Prologue

Dear Colleague:

This document summarizes the comments provided by peer reviewers on hydrogen and fuel cell projects presented at the fiscal year (FY) 2017 U.S. Department of Energy (DOE) Hydrogen and Fuel Cells Program Annual Merit Review and Peer Evaluation Meeting (AMR), held in conjunction with DOE's Vehicle Technologies Office Annual Merit Review, on June 5–9, 2017, Washington, DC. In response to direction from various stakeholders, including the National Academies, this review process provides evaluations of the DOE-funded projects in applied research, development, demonstration, and analysis of hydrogen and fuel cell technologies. Acting Assistant Secretary for the Office of Energy Efficiency and Renewable Energy (EERE) Daniel Simmons opened the joint plenary session with more than 1,000 attendees, followed by keynote addresses and a fireside chat hosted by Deputy Assistant Secretary Reuben Sarkar with Jon Lauckner (Chief Technical Officer, Vice President of Research & Development, and President, GM Ventures, General Motors) and Joseph Powell (Chief Scientist – Chemical Engineering, Shell). The joint plenary also included overview presentations from the Fuel Cell Technologies Office and the Vehicle Technologies Office.

DOE values the transparent public process of soliciting technical input on its projects and overall programs from relevant experts with depth and breadth of knowledge across a number of broad areas. The recommendations of the reviewers are taken into consideration by DOE technology managers in generating future work plans. The table in this report lists the projects presented at the review, evaluation scores, and the major reviewer recommendations to be considered during the upcoming fiscal year (October 1, 2017–September 30, 2018). The projects have been grouped according to sub-program and reviewed according to the appropriate evaluation criteria. To furnish principal investigators (PIs) with direct feedback, all of the evaluations and comments are provided to each presenter; however, the authors of the individual comments remain anonymous. The PIs are instructed by DOE to fully consider these summary evaluation comments, along with any other comments by DOE managers, in their FY 2018 plans. In addition, DOE managers contact each PI individually and discuss the comments and recommendations as future plans are developed.

In addition to thanking all participants of the AMR, I would like to express my sincere appreciation to the reviewers for your strong commitment, expertise, and dedication in advancing hydrogen and fuel cell technologies. You make this report possible, and we rely on your comments, along with other management processes, to help make project decisions for the new fiscal year. We look forward to your participation in the FY 2018 AMR, which is tentatively scheduled for June in Washington, DC. Thank you for participating in the FY 2017 AMR.

Sincerely,

Sunita Satyapal
Director
Hydrogen and Fuel Cells Program
U.S. Department of Energy

Hydrogen Production and Delivery

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
PD-014	Hydrogen Refueling Analysis of Heavy-Duty Fuel Cell Vehicle Fleet *Amgad Elgowainy; Argonne National Laboratory*	3.4	X			Reviewers were supportive of the project's approach and praised the accomplishments to date, particularly noting the importance of working on hydrogen heavy-duty vehicles. Reviewers suggested collaborating with industry on the analysis results and ensuring that European work is referenced and incorporated as appropriate.
PD-025	Fatigue Performance of High-Strength Pipeline Steels and Their Welds in Hydrogen Gas Service *Joe Ronevich; Sandia National Laboratories*	2.9	X			The overall approach and objectives of this project were commended by reviewers. However, the reviewers questioned the delays in the project schedule and expressed concern about how time will be made up. Reviewers were also interested in seeing additional information on the detailed input and contributions of collaborators, particularly NIST.
PD-031	Renewable Electrolysis Integrated System Development and Testing *Michael Peters; National Renewable Energy Laboratory*	3.2			X	Reviewers commended the project for the thoroughness of the approach, including analysis and validation of technologies from leading electrolyzer industry members. According to reviewers, the project enabled clear, open, and comprehensive interaction between the U.S. Department of Energy (DOE) and industry stakeholders. It was further noted by reviewers that this project provided robust data on electrolyzer performance and capabilities with a rigorous, independent assessment of electrolyzer technologies.
PD-038	Biomass to Hydrogen (B2H2) *Pin-Ching Maness; National Renewable Energy Laboratory*	3.7	X			Reviewers agreed that this project has been successful in identifying and addressing the barriers of biohydrogen production. Reviewers identified the progress made in the genetic engineering of the C. thermocellum enzyme to yield increased hydrogen production as a major success. The principal investigator (PI) was commended for successfully leveraging collaborations, given that the project tasks cover a wide range of areas, including chemistry, process engineering, and molecular biology. The reviewers mentioned that they would like to see how the progress more directly connects to the overall cost of hydrogen.

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PD-100	700 bar Hydrogen Dispenser Hose Reliability Improvement *Kevin Harrison; National Renewable Energy Laboratory*	3.4	X			Reviewers praised the project approach and overall accomplishments, although they noted that testing has been limited in cycles and numbers of hoses. Reviewers would like to see additional scenarios for fueling and hose pressurization covered in the testing to ensure laboratory results are representative of real-world operations.
PD-102	Hydrogen Production and Delivery Cost Analysis *Brian James; Strategic Analysis, Inc.*	3.4	X			There was broad reviewer consensus that the technoeconomic analyses performed in this project are extremely important to DOE objectives, particularly in identification of the long-term potential and bottlenecks of hydrogen production and delivery pathways. Reviewers noted that the project has exhibited strong collaboration with DOE, industry stakeholders, and technology providers. Reviewers recommended that the analyses should be more transparent in key assumptions and sensitivities used.
PD-108	Hydrogen Compression Application of the Linear Motor Reciprocating Compressor *Eugene Broerman; Southwest Research Institute*	3.1	X			Reviewers supported this project's approach and importance, but they would like to see additional detail on technology comparisons and how targets align with DOE goals. Reviewers praised existing collaborations and suggested collaborating with additional suppliers to avoid project delays in the future.
PD-110	Low-Cost Hydrogen Storage at 875 bar Using Steel Liner and Steel Wire Wrap *Amit Prakash; Wiretough Cylinders*	3.2	X			Reviewers were generally pleased by the project's progress, collaborations, and contributions to meeting DOE goals. Reviewers had a number of technical questions on details presented and expressed the need for additional technical information to enable a complete assessment of the approach's technical merits and potential.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
PD-111	Monolithic Piston-Type Reactor for Hydrogen Production through Rapid Swing of Reforming/Combustion Reactions *Kenneth Rappe; Pacific Northwest National Laboratory*	3.2		X		Reviewers praised this project for its straightforward approach and innovative design. They noted that despite missing scheduled project milestones, the project showed reasonable progress in increasing the hydrogen production rate through improvements in both sorbent and catalyst formulations. Reviewers suggested incorporating additional cost data to better evaluate the impact of system optimization on capital cost.
PD-113	High-Efficiency Solar Thermochemical Reactor for Hydrogen Production *Tony McDaniel; Sandia National Laboratories*	3.1			X	Reviewers commended the project for its innovative approach and its work on reactor design. However, they felt that the project's scope was too broad and not enough attention was paid to the material screening and development process. Overall, the reviewers were impressed with the project team's extensive collaborations.
PD-114	Flowing Particle Bed Solarthermal Reduction–Oxidation Process to Split Water *Al Weimer; University of Colorado Boulder*	3.1			X	The reviewers praised this project for its progress in the on-sun reactor demonstration and for meeting the hydrogen production targets. The project's excellent collaboration with partners was highlighted. However, reviewers felt that the project scope was too broad to meet all of its milestones and that the project would have benefitted from additional technoeconomic analysis.
PD-115	High-Efficiency Tandem Absorbers for Economical Solar Hydrogen Production *Todd Deutsch; National Renewable Energy Laboratory*	3.5			X	Reviewers commended the project's approach to improving efficiency, which yielded a new world record in solar-to-hydrogen conversion efficiency. The project was praised for its careful attention to benchmarking the device accurately. However, reviewers were concerned that the project was unlikely to meet its durability goals, specifically emphasizing key durability challenges for the device when exposed to 10x solar illumination, a future goal.

