HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE

MEETING MINUTES

April 23-24, 2013

National Renewable Energy Laboratory, Washington, D.C.

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DAY 1 – APRIL 23, 2013

The Hydrogen and Fuel Cell Technical Advisory Committee (HTAC) meeting began at 9:04 a.m. EDT.

HTAC Chair John Hofmeister welcomed all attendees and staff. He called roll of HTAC members, both present and on the phone. The U.S. Department of Energy (DOE) Designated Federal Official (DFO) Joseph Stanford explained meeting rules and logistics and invited any written comments from the public be submitted to htac@nrel.gov.

1. HTAC Business (including Public Comment Period)

1.1. Renewal of Existing Members

This topic was not addressed at this time.

1.2. Approval of Prior Meeting's Minutes

Chair Hofmeister asked for any comments on the minutes from the February 15, 2013 HTAC conference call meeting. Hearing no comments, he invited a motion to approve the minutes. Mr. Shaw moved to approve the minutes and the motion was seconded. The motion passed unanimously.

1.3. Public Comment: Jeff Serfass, Managing Director, California Hydrogen Business Council (CHBC) and President, Technology Transition Corporation

Mr. Serfass described the CHBC as an organization of a little over 50 members that represents the breadth of the hydrogen community, including fuel cell companies. He expressed his view that hydrogen has a very important role to play in facilitating the increasing role of renewable energy on the electric grid and in transportation. He noted that the analysis presented at the last HTAC meeting by member Mr. Frank Novachek and others recognized the role for hydrogen energy storage, particularly where there is stranded wind power or other renewable energy assets.

According to Mr. Serfass, approximately 20 members of the CHBC believe that the dialogue on hydrogen's role in energy storage needs to be expanded. Beyond simply serving as a way to store electric power, hydrogen is also an important asset for managing renewable energy content through other mechanisms, for example as a high-value transportation fuel and as a fuel that can be injected into pipelines and recovered downstream. He noted that demonstrations are ongoing in Europe, Germany, and Asia and suggested California as a place to evaluate hydrogen's potential for the following reasons: (1) the strong energy leadership in California on a number of issues; (2) renewable energy penetrations that approach the levels seen in Europe, so there is an opportunity to explore how renewable energy interacts with the grid and how it might be used with hydrogen to provide other services; and (3) uniquely, the Public Utility Commission (PUC) in California has an open proceeding on energy storage. The proceeding is intended to decide whether or not energy storage in general should be a part of a capacity plan or a utility plan for its resources. The California PUC has already decided a planning case for Southern California Edison that requires the utility to put 50 megawatts of storage on the grid in conjunction with their other capacity plans. He

invited DOE and HTAC to work with California to recognize the role that hydrogen can play and to accelerate understanding of this potential.

As a manager of the Hydrogen Education Foundation (HEF), Mr. Serfass concluded by announcing that the HEF's next design contest will address the role of energy storage. HEF is currently working on developing the challenge statement and plans to initiate the contest itself over the course of the next year.

Questions, answers, and discussion

- Dr. Shaw asked about the frequency of CHBC meetings and whether HTAC members could attend.
    - Mr. Serfass replied that the CHBC has two open meetings per year. The next meeting is tentatively scheduled to be held in Sacramento, California, on October 9–10, 2013. HTAC members are welcome to attend.
    - **Action**: Inform HTAC members about meetings of the CHBC.
- Chair Hofmeister asked for opinions from the speaker or HTAC members on how far California would be willing to go on its own with respect to building out a hydrogen infrastructure, even if the rest of the country is lagging.
    - Mr. Serfass cited strong support in California, including its commitment to reduce greenhouse gases to 1980 levels by 2020, and the directive from Governor Brown reaffirming greenhouse gas reduction goals and making zero emission vehicles (hydrogen fuel cell vehicles and battery-electric vehicles) the vehicles of choice by 2040. Meeting these goals requires starting now.
    - HTAC member Mr. Anthony Eggert added that Governor Brown's Executive Order issued in April 2012 was converted into what's being called a "zero emission vehicle (ZEV) action plan." The *2013 ZEV Action Plan: a roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025* was published in February 2013 and lays out very specific 2015, 2020, and 2025 milestones for the development of infrastructure and the support of the market, including the state's commitment to procure vehicles. Mr. Eggert noted that the roadmap is very comprehensive, addressing all state agencies that have any sort of influence over such activities. Currently, the state administration's commitment is very strong to support these technologies as part of a portfolio of different solutions to achieve both energy and climate goals. Mr. Eggert cautioned that this support is political, and the funding requires reauthorization by the legislature. Right now the state is reauthorizing the primary program that provides funding to infrastructure, and its passage requires a two-thirds vote of the legislature. He noted that there is fairly vigorous debate about the program, especially in relation to hydrogen infrastructure investments.

