Prologue

Dear Colleague:

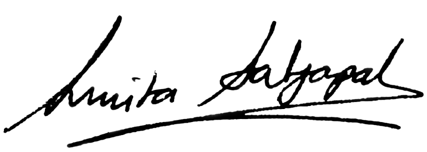
This document summarizes peer review comments and scores for the fiscal year (FY) 2021 U.S. Department of Energy (DOE) Hydrogen Program Annual Merit Review and Peer Evaluation Meeting (AMR), held virtually June 7–11, 2021. In response to direction from various stakeholders, including the National Academies, this review process provides project- and program-level evaluations of DOE-funded research, development, demonstration, and analysis of hydrogen and fuel cell technologies.

This year's AMR kicked off with opening remarks from Energy Secretary Jennifer M. Granholm, who announced the launch of Hydrogen Shot—DOE's first Energy Earthshot. Hydrogen Shot seeks to reduce the cost of clean hydrogen to $1 per kilogram—an 80% decrease—in one decade, setting an ambitious yet achievable cost target for the DOE Hydrogen Program going forward. The opening plenary also included a panel discussion on H2@Scale opportunities and activities among leadership from DOE's Offices of Energy Efficiency and Renewable Energy (EERE), Fossil Energy and Carbon Management (FECM), Nuclear Energy (NE), and Science (SC), as well as program and subprogram overview presentations. The AMR technical session included a dedicated two-day track on DOE intra-agency activities, including project updates from FECM, NE, SC, and the Advanced Research Projects Agency–Energy (ARPA-E), and a one-day session on interagency- and state-level activities. The AMR was attended by more than 1,800 people, including more than 150 reviewers who reviewed 125 projects funded by EERE's Hydrogen and Fuel Cell Technologies Office and more than 50 reviewers who were asked to provide feedback on the overall R&D program and subprograms.

DOE values the transparent public process of soliciting technical input on its projects and programs from relevant experts with depth and breadth of knowledge across a wide range of areas. The reviewers' recommendations are taken into consideration by DOE technology managers in generating future work plans. The summary table that follows lists the projects presented at the review and the overall evaluation score for each project, and Appendix A provides the scores and comments from the program reviewers. The individual reports present the reviewer comments to be considered during the upcoming fiscal year (October 1, 2021–September 30, 2022). The projects have been grouped according to subprogram 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. DOE instructs the PIs to consider these summary evaluation comments fully, along with any other comments by DOE managers, in the PIs' FY 2022 plans.

One behalf of the DOE Hydrogen Program, I would like to express my sincere appreciation to all the 2021 AMR participants and the reviewers, researchers, and presenters for your strong commitment, expertise, and dedication to 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 2022 AMR, which is scheduled for the week of June 6, 2022.

Sincerely,



Dr. Sunita Satyapal
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Hydrogen Technologies

Hydrogen Production

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
P-148	HydroGEN Overview: A Consortium on Advanced Water-Splitting Materials *Huyen Dinh, National Renewable Energy Laboratory*	3.7	X		
P-179	BioHydrogen (BioH2) Consortium to Advance Fermentative Hydrogen Production *Katherine Chou, National Renewable Energy Laboratory*	3.3	X		
P-182	Binary Chloride Salts as Catalysts for Methane to Hydrogen and Graphitic Powder *Eric McFarland, C-Zero, LLC*	3.1	X		
P-183	Extremely Durable Concrete Using Methane Decarbonization Nanofiber Co-Products with Hydrogen *Alan W. Weimer, University of Colorado, Boulder*	3.3	X		
P-184	Scalable and Highly Efficient Microbial Electrochemical Reactor for Hydrogen Generation from Lignocellulosic Biomass and Waste *Hong Liu, Oregon State University*	2.9	X		
P-196	H2NEW Consortium: Hydrogen from Next-Generation Electrolyzers of Water *Bryan Pivovar, National Renewable Energy Laboratory, and Richard Boardman, Idaho National Laboratory*	3.4	X		

Hydrogen Production—HydroGEN Seedling[1]