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PD-116	Wide-Bandgap Chalcopyrite Photoelectrodes for Direct Solar Water Splitting *Nicolas Gaillard; University of Hawaii*	3.2	X			Reviewers appreciated the significant progress being made toward the project goals with successful integration of synthesis, characterization, and theory. They highlighted the excellent collaboration with university and national lab partners that comprise a team well suited to achieve the project goals. However, the reviewers expressed concern over the project's ability to meet all final targets relating to open circuit voltage, durability, and solar-to-hydrogen efficiency.
PD-125	Tandem Particle-Slurry Batch Reactors for Solar Water Splitting *Shane Ardo; University of California, Irvine*	3.1	X			The reviewers commended the project for developing an innovative system for photoelectrochemical hydrogen production, highlighting the excellent synergy between theory and design. The PI was encouraged to place additional emphasis on photoactive materials discovery and development relative to the extensive work on reactor design. Reviewers agreed that meeting the DOE solar-to-hydrogen efficiency targets will be a key challenge to this approach.
PD-127	Sweet Hydrogen: High-Yield Production of Hydrogen from Biomass Sugars Catalyzed by in vitro Synthetic Biosystems *Y-H Percival Zhang; Virginia Tech*	3.2			X	Reviewers praised this project for its progress in increasing hydrogen production rates from enzyme engineering and for its unique approach to incorporating several parallel research thrusts. It was noted, however, that there was not sufficient cost analysis performed to gauge the practicality of this approach. Reviewers also emphasized that further attention should be given to scale-up efforts to determine the project approach's feasibility.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
PD-129	Novel Hybrid Microbial Electrochemical System for Efficient Hydrogen Generation from Biomass *Hong Liu; Oregon State University*	3.7	X			According to reviewers, the project has a strong and comprehensive approach, with a focus on evaluating both system and feedstock costs to provide critical guidance in the design of the bio-reactor. Reviewers praised the overall progress of the project toward meeting milestones and cost targets as well as the collaboration between partners. A specific project strength cited was the use of, and cost analysis on, wastewater as a money-saving feedstock. Reviewer recommendations emphasized that further work is needed to address the electrocatalyst stability.
PD-130	Improved Hydrogen Liquefaction through Heisenberg Vortex Separation of Para- and Orthohydrogen *Christopher Ainscough; National Renewable Energy Laboratory*	3.3	X			Reviewers praised the project's innovative approach, potential impact, and progress to date, while recognizing specific project delays resulting from the reported facility failure. Reviewers expressed confidence in the collaborative partnership's collective abilities, but would have liked additional information explicitly detailing the partner roles and contributions.
PD-131	Magnetocaloric Hydrogen Liquefaction *Jamie Holladay; Pacific Northwest National Laboratory*	3.2	X			Reviewers were supportive of this project's innovative approach to hydrogen liquefaction and novel implementation. They praised current collaborations but encouraged adding collaborators as the project and technology progress. Reviewers suggested that the project could be presented more clearly to better explain the project steps in developing this complex technology.
PD-133	Hydrogen Fueling Infrastructure Research and Station Technology (H2FIRST) – Consolidation *Christopher Ainscough; National Renewable Energy Laboratory*	3.7	X			Reviewers praised the relevance of this project, highlighting its importance to industry stakeholders. They also commended the excellent leveraging of the project's collaborative efforts in successful project execution. Reviewers were particularly supportive of the combination of analytical and experimental work implemented to achieve project targets in support of broader DOE goals.

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PD-135	Liquid Hydrogen Infrastructure Analysis *Guillaume Petitpas; Lawrence Livermore National Laboratory*	3.2	X			While this project has just started, reviewers provided positive feedback on the approach and scope of the project, as well as the collaborations. Reviewers emphasized the importance of this work, noting that liquid delivery may become critical to hydrogen infrastructure in the future.
PD-136	Electrochemical Compression *Monjid Hamdan; Giner, Inc.*	3.4	X			Reviewers praised the accomplishments made by the project team in the short time since the project started. They were also broadly supportive of the project approach, importance to DOE goals, and project partners.
PD-137	Hybrid Electrochemical–Metal Hydride Compression *Scott Greenway; Greenway Energy, Inc.*	3.3	X			Overall, reviewers were pleased with this project's approach, importance, goals, creativity, and accomplishments to date. Recommendations included increasing the focus on technoeconomic analysis of the hybrid approach to determine at an earlier stage whether the hybrid approach can be cost-competitive. Clarifying the collaborators' roles was also encouraged.
PD-138	Metal Hydride Compression *Terry Johnson; Sandia National Laboratories*	2.9	X			While reviewers praised the relevance of this work and its coordination with other compressor projects, they questioned whether additional work should go into metal hydride compression. They recommended development of a solid value proposition to justify this specific implementation of the technology. Reviewers also suggested the project add additional collaborations in this area, particularly to assist with cost projection analysis.
PD-139	Reference Station Design, Phase II *Ethan Hecht; Sandia National Laboratories*	3.3	X			Reviewers praised this project for its contributions to the understanding of station design and cost drivers. Also commended were the project's collaborations, potential impact, and future plans. Reviewers emphasized the critical importance of continuing to focus on market-relevant station advancements, given the rapidly changing context for station designs.

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PD-140	Dispenser Reliability *Christopher Ainscough; National Renewable Energy Laboratory*	3.2	X			Reviewers provided positive feedback on the accomplishments to date and the impact and relevance of this project to DOE objectives. However, reviewers expressed concern that the component-testing part of the project may not be the best or most cost-effective approach. They also encouraged partnership with component manufacturers.
PD-143	High-Temperature Alkaline Water Electrolysis *Hui Xu; Giner, Inc.*	3.2	X			Reviewers commended the project for its novel concept and progress, given its recent start. They also noted that this project has significant potential to reduce the cost of electrolytic hydrogen production. However, reviewers felt that the project will face daunting technical challenges as the project progresses, including electrolyte and interfacial stability, and suggested that it would benefit from enhanced collaboration. There was also concern that the project's efficiency and current density goals might be overly ambitious.
PD-144	Multiscale Ordered Cell Structure for Cost-Effective Production of Hydrogen by High-Temperature Water Splitting *Elango Elangovan; Ceramatec*	3.1	X			The reviewers noted that the project has a strong team with significant potential to reduce the cost of hydrogen production via high-temperature electrolysis. Reviewers were critical of the device architecture, noting that it will be very complex to assemble, given the constraints of the electrode fabrication methods and the seals with which it will interact. Reviewers were also critical of the lack of durability testing and power and efficiency targets.
PD-146	Advancing Hydrogen Dispenser Technology by Using Innovative Intelligent Networks *Darryl Pollica; Ivys Energy Solutions Inc.*	3.6	X			Reviewers were impressed by this project and praised its innovative approach, progress to date, and effective leveraging of collaborations. The potential impact and relevance to DOE goals were also commended. Reviewers suggested expanding collaborations in the future to include an automotive original equipment manufacturer.

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PD-147	Economical Production of Hydrogen through Development of Novel, High-Efficiency Electrocatalysts for Alkaline Membrane Electrolysis *Kathy Ayers; Proton Onsite*	3.5	X			The project was commended for its demonstrated progress toward lowering costs and expanding hydrogen production options. Reviewers praised the project approach, noting that improved alkaline exchange membranes (AEMs) are critical to hydrogen production from AEM-based water electrolysis. Reviewers noted that while replacing Ir with Rr will result in cost savings, this is a short-term solution, as Ru is also a platinum group metal. Suggestions included validating the initial durability testing on longer timescales and placing more emphasis on performing detailed technoeconomic analysis.

Hydrogen Storage

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
ST-001	System-Level Analysis of Hydrogen Storage Options *Rajesh Ahluwalia; Argonne National Laboratory*	3.1	X			According to the reviewers, the project approach is sound, and the independent assessment of hydrogen storage systems and materials is useful. The reviewers felt that the project effectively applies strong physical and chemical modeling and analysis while providing sensitivity studies to understand tradeoffs for hydrogen storage system materials and performance. The reviewers noted that the assessment of cryogenic-compressed hydrogen storage systems were of high technical quality, but questioned the focus of this year's effort on bus applications.
ST-008	Hydrogen Storage System Modeling: Public Access, Maintenance, and Enhancements *Matt Thornton; National Renewable Energy Laboratory*	2.9	X			The reviewers stated that the models the project is providing and improving are an important resource for the hydrogen storage community. They commended the makeup of the team and the approach. However, reviewers also added that there are additional metrics beyond gravimetric and volumetric capacities that should be addressed.
ST-063	Formation and Regeneration of Alane *Ragaiy Zidan; Savannah River National Laboratory*	2.8			X	This project was completed in fiscal year (FY) 2017. Reviewers stated that the impact coming from the project's progress on the production of alane will be relevant to non-automotive and portable power applications. The team's effort in scaling up the quantities of material was commended.

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ST-100	Hydrogen Storage Cost Analysis *Brian James; Strategic Analysis, Inc.*	3.4	X			The reviewers noted that the project team provides quality results to address the primary barrier of cost for hydrogen storage system technology development. The reviewers felt that the project team has very good collaboration with external researchers to provide increased technical background for more accurate cost analyses, and the transparency of assumptions and technical rigor was commended. The reviewers suggested that the project consider new hydrogen storage materials that are being commercialized for other applications, such as alane, and identify key cost drivers for new hydrogen storage materials where research and development could lead to cost reductions.
ST-113	Innovative Development, Selection, and Testing to Reduce Cost and Weight of Materials for Balance-of-Plant Components *Jon Zimmerman; Sandia National Laboratories*	3.0	X			The reviewers commented that the project's combination of computational and empirical activities to identify novel hydrogen-compatible materials is a good approach to providing lower-cost balance-of-plant material alternatives. It was noted that the project could benefit from more consideration of whether discovered materials are able to be manufactured into balance-of-plant components. The reviewers highlighted the project's interactions with industrial partners and recommended that the project team seek more collaboration with original equipment manufacturers (OEMs).
ST-116	Low-Cost α-Alane for Hydrogen Storage *Tibor Fabian; Ardica*	2.9			X	This project was completed in FY 2017. The reviewers stated that the project's cost model is strong and takes into account key areas relevant to the material's synthesis and recovery processes. However, the reviewers stated that the approach should have a greater focus on higher yield of adduct and on optimizing the regeneration process using spent AlH_3.

