

**HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE**

**MEETING MINUTES**

**February 23, 2010**

**Radisson Reagan National, Arlington, VA**

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**February 23, 2010**

[Note: This meeting was originally scheduled for February 10 – 11, 2010, but was postponed because of snow storms in the Washington, DC area.]

**1. Call to Order, Agenda Review, Comments on Minutes, Subcommittee Reports and Public Comment Period**

Chairman Walker called the February 23<sup>rd</sup> meeting of the Hydrogen and Fuel Cell Technical Advisory Committee (HTAC or Committee) to order at 8:33 a.m. and briefly reviewed the agenda for the day. Chairman Walker asked members for comments on the minutes from the previous meeting. Hearing none, Chairman Walker moved to accept the minutes as written. The motion was seconded by Mr. Frank Novachek, and unanimously accepted by the Committee.

Vice-Chairman Robert Shaw mentioned that he will be working with DOE Designated Federal Officer, Michael Mills, on standardizing a process for welcoming new HTAC members and formally recognizing departing or renewing members. Dr. Shaw noted that the terms of a number of HTAC members will be expiring this summer, so a process should be in place by the June HTAC meeting.

## 1.1 Subcommittee Reports

There were no subcommittee reports at the time.

## 1.2 Public Comments

Chairman Walker opened up the floor for public comments. There were no public comments at the time.

## 2. Government Program Presentations

Mr. Richard Farmer, DOE-EERE; Dr. John Vetrano, DOE-BES; Dr. Richard Carlin, DOD

### 2.1 Mr. Richard Farmer, U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy (EERE), Fuel Cell Technologies Program (FCT) Program Update

>> see full presentation at [http://www.hydrogen.energy.gov/htac\\_meeting\\_feb23.html](http://www.hydrogen.energy.gov/htac_meeting_feb23.html)

Chairman Walker introduced Mr. Rick Farmer, Acting Program Manager of EERE's Fuel Cell Technologies Program (FCT), to give an update on the program.

Mr. Farmer's presentation focused primarily on the FY11 budget request for the FCT Program, which was recently made public. He also gave an update on the program's activities and progress since the last HTAC meeting. His remarks included the following:

- An update of the FCT organizational chart, including vacancies and current staff assignments;
- A discussion of the FY11 R&D budget request, which creates new subprograms for Fuel Cell Systems R&D, Hydrogen Fuel R&D, and Market Transformation, consolidates previous subprograms under these three main activities, and defers funding for education and early market fuel cells;
- A comparison of all EERE program budgets from FY08 through FY11;
- Key R&D challenges, planned activities, and progress for each of the program's subprograms;
- Upcoming workshops and events relevant to hydrogen and fuel cell technologies;
- Key program documents, including the Fuel Cell Program Plan, Annual Merit Review Proceedings, Annual Merit Review & Peer Evaluation Report, and the Annual Progress Report.

### *Questions, Answers, and Discussion*

- Mr. David Friedman asked Mr. Farmer about the current vacancies in the FCT program and the general timeline for getting those positions filled. Mr. Farmer said that one position in the fuel cell subprogram, one in systems analysis and another in market transformation, should be filled relatively soon. The energy technology specialist, administrative assistant, production and delivery positions are also open, and applications are being received. Dr. Kathy Taylor asked about the status of the Program Manager position. Mr. Farmer said that filling the position has been delayed, pending the official transfer of the previous Program Manager, Dr. JoAnn Milliken, out of the Program Manager job slot and into a new position as Senior Advisor to the EERE Principal Deputy Assistant Secretary. Once the Executive Board approves the new position for Dr. Milliken, the FCT Program Manager slot will open up.

