

HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE

MEETING MINUTES

July 15, 2009

Hartford/Windsor Marriott, Hartford, CT

AGENDA IN BRIEF/TABLE OF CONTENTS

JULY 15, 2009 1

1. Call to Order, Agenda Review, Subcommittee Reports, and Opening Comments.....1

2. DTI Fuel Cell Cost Estimate Overview: “Mass Production Cost Estimation of Automotive Fuel Cell Systems”3

3. Update on Hydrogen and Fuel Cell RD&D Program Activities of Key Foreign Governments6

4. DOE Program Update (Including Congressional Activities).....7

5. Local Hydrogen and Fuel Cell Company Updates

6. Electronic Vehicle Technology Presentations: Battery, PHEV, and Fuel Cells.....11

7. Discussion on the Appropriate Role of the Government in Hydrogen and Fuel Cell RD&D.....15

8. Correspondence with DOE Leadership.....19

9. HTAC Planning Discussion23

10. Discussion of 2010 HTAC Meeting Schedule and Other Business25

PARTICIPANT LIST 27

July 15, 2009

1. Call to Order, Agenda Review, Subcommittee Reports, and Public Comments

Chairman Walker called the July 15, 2009, meeting of the Hydrogen and Fuel Cell Technical Advisory Committee (HTAC or Committee) to order at 8:30 a.m. and briefly reviewed the agenda for the day. He noted that the past few months have been a challenging period for hydrogen in the public policy sense; the timing of this Committee meeting will allow the members to discuss what has been happening and how policy regarding hydrogen and fuel cells is being reformulated in the new administration.

Chairman Walker offered his thanks to Mr. Robert Rose, Dr. Robert Shaw, and Mr. Jan van Dokkum. In their private or professional roles, these individuals have helped Congress respond to the reduced fiscal year (FY) 2010 budget request for hydrogen and fuels cells that the administration sent forward. He observed that the efforts put forth by the hydrogen and fuel cell industry to restore the budget have had a positive influence, which shows that the industry has undergone a good deal of development over the past few years. He was encouraged to see that the industry represents a real economic presence in the country and was able to respond in a timely fashion to political pressures. Mr. Rose followed up with his thanks to several other people who contributed to the progress in Washington: Ms. Judith Bayer of United Technologies, Mr. David Friedman, and Mr. Anthony Eggert.

Congressman Walker recognized the large number of local attendees in the audience, expressing his appreciation for the vibrancy of the hydrogen and fuel cell industry in Connecticut. He noted that the HTAC members are looking forward to the opportunity to have both formal and informal dialogue with some of the people who are actively involved in the business.

1.1 Subcommittee Reports

Chairman Walker asked Dr. Shaw for a brief report on the activities of the HTAC Policy and Planning Committee (PPC) since the last HTAC meeting in February 2009. Dr. Shaw reported that the PPC held a meeting via teleconference on May 12, shortly after U.S. Department of Energy (DOE) Secretary Chu's announcement on the 2010 budget request. In discussing appropriate responses to the announcement, PPC decided on three actions:

- 1) Try to set up a meeting of HTAC members with Secretary Chu to discuss his position and advise him on some of the technical issues.
- 2) Learn about the process that led to the DOE decision to zero the budget for hydrogen R&D. What information, what reports, and what logic stream led to the decision?
- 3) Actively engage (not as HTAC members, but rather as private individuals and/or representatives of professional organizations) in working with Congress and/or Administration officials in efforts to restore the budget for hydrogen and transportation fuel cell research and development (R&D). Dr. Shaw noted that some success has been made in this regard, as already mentioned, but that these efforts should be continued.

Congressman Walker reported that the HTAC has scheduled a meeting with DOE Under Secretary Kristina Johnson, who was asked to take the meeting for Secretary Chu. While Chairman Walker and Vice Chairman Shaw were not fully satisfied with that response, they agreed that this meeting still offers the opportunity to meet soon with senior DOE management. The meeting is scheduled for July 30, 2009, from 11:00 to 11:30 a.m. Congressman Walker asked any HTAC members who wish to attend to let him know by the end of the week (July 17, 2009) so that he can submit the requisite paperwork for the visit, including who will attend and what will be discussed.

1.2 Public Comments

Chairman Walker opened the floor for public comments. Public comments were provided by Mr. Douglas Rode of Hydrogen Safety, LLC, as summarized below. (The full written statement, as well as a written statement from UTC Power Corporation, are provided at http://hydrogen.energy.gov/htac_meeting_july09.html).

Mr. Douglas Rode, Principal and Managing Director, Hydrogen Safety, LLC

Mr. Rode explained that Hydrogen Safety, LLC is an engineering consulting firm located in East Hartford, Connecticut, which focuses on providing risk management strategies for the main street use of hydrogen. Mr. Rode spoke on behalf of his colleague, Mr. Mike Pero, who is also a member of the DOE Hydrogen Safety Panel. Mr. Rode reported that the Hydrogen Safety Panel is currently exploring the issues of insuring hydrogen-powered vehicles and fueling stations, but has yet to reach any final conclusions. To promote efforts toward developing an effective risk management program, the Panel specifically advocates the following:

- 1) Investigate the establishment of a professional designation for competency under the prescripts of ISO 17024 for granting personal certification. The industry would define the parameters for recognizing an individual's competency with hydrogen. This is good for the growth of the

individual's professional career, good for the employers to showcase to their customers, and bolsters the public's confidence that people in the industry are judged to be independently competent to do their work. This would also place the industry on par with other industries that have similar professional certification procedures.

- 2) Work to establish statutory liability limits for applications of stationary fuel cells, hydrogen vehicles, and fueling stations. This would allow for consistent insurance coverage at a more competitive price and also allow reasonable insurance to be offered to all firms in the supply chain.
- 3) Implement a uniform and consistent expert system to provide recommendations in real time to first responders. As of yesterday, the number of hydrogen accidents were 140, as reported to the DOE incident database. This expert system would supplement the current GPS-type data and computer hardware that is being installed in police and fire vehicles in central Connecticut under U.S. Department of Homeland Security funding.

2. DTI Fuel Cell Cost Estimate Overview: “Mass Production Cost Estimation of Automotive Fuel Cell Systems”

Mr. Brian James, Directed Technologies, Inc. (DTI)

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

Chairman Walker introduced Brian James, a Research Director at Directed Technologies, Incorporated (DTI), for a presentation on DTI's 2008 automotive (80 kilowatt) fuel cell cost analysis for DOE. Congressman Walker noted that the presentation is very timely because fuel cell costs have been very much a part of the public policy debate over the last few weeks.

Mr. James' presentation included the following:

- Discussion of DTI's assumptions and modeling methodology
- Comparison of 2008 modeled technology status with 2010 and 2015 fuel cell goals
- Fuel cell system architecture and manufacturing, and how they impact the modeling
- Stack component cost breakout at low and high manufacturing rates for 2008 status and 2010 and 2015 targets
- 2008 stack and system cost versus annual production rate (from 1,000 to 500,000 units per year)
- Sensitivity analysis of various components and factors (e.g., platinum cost)
- Progress in cost reduction over the past three years (from an estimated \$105.81/kW in 2006 to \$73/kW in 2008) – a 29% reduction in 2 years due to a combination of technology improvements (such as reduced platinum loading and increased power density) and refinement of the analysis

Questions, Answers, and Discussion

- Mr. Anthony Eggert asked about the basis for the change in platinum group metal (PGM) catalyst loading, from 0.35 mg PGM/cm² in the 2007 cost analysis to 0.25 mg PGM/cm² in the 2008 cost analysis. Mr. James responded that the fuel cell technology team (the Fuel Cell Technical Team of the FreedomCAR & Fuel Partnership) correlated the current state of the art as they understood it from public, open source references on power densities and catalyst loadings and made an amalgam estimate for DTI to use. He noted that a complementary cost analysis conducted by TIAX LLC used a

slightly different loading than DTI; as a result, DOE worked with the Technical Team to develop an average that could be used in both studies, so an apples-to-apples comparison could be made.

- Dr. Shaw asked whether the assumptions used in the analysis are reviewed by fuel cell manufacturers. Mr. James replied that each year DTI provides the full, detailed, updated report to fuel cell manufacturing companies for review and also meets with them for one-on-one discussions. He noted that the feedback is usually not specific, but DTI does get directional statements as to whether their assumptions are sound (e.g., “looks reasonable” or “you might want to check the cost of the elastomer you are using because our costs are much higher”).
- Congressman Walker asked whether the cost would remain the same in a 20-kilowatt (kW) system. Mr. James replied that the DTI analysis estimates the cost for an 80-kW (net) system. He would expect the cost for a smaller system to be higher on a per-kW basis. However, DTI has not done any studies that specifically chart how much the cost changes with size. Congressman Walker explained that his question relates to worldwide automotive applications and the likelihood that the fuel cell would be built into a hybrid system rather than as a total power unit for future cars, which might also require a lower-power system overall. Mr. James responded that the total vehicle power requirement will depend on the class of vehicle (e.g., mid-size, subcompact, large SUV), but that 80 kW “splits the difference” in that it is not unreasonable to think of a hybridized system employing an 80-kW fuel cell. He went on to explain that a fuel cell system sized for sustained uphill driving at 6 percent grade at highway speeds (depending on the size and weight of the vehicle) might very well need close to 80 kW – and certainly more than 20 kW. A smaller car that is not sized by the criteria of sustained uphill drive may be able to get by with 20 kW. Congressman Walker added that it is possible to envision a fuel cell architecture in which the fuel cell is used only to recharge the batteries rather than to drive the car at any point.
- Mr. Rose referred to the “Current Technology Cost Evolution” chart provided on page 39 of Mr. James’ presentation as he remarked that the cost for the first 100,000 vehicles is of particular interest due to recent discussion about the entry of fuel cell vehicles into the marketplace and how fast those costs can come down. Mr. Rose asked why DTI’s cost projection for the first 100,000 vehicles is lower than that developed by the National Academies study.¹ Mr. James noted that all the assumptions for all of the manufacturing rates are included in DTI’s detailed final report.² He stated that while the Design for Manufacturing and Assembly (DFMA) methodology is applicable across all manufacturing rates, the margin of error is slightly greater at lower manufacturing rates. This is because factors that are negligible at high manufacturing rates become appreciable cost drivers at low rates. He expressed confidence in the DTI numbers at 1,000 systems a year, but was not willing to go lower (to 100 systems a year). He continued, saying that the stack numbers should be “pretty good” at 1,000 because of the high number of repeat parts associated with each fuel cell system; the balance-of-plant parts (which are not required in large numbers per system) are harder to model at low manufacturing rates.
- Mr. Rose made note of the decision to use a lower labor rate in the 2008 DTI cost analysis (\$45 per fully loaded hour versus \$60 in 2007). He asked what impact this had on the fuel cell system cost. Mr.