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ST-118	Improving the Kinetics and Thermodynamics of $Mg(BH_4)_2$ for Hydrogen Storage *Brandon Wood; Lawrence Livermore National Laboratory*	3.2			X	This project was completed in FY 2017. The reviewers stated the insights gained on the reaction pathways and properties of magnesium borohydride at the nanoscale level are valuable. Reviewers commended the team's ability to leverage collaborations to produce concrete results that benefit the hydrogen storage materials community. However, the reviewers stated that it is not clear how insights gained throughout the project could be translated into strategies to develop new and novel hydrogen storage materials.
ST-119	High-Capacity Hydrogen Storage Systems via Mechanochemistry *Vitalij Pecharsky; Ames Laboratory*	2.9		X		This project is planned to be discontinued after FY 2017. Reviewers commended the project's use of mechanochemistry as the means to gain a fundamental understanding of complex metal hydrides. However, the project's link between applying the fundamental understanding gained and identifying practical hydrogen storage materials with the potential to meet the targets was described as weak. Reviewers also stated the project has little to no collaboration with the Hydrogen Materials–Advanced Research Consortium (HyMARC).
ST-120	Design and Synthesis of Materials with High Capacities for Hydrogen Physisorption *Brent Fultz; California Institute of Technology*	3.2	X			The project was given high marks for its approach to determining how pore chemistry can control binding energies and its potential impact on the Hydrogen and Fuel Cells Program. The reviewers commended the upcoming collaborations with project partners to generate large-scale reproducible carbons. However, reviewers also commented that several aspects of the synthetic processes, both in the accomplishments to date and in the proposed future work, lacked sufficient detail.

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ST-122	Hydrogen Adsorbents with High Volumetric Density: New Materials and System Projections *Don Siegel; University of Michigan*	3.1	X			The reviewers were complimentary of the computational screening approach used in this project to direct synthetic targets. It was felt that the project has made excellent progress toward linking structural properties and capacities. Reviewers also noted that the project should place more emphasis on higher-temperature adsorption by addressing binding enthalpies, as well as potential volumetric capacity losses through low packing densities.
ST-126	Conformable Hydrogen Storage Coil Reservoir *Erik Bigelow; Center for Transportation and the Environment*	2.7	X			Reviewers noted that this project presents a promising concept for conformable hydrogen storage, with potential high impact if successfully demonstrated. It was also noted how progress was made in identifying a reinforcement fiber for burst requirements. However, the reviewers observed that the project's main challenge continues to be finding a suitable barrier liner material with low enough permeability to prevent hydrogen leakage. Recommendations for the project team included seeking out more collaborations with materials experts to assist in finding suitable liner materials to meet the permeability requirements.
ST-127	Hydrogen Materials–Advanced Research Consortium (HyMARC) – A Consortium for Advancing Solid-State Hydrogen Storage Materials *Mark Allendorf; Sandia National Laboratories*	3.4	X			The reviewers were impressed by the progress made in several aspects of the consortium's work, including the overall coordination of the effort, communication of and justification for its goals, engagement with the seedling projects, and integration of theory with experiments. According to reviewers, it will be important going forward to provide clarity as to how the foundational knowledge gained through model system studies will be applied to develop more complex, relevant systems.

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ST-128	Hydrogen Materials–Advanced Research Consortium (HyMARC) – Sandia National Laboratory's Technical Effort *Mark Allendorf; Sandia National Laboratories*	3.3	X			Reviewers commended the level of collaboration between all the HyMARC/ Hydrogen Storage Characterization and Optimization Research Effort (HySCORE) laboratories and the seedling projects. Much of the consortium's modeling work for both sorbents and hydrides was described as a significant success over the past year. Reviewers suggested that the topics of reaction kinetics and additives/catalysts be enhanced in future work.
ST-129	Hydrogen Materials–Advanced Research Consortium (HyMARC) – Lawrence Livermore National Laboratory's Technical Effort *Brandon Wood; Lawrence Livermore National Laboratory*	3.3	X			Reviewers were very complimentary of the many computational modeling accomplishments presented by the project. The reviewers were impressed by the quality of the team, the results, and the high level of collaboration with the seedling projects. However, reviewers were concerned that there is not enough experimental validation of the modeling work and hoped that this would be a focus in future work.
ST-130	Hydrogen Materials–Advanced Research Consortium (HyMARC) – Lawrence Berkeley National Laboratory's Technical Efforts *Jeffrey Urban; Lawrence Berkeley National Laboratory*	3.0	X			Reviewers were particularly satisfied with advancements on modeling of metal–organic frameworks in conjunction with other HyMARC partners and with the progress on the metal hydride encapsulation work. The reviewers indicated that the capabilities at the Advanced Light Source are unique and very important to the consortium's overall efforts. A few specific concerns were raised involving the integration of the encapsulation effort with the HyMARC computational work, as well as the nature of the graphene oxide coating in these composites.
ST-131	Hydrogen Storage Characterization and Optimization Research Effort (HySCORE) – National Renewable Energy Laboratory's Technical Efforts *Thomas Gennett; National Renewable Energy Laboratory*	3.4	X			The reviewers had a very positive view of the organization and coordination of the HySCORE group within HyMARC. They were extremely supportive of the interlab round-robin study and believe it is of great significance to the hydrogen storage community. The reviewers also commended many of the other characterization tools for sorbent investigations. Collaborations within HyMARC were noted, but some reviewers felt that these could be stronger or broader.

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ST-132	Hydrogen Storage Characterization and Optimization Research Effort (HySCORE) – Pacific Northwest National Laboratory's Technical Efforts *Tom Autrey; Pacific Northwest National Laboratory*	3.2	X			The project's in situ nuclear magnetic resonance (NMR) capabilities were noted by reviewers as being essential to the overall consortium and the Hydrogen Storage sub-program. Reviewers were complimentary of the project's collaboration on work related to magnesium borohydride with several other core consortium laboratories and seedling projects. However, some concerns were expressed about the liquid organic carrier component of the project. Reviewers noted this work was an outlier among the overall consortium efforts and that the goals of future work on these materials are unclear.
ST-133	Hydrogen Storage Characterization and Optimization Research Effort (HySCORE) – Lawrence Berkeley National Laboratory's Technical Efforts *Jeffrey Long; Lawrence Berkeley National Laboratory*	3.2	X			Reviewers commended progress made in several areas of the project, specifically the installation and utilization of the diffuse reflectance Fourier transform infrared spectroscopy (DRIFTS) instrument for hydrogen binding characterization, the technoeconomic analysis performed for metal–organic framework synthesis, and the continued experimental and computational work in pursuit of materials capable of binding several hydrogen molecules at a single open metal site. Some reviewers questioned the importance of the calcium oxalate work and recommended that it be either discontinued or more focused to align with the overall goals of the project.
ST-134	Investigation of Solid-State Hydrides for Autonomous Fuel Cell Vehicles *Joseph Teprovich; Savannah River National Laboratory*	3.3	X			The approach and achievements presented by the project were strongly praised by the reviewers, who were impressed by the innovative design of the unmanned underwater vehicle systems. They commended the collaboration between U.S. Department of Defense and U.S. Department of Energy (DOE) groups to demonstrate an important extension of fuel cell technology to a new type of mobile application. While some reviewers pointed out that the design choices were ideal for this application, others mentioned that this would ultimately require a scaled-up alane production process to lower material costs.

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ST-136	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: "Graphene-Wrapped" Complex Hydrides as High-Capacity, Regenerable Hydrogen Storage Materials *Di Jia Liu; Argonne National Laboratory*	3.0	X			The reviewers stated that the project is a novel and innovative approach to addressing the important kinetic barriers present in complex metal hydrides. They noted that advancements in material performance over what was reported in the original publication have not been that significant, but did acknowledge that the project is still at a very early stage. Some reviewers were troubled by what they viewed as disconcerting or confusing NMR results. With regard to future work, suggestions included expanding the scope of complex hydrides beyond sodium borohydride, as well as carrying out more mechanistic studies in conjunction with HyMARC.
ST-137	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Electrolyte-Assisted Hydrogen Storage Reactions *Channing Ahn; Liox Power*	2.7	X			As this project had been underway for only a few months at the time of the presentation, the reviewers found it difficult to rate progress; however, they commended the novelty of the project's approach and the strength of the team. Looking forward, the reviewers believed that the project may find solvents or electrolytes that will enhance kinetics, but were somewhat skeptical that any system would provide significant progress toward the storage targets. Multiple reviewers identified the ionic liquid and eutectic tasks as being the most promising future work.
ST-138	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Development of Magnesium Boride Etherates as Hydrogen Storage Materials *Godwin Severa; University of Hawaii*	3.3	X			The reviewers all agreed that the project is addressing a very relevant problem in the storage materials field by focusing on improving the thermodynamics and kinetics of magnesium borohydride. They believe that the project has made good progress in its early stages and commended the level of integration it displays with the HyMARC and HySCORE laboratory teams. The reviewers were also supportive of the planned future efforts and tasks, but did state that going forward it will be important to utilize the computational capabilities of the core teams to assist with the elucidation of reaction mechanisms.