1.4. Public Comment: Morry Markowitz, President and Executive Director, Fuel Cell and Hydrogen Energy Association (FCHEA)

Mr. Markowitz began by thanking Dr. Sunita Satypal, Mr. Steve Chalk, and Dr. David Danielson for the work they have done at DOE to spur the development and adoption of hydrogen and fuel cell technologies. He reported that FCHEA's initiative to reenergize the Fuel Cell and Hydrogen caucuses in the Senate and House of Representatives has been very successful. Since August of last year, they have recruited eleven senators to join the Senate caucus and close to 40 congressmen to join the House caucus. In fact, FCHEA and the House caucus are sponsoring the first Congressional Fuel Cell and Hydrogen Energy Expo on April 24, at 3:30 p.m., in the Cannon Caucus Room. The event will include presentations by DOE and five members of Congress, as well as a panel of state organizations, including representatives from organizations in Ohio, California, Connecticut/New England, and South Carolina. Mr. Markowitz encouraged the HTAC members to attend, and noted that the event is open to the public. Other initiatives FCHEA and its members are working on include: (1) supporting the development of the H2 USA partnership and (2) engaging the states of New Jersey, New York, and Connecticut on understanding the role fuel cells can play in providing reliable emergency backup power and distributed power generation services, especially regarding potential policy decisions that may emerge as a reaction to Hurricane Sandy.

Questions, answers, and discussion

- HTAC Member Mr. Gary Flood asked whether FCHEA has engaged with the Federal Communications Commission (FCC), which mandates the reliability and performance of telecommunications networks. He noted that in 2007 the FCC issued a ruling known as the Katrina Order, which would have required telecommunications providers to maintain emergency backup power for minimum time periods. The order was challenged in court, and as a result the rules have never been enforced. Mr. Flood noted that there are currently requirements for reliability in the "wired in side of the system," but that the wireless carriers do not have the same requirements. He asked if FCHEA had considered working with the FCC to get the rules reissued or revised.

  Mr. Markowitz replied that the FCHEA board has approved an initiative to work in this area, but could use help as only a few member companies are really focused on this issue.

1.5. HPEP Subcommittee Update, Levi Thompson, Subcommittee Chair

HTAC Member Dr. Levi Thompson gave a brief update on the status of the HTAC Hydrogen Production Expert Panel (HPEP) Subcommittee report. Comments on the report were received from various DOE programs, and the group is working to address those by clarifying a few points. He noted that the comments were not major and did not affect the conclusions of the report. Dr. Thompson reported that the authors of the sections in which comments were made have been involved in addressing the comments, but since they are minor in nature he does not believe it is necessary to have the document re-reviewed by the entire Subcommittee or HTAC. Dr. Shaw agreed, saying that HTAC previously agreed to leave any final, minor revisions to the report at the discretion of Dr. Thompson.