- Dr. Shaw asked whether the FCT program organizational chart will have to be restructured to reflect the changes in the budget structure. Mr. Farmer said that the program's organizational structure will be altered over the next few months to align the team leads with the new budget headings for Fuel Cell Systems R&D, Hydrogen Fuel R&D, and Market Transformation.
- Chairman Walker commented that the funding levels in the FY11 budget request appear too low to successfully jumpstart a strong domestic fuel cell industry. He is particularly concerned that DOE has not directed funding into the Education line item, since resources are needed to communicate the benefits of hydrogen and fuel cells to consumers. Mr. Farmer noted that many of the education needs can be handled within the Safety, Codes and Standards portion of the Market Transformation line item.
- Dr. Kathy Taylor asked how the funds in the FY11 request will be split between continuing and new projects, for both Fuel Cell Systems R&D and Hydrogen Fuel R&D. Mr. Farmer said that for Hydrogen Fuel R&D, the request is primarily for existing projects, depending on project progress and go/no-go decisions. For Fuel Cell Systems, some new fuel cell project starts are planned in 2011, but he did not know the funding amount offhand.
- Dr. Joan Ogden asked whether the items that were moved to the Office of Vehicle Technologies in FY09 (Education, Technology Validation, and Safety, Codes and Standards), will stay in the Fuel Cell Technology Program. Mr. Farmer said they are in the FCT program.
- Mr. Friedman asked whether the funding cut in the FY11 request reflects fiscal constraints, a strategic decision to cut the budget based on good progress, or some other reason. He noted that the National Academies of Science report suggested that funding levels need to be increased, not decreased, in order to accelerate the technology. Mr. Farmer responded that the program has made very good progress, and the funding levels will allow the program to continue making progress and to maintain the currently funded projects. Chairman Walker noted that whereas the FCT Program took a 15% budget cut in FY11, the funding for all other EERE programs increased, which implies an expression of program priorities. Mr. Farmer reiterated that the funding levels will allow the program to continue moving forward and making progress on R&D, and noted that the final budget will come from Congress, which may alter the amount requested by DOE. Vice-Chair Shaw suggested that HTAC raise these concerns in the cover letter that will accompany the 2009 HTAC Annual Report. Dr. Ken Schultz suggested that the budget request could be viewed as recognition of the program's successes, and that the federal government is decreasing funding because industry is ready to play a larger role. Mr. Farmer said that the program is not winding down, and that the decrease in the budget request is not an expression that DOE is planning to end hydrogen and fuel cell R&D.
- Dr. Joan Ogden asked Mr. Farmer whether the program has decided how to break down the funding under the three broad line items (for example, how will the funding in Fuel Cell Systems R&D be apportioned among Fuel Cell Stack Component R&D, Transportation Systems R&D, Distributed Energy Systems R&D, and Fuel Processor R&D?). Mr. Farmer said that no final decisions have been made, but the funding break down will probably be similar to current levels.
- Dr. Shaw asked which EERE department is responsible for research related to hydrogen production and renewable energy grid integration. Mr. Farmer responded that the program recognizes the importance of the issue, which is cross-cutting and relates to hydrogen production, delivery, storage, fuel cells, and systems analysis. He noted that NREL is doing some work in this area, which Darlene Steward will be reporting on later in today's HTAC meeting. Dr. John Vetrano added that the responsibility for grid reliability and stability lies with DOE's Office of Electricity Delivery and Reliability (OE), though he did not think that OE is currently funding hydrogen storage projects.

- Mr. Friedman asked whether the DOE is considering a reevaluation of the hydrogen cost targets. Mr. Farmer responded that the program is reexamining the targets to reflect the most recent estimates of energy prices and the inclusion of plug-in hybrid electric vehicles (PHEVs) along with hybrid electric vehicles (HEVs) as the competing vehicles for fuel cell vehicles (FCVs), rather than just internal combustion engines (ICEs). Dr. Ogden asked whether the cost targets take into account the higher efficiency of FCVs over ICEs. Mr. Farmer said the targets do account for the higher efficiency, which allows hydrogen to cost about double that of gasoline and still give drivers roughly equivalent fuel costs per mile driven.
- Dr. Shaw asked whether the materials presented at the IPHE Infrastructure Workshop in Sacramento (February 25-26, 2010) could be made available to HTAC members. Mr. Farmer said that they would be. [The workshop proceedings are available at <http://www.iphe.net/workshops.html> .]
- Dr. Shaw noted that the next HTAC meeting, which will be held June 3-4, is the week before the Fuel Cell Technology Program's Annual Merit Review (AMR), so members can stay for the weekend if they want to attend the AMR, which begins on Monday, June 7.
- Mr. Bob Rose asked Mr. Farmer whether the Storage R&D work is completed, since the Centers of Excellence will be closing. Mr. Farmer explained that the Centers are closing, but many of the individual projects will continue.

## **2.2 Dr. John Vetrano, DOE Office of Science, Office of Basic Energy Science (BES) Program Update**

>> see full presentation at [http://www.hydrogen.energy.gov/htac\\_meeting\\_feb23.html](http://www.hydrogen.energy.gov/htac_meeting_feb23.html)

Dr. John Vetrano gave HTAC an overview of the Office of Basic Energy Science (BES), the organization's structure, its hydrogen-related efforts, and how the BES program fits within and complements the hydrogen and fuel cell work at EERE and the DOE Offices of Fossil and Nuclear Energy. His remarks included the following:

- A description of the BES organizational chart relative to the other DOE programs;
- An explanation of the BES-funded hydrogen and fuel cell work and coordination with the other DOE technology programs;
- BES hydrogen budget, which includes approximately \$38.7 million in FY2010 funding for:
  - Storage
  - Membranes
  - Nano-scale catalysts
  - Solar hydrogen production
  - Bio-inspired hydrogen production
- Background on the 46 Energy Frontier Research Centers (EFRCs), which pursue collaborative research to address energy and scientific challenges in a variety of areas, including hydrogen; and
- An overview of the new Fuels from Sunlight Hub, which will award \$22 million for the development of an effective solar energy to chemical fuel conversion system (<http://www.hubs.energy.gov>).

