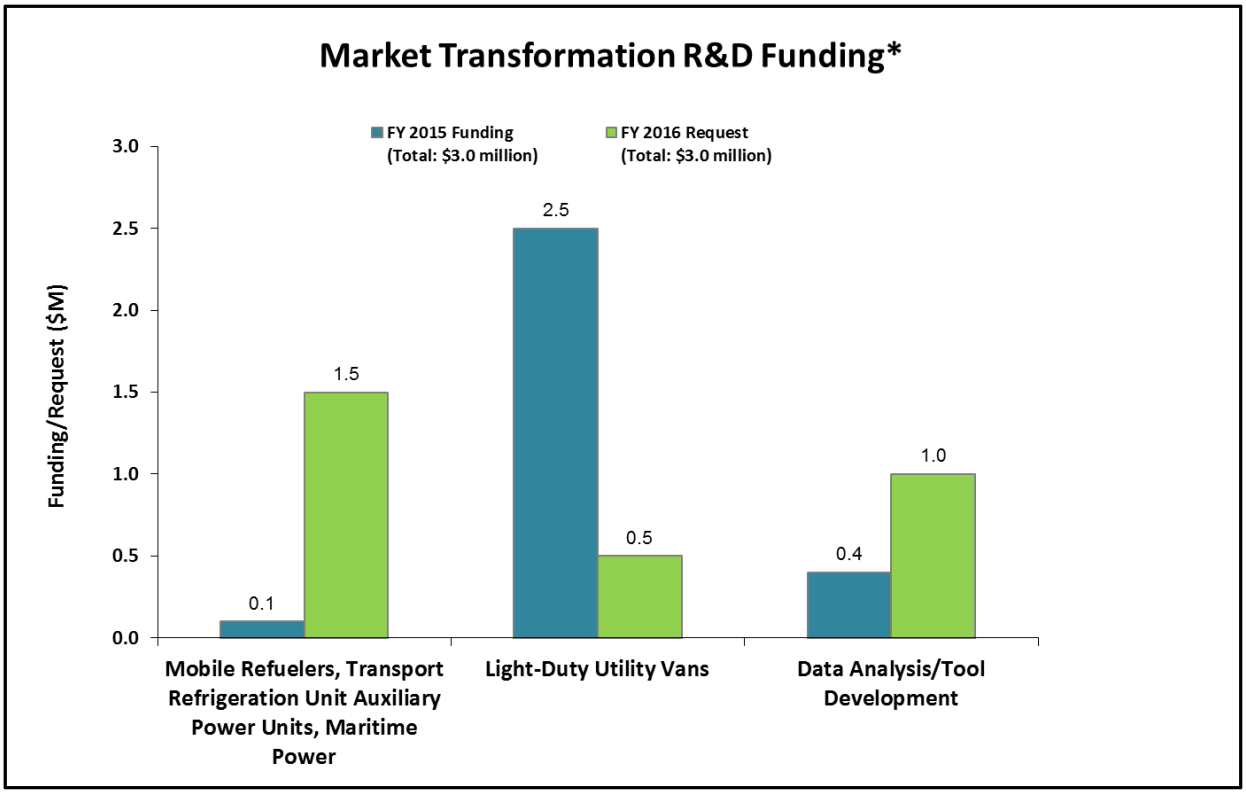
Summary of Reviewer Comments on the Market Transformation Sub-Program:

The purpose of the Market Transformation sub-program is to spur market introduction by testing technologies in pre-commercial applications. By supporting initial commercialization in key new technology applications, this sub-program helps to identify and overcome barriers to marketability and to reduce the life cycle costs of fuel cell power through various technical and non-technical solutions. The current focus of the Market Transformation sub-program is to build on past successes in lift truck and emergency backup power applications (part of the U.S. Department of Energy's [DOE's] American Recovery and Reinvestment Act of 2009 [Recovery Act] efforts) by exploring the market viability of other potential technology applications. Four projects were reviewed this year, and these projects are highly leveraged, with more than half of the funds provided by DOE's partners. This substantial commitment of external resources shows the high level of interest in exploring applications and markets where the hydrogen and fuel cell industry can expand and the technologies can play a valuable role.

Reviewers generally shared positive comments about the sub-program's projects, noting that the projects have been well planned. Reviewers stated that the sub-program's coordination with agencies is commendable and allows the sub-program and the other agencies to leverage funding to achieve mutual and individual goals; however, reviewers also suggested that increased collaboration with private companies could be beneficial.

Market Transformation Funding:

With the market successes achieved by fuel cells in lift trucks and backup power applications as a result of prior fiscal years' and Recovery Act funding, the focus of fiscal year (FY) 2015 funds was on a new application: battery/fuel cell light-duty hybrid service vans that will demostrate a value proposition for utlities and other types of operations and maintence fleets. The Market Transformation sub-program budget for FY 2015 was $3 million.



