PROLOGUE

Dear Colleague:

This document summarizes the comments provided by the peer reviewers at the U.S. Department of Energy (DOE) Hydrogen Program's FY 2008 Annual Merit Review and Peer Evaluation meeting, held on June 9-13, 2008 in Washington, D.C. In response to direction from the Under Secretary of Energy, this review process provides evaluations of the Program's projects in applied research, development and demonstration, and analysis of hydrogen, fuel cells and infrastructure technologies. All four Offices that support the President's Hydrogen Fuel Initiative, Energy Efficiency and Renewable Energy (EERE), Fossil Energy (FE), Nuclear Energy (NE), and Science (SC), participated in the meeting to provide the hydrogen community a view of the breadth and depth of DOE's efforts under the Initiative. Overview presentations were given by all four Offices during the opening plenary session; projects from EERE, FE, and NE were presented and peer reviewed, and the hydrogen production related projects from SC were presented.

The recommendations of the reviewers have been taken into consideration by DOE Technology Development Managers in the generation of future work plans. The table below lists the projects presented at the review, evaluation scores and the major actions to be taken during the upcoming fiscal year (October 1, 2008 to September 30, 2009). The projects have been grouped according to Program Element (Production, Delivery, Storage, Fuel Cells, etc.) and then by the five evaluation criteria. The weighted scores are based on a 4-point scale. To furnish all principal investigators (PIs) with direct feedback, all evaluations and comments are provided to each presenter; however, the authors of the individual comments remain anonymous. The PI of each project is instructed to fully consider these summary evaluation comments, as appropriate, in their FY 2009 plans.

I would like to express my sincere appreciation to the reviewers. You make this report possible, and we rely on your comments to help make project decisions for the new fiscal year.

We look forward to your participation in the FY 2009 Hydrogen and Vehicle Technologies Programs' joint Annual Merit Review and Peer Evaluation meeting, which is presently scheduled for May 18-22, 2009 at the Crystal Gateway Marriott and Crystal City Marriott hotels in Arlington, VA. Thank you for participating in the FY 2008 Annual Merit Review and Peer Evaluation meeting.

Sincerely,

JoAnn Milliken
DOE Hydrogen Program Manager
Office of Energy Efficiency and Renewable Energy

Hydrogen Production and Delivery:

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
PD-01	Low-Cost Hydrogen Distributed Production System Development; H2Gen Inno. Inc.; Frank Lomax	3.2	X			This project supports DOE cost targets for distributed natural gas reforming hydrogen production. Reviewers observed that the hydrogen output and efficiency of the prototype plant are good, albeit the hydrogen output capacity is a little short of the target. Future work will focus on hydrogen from ethanol through catalyst and micro-reactor life-testing on fuel-grade ethanol. Techno-economic analyses of H2Gen SMR and ethanol reforming systems will continue.
PD-02	Bio-derived Liquids Reforming; PNNL; David King	2.8	X			The researchers understand the role of variables such as space velocity, catalyst, and steam/carbon ratio in reforming and in achieving project goals for sugar and alcohol reforming. The improvements are significant steps towards achieving the research objectives. However much work still needs to be done to improve catalyst activity and to obtain the right balance of selectivity, conversion and reactivation. Project will continue catalyst modifications and performance characterizations, and H2A analyses for both ethanol reforming and APR systems.
PD-03	Analysis of Ethanol Reforming System Configurations; DTI; Brian James	3.4	X			The project focuses on an economic comparison of distributed reforming of bio-derived liquids (focus on ethanol). Excellent progress has been made on this project. The various distributed ethanol reforming technologies and process configurations have been defined and fully analyzed for cost and energy efficiencies, identifying all the key cost leverages. Project will conclude with a report of analysis of all bio-derived liquids pathways as discussed.
PD-04	Pressurized Steam Reforming of Bio–Derived Liquids for Distributed Hydrogen Production; ANL; Shabbir Ahmed	2.5	X			The project objective is to reduce compression costs and therefore the cost of hydrogen production. Membrane technology is being investigated for the removal of oxygen, carbon dioxide and hydrogen. However, the project may not be technically feasible unless new membrane technology to remove carbon dioxide becomes available to facilitate reaching the targets of this project. Next steps include a Go/No Go decision on the use of Pd-based H_2 membranes, and systems analyses to evaluate the feasibility of alternative fuel processor designs using pressurized reforming.

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PD-05	Investigation of Reaction Networks and Active Sites in Bio–Ethanol Steam Reforming Over Cobalt–Based Catalysts; Ohio State U; Umit Ozkan	3.0	X			Non-precious metal catalyst development is necessary to achieve long-term DOE cost targets. Good progress has been made in catalyst formulation and testing and the application of the H2A model to obtain preliminary cost data. Should test the catalyst for more than 100 hours. Further testing of impurity effects under realistic H_2O/EtOH ratios is warranted. Next steps include long- term (> 100 hrs) time-on-stream experiments and accelerated deactivation and regeneration studies.
PD-07	Integrated Hydrogen Production, Purification & Compression System; Linde; Satish Tamhankar	3.2	X			The project approach combines good engineering and pilot scale testing with the complex integration of the membrane reactor and thermal compressor systems. The heat exchanger shown is novel and should be investigated for synergies in other parts of the Hydrogen Program. However, the issues with membrane stability, startups and shutdowns, and the ability to recover hydrogen from permeate and retentate steams remain. Project will complete proof-of-concept performance tests, and economic assessment. Based on results, a decision will be made regarding construction of a prototype unit.
PD-08	Zeolite Membrane Reactor for Water–Gas–Shift Reaction for Hydrogen Production; Arizona State U; Jerry Y.S. Lin	3.1	X			Materials development in the photo-electrochemical arena is clearly relevant, especially if such materials show improvements over photovoltaics / electrolyzer systems. The technology seems to be technically feasible. A cost analysis is needed to validate the potential for significant cost reductions in hydrogen production. Research would benefit from partnering with industry. Project will continue CVD modifications of membrane materials and H2A analysis of technology will be initiated.
PD-10	Low Cost, High Pressure Hydrogen Generator; Giner Electrochemical Systems LLC; Monjid Hamdan	2.9			X	This Project is completed. Lower-cost materials and fabrication methods for cell components were developed, and systems innovations reduced the cost of components. The initial DSM membrane performance reported very high efficiencies. Future work should focus on understanding the membrane durability, testing the membrane in a stack, and cost reduction.
PD-11	Hydrogen Generation from Electrolysis: 100 kg H_2/day Trade Study; Proton Energy Systems; Stephen Porter	2.4			X	This Project is completed. The challenges identified were not new or surprising. Final results do not meet Department of Energy 2012 targets in terms of energy efficiency, hydrogen cost or capital costs. Future work should include membrane and catalyst work to enhance efficiency.

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PD-12	Development of Water Splitting Catalysts Using a Novel Molecular Evolution Approach; ASU; Neal Woodbury	2.9	X			The milestones and technical barriers are clearly laid out for the project. Although they have not yet shown water splitting, they have shown catalyst activity. Significant focus was on development of a high volume process to screen different structures. Work will continue toward the goals of understanding the activity mechanisms of the catalysts and water splitting.
PD-13	Development of Solar Powered Thermochemical Production of Hydrogen from Water; STCH Collaboration; Nate Siegel	2.9	X			The overall objective of this project is to select one or two cost competitive solar powered hydrogen production cycles for large scale demonstration. This group has considerable technical ability and a strong team that is working together. The research team will examine material durability as the project progresses.
PD-14	Solar–Driven Photocatalitically–Assisted Water Splitting; UCF/FSEC; Ali T-Raissi	2.7	X			The project is updating the sulfur-ammonia cycle through the use of a photocatalysis assisted reaction. Progress has been demonstrated on the catalyst. In the second year of this project, the investigators will complete economic analysis with a particular emphasis on the solar field size.
PD-16	Hydrogen Delivery Infrastructure Analysis; ANL; Marrianne Mintz	3.1	X			Delivery represents a significant portion of the consumers' cost of hydrogen; it is necessary that we understand the costs associated with the various options. Importantly, the project showed the significant cost reductions available through flattening the hydrogen demand profile. As new delivery technologies and scenarios are developed, they will be added to the model.
PD-17	A Combined Materials Science/Mechanics Approach to the Study of Hydrogen Embrittlement of Pipeline Steels; U of Illinois; Sofronis Petros	3.7	X			Embrittlement is a serious failure mode of steel pipelines for a hydrogen infrastructure; and this study aims at a science-based approach to obtain mechanistic insights into why failures occur. The work has generated considerable insights on the mechanism of steel pipeline failures due to hydrogen transport. The researchers used pipeline samples supplied by manufacturers (Air Products, Air Liquide, OSM steels) to provide a basis for further work. The project ends in FY2009.
PD-18	Materials Solutions for Hydrogen Delivery in Steel Pipeline; Secat/ORNL; Doug Stalheim	3.1	X			This project explores the potential to use commercially available steel materials. Understanding the embrittlement mechanisms will be critical to extrapolate the focused studies. Expanding the number of samples that are tested will help to define whether the test results of the subject materials will be similar for materials fabricated by other manufacturers and whether microstructure improvement needs can be accommodated. The project ends in FY2009.

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PD-19	Composite Technology for Hydrogen Pipelines; ORNL; Barton Smith	3.2	X			This project appears to have significant potential to reduce the cost of hydrogen pipelines to meet the DOE targets. Composites experience in the natural gas industry provides a good basis for this work. Surface treatments and associated testing will yield valuable data on the ability to improve the permeability of polymer pipelines. A strong collaboration with pipe, liner, and coupling manufacturers will be pursued moving forward into next year.
PD-20	Hydrogen Permeability and Pipeline Integrity/Fiber Reinforced Composite Pipeline; SRNL; Thad Adams	3.3	X			The hydrogen permeation and integrity part of this project is finished. Test samples from actual weldment were prepared and tested for hydrogen solubility, diffusivity, & permeability at sub-atmospheric pressure and moderate temperatures. This data is valuable in evaluating pipeline costs. The pressure testing of fiber-reinforced polymer and joint types to determine hydrogen leakage rates is a good approach.
PD-21	Innovative Hydrogen Liquefaction Cycle; Gas Equipment Engineering Corporation; Martin Shimko	3.2	X			The project's approach is good and advances hydrogen liquefaction technology toward the goal of reducing energy requirements. Liquid hydrogen significantly reduces delivery costs downstream of production. GEECO will develop catalytic heat exchangers and validate dual hydrogen expander designs.
PD-22	High Pressure, Low Temperature Hydrogen Tube Trailers; LLNL; Salvador Aceves	3.0	X			This method could provide significantly cheaper and stronger overwrap materials by assuming the material is kept at low temperature and environmentally protected from water and air. There are many variables surrounding the glass fibers (humidity, temperature, time at temperature) that must be addressed. The proposed concept has the potential to lower the vessel cost by 25% and to reach the delivery target of $1/kg. Testing must clearly show the projected advantages next year.
PD-23	Reversible Liquid Carriers for an Integrated Production, Storage and Delivery of Hydrogen; APCI; Bernard Toseland	2.8	X			This project addresses hydrogen carriers for both onboard and off board hydrogen regeneration, but its potential to meet hydrogen production, delivery, and storage targets is not well defined. The evaluation of dehydrogenation reactors appears competent and thorough. Testing will continue next year.
PD-24	Coatings for Centrifugal Compression; ANL; George Fenske	3.3	X			This project is very important for successful pipeline delivery of hydrogen. The approach has logically identified, evaluated, and characterized critical tribological performance of materials. However, hydrogen impurities could have a significant impact on materials selected. Coordination with commercial partners and additional compressor manufacturers in particular will occur next year.