### ***Questions, Answers, and Discussion***

- Chairman Walker asked whether BES would be working on materials science that affects fuel cell membranes, and where work like that would fit on the BES organizational chart. Dr. Vetrano explained that it could fall under a number of different teams, including Scattering & Instrumentation, Separations & Analysis, or Material Science, depending on the specific details of the project.
- Dr. Shaw asked whether all the BES funding is distributed to universities and national labs, or whether any goes to industry. Dr. Vetrano said that currently all the BES funding for hydrogen and fuel cells-related work goes to universities and labs, but that has not always been the case. Dr. Shaw then asked how promising technologies that are funded by BES are picked up by industry when they become feasible or near-feasible for commercialization. Dr. Vetrano responded that one way for BES technologies to reach the commercial market is by moving from a basic science project in BES to an applied science project in EERE or the Small Business Innovative Research Program, and then initiating a new company to produce that technology, like what happened with A123 Systems, which is now a public company.
- Chairman Walker asked Dr. Vetrano about the Fuels for Sunlight Hub, and whether the funding for that Hub is already available. Dr. Vetrano said funding for that Hub was appropriated in FY10, and applications are due by March 29. Decisions will be made later in the year. Another Hub, for batteries and electrical energy storage, is being proposed in the FY11 budget.

### **2.3 Dr. Richard Carlin, U.S. Department of Defense (DOD), Office of Naval Research, DOD R&D Deployment Update**

>> see full presentation at [http://www.hydrogen.energy.gov/htac\\_meeting\\_feb23.html](http://www.hydrogen.energy.gov/htac_meeting_feb23.html)

Dr. Rich Carlin briefed HTAC on the Department of Defense's hydrogen-related goals, energy targets, hydrogen and fuel cell R&D, hydrogen roadmap, and fuel cell deployments. His remarks included the following:

- An overview of DOD goals, which include being an early adopter and demonstrator of new energy technologies that improve energy security and improve the efficiency of supply chains;
- A breakdown of DOD energy consumption and associated costs to the agency;
- Description of the energy security drivers for the procurement of fuel cells and hydrogen;
- The Navy's energy goals, which include generating 50% of the Navy's energy from alternative fuels by 2020;
- A brief description of the DOD R&D related to hydrogen and fuel cells;
- An outline of the coordinated fuel cell deployments between DOD, DOE, and DLA; and
- Further details on specific DOD fuel cell projects, including both stationary and transportation applications.

### ***Questions, Answers, and Discussion***

- Dr. Shaw asked Dr. Carlin whether the hydrogen-funded research included in the DOD budget consists of Congressional earmarks. Dr. Carlin answered that some of the funding is from earmarks, because certain projects can be tied to particular Congress members, but not all of them are earmarks.

- Dr. Carlin noted that he only has authority to show the budget numbers for the Navy R&D; if HTAC wants to see further funding detail for DOD hydrogen and fuel cell projects, he suggested that DOE request that data from OMB. There is an OMB budget table that compiles all the DOD energy funding, but to release it would require concurrence from all the services. Chairman Walker asked Ms. Kathi Epping-Martin if she could make that request for the Committee. Chairman Walker asked Dr. Carlin whether there is more DOD money allocated to hydrogen and fuel cells R&D than the \$53 million listed in the presentation. Dr. Carlin said there is more money for energy R&D than is listed in his presentation, but not necessarily for hydrogen and fuel cells.
- Mr. Friedman commented that there are areas of significant overlap between the work EERE, BES, and DOD are doing on hydrogen and fuel cells, and asked whether the three agencies share information with one another. Dr. Carlin said that the agencies participate in an Interagency Working Group (IWG) that meets regularly and works to coordinate activities. Also, the Program Managers meet to discuss their respective programs and ensure effective cooperation and efficient division of responsibilities. DOE also participated in the DOD's hydrogen roadmapping efforts.
- Dr. Shaw asked whether the data gathered from DOD's energy projects—on performance, results, challenges, etc.—is used by or shared with the public or industry. Dr. Carlin said he did not know for sure, but some of the projects are disseminating information through their websites and their respective working groups. They may issue reports as well. Though he did not know whether anyone was considering this, it may be helpful for each project to provide publicly available data on their websites, and he offered to bring this idea to the attention of the Defense Logistics Agency (DLA).
- Mr. Rose asked Dr. Carlin to explain the prospects for the bio-derived hydrogen fuel project at DOD. Dr. Carlin did not have many details on that particular project, but said that DOD is especially considering bio-derived hydrogen as a way to reduce the amount of waste generated, even though it cannot produce large amounts of fuel compared to other production methods.
- Dr. Shaw asked for the DOD perspective on transitioning hydrogen to eventually replace all fuels. Dr. Carlin responded that substantial challenges remain for hydrogen to replace fuel for jets and ships, so DOD's current strategy is to start by transitioning smaller devices, like Unmanned Aerial Vehicles (UAVs) and other specialty applications.
- Dr. Shaw asked for an update on the status of the hydrogen storage integration project in Hawaii, which is being planned jointly with DOE. Dr. Carlin said that the project has been in planning stages for the last two years, and the grant was awarded in November 2009. The first buildings will be constructed this year. The total cost for the project, excluding the military aspects of the project, is about \$16-18 million for 2010 and about \$17 million for 2011. Dr. Shaw asked Dr. Carlin if he could estimate what a project like this would cost in a commercial setting. Dr. Carlin responded that most of the technologies for this project are pre-commercial, so the cost will certainly decrease over time.
- Dr. Shaw recommended to Chairman Walker that HTAC invite Dr. Carlin to speak to HTAC at later meetings to discuss the DOD projects as they continue to make progress. Dr. Shaw thanked Dr. Carlin for speaking to the Committee and noted the importance of the work DOD is doing to help deploy fuel cell technologies, especially given the national security implications of energy and the need to develop new domestic sources of fuel. Dr. Carlin agreed and noted that, as the DOD projects make more progress and come online, the agency will work to make information about the progress publicly available.
- Mr. Friedman suggested that Dr. Carlin review the HTAC Annual Report to ensure that the work DOD is doing is appropriately characterized in the report.

