Introduction

The fiscal year (FY) 2011 U.S. Department of Energy (DOE) Hydrogen and Fuel Cells Program and Vehicle Technologies Program Annual Merit Review and Peer Evaluation Meeting (AMR) was held May 9–13, 2011, at the Crystal City Marriott and Crystal Gateway Marriott in Arlington, Virginia. This report is a summary of comments by AMR peer reviewers on the hydrogen and fuel cell projects funded by DOE's Office of Energy Efficiency and Renewable Energy (EERE) and the hydrogen production projects funded by the Office of Fossil Energy. DOE uses the results of this merit review and peer evaluation, along with additional review processes, to make funding decisions for upcoming fiscal years.

The objectives of this meeting were as follows:

- Review and evaluate FY 2011 accomplishments and FY 2012 plans for DOE laboratory programs; industry/university cooperative agreements; and related research, development, and demonstration (RD&D) efforts.
- Provide an opportunity for program stakeholders and participants (e.g., fuel cell manufacturers, component developers, and others) to shape the DOE-sponsored RD&D program in order to address the highest-priority technical barriers and facilitate technology transfer.
- Foster interactions among the national laboratories, industry, and universities conducting RD&D.

The peer review process followed the guidelines of the Peer Review Guide developed by EERE. The peer review panel members, listed in Table 1, provided comments on the projects presented. Panel members included experts from a variety of related backgrounds involving hydrogen and fuel cells, and represented national laboratories; universities; various government agencies; and manufacturers of hydrogen production, storage, delivery, and fuel cell technologies. Each reviewer was screened for conflicts of interest as prescribed by the Peer Review Guide. A complete list of the meeting participants is presented as Appendix A.

Table 1: Peer Review Panel Members

No.	Name	Organization
1	Abts, Leigh	University of Maryland
2	Aceves, Salvador	Lawrence Livermore National Laboratory
3	Adjemian, Kev	NISSAN Technical Center North America
4	Adzic, Radoslav	Brookhaven National Laboratory
5	Ahluwalia, Rajesh	Argonne National Laboratory
6	Ahmed, Shabbir	Argonne National Laboratory
7	Ainscough, Chris	National Renewable Energy Laboratory
8	Akiba, Etsuo	Kyushu University, Department of Mechanical Engineering
9	Anderson, Michele	Office of Naval Research
10	Anton, Donald	Savannah River National Laboratory
11	Antoni, Laurent	Commissariat A l'Energie Atomique et aux Energies Alternatives
12	Araghi, Koorosh	National Aeronautics and Space Administration
13	Ardo, Shane	California Institute of Technology
14	Autrey, Thomas	Pacific Northwest National Laboratory
15	Ayers, Katherine	Proton OnSite
16	Balachandran, U. (Balu)	Argonne National Laboratory
17	Barbier, Francoise	Air Liquide
18	Baturina, Olga	U.S. Navy, Naval Research Laboratory (former)
19	Benard, Pierre	Hydrogen Research Institute, Institut de recherche sur l'hydrogene
20	Bender, Guido	National Renewable Energy Laboratory
21	Bendersky, Leonid	National Institute of Standards and Technology
22	Benjamin, Thomas	Argonne National Laboratory
23	Bessette, Norman	Acumentrics Corporation