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
P-185	High-Performance Alkaline Electrolyte Membrane Low-Temperature Electrolysis with Advanced Membranes, Ionomers, and Platinum-Group-Metal-Free Electrodes *Paul A. Kohl, Georgia Institute of Technology*	3.0	X		
P-186	Performance and Durability Investigation of Thin, Low-Crossover Proton Exchange Membranes for Water Electrolyzers *Andrew Park, The Chemours Company FC, LLC*	3.3	X		
P-187	Pure Hydrogen Production through Precious-Metal-Free Membrane Electrolysis of Dirty Water *Shannon Boettcher, University of Oregon*	2.9	X		
P-188	Advanced Coatings to Enhance the Durability of Solid Oxide Electrolysis Cell Stacks *Neil Kidner, Nexceris, LLC*	3.4	X		
P-189	Scalable High-Hydrogen-Flux, Robust Thin Film Solid Oxide Electrolyzer *Colin Gore, Redox Power Systems, LLC*	3.4	X		
P-190	A Multifunctional Isostructural Bilayer Oxygen Evolution Electrode for Durable Intermediate-Temperature Electrochemical Water Splitting *Kevin Huang, University of South Carolina*	3.2	X		
P-191	Perovskite–Perovskite Tandem Photoelectrodes for Low-Cost Unassisted Photoelectrochemical Water Splitting *Yanfa Yan, The University of Toledo*	3.2	X		
P-192	Development of Composite Photocatalyst Materials That Are Highly Selective for Solar Hydrogen Production and Their Evaluation in Z-Scheme Reactor Designs *Shane Ardo, University of California, Irvine*	3.7	X		
P-193	Highly Efficient Solar Water Splitting Using Three-Dimensional/Two-Dimensional Hydrophobic Perovskites with Corrosion-Resistant Barriers *Aditya D. Mohite, William Marsh Rice University*	3.3	X		

[1] HydroGEN seedling projects marked "Continue" are on track, but project continuation is contingent on passing a go/no-go decision.

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
P-194	New High-Entropy Perovskite Oxides with Increased Reducibility and Stability for Thermochemical Hydrogen Generation *Jian Luo, University of California, San Diego*	3.1	X		
P-195	A New Paradigm for Materials Discovery and Development for Lower-Temperature and Isothermal Thermochemical Hydrogen Production *Jonathan Scheffe, University of Florida*	3.1	X		

Hydrogen Infrastructure

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
H2-061	Innovating Hydrogen Stations: Heavy-Duty Fueling *Michael Peters, National Renewable Energy Laboratory*	3.8	X		
IN-001a	Hydrogen Materials Compatibility Consortium (H-Mat) Overview: Metals *Chris San Marchi, Sandia National Laboratories*	3.1	X		
IN-001b	Hydrogen Materials Compatibility Consortium (H-Mat) Overview: Polymers *Kevin Simmons, Pacific Northwest National Laboratory*	3.0	X		
IN-004	Magnetocaloric Hydrogen Liquefaction *John Barclay, Pacific Northwest National Laboratory*	2.4	X		
IN-015	Optimizing the Heisenberg Vortex Tube for Hydrogen Cooling *Jacob Leachman, Washington State University*	3.0	X		
IN-016	Free-Piston Expander for Hydrogen Cooling *Devin Halliday, Gas Technology Institute*	3.0	X		
IN-019	Ultra-Cryopump for High-Demand Transportation Fueling *Kyle Gross, RotoFlow/Air Products*	2.9	X		
IN-020	Self-Healable Copolymer Composites for Extended-Service Hydrogen Dispensing Hoses *Marek Urban, Clemson University*	2.9	X		

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
IN-021	Microstructural Engineering and Accelerated Test Method Development to Achieve Low-Cost, High-Performance Solutions for Hydrogen Storage and Delivery *Kip Findley, Colorado School of Mines*	3.5	X		
IN-022	Tailoring Carbide-Dispersed Steels: A Path to Increased Strength and Hydrogen Tolerance *Gregory Thompson, The University of Alabama*	2.9	X		
IN-025	Hydrogen Delivery Technologies Analysis *Amgad Elgowainy, Argonne National Laboratory*	3.5	X		
IN-026	Tailoring Composition and Deformation Modes at the Microstructural Level for Next-Generation Low-Cost, High-Strength Austenitic Stainless Steels *Petros Sofronis, University of Illinois Urbana–Champaign*	3.2	X		
IN-029	Reducing the Cost of Fatigue Crack Growth Testing for Storage Vessel Steels in Hydrogen Gas *Kevin Nibur, Hy-Performance Materials Testing, LLC*	3.4	X		
IN-030	Micro-Mechanically Guided High-Throughput Alloy Design Exploration toward Metastability-Induced Hydrogen Embrittlement Resistance *C. Cem Tasan, Massachusetts Institute of Technology*	3.4	X		