### 3. National Academy of Sciences PHEV Study Overview

Mr. Michael Ramage

>> *see full presentation at [http://www.hydrogen.energy.gov/htac\\_meeting\\_feb23.html](http://www.hydrogen.energy.gov/htac_meeting_feb23.html)*

The National Academy of Sciences/National Research Council PHEV study [Transitions to Alternative Transportation Technologies -- Plug-in Hybrid Electric Vehicles] expands on the Academy's 2008 report analyzing the costs, GHG emissions, and petroleum reduction impacts of fuel cell vehicles compared to biofuels and highly efficient ICEs. The 2009 update also compares FCVs to PHEVs, and examines scenarios for PHEV introduction into the market. The report's major conclusions include:

- Though battery technology has improved, it remains high-cost, and the potential for dramatic cost reductions is limited;
- PHEV-40s are unlikely to achieve cost-effectiveness before 2040 but PHEV-10s may be cost-effective by 2030;
- A plausible rate of market introduction for PHEVs is 13 million by 2030;
- PHEVs show little potential for significant reductions in oil use or CO<sub>2</sub> emissions by 2030; No major problems are likely to be encountered for several decades in supplying the power to charge PHEVs, as long as most of the vehicles are charged at night, during off-peak hours;
- A portfolio approach to vehicle RD&D and market transition support is essential.

#### *Questions, Answers, and Discussion*

- Chairman Walker commented on the estimated \$11,000 cost estimate for PHEV-40 battery pack cost in 2030, and asked Mr. Ramage whether that compares to an assumed \$6,100 fuel cell cost using today's technology. Mr. Ramage cautioned against making that comparison, and suggested that the more important comparison for FCVs is the cost needed to make FCVs competitive with ICEs.
- Mr. Rose asked whether the cost estimates assume the technology is produced at scale, like the \$61/kW cost estimate for fuel cells. Mr. Ramage said the future costs are at scale, but the current costs are not. However, the study does not assume a large cost reduction due to scale-up, because battery manufacturing is relatively mature.
- Mr. Rose asked at what year GHG emissions and fuel savings begin to level off in the NAS study scenario. Mr. Ramage responded that they flatten out when the vehicle fleet achieves a 100% turnover to PHEVs and FCVs.
- Mr. Rose asked whether the costs for FCVs and PHEVs are comparable in the scenario when all DOE goals are assumed to be met. Dr. Ogden said the costs are roughly comparable, but noted that the infrastructure cost for FCVs are higher than for PHEVs. However, even with the infrastructure costs included, FCVs and PHEVs are still comparable. Mr. Ramage added that, in the NAS committee's view, the vehicle technologies for both FCVs and PHEVs are approximately the same distance from meeting DOE goals and both still require substantial technological improvements and advancements.