* Subject to appropriations, project go/no-go decisions, and competitive selections. Exact amounts will be determined based on progress in each area.

Majority of Reviewer Comments and Recommendations:

The Market Transformation sub-program's projects were rated average to high, as overall ratings ranged from 2.3 to 3.5, with an average score of 3.2. The projects were judged to be relevant to DOE activities and employ good or adequate technical approaches. Reviewers emphasized the need for data collection to develop business case reports that can be used to support further market expansion.

Airport Ground Support Vehicles: This project received an overall score of 3.4. Reviewers reported that the plan to complete this project is reasonable and progress to date is on schedule, scope, and budget. However, they mentioned that the cost of delivered hydrogen was not reported, making it impossible to understand the value proposition. In addition, reviewers were concerned that the data set for fleet operations—which is critical for identifying further technology improvements—was not reported.

Hydrogen Energy Systems as a Grid Management Tool: This project received an overall score of 3.4 for its efforts in modeling, testing, and validating potential applications for hydrogen energy systems to address grid stability issues. Reviewers stated the project does a great job of recognizing barriers and issues and taking actions to address them. Reviewers also stated that the project is worth continuing, and that data collection and analysis will be a key factor in determining a business case. Reviewers pointed out the lack of installed operating equipment as a weakness, and that more economic analysis showing cost components was needed.

Maritime Fuel Cell Generator Project: This project received an overall score of 3.5 for its efforts in developing, designing, and testing a first-of-its-kind hydrogen fuel cell power generator for maritime applications. Reviewers stated that the project has done a great job in its outreach campaign. Reviewers asserted that cost and benefits analyses are needed, as well as potential markets.

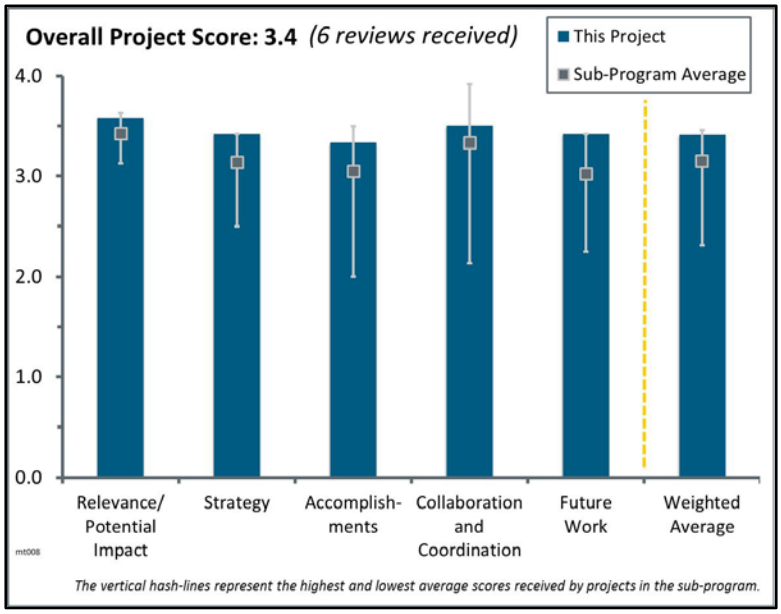
Fuel Cell Hybrid Electric Delivery Van Project: This project received an overall score of 2.3. Reviewers praised the project's concept; however, they also noted the project has fallen behind schedule because of supplier and other issues. Reviewers commented that the project team spent nearly a year developing the project requirements, an inappropriate amount of time to allow for attaining the project goals within the project schedule and budget. Reviewers stated that the project had a good strategy and plan for implementation; however, they also commented that the recipient had failed to obtain the required cost-share resources. Reviewers stated that the project had the potential to impact Fuel Cell Technologies Office goals related to the implementation of fuel cells in commercial vehicles and initially had a considerable amount of non-federal funding; however, they reported that changes to the project team and funding has put this project in jeopardy of not meeting its objectives.

Project # MT-008: Hydrogen Energy Systems as a Grid Management Tool

Richard Rocheleau; Hawaii Natural Energy Institute

Brief Summary of Project:

The objectives of this project are to (1) demonstrate the performance, durability, and cost benefits of grid-integrated hydrogen systems; and (2) support development of regulatory structures for permitting and installation of hydrogen systems in Hawaii. Electrolyzers will operate under dynamic load conditions to mitigate impacts of intermittent renewable energy. Hydrogen will be supplied to shuttle buses operated by County of Hawaii Mass Transit Agency and Hawaii Volcanoes National Park.



Question 1: Relevance/potential impact on supporting and advancing progress toward the Hydrogen and Fuel Cells Program goals and objectives delineated in the Multi-Year Research, Development, and Demonstration Plan

This project was rated **3.6** for its relevance/potential impact.