No.	Name	Organization
24	Bestvater, Bryan	Plug Power
25	Blair, Larry	Consultant, U.S. Department of Energy
26	Blanchet, Scott	Nuvera Fuel Cells
27	Bordeaux, Christopher	Bordeaux International Energy Consulting, LLC
28	Borup, Rod	Los Alamos National Laboratory
29	Bowman, Robert	Oak Ridge National Laboratory
30	Brosha, Eric	Los Alamos National Laboratory
31	Burrell, Tony	Los Alamos National Laboratory
32	Busby, F. Colin	W.L. Gore & Associates
33	Button, Jackie	California Fuel Cell Partnership
34	Cai, Mei	General Motors, Research & Development Center
35	Campbell, Stephen	Automotive Fuel Cell Cooperation
36	Carlstrom, Chuck	MTI MicroFuel Cells
37	Carter, John	Argonne National Laboratory
38	Cerveny, John	TechCity Properties
39	Choudhury, Biswajit	DuPont Fuel Cells
40	Christensen, John	Consultant, U.S. Department of Energy/National Renewable Energy Laboratory
41	Cole, Brian	U.S. Army, Research Development and Engineering Command Communications–Electronics Research Development and Engineering Center
42	Collins, William	UTC Power
43	Conti, Amedeo	Nuvera Fuel Cells
44	Cooper, Alan	Air Products and Chemicals, Inc.
45	Cox, Phil	University of North Florida
46	David, Bill	Rutherford Appleton Laboratory
47	De Castro, Emory	BASF Fuel Cell, Inc.
48	Debe, Mark	3M
49	Dillon, Anne	National Renewable Energy Laboratory
50	Dinh, Huyen	National Renewable Energy Laboratory
51	Dixon, David	The University of Alabama
52	Dross, Robert	Nuvera Fuel Cells
53	Edlund, Dave	Element 1, LLC
54	Eisman, Glenn	Rensselaer Polytechnic Institute
55	Elrick, William	California Fuel Cell Partnership
56	Erdle, Erich	Erdle Fuel Cell & Energy Consulting
57	Ewan, Mitch	University of Hawaii, Manoa
58	Fan, Chinbay	Gas Technology Institute
59	Fassbender, Linda	Air Products and Chemicals, Inc.
60	Fenske, George	Argonne National Laboratory
61	Fletcher, James	University of North Florida
62	Fox, Michelle	SRA International
63	Gangi, Jennifer	Fuel Cells 2000
64	Garzon, Fernando	Los Alamos National Laboratory
65	Gervasio, Don	University of Arizona
66	Gittleman, Craig	General Motors, Research & Development Center
67	Glass, Robert	Lawrence Livermore National Laboratory
68	Grassilli, Leo	Consultant, Office of Naval Research
69	Gross, Karl	H2 Technology Consulting, LLC
70	Gross, Thomas	Energy Planning and Solutions
71	Gupta, Nikunj	Shell Hydrogen, LLC
72	Hamilton, Jennifer	California Fuel Cell Partnership
73	Hamrock, Steven	3M

No.	Name	Organization
74	Hardis, Jonathan	National Institute of Standards and Technology
75	Hennessey, Barbara	U.S. Department of Transportation
76	Herbert, Thorsten	NOW GmbH
77	Herring, Andy	Colorado School of Mines
78	Hershkowitz, Frank	ExxonMobil, Research & Engineering Company
79	Hirano, Shinichi	Ford Motor Company
80	Hoberecht, Mark	National Aeronautics and Space Administration
81	Holladay, Jamie	Pacific Northwest National Laboratory
82	Hua, Thanh	Argonne National Laboratory
83	Imam, Ashraf	Naval Research Laboratory
84	Inman, Matthew	U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy
85	Jacobson, David	National Institute of Standards and Technology
86	James, Brian	Directed Technologies, Inc.
87	Jarvi, Tom	Sun Catalytix Corp
88	Jensen, Craig	University of Hawaii, Honolulu
89	Johnston, Christina	Los Alamos National Laboratory
90	Jorgensen, Scott	General Motors, Research & Development Center
91	Josefik, Nick	U.S. Army Corps of Engineers
92	Kabza, Alexander	Zentrum für Sonnenenergie- und Wasserstoff-Forschung Baden-Württemberg
93	Keller, Jay	Sandia National Laboratories
94	Kerr, John	Lawrence Berkeley National Laboratory
95	King, Dave	Pacific Northwest National Laboratory
96	Knights, Shanna	Ballard Power Systems
97	Kopasz, John	Argonne National Laboratory
98	Kosourov, Sergey	Russian Academy of Sciences, Institute for Basic Biological Problems
99	Krumholz, Lee R	University of Oklahoma
100	Kumar, Romesh	Argonne National Laboratory
101	Kunze, Klaas	BMW CleanEnergy Fuel Systems
102	Kurtz, Jennifer	National Renewable Energy Laboratory
103	Laffen, Melissa	Alliance Technical Services
104	Lear, William	University of Florida
105	Lewis, Michele	Argonne National Laboratory
106	Linkous, Clovis	University of Central Florida
107	Lipp, Ludwig	FuelCell Energy, Inc.
108	Litt, Morton	Case Western Reserve University
109	Maes, Miguel	National Aeronautics and Space Administration
110	Markovic, Nenad	Argonne National Laboratory
111	Maroni, Victor	Argonne National Laboratory
112	McLean, Gail	U.S. Department of Energy, Office of Science
113	McWhorter, Scott	U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy
114	Melis, Tasios	University of California, Berkeley
115	Mergel, Jurgen	Forschungszentrum Jülich GmbH
116	Merritt, James	U.S. Department of Transportation
117	Mets, Laurens	University of Chicago
118	Meyers, Jeremy	University of Texas, Austin
119	Miller, James	Argonne National Laboratory
120	Miller, Robert N.	Leonardo Technologies, Inc.
121	Minh, Nguyen	General Electric Global Research Center
122	Mitrokhin, Sergey	Moscow State University, Chemistry Department