¹ *Transitions to Alternative Transportation Technologies—A Focus on Hydrogen*. The National Research Council of the National Academies. 2008.

² *Mass Production Cost Estimation for Direct H₂ PEM Fuel Cell Systems for Automotive Applications: 2008 Update*. Directed Technologies, Inc. March 2009.

James replied the impact was “not that appreciable” and that the information is available in the report. In addition, he said that he would provide the HTAC with a specific answer to the question.

- Mr. Rose asked if anyone was looking at the range of costs for different horsepower vehicles (e.g., a 400-horsepower Lexus engine versus a 75-horsepower KIA engine). Mr. James replied that DTI is not evaluating those cost ranges at this time, although they had done some work like that in the past. He believes the \$30/kW DOE target roughly corresponds to a mass manufactured non-premium American car. He pointed out that some cars will therefore be cheaper than \$30/kW. In any case, the electric motor and fuel tank also need to be included in the final cost, so it's important to remember that the DTI's analysis covers only the fuel cell system based on their assessment of current component state of the art and system configurations. This helps to identify what can be, or needs to be, done to lower costs further towards the target.
- Dr. Shaw asked if the parallel cost analysis conducted by TIAX, LLC had comparable results to the DTI study, and how did results from both studies correlate to the 2008 cost status reported by DOE of \$73/kW. Mr. James responded that the TIAX report had generally similar cost results, but their costs were slightly less than DTI's and the \$73/kW number is a combination of the two results. He noted that DOE's objective in funding the two studies is to have two independent cost analyses, so DTI and TIAX take care not to “collude” or force their analyses to be similar.
- Dr. Shaw questioned whether DTI's future work plans included analysis of the potential impact of “dramatic shifts in the structure of the cell,” such as replacing platinum with a redox reaction on the air side of the cathode. He noted that this technology is “moving quite aggressively in producing power densities well in excess of the numbers [used in the DTI analysis].” Mr. James replied that DTI is interested in evaluating other systems; they have not yet analyzed the redox system, but it is within their purview to do so. Dr. Shaw encouraged DTI to include that technology in future cost analyses.
- In a third question, Dr. Shaw asked whether DTI plans to analyze methods that fuel cell manufacturers (or others) might use to help reduce the price volatility of platinum, such as entering into long-term contracts or supply control on the part of producers. Mr. James replied that there have been discussions about leasing structures that could be used along with platinum recycling. He noted that TIAX, LLC has done some studies to quantify the cost of platinum recycling. To date, these types of platinum cost-control measures have not been included in the costs analyses, partially due to specific direction from DOE. However, Mr. James asserted that it would be simple for them to include a different structure for platinum costs and show the effect this would have on the net cost to the consumer. Dr. Shaw noted that since platinum is such a large part of the fuel cell cost, it is pretty clear that a manufacturer would work hard to get those costs down through contracting mechanisms; he would therefore encourage an analysis of these possibilities.
- Dr. Ogden asked if the markup costs included in DTI's analysis were only for system components or whether there was also a mark-up for the system integrator, which she assumed would occur at the original equipment manufacturer (OEM) level. Mr. James replied that a markup factor is only applied to system components that are purchased from lower tier suppliers. The analysis assumes that the OEM (whether it's a company like UTC, GM, or Ballard) assembles and produces most of the stack components (with the exceptions of the membrane and the gas diffusion layer); everything else (e.g., end plates, bipolar plates, frame gaskets) are produced in-house. Most of the purchased components to which a markup is applied are balance of plant components. Mr. James also clarified that the cost analysis represents the manufacturing costs only and does not include any markup for retail sale.
- Mr. Eggert commented that this type of detailed work, which is done very well and in a transparent way, is extremely valuable – both for informing the R&D portfolio (in identifying opportunities to

reduce cost) and for policy analysts. He asserted that the analysis gives a tremendous amount of credibility to the estimates of future costs, which has been very useful to the Committee.

- Mr. van Dokkum agreed that the analysis is well done and provides a lot of credibility. He stressed, however, that the key is cost reduction in the first 100,000 units; moving from producing a couple of hundred units to 100,000 units will be the main challenge. He struggles with the projections because he “can't see getting close to 70 percent cost reduction.” He believes that the cost reduction timelines used are very aggressive and that there is an “obvious disconnect” between the timeline required for innovation and the cost reduction curves. He would also like to include lifecycle costs in the analysis, so that fuel cells are evaluated against other technologies on a lifecycle cost basis.

3. Update on Hydrogen and Fuel Cell RD&D Program Activities of Key Foreign Governments

Mr. Praveen Kedar, General Motors

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

Chairman Walker introduced Mr. Praveen Kedar, Manager of Strategy and Enterprise Development at General Motors, for an update on the current status of international automotive fuel cell research, development, and commercialization activities. Congressman Walker recognized that current information on global activities is very valuable going forward, given the competitive nature of the global economy and the associated public policy implications.

Mr. Kedar began by acknowledging Dr. Byron McCormick (former HTAC member and retired General Motors Executive Director of Fuel Cell Activities), Mr. Charlie Freese (who has taken over for Dr. McCormick at GM), as well as his GM colleagues in Japan and Germany. Mr. Kedar's presentation stressed three points: 1) the real commitment and conviction that the automotive companies, hydrogen producers, and governments have to develop fuel cell vehicles and hydrogen fueling infrastructure in these countries, as well as the steady, sustained involvement of industry and government partners over the years; 2) the emphasis on research into a portfolio of alternative fuel vehicle technologies to fill different transportation niches and to reach greenhouse gas (GHG) reduction goals; and 3) the necessity of consistent U.S. investment in hydrogen and fuel cell vehicles to maintain international competitiveness. Mr. Kedar noted that the key drivers for countries like Japan and Germany are energy, environment, and the economy. The governments and consumers in these countries have a heightened awareness about reducing use of imported petroleum and protecting the environment. They are also export-driven economies that recognize the value of clean energy technologies for the future. Mr. Kedar's presentation also addressed the following topics:

- Energy cost and GHG emission projections (hydrogen and fuel cell vehicles are ultimately needed to reach GHG reduction goals)
- Emphasis on strategies that maintain a full research portfolio, starting with early options (e.g., E-85 vehicles) and moving towards increasing electrification of the vehicle fleet with fueling provided by liquid fuels, electricity, and hydrogen
- Suitability of different technologies for different vehicle applications
- Hydrogen fuel cell planning initiatives and strategies in Japan and Germany
- Vehicle fueling infrastructure activities in Japan and Germany

- Global automotive fuel cell competitors: United States (General Motors), Germany (Daimler, BMW, and VW), Japan (Toyota, Honda, and Nissan), Korea (Hyundai-Kia), and China (Shanghai Automotive Industry Corp.)
- Vehicle and infrastructure deployment timelines for various companies and countries
- Competitive position of GM and the United States in automotive fuel cell technology

Questions, Answers, and Discussion

Given time constraints and the inability of Mr. Kedar to attend the entire HTAC meeting, questions were deferred.

4. DOE Program Update (Including Congressional Activities)

Dr. Sunita Satyapal, Hydrogen, Fuel Cells and Infrastructure Technologies Program, DOE

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

Dr. Satyapal began by thanking the members of the Committee for their support and for their continuing interest in and commitment to the program. She described the current and future direction of the DOE Fuel Cell Technologies Program, including the fiscal year 2010 funding request and Congressional budget activities. Her remarks included the following:

- R&D progress and accomplishments in fuel cells, hydrogen production and delivery, hydrogen storage, technology validation, early markets (such as combined heat, hydrogen, and power), and market transformation (particularly efforts to deploy fuel cells in government and industry to increase manufacturing rates and lower costs through learning-by-doing and economies of scale)
- Deployment of close to 1,000 fuel cells through funding provided by the American Recovery and Reinvestment Act (ARRA) and the new provision under Section 1603 of ARRA that provides grants in lieu of tax credits for fuel cells and other renewable energy technologies
- The new Fuel Cell Technologies Program structure (as reflected in the 2010 budget request), which focuses on technology-neutral fuel cell systems R&D and includes a greater emphasis on R&D for nearer term applications in stationary, portable, and specialty (e.g., forklift) fuel cell systems and diverse fueling sources, including biogas and hydrogen
- Recent DOE Request for Information (RFI) on targets for combined heat and power (CHP) and auxiliary power units (APUs)
- FY2007 to FY2009 budget appropriations, FY2010 budget request, and FY2010 House and Senate Appropriations Committee's budget marks and committee language
- Program priorities and next steps
- Examples of hydrogen and fuel cell RD&D activities in other agencies

Questions, Answers, and Discussion

- Mr. Rose informed the Committee about a pending amendment on the House floor to add another \$45 million to the Program, which would bring the total House budget mark to about \$153 million. He agreed that the language (describing where that funding should go and how it is allocated) is

confusing, and he hoped that it would be cleared up by the time the appropriations bill goes to Congress. The goal is, he said, to have that funding allocated similarly to the FY09 appropriation.