- Electrolyzers can play a critical role in energy systems that have a substantial share of fluctuating renewable energies. This project addresses renewable hydrogen production and its use in vehicles and provides learnings in this context.
- This is a highly leveraged project across many different organizations and is highly focused to balance with natural, renewable energy systems. The reviewer is not aware of a more advanced grid support hydrogen project anywhere in the United States or the world.
- The location, partners, and objectives are well aligned with U.S. Department of Energy (DOE) goals from the perspective of hydrogen generation for transportation (leveraging grid services and available renewables). The project also aligns with market transformation objectives for the learning of one site to have a positive impact on future sites.
- The project addresses a real need to deal with grid perturbations due to heavy amounts of renewables.
- The project has had its ups and downs, but the data collected on the operation of the electrolyzer and refueling the hydrogen vehicles will be worthwhile and would add to the Hydrogen and Fuel Cells Program.
- The project appears to generally line up with research and development objectives.

Question 2: Strategy for technology validation and/or deployment

This project was rated **3.4** for its project design, approach to addressing barriers, feasibility, and integration with other efforts.

- Barriers faced by Hawaii Natural Energy Institute (HNEI) have been unique and challenging, and the fact that HNEI has overcome them will serve as a potential response for later projects. HNEI's project is a mix of great and unique challenges coupled with equally unique responses.
- Overcoming the barriers has consistently been a challenge for this project. This highlights the real-world challenges. It would be good to see how the lessons learned from this project are used for addressing Barriers A and H.

- The project does a great job of recognizing barriers and issues and then taking the necessary actions to address them.
- The project has a good plan to identify and evaluate all issues.
- This project does address many of the barriers required to implement hydrogen technology. Unfortunately, many of the problems encountered and overcome were regional and specific to this project. However, lessons learned from this project would still be worthwhile.
- It is unclear how far the project addresses the analysis of the benefits of the electrolyzer operation for the grid (the link between field testing and modeling). This may include not only frequency stabilization but also storage capacity and provision of hydrogen to other energy sectors.

Question 3: Accomplishments and progress toward overall project and U.S. Department of Energy (DOE) goals

This project was rated **3.3** for its accomplishments and progress.

- The project has done a great job on developing grid support as planned, on developing data for operating systems in harsh environments as planned, and on responding to unforeseen natural challenges (lava) and manmade challenges (parental protests).
- The project has had some delays but overall appears to be working well toward accomplishing its goals. Some of the delays due to environmental conditions were unavoidable.
- The project has had many delays, but the project team has agreed to continue the program and to collect data for two years past the project's end date, which is this September. The data collected are still important and should be gathered and disseminated.
- Moving the initial testing to Powertech was a good strategy, given the siting challenges that have continued to be a problem. It seems that testing is still delayed, and response time testing does not seem as relevant because that testing has been completed already. Even given the real-world challenges of siting, not having the equipment in place and operational is a negative.
- The project has identified analytically the value of an electrolyzer in stabilizing the grid.
- The complete system operation (hydrogen production, including service to the grid and bus operation) has not yet started.

Question 4: Collaboration and coordination with other institutions

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

- The project does well at collaborating and utilizing available resources to achieve its goals. The project's interaction and support of other DOE projects in Hawaii is noteworthy!
- There are many good state partners, and there is also involvement from National Renewable Energy Laboratory (NREL) and Pacific Northwest National Laboratory for safety. Involving NREL in data analysis is recommended for the extended portion of the project.
- There is great partnering with a number of partners.
- The collaborations are strong and represent many different stakeholders. Missing from this collaboration list are Powertech and the company providing the electrolyzer, which seem to be important collaborations for project success.
- The project needs more involvement with the electric utility, although admittedly, this is difficult.
- Including the local utility/grid operator is critical.

Question 5: Proposed future work

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

- The commitment to operate the system beyond the end of the DOE-funded project is critical. A detailed analysis will be needed to quantify the benefits of electrolyzer operation to the grid. Future work should focus on identifying opportunities in Hawaii to increase the share of renewables and the role hydrogen can play in this context.

- Though not a ding on the project, DOE should consider remaining a part of this activity (at no cost) for data gathering. The results could be beneficial for other parts of the Hydrogen and Fuel Cells Program .
- The team is strongly encouraged to go forward after the official project ends to collect as many data as possible.
- The future work makes sense for the tasks. The dates do not seem to match with the project status, as of the Annual Merit Review material due date. It would be good to see what the projected run time is outside of the DOE-funded project.
- A key indicator here is that DOE funding is ending, but the project has two more years of life.
- The need for cyclic testing of electrolysis modules is recognized.

Project strengths:

- The project has strong leadership. Project activities are bringing visibility and a positive attitude toward fuel cells in the state of Hawaii.
- The team was flexible in addressing siting issues. Complete system testing at Powertech should help to ensure a smooth start of operations in Hawaii.
- This is an invaluable project with a strong, well-run management team.
- This is a good team that had to overcome a considerable number of everyday and not-so-everyday issues. The goal of the team to go forward and collect data beyond the project's official end is commendable.
- The project is strong in the collaborations, project goal, and siting.
- There is great planning and contingency response.