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ST-139	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Fundamental Studies of Surface-Functionalized Mesoporous Carbons for Thermodynamic Stabilization and Reversibility of Metal Hydrides *Eric Majzoub; University of Missouri–St. Louis*	3.2	X			The reviewers found the project's approach to be a novel and innovative method of altering the thermodynamics of high-capacity hydrides. Reviewers commended the expertise of the project team and the amount of collaboration with the HyMARC core team at this early stage of the project. According to the reviewers, knowledge gained through this work may have impact on other efforts and projects. However, concerns were raised about whether the materials developed in this project could ultimately meet the DOE storage targets. There were also questions raised regarding alane as the best choice for the infiltration material.
ST-140	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Developing a Novel Hydrogen Sponge with Ideal Binding Energy and High Surface Area for Practical Hydrogen Storage *Mike Chung; The Pennsylvania State University*	3.1	X			Reviewers commended the overall approach of the project and said that the targeted materials are promising. The project was seen as having the potential for high impact on the hydrogen storage field in terms of quantifying the effects of boron sites on adsorption behavior. However, the reviewers were somewhat concerned with the isotherms shown in the presentation and suggested that the project leverage the program's existing adsorption validation and characterization capabilities to accelerate the understanding of the material properties.
ST-141	Integrated Insulation System for Automotive Cryogenic Storage Tanks *Barry Meneghelli; Vencore*	3.0	X			The reviewers noted that the project's system-level approach is well suited to addressing key challenges associated with maintaining thermal vacuum insulation quality for cold/cryo-compressed hydrogen storage systems. The reviewers highlighted the project's structure of modeling and experimental activities for identifying heat leakage pathways and potential system improvements. Also highlighted were the project team's strong collaborations, but it was noted that the team could benefit from collaboration with OEMs.