- Congressman Walker made the following comment:

“As someone who spent a decade trying to get hydrogen carved out as a specific program inside of DOE, I find this extremely disturbing, and have just been appalled at what I've seen in recent weeks. To move to a fuel cell program only is to eliminate a whole host of other things that need to be going on in the Department with regard to hydrogen... I personally find this to be about a 20 year regression from where the Department has been on hydrogen issues.”
- Mr. Friedman asked for clarification on the difference between the work conducted by Oak Ridge National Laboratory (ORNL) (which showed that fuel cell costs could be brought down to \$1,000/kW with government acquisition programs) and the DTI cost analysis (which showed much lower costs per kilowatt). Dr. Satyapal responded that the DTI study addresses the automotive fuel cell cost status, whereas the ORNL study addressed stationary and niche applications, like forklifts and backup power units. The cost targets are set relative to the competing technology options, and the cost per kilowatt requirements are much lower for automobiles than they are for these other applications. Dr. Schulz followed up, asking why these other applications should cost so much more if the automotive fuel cell cost status (projected at high volume production) is \$73/kW. Dr. Satyapal responded that the durability requirements and the production volumes are different. If millions of stationary power units were manufactured with the same stack components and ancillary equipment as automotive applications, then costs could be brought down and fuel cells would be even more competitive with technologies like diesel generators and microturbines. But stationary fuel cell systems have a targeted lifetime of 40,000 hours, versus 5,000 hours for vehicles, which requires higher platinum loadings and more expensive components. The current DOE targets for stationary polymer electrolyte membrane fuel cell systems (5–250kW) are \$750 per kilowatt and 40,000 hours durability.
- According to Mr. Hofmeister, the energy industry considers “near term” to mean 0 to 10 years, “mid-term” as 10 to 20 years, and “long-term” as greater than 25 years. This is in contrast to DOE’s definition of these terms (slide 23) as 0 to 5 years, 5 to 15 years, and more than 15 years, respectively. Mr. Hofmeister contended that if the industry that produces energy is looking at longer time cycles than DOE, then “there is a serious inconsistency.” Dr. Satyapal reminded Mr. Hofmeister that the DOE Office of Science (SC) conducts long term hydrogen-related, basic R&D and that up to \$50 million was included in the SC budget request for this activity.
- Mr. Rose asked about the status of the website known as Hydrogen.gov (<http://h2.rita.dot.gov/>), noting the website currently displays a message saying the site has been taken down for maintenance. Dr. Satyapal replied that the website (which is primarily a portal to hydrogen- and fuel-cell-related activities within the federal government) is being transferred from the Department of Transportation (DOT) to DOE servers. The site has been taken down during this transition period; however, the main DOE hydrogen websites (at <http://www.hydrogen.energy.gov/> and <http://www1.eere.energy.gov/hydrogenandfuelcells/>) are still up and running.

5. Local Hydrogen and Fuel Cell Company Updates

Mr. Joel Rinebold, Connecticut Center for Advanced Technology; Mr. Frank Wolak, FuelCell Energy; Mr. Anthony Anderson, Precision Combustion, Inc.; Dr. Martin Shimko, Avalence LLC; and Ms. Lise Dondy, Connecticut Clean Energy Fund

5.1 Fuel Cell Supply Chain: New England: Mr. Joel Rinebold, Connecticut Center for Advanced Technology, Inc.

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

Mr. Rinebold introduced the next set of speakers who would discuss hydrogen and fuel cell research, development, and commercialization activities in Connecticut. He noted that the state government and the industry are very engaged; they see this as an opportunity to develop strength in manufacturing equipment that will reduce oil imports, provide renewable energy, reduce emissions and GHGs, and also provide jobs.

5.2 Stationary Fuel Cells, Hydrogen Production: Mr. Frank Wolak, FuelCell Energy

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

FuelCell Energy is a fuel cell research and manufacturing company with approximately 500 employees. They have about 60 units worldwide, totaling about 50 MW installed—mostly in Japan and Korea, with over half used for grid support. They offer 300-kW, 1.4-MW and 2.8-MW systems (and multiples thereof), which use a variety of fuels. Current R&D efforts include improved tri-generation (power, heat, and hydrogen) and electrochemical hydrogen compression. Visit <http://www.youtube.com/watch?v=LZEiQ8-vf1Q> for a video walkthrough of the FuelCell Energy 1-MW fuel cell system at California State University, Northridge.

5.3 Fuel Reforming and Fuel Processing Systems: Mr. Anthony Anderson, Precision Combustion, Inc.

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

Precision Combustion is a small, but growing, business that develops and manufactures advanced catalytic systems for hydrogen generation. They specialize in producing compact fuel reformers and fuel processing systems for solid oxide fuel cells (SOFC) and polymer electrolyte membrane (PEM) fuel cell systems using a variety of feedstocks, including defense logistics fuels (JP8, JetA, and diesel), ethanol, gasoline, natural gas, and paint solvents. A major client is the Department of Defense, with applications including shipboard power, vehicle auxiliary power units, soldier power, and field generator sets. They are also developing systems for commercial applications, including a paint solvent reformer that can produce reformat while eliminating the costs of hazardous waste disposal.

5.4 Hydrogen Production: Dr. Martin Shimko, Avalence LLC

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

Avalence makes an electrolyzer for onsite production of hydrogen directly at a high pressure. Currently they are commercializing and certifying a 2,500 psi unit and developing a 5,500 psi unit with DOE funding. Their device is a high-pressure alkaline electrolyzer, which allows them to use lower cost components and to eliminate or downsize some components like a compressor. They are targeting near-term markets for industrial gas (as an alternative to delivered hydrogen) and self-refueling backup power systems. They are also manufacturing prototype transportation fueling units, including systems for the Department of Defense, General Motors (solar-powered), and the Greater New Haven Transit District.

They also recently began a contract with DOE to build a utility-scale prototype electrolyzer for energy storage. Dr. Shimko stressed the need for hydrogen funding consistency, especially for small businesses involved with DOE.

5.4 State Funding Program: Ms. Lise Dondy, Connecticut Clean Energy Fund

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

The Connecticut Clean Energy Fund (CEF) promotes, develops, and invests in clean energy for the benefit of Connecticut ratepayers. Their funding comes from the electric ratepayers of the state and from the two major utilities, so their focus is on stationary power generation rather than transportation. Ms. Dondy explained that CEF supports different stages of the technology development continuum. They helped found the University of Connecticut's Global Fuel Cell Center, a state-of-the-art fuel cell R&D center. They also manage and administer several incentive programs that include 1) the On-Site Renewable Distributed Generation Program, which provide grants or loans for operational demonstrations of fuel cells or other renewable, and 2) the Project 150 Program, which requires utilities to purchase 150 MW of renewable power through long-term power purchasing agreements. To date, 13 fuel cell projects (totaling 4.2 MW) are in some stage of deployment or operation through the on-site distributed generation programs, and another 8 fuel cell projects are scheduled to be deployed under the Project 150 Program (ranging in size from 2.4 to 14.9 MW). The CEF also operates a fuel cell monitoring program to capture, record, and report performance and operating data.

Questions, Answers, and Discussion

- Mr. Rose asked for additional details on the incentives provided for fuel cell (and other renewable energy) projects in the state. Ms. Dondy replied that under Project 150, the utilities are required to pay 5.5¢/kWh above wholesale for renewable electricity. The On-Site Renewable Distributed Generation Program provides up to \$4.70/watt (W) in incentives, to make up the gap between what the customer pays for electricity currently and what they would pay with the new fuel cell system (including the Federal tax incentive). She added that the amount paid by CEF has typically been far less than \$4.70 and has averaged about \$2.50/W. She noted that the economics of each project are different, and there are a variety of other factors that can provide benefits (such as the indexing of natural gas prices). She also clarified that fuel cells powered by natural gas are considered a Class-1 renewable technology in Connecticut, by statute.
- Dr. Shaw asked whether the CEF provides grants or whether it expects a return on loans. Ms. Dondy explained that the objective of the CEF is to stimulate innovation, so they view the projects as high risk. Some of the projects are provided grants and others are provided “soft loans,” where the return is tied to what is defined as commercial success. The CEF also provides some direct equity funding through their clean tech fund, in which they invest through standard venture funding mechanisms with other equity investors. This fund is operated in conjunction with Connecticut Innovations and with the Connecticut Department of Economic Development.
- Mr. Eggert asked whether the CEF gets involved in activities like identifying potential customers, project siting, permitting, or other types of project implementation activities. Ms. Dondy replied that they have worked with customers to help identify what renewable technology would be best, depending on their particular load, demand cycle, waste heat needs, etc. She said that permitting is not much of an issue in the fuel cell area; however, if there are problems, the CEF does have a “predevelopment program” that does fund some permitting.