Project weaknesses:

- The project has no noted weaknesses.
- In this project, the hydrogen produced will be used to fuel buses. Other potential hydrogen users and their impact on the business case should be identified.
- The fact that the electrolyzer is not now directly tied to a renewable energy source is a weakness. It would have been good to assess the cost of producing hydrogen from renewables in Hawaii's high electrical cost market.
- The project weakness is the lack of installed and operational equipment at the site. If the project does not find ways to decrease the time from start to implementation, future projects may not be able to sustain this level of effort.
- There are too many development issues in series, i.e., cycling electrolyzer and fuel cell-powered buses.

Recommendations for additions/deletions to project scope:

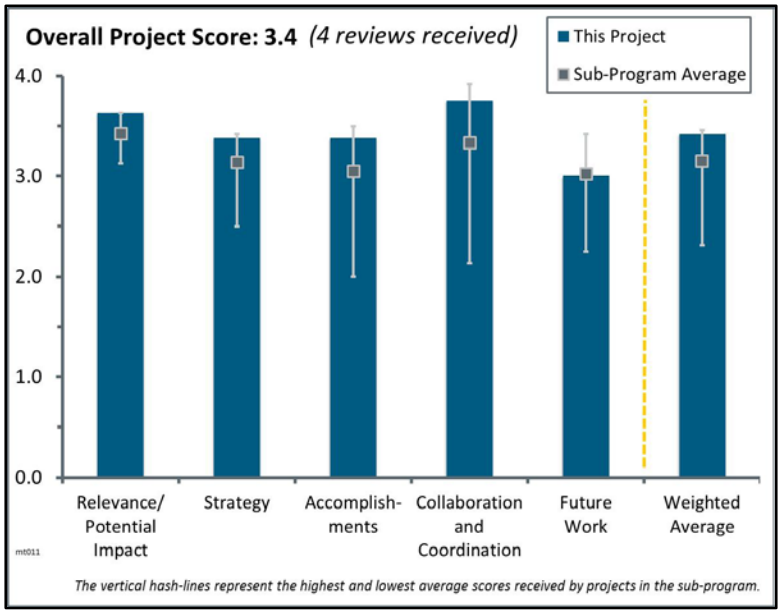
- It is to be hoped that the team can continue to collect data, and it would be good to involve NREL if NREL staff are available.
- DOE should remain a partner with HNEI (at no cost) to gather data through the life of this project.
- Identification of ways to decrease the time and effort for installation and operation is important. It would also be good to see how the electrolyzer will effectively be operated for grid services and hydrogen demand if the hydrogen demand is not high or consistent. It is not clear whether this will be handled by hydrogen storage or through operating the electrolyzer.
- The overall economics of the system need to be analyzed.
- The project should measure the life of the electrolysis stack in cycling conditions.

Project # MT-011: Ground Support Equipment Demonstration

Jim Petrecky; Plug Power

Brief Summary of Project:

The objectives of this project are to (1) develop an 80 V (~20 kW) fuel cell product for cargo tractors, (2) conduct testing with the Charlatte CT5E cargo tractor, (3) conduct a factory acceptance test to demonstrate performance parity with the battery, (4) build 15 cargo tractors for deployment, (5) build a hydrogen installation at Memphis–Shelby County Airport, (6) conduct permitting with the Memphis Fire Services Bureau, (7) conduct two years of demonstration in airport operations, and (8) use lessons learned to make improvements.



Question 1: Relevance/potential impact on supporting and advancing progress toward the Hydrogen and Fuel Cells Program goals and objectives delineated in the Multi-Year Research, Development, and Demonstration Plan

This project was rated **3.6** for its relevance/potential impact.

- This is an outstanding project. The project has designed and tested a fuel cell-based baggage tractor and will soon deploy it. The project will help pave the way for bringing fuel cell technology to areas that complement the fuel cell vehicles and help promote hydrogen infrastructure and dissemination of safety information. This is all very positive.
- The project addresses safety issues with hydrogen, value of low emissions, hydrogen refueling issues, and delta for fuel costs. The project also quantifies the market size.
- The project demonstrates the feasibility and practicality of fuel cell systems replacing diesel power airport equipment. Acceptance of this technology will reduce the CO_2 emissions. The objective of lower energy expenses will have to be demonstrated with low cost of delivered hydrogen.

Question 2: Strategy for technology validation and/or deployment

This project was rated **3.4** for its project design, approach to addressing barriers, feasibility, and integration with other efforts.

- The project seems to be well organized and very feasible, and at the end, it will be very successful. Installing hydrogen technology (particularly liquid hydrogen technology) is no small achievement in any setting but is very noteworthy at an airport. The project team seems to have properly engaged the local fire/safety authorities at the deployment airport, which is critically important.
- It is a good strategy for a fuel cell company to explore a new market with fleet operations.
- The project addresses most issues; however, there is no mention of economics based on fuel cell capital cost. The project should highlight that $2500/kw is a break-even number. Any air quality measurements and the impact on the fuel cell should be shown.