#### 4. University of California Davis Electric Vehicle Study Overview

Dr. Ryan McCarthy, UC Davis, Institute for Transportation Studies

Dr. McCarthy presented the results of a UC Davis study, which analyzed and projected the impact of vehicle electrification on the grid and the carbon intensity of various transportation technologies. The study focused specifically on the California grid, which is less carbon-intensive than the overall U.S. average. The marginal emissions, however, are higher than the average emissions rate, and electric vehicles would probably receive power “on the margin,” which means that the electricity for vehicles is dirtier than average in California. Important findings include:

- Using the California grid mix, PHEVs are slightly less carbon-intensive than HEVs.
- Battery electric vehicles (BEVs) reduce emissions more significantly than PHEVs.
- Hydrogen fuel cell vehicles reduce emissions more than any other transportation option, unless the hydrogen is produced using grid electrolysis.
- Marginal emissions are highest from 5:00 to 8:00 pm, so those hours would be the worst to recharge a vehicle, from a carbon intensity perspective.
- The best time to recharge a vehicle is from 2:00 to 4:00 am.

>> see full presentation at [http://www.hydrogen.energy.gov/htac\\_meeting\\_feb23.html](http://www.hydrogen.energy.gov/htac_meeting_feb23.html)

#### *Questions, Answers, and Discussion*

- Dr. Shaw asked Dr. McCarthy for the assumed efficiency of the electrolyzer included in the model. Dr. McCarthy said he could not remember the efficiency offhand, but it is the same assumption included in DOE’s H2A model. Dr. Ogden said she thinks the efficiency used was 75%. Dr. Shaw asked why the emissions rate for grid electrolysis is twice as high as the other pathways. Dr. McCarthy responded that grid electricity is 70-80% as carbon-intensive as gasoline. Additionally, the model assumes that most of the hydrogen is produced as needed, generally during on-peak hours, when the emissions rate is the highest. Dr. McCarthy noted that California mandates that at least 33% of hydrogen must come from renewable sources, so in reality it would not be this dirty. Dr. Ogden also reminded the Committee that natural gas reforming is the cleanest of all the options for California.
- Mr. Rose commented that the study suggests that gasoline still appears to be the best option for the next ten years. Dr. McCarthy noted that this study only looks at emissions, but all the alternative pathways have other benefits, including reducing petroleum use.
- Mr. Anthony Eggert asked Dr. McCarthy whether he has completed the analysis using a 33% renewable electricity scenario. Dr. McCarthy said he is currently working on that analysis.
- Mr. Friedman asked whether the study examined any carbon pricing scenarios, or whether the addition of a carbon price changes anything about the results. Dr. McCarthy said the carbon price changes the type of power plants that are added in the long-term.
- Dr. Shaw asked what the assumption for BEV vehicle range was. Dr. McCarthy said he did not make any explicit assumptions about vehicle range, but instead used the multiplier included in the GREET model.
- Mr. Rose asked whether the Northern California, Southern California, and the Los Angeles district regions were run separately in the model. Dr. McCarthy said they were run together, as an integrated region. The last—or marginal—power plant is often a natural gas plant in Southern California.



## 5. NREL Study Overview: Analysis of Hydrogen and Competing Technologies for Utility-Scale Energy Storage

Dr. Darlene Steward, NREL

>> see full presentation at [http://www.hydrogen.energy.gov/htac\\_meeting\\_feb23.html](http://www.hydrogen.energy.gov/htac_meeting_feb23.html)

Dr. Steward presented the results of an NREL analysis of the potential for hydrogen as a large-scale energy storage medium compared to competing technologies, including compressed air energy storage (CAES), pumped hydro, and batteries. The results of the analysis show that hydrogen would be cost-competitive with battery storage and, under certain scenarios, could be competitive with CAES and pumped hydro.

The benefits of using hydrogen as an energy storage mechanism for renewable energy sources include:

- Decreased cost associated with transmission system expansion to reach remote renewable energy resources;
- The ability to use renewable energy as baseload power; and
- Dispatchability of off-peak, excess renewable energy during peak energy hours.

Hydrogen has other advantages over competing energy storage technologies, such as:

- Higher storage energy density (170 kWh/m<sup>3</sup> versus 2.4 for CAES and .7 for pumped hydro), which allows for potential economic viability of above-ground storage; and
- Additional flexibility—hydrogen could be co-fired in a combustion turbine with natural gas;

The major disadvantage for hydrogen energy storage is cost, but additional R&D for electrolyzers and fuel cells may significantly reduce cost, making hydrogen storage even more competitive.