- Mr. Eggert asked about the costs of the Avalence self-refueling backup power system. Mr. Shimko replied that the current cost to the consumer is about \$90,000/kW but he sees a clear pathway to reducing the costs to \$15,000/kW for the complete system.

6. Electronic Vehicle Technology Presentations: Battery, PHEV, and Fuel Cells

Prof. Joan Ogden, University of California, Davis and Dr. Sandy Thomas, H₂Gen Innovations, Inc.

6.1 Transition Costs for New Transportation Fuels: A Comparison of Hydrogen Fuel Cell and Plug-In Hybrid Vehicles:

Prof. Joan Ogden, University of California at Davis (UC-Davis), Sustainable Transportation Energy Pathways program (STEPS)

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

Dr. Ogden reviewed the results of a preliminary analysis conducted at UC-Davis (which she presented at the 2009 National Hydrogen Association's annual conference) comparing the transition costs for hydrogen fuel cell vehicles (FCVs) with those for plug-in hybrid electric vehicles (PHEVs). She is also working with the National Research Council (NRC) on a more comprehensive analysis on the same topic, and the results of that study will be coming out this fall. While the new study will be more thorough, she expects the results to be similar to her initial analysis, in which she did the following:

- Estimated GHG and gasoline consumption for FCVs and PHEVs relative to a reference case with no advanced technologies; examined and compared transition costs to bring FCV and PHEV technology to cost competitiveness
- Added a PHEV case to the scenarios developed for the 2008 NRC report³; many of the other modeling assumptions were the same
Cost assumptions for a PHEV-30 battery (an 8-kWh battery capable of providing a 30-mile, all-electric range) included the following:
 - Learned out, mass produced cost OEM battery cost of \$320/kWh (with current technology costs projected at \$700 - \$1,000/kWh when mass produced)
 - Electricity price for charging of 6¢/kWh
- Introduced PHEVs at the same rate as FCVs, but earlier (2010 versus 2012)
- Found that both FCVs and PHEVs became cost competitive in the early 2020s, with similar transition costs: \$40 to \$110 billion for FCVs (\$7,000 - \$9,000 per car for FCVs and \$1,400 - \$2,000 per car for full hydrogen fueling infrastructure) and \$29 to \$214 billion for PHEVs (\$7,000 - \$9,000 per car for PHEVs and \$800 - \$2,000 per car for residential charging equipment – the cost of any electric transmission system upgrades or generation additions was not included)
- Found that PHEVs enter the market sooner, and at lower price, but the learned-out price could be less for FCVs, depending on the learned-out cost of the batteries
- Assumed a future grid mix modeled by the Electric Power Research Institute (that includes coal with carbon capture sequestration, new biomass, nuclear, and advanced renewable to reduce emissions of CO₂ per kWh by two-thirds). Even with this future grid mix, “long-term GHG and oil use reductions

³ *Transitions to Alternative Transportation Technologies—A Focus on Hydrogen*. The National Research Council of the National Academies. 2008.

are significantly greater with FCVs than PHEVs for a similar level of energy supply decarbonization.”

6.2 Comparison of Plug-In Hybrids, Fuel Cell EVs and Battery EVs: Dr. Sandy Thomas, H2Gen Innovations, Inc.

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

Dr. Thomas presented on a similar, but separate, analysis conducted by the National Hydrogen Association’s (NHA) Energy Evolution Task Force. The purpose of the study, which was led by Mr. Frank Novachek of Xcel Energy, was to review the NHA’s “Energy Evolution” model; to compare fuel cells with batteries; and to estimate the government incentives required to jump-start FCVs, PHEVs, and battery electric vehicles (BEVs). They considered four major scenarios, with different market penetration curves over time: 1) gasoline internal combustion engine (ICE) hybrid electric vehicle (HEV), 2) gasoline ICE PHEV, 3) cellulosic ethanol ICE PHEV, and 4) hydrogen FCV. Two secondary scenarios were also considered: 1) BEVs and 2) hydrogen ICE HEVs.

For all technologies, the analysis assumed technical success, economic success, and that (with stringent climate change constraints) both hydrogen production and electricity generation became “green” over time. In their model, hydrogen is initially produced primarily from on-site natural gas reforming and gradually shifts to on-site biofuels reforming and central production from biomass and coal gasification and renewable and nuclear-powered electrolysis. A “blended charge depleting” mode of operation is assumed for the PHEVs, in which the ICE is turned on when high power is required from the engine; this enables the battery to be smaller and more affordable for a given all-electric range. Dr. Thomas showed data on the efficiency of converting biomass to hydrogen (both with and without an intermediate step of producing ethanol). In both cases (conversion of ethanol to hydrogen or direct conversion of biomass to hydrogen via gasification) the hydrogen fuel cell vehicle will drive more miles per unit of feedstock (ethanol or biomass). He briefly reviewed some of the other assumptions of the analysis, including market penetration rates, PHEV charging profiles and grid energy usage, GHG emissions, etc. Dr. Thomas also provided some data on the cost of producing hydrogen today via on-site natural gas reforming using H₂Gen’s HGM 10000 unit at today’s low manufacturing volumes and natural gas prices (\$2.04 per gallon on a miles-driven basis). The primary results of the NHA analysis are summarized below.

- All-electric vehicles (BEVs or FCVs) are required, in conjunction with ICE hybrids, PHEVs, and biofuels, to simultaneously accomplish the following targets:
 - Reduce GHGs to 80% below 1990 levels
 - Achieve petroleum energy “quasi-independence”
 - Nearly eliminate urban air pollution from vehicles
- For most of the study period (2010–2100) plugging in reduces GHG emissions from gasoline HEVs but increases GHG emissions from hydrogen FCVs.
- Even in the near term (2020–2030) timeframe, hydrogen FCVs will have a bigger impact on GHG emissions than the other study options (except hydrogen ICE HEVs). This result is expected despite the fact that other options are projected to penetrate the market sooner than hydrogen FCVs.
- Using the average U.S. electrical grid mix for charging EV batteries, and assuming hydrogen is made on-site from natural gas, lithium-ion battery electric vehicles will generate more GHGs than hydrogen FCVs.

- Using the average marginal California electrical grid mix for charging EV batteries, and assuming hydrogen is made on-site from natural gas, lithium-ion battery electric vehicles will generate similar GHGs to hydrogen FCVs.
- A lithium-ion battery system weighs more and takes up more volume than a fuel cell system (including the fuel cell, battery and hydrogen storage tank).
- BEVs are projected to cost more in 2030 than FCVs (assuming \$50/kW for the fuel cell system, \$15/kWh for hydrogen storage, and \$250/kWh for the BEV battery with a 200-mile range).
- Cash flow break-even points are similar between the NHA, NRC and UC-Davis analyses.
- Total private and government investment required for FCVs is on the same order of magnitude as the results presented by Dr. Ogden: in the tens of billions of dollars over 15 years. Incentives for BEVs will be higher due to the higher cost of the battery.
- If the costs for urban air pollution, importing foreign oil, and other societal costs are monetized and included in the cash flow analysis, FCVs are even more attractive.

Questions, Answers, and Discussion

- Mr. van Dokkum asserted that one of the key challenges is making the fuel cell value proposition clear to policy makers. He noted that the NRC estimate of \$48 billion (cumulative over 15 years) to support a transition to hydrogen and fuel cell vehicles would likely translate to a minimal carbon tax in terms of pennies per gallon. He urged the HTAC to articulate the business equation behind the NRC and NHA studies so that policy makers can make the right decisions. Dr. Ogden agreed and hoped that the new NRC study comparing hydrogen FCVs and PHEVs (currently in progress) will receive attention on Capitol Hill. She said that a tax of 1¢ per gallon on gasoline yields about \$1 billion in revenues. In communicating the value proposition, a comparison might also be made, she said, between the subsidies provided for ethanol or other alternative fuels.
- Congressman Walker asked Mr. Thomas whether he knew what information the DOE decision makers used to formulate the 2010 budget request, adding that none of the HTAC members met with the Obama Transition Team. Mr. Thomas noted that the NHA was able to schedule a briefing with the Center for American Progress (CAP), including John Podesta, co-Chairman of the Transition Team. He reported that, at the end of the briefing with CAP, Mr. Podesta mentioned that Joseph Romm is on the CAP staff. When he then asked Dr. Romm to come to the briefing, Dr. Romm said he did not want to spend any time on hydrogen. Congressman Walker stated that it would be disturbing if one active opponent carried so much weight in the decision making. Mr. van Dokkum asserted that the only way to counter this kind of opposition is to present the facts and the results of credible analytical studies. He suggested that it may be most effective to bring the message to the grass roots level rather than to Washington. Congressman Walker agreed, but noted that the Committee should take whatever opportunities it can to brief policymakers and government officials on the facts.
- Mr. Eggert added that he has had quite a few conversations both within the Administration and with congressional staff ; he believes that even the highly educated, intelligent, scientific congressional staff do not have a good understanding of the results of this analysis. He believes that the results need to be communicated clearly and directly, to dispel the perspective that “this attempt to do something with hydrogen didn't quite pan out -- the industry seems to be backing away [and] it was really expensive and long term.” These kinds of generic perspectives need to be countered directly with honest and factual information. Mr. Eggert stated that the comparison of PHEVs to fuel cells in the temporal sense is particularly interesting, since these results show hydrogen FCVs can have a bigger

impact on petroleum consumption and GHGs than PHEVs, even in the nearer term. People need to understand that all of these new technologies will take a long time to fully deploy, but getting started today can accrue real benefits.