No.	Name	Organization
123	Mittelsteadt, Cortney	Giner Electrochemical Systems, LLC
124	Mohtadi, Rana	Toyota Motor Engineering and Manufacturing North America
125	Moreland, Gregory	SRA International
126	Morello, Joanne	U.S. Department of Energy, Biomass Program
127	Morgan, Jason	Ballard Material Products
128	Mountz, David	Arkema Inc.
129	Mukerjee, Sanjeev	Northeastern University
130	Mukundan, Rangachary	Los Alamos National Laboratory
131	Myers, Deborah	Argonne National Laboratory
132	Neumann, Dan	National Institute of Standards and Technology
133	Nicholas, Mike	University of California, Davis
134	Nowak, Bob	Consultant
135	Ohi, James	Consultant
136	O'Leary, Kelly	General Motors, Research & Development Center
137	Olson, Gregory	Consultant
138	Ott, Kevin	Los Alamos National Laboratory
139	Owejan, Jon	General Motors, Research & Development Center
140	Ozkan, Umit	Ohio State University
141	Padro, Catherine	Los Alamos National Laboratory
142	Parks, George	FuelScience LLC
143	Paster, Mark	Consultant
144	Patel, Pinakin	FuelCell Energy, Inc.
145	Pecharsky, Vitalij	Iowa State University
146	Penev, Michael	National Renewable Energy Laboratory
147	Perret, Robert	Nevada Technical Services, LLC
148	Perry, Mike	United Technologies Research Center
149	Petrovic, John	Petrovic and Associates
150	Pez, Guido	Air Products and Chemicals, Inc. (retired)
151	Phillippi, Harold	ExxonMobil, Research & Engineering Company
152	Pintauro, Peter	Vanderbilt University
153	Pivovar, Bryan	National Renewable Energy Laboratory
154	Podolski, Walt	Argonne National Laboratory
155	Ramani, Vijay	Illinois Institute of Technology
156	Rambach, Glenn	Third Orbit Power Systems, Inc.
157	Richards, Mark	Versa Power Systems
158	Ricker, Richard	National Institute of Standards and Technology
159	Rinebold, Joel	Connecticut Center for Advanced Technology, Inc.
160	Rinker, Mike	Pacific Northwest National Laboratory
161	Roan, Vernon	University of Florida
162	Rohr, Donald	Plug Power
163	Rossmeissl, Neil	U.S. Department of Energy, Biomass Program
164	Rufael, Tecle	Chevron
165	Ruth, Mark	National Renewable Energy Laboratory
166	Sandrock, Gary	Sandia National Laboratories
167	Schlasner, Steven	University of North Dakota, Energy and Environmental Research Center
168	Schneider, Jesse	BMW
169	Schoenung, Susan	Longitude 122 LLC
170	Serfass, Patrick	Technology Transition Corporation
171	Shaw, Leon	University of Connecticut
172	Siegel, Don	University of Michigan, Ann Arbor
173	Sievers, Robert	Teledyne Energy Systems

No.	Name	Organization
174	Simnick, James	BP America
175	Simpson, Lin	National Renewable Energy Laboratory
176	Slattery, Darlene	University of Central Florida/Florida Solar Energy Center
177	Spendelow, Jacob	Los Alamos National Laboratory
178	Stack, Bob	U.S. Department of Energy, Office of Science
179	Stanic, Vesna	EnerFuel
180	Startek, Cara	Ballard Power Systems
181	Steele, Mike	Consultant
182	Steen, Marc	European Commission, Joint Research Centre
183	Stevenson, Jeff	Pacific Northwest National Laboratory
184	Stolten, Detlef	Forschungszentrum Jülich GmbH
185	Sudik, Andrea	Ford Motor Company
186	Sutton, Robert	Argonne National Laboratory
187	Swider Lyons, Karen	U.S. Navy, Naval Research Laboratory
188	Tamhankar, Satish	Linde LLC
189	Thomas, C.E. (Sandy)	Consultant
190	Tran, Thanh	U.S. Navy, Naval Service Warfare Center, Carderock Division
191	Trocciola, John	SRA International
192	Vanderborgh, Nicholas	Los Alamos National Laboratory (retired)
193	Veenstra, Mike	Ford Motor Company
194	Vernstrom, George	3M
195	Voecks, Gerald	California Institute of Technology
196	Vora, Shailesh	National Energy Technology Laboratory
197	Wagner, Fred T.	General Motors
198	Waldecker, James	Ford Motor Company
199	Wang, Heli	National Renewable Energy Laboratory
200	Watkins, Matt	ExxonMobil
201	Weber, Adam	Lawrence Berkeley National Laboratory
202	Weeks, Brian	Gas Technology Institute
203	Wheeler, Douglas	DJW TECHNOLOGY, LLC
204	White, Chris	University of New Hampshire
205	Wichert, Robert	Fuel Cell Council
206	Williams, Mark	National Energy Technology Laboratory
207	Wipke, Keith	National Renewable Energy Laboratory
208	Yuzugullu, Elvin	SRA International.
209	Zawodzinski, Thomas	University of Tennessee, Knoxville
210	Zheng, Jinyang	Zhejiang University
211	Zhu, Yimin	Nanosys, Inc.
212	Ziegler, Richard	SRA International