2. DOE Updates

2.1. David Sandalow, Acting Under Secretary of Energy, U.S. Department of Energy

Dr. Sunita Satyapal, Director of the Fuel Cell Technologies Office (FCTO) at DOE, introduced Mr. David Sandalow, who served as Assistant Secretary for Policy and International Affairs at DOE before being appointed to his current position as Acting Under Secretary for Energy. She thanked him for his support of the FCTO research and development (R&D) program and noted that DOE is now forming an inter-office tech team on fuel cells. Dr. Satyapal went on to provide some background on his career. Prior to his appointment at DOE, he was a Senior Fellow, Foreign Policy Studies, and an Energy and Environment Scholar at the Brookings Institution. He also chairs the Energy & Climate Change Working Group at the Clinton Global Initiative (GCI). He is the author of *Freedom from Oil: How the Next President Can End the United States' Oil Addiction* and Editor of *Plug-In Electric Vehicles: What Role for Washington?* Mr. Sandalow has written widely on energy and environmental policy including op-eds in the New York Times, Washington Post, Financial Times, and many other publications. Previously, he served as Assistant Secretary of State for Oceans, Environment & Science; Senior Director on the National Security Council staff; Associate Director on the staff of the White House Council on Environmental Quality; and Executive Vice President of the World Wildlife Fund.

Mr. Sandalow began by thanking the HTAC members for their service and Chair Hofmeister for serving as HTAC Chair. He underscored how much DOE values the work of HTAC. He also praised the efforts of Dr. Satyapal, especially the diligence, intellectual rigor, and thorough technical approach that she applies to her work on behalf of the program. He recently accepted a position at Columbia University as the first Fellow at the Center on Global Energy Policy, and will soon be leaving DOE. He has been honored to work at DOE and expressed his admiration for the high caliber of the staff there.

He is hopeful that the President's "all of the above" energy strategy will dissuade the tendency for alternative energy technologies to compete with each other, since it is important to pursue all different types of energy technologies and all different types of energy pathways. One example is the hydrogen and fuel cells program area, which received a fiscal year (FY) 2014 budget request that was $20 million above (25% higher) than the FY 2013 request. He explained that the $100 million dollar FY 2014 request provides stable funding to enable continued progress in developing hydrogen and fuel cell technologies, which aligns well with the President's strategy as well as automakers' plans for commercial fuel cell and electric vehicles in the 2015 timeframe and beyond.

Mr. Sandalow noted that nearly 300 hydrogen and fuel cell projects are currently funded by DOE at companies, national labs, and universities across the country. DOE-funded activities have (1) reduced the cost of fuel cells by 35% since 2008, and more than 80% since 2002; (2) reduced the cost of electrolyzer stacks by 60%; (3) achieved more than a five-fold reduction in the platinum content of fuel cells; and (4) led to more than 360 patents, 35 commercial technologies, and 65 emerging technologies. The FY 2014 budget request will enable the U.S. to sustain its leadership in this emerging energy technology and help maintain domestic competitiveness.

DOE investments, he explained, have also acted as a catalyst for market success. Through American Recovery and Reinvestment Act market transformation activities, over 1,200 fuel cells have been deployed in emergency backup power and material handling applications. These successful deployments have led to the purchase of more than 5,000 additional fuel cells, with no additional DOE funding. By accelerating early adoption, DOE has been enabling the growth of a domestic manufacturing base, prompting additional private sector investment, and helping drive down cost through economies of scale.

Mr. Sandalow pointed out that the "natural gas revolution" in the United States today is occurring because of new technology for hydraulic fracturing and horizontal drilling, which DOE invested R&D funds in more than thirty years ago. He asserted DOE's investment helped make the difference, and this should be kept in mind as we consider investing in technology today. Mr. Sandalow framed the question as "what are we going to be investing in today that will make the same difference for our children and our grandchildren?" He expressed his hope that technology being focused on by HTAC today will be among those that will make a difference. He pointed to some of the cutting-edge approaches that DOE R&D is exploring, such as direct photoelectrochemical conversion and photobiological production to produce hydrogen from renewable sources. Here the input of HTAC's Hydrogen Production Expert Panel has been valuable, and DOE is in the process of implementing many of the Panel's recommendations. DOE is also supporting R&D to address other barriers to commercialization, such as reducing technology cost. He stated that the largest barrier to widespread adoption of hydrogen is development of infrastructure.