Question 3: Accomplishments and progress toward overall project and U.S. Department of Energy (DOE) goals

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

- Progress is good in site preparations, refueling infrastructure building, and hardware demonstration. Cost benefits have been presented. However, the (assumed) cost of delivered hydrogen is not reported, which makes it difficult to estimate the value of the fuel savings projections.
- In reviewing the 2014 presentation, the project was originally listed as ending in 2015. This 2015 presentation lists the project end as 2017, so there seems to have been an extension. This reviewer is unsure about this, as he also reviewed this project in 2014. If the extension is due to project delay, then there could have been improved project progress, so the rating for this category is only a 3.5. On the whole, however, a good deal has been accomplished, even if it was not on the original schedule. This is still excellent progress.
- This is a great project—well organized and well planned.

Question 4: Collaboration and coordination with other institutions

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

- Deploying technology like this, along with creating a refueling infrastructure, involves many moving parts and requires being highly collaborative, not only within the project team but also with the local aviation and fire/safety authorities. Based on the project presentation, this all seems to have gone well and will continue to go well. The project team should be commended on this front.
- Collaboration and coordination could not be any better.
- This project needed much coordination with several organizations.

Question 5: Proposed future work

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

- Demonstration data and assessments remain for the next two years. There were no specifics on what sort of data will be provided to the National Renewable Energy Laboratory; the data should include capital and operating costs, durability, and records of maintenance to identify high-maintenance components and research and development needs.
- There was not much focus on this because of where the project is, with two years to go. In a general way, the project presented some ideas for where this technology could go with other pieces of non-vehicular fuel cell ground equipment.
- The project needs to get units at the site as soon as possible. Field data are the most critical.

Project strengths:

- Strengths include the following: (1) replacement of diesel-operated equipment with high-efficiency, clean-emissions fuel cell power, (2) successful installation and demonstration, and (3) good coordination with several organizations.
- This is a well-conceived project that addresses fuel cell market transformation in the high-priority aviation ground service equipment market. The deployment site looks ideal because it starts in an aviation application that does not involve the public (but the public is right next door).
- The project is well organized and has good partnerships.

Project weaknesses:

- Economic analysis will be the key to others' recognizing the potential of this technology. More information is needed about the cost breakdown in the public domain.

- The deployment site does not test the technology against cold weather. The project has, however, tested the technology down to -20°C in an environmental chamber. However, it would be good to do some real cold weather testing on these units. This is not a recommendation that the project be modified in response to this comment, only an identification of a weakness in the location with regard to the local climate.
- It is taking too long to get to airport testing. The impact on fuel cells of air impurities at the airport should not be minimized.

Recommendations for additions/deletions to project scope:

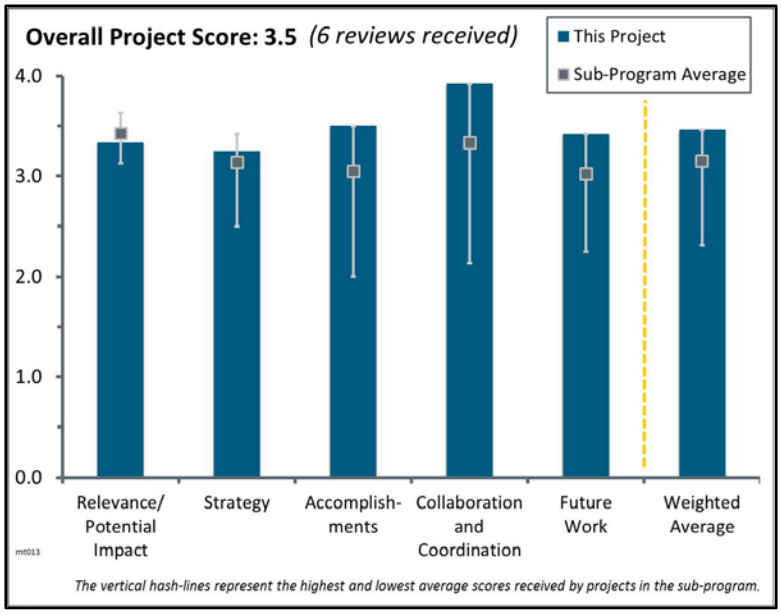
- There are no recommendations for additions/deletions. The project should keep doing what it is doing and carefully keep track of how the units fail in the field. It will be very important to get feedback from the end users on how the units can be improved. A note on the presentation: the authors should be careful about the technical details in the presentation. On slide 15, there was a plot showing the use of the battery in surge mode, but there were no identifying numbers on the y-axis, so one could not tell what power was being provided by the battery. Also, no mention was made of the assumed hydrogen price in the cost savings slide, which is required to understand the plots. These are important details that need to be provided in such presentations.
- The project should show economics, including fuel cell cost assumptions; gas analysis results; and impact on stack life.
- The project should consider an independent assessment of the economics of this demonstration.