Fuel Cells

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-017	Fuel Cell System Modeling and Analysis *Rajesh Ahluwalia; Argonne National Laboratory*	3.5	X			Reviewers widely agreed that the approach to the analysis was sound and that the results would be useful to the fuel cell original equipment manufacturer (OEM) community-at-large. Reviewers also expressed approval of the results achieved since the last review and said that they will be key to the development of the U.S. Department of Energy's (DOE's) future objectives and targets for fuel cells. It was noted that future work could be better focused on validating durability of stack- or system-level models.
FC-021	Neutron Imaging Study of the Water Transport in Operating Fuel Cells *David Jacobson; National Institute of Standards and Technology*	3.1		X		Based on the fiscal year (FY) 2018 Budget, no further DOE funding is requested for this project at this time.
FC-052	Technical Assistance to Developers *Tommy Rockward; Los Alamos National Laboratory*	2.9			X	Based on the FY 2018 Budget Request's focus on early-stage applied energy research and development (R&D) activities, no further DOE funding is requested for this project at this time.
FC-081	Fuel Cell Technology Status: Degradation *Jennifer Kurtz; National Renewable Energy Laboratory*	3.0		X		Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-105	Novel Structured Metal Bipolar Plates for Low-Cost Manufacturing *C. H. Wang; TreadStone Technologies, Inc.*	3.2	X			Reviewers generally agreed that while the project was in its early stages, initial progress in modifying the deposition process was satisfactory. Reviewers also said that the approach was based on sound cost analysis and testing partnerships were well structured. There was some concern about whether spray-coating on pre-stamped plates is scalable. It was noted that the project's origins as a Small Business Innovation Research Program (SBIR) project has given it a clear understanding of challenges and goals related to bipolar plate R&D. Reviewers affirmed that future work should adjust primary targets and timelines, including scaled-up system analysis and characterization.
FC-110	Advanced Hybrid Membranes for Next-Generation Polymer Electrolyte Membrane Fuel Cell Automotive Applications *Andrew Herring; Colorado School of Mines*	3.2			X	Reviewers noted that recent progress has been promising. They agreed that, with further rigorous degradation testing and analysis, the new membrane has the potential to outperform others and to meet several critical DOE targets. However, they expressed mixed approval of the overall design of the project, noting that there is a need for proper balance between testing of membranes in fuel cells and fundamental understanding of the novel membranes. Additionally, questions were raised about the collaboration and proposed work with certain partners. Reviewers proposed more attention be paid to meeting cost and durability targets.
FC-128	Facilitated Direct Liquid Fuel Cells with High-Temperature Membrane Electrode Assemblies *Emory DeCastro; Advent Technologies, Inc.*	3.1	X			Reviewers viewed the project's approach as sound and remarked that it is addressing key barriers to commercialization. Reviewers widely noted that there was still a lack of demonstration of the focused catalyst, PtRuPd, and that the team remains short of stated targets. They urged greater collaboration on imaging techniques and agreed that the potential applications for liquid-fueled high-temperature direct dimethyl ether (DME) cells were generally beneficial to DOE's strategic goals.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-130	Development of Platinum-Group-Metal-Free Catalysts for Hydrogen Oxidation Reaction in Alkaline Media *Alexey Serov; University of New Mexico*	3.3	X			Reviewers commended the project's approach to testing a platinum-group-metal (PGM)-free anode for alkaline membrane fuel cells (AMFCs). However, some reviewers noted a lack of clear rationale for some tested material combinations. They were clear that the project has met its stated goals but that the catalyst was still not performing highly. Reviewers were generally optimistic about potential future work and breakthroughs, but it was noted that the project was nearing completion and any additions to scope or future work may not be able to happen. Reviewers raised the possibility of a no-cost extension of the project while project partners continued to optimize carbon-supported NiCu.
FC-131	Highly Stable Anion-Exchange Membranes for High-Voltage Redox-Flow Batteries *Yushan Yan; University of Delaware*	3.0			X	Reviewers mostly agreed that the approach toward membrane fabrication is reasonable and well integrated into existing testing systems. According to reviewers, the project's switch to a polybenzimidazole (PBI) backbone demonstrated improvements in stability and progress toward the project targets, although further work is needed to improve overall membrane conductivity. Reviewers said it was difficult to assess the relevance to DOE goals and potential impact, given that the focus was on redox flow batteries, but the work could yield benefits in advancing hydroxide-exchange membrane technology. Finally, they suggested the future focus be on testing and making improvements at high temperatures to better assess performance in fuel cells.
FC-132	Innovative Non-Platinum-Group-Metal Catalysts for High-Temperature Polymer Electrolyte Membrane Fuel Cells *Sanjeev Mukerjee; Northeastern University*	3.5	X			Reviewers expressed wide approval for the approach in testing PGM-free catalysts, noting its innovative work in related durability studies and performance. Additionally, the strength of the wide collaboration between university and industry partners was noted. Reviewers agreed that future work should include longer durability testing periods with a focus toward commercialization of the catalyst.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-135	FC-PAD: Fuel Cell Consortium for Performance and Durability *Rod Borup;* *Los Alamos National Laboratory*	3.0	X			Reviewers spoke highly of the consortia approach, which allows the project to collaborate with complementary projects. Reviewers pointed to this collaboration and facilitation of inter-laboratory work as a key strength of the project. They pointed to clear and measured progress in the 1.5 years the project has been underway, highlighting modeling and degradation analysis work. According to reviewers, the project is critical to meeting DOE targets. It was noted that one risk is an increased level of administration that gets in the way of progress. For future work, reviewers suggested an increased focus on model quantification and extrapolation of results leading to new stack designs.
FC-136	FC-PAD: Fuel Cell Consortium for Performance and Durability – Components and Characterization *Karren More;* *Oak Ridge National Laboratory*	3.4	X			Reviewers observed that the project has made significant progress in its role in supporting other work, such as the characterization and quantification of PtCo catalyst degradation through use of state-of-the-art techniques. There was strong agreement that the dissemination of this work is very beneficial for the fuel cell industry as well. One weakness identified was the lack of wider industry participation in the project's characterization efforts. Reviewers were supportive of the project's future work in developing new characterization methods and increasing understanding of fuel cell performance and durability issues.
FC-137	FC-PAD: Fuel Cell Consortium for Performance and Durability – Electrode Layers and Optimization *Adam Weber;* *Lawrence Berkeley National Laboratory*	3.3	X			Reviewers affirmed that significant progress has been made in characterization and diagnostic methods for optimization. Reviewers thought the project's relevance was dependent on achieving a better understanding of ionomer structure conditions, which will have a greater impact on DOE targets. Several reviewers also encouraged further collaboration with projects focused on studying novel structures for enhanced performance and durability.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-140	Tailored High-Performance Low-Platinum-Group-Metal Alloy Cathode Catalysts *Vojislav Stamenkovic; Argonne National Laboratory*	3.3	X			Reviewers enthusiastically approved of the project's approach, design, state-of-the-art methods, and aggressive targets for low-PGM novel catalysts. They agreed, however, that progress has slowed since 2016 and that while more catalysts had been developed, performance remains low. They agreed that the project will align well with DOE goals if catalyst activity can be improved within the membrane electrode assembly (MEA), demonstrating potential for significant cost reductions for polymer electrolyte membrane fuel cells (PEMFCs). Finally, several reviewers noted that future work for the project remained unclear.
FC-141	Platinum Monolayer Electrocatalysts *Radoslav Adzic; Brookhaven National Laboratory*	3.1	X			Reviewers generally approved of the project's approach to addressing key barriers and including proper MEA testing. They specifically pointed to MEA testing of Pt/PdNiN/C systems as an important part of the project. These tests, in their view, are critical to meeting the goals of PEMFC cost reduction and could significantly improve Pt utilization in fuel cells; more effort is needed to understand limiting factors. However, reviewers noted that catalyst performance needs to be improved. They feel that the new catalyst synthesis and characterization shows potential but that it runs the risk of moving in too many directions. They believe that there may be advantages to focusing more on a single catalyst. Reviewers suggested future work should include scale-up of materials with collaboration with MEA OEMs and FC-PAD.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-142	Extended-Surface Electrocatalyst Development *Bryan Pivovar; National Renewable Energy Laboratory*	3.0	X			Reviewers were in agreement that the approach to low-PGM nanowire was relevant and appropriate for the project. They noted that some moderate progress has been made in atomic layer deposition activities and in improving batch sizes. There was concern about remaining issues regarding durability, stability of the Ni core, and catalyst performance. Suggestions included focusing future work on improving the mechanical integrity of the catalyst and demonstrating scaled-up performance at MEA levels.
FC-143	Highly Active, Durable, and Ultra-Low-Platinum-Group-Metal Nanostructured Thin-Film Oxygen Reduction Reaction Catalysts and Supports *Andrew Steinbach; 3M*	3.0	X			For this project, reviewers expressed mixed support for the dual approach to thin-film catalysts, unitized thin film and nanoporous thin film, noting that performance of one was clearly superior to the other. Reviewers recognized that pursuing both does mitigate risk. They pointed to performance progress through extensive testing on nanostructured thin-film (NSTF) catalysts as important to meeting 2020 targets for catalyst mass activity. The reviewers affirmed that both approaches generally support DOE goals and that only one will meet final project goals, which should define future work. The focus of this future work should include an increased focus on optimizing the catalyst layer structure for improved performance.
FC-144	Highly Accessible Catalysts for Durable High-Power Performance *Anu Kongkanand; General Motors*	3.2	X			Reviewers thought the project's approach to addressing varying causes of performance degradation of PEMFCs was relevant and appropriate. They praised the work to develop high-performing PtCo catalysts on porous supports and investigate Pt-electrolyte interactions. This work was seen as having potential to significantly increase the understanding of degradation and make key improvements in durability, which could lead to new approaches in PEMFCs. The project was viewed as having a strong mix of technical expertise and avenues to achieve stated goals. Reviewers also felt that further work was needed to better understand the interactions of ionic liquids in the catalyst layer.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-145	Corrosion-Resistant Non-Carbon Electrocatalyst Supports for Proton Exchange Fuel Cells *Vijay Ramani; Washington University in St. Louis*	2.5		X		Reviewers commended the results attained using density functional theory modeling. There was disagreement as to whether the approach is appropriate, specifically in regard to support stability of a platinum catalyst and whether a better understanding is required. Reviewers showed some doubts on the relevance of the project and suggested more clarity was needed around fuel cell testing. Reviewers felt that collaboration could focus on catalyst supplier and automotive OEM interactions to help meet requirements.
FC-146	Advanced Materials for Fully Integrated Membrane Electrode Assemblies in Anion-Exchange Membrane Fuel Cells *Yu Seung Kim; Los Alamos National Laboratory*	3.4	X			Reviewers agreed that the innovative approach to studying alkaline membranes will most effectively help determine stability and, by extension, practicality for commercial application. They also affirmed that the project has made solid progress in reaching milestones and in situ testing of membranes under basic conditions of the AMFC, with the exception of the milestone of a downselect ionomer. Collaborations were seen to be well structured. Reviewers thought that the work on alkaline membrane stability was aligned with DOE goals and that future work should focus on PGM-free rather than low-PGM catalysts.
FC-147	Advanced Ionomers and Membrane Electrode Assemblies for Alkaline Membrane Fuel Cells *Bryan Pivovar; National Renewable Energy Laboratory*	3.3	X			Reviewers were generally supportive of the project's approach to developing stable AMFCs, specifically in regard to eliminating sulfonamide linkage, which reviewers believe will result in a more stable membrane. They did, however, conclude that there could be more of a focus on cost and performance, in addition to stability. They recognized the project's potential to fulfill relevant DOE targets for an alkaline membrane for automotive applications, and to advance general understanding of new membranes. As a result, the reviewers felt that future work should focus on the limitations preventing the project from meeting the targets at a fuel-cell-system level.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-154	Regenerative Fuel Cell System (Small Business Innovation Research Phase II) *Paul Matter;* *pH Matter LLC*	3.1	X			Reviewers stated that, while the benefits of a regenerative fuel cell were obvious, the approach was perhaps too broad and optimistic to reach certain targets. It was observed that certain cost and performance targets are already being met by other dedicated systems, but that the niche-application potential of the regenerative fuel cell makes the targets more reasonable. Reviewers thought future work should focus on the individual technology readiness levels of components and cost-effectiveness of the system to ensure market relevance and a clear business case, which would broadly help meet DOE goals.
FC-155	Novel Ionomers and Electrode Structures for Improved Polymer Electrolyte Membrane Fuel Cell Electrode Performance at Low-Platinum-Group-Metal Loadings *Andrew Haug; 3M*	3.4	X			Reviewers agreed that both the approach for ionomer characterization and the NSTF performance were well designed and have high potential for results. Additionally, they felt that good progress has been made in the short time the project has been active, particularly in catalyst layer and ionomer activities. It was clear to reviewers that the project was well leveraged within FC-PAD and that the team communicated well between project partners, with the dispersion capabilities being a particular strength of the effort. Reviewers stressed that the characterization work was relevant to both FC-PAD objectives and Multi-Year Research, Development, and Demonstration Plan targets and that the project should continue to focus on those aspects over developmental efforts.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-156	Durable High-Power Membrane Electrode Assemblies with Low Platinum Loading *Swami Kumaraguru; General Motors*	3.2	X			Reviewers agreed that the project's initial approach to developing state-of-the-art (SOA) MEAs was comprehensive and followed DOE guidelines, which will help to integrate with FC-PAD activities. It was noted that this should produce results in line with targets in the project's first year. According to reviewers, the project partners' MEA expertise will ensure appropriate access to SOA materials and will contribute to the development of a durable, high-performance electrode. Reviewers suggested feedback from first-year results guide MEA optimization in the second project year.
FC-157	High-Performance Polymer Electrolyte Fuel Cell Electrode Structures *Mike Perry; United Technologies Research Center*	3.1	X			Reviewers agreed overall with the high-level focus and the experimental design to further understand transport losses in low-PGM electrodes. However, it was noted that project partners could have provided more clarity on metrics to validate results for mass transport losses. Early results, according to reviewers, showed satisfactory progress in the development of a model for getting insight on the catalyst at the rotating disk electrode (RDE) layer. They indicated that the challenge will be transferring those findings to useful results at the MEA level. Reviewers concurred that future work needs to aim toward ensuring SOA performance and to streamline thin-film catalyst activities by approaching project partners.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-158	Fuel Cell Membrane Electrode Assemblies with Ultra-Low-Platinum Nanofiber Electrodes *Peter Pintauro; Vanderbilt University*	3.3	X			Reviewers widely commended the project's novel approach in using electrospun nanofibers to address key barriers to MEA commercialization. They indicated electrospun catalyst results showed good progress in catalyst performance and mass activity in a short amount of time, especially within the PtCo/C nanofiber cathode. Reviewers were confident that the approach and the diversified team of experts showed high potential for reaching DOE 2020 targets and that, as the project moves forward, FC-PAD laboratories will be able to collaborate further. Reviewers thought the project could do a better job of understanding the correlation between electrospun nanofiber MEAs and performance improvements. It was suggested that future efforts include work to increase characterization of electrospun electrode transport properties, with comparison to SOA MEAs.
FC-160	ElectroCat (Electrocatalysis Consortium) *Piotr Zelenay; Los Alamos National Laboratory*	3.1	X			Reviewers widely agreed that the approach to PGM-free catalysts was sound and comprehensive. Reviewers expressed approval of the electrode performance progress achieved thus far but indicated that further progress was needed to improve catalyst stability. They agreed that the laboratory collaboration structure worked well, especially with the consortium's strong technical team. Some reservations were expressed about the lack of any outside partners. Reviewers agreed future work should increasingly address catalyst stability and durability.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-161	Advanced Electrocatalysts through Crystallographic Enhancement *Jacob Spendelow; Los Alamos National Laboratory*	3.2	X			Reviewers stated that the alloying approach to catalyst improvements in stability and activity was appropriate and will address major barriers to commercialization. The project was observed to have shown good initial results, particularly in the mass activity of the face-centered tetragonal (fct)-CoPt catalyst. Also praised were the level of collaboration and no-cost involvement of project partners. Reviewers agreed that the project is focused on all key catalyst target barriers identified by DOE, though some felt it was unclear whether they could reach such aggressive one-year targets. Reviewer recommendations for future work included additions of go/no-go decision points for catalyst activity and stability.
FC-162	Vapor Deposition Process for Engineering of Dispersed Polymer Electrolyte Membrane Fuel Cell Oxygen Reduction Reaction $Pt/NbO_x/C$ Catalysts *Jim Waldecker; Ford Motor Company*	3.0				Reviewers expressed skepticism in the project's methodology, pointing to poor RDE results and the choice of component materials. Reviewers observed that these issues were reflected in the lack of progress but understood that the project is new and further characterization and testing of Pt/C is needed. They maintain that the project will remain relevant if it can reach the performance targets for this component material, though it is not clear based on initial results whether the project will be able to. Reviewers recommended that the team better characterize Pt/C and develop risk mitigation strategies with go/no-go decision points in the event the material is not able to meet targets.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-163	Fuel Cell Systems Analysis *Brian James; Strategic Analysis, Inc.*	3.4	X			Reviewers widely agreed that the design for manufacture and assembly approach in cost estimation is sound and will be extremely helpful in setting realistic cost targets at DOE in the future. Reviewers pointed to the work in high-power-density automotive applications as particularly good progress. It was also noted that the project accurately captured cost benefits of recent catalyst developments in other DOE projects. It was clear to reviewers that collaboration was strong, making good use of a wide range of supplier sources for analysis. Suggestions for future work included using OEM data for model validation.
FC-164	Development of Corrosion-Resistant Carbon Support for Ultra-Low-Platinum-Group-Metal Catalysts (Small Business Innovation Research Phase I) *Prabhu Ganesan; Greenway Energy, LLC*	3.2	X			Reviewers agreed that the use of corrosion-resistant carbon support is logical and builds soundly upon previous work, if perhaps lacking a little detail. They remarked that encouraging progress has been made so far in carbon scale-up and that this work demonstrated satisfactory stability. Reviewers approved of the integration of project partners to enhance capabilities of resistant carbon supports, which are highly relevant to DOE goals. It was felt that future work should focus on expanding this work, along with fundamental analysis on impacts of pore size, durability, and stability.
FC-165	Mesoporous Non-Carbon Catalyst Supports of Polymer Electrolyte Membrane Fuel Cells (Small Business Innovation Research Phase I) *Jacob Coppage-Gross; Certaintech, Inc.*	2.9	X			Reviewers agreed that the project is relevant to DOE goals and on track to reach the first set of targets. Reviewers expressed some doubt about the project's approach. They felt that, while novel, the approach presented concerns about selecting and investigating metal carbides and made them question whether the work would result in lower Pt loadings or higher catalyst stability. Reviewers also noted that meeting performance and durability targets will be challenging. For future work, they thought the project should focus more on substrates in Phase I, with clear and measurable goals or milestones before Phase II and MEA testing.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
FC-166	Development of Durable Active Supports for Low-Platinum-Group-Metal Catalysts (Small Business Innovation Research Phase I) *Barr Halevi; Pajarito Powder*	3.3	X			Reviewers stated that early progress in durability testing has been noteworthy. However, they expressed some skepticism of the techniques, normally used for PGM-free catalyst supports, to create low-PGM catalysts. Reviewers stated that there is a need for further work regarding catalyst support stability to justify these techniques. There was also agreement that the project's durability testing addresses DOE's goals to reduce Pt loading and PEMFC durability. Reviewers identified improvement of support stability as potential future work and agreed that the project is on the right path for MEA development.
FC-167	Multi-Functional Catalyst Support (Small Business Innovation Research Phase I) *Minette Ocampo; pH Matter LLC*	2.9	X			Reviewers generally agreed that using PGM-free carbon catalysts as supports for low-Pt electrodes was appropriate and will address cost and performance targets, but questions were raised about overall impact on durability. Reviewers largely thought it was too early in the project to judge progress, but early accomplishments in RDE performance with Pt deposits were viewed as encouraging. Reviewers did note the apparent lack of collaboration but said that it may be due to the nature of the SBIR project. Reviewers stressed the need to validate RDE data with MEA fabrication and fuel cell tests.
FC-168	Highly Robust Low-Platinum-Group-Metal Membrane Electrode Assemblies Based upon Composite Supports *Arrelaine Dameron; Forge Nano*	3.0	X			Reviewers expressed approval of the project's novel, durability-focused approach in using an overcoat on the catalyst. They were less clear on how the project would ensure a carbon-only coating. Reviewers also agreed that the project is a sound translation of demonstrated gas-phase catalysis to electrocatalysis technology that will address key DOE durability targets. It was thought that future work could include clearer targets for each project phase, including conductivity of the overcoat material, activity, and durability.