Summary of Peer Review Panel's Crosscutting Comments and Recommendations

AMR panel members provided comments and recommendations regarding selected DOE hydrogen and fuel cell projects, overall management of the DOE Hydrogen and Fuel Cells Program, and the AMR peer evaluation process. The project comments, recommendations, and scores are provided in the following sections of this report, grouped by sub-program area. Comments on sub-program management are provided in Appendix B.

Analysis Methodology

A total of **216** projects were reviewed at the meeting. As shown in Table 1, **212** panel members participated in the AMR process, providing a total of **1,239** project evaluations (not every panel member reviewed every project).

These reviewers were asked to provide numeric scores (on a scale of 1–4, with 4 being the highest) for five aspects of the work presented. Sample evaluation forms are provided in Appendix C. Scores and comments were submitted using laptops (provided on-site) to an online, private database allowing for real-time tracking of the review process. A list of projects that were presented at the AMR but not reviewed is provided in Appendix D.

Scores were based on the following five criteria and weights (for all projects except American Recovery and Reinvestment Act [ARRA] projects, which used separate criteria):

Score 1: Relevance to overall DOE objectives (20%)
Score 2: Approach to performing the work (20%)
Score 3: Technical accomplishments and progress toward project and DOE goals (40%)
Score 4: Collaboration and coordination with other institutions (10%)
Score 5: Proposed future work (10%)

For each project, an average score was calculated from the weighted scores of individual reviewers for each of the five aforementioned criteria. These average scores were then weighted and combined to produce a final overall score for each project. In this manner, a project's final overall score can be meaningfully compared to that of another project. The following formula was used to calculate the weighted, overall score:

Final Overall Score = [Score 1 x 0.20] + [Score 2 x 0.20] + [Score 3 x 0.40] + [Score 4 x 0.10] + [Score 5 x 0.10]

A perfect overall score of "4" indicates that a project satisfied the five criteria to the fullest possible extent; the lowest possible overall score of "1" indicates that a project did not satisfactorily meet any of the requirements of the five criteria.

Reviewers were also asked to provide qualitative comments regarding the five criteria, specific strengths and weaknesses of the project, and any recommendations relating to the work scope. These scores and comments were entered into a database for easy retrieval and analysis.

Reviewers of ARRA projects used the following criteria:

Score 1: Relevance (20%)
Score 2: Development/Deployment Approach (30%)
Score 3: Technical Accomplishments and Progress (40%)
Score 4: Collaborations (10%)