- Mr. Eggert asked why the NHA and NRC studies produced different results for the level of vehicle subsidies required during the transition (with the NRC study being higher by about a factor of two). Dr. Thomas explained that the NHA analysis of FCV costs included a factor for vehicle fuel savings to the consumer, so the overall incentives needed were lower.
- Mr. Kaya commented that meeting the 80% carbon reduction goal (if it is signed onto by the administration) will be very difficult. He wondered who would be responsible for developing a strategy to meet the goal and how it could be done without hydrogen fuel cell vehicle technology. Dr. Thomas agreed, but said that some have suggested it won't be necessary to reduce carbon emissions in the light-duty transportation sector to 80% below 1990 levels, since it could be made up in other sectors. However, he pointed out that the majority of GHG emissions come from electricity generation and transportation, and he believes it will be extremely difficult to make it up in the electric utility business. Dr. Ogden added that UC-Davis studies of this question have concluded that it may require an almost completely electrified light-duty transportation sector to get to the 80% reduction.
- Mr. Hofmeister suggested that much more public debate on these kinds of questions is needed. He foresees a number of obstacles, including "government ownership of the automobile industry and the role that plays with respect to the kinds of vehicles that will be developed." He expressed concern over the news that Ford is not moving forward with their hydrogen fuel cell program. He believes there is a strong coalition of biofuel and battery venture capital folks who had a lot of influence on the Transition Team, as well as on the campaign team before the election. He thinks hydrogen is viewed as a product of the last Administration and is directly tied to big oil, since several oil companies supported hydrogen. He agreed with Mr. van Dokkum, that overcoming this bias will require grass roots public debate, with the right kind of spokespersons in the right forums to emphasize the facts on GHG savings, societal savings, and vehicle costs to the consumer.
- Dr. Shaw agreed on a need for better communication of clear messages and recommended using "today's technology" to get the messages across. He suggested that Dr. Ogden and Dr. Thomas videotape their presentations and post them to YouTube, with a blog to respond to the comments. He suggested that these presentations should be concise and address some of the key arguments presented by opponents, or by proponents of alternative technologies, in a way that addresses what the average person is thinking.
- Mr. Friedman conveyed his opinion that we are going through a "classic cycle [...] in energy policy in this country," which is fed by the "chase for the silver bullet." He contended that hydrogen had Presidential favor in the past administration, but that results were over-promised. When fuel cells did not deliver the results, people moved on to the next thing; when PHEVs do not deliver as promised, the same thing will happen again. He contended that this kind of "chase-the-tail" approach will not get us to an 80% reduction in GHGs. There is a need, he said, to move beyond the "us versus them" approach. He agreed that the NRC and NHA analysis is very useful and should be presented, but he urged the HTAC to recognize that people who do not believe the cost curves will not be swayed by the technical information. These people have the perception that fuel cells will "always be twenty years away." He encouraged the Committee members to address the perception issues up front, rather than by saying "this is better than that." He suggested that the members think in terms of energy

policy rather than technology policy, and that they “think bigger picture” to help create a rational energy policy.

- Dr. Ogden agreed with Mr. Friedman and noted that every study that is looking at the issue of reducing petroleum use and GHG emissions is coming to the same conclusions: this is a serious societal problem, a portfolio approach is needed, there are huge uncertainties, so patience and commitment to all the options is needed.
- Chairman Walker agreed, but asserted that a strong voice is necessary to maintain the attention of policymakers. He is concerned that hydrogen and fuel cell technology is going to go the same way hybrid technology did, with overseas manufacturers building on our early research success.
- Dr. Shaw agreed that the role of HTAC is not “advocacy,” but that as the Hydrogen and Fuel Cell Advisory Committee, he believes it is incumbent on the members to present the facts to the Secretary as best they can. He thinks some of the facts are being misrepresented and argued that it does fall into the Committee’s domain to clarify what can potentially be accomplished with current and future technology. Mr. Friedman agreed that facts are important, but cautioned against a communications strategy that focuses on attacking the arguments made by others.

7. Discussion on the Appropriate Role of the Government in Hydrogen and Fuel Cell RD&D

>> see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html

Mr. Eggert facilitated a discussion on the appropriate role of government in hydrogen and fuel cell research, development, demonstration, and deployment. He led off with a short presentation (see full presentation at http://hydrogen.energy.gov/htac_meeting_july09.html) and began by referring to a journal article by Jeffrey Dukes called “Burning Buried Sunshine.”⁴ He reminded the audience that virtually all of our energy comes from the sun in some form, most of it from ancient plant matter that has been buried and converted into coal, gas, and oil. In the paper, Dr. Dukes tried to calculate how much original sun energy or biological energy was necessary to produce a ton of coal, a gallon of gasoline, and a million British thermal units (Btus) of natural gas. Based on his calculations, a single gallon of gasoline used today required about 90 metric tons of ancient plant matter as precursor material. According to the presentation from Dr. Thomas earlier today, a ton of biomass will produce about 77 kilograms of hydrogen. This means that converting solar energy along the biomass pathway is about 5 to 6 times more efficient than obtaining gasoline from fossil plant material. This highlights the point that efficiency matters – and the definition of efficiency begins at the point from which you start the calculation.

Mr. Eggert went on to present several slides showing different representations of the stages of “energy technology innovation.” He touched on recognized barriers to moving products through the R&D pipeline, especially as related to private investment and the difficulty that private investors have in capturing all the benefits of R&D; the importance of learning and feedback loops in the process of moving from invention to eventual deployment into the marketplace; the importance of review processes and milestones in managing R&D; and the need for continuous improvement of products.

Mr. Eggert noted that the need for government support for R&D is typically called for when there is a particular externality (a social cost or benefit) that is not being accurately reflected in the marketplace,

⁴ Jeffrey S. Dukes. “Burning Buried Sunshine: Human Consumption of Ancient Solar Energy.” *Climatic Change* 61: 31–44. 2003.

such as the need to reduce GHG emissions or oil dependency. Government intervention can take a variety of different forms, he said, including direct government funding, indirect support for commercialization, diffusion of knowledge, and so on.

He went on to deliver the present five discussion questions for consideration by the Committee:

- 1) What is (or should be) the evolving role of DOE spending on RD&D?
- 2) Does the current plan reflect the appropriate priorities across categories? Across time?
- 3) How can this spending best leverage existing and future private sector spending?
- 4) How do we create durable RD&D policy and avoid the typical boom/bust cycles of government RD&D spending?
- 5) What is the role of government RD&D in relation to other proposed policies/regulations?

The following bullets highlight the discussion that followed.

Discussion

- Mr. Eggert noted that he is working with the California Air Resources Board to create a new program relating to transportation fuels and advanced vehicle technologies. The idea of establishing a portfolio across those options is critical, as is an understanding of the full supply chain and how to most efficiently and effectively interject government spending when it is needed. In this regard, they are developing a true gap analysis to understand how government investments can most substantially leverage private spending towards specific goals and policies as well as develop technologies that actually deliver social benefits.
- Chairman Walker asked the HTAC members to provide feedback on what single thing the government could do, right now, to most advance the goal of putting hydrogen substantially into the energy mix. Is it a large subsidy of the industry? Is it a change of policy that mandates a certain reduction of GHGs by 2050?
- Dr. Shaw contended that the 2008 NRC study made a clear case for what should be done: \$55 billion in government support over the next 15 years, of which \$40 billion is vehicle buy-down and \$8 billion is infrastructure support. Without those kinds of dollar commitments, he stressed, you're asking an industry to support crossing the chasm (or the valley of death) with their own capital, and that is a challenging thing to do in this day and age. What is needed is for the government to help bring the vehicle and infrastructure price down to the point where private money will invest because there is a return.
- Mr. Eggert followed up with a question on how to select the funding priorities. He noted that the DOE Hydrogen Program's 2010 budget may be largely restored by Congress. If it is, he wondered how to best apportion that spending "in a way that's going to give you the biggest bang for the buck." He speculated that there may be a lot of discussion about whether or not the previous years' expenditures were the right ones, and suggested that the HTAC could be a positive contributor to that dialogue (for example, on the matter of whether more funding should be directed towards technology validation, vehicle buy-down incentives, etc.).
- Mr. Hofmeister, characterizing himself as a "risk taker," suggested that one of the jobs of the HTAC may be to "train a new Energy Secretary." Drawing on his experience in the corporate world, he observed that every new CEO has not "know[n] what they needed to know from Day One." He suggested that the HTAC think about exercising a methodical training exercise over the months and years ahead to help avoid the boom/bust cycle of spending. This education will be sought after by the

Secretary if he is being asked questions by Congress, special interests, or others on the outside to whom he has to respond.