Hydrogen Storage

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
ST-001	System-Level Analysis of Hydrogen Storage Options *Rajesh Ahluwalia, Argonne National Laboratory*	3.5	X		
ST-100	Hydrogen Storage Cost Analysis *Cassidy Houchins, Strategic Analysis, Inc.*	3.5	X		
ST-127	Hydrogen Materials—Advanced Research Consortium (HyMARC) Overview *Mark Allendorf, Sandia National Laboratories*	3.2	X		

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
ST-209	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Theory-Guided Design and Discovery of Materials for Reversible Methane and Hydrogen Storage *Omar Farha, Northwestern University*	3.5	X		
ST-211	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Optimal Adsorbents for Low-Cost Storage of Natural Gas and Hydrogen: Computational Identification, Experimental Demonstration, and System-Level Projection *Don Siegel, University of Michigan*	3.5	X		
ST-212	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Methane and Hydrogen Storage with Porous Cage-Based Composite Materials *Eric Bloch, University of Delaware*	3.6	X		
ST-214	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Heteroatom-Modified and Compacted Zeolite-Templated Carbons for Gas Storage *Nicholas Stadie, Montana State University*	3.4	X		
ST-215	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Developing A New Natural Gas Super-Absorbent Polymer *Mike Chung, The Pennsylvania State University*	2.9		X	
ST-216	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: Hydrogen Release from Concentrated Media with Reusable Catalysts *Travis Williams, University of Southern California*	3.7	X		
ST-217	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: A Reversible Liquid Hydrogen Carrier System Based on Ammonium Formate and Captured Carbon Dioxide *Hongfei Lin, Washington State University*	3.1	X		
ST-218	Hydrogen Materials–Advanced Research Consortium (HyMARC) Seedling: High-Capacity, Step-Shaped Hydrogen Adsorption in Robust, Pore-Gating Zeolitic Imidazolate Frameworks *Michael McGuirk, Colorado School of Mines*	3.6	X		
ST-223	Cost Assessment and Evaluation of Liquid Hydrogen Storage for Medium- and Heavy-Duty Transportation Applications *Rajesh Ahluwalia, Argonne National Laboratory*	3.5	X		

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
ST-227	Integrated Onsite Waste-Heat-Driven Hydrogen Carrier System for Steel and Renewables *Hanna Breunig, Lawrence Berkeley National Laboratory*	3.6	X		
ST-228	Determining the Value Proposition of Materials-Based Hydrogen Storage for Stationary Bulk Storage of Hydrogen *Bruce Hardy, Savannah River National Laboratory*	3.5	X		

Fuel Cell Technologies

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
FC-117	Fiscal Year 2018 Small Business Innovation Research Phase IIB: Ionomer Dispersion Impact on Advanced Fuel Cell Performance and Durability *Hui Xu, Giner, Inc.*	3.3			X
FC-158	Fuel Cell Membrane Electrode Assemblies with Ultra-Low-Platinum Nanofiber Electrodes *Peter Pintauro, Vanderbilt University*	2.6			X
FC-160	ElectroCat 2.0 (Electrocatalysis Consortium) *Deborah Myers, Argonne National Laboratory, and Piotr Zelenay, Los Alamos National Laboratory*	3.5	X		
FC-163	Fuel Cell Systems Analysis *Brian James, Strategic Analysis, Inc.*	3.3			X
FC-167	Fiscal Year 2020 Small Business Innovation Research Phase IIA: Multi-Functional Catalyst Support *Minette Ocampo, pH Matter, LLC*	3.5	X		
FC-170	ElectroCat: Durable Manganese-Based Platinum-Group-Metal-Free Catalysts for Polymer Electrolyte Membrane Fuel Cells *Hui Xu, Giner, Inc.*	3.2		X	
FC-172	ElectroCat: Highly Active and Durable Platinum-Group-Metal-Free Oxygen Reduction Reaction Electrocatalysts through the Synergy of Active Sites *Yuyan Shao, Pacific Northwest National Laboratory*	3.2	X		