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PD-25	Sulfur–Iodine Thermochemical Cycle; SNL/GA/CEA; Paul Pickard	3.0	X			The production of hydrogen through the sulfur-iodide thermochemical cycle has shown significant progress with the construction of the integrated testing unit. Three separate excellent research groups (GA, Sandia National Laboratories, and CEA) are each responsible for one of the three steps and also collaborate with each other well. This approach will continue as the integrated test unit commences operation.
PD-26	Hybrid Sulfur Thermochemical Process Development; SRNL; Bill Summers	3.0	X			The project has identified the key challenges and is focused on research to overcome the challenges. Critical technical issues included sulfur crossover through the membrane, a membrane with improved ion conductivity, a better and longer lasting catalyst, and good flow field/diffusion media for sulfur dioxide transport. Significantly improved membranes that reduce sulfur crossover and enable higher temperature operations have been identified and tested, and catalyst work will continue.
PD-27	Laboratory–Scale High Temperature Electrolysis System; INL/ANL/Ceramatec; Ed Harvego	2.6	X			The project's approach depends on availability of high temperature nuclear heat, and it is a very long range goal. The project is going in the right direction regarding durability, but plans for scale-up should be slowed until durability problems are solved. Future work should focus on increasing the SOEC stack durability.
PD-28	Alternative Thermochemical Cycles; ANL; Michelle Lewis	3.2	X			Thermochemical water splitting for hydrogen production supports the Hydrogen Fuel Initiative. Overall, very good work has been done toward the development of this "Copper-Chloride" cycle, but it's not clear what the yields and selectivities were for the engineering lab scale hydrolysis reactor. This project is in the early stages and significant development for each unit operation and in understanding the detailed cycle chemistry is needed.
PD-29	Indirectly Heated Biomass Gasification; NREL; Richard Bain	3.7	X			The objective of this project is to experimentally update the technical and economic performance of an integrated biomass gasification-based hydrogen production process based on steam gasification. This project has a strong integration of technical evaluation, process modeling, and economic modeling. Future work will focus on catalyst development and evaluation.
PD-30	One Step Biomass Gas Reforming–Shift Separation Membrane Reactor; GTI; Michael Roberts	2.9	X			The long-term objective of this project is to determine the technical and economic feasibility of using the gasification membrane reactor to produce hydrogen from biomass. Membrane material development will be a key, but locating the membrane in or after the cyclone could compromise performance. The investigators will examine optimum membrane location.

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PD-31	A Novel Slurry Based Biomass Reforming Process; UTRC; Thomas Vanderspurt	2.5	X			The objectives of this project are to illustrate, through an initial feasibility analysis on a 2000 ton/day (dry) biomass plant design, that there is an economical path towards the Department of Energy's (DOE's) 2012 cost and efficiency targets. The project did not demonstrate significant progress. The focus over the next year should be on catalyst development.
PD-32	Hydrogen From Water in a Novel Recombinant Oxygen–Tolerant Cyanobacteria System; J Craig Venter Institute; Qing Xu	3.3	X			The project goals are well-aligned with DOE program targets. The metagenomic approach for identification of novel hydrogenase-related sequences is logical, and builds upon progress in the investigators' labs. The progress towards goals was excellent, with successful reconstruction and identification of a novel environmental nickel-iron hydrogenase and stable expression in a heterologous host. The multi-pronged approach ensures casting a wide net for knowledge of optimizing hydrogenase activity. Work on this project toward an oxygen insensitive hydrogenase/organism will continue.
PD-33	Maximizing Light Utilization Efficiency and Hydrogen Production in Microalgal Cultures; UC Berkeley; Tasios Melis	3.7	X			The focus on construction of a minimal photosynthetic antenna complex is good, and the usage of molecular biology toolkits for introducing altered hydrogenase-related gene cassettes into heterologous or homologous host strains is appropriate. The progress towards goals was excellent - a dramatic improvement over the last four years - with efficiency targets achieved ahead of schedule (already completed 2010 milestones). Work on this project toward an ideally efficient microorganism will continue.
PD-34	Use of Biological Materials and Biologically Inspired Materials for Hydrogen Catalysts; Montana State University; Trevor Douglas	3.1	X			The focus on improving hydrogenase stability and on enzymes and catalyst supports is good. The approach demonstrates a good synergism between enzymology and protein structure-function with materials composite synthesis and design. The project will continue and will be encouraged to more clearly define its benchmarks for hydrogen production, with respect to improvements in enzyme stability, enzyme activity, and metrics for sol-gel encapsulants or supported/caged matrices.
PD-35	Photoelectrochemical Hydrogen Production: DOE PEC Working Group Overview & UNLV-SHGR Program Subtask; MV Systems; Eric Miller	3.5	X			The photoelectrochemical working group is an important effort aimed at coordinating research from a dozen institutions. This project shows good integration of theory, synthesis, surface science, and electrochemistry with exceptionally strong collaborations that have leveraged unique abilities. This project will be encouraged to focus on discovering and characterizing new classes of photoelectrochemical materials rather than just extending the findings from other groups.

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PD-36	Photoelectrochemical Water Splitting; NREL; John Turner	3.9	X			The reviewers consider this group to be a consistent bright spot in the photoelectrochemical hydrogen field since 1991 and the research program is critical for progress towards DOE goals and objectives. The project provides a good basis to understand the limitations of various material classes along with a good mix of theory and wet chemistry techniques that start with a known material, use theory to suggest improvements, and then make theoretically suggested materials prior to testing the new material. This project will continue so that work in this important area, and by this working group, can progress.
PD-37	Critical Research for Cost–effective Photoelectrochemical Production of Hydrogen; Midwest Optoelectronics; Liwei Xu	3.5	X			This project provides a good balance with respect to other material discovery oriented projects in this technology area. The project addresses a number of important applied issues associated with development of photoelectrochemical-hydrogen technology and leverages Midwest's expertise in the manufacture of multi-junction thin film photovoltaic devices. The project will continue and will be encouraged to show the advantages of this concept (a solar cell immersed in an electrolyte) over an external solar cell/electrolyzer system and provide information on economics of a system.
PD-38	Development and Optimization of Cost Effective Materials for PEC Hydrogen Production; U. of CA Santa Barbara; Eric McFarland	3.6	X			This project is advancing many areas of understanding and technology in photoelectrochemical hydrogen production and has made progress in understanding αFe_2O_3 that may also be useful when developing other low gap oxide materials or for using αFe_2O_3 in a tandem system. The project will continue and will be encouraged to work toward finding an adequate photoelectrochemical material prior to engineering a complete system.
PD-39	Scale–up of Hydrogen Transport Membranes for IGCC and FutureGen Plants; Eltron Research Inc.; Doug Jack	3.4	X			The project was recognized for its relevance to the FutureGen project and Hydrogen Fuel Initiative. Additionally, the project is making progress in addressing the DOE/FE technical targets for hydrogen separation. The investigators should clearly define technology transfer and partner relationships and should conduct lifecycle testing under real-world syngas conditions.

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PD-40	Cost–Effective Method for Producing Self–Supporting Pd Alloy Membrane for Use in the Efficient Production of Coal–derived Hydrogen; Southwest Research Institute; Kent Coulter	3.2			X	The first contract with SwRI was completed March 31, 2008. A second contract investigating ternary Pd alloy membranes was also presented. This project began May 2007 and will be completed May 2010. Overall, the project was scored favorably. Collaborations with project partners were well established; however technology transfer efforts need to be more clearly defined. It is suggested that the project review historical DOE project data so as not to duplicate efforts previously performed.
PD-41	Experimental Demonstration of Advanced Palladium Membrane Separators for Central High–Purity Hydrogen Production; United Technologies; Sean Emerson	3.0	X			This project is developing a sulfur-, halide-, and ammonia-resistant hydrogen separation membrane. The project team has very strong experimental testing and modeling capabilities. It was suggested to test the membranes in contaminant containing gas streams and to review prior work on Pd membranes for additional insight.
PD-42	Integration of a Structural Water Gas Shift Catalyst with a Vanadium Alloy Hydrogen Transport Device; Western Res. Ins. & U of Wyoming Res.Corp.; Thomas Barton	3.3	X			The project is well focused on reducing capital and membrane costs by incorporating two unit operations into one for water gas shift. The project was noted for its testing facilities which included an on-site gasifier for experimentation under syngas conditions. It is recommended that additional lab-scale experimentation be completed prior to scale-up and that investigation of vanadium membrane fabrication be conducted.
PD-43	High Flux Metallic Membranes for Hydrogen Recovery & Membrane Reactors; REB Research & Consulting; Robert Buxbaum	3.6	X			This project scored favorably and was noted for its strong collaborative efforts and research partners. The project was also noted for its capability in potential commercialization. It is suggested that greater importance be placed on impurity tolerance of the membranes and that additional discussion is needed on cost targets.
PDP-01	Fundamentals of a Solar–thermal Mn_2O_3/MnO Thermochemical Cycle to Split Water; CU; Al Weimer	2.8	X			The objective of this project is to research and develop a cost effective Mn_2O_3/MnO solar-thermal thermochemical cycle through theoretical and experimental investigation. The investigators were commended for their strong technical background and collaboration efforts. This project has achieved significant results with little funding. Future work should focus on material and energy balances and cost analysis.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
PDP-02	Novel Low–Temperature Proton Transport Membranes; ORNL; Andrew Payzant	3.0	X			If successful, this research could provide an improved method for hydrogen purification using non-PM membranes. The reviewers thought the project had a good approach, was well run, worth doing, and had a competent PI. However, they indicated that the results were modest with very low hydrogen fluxes to-date, and that targets, milestones and performance metrics for the project were lacking. Project will continue R&D to improve hydrogen flux and stability of membranes. Performance milestones and metrics will be identified.
PDP-03	Ultra–thin Proton Conduction Membranes for H_2 Stream Purification with Protective Getter Coatings; SNL; Margaret Welk	2.9	X			Project is developing a membrane that could lead to cost, operability and footprint advantages over PSA. Success has been reported for building a support with fine pore structure to enable synthesis of an ultra thin proton conducting membrane. Reviewers recommended that the membranes be tested under real in-service operating conditions; and that clear Go-No-Go decision points be added to the project. Future work will focus on optimization of membrane structures. Success metrics and decision points will be identified. Life-time testing and testing under in-service conditions will take place in FY2010.
PDP-04	Renewable Electrolysis Integrated System Development and Testing; NREL; Kevin Harrison	3.1	X			The project is very relevant to the DOE Hydrogen program and uses a sound experimental approach along with good collaborations and technical transfer. The power electronic development has been solid. The wind to hydrogen system was completed in early FY07, but there was little data generation due to mechanical failures. Future work should include significant data generation from the system, validation of the system models with the data, and a cost analysis to determine the savings potential of the advanced power supply.
PDP-07	Photobiological Hydrogen Research; Florida International University; George Philippidis	2.6			X	Congressionally directed project. Although still somewhat in its infancy, this work has great potential for numerous applications - the "top-down" approach of reconstructing a functional hydrogen-producing gene cassette in a heterologous host is not particularly innovative but seems feasible. It is not clear why they have not yet achieved the goal of obtaining an active enzyme. The progress towards goals was good, with some specific milestones achieved in a timely fashion. The project will continue and will be encouraged to update their techniques for testing successful transformation.