Mr. Sandalow noted that outreach and collaboration activities are also on the rise. DOE recently signed a letter of understanding to join H2USA, a public/private partnership among DOE and other federal agencies, automakers, state governments, academic institutions and additional stakeholders, to promote widespread adoption of FCEVs. He also noted that on the following day (April 24), the House Hydrogen and Fuel Cell Caucus would hold an expo for congressional members, staff, and interested public. On March 16, 2013, President Obama visited Argonne National Laboratory to talk about his blueprint for a green and secure energy future. The President described his plans for an Energy Security Trust that focuses on developing cost-effective alternatives to oil-based transportation technologies, including FCEVs. On March 26, 2013, DOE launched the Clean Energy Manufacturing Initiative, focused on growing American manufacturing of clean energy products and boosting U.S. competitiveness through major improvements in manufacturing energy productivity. The announcement was made at the ribbon-cutting of the carbon fiber manufacturing facility at Oak Ridge National Laboratory, an advanced manufacturing facility with the goal of reducing the cost of carbon fiber, a critical material for hydrogen storage tanks. Finally, earlier this year, DOE launched a new internal fuel cell tech team, to encourage collaboration among DOE offices and bring together expertise to work on fuel cell and hydrogen issues.

Mr. Sandalow observed that it is a time of management transition at DOE. Energy Secretary Chu's resignation became official yesterday, and Deputy Secretary Daniel Poneman will serve as Acting Secretary until the next secretary is confirmed. Mr. Sandalow noted that should Dr. Ernest Moniz be confirmed by Congress as the new Secretary, DOE will be privileged to have a tremendous leader and scientist at the helm.

Dr. Moniz is now a professor of theoretical physics at MIT, and served as the Under Secretary of DOE from 1995 to 2001. Mr. Sandalow concluded by thanking HTAC for the opportunity to kick off their discussions, and said that he is looking forward to the next chapter with the President's focus on energy issues and his "all of the above" approach.

Questions, answers, and discussion

- Mr. Eggert noted Mr. Sandalow's mention of infrastructure as one of the key remaining challenges for getting product on the road. He explained that California is embarking on an effort to try to fill that gap. He asked whether Mr. Sandalow could comment on the role DOE will play in H2USA or the Energy Security Trust, or whether DOE might play a more active role in a state like California.
    - Mr. Sandalow asked HTAC to provide recommendations to DOE on ways to do this most effectively. Funding is highly constrained, but there likely are deployment activities where targeted funding could make a big difference.
- Mr. Rose noted that during the Obama administration the hydrogen and fuel cells program went from one of the larger DOE Energy Efficiency and Renewable Energy (EERE) programs in terms of budget to one of the smaller ones, and the FY 2014 request is a little more than 10% of the total DOE transportation R&D budget request. He asked for Mr. Sandalow's thoughts on whether there may be a trend towards regaining a better balance among the various transportation technology budgets.
    - Mr. Sandalow explained that the 25% increase in the Fuel Cell Technologies Office request from FY 2013 to 2014 should be seen as significant, given the pressure on federal budgets. He also noted that decision makers are most interested in research and energy technology that has made, or will make, a difference in the lives of American people—that is the case that needs to be made.
- HTAC member Dr. Alan Lloyd asked Mr. Sandalow for his view, from the international perspective and considering DOE's involvement in the Clean Energy Ministerial (CEM), on DOE's position on the role of fuel cells in both transportation and power generation.
    - Mr. Sandalow attended the recent CEM meeting in India (CEM4), and provided a bit of background on the CEM's origin and purpose. One of the CEM's 13 initiatives is the Electric Vehicles Initiative (EVI), in which the U.S. and 14 other CEM member countries participate. He explained that the EVI was proposed by China to work on electric vehicles. The goal of EVI is to facilitate the global deployment of 20 million EVs, including plug-in hybrid electric vehicles and FCEVs, by 2020. Mr. Sandalow reported that one of the proposals that came out of CEM4 was to broaden the range of EVI to the whole range of alternative transportation fuel technology. Since there was considerable interest in the proposal, it appears that there may be more international work in this area.
- Chair Hofmeister observed that he hears more and more skepticism, both on a national and international level, about battery electrification, given the "mystery" of

batteries. He asked whether the balance of attention or interest in batteries for electrification has shifted, from a DOE standpoint. He questioned whether there was internal consideration of the practical realities of battery-based and hydrogen-based electrification, given what is happening around the world.