Manufacturing R&D

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
MN-001	Fuel Cell Membrane Electrode Assembly Manufacturing Research and Development *Michael Ulsh; National Renewable Energy Laboratory*	3.3	NA			Based on the fiscal year 2018 Budget Request's focus on early-stage applied energy research and development activities, no further U.S. Department of Energy (DOE) funding is requested for this project at this time.
MN-012	Clean Energy Supply Chain and Manufacturing Competitiveness Analysis for Hydrogen and Fuel Cell Technologies *Pat Valente; Ohio Fuel Cell Coalition*	2.9			X	Reviewers approved of the project's approach to developing technical exchange centers and leveraging other relevant DOE projects, which also received positive feedback from attendees at the exchange centers. However, reviewers expressed that further metrics are needed to determine the actual efficacy and impacts of matchmaking events. Several reviewers shared concerns about the industry brochure deliverable timetable and its apparent decrease in scope, which has not been reflected in the project in the budget. Reviewers suggested that future exchanges focus on more specific themes, such as standardization of specific components, as the supply chain is not yet mature. They also highlighted the continued need for increased industry and trade group collaboration. This project was funded through prior year funds and will continue to completion.
MN-013	Fuel Cell and Hydrogen Opportunity Center *Alleyn Harned; Virginia Clean Cities at James Madison University*	3.1			X	Reviewers commented favorably on the project's approach and effective presentation of industry participants via the Hydrogen Fuel Cell (HFC) Nexus website. Several reviewers raised questions about the extent of collaboration with outside groups and the international community, which is viewed as critical. Additionally, some doubts were expressed about project sustainability, specifically maintenance. Reviewers urged that a plan be put in place to address this concern. This project was funded through prior year funds and will continue to completion.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
MN-014	U.S. Clean Energy Hydrogen and Fuel Cell Technologies: A Competiveness Analysis *Patrick Fullenkamp; GLWN – Westside Industrial Retention & Expansion Network*	3.3			X	Reviewers provided positive comments on the project approach, noting the quality of the team and clear and concise analysis. It was agreed that clear conclusions could be drawn from the strength of the competitive analysis on the manufacturing sector. Reviewers remarked that most of the work has been completed and that the remainder of the project should focus on reporting activities to overcome regional and global barriers to competitiveness. Lastly, several reviewers suggested future work could target a broader scope internationally or target specific fuel cell components for analysis. This project was funded through prior year funds and will continue to completion.
MN-015	Continuous Fiber Composite Electrofusion Coupler *Brett Kimball; Automated Dynamics*	3.2			X	Reviewers commended the project for its approach to component materials adjustment and simple and elegant engineering, and for meeting the project's testing targets. It was agreed that the project will help achieve DOE's goals of increasing pipeline safety and integrity. Reviewers expressed the importance of more clearly communicating cost factors and impacts. They said that future work is straightforward and that the project is properly focused on fatigue testing and finishing the prototype. This project was funded through prior year funds and will continue to completion.
MN-016	In-Line Quality Control of Polymer Electrolyte Membrane Materials *Paul Yelvington; Mainstream Engineering*	3.2			X	Reviewers largely agreed that the project's approach in optical inspection is appropriate and expected. They concluded that progress was evident and significant for targeted inspection methods. Furthermore, reviewers concluded the project was relevant to DOE's goals for roll-to-roll processing and cost/ performance targets. It was suggested that future work be focused on real-world detection and increased collaboration with parallel projects at the National Renewable Energy Laboratory. This project was funded through prior year funds and will continue to completion.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
MN-017	Manufacturing Competitiveness Analysis for Hydrogen Refueling Stations *Margaret Mann; National Renewable Energy Laboratory*	2.9			X	Reviewers had mixed reactions to the project approach, specifically in the clarity of methodologies and the lack of specificity in quantitative metrics. Reviewers also commented on the appearance of incomplete data in some areas such as hydrogen refueling station rollout and intra-country trade. Recommendations included completing more detailed and complete analysis of trade flows. Citing a lack of actionable results and clarity, reviewers said that future work should focus on expanding collaborations, standardization of refueling station components, and electrolyzers.