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PDP-11	Enabling Hydrogen Embrittlement Modeling of Structural Steels; SNL; Brian Somerday	3.5	X			Progress has been made in the basic understanding of embrittlement, but more is needed before methods of overcoming the barriers can be suggested. They have made significant progress in measuring the properties of pipeline steels in high-pressure hydrogen gas using fracture mechanics methods. Barriers to further progress will be appropriately addressed next year.
PDP-14	Advanced Alkaline Electrolysis; GE Global Res.; Dana Swalla	3.1			X	This project will be completed December 2008. The use of high volume low cost plastic manufacturing was an innovative approach to fabricating low cost electrolyzers. There was considerable focus on durability of the plastics used. However, the project did not demonstrate that cells/stacks can be made using this method. The cost analysis was not detailed enough and used some inappropriate assumptions.
PDP-15	Photoelectrochemical Generation of Hydrogen Using Heterostructural Titania Nanotube Arrays; U of Nev. Reno; Mano Misra	3.1			X	Congressionally directed project. This project includes a good mix of science, system design, and engineering. However, even optimization of TiO_2, as a hydrogen producing photoelectrode, will not result in a useful system since its band gap is too large to use much of the solar spectrum. They have developed a good level of expertise in the area of synthesizing TiO_2 nanotube arrays and related structures but are committed to the idea that they can empirically find a way to lower the band gap of TiO_2 through doping, alloying or sensitization, despite the numerous unsuccessful attempts to do this over the past 30 years. The researchers will continue to be encouraged to look beyond TiO_2 for a useable photoelectrochemcial material.
PDP-16	Distributed Bio–Oil Reforming; NREL; Bob Evans	3.2	X			This project is developing methods of hydrogen production from bio-oil, taking into account the complexity of the fuel, its difficulty in handling, and other factors. Reviewers approved the project focus on effects of different feedstocks on bio-oil quality and composition, and suggested that certain bio-crops may be better aligned with this technology than others. Project will continue the development of a compact, low capital cost, low/no maintenance reforming system, as well as catalyst optimization and long-term testing.
PDP-18	Solar Thermochemical Hydrogen (STCH) Production -H2A Analysis; TIAX; Kurt Roth	3.3	X			The objective of this project is to evaluate which solar-thermochemical hydrogen (STCH) cycles have the potential to meet the DOE central production cost target of $3.00/kg. The level of collaboration and the ability to provide a consistent method of cost analysis were noted as significant achievements. This project will continue to compile cost data input for the STCH projects.

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PDP-19	Ocean Thermal Plantships for Production of Ammonia as the Hydrogen Carrier; ANL; Chandrakant Panchal	3.2			X	This project has been completed. A solid approach was taken for the evaluation of this technology. Proposed future work would need to be quantified prior to beginning a new project.
PDP-21	Photoelectrochemical Hydrogen Production; U. Arkansas Little Rock; Malay Mazumber	2.2			X	Congressionally directed project. The objective is to modify the surface of TiO_2 to absorb more of the visible portion of the solar spectrum and split water; however, this objective has been extensively researched over the past 30 years and has achieved very little. TiO_2 will not work as a useful water photoelectrolysis system since its band gap is too large to be efficient. Fundamental science to help understand charge transfer or surface chemistry of oxide semi-conductors will be useful but this project is mainly empirical. The researchers will continue to be encouraged to look beyond TiO2 for a useable photoelectrochemcial material.
PDP-22	Distributed Reforming of Renewable Liquids via Water Splitting using Oxygen Transport Membrane (OTM); ANL; Balu Balachandran	2.9	X			The project aims to develop an oxygen transport membrane (OTM) for distributed reforming of bio-derived liquids to produce hydrogen. Reviewers found the project approach sound and the concept to be a potentially cost effective, renewable hydrogen process relevant to the overall objectives. Recommendations to project team included addressing flux and heat management issues and 3rd party analysis of costs. Project will continue to optimize OTM for hydrogen production and chemical stability, and will refine the H2A techno-economic analysis of process.
PDP-25	Carbon Molecular Sieve Membrane as Reactor/Separator for Water Gas Shift Reaction; Media and Process Technology Inc.; Paul Liu	3.0	X			The project focus is on increased production efficiency and cost reductions through a WGS/membrane reactor which combines low and high temperature shift reactions and hydrogen purification and separation, which eliminates the need for an extra water gas shift step. The testing of the system has yet to be completed. The modeled 90 percent hydrogen recovery and 99 percent purity needs to be demonstrated experimentally. Next steps will include completion of a pilot testing unit, in-house pilot demonstration of the system, and completion of H2A analysis of the process.

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PDP-26	Biological Systems for Hydrogen Photoproduction; NREL; Maria Ghirardi	3.8	X			The project goals include optimizing photosynthetic water-splitting biological hydrogen production and increasing catalyst stability while improving oxygen tolerance. Excellent, cutting edge, molecular and physiological approach. The partnership between various universities, an international institution, and a national lab is good. This project will continue to work toward efficient, cost-effective biological hydrogen production.
PDP-27	Fermentative and Electrohydrogenic Approaches to Hydrogen Production; NREL; Pin-Ching Maness	3.5	X			The progress towards goals was excellent, with pathway engineering targets achieved ahead of schedule. This project takes a very good approach, particularly the inhibitors. The project will continue and the researchers will be encouraged to complement their current approach with the addition of genomics and genetic-based techniques, possibly through collaborations.
PDP-34	Theory of Oxides for Photoelectro-chemical Hydrogen Production; NREL; John Turner	3.6	X			This project is an important demonstration of how an effective mix of theory and experiment can be used to design new multi-element semiconductors that move toward DOE program goals. As work is completed to more accurately correlate the theories to experiments, theoretical methods as part of material research will move the research forward at an increased pace. The work clearly demonstrates that the search for improved optical response semiconductors that are thermodynamically able to split water can be dramatically enhanced by using a DFT based materials search. This project will continue.

Hydrogen Storage:

ST-01	Analyses of Hydrogen Storage Materials and On-Board Systems; TIAX; Stephen Lasher	3.1	X			The project is important in that it provides an early indication of storage system cost. The limits of the analyses need to be well communicated. It is critical to disseminate key findings among the hydrogen storage R&D community.
ST-02	System Level Analysis of Hydrogen Storage Options; Argonne; Rajesh Ahluwalia	3.3	X			The project provides systems analyses of key storage system performance (e.g. capacity and transient performance). The limits of the analyses need to be well communicated. It is critical to disseminate key findings among the hydrogen storage R&D community.