### *Questions, Answers, and Discussion*

- Dr. Shaw asked what caused the variation in cost for hydrogen energy storage, since the electrolyzers used in the model are large, industrial-scale systems that have well-established costs that are unlikely to vary. Dr. Steward responded that the variation is mostly due to the cost of the fuel cell itself.
- Dr. Ogden asked why the price of hydrogen via forecourt electrolysis is only \$4/kg, but central electrolysis is \$7/kg. Dr. Steward responded that the assumed size of the central plant is considerably smaller than what is assumed in the H2A model, and the scaled-down size generates a higher cost.
- Dr. Steward noted that CAES is a relatively mature technology, with a number of designs and proposals already developed, but few have actually been built, and it is not clear why. Dr. Shaw suggested that financing may be an issue, because the “presumed risk” is high and capital is hard to obtain. Dr. Steward added that CAES only makes sense with renewable energy, because of the associated storage and efficiency losses, so if utilities are trying to reduce their greenhouse gas emissions and increase efficiency, storage systems like this do not provide an emissions reduction benefit. Mr. Novachek agreed, saying it depends on the marginal CO<sub>2</sub> emissions contribution. Dr. Shaw suggested that CAES might be very attractive for a nuclear generator.
- Dr. Shaw asked Dr. Steward for the fuel cell efficiency assumption in her study. Dr. Steward said the study used three different values for fuel cell efficiency in different scenarios. The low-case used 45% efficiency and the high-case, which was based on DOE targets, used 60% efficiency.

- Dr. Ogden asked Dr. Steward to explain in more depth the configuration of the electrolyzer and the storage system. The electrolyzer is connected to the grid and to a standalone wind farm, and it can take power from either source, depending on the wind resource. During the off-peak hours, the electrolyzer, storage and fuel cell system charges up, and during the peak hours, it discharges power to the grid. Dr. Ogden asked what percentage of power comes from wind and what percentage comes from the grid. Dr. Steward responded that the study does not specify a percentage. Dr. Ogden noted that the price of electricity from wind varies greatly depending on the strength of the wind resource, and suggested that it would be interesting to do a similar study using regional data to see where this type of system could be cost effective. Mr. Novachek noted that he found that the price ranges used in the study to be reasonable. Mr. Novachek added that, in some cases, utilities have to pay for wind whether they use it or not, because of their power purchase agreements. This means that, in these instances, using the energy from wind turbines to electrolyze water and storing the resulting hydrogen for later use is much better than letting it go to waste.
- Dr. Shaw noted that Mr. Novachek had said the price of sodium sulfur batteries is too high to be competitive, but the NREL study shows that they are competitive with hydrogen. Mr. Novachek commented that Xcel Energy did an analysis after the NREL report was released and found the price of sodium sulfur batteries to be about 20% higher using current estimates.
- Dr. Shaw suggested that Dr. Steward do a similar analysis using a large photovoltaic (PV) system in the Southwestern U.S., and make an estimate of what the cost of the PV plant has to be to make the system dispatchable. Dr. Steward noted that others at NREL have looked at this question for wind and solar thermal, and said it would be an interesting analysis with PV.

## **6. HTAC Report on the State of the Hydrogen and Fuel Cell Industry - 2009**

Mr. Frank Novachek, Xcel Energy

- Mr. Frank Novachek opened the discussion of the 2009 HTAC Annual Report by outlining the process used to develop the draft report. In November 2009, HTAC members were asked to provide inputs to the report, including any events that were significant for the hydrogen and fuel cell industry in 2009. That input was used to draft the report, and at the beginning of January 2010, the draft was submitted to the HTAC Policy and Planning Committee (PPC) for review. The PPC's comments were incorporated, and the draft was sent to the entire HTAC for review. HTAC members submitted further comments and additions, and the version presented today represents the final draft, ready to be approved pending further comments.
- Mr. Novachek noted that Byron McCormick reviewed the report, and Dr. McCormick suggested that more emphasis be placed on the potential for hydrogen energy storage to help manage the grid. He asked HTAC members whether the report should incorporate this suggestion. Dr. Shaw commented that the report already mentions the Hawaii Air Force demonstration project, as well as the NREL report on hydrogen energy storage, which adequately addresses the issue. Mr. Novachek agreed, but added that this is becoming a significant issue in Europe, where integration of renewable energy is becoming difficult without an energy storage option. However, there have not been any large demonstration projects, and the HTAC report covers only events that happened in 2009.
- Dr. Kathy Taylor commented that the section about the Storage Centers of Excellence should be changed to reflect that the materials Centers of Excellence are closing in 2010 and will be replaced by the Engineering Center of Excellence, which will build on the work completed at the materials Centers.

- Mr. Novachek said that Mr. McCormick had one additional comment, which was that the report should mention that 2009 was the year the rest of the world committed to developing fuel cell vehicles, with the exception of the United States. Mr. Novachek suggested that this language only be added to the cover letter that will accompany the report, because the report is intended to include factual information only, while the cover letter will include some interpretation of the events that occurred in 2009.
- Mr. Novacheck suggested that Dr. Carlin's presentation on DOD activities be compared to the report to ensure that all relevant DOD activities were included. Dr. Shaw added that many of the activities in the DOD presentation were only announced in 2009, but will be implemented in later years, so these should not be added to the 2009 report.
- Mr. James Narva suggested that the report should recognize the safe operation of the hydrogen refueling stations in the U.S. and mention that there have been no refueling safety incidents. Mr. Novachek asked members whether they know of any safety incidents that occurred in 2009. None of the members knew of any, and Mr. Novachek said that he would follow up with DOE and add it to the report if there were no incidents.
- Dr. Shaw moved that the report be approved as amended, with the changes suggested at the meeting. He also suggested that Mr. Farmer and Dr. Sunita Satyapal review the report one last time. Mr. Friedman seconded the motion, and the Committee approved.