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
FC-302	ElectroCat: Developing Platinum-Group-Metal-Free Catalysts for Oxygen Reduction Reaction in Acid: Beyond the Single Metal Site *Qingying Jia, Northeastern University*	3.0		X	
FC-303	ElectroCat: Mesoporous Carbon-Based Platinum-Group-Metal-Free Catalyst Cathodes *Jian Xie, Indiana University–Purdue University Indianapolis*	3.5		X	
FC-305	Active and Durable Platinum-Group-Metal-Free Cathodic Electrocatalysts for Fuel Cell Application *Alexey Serov, Pajarito Powder*	3.2	X		
FC-307	Cyclic Olefin Copolymer-Based Alkaline Exchange Polymers and Reinforced Membranes *Chulsung Bae, Rensselaer Polytechnic Institute*	3.3	X		
FC-308	Advanced Anion Exchange Membranes with Tunable Water Transport for Platinum-Group-Metal-Free Anion Exchange Membrane Fuel Cells *Michael Hickner, The Pennsylvania State University*	3.3	X		
FC-309	Polymerized Ionic Liquid Block Copolymer/Ionic Liquid Composite Ionomers for High-Current-Density Performance *Joshua Snyder, Drexel University*	3.0	X		
FC-310	Composite Polymer Electrolyte Membranes from Electrospun Crosslinkable Poly(Phenylene Sulfonic Acid)s *Ryszard Wycisk, Vanderbilt University*	3.3			X
FC-313	Novel Bifunctional Electrocatalysts, Supports, and Membranes for High-Performing and Durable Unitized Regenerative Fuel Cells *Nem Danilovic, Lawrence Berkeley National Laboratory*	2.9	X		
FC-314	Efficient Reversible Operation and Stability of Novel Solid Oxide Cells *Scott Barnett, Northwestern University*	3.4	X		
FC-316	Durable, High-Performance Unitized Reversible Fuel Cells Based on Proton Conductors *Meilin Liu, Georgia Institute of Technology*	3.3	X		
FC-317	Stationary Direct Methanol Fuel Cells Using Pure Methanol *Xianglin Li, University of Kansas*	3.0	X		

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
FC-319	Low-Cost Gas Diffusion Layer Materials and Treatments for Durable High-Performance Polymer Electrolyte Membrane Fuel Cells *Rod Borup, Los Alamos National Laboratory*	3.3			X
FC-320	Electrode Ionomers for High-Temperature Fuel Cells *Michael Hibbs, Sandia National Laboratories*	3.1			X
FC-323	Durable Fuel Cell Membrane Electrode Assembly through Immobilization of Catalyst Particle and Membrane Chemical Stabilizer *Nagappan Ramaswamy, General Motors LLC*	3.4	X		
FC-324	Reversible Fuel Cell Stacks with Integrated Water Management *Teddy Wang, Plug Power Inc.*	2.9	X		
FC-325	Fiscal Year 2019 Small Business Innovation Research Phase II: Controlled Porosity and Surface Coatings for Advanced Gas Diffusion Layers *Kristina Bennett, Physical Sciences, Inc.*	2.8			X
FC-326	Durable Membrane Electrode Assemblies for Heavy-Duty Fuel Cell Electric Trucks *Vivek Murthi, Nikola Motor Company*	3.0	X		
FC-327	Durable High-Power-Density Fuel Cell Cathodes for Heavy-Duty Vehicles *Shawn Litster, Carnegie Mellon University*	3.6	X		
FC-328	Fiscal Year 2019 Small Business Innovation Research Phase II: Novel Fluorinated Ionomer for Polymer Electrolyte Membrane Fuel Cells *Hui Xu, Giner, Inc.*	3.3			X
FC-330	High-Efficiency Reversible Solid Oxide System *Hossein Ghezel-Ayagh, FuelCell Energy, Inc.*	3.1	X		
FC-331	A Novel Stack Approach to Enable High Round-Trip Efficiencies in Unitized Polymer Electrolyte Membrane Regenerative Fuel Cells *Katherine Ayers, Nel Hydrogen*	3.0	X		
FC-333	Advanced Membranes for Heavy-Duty Fuel Cell Trucks *Vivek Murthi, Nikola Motor Company*	3.3	X		
FC-334	Extending Perfluorosulfonic Acid Membrane Durability through Enhanced Ionomer Backbone Stability *Michael Yandrasits, 3M Company*	3.5	X		