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ST-03	Best Practices for Characterizing Hydrogen Storage Properties of Materials; H2 Technology Consulting LLC; Karl Gross	3.4	X			It is recommended that the Best Practices document also cover measurement issues of adsorbent materials. It is critical to disseminate the final revised document among the hydrogen storage R&D community. This project is expected to be completed in FY2009.
ST-04	DOE Chemical Hydrogen Storage Center of Excellence (CoE) Overview; LANL; Kevin Ott	3.6	X			This is a well working CoE, with good interaction/coordination among the partners. The team should refine theory work with experimental feedback; continue effort on release kinetics and efficient spent fuel regeneration, and initiate cost analyses to assess the spent fuel regeneration schemes in FY2009.
ST-05	Chemical Hydrogen Storage R&D at Pacific Northwest National Laboratory; PNNL; Chris Aardahl	3.8	X			This project is part of the Chemical Hydrogen Storage Center of Excellence and includes a strong team with interaction among theory, applied science and engineering. The project should continue to address hydrogen discharge issues including complexity of the solid fuel. The project should continue effort on spent fuel regeneration including lithium ammonia borane. Include cost analysis to assess regeneration schemes.
ST-06	Chemical Hydrogen Storage R&D at Los Alamos National Laboratory; LANL; Anthony Burrell	3.7	X			This project is part of the Chemical Hydrogen Storage Center of Excellence and is a good mix of theory, synthesis/characterization, and mechanistic and kinetic studies. The project should continue to improve hydrogen discharge parameters including hydrogen purity & liquid fuel range. LANL should incorporate cost analyses to assess regeneration schemes and investigate methods to avoid spent fuel solidification.
ST-07	Amineborane-Based Chemical Hydrogen Storage; U of Penn.; Larry Sneddon	3.4	X			This project is part of the Chemical Hydrogen Storage Center of Excellence. UPenn should emphasize efficient spent fuel regeneration and consider the effect of additives in the spent fuel. UPenn should also note spent fuel morphology and avoid formation of solid phases.
ST-08	Chemical Hydrogen CoE - Novel Approaches to Hydrogen Storage: Conversion of Borates to Boron Hydrides; Rohm and Haas; Suzanne Linehan	2.9	X			This project is part of the Chemical Hydrogen Storage Center of Excellence. Rohm & Haas should evaluate and validate reaction conditions and products in both synthesis schemes. Greenhouse gas footprint should be minimized for the carbothermal route.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
ST-09	Main Group Element and Organic Chemistry for Hydrogen Storage and Activation; UA; David Dixon	3.5	X			This project is part of the Chemical Hydrogen Storage Center of Excellence. UA should validate theory work with input from experimentalists to establish simulation models that best represent the experimental results. Emphasize obtaining results from carbene and amino(imidazolo)-boranes and discontinue if results are not promising.
ST-10	Solutions for Chemical Hydrogen Storage: Hydrogenation/ Dehydrogenation of B-N Bonds; U of Washington; Karen Goldberg	3.0	X			This project is part of the Chemical Hydrogen Storage Center of Excellence. UWA should investigate dehydrogenation and rehydrogenation temperatures for materials with BN and CC bonds to arrive at the most favorable CBN materials they are starting to investigate.
ST-11	Chemical Hydrogen Storage using Ultra-High Surface Area Main Group Materials & The Development of Efficient Amine-Borane Regeneration Cycles; UC Davis; Philip Powers	2.9	X			This project is part of the Chemical Hydrogen Storage Center of Excellence. UC Davis should address the Argonne ammonia borane spent fuel regeneration analyses findings and coordinate with LANL on the path forward. The approach should address the reduction step with metal hydride in the ammonia borane spent fuel regeneration scheme. Collaboration with UA should be increased to guide spent fuel regeneration efforts.
ST-12	Hydrogen Storage in Metal-Organic Frameworks; UCLA; Omar Yaghi	3.3	X			Professor Yaghi is an innovator in this approach to designing sorbent materials. UCLA should continue to emphasize increasing volumetric capacity and hydrogen binding energy to increase net capacity at near ambient temperatures and nominal pressure.
ST-13	Carbide-Derived Carbons with Tunable Porosity Optimized for Hydrogen Storage; U of Penn./Drexel Univ.; Jack Fischer and Yury Gogotsi	2.7			X	The project is nearly complete. The carbide-derived carbon (CDC) materials and activation procedures produce some of the best understood "amorphous carbons" under study. The R&D is focused on tuning pore size to increase binding energy.
ST-14	Effects and Mechanisms of Mechanical Activation on Hydrogen Sorption/Desorption of Nanoscale Lithium Nitrides; U of Connecticut; Leon Shaw	2.1			X	This project will have a Go/No Go decision at the end of the first quarter of FY2009 based on progress at meeting set milestones. The reviewers commented that there is benefit to understanding the inter/intraphasic reaction mechanisms. However further understanding is needed than provided and the approach used should be reevaluated. Closer collaboration with other groups is recommended.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
ST-15	DOE Hydrogen Sorption Center of Excellence (HSCoE): Overview; NREL; Mike Heben	3.1	X			The Hydrogen Sorption Center of Excellence has made progress in improving volumetric capacity and hydrogen binding energy. The HSCoE needs to stress increasing the net available volumetric capacity at near ambient temperature while improving hydrogen uptake & discharge kinetics.
ST-16	A Biomimetic Approach to New Adsorptive Carbonaceous Hydrogen Storage Materials; Texas A&M; Joe Zhou	3.3	X			This is a new project in the Hydrogen Sorption Center of Excellence emphasizing Metal Organic Frameworks (MOFs). The approach should stress improving volumetric capacity along with net capacity at close to room temperature. Increased collaborations with relevant theory groups is recommended.
ST-17	Hydrogen Storage by Spillover; U of Michigan; Ralph Yang	3.3	X			This project is part of the Hydrogen Sorption Center of Excellence. Efforts should be expanded to improve hydrogen uptake/discharge kinetics along with net available volumetric capacity. The reproducibility of the MOF synthesis needs to be improved. Increased collaborations with relevant theory projects that are associated with understanding spillover are recommended.
ST-18	Theoretical Models of H2-SWNT Systems for Hydrogen Storage and Optimization of SWNT; Rice U.; Boris Yakobson	3.2	X			This project is part of the Hydrogen Sorption Center of Excellence. For the theory portion of the project, NREL should place more emphasize on spillover work and increased collaborations with experimentalists. For the project's experimental work, there should be decreased overlap with other efforts within the HSCoE and restructure to be more relevant to the program.
ST-19	NREL Research as Part of the Hydrogen Sorption Center of Excellence; NREL; Anne Dillon	2.8	X			This project is part of the Hydrogen Sorption Center of Excellence. For NREL's experimental work, there should be reduced emphasis on "exotic" synthetic materials and increased effort on more synthetically viable materials. Also, improved communications between the experimental and theory groups to improve and validate theoretical predictions is recommended. NREL should increase spillover efforts to improve synthesis reproducibility, net capacity and hydrogen kinetics.
ST-20	Single-Walled Carbon Nanohorns for Hydrogen Storage and Catalyst Supports; ORNL; David Geohegan	3.1	X			This project is part of the Hydrogen Sorption Center of Excellence. ORNL should increase coordination of theory and experimental work within their project and with other theory work in the HSCoE. ORNL should reduce emphasis on "exotic" synthetic materials and increase efforts on more synthetically viable materials. Also they should work more closely with the theory groups to validate theoretical predictions.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
ST-21	Hydrogen Storage through Nanostructured Polymeric Materials; Argonne; D.J. Liu	2.8	X			This project is part of the Hydrogen Sorption Center of Excellence. Polymer adsorbents is an area that needs to be explored. ANL should provide predictive rationale for designing hydrogen bonding sites in the polymers. ANL needs to increase emphasis on net volumetric capacity and transient performance. Increase ANL's theory collaboration within the HSCoE.
ST-22	Enabling Discovery of Materials With a Practical Heat of H2 Adsorption; Air Products; Alan Cooper	2.8	X			This project is part of the Hydrogen Sorption Center of Excellence. APCI should increase coordination of theory and experimental work with theory work in the HSCoE. APCI should closely collaborate with the theory work to validate theoretical predictions. APCI should provide more leadership within the HSCoE to address system application performance needs (e.g. net available volumetric capacity, transient performance, energetics).
ST-23	Enhanced Hydrogen Dipole Physisorption: Henry's Law and isosteric heats in microporous sorbents; CalTech; Channing Ahn	3.2	X			This project is part of the Hydrogen Sorption Center of Excellence. CalTech should continue to focus on elucidating the interrelationships among: pore size & distribution, enthalpies, temperature & pressure effects and how they collectively influence hydrogen uptake and release. CalTech should expand collaborations to include experts in other fields, such as catalysis.
ST-24	Carbon Aerogels for Hydrogen Storage; LLNL; Ted Baumann	3.0	X			This project is part of the Hydrogen Sorption Center of Excellence. LLNL should continue to emphasize net available volumetric capacity and hydrogen uptake and discharge kinetics. LLNL should increase collaborations with theoretical and experimental spillover research groups.
ST-25	Characterization of Hydrogen Adsorption by NMR; U of North Carolina; Yue Wu	3.3	X			This project is part of the Hydrogen Sorption Center of Excellence. UNC should compare NMR results with neutron scattering results where available. UNC should consider isotopic studies to evaluate spillover in pores and lower the measurement temperature range capability to allow evaluation of heterogeneous pore size distributions as well as more weakly bound hydrogen species.
ST-26	Hydrogen Storage Materials with Binding Intermediate between Physisorption and Chemisorption; UC-Santa Barbara; Juergen Eckert	2.8	X			This project has resulted in several metal/organic linker combinations to evaluate for higher hydrogen binding energy as well as chemical modifications to increase surface area. Recommendations include reevaluation of approaches to increase H-binding energy and to increase net available volumetric capacity.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
ST-27	A Synergistic Approach to the Development of New Hydrogen Storage Materials, Part I; UC Berkeley/LBNL; Jeffrey Long	2.9	X			This project has several PIs at UCB and LBNL. The porous polymers project develops a rational approach to increasing volumetric capacity and hydrogen binding energy. The MOF work should continue to stress net available volumetric capacity at higher temperatures.
ST-29	Metal Hydride Center of Excellence; SNL; Lennie Klebanoff	3.2	X			The Metal Hydride Center of Excellence was praised for the material down-select performed in FY2007. The reviewers recommended closer coordination between the materials CoEs and the new Engineering CoE. The MHCoE should continue to stress net available volumetric capacity while taking into account the temperature, pressure and kinetics requirements of the application and sorption energetics.
ST-30	Thermodynamically Tuned Nanophase Materials for Reversible Hydrogen Storage; HRL Laboratories; Ping Liu	3.2	X			This project is part of the Metal Hydride Center of Excellence and was found to be highly focused on sorption kinetics and thermodynamics, two key issues with metal hydrides. The work on incorporating destabilized metal hydrides into scaffolds was thought to be innovative and promising. The work should be more closely coordinated with the theory group to include appropriate destabilized systems for investigation.
ST-31	Chemical Vapor Synthesis and Discovery of H2 Storage Materials: Li-Al-Mg-N-H System; Univ. of Utah; Zak Fang	3.0	X			This project is part of the Metal Hydride Center of Excellence. The mechanistic studies are well aligned with DOE's objectives. However there is concern over ammonia release from amides and reviewers strongly recommended a down-select this year based on the ammonia concentration released during desorption. The chemical vapor synthesis work is promising and further collaborations are encouraged.
ST-32	Reversible Hydrogen Storage Materials – Structure, Chemistry and Electronic Structure; U of Illinois; Ian Robertson	3.0	X			This project is part of the Metal Hydride Center of Excellence. The experimental work, particularly the imaging of catalyst dispersion in hydrogen storage materials, is highly relevant to the program. However the role and relevance of the computational theory work is uncertain. It is recommended that collaborations be expanded and that the theory work be realigned with other efforts in the MHCoE.
ST-33	First-Principles Modeling of Hydrogen Storage in Metal Hydride Systems; Univ. of Pittsburgh/Georgia Tech; Karl Johnson	3.4	X			This project is part of the Metal Hydride Center of Excellence. The computational work of this project is valuable and the predictions have been widely used by the hydrogen storage R&D community. A stronger tie with the experimentalists is recommended. Updating the library of phases for inclusion in the predictions, specifically for carbon-containing phases, is recommended.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
ST-34	Development and Evaluation of Advanced Hydride Systems for Reversible Hydrogen Storage; Jet Propulsion Laboratory; Bob Bowman	3.3	X			This project is part of the Metal Hydride Center of Excellence and is of high importance. The identification of the $[B_{12}H_{12}]^{-1}$ species as an intermediate in the $Mg(BH_4)_2$ desorption pathway is a significant finding. Specific recommendations include ensuring the mechanistic findings are being employed in the material development efforts and offering the project's NMR analysis capabilities to the other CoEs and independent projects.
ST-35	Complex Hydrides for Hydrogen Storage Studies of the Al(BH4)3 System; ORNL; Gilbert Brown	2.9	X			This project is part of the Metal Hydride Center of Excellence. The materials being investigated in this project are highly relevant and the work on identifying mechanisms is important. However it was not clear that the mechanistic work is being effectively transferred and followed up on by the appropriate experimentalists. Overall the project should be better focused and needs to define a clear future work plan focused on specific materials.
ST-36	Discovery and Development of Metal Hydrides for Reversible On-board Storage; SNL; Ewa Ronnebro	3.4	X			This project is part of the Metal Hydride Center of Excellence and its work is highly relevant. The project has a good mix of experiment and theory. The progress in finding additives to moderate the conditions required to rehydrogenate $Ca(BH_4)_2$ is a significant improvement. It is recommended that enthalpy measurements on $Ca(BH_4)_2$ polymorphs be completed and compared with predictions as soon as possible. The impact on gravimetric and volumetric properties should be considered early on in the work of incorporating hydrogen storage material into nanoframeworks.
ST-37	Effect of Trace Elements on Long-Term Cycling and Aging Properties of Complex Hydrides for Hydrogen Storage; UNR; Dhanesh Chandra	3.0	X			This project is part of the Metal Hydride Center of Excellence. The investigation of impurity effects on long-term cycling and identification of vapor pressures and volatile products for hydrogen storage materials is very important to the program. However it is recognized that the selection of hydrogen storage materials for investigation is problematic since no material currently possesses all the properties required for on-board hydrogen storage. Recommendations include resolution of unanswered questions, such as $H_2 + O_2$ versus $H_2 + H_2O$ results, and testing of more promising materials.