- Mr. Sandalow recalled Secretary Chu's meeting with HTAC last year, in which the Secretary expressed his interest and enthusiasm in this area. Mr. Sandalow also noted that he has spoken with a number of automakers around the world about their interest in FCEV technology and their belief that it offers some significant benefits over other alternatives. While he did not want to speak for the new DOE management, he did advise that they will be looking for opportunities that can make a difference, and for investments that can have the most impact. His recommendation to HTAC and others interested in promoting hydrogen and fuel cells is to demonstrate the impacts the technology can have with as much technical rigor and strategy you can bring to bear on the issue. Having known Dr. Moniz for many years, Mr. Sandalow believes he will continue to bring rigorous scientific and technical judgment into his analysis and decision making.

2.2. Fuel Cell Technologies Update, Sunita Satyapal, Director, Fuel Cell Technologies (FCT) Office, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

Dr. Satyapal thanked the HTAC members on behalf of the FCT Office, noting that the Office greatly appreciates HTAC's inputs and urging HTAC members to continue to correspond with her through phone calls and emails. She also thanked the National Renewable Energy Laboratory (NREL) for hosting the HTAC meeting at their Washington, DC office. She explained that the switch from a hotel-based venue is a budget-saving measure, and hoped it does not inconvenience the members. She introduced Mr. Joseph Stanford, the new Designated Federal Official for HTAC, who is taking over that role from Jason Marcinkoski, and thanked support staff for their help in organizing the meeting.

Dr. Satyapal provided a summary of the FCT Office's activities and highlights since the previous HTAC meeting. She gave an overview of the DOE Hydrogen and Fuel Cells Program (the Program) and discussed the strong impact DOE funding has had on the advancement of hydrogen and fuel cell technologies, such as doubling fuel cell durability since 2006. She previewed the FCT Office's FY 2014 budget request, noting that it is 25% higher than the FY 2013 request, and that hydrogen and fuel cells are an integral part of the administration's "all-of-the-above" energy strategy. She explained that R&D efforts are focused on pre-competitive, high-risk technologies with near-, mid-, and long-term impacts. New this year, the Office plans to set aside about 10% of its budget to fund "incubator" projects—with the intent of fostering "outside the box" approaches compared with the ongoing program activities. Dr. Satyapal gave updates on the different programs within the FCT, touching on their challenges, strategies, activities, and paths forward. She discussed the FCT's future plans, which include continuing to promote and strengthen R&D activities; conducting strategic, selective demonstrations on innovative technologies; continuing to conduct key analyses to guide research, development, and demonstration, and the path forward; and leveraging activities such as H2USA to maximize impact. She concluded with a slide highlighting HTAC's activities

and inputs to DOE, including the HTAC Annual Report, input on the hydrogen threshold cost revision, input on potential H-Prize topics, input on the upcoming DOE Request for Information on home hydrogen refueling, and the recent reports from the Hydrogen Enabling Renewables and the Hydrogen Production Expert Panel Subcommittees, which she hopes to present to the new DOE leadership. She also issued a request to HTAC to form a Fuel Cell Manufacturing Subcommittee to provide feedback to DOE on manufacturing R&D gaps and opportunities for government to accelerate hydrogen and fuel cell manufacturing technology.

>>see full presentation at
http://www.hydrogen.energy.gov/pdfs/htac_apr13_1_satyapal.pdf

Questions, answers, and discussion

- Dr. Shaw asked whether HTAC was required by statute to review the September 2011 *DOE Hydrogen and Fuel Cells Program Plan.*
    - Dr. Satyapal explained that the Committee completed that requirement when it reviewed the *Hydrogen Posture Plan*. The *Program Plan* is a revised, updated guiding document for the Program, and was provided for the HTAC members to review during the public comment period, during which time a number of comments from HTAC members were received and incorporated.
- Dr. Thompson asked whether the Program is tracking the revenues associated with commercial products that have come about as the result of DOE investment.
    - Dr. Satyapal replied that they have started tracking return on investment and have some preliminary numbers, but the work has not been completed.
- HTAC member Dr. Peter Bond asked about the FY 2013 budget and whether the actual budget was higher under the Continuing Resolution (CR) than the DOE request.
    - Dr. Satyapal replied that the FY 2013 budget request was $80 million; under the CR the actual budget was about $103 million, but that amount has been reduced to about $98 million by the sequestration and other rescissions.
    - **Action:** DOE will include the final FY 2013 budget in the final HTAC presentation materials that are posted to the website.
- Chair Hofmeister asked if there is an inter-agency accounting of funding for hydrogen and fuel cell R&D.
    - Dr. Satyapal replied that there is a call out now to gather that information, but it has been difficult since most of the other agencies or departments do not have specific budget line items for hydrogen or fuel cells. It can be difficult to determine how much of a project's budget is related to hydrogen and fuel cell RD&D. She noted that some years ago, the interdepartmental budget was about $400 million, with about $100 million coming from agencies other than DOE. The DOE Hydrogen and Fuel Cells Program continues to collaborate with