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
FC-335	Additive Functionalized Polymers for Extended Heavy-Duty Polymer Electrolyte Membrane Lifetimes *Tom Corrigan, The Lubrizol Corporation*	3.2	X		
FC-336	A Systematic Approach to Developing Durable Conductive Membranes for Operation at 120°C *Tom Zawodzinski, University of Tennessee, Knoxville*	3.2	X		
FC-337	Cummins Polymer Electrolyte Membrane Fuel Cell System for Heavy-Duty Applications *Darren Hickey, Cummins Inc.*	2.8	X		
FC-338	Domestically Manufactured Fuel Cells for Heavy-Duty Applications *John Lawler, Plug Power Inc.*	2.2	X		
FC-339	M2FCT: Million Mile Fuel Cell Truck Consortium *Rod Borup and Adam Weber, M2FCT*	3.3	X		
FC-341	Advanced Anion Exchange Membrane Fuel Cells through Material Innovation *Yu Seung Kim, Los Alamos National Laboratory*	3.3	X		
FC-342	Advanced Ionomers and Membrane Electrode Assemblies for Alkaline Membrane Fuel Cells *Bryan Pivovar, National Renewable Energy Laboratory*	3.5	X		
FC-343	Fiscal Year 2020 Small Business Innovation Research Phase II: Improved Ionomers and Membranes for Fuel Cells *Chris Topping, Tetramer Technologies, LLC*	3.1	X		

Technology Acceleration

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
TA-001	Membrane Electrode Assembly Manufacturing Research and Development *Michael Ulsh, National Renewable Energy Laboratory*	3.1	X		

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
TA-005	In-Line Quality Control of Polymer Electrolyte Membrane Materials *Andrew Wagner, Mainstream Engineering*	3.3	X		
TA-007	Roll-to-Roll Advanced Materials Manufacturing Lab Collaboration *Yarom Polsky, Oak Ridge National Laboratory*	3.4	X		
TA-009	Maritime (Pierside Power) Fuel Cell Generator Project *Lennie Klebanoff, Sandia National Laboratories*	3.2	X		
TA-016	Fuel Cell Hybrid Electric Delivery Van *Jason Hanlin, Center for Transportation and the Environment*	3.4	X		
TA-017	Innovative Advanced Hydrogen Mobile Fueler *Sara Odom, Electricore Inc.*	3.5	X		
TA-018	High-Temperature Electrolysis Test Stand *Micah Casteel, Idaho National Laboratory*	3.5	X		
TA-024	Analysis of Fuel Cells for Trucks: Real-World Benefits *Ram Vijayagopal, Argonne National Laboratory*	3.4		X	
TA-025	Laser Three-Dimensional Printing of Highly Compacted Protonic Ceramic Electrolyzer Stack *Jianhua Tong, Clemson University*	3.0	X		
TA-026	Low-Cost, High-Performance Catalyst-Coated Membranes for Polymer Electrolyte Membrane Water Electrolyzers *Andrew Steinbach, 3M Company*	3.5			X
TA-027	Catalyst Layer Design, Manufacturing, and In-Line Quality Control *Radenka Maric, University of Connecticut*	3.2			X
TA-028	Demonstration of Electrolyzer Operation at a Nuclear Plant to Allow for Dynamic Participation in an Organized Electricity Market and In-House Hydrogen Supply *Uuganbayar Otgonbaatar, Exelon Corporation*	3.3	X		
TA-030	Demonstration of Integrated Hydrogen Production and Consumption for Improved Utility Operations *Monjid Hamdan, Plug Power Inc.*	3.5	X		
TA-032	Electrolyzer Integrated Modular Nano-Array Monolithic Catalytic Reactors *Trent Molter, Skyre, Inc.*	2.8			X