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ST-38	Fundamental studies of advanced high-capacity reversible metal hydrides/ Recharging of Light Metal Hydrides Through Supercritical Fluid Hydrogenation; Univ. of Hawaii; Craig Jensen	3.2	X			This project is part of the Metal Hydride Center of Excellence and is highly relevant and focused on key issues for metal hydride materials. The research team is highly qualified with strong collaborations. It is recommended to reduce the number of material types being investigated and to put more emphasis on development of regeneration of spent alane in supercritical fluids.
ST-39	Aluminum Hydride Regeneration; BNL; Jason Graetz	3.3	X			This project is part of the Metal Hydride Center of Excellence. BNL has made significant progress on developing the adduct formation method as a route for spent alane regeneration. While it is recognized that this work is in an early stage and focused on development of regeneration processes, it is recommended that the new Hydrogen Storage Engineering Center of Excellence be engaged early and that cost estimations for regeneration be conducted.
ST-40	Fundamental Reactivity Testing and Analysis of Hydrogen Storage Materials & Systems; SRNL; Don Anton	3.2	X			The determination of the chemical and environmental reactivity of hydrogen storage materials is important. However without any current material meeting all requirements for on-board hydrogen storage, the selection of material for testing is problematic. Additionally the UN test methods for the classification of goods for shipment may not be the most appropriate tests for use. It is recommended that appropriate quantitative analytical test methods be utilized.
ST-41	Quantifying & Addressing the DOE Material Reactivity Requirements with Analysis & Testing of Hydrogen Storage Materials & Systems; UTRC; Dan Mosher	3.4	X			This project's objective of performing risk analysis of hydrogen storage materials and systems is of high importance. An appropriate and professional approach is being taken in this project. It is recommended that the project coordinate and interact with codes and standards development efforts.
ST-42	Chemical and Environmental Reactivity Properties of Metal Hydrides within the Context of Systems; Sandia-Livermore; Dan Dedrick	3.4	X			The work of this project is highly relevant and important to the Hydrogen Program. The approach and methodology are well-developed. It is recommended that the project coordinate and interact with codes and standards development efforts, especially in the later stages.

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STP-04	Purdue Hydrogen Systems Laboratory; Purdue University; Jay Gore	3.0			X	This is a Congressionally-direct project. For off-board reversible approaches, Purdue should provide transparent arguments that support estimates of regeneration energy requirements (and greenhouse gas emissions). Purdue should increase collaborations with the Chemical Hydrogen Storage CoE as appropriate.
STP-05	Development of Regenerable, High-Capacity Boron Nitrogen Hydrides For Hydrogen Storage; RTI; Ashok Damle	2.5			X	The project has a go/no-go decision point in the third quarter of FY 2009 based on efficient spent fuel regeneration and release parameters. RTI should focus on regeneration of ammonia borane from spent fuel and evaluate their approach of direct re-hydrogenation of spent fuel due to unfavorable thermodynamics.
STP-06	Neutron Characterization in support of the Hydrogen Sorption Center of Excellence; NIST; Dan Neumann	3.5	X			This project is part of both the Hydrogen Sorption and Metal Hydride Centers of Excellence. If appropriate, NIST should use their capabilities to characterize "controversial samples or materials." This would allow erroneous claims of unusually high capacity to be disproved sooner, and accurate claims to be recognized and advanced. NIST should continue to increase collaborations across the DOE hydrogen storage portfolio.
STP-08	Optimizing the Binding Energy of Hydrogen on Nanostructured Carbon Materials through Structure Control and Chemical Doping; Duke U; Jie Liu	2.5	X			This project is part of the Hydrogen Sorption Center of Excellence. The project would be strengthened by addressing carbon microchemistry, surface activity/basicity, and other relevant characterization to the materials under study. Duke should increase collaborations with HSCoE theory groups as appropriate and with HSCoE experimental efforts to reduce overlap and leverage resources.
STP-11	Advanced Boron and Metal Loaded High Porosity Carbons; Penn State; Mike Chung	2.9	X			This project is part of the Hydrogen Sorption Center of Excellence. The Penn State project should increase the effectiveness of its internal collaborations and ties across the HSCoE. Penn State should leverage HSCoE resources to obtain near room temperature net capacity measurements of its most promising materials to determine the effectiveness of the incorporated boron. Penn State should also emphasize net volumetric capacity.
STP-12	Nanoengineering the Forces of Attraction in a Metal-Carbon Array for H2 Uptake at Ambient Temperatures; Rice University; James Tour and Carter Kittrell	3.0	X			The project is addressing increasing hydrogen binding energy; a key strategy towards enabling near room temperature storage of hydrogen at nominal pressure. The Tour group should increase collaborations particularly for measurement of H2 storage properties such as hydrogen binding energy and net gravimetric and volumetric capacity.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
STP-16	Catalyzed Nano-Framework Stablized High Density Reversible Hydrogen Storage Systems; UTRC; Dan Mosher	3.1	X			This project is part of the Metal Hydride Center of Excellence. While the project is in its early stages, it is considered to have great potential at improving sorption kinetics. The nanoframework structures are expected, however, to negatively impact gravimetric and volumetric capacities. It is recommended that the team coordinate with the aerogel activities from the Hydrogen Sorption Center of Excellence.
STP-18	Thermodynamically Tuned Nanophase Materials for Reversible Hydrogen Storage: Structure & Kinetics of Nanoparticle and Model System Materials; Stanford U; Bruce Clemens	3.3	X			This project is part of the Metal Hydride Center of Excellence. The work is well planned with a very good approach for determining thermodynamic and kinetic effects. It is recommended that the selection of materials be based on systems under investigation within the MHCoE.
STP-19	Alane Electrochemical Recharging; SRNL; Ragaiy Zidan	3.2	X			This project is part of the Metal Hydride Center of Excellence. Good progress has been made in this highly focused project. The development of an electrochemical process for the regeneration of spent alane is important. Increased collaboration with other partners and detailed cost estimates for the process are recommended.
STP-20	LiMgN Sorption Kinetics and Solid State Hydride System Engineering for the MHCOE; SRNL; Don Anton	3.1	X			This project is part of the Metal Hydride Center of Excellence. Two lines of work were presented for this project. The LiMgN work, while it was preliminary, is well planned and logical. It is recommended that ammonia release be quantified for this material in the early stages of this research. The effort on forecourt heat rejection analysis is essentially complete and it is recommended that if any further analysis is required, it be carried out by either the Hydrogen Storage Engineering Center of Excellence or by other analysis groups.
STP-21	Synthesis of Nanophase Materials for Thermodynamically Tuned Reversible Hydrogen Storage; California Institute of Tech; Channing Ahn	3.1	X			This project is part of the Metal Hydride Center of Excellence. The work in this project is highly relevant to the MHCoE activities and carefully carried out. However work should be focused on one area versus multiple lines of research. The collaborations are strong although closer ties with computational modelers is encouraged.

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STP-24	Center for Hydrogen Storage Research at Delaware State University; Delaware State University; Andrew Goudy	2.4			X	This is a Congressionally-direct project. Reviewers recommended improved alignment of the project with DOE goals. For example, the emphasis should consider the net available capacity of the materials under study, taking into account the energetics and temperature and pressure required for suitable hydrogen uptake/release kinetics.
STP-26	Novel Metal Perhydrides; Michigan Tech Univ.; Jim Hwang	2.5			X	Due to funding delays, the research for this project is in its early stages. The project has a go/no-go decision point in third quarter FY 2009 based on storage capacity. It is recommended that surface hydride structure studies be conducted to validate the density functional theory models employed. Also, validation of the hydrogen uptake/release modeling results via direct measurements is needed.
STP-27	Glass Microspheres for Hydrogen Storage; Alfred; Jim Shelby	2.3			X	In second quarter of FY 2009 this project has an end of phase I go/no-go decision point based on storage capacity. Work should focus on high-pressure filling and cycling of hydrogen and determination of volumetric and gravimetric storage capacity as well as uptake/discharge kinetics.
STP-28	Electron-Charged Graphite-Based Hydrogen Storage Material; Gas Technology Institute; Chinbay Fan	2.8	X			GTI has demonstrated initial success in increasing uptake at room temperature using electron-charged graphite. However the baseline material hydrogen uptake is low. GTI should estimate net volumetric capacity of the materials. DOE will continue to monitor their progress in 2009 and pursue independent verification.
STP-29	Polymer-Based Activated Carbon Nanostructures for H_2 Storage; State University of New York; Israel Cabasso	2.7	X			PI will continue to make high surface area materials with a narrow pore size distribution. Project should focus on estimating net available volumetric capacity and increasing the hydrogen bonding energy to enable near room-temperature storage at nominal pressure.
STP-32	An Integrated Approach for Hydrogen Production and Storage in Complex Hydrides of Transitional Elements; U of Arkansas; Abhijit Bhattacharyya	2.7			X	This is a Congressionally-direct project. This effort includes two different lines of effort, one on polymeric materials and one on glancing angle deposited thin film materials. The reviewers found the practicality of the thin film work questionable due to the materials being investigated and the need to use a quartz crystal microbalance. The polymeric materials were considered to be more promising. Focusing on the polymeric materials, stronger collaborations and avoiding duplication of work carried out by others are recommended.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
STP-33	Hydrogen Fuel Cells and Storage Technology Project; UNLV; Clemens Heske	2.5			X	This is a Congressionally-direct project. The work includes efforts on hydrogen storage materials and fuel cell membranes. The fuel cell membrane work was considered more promising by the reviewers. The reviewers expressed concerns that the materials would not be able to meet DOE targets or are duplicative of other efforts within the Hydrogen Storage Program. More extensive collaborations are recommended.
STP-34	Modular Storage Systems; Limnia (formerly FST); Scott Redmond	1.6			X	This is a Congressionally-direct project completed in FY 2007. Reviewers stated that a more detailed analysis should have been conducted to improve the storage performance. Actual experimental data for the cassette device is needed to provide detailed evaluation of the concept.