the National Science Foundation, Department of Defense, Department of Commerce, and other agencies.

- HTAC member Mr. Maurice Kaya asked whether DOE is considering working more closely with states and other regional organizations as it moves into more market transformation and incubator activities, especially on issues associated with the environmental impacts and siting of new technologies.

    - Dr. Satyapal responded that DOE is working with California, states in the northeast cluster, Ohio, and others. Given funding limitations, they are trying to target some of the main obstacles these states are facing. For example, in its work with California, DOE learned that even though stations are being built for public use, a vehicle cannot be commercially filled with hydrogen unless the dispensed hydrogen can be metered to a specific accuracy. So, DOE is working to help catalyze the development of an appropriate meter as well as working with the state to validate the existing meters. DOE is also working with state and other organizations to support codes and standards development, in areas like refueling protocols, station setback distances, and so on. In addition, a solicitation was released seeking proposals for additional early fuel cell market applications, such as ground support equipment at airports, fuel cell battery hybrids for extended-range medium-duty trucks, and refrigerated trucks.

- HTAC member Dr. Robert Shaw commented on slide 10's innovation and commercialization timeline, noting that the placement of "Commercialization" before "Market Entry" on the timeline was curious, since generally a technology will enter the market in niches before widespread market adoption and commercialization occurs. Secondly, he pointed out that the "Pre-IPO Gap" can be very much longer than the one shown in the slide. He noted that numerous companies have issued successful IPOs only to struggle for a decade or more to achieve profitability. He observed that the readiness of the market usually has more to do with the cost of the product than it does the working of the product. He suggested that the phase from early market entry to widespread commercialization needs a lot of thinking about how to help carry businesses through, not just a short valley of death, but a protracted period of trying to drive costs down and move up the technology and manufacturing learning curve while sales volumes are low.

    - Dr. Satyapal agreed, and noted that the slide is meant to be an example of one possible technology development timeline, and is not representative of all industry start-ups.

- HTAC member Dr. Timothy Lipman asked if there is a map showing the clusters where fuel cell commercialization is expected and first-responder training is being conducted by DOE, and which jurisdictions DOE has covered and where there are gaps that others could address.

    - Dr. Satyapal responded that there are 44,000 jurisdictions, and DOE has been trying to focus education efforts in specific areas where there have been opportunities for early markets. That type of map might not necessarily be helpful by itself, although DOE does have the information. The main goal is to

match the education and outreach strategy with the market transformation strategy.