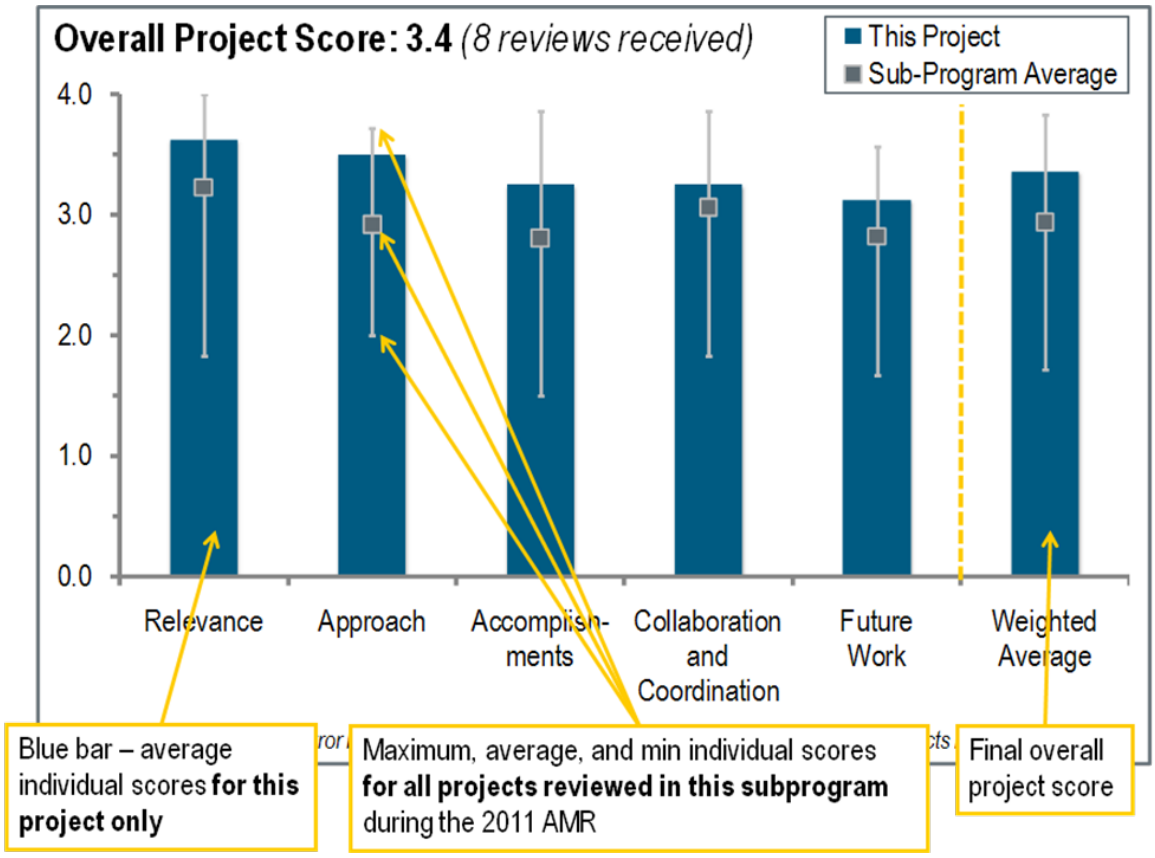
Reviewers were also asked to provide summary comments regarding ARRA project strengths and weaknesses and specific recommendations.

Organization of the Report

The project comments and scores are grouped by sub-program (Hydrogen Production and Delivery; Hydrogen Storage; Fuel Cells; Manufacturing Research and Development [R&D]; Technology Validation; Safety, Codes and Standards; Education; Systems Analysis; and ARRA activities) in order to align with the DOE Hydrogen and Fuel Cells Program planning scheme. Each of these sections begins with a brief description of the general type of R&D or other activity being conducted. Next are the results of the reviews of each project presented at the 2011 AMR. The report also includes a summary of the qualitative comments for each project, as well as a graph showing the overall project score and a comparison of how each project aligns with all of the other projects in its sub-program area. A sample graph is provided in Figure 1.

Projects are compared based on a universal set of criteria. Each project has a chart with bars representing that project's average scores for each of the five designated criteria. The gray line bars that overlay the blue bars represent the corresponding maximum, average, and minimum scores for all of the projects in the same sub-program.

Figure 1: Project Score Graph with Explanation



For clarification, consider a hypothetical review in which only five projects were presented and reviewed in a sub-program. Table 2 displays the average scores for each project according to the five rated criteria.

Table 2: Sample Project Scores

	Relevance (20%)	Approach (20%)	Accomplish-ments (40%)	Collaboration and Coordination (10%)	Future Work (10%)
Project A	3.4	3.3	3.3	3.2	3.1
Project B	3.1	2.8	2.7	2.7	2.9
Project C	3.0	2.6	2.7	2.8	2.9
Project D	3.4	3.5	3.4	3.2	3.3
Project E	3.6	3.7	3.5	3.4	3.4
Max	3.6	3.7	3.5	3.4	3.4
Average	3.3	3.2	3.1	3.0	3.1
Min	3.0	2.6	2.7	2.7	2.9

Using this data, the chart for Project A would contain five bars representing the values listed in Table 2. A gray line bar indicating the related maximum, minimum, and average values for all of the projects in Project A's sub-program area would overlay each corresponding bar to facilitate comparison. In addition, each project's criteria scores would be weighted and combined to produce a final, overall project score that would permit meaningful comparisons to other projects. Below is a sample calculation for the Project A weighted score.

Final Score for Project A = [3.4 x 0.20] + [3.3 x 0.20] + [3.3 x 0.40] + [3.2 x 0.10] + [3.1 x 0.10] = 3.3

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