Fuel Cells:

FC-01	Advanced Cathode Catalysts and Supports for PEM Fuel Cells; 3M Company; Mark Debe	3.7	X			Work will continue on improving mass activity, durability, and water management of nanostructured thin film technology over baseline by increasing catalyst surface area and identifying new catalyst compositions, structures, and processes; reducing losses in overpotential and improving anode cell reversal tolerance; and optimizing GDL interfaces.
FC-02	Non-Platinum Bimetallic Cathode Electrocatalysts; ANL; Debbie Myers	3.1	X			This project exhibits strong experimental and modeling work. Some testing at the MEA level may be appropriate to screen catalysts.
FC-03	Advanced Cathode Catalysts; LANL; Piotr Zelenay	2.8	X			LANL will re-assess metrics for various catalysts and integrate MEA level testing into research plan. The project scored low in the area of future planning- the reviewers advised that it would be appropriate for the project to begin down-selecting the catalyst approach in order to focus resources on achieving performance targets.
FC-04	Development of Alternative and Durable High Performance Cathode Supports for PEM Fuel Cells; PNNL; Yong Wang	2.6	X			PNNL will focus on developing a fundamental understanding of interfacial interactions in Pt/C and Pt/WC catalysts and will continue investigation of other conductive metal oxide-modified XC-72 materials. The PI should focus on *in situ* rather than *ex situ* testing.
FC-05	Highly Dispersed Alloy Cathode Catalyst for Durability; UTC Power; Sathya Motupally	3.1	X			UTC will continue with investigation of Pd_3Co/Pt, Ir/Pt core/shell durability testing and scale-up optimization, new synthesis and characterization of Ir_xCo_y alloy cores, and validation of modeling results on core/shell stability and durability.

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FC-06	Fuel Cell Systems Analysis; ANL; Rajesh Ahluwalia	3.2	X			Start-stops, transients, variation in operating environment, and other dynamics will be modeled and reported. Alternate humidification devices will be modeled and explored with the system model.
FC-07	Mass Production Cost Estimation for Direct H_2 PEM Fuel Cell Systems for Automotive Applications; DTI; Brian James	3.1	X			The cost estimate will be refined by bottom-up analysis of the balance-of-plant components. DTI will analyze the cost-saving potential of components identified in the sensitivity analysis. The 2008 technology update will include optimization of power density vs. catalyst loading, consideration of alternative catalyst alloys and application methods, and coating for bipolar plates.
FC-08	Direct Hydrogen PEMFC Manufacturing Cost Estimation for Automotive Applications; TIAX; Jayanti Sinha	2.9	X			The project scored poorly in approach because TIAX focuses on an MEA technology that has only been tested in the lab and not in the field. However, the PI uses the Argonne National Laboratory's model as a reference fuel cell system, and complements the DTI cost analysis, which assumes a more conventional fuel cell system architecture. The PI has explored conventional Pt on carbon catalysts in prior work and will include the results of the prior work in their comprehensive report of the 2007 technology that the cost estimates are based on.
FC-09	Microstructural Characterization of PEM Fuel Cell MEAs; ORNL; Karren More	3.7	X			Expansion of facilities will continue, including the capability to rotate a specimen within the column of the TEM. In addition, recommendations include reducing the effort to study carbon corrosion, focusing, instead, on developing capabilities to reveal surface structure and surface composition of catalysts that determine activity and stability under high voltage; performing statistical analysis on the samples imaged; collaborating with researchers with strong modelling capability, and further developing the 3D technique.
FC-10	Applied Science for Electrode Cost, Performance, and Durability; LANL; Christina Johnston	3.0	X			LANL will examine proton conductivity pathways from the catalyst to the membrane; evaluate carbon support properties and correlate to performance; investigate interaction of carbon with ionomer, depending on pre-treatment with solvents; and explore layered and gradient structures for improved catalyst utilization. Reviewers scored the project low in technology transfer and collaboration. Work with commercial partners and better dissemination of results will be considered and encouraged.
FC-11	Low-cost Co-Production of Hydrogen and Electricity; Bloom Energy Corp.; Fred Mitlitsky	2.4			X	Congressionally directed. The hydrogen impurity analysis needs to extend beyond CO and CO_2, and particularly address S compounds.

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FC-12	Improved, Low-Cost, Durable Fuel Cell Membranes; Arkema; James Goldbach	2.7	X			Arkema will determine whether actual M43 MEA performance correlates with *ex situ* data. Morphology will be studied by ORNL. Other families of polyelectrolytes will be tested.
FC-13	Membranes and MEA's for Dry, Hot Operating Conditions; 3M; Steven Hamrock	3.4	X			3M will continue to pursue multiple approaches for changing the nature of the acid group to develop lower-equivalent weight, higher-conductivity membranes and to study the degradation pathways for these approaches. Reviewers recommend downselection of the approaches to focus resources; downselection will occur in FY2010.
FC-14	New Polyelectrolyte Materials for High Temperature Fuel Cells; LBNL; John Kerr	2.9	X			In the planned work, the investigators were primarily concerned with MEA testing and mechanical and chemical stability. However, based on reviewer suggestions, the PI will focus on developing materials with a path to meeting the 2015 conductivity targets.
FC-15	Lead Research and Development Activity for DOE's High Temperature, Low Relative Humidity Membrane Program; University of Central Florida; James Fenton	3.0	X			A key recommendation for this project is resolution of issues germane to the conductivity test protocol. An MEA test protocol prepared by UCF will be disseminated to appropriate parties for comment in FY08 and FY09.
FC-16	Advanced Materials for Proton Exchange Membranes; Virginia Tech; James McGrath	3.0	X			Stability and durability issues of these materials will be addressed during the next year. The PI will identify the chemistry and morphology needed to meet the DOE objectives before pursuing scale-up.
FC-17	Protic Salt Polymer Membranes: High-Temperature Water-Free Proton-Conducting Membranes; Arizona State University; Dominic Gervasio	2.4	X			Recommendations include a more systematic approach to understand and enable improvements in conductivity and fuel cell performance. Membranes using ammonia as a proton shuttle are unlikely to be stable or surpass current systems.
FC-18	Fluoroalkyl-phosphonic-acid-based Proton Conductors; Clemson University; Stephen Creager	3.2	X			ASU plans to study non-water mechanisms of proton transport by performing conductivity studies on materials with lower water content, which is reasonable for this project. Also, work directed at refining monomer and ionomer synthesis will continue.

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FC-19	Rigid Rod Polyelectrolytes: Effect on Physical Properties Frozen-in Free Volume: High Conductivity at low RH; Case Western Reserve University; Morton Litt	3.2	X			The PI will explore several new approaches for making a high molecular weight, water-insoluble polymer. When a water-insoluble polymer is obtained, attention will be directed at developing reasonable mechanical properties.
FC-20	Nanocapillary Network Proton Conducting Membranes for High Temperature Hydrogen/Air Fuel Cells; Case Western Reserve University; Peter Pintauro	3.2	X			The PI will seek collaborations with other groups that can provide information and/or assistance. The planned future work will increase membrane conductivity at higher temperatures and lower RH.
FC-21	Novel Approaches to Immobilized Heteropoly Acid (HPA) Systems for High Temperature, Low Relative Humidity Polymer-Type Membranes; Colorado School of Mines; Andrew Herring	3.1	X			The investigators plan to complete investigation of the Si-linked design space for polyPOMs and develop more mechanically stable polyPOMs. Reviewers were generally supportive of these plans.
FC-22	New Proton Conductive Composite Materials with Co-continuous Phases Using Functionalized and Crosslinkable VDF/CTFE Fluoropolymers; Penn State; Serguei Lvov	2.3	X			During the next year, Penn State will further modify the terpolymer using inorganic proton conductors. In addition, the effects of new inorganic additives upon conductivity, structure, and particle size will be determined.
FC-23	High Temperature Membrane with Humidification-Independent Cluster Structure; FuelCell Energy, Inc.; Ludwig Lipp	3.0	X			Future activities will include development of a better MEA interface for these novel composite membranes.