Project # MT-013: Maritime Fuel Cell Generator Project

Joe Pratt; Sandia National Laboratories

Brief Summary of Project:

The overall objectives of this project are to (1) lower the technology risk of future port fuel cell deployments by providing performance data of hydrogen proton exchange membrane fuel cell technology in this environment; (2) lower the investment risk by providing a validated business case assessment for this and future potential projects; (3) enable easier permitting and acceptance of hydrogen fuel cell technology in maritime application by assisting the U.S. Coast Guard and American Bureau of Shipping in developing hydrogen and fuel cell codes and standards; (4) act as a stepping stone for more widespread shipboard fuel cell auxiliary power unit deployments; and (5) reduce port emissions with this and future deployments.



Question 1: Relevance/potential impact on supporting and advancing progress toward the Hydrogen and Fuel Cells Program goals and objectives delineated in the Multi-Year Research, Development, and Demonstration Plan

This project was rated **3.3** for its relevance/potential impact.

- This is potentially a high-visibility project that clearly advances hydrogen applications for transportation and refrigeration—the team deserves credit for both points. While storage limits the amount of refrigeration in this early first adaption, the deployment nonetheless demonstrates the wide-open scope of hydrogen possibilities. Equally significant is that this project provides important data on the operation of fuel cells in a harsh maritime environment with multi-axis movement.
- The project will help the Hydrogen and Fuel Cells Program (the Program) and the fuel cell industry better understand the challenges and benefits of semi-portable auxiliary power units. The use in a difficult environment (salty air) provides an opportunity to evaluate dependability and areas for improvement.
- With changing emission standards (on board as well as in the port), fuel cells are an important innovation for maritime applications. The project introduces this technology to this industry.
- This is an outstanding project to introduce fuel cells into the maritime industry. However, the project team needs to show a quantitative benefits analysis that includes environmental and other factors—and especially cost.
- To be sure that this is not testing an application with a limited market, it would be good to see more discussion of the potential market that could evolve if this demonstration is successful. It would also be useful to see whether the hydrogen infrastructure deployed could be utilized for other applications to expand the project's scope.

Question 2: Strategy for technology validation and/or deployment

This project was rated **3.3** for its project design, approach to addressing barriers, feasibility, and integration with other efforts.

- The investigator provided a key indicator that he is sharply focused on critical barriers: issues from two weeks ago have been resolved, and he indicated that today's issues will not be issues tomorrow. Another

indicator was that in response to a variety of questions from reviewers, the investigator provided answers that indicated the issues had been previously considered. The downside is that the barges do not have enough hydrogen storage to run all the refrigerated container (reefer) units during a run to Maui (somewhat similar to a 19th century steamship relying on sails). That said, it is hard to decide between a grade of 3.5 and 4.0, because 0.5 points seems like too strong of a hit for less than perfection, so the score could easily be switched.

- The use of other Program resources (e.g., Sandia National Laboratories' [SNL's] risk analysis group) to address problems is beneficial to the project and the Program.
- The project seems well designed, with the right array of stakeholders involved. The delays with the fuel cell unit are probably the biggest concern in terms of execution, although it appears these are being addressed. The hydrogen solution also seems to be somewhat of a temporary patch on a bigger problem with how to supply and store hydrogen in this environment, so it should be made clear how much this affects the business case for this application.
- The overall timing seems to be critical. Once the system is installed, sufficient time is needed to field test the complete system in both applications (in the dock and on the barge).
- All the stakeholders have bought into the project. However, the effects of an ocean environment on fuel cells need to be addressed more seriously. Salt spray could be a problem.

Question 3: Accomplishments and progress toward overall project and U.S. Department of Energy (DOE) goals

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

- The project did an excellent job of identifying key regulatory issues that will need to be further addressed to support maritime fuel cell applications. This effort helped identify early regulatory gaps that the Program should help address.
- The project fully meets/met DOE goals. It is unique, valuable, and far-reaching.
- Overall, the project seems to have progressed well. The fuel cell delays were an issue, but they seem to have been addressed.
- The team has managed well, overcoming difficulties as they occurred.
- It is great that the project identifies all the stakeholders and gets their input.

Question 4: Collaboration and coordination with other institutions

This project was rated **3.9** for its collaboration and coordination.

- This is an apparently complete and real team—it is very comprehensive. The best part, something that DOE can probably use elsewhere, is the U.S. Coast Guard letter advising that this hydrogen project is breaking new ground.
- The project has integrated well with other Hawaii activities. Collaborations are appropriate for the successful implementation of the project.
- The partnerships and collaboration on this project appear to be very good, with the right entities included and plenty of outreach and engagement.
- It is hard to think of better cooperation among the stakeholders.
- The team includes all relevant competencies.