- Mr. Kaya observed that Dr. Satyapal's briefing did not touch much upon the stationary power side. He is concerned that DOE is missing this opportunity, particularly in light of the findings from the Hydrogen Enabling Renewables Subcommittee. There are early adoption opportunities for stationary power that also may be missed. He also observed that the electric utility industry is moving increasingly towards power generation from natural gas, and there may be opportunities for synergies between the power generation and transportation sectors on the development and use of gas distribution systems. Lastly, he asked about the EERE reorganization that places the FCT Office under a Sustainable Transportation umbrella, along with the Vehicles and Bioenergy Technologies Offices. He asked whether that shift is creating any issues that HTAC needs to be aware of, e.g., with respect to transportation policy.
    - Dr. Satyapal replied that the Deputy Assistant Secretary for Sustainable Transportation has not been hired yet, and more details will be available once the reorganization is complete. She noted that there has definitely been a shift in her focus towards the transportation side, but there are still opportunities for collaboration with other offices. In addition, some of the FCT work is cross-cutting in nature, for example advanced catalysts could apply to both stationary and transportation fuel cells.
    - Mr. Kaya responded that he, and at least some other members of HTAC, tend to look at the totality of both stationary and transportation applications, and wondered how they can provide DOE with input if DOE is going to subdivide or put different emphasis in different departments. He noted that the HTAC charter asks for input on all fuel cell applications, and the membership reflects this in its balance of expertise. He urged Dr. Satyapal and her leadership team to make the best use of HTAC across both sectors.
    - Dr. Satyapal responded that HTAC's input is to the Secretary of Energy, and the Committee should continue to make specific recommendations, regardless of the sector, because it has purview over all of the applications.
    - Mr. Kaya replied that if this EERE structural split does occur, then the HTAC members may want to consider how to organize to feed into that split governance within DOE, so the totality of the focus is not lost.
- HTAC member Mr. Robert Rose agreed with Mr. Kaya, and followed up by asking about the status of DOE research on solid oxide fuel cells, both in the FCT Office and in the Office of Fossil Energy (FE).
    - Dr. Satyapal noted that the DOE budget request for the Solid State Energy Conversion Alliance (SECA), which is the multi-megawatt-scale fuel cell program in FE, has been zero for the past three years. Congress appropriated $25 million in the last two years, so the exact number for next year is not known. FE's focus has shifted toward carbon capture. If HTAC requests it, DOE could arrange for a presentation from FE at a future HTAC meeting. On the EERE side, the FCT Office

funded small-scale solid oxide fuel cells at a peak of about $10 million; now that funding is less than $2 million, mainly for auxiliary power units and small stationary applications. She noted that there has always been a bit of difficulty in categorizing the FCT Office within EERE, because of the crosscutting nature of fuel cell applications.

- Dr. Shaw recommended that HTAC spend some time looking into ways to reduce the time to build stations, shown in slide 31; for example, a standardized product delivered to sites with a standardized permitting process that everybody follows. The inability to move from a siting decision to station operation in less than a year will make it very difficult to get the high level of coordination needed between the OEMs delivering the vehicles and the station developers.

- Dr. Shaw also commented on slide 34, showing the cost of hydrogen produced from distributed natural gas reforming. He noted that the slide tells us (1) that gas prices are not that sensitive, and (2) that the difference between the delivered price of hydrogen to the dispenser and the cost that you can charge the customer (which almost by definition has to be less than the cost of equivalent per-mile cost of gasoline) is the critical variable. The key is getting volumes up enough and station costs down enough to make hydrogen production and delivery as efficient as gasoline production and delivery. He added that his analysis of the issues has concluded that the first many hundreds of stations will need to be supplied by tube trailer or liquid from a large scale facility.

- Chair Hofmeister noted that reducing time to build stations will depend on working with parties that know the local real estate community and the development plans of an area. It will also require working well with local stakeholders so that the necessary community approvals and permitting process do not get bogged down. He expressed concern that the FCT Office's Education program budget is zero, since it is important to educate the public so that this becomes common language in communities where stations are being proposed.

- HTAC member Mr. Gary Flood noted that his company deals with a lot of siting in various jurisdictions around the country (though not at the volumes or scale required for consumer vehicle refueling). Right now the mean time to go through the site-acquisition process (getting the local jurisdiction to approve) is over six months. His biggest concern is that the timeline does not get shorter the second and third time, even if he is working within the same community. He does not, therefore, think it's an educational problem. Rather, it's a feature of the timeline for getting through the government bureaucracy as well as a wide degree of variance in the staff that make up the permitting offices—both in terms of numbers (who you deal with out of the group of staff) and in terms of staff turnover. Often, each permitting official will assess the project on his or her own, rather than relying on a previous staff-person's assessment.

- HTAC member Mr. David Taylor noted that one key is to figure out how to fit hydrogen stations onto existing gasoline stations. Doing this requires a hydrogen station with a small footprint.

- Chair Hofmeister added that many of the big multi-acre gasoline fueling stations like Wa-Wa are anticipating the future, because they want to be retail centers and have the space to expand and provide fueling choices.