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FC-24	Dimensionally Stable Membranes; Giner Electrochemical Systems, LLC; Cortney Mittelsteadt	3.2	X			The suggested future work on both a reinforcement layer and the polyelectrolyte is good. However, more work will also be done with commercially available ionomeric materials.
FC-25	Poly(cyclohexadiene)-Based Polymer Electrolyte Membranes for Fuel Cell Applications; University of Tennessee; Jimmy Mays	2.5	X			It is unclear how the PI will improve conductivity at high temperatures and low relative humidities by adding inorganics, or even what inorganics will be added. The focus on degradation studies is important. The *ex situ* (i.e., Fenton's test) and the *in situ* tests proposed are important at this stage and should be done as soon as possible.
FC-26	PEM Fuel Cell Durability; LANL; Rod Borup	2.8	X			LANL will consider collaborating with a system integrator or stack developer to improve technology transfer. In addition, LANL will focus on an improved understanding of GDL hydrophobicity through the GDL aging characterization and GDL accelerated stress test development tasks.
FC-27	Nitrided Metallic Bipolar Plates; ORNL; Peter Tortorelli	3.4	X			ORNL will continue to refine and optimize the nitriding surface treatment process once feasibility is proven.
FC-28	Next Generation Bipolar Plates for Automotive PEM Fuel Cells; GrafTech International Ltd.; Orest Adrianowycz	3.4	X			Graftech will focus on manufacturability and cost. Future plans include continuous incorporation of new plates into stack systems to evaluate performance.
FC-29	Effects of Impurities on Fuel Cell Performance and Durability; Clemson University; James Goodwin	2.6	X			The project could use some higher impact impurities than ethylene and ethane to study. Future focus on halogenated compounds that might be in H_2 produced from chlor-alkali processes, cleaning solvents, etc., may be of more immediate support of DOE goals.
FC-30	Effects of Fuel and Air Impurities on PEM Fuel Cell Performance; LANL; Fernando Garzon	3.2	X			Cyclic voltammetry measurements will be made in situ with potentiostats to characterize the catalyst surface. High frequency resistance measured by A.C. impedance spectroscopy will be a sensitive probe.
FC-31	The Effects of Impurities on Fuel Cell Performance and Durability; University of Connecticut; Trent Molter	3.1	X			The focus on key organic species is excellent, but selected organics should be chosen carefully. The choice of the standard MEA on which to carry out the impurity effect studies should be revised.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
FC-32	Subfreezing Start/Stop Protocol for an Advanced Metallic Open-Flowfield Fuel Cell Stack; Nuvera Fuel Cells, Inc.; James Cross	3.1	X			Nuvera has made it a priority to install and commission an environmental chamber, which will address reviewers' concerns regarding use of ambient gases in Nuvera's test protocol. In addition, Nuvera will develop a 2D model to afford startup procedure optimization and further investigate MEAs and GDLs.
FC-33	Visualization of Fuel Cell Water Transport and Performance Characterization Under Freezing Conditions; Rochester Institute of Technology; Satish Kandlikar	3.4	X			Future work will include evaluation of the improved GDL and channel properties with combinatorial *in situ* multi-channel and freeze-thaw experiments.
FC-34	Water Transport in PEM Fuel Cells: Advanced Modeling, Material Selection, Testing, and Design Optimization; CFD Research Corp.; Vernon Cole	2.9	X			Future work will include *ex situ* characterization studies (GDL microstructure, transport properties, freezing point) and GDL-channel transport experiments.
FC-35	Water Transport Exploratory Studies; LANL; Rod Borup	3.2	X			Project will proceed as planned, including neutron imaging of NSTF catalyst systems at start-up, transient operation, segmented cell operation, freeze measurement, characterization, and model development. LANL is encouraged to report GDL material properties and consider investigating PTFE migration due to water transport, changes to the water contact angle due to carbon oxidation, and pore structure changes due to freezing.
FC-36	Neutron Imaging Study of the Water Transport in Operating Fuel Cells; NIST; David Jacobson	3.8	X			DOE considers this project to be high priority, as neutron radiography is the only way that researchers can image water inside an operating fuel cell.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
FC-37	Development of Thermal and Water Management System for PEM Fuel Cells; Honeywell; Zia Mirza	2.3	X			Because humidification devices will not meet automotive requirements, the water management effort will be brought to a conclusion. Final humidifier testing will add value by providing data to validate DOE's humidifier models that may be helpful for guiding future humidifier development. Honeywell's data in thermal management has led Argonne National Laboratory to conclude that commercial metal foams are not good candidates for automotive radiators because the radiators would be bulky and require much higher pumping power. In the coming year, Honeywell will validate Argonne's modeling results that show advanced automotive (louver fins, 25 fins/inch) and microchannel radiators are more compact than standard automotive radiators in fuel cell applications.
FC-38	Low-Cost Manufacturable Microchannel Systems for Passive PEM Water Management; PNNL; Ward TeGrotenhuis	2.7	X			Final testing in this project will provide data for modeling and optimizing the humidifier device in a fuel cell system. However, even if the device shows potential, there are still recognized integration issues to be addressed.
FC-39	Development and Demonstration of a New Generation High-Efficiency 1-10 kW Stationary PEM Fuel Cell Power System; Intelligent Energy; Durai Swamy	2.8	X			A go decision was made on August 6, 2008 to complete the engineering design on the Hestia PSA (and not continue the MesoPure). AER development will continue in parallel. Subsequently, validation of the technologies vs. efficiency and other targets will be conducted.
FC-40	International Stationary Fuel Cell Demonstration; Plug Power; John Vogel	3.6			X	The project will conclude with demonstration of the units and performance and decommissioning data reported back to DOE.
FC-41	Intergovernmental Stationary Fuel Cell System Demonstration; Plug Power; Rhonda Staudt	2.9	X			The project's relevance, approach, accomplishments, collaborations, and future work are solid. In the coming year, a prototype will be built, sited, installed, and commissioned. Field operation and support will commence.
FC-42	Stationary PEM Fuel Cell Power Plant Verification; UTC Power; Eric Strayer	3.1	X			UTC will continue to focus on low cost technology. Durability of greater than 20,000 hours will be validated through scale-up and demonstration.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
FC-43	Diesel Fueled SOFC System for Class 7/Class 8 On-Highway Truck Auxiliary Power; Cummins; Dan Norrick	3.1	X			Although some reviewers suggested that there is no path apparent to reach DOE efficiency targets, other reviewers commented that much remains to be done in this project, and the proposed future work should address all issues.
FC-44	Solid Oxide Fuel Cell System Development for Auxiliary Power in Heavy Duty Vehicle Applications; Delphi; Gary Blake	3.0	X			Planned future work is completion the SOFC APU hardware design and build, followed by test fixture design and system testing.
FC-45	DMFC Prototype Demonstration for Consumer Electronic Applications; MTI MicroFuel Cells, Inc.; Chuck Carlstrom	2.6	X			MTI's technology is applicable to small portable power systems. The energy density advantage over lithium batteries is slight, although the technology has some advantages associated with balance-of-plant. Demonstration of the next generation system with higher energy density and cartridges will be performed.
FC-46	DMFC Power Supply for All-Day True-Wireless Mobile Computing; PolyFuel; Brian Wells	2.7			X	This project is ending this year. Remaining tasks include: improving overall system power to meet the 15 W target and durability tests on complete units.
FC-47	Fuel Cell Research at the University of South Carolina; University of South Carolina; John Van Zee	2.5			X	Congressionally directed. Catalyst support durability was not addressed at all, but should be. Reviewers felt that this project contained four largely unrelated projects with no interconnection.
FC-48	Novel PEMFC Stack Using Patterned Aligned Carbon Nanotubes as Electrodes in MEA; ANL; Di-Jia Liu	2.5			X	This project completes at the end of the fiscal year and, therefore, will not be continued. The final task of the project is to complete a durability study on carbon nanotube-based fuel cells to determine whether reviewers are correct that the nanotubes provide no durability benefit as compared to conventional carbon supports.
FC-49	Detection of Trace Platinum Group Element Particulates with Laser Spectroscopy; Montana State; Stuart Snyder	1.9			X	The plan for this Congressionally-directed project is to calibrate the system for platinum detection and continue analyzing fuel cell water for platinum and palladium. There is an urgent need to prove that Pd/Pt loss to fuel cell water is a problem before continuing project.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
FCP-01	Light-weight, Low Cost PEM Fuel Cell Stacks; Case Western Reserve University; Jesse Wainright	2.8	X			Reviewers were concerned about the low current densities and recommended focusing on the engineering concepts, rather than building full systems. The next steps in this project are to continue single-cell testing, refine the CFD model, and fabricate a first-generation sub-stack.
FCP-02	Platinum Group Metal Recycling Technology Development; BASF; Lawrence Shore	2.7	X			This project is in its last year. Remaining tasks include determining the Pt yield from two competing reactor designs and improving the economic model.
FCP-03	Platinum Recycling Technology Development; Ion Power, Inc.; Stephen Grot	3.1			X	This project ends this year. In FY09, Ion Power will focus on lowering the platinum group metal (PGM) content in the diffusion media to 0.05 wt.% PGM.
FCP-04	Component Benchmarking Subtask Reported: USFCC Durability Protocols and Technically-assisted Industrial and University Partners; LANL; Tommy Rockward	3.1	X			LANL has provided high quality support to the fuel cell R&D community and will continue to serve industrial and university partners.
FCP-05	Low Cost, Durable Seals For PEM Fuel Cells; UTC Power Corporation; Jason Parsons	3.0	X			The project completes within a year and proceeds with downselection of next generation candidates, accelerated *ex situ* durability testing, and prototype development. UTC should also include *in situ* fuel cell testing.
FCP-08	Research & Development for Off-Road Fuel Cell Applications; IdaTech; Richard Lawrance	2.7	X			In the next year, performance testing of the system on a dynamometer, on a golf course, and with end-users will be conducted before the researchers design a second prototype and demonstrate the vehicles.
FCP-09	Market Opportunity Assessment of Direct Hydrogen PEM Fuel Cells in Federal and Portable Markets; Battelle Memorial Institute; Kathya Mahadevan	3.0			X	The project has reached planned conclusion.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment

Technology Validation:

TV-01	Hydrogen to the Highways; DaimlerChrysler; Ron Grasman	3.3	X			This project is a key element in determining whether the program's hydrogen and fuel cell activities are on course to achieve established research and development targets. Adding vehicles to government fleets will demonstrate the technology to early adopter markets. DOE will work with technology validation project teams on ways to take advantage of the hydrogen infrastructure investments after the projects are completed.
TV-02	Hydrogen Fuel Cell Vehicle & Infrastructure Demonstration Program Review; Ford; Greg Frenette	3.2	X			This project has direct relevance to the Hydrogen Program's Multi-Year Program Plan and will help DOE achieve its goals. DOE will work with technology validation project teams on ways to take advantage of the hydrogen infrastructure investments after the projects are completed.
TV-03	Controlled Hydrogen Fleet and Infrastructure Demonstration and Validation Project; Chevron; Dan Casey	3.3	X			Acquiring "real world" operational data and experience is vital to making appropriate adjustments to the hydrogen program's research and development projects. DOE will work with technology validation project teams on ways to take advantage of the hydrogen infrastructure investments after the projects are completed.
TV-04	Hydrogen Vehicle and Infrastructure Demonstration and Validation; General Motors; Roz Sell	3.7	X			This project strongly supports the Hydrogen Fuel Initiative and the technology validation aspects of the Multi-Year Program Plan for vehicle and infrastructure demonstration and evaluation. DOE will work with technology validation project teams on ways to take advantage of the hydrogen infrastructure investments after the projects are completed.
TV-05	Controlled Hydrogen Fleet & Infrastructure Analysis; NREL; Keith Wipke	3.5	X			This project is vital to determining whether the Program's hydrogen and fuel cell activities are on course to achieve established research and development targets. This project represents a good summary of the state of hydrogen technology when applied to automotive transportation and will be continued.
TV-06	Validation of an Integrated Hydrogen Energy Station; Air Products; Ed Heydorn	3.5	X			The concept of an integrated electricity and hydrogen production facility is an innovative concept and promises to encourage the use of hydrogen fueling stations even when the vehicle usage might be low, at the start of deployment.
TV-07	California Hydrogen Infrastructure Project; Air Products; Ed Heydorn	3.4	X			Very relevant to have a major hydrogen producer involved in designs and fabrication of hydrogen infrastructure projects. DOE will work with the team to develop plans to allow the hydrogen stations to be used after the project ends.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
TV-08	Hawaii Hydrogen Center for Development and Deployment of Distributed Energy Systems; Hawaii Natural Energy Inst.; Richard Rocheleau	3.1	X			The project presentation clearly demonstrates and supports the President's Hydrogen Fuel Initiative. DOE will work with the project partners to better focus the project on the development of the refueling station and operation of the buses at the Volcanoes National Park.
TV-09	Cryogenic Capable Pressure Vessels for Vehicular Hydrogen Storage; LLNL; Salvador Aceves	2.8			X	The project focuses on one of the key objectives which is to improve on-board hydrogen storage options available to the OEMs. DOE will work with LLNL to have them move towards more realistic packaging for DOE's next vehicle demonstration.
TVP-01	Florida Hydrogen Initiative; Florida Hydrogen Initiative; Pam Portwood	2.5	X			At least two of the four projects discussed are expected to have little or no benefit in terms of contributing to achievement of DOE's Hydrogen goals, targets and objectives. DOE will discuss with the project partners the termination of the diesel reformation project as diesel to hydrogen reformation is highly unattractive from an efficiency and cost standpoint. Additionally, it does not fit within the context of the Florida Hydrogen Initiative.
TVP-02	Technology Validation: Fuel Cell Bus Evaluations; NREL; Leslie Eudy	3.1	X			Making real operational data available for all to view and use is excellent. Will work with NREL to expand the data base to include all fuel cell buses in operation.