Question 5: Proposed future work

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

- The efforts to remain committed to the project through the entire demonstration activity are positive and should provide valuable information for the Program.
- There is room to grow and expand this project—something that will grow the U.S. knowledge base for hydrogen but also something that will reduce the state of Hawaii's dependence on imported petroleum.

- Outlining the business case will be critical to understanding whether this project is simply an interesting demonstration or has real-world potential. In particular, it will be useful to see how a project like this could scale up to a large fleet of reefers for which a significant volume of hydrogen would be needed.
- Market transformation requires the right technology/product but also the market/customer. It is not clear how the project includes or addresses potential system operators in the maritime industry.
- This is good, but a fuel cell needs to be tested close to the ocean on a boat.

Project strengths:

- The project has strong collaborations with many partners, which is great. Using the Hickam station supports the beneficial use of another hydrogen resource in Hawaii. The project's outreach campaign is noteworthy.
- The project lays the groundwork to introduce fuel cells to the maritime industry. The project offers an immediate hydrogen demand for installed hydrogen infrastructure in Hawaii.
- The project has strong program management—it is very professional.
- The partnerships developed for this project appear to be very solid and are helping stakeholders better understand hydrogen and fuel cells. The project also appears to be working particularly well with the end user.
- The project involved all major and minor stakeholders.

Project weaknesses:

- No weaknesses were noted.
- The project would benefit from more analysis or evidence of the overall strength of this application; for example, (1) that this application is a major market or will drive fuel cell deployment in multiple applications, and (2) that it has the ability to scale up to more than 5–10 reefers. It would also benefit from some indication that fuel cells compare well to other alternatives for this application.
- The project needs to pay attention not only to being a valuable one-off showcase, but to opening the door for wider deployment of fuel cells in the maritime sector.
- Some air quality measurements are needed as soon as possible.

Recommendations for additions/deletions to project scope:

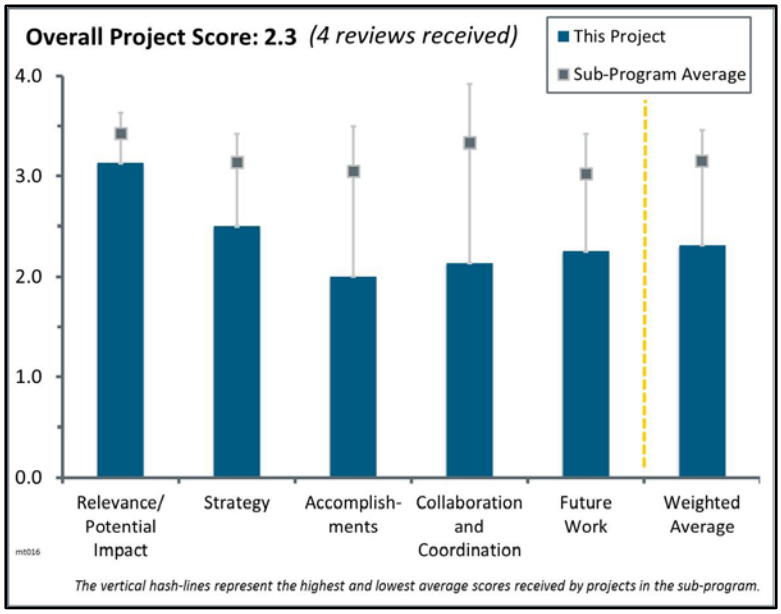
- The benefits (e.g., economics, emissions, and noise) to the site operator need to be made more obvious. Hydrogen supply is probably the most critical factor in terms of the economics. A sound concept is needed, including synergies with other possible applications at the same location. Questions around using hydrogen on board ships/vessels in the context of international standards need to be examined in more detail.
- After the demonstration is completed, the project team is encouraged to broadly share information about what is learned through the operational activities (e.g., performance, salt corrosion issues, safety data, and stakeholder feedback on issues and safety) with the Hydrogen Safety Panel and the National Renewable Energy Laboratory's codes and standards group.
- These results should be disseminated among the right companies or regulatory agencies for this marine application to keep it from being just a "one-off" demonstration.

Project # MT-016: Fuel Cell Hybrid Electric Delivery Van Project

Jason Hanlin; Center for Transportation and the Environment

Brief Summary of Project:

The overall objective of this project is to substantially increase zero emission vehicle driving range and increase the viability of electric drive medium-duty trucks. In Phase I, the project team will carefully develop and fully validate a demonstration vehicle to prove its viability to project stakeholders; funders; and the project's commercial fleet partner, United Parcel Service, Inc. (UPS). In Phase II, the project team will build and demonstrate a pre-commercial volume (up to 16) of the same vehicles for at least 5,000 hours of in-service operation.



Question 1: Relevance/potential impact on supporting and advancing progress toward the Hydrogen and Fuel Cells Program goals and objectives delineated in the Multi-Year Research, Development, and Demonstration Plan

This project was rated **3.1** for its relevance/potential impact.