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
TA-033	Developing Novel Electrodes with Ultralow Catalyst Loading for High-Efficiency Hydrogen Production in Proton Exchange Membrane Electrolyzer Cells *Feng-Yuan Zhang, University of Tennessee Space Institute*	3.3			X
TA-034	Rail, Aviation, and Maritime Metrics *Rajesh Ahluwalia, Argonne National Laboratory*	3.5			X
TA-035	Power Convertor for Electrolyzer Applications *Robert Hovsapian, National Renewable Energy Laboratory*	3.3	X		
TA-036	Advanced Electrode Manufacture to Enable Low-Cost Polymer Electrolyte Membrane Electrolysis *Chris Capuano, Nel Hydrogen*	3.3			X
TA-037	Demonstration and Framework for H2@Scale in Texas and Beyond *Nico Bouwkamp, Frontier Energy, Inc.*	3.6	X		
TA-041	Truck Duty Cycle Analysis *Jason Lustbader, National Renewable Energy Laboratory*	3.4	X		
TA-042	Next-Generation Hydrogen Station Analysis *Genevieve Saur, National Renewable Energy Laboratory*	3.5	X		
TA-043	Electrolyzer Stack Development and Manufacturing *Olga Marina, Pacific Northwest National Laboratory*	3.1	X		
TA-047	Rail Refueling Analysis *Brian Ehrhart, Sandia National Laboratories*	3.4			X
TA-048	Advanced Research on Integrated Energy Systems (ARIES)/Flatirons Facility – Hydrogen System Capability Buildout *Daniel Leighton, National Renewable Energy Laboratory*	3.4	X		
TA-049	High-Pressure, High-Flow-Rate Dispenser and Nozzle Assembly for Heavy-Duty Vehicles *Spencer Quong, Electricore Inc.*	3.3	X		
TA-050	Overall Research on Electrode Coating Processes (OREO) *Michael Ulsh, National Renewable Energy Laboratory*	2.9	X		

Safety, Codes and Standards

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
SCS-005	Research and Development for Safety, Codes and Standards: Material and Component Compatibility *Chris San Marchi, Sandia National Laboratories*	3.4	X		
SCS-007	Fuel Quality Assurance Research and Development and Impurity Testing in Support of Codes and Standards *Tommy Rockward, Los Alamos National Laboratory*	3.2		X	
SCS-010	Research and Development for Safety, Codes and Standards: Hydrogen Behavior *Ethan Hecht, Sandia National Laboratories*	3.6	X		
SCS-011	Hydrogen Quantitative Risk Assessment *Brian Ehrhart, Sandia National Laboratories*	3.5	X		
SCS-019	Hydrogen Safety Panel, Safety Knowledge Tools, and First Responder Training Resources *Nick Barilo, Pacific Northwest National Laboratory*	3.6	X		
SCS-021	Hydrogen Sensor Testing Laboratory *William Buttner, National Renewable Energy Laboratory*	3.5	X		
SCS-022	Fuel Cell and Hydrogen Energy Association Codes and Standards Support *Karen Quackenbush, Fuel Cell & Hydrogen Energy Association*	3.1	X		
SCS-029	Point-of-Use Hydrogen Purification and Impurity Reporting Systems that Utilize Metal–Organic Frameworks *William Morris, NuMat Technologies, Inc.*	3.2	X		

Systems Analysis

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
SA-169	Market Segmentation Analysis of Medium- and Heavy-Duty Trucks with a Fuel Cell Emphasis *Chad Hunter, National Renewable Energy Laboratory*	3.8			X

Project Number	Project Title *Principal Investigator Name & Organization*	Final Score	Continue	Discontinue/ Further Review	Completed
SA-174	Technoeconomic and Lifecycle Analysis of Synthetic Fuels and Steelmaking *Amgad Elgowainy, Argonne National Laboratory*	3.6	X		
SA-175	Regional Hybrid Energy Systems Technoeconomic Analysis *Mark Ruth, National Renewable Energy Laboratory*	3.8	X		
SA-176	Annual Technology Baseline – Transportation *Laura Vimmerstedt, National Renewable Energy Laboratory*	3.0	X		
SA-177	Analysis of Hydrogen Export Potential *Amgad Elgowainy, Argonne National Laboratory*	3.4	X		
SA-178	Cradle-to-Grave Transportation Analysis *Amgad Elgowainy, Argonne National Laboratory*	3.5	X		
SA-179	Transportation Benefits Analysis *Aaron Brooker, National Renewable Energy Laboratory*	3.3	X		
SA-180	Advanced Network Analysis of Hydrogen Fuel Cell Automated Vehicles for Goods Delivery (ATLAS) – Total Cost of Ownership of Autonomous Fuel Cell Fleet Vehicles *Tim Lipman, Lawrence Berkeley National Laboratory*	3.3	X		