- Mr. Eggert said that he is optimistic about the HTAC's ability to communicate with the Secretary, since one of the stated goals of the Administration is science-based policymaking.
- Mr. van Dokkum expressed his disappointment that hydrogen and fuel cells, as an industry group, was not better connected when the Obama campaign team and Transition Team were developing their energy vision. He thinks that progress has been made on convincing the Administration about the value of stationary fuel cells, but thinks it is still an uphill battle for transportation fuel cells, even though this is where the biggest societal benefits are. He asserted that the only way to get the message across is to "get the facts on the table and continue to press inside and outside of Washington to get the debate going." He noted that a number of studies have been published over the last year that provide a lot of new data and information, particularly with respect to how hydrogen and fuel cells compare to other technologies. He pressed for making that information widely available in a clear and compelling way.
- Mr. Friedman recalled that President Obama had once talked about putting \$150 billion into technologies of the future. Responding to the previous question about R&D budget priorities, Mr. Friedman said that if he were going to put all that into transportation technologies, he would direct \$50 billion to batteries, \$50 billion to fuel cells and hydrogen, \$25 billion to biofuels, and \$25 billion to high-strength materials and similar technologies. Furthermore, he would set up a long-term program with mile markers, down-select opportunities, and up-select opportunities (to harness the competition that is going on and to deal with uncertainty). He commended DOE for initially funding on-board hydrogen reforming, but then ending that funding and reallocating it to different hydrogen production options when a formal go/no-go review process determined that this was not a viable pathway. He also suggested that R&D should be directed towards meeting goals that are supported by policies that "give people some certainty that their investments are going to pan out in the long run [...] like a cap and trade or a carbon tax."
- Chairman Walker noted that many people bought hybrid vehicles in large part because they got to use the high-occupancy-vehicle lanes as single individuals. He offered this as an example where a "fairly simple public policy [put] a lot of technology onto the roads." He suggested that policies directed towards investment decisions are "where you ought to go."
- Mr. Rose drew an analogy to religious believers and suggested that there is a need to think in terms of having a dialogue with an "unbeliever." Because proponents of alternative technologies are equally passionate about their positions, it is unlikely that you'll get someone to "switch sides" so a pathway towards compromise is essential.
- Dr. Ogden praised Secretary Chu as a Nobel Prize winning scientist who is likely to have an open mind to good ideas. She suggested that he might be interested in meeting with members of academia who are not identified with hydrogen per se, but have looked at the broad energy problem – people like John Heywood at MIT or others in that category.
- Dr. Richmond suggested one effective grass roots communication technique: writing op-ed pieces for local newspapers as a concerned scientist or businessperson. In some cases, these pieces get circulated to other newspapers or result in radio interviews that get expanded press coverage and increased visibility. She asserted that this is a good way to express your views in a way that ties the message to the local community and also to address issues and concerns that matter to real people.

- Mr. Eggert said that there seems to be some support among senior advisors at DOE for the idea of having multiple options to address the big problems of climate change and petroleum dependency. So one message might be that, if we are really serious about these societal goals, there are not that many options available to us. And if we want to mitigate risk, the options that can simultaneously achieve deep reductions in petroleum use and GHG savings look very favorable.
- Dr. Shaw expressed his view that research should be a priority of the government, since sponsoring research is a public benefit and many of the large private laboratories, like Bell Labs, have been closed or seriously cut back. He noted that the government has stepped in to support many technologies that have needed to undergo a lengthy period of RD&D before they became commercial (e.g., nuclear technology, nanotechnology, aerospace technology). He pointed out that the time scales are long for energy technology innovation, so there is a need for policies that help move technologies to the marketplace while recognizing that crossing the “valley of death” can take a long time. He believes that funding should be focused on those activities that will “get the best leverage to move things into the private sector.” Dr. Shaw expressed his confusion with the DOE budget request, saying that R&D into hydrogen production, storage, and delivery would still be needed even with a focus on stationary fuel cell applications.
- Chairman Walker suggested that the NHA or U.S. Fuel Cell Council could issue a summary of key “facts and figures” from Dr. Ogden’s and Dr. Thomas’ presentations. This could serve as a good reference for anyone who wants to write an op-ed or similar piece. Dr. Richmond followed up, saying that former HTAC members would be good candidates for witting articles, letters, or op-ed pieces.
- Dr. Richmond stressed the importance of understanding what hydrogen-related research is being done in DOE’s Office of Science (SC) and how this relates to the applied hydrogen and fuel cell research programs in Office of Energy Efficiency and Renewable Energy (EERE), Fossil Energy (FE), and Nuclear Energy (NE). She contended that one of the messages HTAC needs to bring to Secretary Chu is that the applied and fundamental research programs share some common goals and complement each other.
- Dr. Satyapal agreed on the importance of the basic research program, which is being pursued through SC, and the continuing need for cooperation and coordination with the applied research program in EERE. She noted that the two programs have a very good working relationship and have established some good synergies. She pointed out that the two programs fund very different kinds of work. SC funds mostly provide grants for basic research to universities with no specific targets or metrics; EERE funds national laboratories, universities, and industry (with about 35% going to industry in 2008). She noted that many of the EERE hydrogen program’s industry partners have said that they would not have been able to make the kind of progress that has been made without DOE funding (e.g., Quantum’s progress on developing high-pressure carbon-fiber composite storage tanks; 3M’s progress on more durable fuel cell membranes; and Avalence’s progress on high-pressure electrolysis). The applied research focuses not just on technology development, she said, but also on research with very specific metrics. In this way, the applied researchers are “translating what the consumer or product requirements are into what is needed for R&D.” This strategy is in contrast to the basic research programs that focus on developing fundamental understanding. She referred HTAC members to the multi-year R&D plan⁵ which “clearly indicates what the challenges are in the

⁵ *Multi-Year Research, Development and Demonstration Plan: Planned Program Activities for 2005-2015*. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Hydrogen, Fuel Cells and Infrastructure Technologies Program. <http://www1.eere.energy.gov/hydrogenandfuelcells/mypp/index.html>. April 2009.

different [technology areas] and where the R&D needs are [...] including] detailed timelines, metrics, and milestones.” She noted that the R&D plan was last updated in April 2009, so it will be updated again to reflect the emphasis on stationary fuel cells R&D.

- Dr. Richmond agreed that the interaction and coordination between SC and EERE on hydrogen and fuel cells RD&D is exemplary; she encouraged that relationship to continue and to be brought to the attention of the Secretary.
- Mr. Novachek suggested that the Committee “take a bigger picture view and [...] advance a portfolio view of all of the options [including] biofuels, PHEVs, electric batteries, and the like” and clarify the synergies that the options have with each other. He suggested a “classic options analysis,” in which incremental investment associated with each option is measured against its benefits. This would help answer the question, “Is your portfolio more valuable if you have hydrogen included or not?”

8. Correspondence with DOE Leadership

Chairman Walker opened a discussion, facilitated by Dr. Schultz, on next steps with regard to HTAC communications with Secretary Chu. Discussion included the preferred (or appropriate) channels for communicating with the Secretary (or other DOE leadership), the possibility of writing a letter to the Secretary responding to the 2010 budget request, and planning for the August 30 meeting with Under Secretary Johnson and, possibly, a future meeting with Secretary Chu.

Dr. Schultz introduced the discussion session by providing some background. He conveyed his dissatisfaction with Secretary Chu’s 2010 budget request for hydrogen, which essentially zeroes funding for hydrogen production, delivery, and storage, and focuses fuel cell work on stationary applications as opposed to both stationary and transportation applications. He was concerned that Secretary Chu’s public justifications for the program shift are technically wrong, so he contacted Chairman Walker and Vice Chairman Shaw to ask what the HTAC could do to correct the misunderstanding. They recommended that Dr. Schultz lead a discussion of the matter at the July 15, 2009, HTAC meeting. A summary of the discussion that followed is presented below.

- Dr. Schultz asked the HTAC members whether it is appropriate for HTAC to offer unsolicited advice to the Secretary. Is the role of the Committee strictly responsive, or should the Committee be proactive in addressing technical errors that we believe have been made? Dr. Schultz asserted that, as a “technical advisory committee,” their role should be the latter. If the Committee members agree, then Dr. Schultz suggested that the HTAC write a letter to the Secretary to directly address the underlying technical errors in the justifications that he gave for restructuring the program.
- Dr. Schultz went on to review a letter that he had drafted as a point of departure for the discussion. In it, he made a number of points:
 - There are pathways towards technical solutions for the challenges still facing transportation FCVs and hydrogen production, storage, and delivery infrastructure. A lot of progress has been made and continuing funding is needed to sustain the advances and to help the developers cross the “valley of death.”

- Today's FCV and hydrogen production, delivery, and storage technologies are already gaining entry into consumer use through limited industry and government demonstration programs, using technologies like on-site reforming and solar-powered electrolysis for fueling and high-pressure tanks for hydrogen delivery and storage.
- The National Academy of Sciences/National Research Council has conducted two comprehensive studies of hydrogen for transportation and concluded that (in Dr. Schultz's words) "it is doable, affordable, and probably the only way [to simultaneously achieve] the Administration goals of significantly reducing CO₂ emissions and significantly reducing petroleum imports."
- Mr. van Dokkum agreed that it is the Committee's duty to call out factual errors, whether solicited or not.
- Mr. Hofmeister agreed and suggested that the decision may have originated in the White House rather than with Secretary Chu; the White House position may in part be driven by a desire to "distance the new Administration from the old Administration." He also contended that the new Administration may believe their position promotes both "good science and what is achievable in a period of time in which they have the opportunity to leverage." Mr. Hofmeister stressed, however, the need for correcting the misapprehension that hydrogen is "too far out to matter" in the effort to address climate change. He suggested that, since direct access to the Secretary may not be immediately available, that the HTAC work with whoever is directly available to them and methodically set about the job of getting the facts and information into the right channels to affect future decision making.
- Mr. Katsaros stated his preference for a more direct approach, by writing a letter to the Secretary. He preferred a short, concise letter that would serve to gain an audience with the Secretary.
- Mr. Eggert conveyed his perception that, while politics may have played a part in the decision to de-emphasize the hydrogen program, the Administration has a "sense of extreme urgency" about addressing climate change. He thinks this has led them to focus resources on particular pathways that they think can have an impact in the near term. He proposed that the HTAC "challenge that perspective [by] talking their language and providing solid data in a form they can digest." For example, it appears to Mr. Eggert that the Secretary "did not have the proper information relating to the greenhouse gas performance of the use of natural gas for hydrogen production." He stressed that though natural gas reforming is only a transitional strategy on the pathway to producing hydrogen with even lower GHG emissions, it does produce GHG benefits in the near-term.
- Mr. Rose said that "there is no question that the Committee has the obligation to do something." He referred to the legislative language that established the HTAC (Energy Policy Act of 2005, Title VIII - Hydrogen, Section 807), which states that the HTAC "shall review and make recommendations to the Secretary on the implementation of programs and activities under this title," which authorizes funding for R&D on hydrogen production, distribution, storage and use in fuel cells for stationary, transportation, and portable applications and related infrastructure; codes and standards development; and learning demonstrations. Mr. Rose submitted that the "zeroing out the program is kind of a significant act that maybe we should make note of." He asked Dr. Satyapal whether and when the HTAC's 2008 letter to the Secretary was actually delivered. Dr. Satyapal confirmed that the letter was delivered to the Secretary, but did not know when. When questioned about the process, she explained that DOE, like most Federal agencies, has a controlled correspondence system into which letters are logged and processed, so it can take some time for a letter to work its way through to the Secretary level.