Technology Validation

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
TV-001	Fuel Cell Electric Vehicle Evaluation *Jennifer Kurtz; National Renewable Energy Laboratory*	3.4	NA			Based on the fiscal year (FY) 2018 Budget Request's focus on early-stage applied energy research and development (R&D) activities, no further U.S. Department of Energy (DOE) funding is requested for this project at this time.
TV-008	Fuel Cell Bus Evaluations *Leslie Eudy; National Renewable Energy Laboratory*	3.7	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
TV-017	Hydrogen Station Data Collection and Analysis *Sam Sprik; National Renewable Energy Laboratory*	3.6	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
TV-019	Hydrogen Component Validation *Daniel Terlip; National Renewable Energy Laboratory*	3.0	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
TV-025	Performance Evaluation of Delivered Hydrogen Fueling Stations *Ted Barnes; Gas Technology Institute (GTI)*	3.5	X			Reviewers said that data collection at hydrogen stations is an important part of measuring station maturity and progress toward goals, and that data gathered will be useful in estimating hydrogen fuel demand. While reviewers acknowledged that progress has been made in installing and collecting data of value on two stations, concern was expressed over permitting challenges and having adequate time for data collection on the remaining three stations. The experience and capabilities of the project team and collaboration between project partners were commended. Because of concerns about severely curtailing data, reviewers proposed having at least four quarters of data provided for each of the five stations via a no-cost extension of the project. Moreover, reviewers suggested that alternative approaches to dealing with delays in permitting new stations be cited, and that a specific plan to communicate lessons learned on subjects such as system development, network communications, and commissioning be outlined. This project was funded through prior year funds and will continue to completion.
TV-029	Performance and Durability Testing of Volumetrically Efficient Cryogenic Vessels and High-Pressure Liquid Hydrogen Pump *Salvador Aceves; Lawrence Livermore National Laboratory*	3.2	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
TV-031	Dynamic Modeling and Validation of Electrolyzers in Real-Time Grid Simulation *Robert Hovsapian; Idaho National Laboratory*	3.6	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
TV-034	Fuel Cell Hybrid Electric Delivery Van Project *Jason Hanlin; Center for Transportation and the Environment*	3.2	X			Reviewers saw potential in the findings of this project, stating that it addresses a critical need in the medium- and heavy-duty vehicle space and has the potential to show that the technology is competitive. The project team was praised for a well-designed truck platform and detailed simulations of actual routes and fuel requirements. However, reviewers expressed concern over the project's delayed start and uncertainty regarding remaining cost share, which could result in fewer metrics or less progress. Developing a risk mitigation strategy for the potential of such a case was suggested. It was also stressed that fueling tests should be scheduled, since California retail hydrogen stations may respond differently to the different configuration and capacity of hydrogen tanks found on medium-duty delivery trucks (compared to light-duty fuel cell electric vehicles); reviewers cautioned against assuming that these delivery trucks can be fueled without any challenges. A suggestion for future consideration was to involve more hydrogen tank suppliers to provide a new "off-the-shelf" tank choice or to look at a new design that could be shared among multiple customers. This project was funded through prior year funds and will continue to completion.
TV-037	Hydrogen Meter Benchmark Testing *Michael Peters; National Renewable Energy Laboratory*	3.6	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
TV-039	Innovative Advanced Hydrogen Mobile Fueler *Sara Odom; Electricore*	3.6	X			Reviewers saw the mobile fueler developed by this project as filling infrastructure gaps and increasing the understanding of local authorities having jurisdiction. The use of existing design and equipment was praised by reviewers, and design features were considered to be well-thought-out. The reviewers thought that the next steps were going to be the most difficult for the project because of risks related to hardware and safety testing. Therefore, reviewers suggested that project partners continue to maintain their close and strong collaboration to ensure success. Reviewers suggested that remaining uncertainties regarding siting, permitting, and transporting the fueler be considered and resolved. Suggestions for future enhancements included using an alternative source for on-board power, investigating whether 24/7 fueling would be possible with the fueler not connected to onsite power, performing Hydrogen Station Equipment Performance (HyStEP) testing to prove fueling performance per SAE J2601 requirements, engaging Northeastern Weights and Measures Association officials with their counterparts in California, adopting California regulations on retail sale (metering) of hydrogen for the fueler, and improving the user interface for the dispenser to support unattended fueling. This project was funded through prior year funds and will continue to completion.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
TV-041	Modular Solid Oxide Electrolyzer Cell System for Efficient Hydrogen Production at High Current Density *Hossein Ghezel-Ayagh; FuelCell Energy*	3.3	X			This project was regarded as well managed, as having the potential to advance understanding of high-temperature electrolysis, and as a significant step change in the ability to meet hydrogen needs for the medium and long terms. Reviewers praised the progressive approach, such as cell-level testing and exploration of operation range with multiple parameters. Reviewers highlighted that progress has been steady and the initial results have built confidence, but advised that cell degradation and project economics issues be moved to the forefront of focus. Concern was expressed over validation and/or deployment being at the end of the project and being poorly defined. Reviewers liked that the technology leverages previous work, but they noted that the role of partners was confusing and that there was limited outreach to appropriate end users or low-cost electricity providers. A third-party validation of system performance was suggested. Reviewers also suggested investigating the comparative advantage of the current work and accounting for the impact of integration with intermittent renewable power on system performance and cost. This project was funded through prior year funds and will continue to completion.
TV-042	Optimal Stationary Fuel Cell Integration and Control (Energy Dispatch Controller) *Genevieve Saur; National Renewable Energy Laboratory*	3.3	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
TV-043	Integrated Systems Modeling of the Interactions Between Stationary Hydrogen, Vehicle, and Grid Resources *Samveg Saxena; Lawrence Berkeley National Laboratory*	3.0	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.

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TV-045	H2@ Scale Analysis *Mark Ruth; National Renewable Energy Laboratory*	3.6	X			This analysis was seen as an important and valuable effort in understanding the challenges and potential impacts of large-scale deployment of hydrogen technologies. Reviewers appreciated the comprehensive evaluation and analysis methodology, while praising the use of well-established models by a team with strong analytic capabilities. Concern was raised that the market potential was overstated as a result of double counting hydrogen needs in some sectors, as well as assuming that there would be high growth in hydrogen demand. Reviewers also expressed concern that this analysis may be too internally focused and thus encouraged the project team to seek additional collaborations with industry to look for synergies between supply and demand. Additional suggestions for enhancement were to consider transmission build-out, include a range of policy decisions as input, add uncertainty/variability to the hydrogen market potential numbers, and analyze nearer-term projects.

Safety, Codes and Standards

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
SCS-001	National Codes and Standards Deployment and Outreach *Carl Rivkin; National Renewable Energy Laboratory*	3.3	X			Reviewers were supportive of the approach, scope, collaborations, and design of this project and noted the excellent accomplishments achieved in outreach. However, reviewers would like to see clearer accomplishments and progress related to codes and standards development. Overall, reviewers were supportive of the importance of this work and praised the outreach portion in particular.
SCS-005	Research and Development for Safety, Codes and Standards: Materials and Component Compatibility *Chris San Marchi; Sandia National Laboratories*	3.7	X			Reviewers praised the project's approach, impact, collaborations, and progress toward goals. In particular, the focus on performance-based methods for materials compatibility was deemed useful for fuel cell electric vehicles. Reviewers suggested that additional public documentation of results through the code development and standard development organizations would be beneficial.
SCS-007	Fuel Quality Assurance Research and Development and Impurity Testing in Support of Codes and Standards *Tommy Rockward; Los Alamos National Laboratory*	3.3	X			Reviewers had positive feedback overall, particularly on the importance of developing an in-line fuel quality analyzer and on the progress made so far. They recognized that the membrane hydration challenge is a significant barrier to overcome and encouraged additional collaborations to expand the impact of the project. Suggestions included adding deliverables to ensure that the product is moving toward being commercially available to station developers.
SCS-010	Research and Development for Safety, Codes and Standards: Hydrogen Behavior *Ethan Hecht; Sandia National Laboratories*	3.6	X			Reviewers praised the interconnections between, and importance of, this project and others run by Sandia National Laboratories to advance hydrogen safety. A suggestion was made to consider integrating more tests at the same time to improve project results. Overall, extremely positive feedback was given on the progress and accomplishments of this project.

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SCS-011	Hydrogen Quantitative Risk Assessment *Katrina Groth; Sandia National Laboratories*	3.4	X			Reviewers praised the cross-cutting and unique nature of this project, as well as the many collaborations behind it. There was interest in providing additional details on how the Hydrogen Risk Assessment Model (HyRAM) has affected codes and standards development. Reviewers would like to see future plans include incorporating liquid hydrogen models into the tool.
SCS-019	Hydrogen Safety Panel, Safety Knowledge Tools, and First Responder Training Resources *Nick Barilo; Pacific Northwest National Laboratory*	3.9	NA			Based on the fiscal year (FY) 2018 Budget Request's focus on early-stage applied energy research and development (R&D) activities, no further U.S. Department of Energy (DOE) funding is requested for this project at this time.
SCS-021	National Renewable Energy Laboratory Hydrogen Sensor Testing Laboratory *Bill Buttner; National Renewable Energy Laboratory*	3.4	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
SCS-022	Fuel Cell & Hydrogen Energy Association Codes and Standards Support *Karen Quackenbush; Fuel Cell & Hydrogen Energy Association*	3.6	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
SCS-025	Enabling Hydrogen Infrastructure through Science-Based Codes and Standards *Chris LaFleur; Sandia National Laboratories*	3.5	X			Reviewers were supportive of this project's approach, collaborations, and accomplishments, although they recognized a lack of progress made in real-world testing due to factors outside of the project team's control. Reviewers suggested pursuing additional collaborations to help move this forward and to increase overall impact.