## 7. Discussion on Recommendations to the Secretary

>> *see full presentation at [http://www.hydrogen.energy.gov/htac\\_meeting\\_feb23.html](http://www.hydrogen.energy.gov/htac_meeting_feb23.html)*

Mr. Rose led a discussion of the potential recommendations from HTAC to Secretary Chu. Together with Mr. Jan van Dokkum, Mr. Rose drafted six potential recommendations, including:

1. That the hydrogen and fuel cell pathway facilitates the President's energy strategy by supporting a cleaner and more responsive grid, providing efficiency, reducing emissions, and by reducing our dependence on foreign oil.
2. Hydrogen and fuel cells support the President's energy initiative, but the U.S. risks losing its global leadership position in this technology if federal action continues to lag.
3. The U.S. should adopt a portfolio approach to transportation, recognizing that the future is too uncertain to predict, and the best way to ensure that the U.S. remains a technology leader is to keep all technologies moving forward.
4. The Secretary should ensure that the Interagency Task Force (ITF), with members at the Assistant Secretary-level who coordinate activities on hydrogen and fuel cells, becomes active again.
5. To ensure that hydrogen and fuel cell industry jobs remain in the United States, the federal government should play an active role.
6. The hydrogen and fuel cell industry that exists today is an emerging success story of the Department of Energy, which began with R&D work in the 1970s on technologies that are now commercial products.

### *Questions, Answers, and Discussion*

- Dr. Shaw and Mr. Rose discussed recommending that the Secretary initiate regular meetings between the Program Managers of all relevant programs, due to the interdisciplinary and cross-cutting nature

of the research. Mr. Farmer commented that the Program Managers do meet informally once a month to discuss these issues, though it is not formal. The Program Managers of all the renewable energy programs meet formally twice a year. Chairman Walker also noted that one of the recommendations should be to re-engage the ITF. Mr. Friedman suggested that all the alternative energy related Technical Advisory Committees, like HTAC, could meet to discuss their activities.

- Dr. Taylor suggested that another way to enable a portfolio approach to transportation technologies is to recommend that DOE engage in long-term planning.
- Dr. Shaw remarked that the list of recommendations drafted by Mr. Rose and Mr. van Dokkum captures all the major points, and the most significant of those points are:
  - Progress in 2009 was substantial, despite the recession.
  - The Europeans and the Japanese made aggressive announcements regarding fuel cell vehicle commercialization, and the U.S. could lose a leadership position if the government fails to take action.
  - In addition to being a vehicle technology, fuel cells and hydrogen could provide a way to enable the full integration of intermittent renewable energy into the electric grid.
  - Due to the cross-cutting nature of hydrogen and fuel cells, aggressive communication between and within agencies is needed.
- Chairman Walker agreed with Dr. Shaw's suggestions, and added that the letter should mention the strong role the United States has played in the hydrogen and fuel cell space in the last few years, and how that support has caused a great deal of progress in 2009.
- Mr. Rose commented that the letter needs to contain more concrete, actionable recommendations for the Secretary to pursue. Mr. Friedman said that a concrete study synthesizing the various technologies and creating a plan for a portfolio approach could be a strong first step. Dr. Shaw noted that, in light of the budget deficit, HTAC should be careful when prescribing actions that might substantially add to the budget.
- Vice-Chairman Shaw asked the other members for their thoughts on what type of argument will most appeal to Secretary Chu. Dr. Richmond suggested arguing that the successes and strengths of the fundamental research into hydrogen should be applied to technology development in order to move the industry along at a more rapid rate. Mr. Rose noted that, even in Basic Energy Sciences, the hydrogen budget has remained flat, while other programs have increased. Dr. Vetrano commented that the hydrogen budget in BES has increased slightly. Chairman Walker said that the perception among many in the industry is that hydrogen has been largely abandoned by the DOE. Mr. Rose agreed, and suggested recommending to Secretary Chu that he keep the door open for hydrogen-related funding and research budget increases. Dr. Ogden agreed that the letter should highlight the successes of fundamental research, but also relate those successes to real-world technology development and improvement. These technologies are being introduced commercially by international competitors, and while fundamental research is and will continue to be important, the time has come to leverage that fundamental research in technology development.
- Dr. Shaw noted that two important points made in the annual report should be reflected in the cover letter. The first point is that the venture capital community has abandoned hydrogen and fuel cell technologies, largely because government interest in hydrogen has waned. The second point is that applied research and demonstration projects are just as important as fundamental research to get a technology into the market. This point is highlighted by the successes made by the DOD.