- Mr. Rose went on to suggest that the HTAC write another letter to the Secretary saying something along the lines of “given our advisory role, [and the fact that] Congress appears poised to restore the bulk of the program, here are some things you might think about in moving forward.” Including the message that this is a strategic technology of national interest.
- Mr. Friedman noted that how the Secretary receives the letter will affect its impact (e.g., whether it is delivered to him personally or put into his office mail). Congressman Walker agreed, and suggested that the HTAC produce a letter to the Secretary in time for the meeting with Under Secretary Johnson, and request that she make certain that the letter is delivered directly to the Secretary. He further suggested that the HTAC consider preparing a bound package of information materials for delivery to the Under Secretary and perhaps to include Dr. Ogden and Dr. Thomas’ presentations from earlier today.
- Dr. Richmond agreed with Mr. Eggert’s impression that the program changes were not so much a political agenda as an attempt to “get something out the door very quickly.” She liked the idea of producing a very short, one-page letter with a back-up package of information materials. She suggested that the tone of the letter be collegial, to support what she perceived as the letter’s main goal: stimulating a real dialogue in which the Secretary, or someone from the upper DOE management, engages with the HTAC, comes to the meetings, and interacts directly with HTAC members in working towards the common goal of achieving a sustainable energy future. She hoped that the Secretary would also affirm that the information provided by the Committee is valuable and that he would like the HTAC to continue.
- Dr. Ogden agreed that the HTAC has an obligation to correct any information that is not technically correct and to make this part of the public record. She agreed with producing a short letter along with an “appendix” containing citations for papers or weblinks for information on particular subjects. She also agreed that the letter be sent in the spirit of promoting dialogue and with the intention of guiding the Secretary to scholarly studies with which he may not be familiar.
- Mr. Rose suggested that the Under Secretary and Secretary be provided with a list of all the current HTAC members, including their current titles and bios.
- Vice Chairman Shaw suggested that the HTAC first think about the talking points that they want to present to the Under Secretary, since that meeting is scheduled. He suggested that they should stress the following:
 - The Committee’s desire to serve the Secretary in its role as a technical advisory group
 - The Committee’s almost universal negative reaction to the 2010 budget request
 - The Committee’s eagerness to share their views on how hydrogen fits into the energy portfolio
 - The importance of hydrogen and fuel cells to competitiveness
 - That industry seems still to be committed to hydrogen fuel cells for transportation.

In former communications with Chairman Walker, Dr. Shaw committed to meet with any DOE officials, including Assistant Secretary for EERE, Cathy Zoi.

- Mr. Rose expressed his belief that the upcoming meeting with the Under Secretary is very important, since a meeting with the Secretary is not pending. He sees the meeting with the Under Secretary as a positive sign and urged them to be well-prepared for the meeting.
- Chairman Walker summed up what he understood to be key talking points for the letter to the Secretary: “we’re seeking to help you and here are some things that are useful for you to know about

the present state of the hydrogen industry... ” The supplementary information package would contain Dr. Ogden and Dr. Thomas’ presentations, the NRC reports, and whatever other information the members want to include. One of the requests to the Under Secretary would be to make sure that the letter and information package are delivered to the Secretary. He did not think the letter should reference the budget cut directly, since that might be viewed as adversarial. He also suggested including the “competitiveness and jobs issue” in the letter because of its importance to the White House. The Committee can draw from the earlier briefing from Mr. Kedar on the commitment of other countries and the fact that they see a roadmap for commercialization by 2015. The letter, he suggested, could end with a statement conveying that the HTAC truly wants to be helpful in formulating a near-term mix of energy strategies that will help to achieve the Administration’s goals.

- Vice Chairman Shaw suggested that one of the messages should be that the change in direction may result in losing an important option that has received a substantial investment of U.S. government capital and made significant technical progress. It could lead to a missed opportunity on which our international competitors are poised to capitalize. But one of the key points to convey, he said, is the finding from recent studies that hydrogen and fuel cells are needed to meet the goals for deep reductions in petroleum use and GHG emissions. While they may not have the same short-term impact as energy conservation, we need to start now to get the impacts we are looking for by 2050.
- Dr. Richmond agreed and noted that a lot of new information has come out in the last year, information which may not have been available or known about when the current policy was formulated. The letter could convey that the HTAC wishes to share these recent developments with the Secretary.
- Mr. Rose interjected to “dispel the myth that huge amounts of federal money have gone into hydrogen at the expense of other options.” He informed the Committee that all the money that the federal government has spent on fuel cells in the history of the program is less than what the federal government is spending this year and next year on batteries. [He later clarified that the DOE budget for fuel cells and hydrogen from 1990 to 2009 was \$2 billion while the FY 2009 budget for batteries was \$2.3 billion.]
- Mr. Hofmeister asked the Committee to consider meeting with the Under Secretary before writing the letter to the Secretary. He suggested that they prepare some talking points for the meeting with the Under Secretary and inform her during the meeting that it is the intent of the HTAC to write a follow-up letter to the Secretary. Since the Committee wants the letter to be well received, constructive, and helpful, they could ask for the Under Secretary’s advice on “what is the appropriate letter to write.” Chairman Walker agreed with this approach.
- Mr. Eggert suggested using the points in Dr. Satyapal’s presentation slide on the Secretary’s budget strategy [slide 23] as an outline for the talking points. Address the benefits of hydrogen and how it advances DOE and administration goals, including impact on economic prosperity, GHG emissions, and national security; meaningful science that is taking risks for breakthrough results; and working through effective partnerships with other programs, industry, and international organizations.
- Mr. Novachek said that one key message to get across is the synergy of the options: biofuels, hydrogen, and renewable electricity (and fuel cells and batteries) are not just stand-alone technologies – they complement one another and advances in each area will “build towards something that will ultimately be a great solution.”

- Vice Chairman Shaw suggested that the Committee address next steps for preparing talking points for the meeting with the Under Secretary and the follow-up letter to the Secretary. The following action items were agreed to:
 - Dr. Richmond will produce a first draft of a letter to the Secretary by July 16. She will provide that to Mr. Eggert to add to or revise so that it is alignment with the Secretary’s budget strategy. The final letter will not be delivered to the Secretary until after the meeting with the Under Secretary.
 - Mr. Eggert will produce a one-page draft set of talking points for the meeting with the Under Secretary and provide this to Chairman Walker, Vice Chairman Shaw, and Dr. Schultz.
 - Chairman Walker will prepare the discussion outline required by DOE in advance of the meeting with the Under Secretary.
 - Any HTAC members who plan to attend the meeting with the Under Secretary will let Chairman Walker know within the next few days, so that he can include them in the list of attendees that must be provided to DOE.
 - The leave-behind information package for the Under Secretary will include the one-page talking points, the July 15 presentations to the HTAC from Dr. Ogden and Dr. Thomas, and the 2008 NRC study. Dr. Shaw asked Mr. Michael Mills if DOE could assist the Committee in producing the package.
 - Mr. Eggert will check with Mr. Rose for the most recent data on fuel cell industry employment and federal versus industry spending on fuel cell and hydrogen RD&D.

9. HTAC Planning Discussion

Vice Chairman Shaw facilitated a discussion on a variety of HTAC planning issues including 1) the role of HTAC going forward and the frequency of meetings, 2) the 2009 HTAC report to the Secretary, 3) the 2009 report on the “State of Hydrogen and Fuels Cells Commercialization and Technology Development,” and 4) the membership of the HTAC Policy and Planning Committee. The discussion is summarized below.

9.1 Role of HTAC Going Forward and Future Meetings

- Dr. Shaw suggested that the Committee table the discussion on the role of HTAC going forward until the next meeting in November. At that time, they hope to have a better idea of the Secretary’s needs and expectations for the group.
- Dr. Shaw asked for feedback on the frequency of HTAC meetings: should they continue to have three meetings per year, or move to bi-annual meetings? Mr. van Dokkum suggested three meetings per year, two in Washington, D.C., and one in a location where they can combine the meeting with site visits. He suggested that they invite members of the Hydrogen Caucus in Congress to their Washington meetings. Mr. Rose agreed, but offered the advice that it might be easier to get the Hydrogen Caucus to invite HTAC members to meet with them.
- Hearing no objections, Vice Chairman Shaw confirmed that the Committee would plan for three meetings in 2010.