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SCS-026	Compatibility of Polymeric Materials Used in the Hydrogen Infrastructure *Kevin Simmons; Pacific Northwest National Laboratory*	3.5	X			Reviewers stressed the importance of this work and praised the planned future work. However, there were some concerns over a lack of explanation for the parameters selected for testing, as well as which stakeholders have been engaged. Reviewers indicated that collaborations should be more clearly presented in the future.
SCS-028	Diode Laser Sensor for Contaminants in Hydrogen Fuel *Mark Paige; Southwest Sciences*	3.4	X			This project was commended for its importance, progress made to date, and focused approach. The reviewers' primary concern was the development of a cost-effective/practical technology for wide-scale adoption. Reviewers also highlighted that additional collaborations with industry will be critical as the project moves forward. This project was funded through prior year funds and will continue to completion.
SCS-029	Electrochemical Hydrogen Contaminant Detection *Trent Molter; Sustainable Innovations*	3.5	X			Reviewers stressed that the project is impressive, both in approach and in progress so far, given that the project commenced this year. This project's significance to the industry's success was also praised. Reviewers suggested that additional collaborators be added as the project progresses and that adding targets for false detection could be beneficial. This project was funded through prior year funds and will continue to completion.
SCS-030	Advancing Fuel Cell Electric Vehicles in San Francisco and Beyond *Jessie Denver; City and County of San Francisco*	3.5	X			Reviewers were highly supportive of the importance of outreach in general and of the approach of this project. They noted that they would like to see results presented at a national conference. Reviewers are also eager for the project to consider additional interaction and collaboration with technical experts, others doing outreach in hydrogen and fuel cells, and industry stakeholders. This project was funded through prior year funds and will continue to completion.

Market Transformation

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
MT-008	Hydrogen Energy Systems as a Grid Management Tool *Mitch Ewan; Hawaii Natural Energy Institute*	3.4	X			Reviewers stated that the strategy for integration of motive power with grid management was excellent. However, they identified some areas that need attention: utility involvement for controller operation and integration with grid operations, and technical and economic investigation for design and/or selection of energy storage with battery, capacitor, or hydrogen production and storage. This project was funded through prior year funds and will continue to completion.
MT-011	Fuel-Cell-Powered Airport Ground Support Equipment Deployment *Jim Petrecky; Plug Power*	3.5	X			Reviewers commented that progress from the bench to prototype and advanced testing is adequate. According to reviewers, the emphasis on drop-in-place technology resolves many of the system design requirements. A strong emphasis on safety was seen as demonstrating recognition of moving emerging technology to the marketplace. Reviewers noted that the length of this project points to a continuing need to reduce the implementation time for this technology's deployment, adding that five years into the project, there should be a complete data collection set and determination of the value proposition. This project was funded through prior year funds and will continue to completion.
MT-013	Maritime Fuel Cell Generator Project *Joe Pratt; Sandia National Laboratories*	2.8	NA			Based on the fiscal year (FY) 2018 Budget Request's focus on early-stage applied energy research and development (R&D) activities, no further U.S. Department of Energy (DOE) funding is requested for this project at this time.
MT-014	Demonstration of Fuel Cell Auxiliary Power Unit to Power Truck Refrigeration Units in Refrigerated Trucks *Kriston Brooks; Pacific Northwest National Laboratory*	3.1	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.

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MT-017	FedEx Express Hydrogen Fuel Cell Extended-Range Battery Electric Vehicles *Imran Ahmed; FedEx Express*	3.3	X			Reviewers stated that this project has realistic operational requirements for daily range, operation duration, and annual performance. One reviewer concern was that the ability to meet safety barriers and challenges is unclear, adding that a safety plan for the project needs to be completed. This project was funded through prior year funds and will continue to completion.
MT-021	Northeast Demonstration and Deployment of FCRx200 *Abas Goodarzi; US Hybrid Corporation*	2.9	X			Reviewers suggested that an economic assessment of this application and establishment of a duty cycle should both happen early in the project. Another comment was that safety planning and a hazard assessment need to be completed with all partners participating before the demonstration phase starts. This project was funded through prior year funds and will continue to completion.

Systems Analysis

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed	Summary Comments
SA-035	Employment Impacts of Hydrogen and Fuel Cell Technologies *Marianne Mintz; Argonne National Laboratory*	3.5	NA			Based on the fiscal year (FY) 2018 Budget Request's focus on early-stage applied energy research and development (R&D) activities, no further U.S. Department of Energy (DOE) funding is requested for this project at this time.
SA-039	Regional Water Stress Analysis with Hydrogen Production at Scale *Amgad Elgowainy; Argonne National Laboratory*	3.4	X			Reviewers agreed that the project has established a good fundamental understanding of water consumption associated with hydrogen pathways, which is essential for comparing multiple vehicle platforms, fuel pathways, and resource analysis. The work was commended for expanding the capabilities of existing modeling tools and for including county- and regional-level analysis of water consumption and potential for water stress. Suggestions include quantifying the net water impacts of fuel substitution or displacement, providing more context on water usage overall, considering the impacts of varying regional policies or economics affecting water use/cost, and increasing collaboration with/peer review by western state water authorities. Reviewers agreed with continuing the emphasis on completing and expanding regional analysis, especially in areas of the country where water limitations may be an issue.

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SA-044	Cost–Benefit Analysis of Technology Improvement in Light-Duty Fuel Cell Vehicles *Aymeric Rousseau; Argonne National Laboratory*	3.6	X			Reviewers generally agreed that this project is extremely relevant in that it evaluates the value of future early-stage R&D for fuel cell and hydrogen storage technology improvements to consumers, which will help support R&D target-setting and strategic planning. Reviewers praised the use of an established and well-respected modeling tool, and assumptions that enable comparisons across component sizing options and vehicle platforms. Suggestions included adding an industry partner or gathering more outside feedback from industry and conducting analysis to evaluate the impacts of reaching various performance goals on total cost of ownership (e.g., fuel cell efficiency, platinum loading, etc.). Reviewers supported plans to conduct sensitivity analysis on hydrogen cost and to evaluate possible tradeoffs between cost and efficiency.
SA-055	Hydrogen Analysis with the Sandia ParaChoice Model *Rebecca Levinson; Sandia National Laboratories*	3.2	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
SA-059	Sustainability Analysis: Hydrogen Regional Sustainability *Marc Melaina; National Renewable Energy Laboratory*	3.4	X			Reviewers emphasized the importance of a sustainability analysis tool to support technology evaluation and program decision-making and the broader stakeholder community, including technology developers and end users. The reviewers appreciated the project's efforts to integrate existing datasets and models, noting that this increases the utility and capabilities of models already developed. Recommendations included eliminating duplicative work being done by other projects (e.g., water use analysis and regional hydrogen supply analysis), providing additional clarification of input and output metrics, and engaging a broader audience (through increased industry collaboration and education/outreach). There were also some specific suggestions about the model's assumptions regarding technology selections and hydrogen cost. This work is aligned with H2@ Scale efforts.

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SA-062	Hydrogen Financial Analysis Scenario Tool (H2FAST) Updates with Analysis of 101st Station *Marc Melaina; National Renewable Energy Laboratory*	3.5	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
SA-063	Regional Supply of Hydrogen *Marc Melaina; National Renewable Energy Laboratory*	3.3	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
SA-064	Greenhouse Gas Emissions and Petroleum Use Reduction of Medium- and Heavy-Duty Trucks *Amgad Elgowainy; Argonne National Laboratory*	3.5	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
SA-065	Agent-Based Modeling of Consumer Behavior *Marianne Mintz; Argonne National Laboratory*	3.2	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.
SA-066	Life-Cycle Analysis of Air Pollutant Emissions for Refinery and Hydrogen Production from Steam Methane Reforming *Amgad Elgowainy; Argonne National Laboratory*	3.5	NA			Based on the FY 2018 Budget Request's focus on early-stage applied energy R&D activities, no further DOE funding is requested for this project at this time.

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SA-067	Resource Availability for Hydrogen Production *Marc Melaina; National Renewable Energy Laboratory*	3.4	X			Reviewers noted that the project's approach is technically strong and thorough and properly integrates new efforts with existing models and data. There was consensus that updated estimates of regional hydrogen production potential are needed, given the availability of new resource data and technology improvements. Reviewers commended the plans to integrate the results into tools such as the Hydrogen Demand and Resource Analysis tool (HyDRA) and the Scenario Evaluation, Regionalization and Analysis model (SERA), which can be used to understand how supply chains may develop in different regions. Suggestions included adding uncertainty analysis for resource potential and production efficiencies; conducting analysis of relative cost, land use, and carbon dioxide emissions of various options; and increasing industry collaboration to vet key assumptions (such as hydrogen production efficiencies and ranges) and increase industry uptake and use of the results.
SA-068	Benefit Analysis of Multi-Fuel/Vehicle Platforms with a Focus on Hydrogen Fuel Cell Electric Vehicles *Tom Stephens; Argonne National Laboratory*	3.1	X			Reviewers observed that the project's approach is good and uses well-regarded, industry-vetted models to generate results. They recognized the importance of estimating the benefits of DOE R&D but questioned the attribution of benefits to federal programs vs. industry (and others). Reviewers suggested that the model use an estimated market price of hydrogen, as opposed to the Hydrogen Analysis model (H2A)-calculated production cost, and criticized the five-year ownership period as being too short. Other suggestions included quantifying air pollutant reductions; adding medium- and heavy-duty trucks; conducting sensitivity analysis around vehicle ownership, vehicle resale value, and discount rate; evaluating the effects of different policy drivers; and increasing industry review and vetting of the work, possibly by adding an industry advisory or steering committee.