- Dr. Taylor suggested that HTAC recommend that Secretary Chu exercise leadership by talking about and being an advocate for hydrogen. By communicating the benefits of hydrogen and fuel cells—including job creation, international competition, technological advancement, etc.—Secretary Chu can stimulate the industry. Mr. Friedman noted that the letter needs to be more specific than “exercise leadership,” and needs to give concrete recommendations for what leadership really means. Chairman Walker said a good, practical recommendation for HTAC to give Secretary Chu would be to publicly speak and advocate for hydrogen, because that would help Congress appropriate sufficient funds and would help reopen the capital markets for hydrogen and fuel cell investment. Dr. Shaw agreed, and commented that when the FreedomCAR program was established, private sector activity spiked, just because of the announcement. Mr. Friedman asked whether there are any events coming up where Secretary Chu could speak about hydrogen. He also cautioned that a speech from Secretary Chu could create a spike in investment in hydrogen, but what the industry really needs is long-term, stable policy signals to the industry.
- Dr. Ogden suggested inviting Secretary Chu to speak at an industry event, whether it’s specific to hydrogen or more broadly energy-related. Not only would that give a strong signal to industry, but it would also show Secretary Chu how dedicated the rest of the world is to introducing hydrogen and fuel cell vehicle technologies on a commercial scale in the near- to mid-term. Mr. Rose said he would look for opportunities for Secretary Chu’s involvement. Mr. Friedman suggested inviting Secretary Chu to speak at next year’s AAAS conference.
- Dr. Shaw suggested also including information about real world demonstration programs that are on the ground or have been recently announced, like the Hydrogen Highway in California or the hydrogen town concept in Japan. HTAC could recommend meeting with the Secretary to discuss the potential for the DOE to implement similar projects.
- Chairman Walker asked Mr. Rose to draft a letter to Secretary Chu for the Committee to review. The letter should convey the significant progress made in the industry and that DOE has been a big part of that progress. It should also say that continued leadership from the U.S. is needed and that the Secretary should be a leader. These comments should be accompanied with specific examples of things the Secretary and the Department could do to show leadership. The letter should end with a statement about the Annual Report, which shows the progress that was made in 2009. Mr. Rose will draft the letter by the beginning of March and send it to the entire Committee for review.

## **8. Adjourn**

Chairman Walker adjourned the HTAC meeting at 3:42 p.m., February 23, 2010.

**THIRTEENTH MEETING OF THE  
HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE (HTAC)  
PARTICIPANT LIST  
FEBRUARY 23, 2010**

***HTAC Members Present***

- Anthony Eggert (by teleconference)
- David Friedman
- Jim Narva
- Frank Novachek
- Joan Ogden
- Geraldine Richmond
- Bob Rose
- Ken Schultz (by teleconference)
- Bob Shaw
- Kathleen Taylor
- Robert Walker

***HTAC Members Not Present***

- Mark Chernoby
- Janice Hicks
- John Hofmeister
- Art Katsaros
- Maurice Kaya
- Alan Lloyd
- Philip Ross
- Jan van Dokkum

***U.S. Department of Energy Staff***

*Office of Energy Efficiency and Renewable Energy*

- Sara Dillich
- Kathi Epping Martin
- Richard Farmer
- John Garbak
- Michael Mills
- Antonio Ruiz

*Office of Fossil Energy*

- Lowell Miller

*Office of Science*

- John Vetrano

***U.S. Department of Defense Staff***

*Office of Naval Research*

- Richard Carlin

***U.S. Department of Transportation Staff  
Research and Innovative Technology Administration***

- MJ Fiocco

***Members of the Public in Attendance***

- Stephanie Byham – Sentech, Inc.
- Andrea Chew – Sentech, Inc.
- Ryan McCarthy – University of California, Davis
- Jillian McMichael – Sentech, Inc.
- Mamuna Oyoyo – Association of International Automobile Manufacturers
- Michael Ramage
- Brendan Smith – Sentech, Inc.
- Joseph Stanford – Sentech, Inc.
- Darlene Steward – National Renewable Energy Laboratory
- Brian Sullivan – National Interest Security Company

***Support Staff***

- Judi Abraham – Conference Management Associates, Inc.
- Kristin Deason – Sentech, Inc.
- Samantha Jacoby – Energetics Incorporated
- Melissa Laffen – Alliance Technical Services, Inc.
- Shawna McQueen – Energetics Incorporated
- Matthew Simon – Energetics Incorporated
- Neil Snyder – National Renewable Energy Laboratory
- Tom Timbario - Alliance Technical Services, Inc.