9.2 2009 HTAC Report to the Secretary

- After some discussion about the HTAC’s reporting requirements it was clarified that there are no specific reporting requirements for the HTAC set forth in the authorizing legislation (EPACT 2005). The requirement for the HTAC is that it “shall review and make recommendations to the Secretary on 1) the implementation of programs and activities under EPACT Title VIII; 2) the safety, economical, and environmental consequences of technologies for the production, distribution, delivery, storage, or use of hydrogen energy and fuel cells; and 3) the plan under EPACT section 804” (i.e., the Hydrogen Posture Plan). However, the Secretary is required to produce a biennial report to Congress, to be transmitted with the President’s budget proposal, “describing any recommendations made by the Technical Advisory Committee since the previous report [including] a description of how the Secretary has implemented or plans to implement the recommendations, or an explanation of the reasons that a recommendation will not be implemented.” The next biennial report to Congress is due with the 2011 budget request.
- Vice Chairman Shaw noted that the last set of recommendations provided to the Secretary (other than the short letter written over recent months) was a nine-page “letter report” that responded to the requirement to review the Hydrogen Posture Plan, among other things. He suggested that a similar style letter report be prepared this year, summarizing HTAC’s recommendations on program implementation and impacts. He asked for a volunteer from the group to lead the drafting of the letter report.

9.3 2009 HTAC Report on the State of Hydrogen and Fuels Cells Commercialization and Technology Development

- Vice Chairman Shaw asked for feedback from members on whether to continue producing an annual “state of the industry” report using the report prepared in 2008 as a model. Dr. Satyapal informed the Committee that the 2008 report was well received at DOE and is currently posted as a link from the DOE Hydrogen Program’s home page [at <http://www1.eere.energy.gov/hydrogenandfuelcells/>]. Dr. Shaw, who led the drafting of the report in 2008, asked for a volunteer to lead the 2009 report.
- Mr. Novachek volunteered to lead the drafting of the 2009 state of the industry report, with the help of HTAC support staff member, Shawna McQueen. In this capacity, he will accomplish the following tasks:
 - Gather input from HTAC members via email on the notable accomplishments, events, reports, etc. over the past year (and send a topic outline out for inputs one month prior to the November meeting). Dr. Shaw will provide Mr. Novachek with the email and outline that he sent out last year as a model.
 - Organize the information and lead a discussion at the November meeting to review and revise the basic inputs.
 - Produce a first draft of the report for review by the Policy and Planning Committee.
 - Incorporate comments and produce a second draft for review by the full HTAC.
 - Produce a final report for delivery to the Secretary and other interested parties.
- Mr. Novachek suggested that the theme of the 2009 report could be the new information that has been generated over the last year, to which Dr. Shaw agreed.
- Dr. Shaw urged HTAC members to collect information on notable achievements, milestones, or events, and forward those to Mr. Novachek and Ms. McQueen. He also suggested that Mr. Novachek

may want to enlist the help of a few of the Policy and Planning Committee members in drafting the report.

9.4 HTAC Policy and Planning Committee: Leadership and Membership

- Dr. Shaw explained that since he has assumed the position of HTAC Vice Chairman, and also the Chair of the HTAC Executive Committee, he must resign his role as Chair of the Policy and Planning Committee (PPC). He explained that the PPC leads the drafting of the annual state of the industry report, as well as most of the HTAC reports or information pieces that document talking points or recommendations to the Secretary. The Chair will be required to lead or appoint people to lead discussions on these products at HTAC meetings, and the drafting process itself. As the PPC Chair, Dr. Shaw organized four or five conference calls of the PPC members to discuss draft products and/or develop a plan of action for responding to news such as the Secretary's 2010 budget request.
- Dr. Shaw accepted Mr. Rose's nomination as the new Chair of the HTAC Policy and Planning Committee. Dr. Richmond will continue as Vice Chair. Mr. Eggert volunteered to join as a new member of the PPC, which now includes Rose, Eggert, Friedman, Hofmeister, Katsaros, Lloyd, Richmond, Shaw, and van Dokkum.

10. Discussion of 2010 HTAC Meeting Schedule and Other Business

10.1 Other Business

- Mr. Eggert asked about the status of HTAC membership. Mr. Mills replied that the HTAC charter states that the Committee must have a minimum of 12 and no more than 25 members. The number of current members is 20, but the Secretary is considering a new member approval package so there may be new member(s) in FY 2010.
- Dr. Richmond requested that the agenda for the next HTAC meeting include a joint presentation (to include someone from SC and someone from EERE) to brief the Committee on the basic research on hydrogen and fuel cells being conducted within SC and how that dovetails with the applied research in EERE.
- Dr. Shaw let the Committee know that as Chair of the HTAC Executive Committee, he will be taking the lead on organizing the agenda for HTAC meetings, with assistance from Mr. Mills. He took note of Dr. Richmond's request and reminded the members that another topic for the November meeting should be reviewing and gathering inputs for the annual (2009) state of the industry report. He asked the HTAC members send him and Mr. Mills any ideas for agenda topics via email within the next month or so. Mr. Mills also reminded the Committee that there is a list of potential agenda items that have not yet made it to the meeting floor, so he and Dr. Shaw could draw from that in developing the November meeting agenda. Dr. Richmond suggested that any new recommendations from HTAC members should take priority over the old list of items. Dr. Shaw agreed to take her suggestion into consideration, but noted that "priorities keep shifting."
- Mr. Hofmeister expressed his wish for an update on all that has happened in the automotive industry – what is left in terms of hydrogen and fuel cell initiatives, in the U.S. and the rest of the world. He declared that the industry is changing rapidly, at least in the United States.
- Mr. Rose suggested that the Committee be briefed on the "broader state of play" of hydrogen in the world, looking at ongoing activities in India, China, Scandinavia, and the Middle East. In these areas, hydrogen is being considered as a more universal form of energy, not just as a motor fuel.

- Dr. Hicks suggested that a presentation be given on battery technologies, particularly the current status, future potential (targets), and likelihood of success in meeting targets.
- Chairman Walker noted that the HTAC can provide recommendations to the Secretary at any time, so this could also be a subject for discussion at the November meeting.
- Mr. Rose asked whether DOE is still participating in the International Partnership for a Hydrogen Economy (IPHE) and when the next IPHE meeting would occur. Dr. Satyapal said that the next IPHE meeting is tentatively scheduled for December in the United States, but that discussions on U.S. participation are still in progress.

10.2 2009 and 2010 HTAC Meeting Schedule

- The next HTAC meeting is scheduled for November 4-5, 2009, in Washington, D.C.
- The Committee agreed to the dates of February 10-11, in Washington D.C., for the first meeting of 2010. During this meeting, the Committee will review the draft 2009 state of the industry report so that it can be published early in the year.
- The remainder of the 2010 calendar will be discussed at the November 2009 meeting.

Chairman Walker adjourned the HTAC meeting at 5:37 p.m., July 15, 2009.

**ELEVENTH MEETING OF THE
HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE (HTAC)**

PARTICIPANT LIST

JULY 15, 2009

HTAC Members Present

- Anthony Eggert
- David Friedman
- Janice Hicks
- John Hofmeister
- Art Katsaros
- Maurice Kaya
- Jim Narva
- Frank Novachek
- Joan Ogden
- Geraldine Richmond
- Bob Rose
- Ken Schultz
- Bob Shaw
- Jan van Dokkum
- Robert Walker

HTAC Members Not Present

- Larry Bawden
- Mark Chernoby
- Alan Lloyd
- Michael Ramage
- Philip Ross
- Kathleen Taylor

U.S. Department of Energy Staff

Office of Energy Efficiency and Renewable Energy

- Mike Mills
- Sunita Satyapal

Members of the Public in Attendance

- Anthony Anderson – Precision Combustion, Inc.

- Paul Aresta – Connecticut Center for Advanced Technology, Inc.
- Judith Bayer – UTC Power
- Lise Dondy – Connecticut Clean Energy Fund
- Tom Drejer – Connecticut Center for Advanced Technology, Inc.
- Mohammad Enayetullah – Trenergi Corporation
- Robert Friedland – Proton Energy Systems
- James Graeber – Bradley, Foster & Sargent Investment Management, Inc.
- Lee Grannis – Greater New Haven Clean Cities Coalition, Inc.
- Leo Grassilli – U.S. Navy
- Richard Hanley – Connecticut Department of Transportation
- Peter Hoffmann – The Hydrogen & Fuel Cell Letter
- Fred Jahnke – FuelCell Energy, Inc.
- Brian James – Directed Technologies, Inc.
- Praveen Kedar – General Motors
- Keith LaRose – Bradley, Foster & Sargent Investment Management, Inc.
- Andrei Leonida – Axiome Advisors
- Greg Moreland – Sentech, Inc.
- Deborah Moss – Avalence, LLC
- Charles Myers – Trenergi Corporation
- Joel Rinebold – Connecticut Center for Advanced Technology, Inc.
- Douglas Rode – Hydrogen Safety, LLC
- Martin Shimko – Avalence, LLC
- Cheryl Silber – Axiome Advisors
- Kim Stevenson – Connecticut Clean Energy Fund
- Stephen Warren – Connecticut Transit
- Christopher Wiegandt – Federal Mogul Corporation
- Mark Williams – URS Corporation
- Frank Wolak – FuelCell Energy, Inc.

Support Staff

- Judi Abraham – Conference Management Associates, Inc.
- Kristin Deason – Sentech, Inc.
- Anna Domask – Energetics Incorporated
- Melissa Laffen – Alliance Technical Services, Inc.
- Shawna McQueen – Energetics Incorporated