- The project would help determine the potential for fleet operations of range extenders. If feasible, this could provide a valuable user for early refueling station deployments.
- This is a great project and could result in an early adopter of fuel cells, which would get good publicity. Everyone sees the UPS truck.
- This project had the potential to advance progress toward Fuel Cell Technologies Office goals on the implementation of fuel cells in commercial vehicles and initially had considerable non-federal cost share. However, it appears that changes to the project team and funding have put this project in serious jeopardy of not meeting its objectives and goals.

Question 2: Strategy for technology validation and/or deployment

This project was rated **2.5** for its project design, approach to addressing barriers, feasibility, and integration with other efforts.

- The project has a good strategy and plan for implementation.
- The project has the potential to address the stated Hydrogen and Fuel Cells Program barriers.
- The project had the potential to address many of the barriers in adapting fuel cells to commercial vehicles, but the ability of the current team to fulfill all of the project objectives is an issue.

Question 3: Accomplishments and progress toward overall project and U.S. Department of Energy (DOE) goals

This project was rated **2.0** for its accomplishments and progress.

- Nearly a year after its start, the project has failed to achieve any tangible results. The awardee has failed to achieve its milestone deliverable for one prototype vehicle. The awardee indicates that achievement of that milestone is at least one year away. The project's primary vehicle development partner has withdrawn from

the project, which has gone to a new vehicle development partner. The awardee indicated that the cost estimates for the vehicles have increased and that the new design will not meet the project performance objectives. The awardee indicated that the project does not have resources to meet its cost-share commitment. This project is failing with respect to schedule, budget, and technical objectives. The project progress to date is unsatisfactory, and the project performance to date is testimony to the high likelihood that the project will fail.

- Because of partner and funding problems, this project has not been able to show much progress, and it appears to be almost a full year behind schedule.
- The project has gross overruns and lacks financial controls; it is $2 million in the hole, and there are no deliverables yet.
- The project has fallen behind schedule because of supplier issues. Reduced funding from one of the partners may have significant implications for final deliverables.

Question 4: Collaboration and coordination with other institutions

This project was rated **2.1** for its collaboration and coordination.

- The project appears to be working hard at developing good collaborations. The issues with one supplier (who withdrew from the project) have hampered progress.
- The team has a prime partner in UPS but had serious problems due to the replacement of a suitable electric vehicle manufacturer. The replacement supplier, USL, is listed in the presentation as both Unique Electric Solutions and Unique Electric Services. It is unclear whether this supplier has the experience and capability to support this project, especially after having been brought on board so late.
- The awardee has failed to deliver its commitments to obtain the required cost-share resources. The coordination with the project's cost share partners appears to be both slow and non-compliant with the terms of the award.
- A major supplier backed out of the project before it even started, which set the project back months.

Question 5: Proposed future work

This project was rated **2.3** for its proposed future work.

- Most of the future work is now aimed at designing and building a single vehicle that is a technology-validation-type project rather than the proposed market transformation project, which was aimed at building and testing a fleet of vehicles. It is not clear at this time whether funds are available for the Market Transformation sub-program portion of this project.
- Delays and potential funding impacts (due to reduced funding from one partner) need to be fully considered and addressed.
- There is a recognized need for additional funding and potential funding sources.
- The proposed future work is unrealistic in the context of available project resources.

Project strengths:

- The impacts of vehicle routing on the power requirements appear to be well analyzed and thought through.
- The project has good partners in UPS and the state of California.
- This is a good project, in concept.

Project weaknesses:

- The SAE J2601 fueling limitations need to be resolved. The project team recognizes this and is working with the SAE committee. Some of the anticipated routes appeared to require 15 kg, yet only 10 kg of onboard hydrogen will be provided. It will not be possible to facilitate some early routes (e.g., hills). There are significant early project delays.

- Having to add an electric vehicle manufacturer so late in the project is a weakness. Having to reduce the amount of onboard hydrogen from 15 kg to 10 kg may affect range for some UPS routes. The project has not secured funding at this time to complete the Market Transformation sub-program portion of the project.
- The awardee reported that the project has spent almost a year developing the project requirements. The time that has been spent establishing requirements is inappropriate for attainment of project goals within the project schedule and budget.
- There are gross cost overruns.

Recommendations for additions/deletions to project scope:

- It is not clear that any consideration has been given to who will provide approval of the van configuration (e.g., the National Highway Traffic Safety Administration or the Pipeline and Hazardous Materials Safety Administration). It may be beneficial for this project to work with other DOE projects (e.g., refrigeration trucks and the maritime project) to determine what DOE requirements should apply. It is not clear how the vehicle will be identified to assist first responders. This should be considered/addressed for the final van configuration.
- This project should be changed to a Technology Validation sub-program project if funding is available, and the Market Transformation sub-program or fleet portion can be restructured as a separate project.
- The project team needs to identify additional funding sources as soon as possible.
- Based on the current project status and expected outcome, all project activities should be terminated at the earliest opportunity.