Safety, Codes, and Standards:

SA-01	Hydrogen Codes and Standards; NREL; Robert Burgess	3.9	X			This project is critical to the continued support of research and development associated with domestic and international hydrogen standards.
SA-02	Materials Compatibility; SNL; Brian Somerday	3.9	X			This project investigates the hydrogen compatibility of materials for multiple applications including storage, transport and system components.
SA-03	Hydrogen Safety Tools: Software and Hardware; PNNL; Linda Fassbender	3.7	X			This project promotes safety education and information sharing related to the safe handling of hydrogen.
SA-04	Hydrogen Fuel Quality; LANL; Tommy Rockward	3.4	X			This project will provide the specifications on tolerable fuel constituents for the development of an international hydrogen quality standard.
SA-06	Hydrogen Safety Panel; PNNL; Steven Weiner	3.5	X			This project is critical to the safe execution of DOE hydrogen projects and information sharing on hydrogen use and practices.
SAP-01	Codes & Standards for the Hydrogen Economy; Regulatory Logic; Gary Nakarado	3.6	X			This project aims to promote and maintain harmonization among Codes and Standards Development Organizations.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment

Education:

ED-01	Hydrogen Knowledge and Opinions Assessment; ORNL; Rick Schmoyer	2.8	X			The project measures important overall key activity metrics. The subprogram will consider stronger ties to other education projects. The survey methodology may be outdated (use of telephone land line survey) but methodology for follow-up surveys must be consistent over time to retain statistical validity.
ED-02	Hydrogen Safety: First Responder Education; PNNL; Marylynn Placet	3.5	X			The project objectives are highly consistent with Hydrogen Fuel Initiative and DOE program objectives. The project has a sound approach; the large number of reviewers and the inclusion of a steering committee shows strong collaborative effort. The effort demonstrated success and clear progress. The subprogram, will consider greater focus on near-term hydrogen applications.
ED-03	Hydrogen Education for Code Officials; NREL; Melanie Caton	3.1	X			The project strategy and goals are reasonable and well-thought out; the use of e-learning modules is especially effective. The subprogram will consider additional collaboration with partners and a more detailed course rollout plan.
ED-04	Increasing “H2IQ”: A Public Information Program; The Media Network; Henry Gentenaar	3.3	X			The project is well thought-out and is important for providing objective and consistent information. The project has demonstrated good, simple messaging and contemporary multi-media marketing strategies. The subprogram will consider more specific quantifiable metrics and more active collaborations.
ED-05	H2 and You: A Public Education Initiative by the Hydrogen Education Foundation; Hydrogen Education Foundation; Patrick Serfass	3.4	X			The project is important for dispelling myths and correcting misinformation. Assembling a steering committee of public and private sector partners is a good approach. DOE will coordinate more closely with the project steering committee to align the "hydrogen message."
ED-07	H2 Educate! Hydrogen Education for Middle Schools; NEED; Mary Spruill	3.7	X			This is an aggressive, well thought-out program. There has been considerable success in reaching teachers despite funding issues over the project duration. Project strengths include partnerships, effective use of resources, and alignment with science education standards. The subprogram will consider more frequent content updates.

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment

Systems Analysis:

Project Number	Project Title; Presenting Organization; PI Name	Final Score	Continue	Discontinue	Other	Summary Comment
AN-01	HyTrans Model: Analyzing the Transition to Hydrogen-Powered Transportation; ORNL; David Greene	3.5	X			Future work will address the reviewers' suggestions: (a) obtain additional industrial data to establish how federal procurement of smaller PEM fuel cells will bring about the viability of larger PEM fuel cells used in automobiles; and (b) evaluating alternatives such as the plug-in vehicle (both electric hybrid and hydrogen hybrid) and the H2 internal combustion vehicle.
AN-02	GREET WTW Analysis Results and Comparison of Advanced Vehicle Technologies; ANL; Michael Wang	3.6	X			Argonne National Laboratory's future work will address the reviewers' suggestion regarding increasing validation of assumptions through discussion with industry experts and other experts. Work will be focused on developing well to wheel analysis for renewable pathways and plugin vehicles.
AN-04	Macro-System Model; NREL; Mark Ruth	3.5	X			Additional work will address the reviewers' suggestions of better documentation of assumptions, resolving questions on the efficiency of the distributed steam methane reformers, and seeking additional input from experts as needed. The Macro-System Model will incorporate other renewable hydrogen production pathways.
AN-05	Analysis of the Hydrogen Production and Delivery Infrastructure as a Complex Adaptive System; RCF, Inc.; George Tolley	3.4	X			RCF will address the reviewers' suggestion to use different discount rates and include additional scenarios such as hydrogen co-produced in stationary fuel cell system. The project will be completed in FY 2009.
AN-06	Hydrogen Technology Analysis: H2A Production Model Update; NREL; Darlene Steward	3.9	X			NREL will incorporate the reviewers' suggestion of providing better documentation of the assumptions for the H2A. Reviewers concluded the model is necessary for the Hydrogen Program to calculate a standardized cost of hydrogen but the model should be further peer reviewed.
AN-07	Water Resource Analysis for Hydrogen Infrastructure; LLNL; Rich White	2.9	X			Sandia will address the recommendation to provide the documentation of the rationale for selecting hydrogen pathways for analysis and the rationale for comparing hydrogen pathways' water requirements with biofuels and gasoline pathways.
AN-08	HyDRA: Hydrogen Demand and Resource Analysis Tool; NREL; Witt Sparks	3.2	X			NREL will add renewable hydrogen information as the reviewers suggested. Infrastructure information for electrical systems, railroad and natural gas pipeline infrastructure and carbon sequestration sites will be included in the model. The tool is interactive and enables users to understand and analyze a variety of scenarios relevant to production, transport, and uses of hydrogen fuel.

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AN-09	Lessons Learned for Fueling Infrastructure; NREL; Marc Melaina	3.3			X	The project will be completed at the end of FY08 and provides insights to infrastructure deployment and expansion. Understanding lessons from previous successful and unsuccessful efforts to introduce new alternative fuels is important for developing a successful strategy to introduce hydrogen as a transportation fuel.
AN-10	Hydrogen and Fuel Cell Analysis: Lessons Learned from Stationary Power Generation; U Missouri-Rolla; Scott Grasman	2.9	X			The project has just begun and therefore the reviewers did not see many results. The project will continue to be funded through FY 2009. Future documentation will describe the approach and results in more detail as suggested by the reviewers.
AN-11	Hydrogen Quality Issues for Fuel Cell Vehicles; ANL; Romesh Kumar	3.1	X			Future work will focus on alternative hydrogen separation technologies in addition to PSA as appropriate. Additional hydrogen production pathways will be included in the assessment of quality impacts on fuel cell durability and production costs.
AN-12	Update on Platinum Availability and Assessment of Platinum Leasing Strategies for Fuel Cell Vehicles; TIAX; Matt Kromer	3.5			X	This project will be completed by the end of FY08. Project addresses the concern of platinum availability for widespread fuel cell vehicle deployment and investigates cost mitigation opportunities especially with recent price increases in platinum.
AN-13	Evaluation of the Potential Large-Scale Use and Production of Hydrogen in Energy and Transportation Applications; University of Illinois-Urbana-Champaign; Don Wuebbles	3.5	X			In FY 2009 the project team will assess additional hydrogen pathways for environmental impacts, based on the reviewers' suggestion. This project will create awareness about hydrogen emissions during production, hydrogen reactions with hydroxyl radicals in the atmosphere, hydrogen's effect on the ozone layer, increased soil acidity, and, overall, the impact of the emissions on climate.
AN-14	Potential Environmental Impacts of Hydrogen-Based Transportation and Power Systems; Tetra Tech; Thomas Grieb	3.0	X			Future work will address the reviewers' suggestions of selecting a more defensible baseline scenario for comparison and incorporating renewable hydrogen production pathways in the environmental assessment. Study of hydrogen dynamics in the troposphere and stratosphere is very important and should include fossil and renewable hydrogen production sources.
ANP-01	Hydrogen Technology Analysis: H2A Stationary Power Production Model; NREL; Michael Penev	3.2	X			NREL will develop a more systematic plan of investigation of the various fuel cell categories. This model will be part of a scenario analysis to investigate synergies of stationary power generation with hydrogen production for the transportation sector.

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ANP-04	Hydrogen Infrastructure Analyses; SNL; Anthony McDaniel	2.6	X			The project score was low since the project just began and few results were available or presented. The project will be funded through FY 2009 and will address the reviewers' suggestions related to increasing collaboration with other market transition studies funded by the program and include industrial stakeholders early in the project.

Manufacturing:

MF-02	Fuel Cell MEA Manufacturing R&D; NREL; Mike Ulsh	3.1	X			The goals of this project were noted as being directly in line with Hydrogen Program objectives. In the future, the project will focus on making more quantitative, rather than qualitative results, to address reviewer comments.
MF-04	Rapid Manufacturing of Carbon Composite High Pressure Storage Cylinders; Profile Composites; Geoff Wood	3.4			X	Congressionally directed project. Although good progress has been made on the process steps, the project fails to identify how the cycle time reductions relate to overall cost reductions. Additional work could be done to upgrade quality control activities and work to ensure the transfer of technology.
MF-05	Technologies for Mass-Manufacturable Manifolds and Durable Seals for PEM Fuel Cells in Transportation Applications; UTC Power; Patricia Cosentino	3.1			X	Congressionally directed project. The progress claims were not backed up by data. It was not clear which fabrication process resulted in the 90 percent cost reduction.
MF-06	Develop Low-Cost MEA3 Process; DuPont Fuel Cells; Dennis Kountz	2.8			X	Congressionally directed project. DuPont achieved demonstrable performance improvements in a DMFC system. However, this would have been more valuable using a more fundamental approach that would provide information to the DOE Hydrogen Program. The performance results were not made clear.
MF-07	NIST Fuel Cell Manufacturing Research Project Metrology for Fuel Cell Manufacturing; NIST; Eric Stanfield	2.9	X			The project is likely to provide pre-competitive information that the fuel cell industry can use to help achieve the Hydrogen Program goals. Reviewers also noted that NIST is following a logical path to identifying and evaluating non-contact measurement techniques, which will continue in FY09.

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MFP-01	Innovative Inkjetting and Spray Deposition for Low-Cost, High-Performance Fuel Cell Catalyst Coated Membrane Manufacturing; Cabot Corp.; Hanwei Lei	2.5			X	Congressionally directed project. There was no analytical assessment of cost, performance, or durability. Therefore, results are inconclusive.
MFP-02	Novel Manufacturing Process for PEM Fuel Cell Stacks; Protonex Corp.; Michael McCarthy	3.2			X	Congressionally directed project. Protonex developed, designed, and manufactured multiple fuel cell stacks and systems demonstrating small-volume manufacturing potential. However, it is not clear if the project's claim of achieving a 25 percent reduction in manufacturing time resulted in the cost target being met. It was not clear how the claim was determined.
MFP-03	Manufacturable Chemical Hydride Fuel System Storage for Fuel Cell Systems; Millennium Cell; Richard Mohring	3.1			X	Congressionally directed project. While the project overcame some technical barriers, there is no plan to scale up the technology to high-volume applications. The future of the effort to commercialize is therefore unclear.
MFP-04	Non-Destructive Testing and Evaluation Methods; ASME Standards Technology; Jim Ramirez	3.2			X	Congressionally directed project. Modal Acoustic Emission (MAE) definitely shows potential for the non-destructive evaluation (NDE) of flaws in pressure vessels. A quantitative comparison with other technologies should be done next year. Statistical data showing fault detection effectiveness should also be developed.

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