- Dr. Shaw noted that one opportunity he and others have explored is building green-field hydrogen fueling stations on the parking lots of big box stores and shopping centers. This would provide a revenue source for the owner of the property, which goes largely unused for all but a few of the busiest shopping days.

3. Report on Newly Announced Automotive Fuel Cell Partnerships

3.1. Fuel Cell Electric Vehicles and the Consumer, Bob Wimmer, National Manager, Energy & Environmental Research Group, Technical & Regulatory Affairs, Toyota Motor North America

Mr. Wimmer stated that multiple approaches are required to achieve sustainable transportation goals, including alternative fuels, diesel, gasoline, and electricity. He stated that the expansion of their hybrid vehicle sales is the foundation of these efforts. He discussed requirements for fuel cell electric vehicle (FCEV) commercialization in terms of vehicles, the market, and refueling infrastructure. For vehicles, he noted that commercial fuel cell system design is complete, internal 2015 performance targets are being met, and costs have been significantly reduced; however, further cost reductions are needed to achieve their overall goal of a nearly 95% reduction. He described the BMW/Toyota Partnership as a binding, long-term collaboration in the field of sustainable mobility. The partnership is focused o four project areas: (1) fuel cell systems (with a 2020 projected completion date) and collaboration on codes and standards and infrastructure issues; (2) potential joint-platform for a mid-sized sports car (3) light-weight technology; and (4) post-lithium battery technology. In discussing the FCEV market, Mr. Wimmer stated that plug-in hybrid electric vehicle (PHEV) marketing and sales experience provides useful insight for FCEVs, noting, for example, that it was learned that mass market consumers appear unwilling to pay a premium for PHEVs. He then remarked that manufacturers will deploy FCEVs in regions with adequate infrastructure. He discussed the status of hydrogen infrastructure, noting that current station construction is dependent on public funding, and that the return on investment must improve via incentives and tax policy. Mr. Wimmer concluded by sharing four keys to FCEV success: (1) FCEVs need to perform like conventional automobiles; (2) consumers need to value and desire FCEV benefits; (3) FCEVs must offer a convenient, dependable, and comfortable refueling experience; and (4) sustained, consistent policy is needed for technology diffusion.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_2_wimmer.pdf

Questions, answers, and discussion

- Mr. Koyama asked if Toyota or other manufacturers have a specific target in mind with respect to the number of refueling stations that need to be in California or the Northeast to introduce a new vehicle. He also asked whether the "cluster approach"

for rolling out stations, as proposed by the California Fuel Cell Partnership, is the preferred approach from the viewpoint of automakers.

  - Mr. Wimmer replied that the original target for California was 68 stations by the 2015-ish timeframe, but it is not likely that target will be met. He was uncertain whether there are going to be enough stations in enough locations for the auto companies to be comfortable introducing their vehicles. He noted that the cluster approach is slated to start in southern California, with the hope that H2USA will facilitate this build-out and a similar cluster in the Northeast. The idea is that if you have multiple clusters in key urban areas, you might be able to put a few stations between those clusters so FCEVs can travel, for example, from Los Angeles to San Francisco.

  - Mr. Craven replied that Daimler and their partners are counting on 68 to 100 fueling stations in California, and hopes the funding bill for the stations that is currently being debated by the state will be passed.

- Mr. Lloyd noted that Toyota has announced a 2015 target date for FCEV commercialization, but that it would depend on infrastructure. He asked whether Toyota would deploy a smaller number of vehicles in 2015 if the expected number of stations are not there, or if they will push the deployment date back. Dr. Lloyd also commented that he was surprised by Hyundai's announcement that they will begin FCEV deployments in Europe since they have better infrastructure.

  - Mr. Wimmer replied that those discussions continue, in both Toyota's U.S. and Japan-based offices. He said that right now everything is very fluid, but they have set a start-of-production date, and are steadily working toward it. Regarding European hydrogen fueling infrastructure, Mr. Wimmer noted that it is growing, but slowly in most regions.

- HTAC member Mr. Joe Triompo asked if Japan has a better infrastructure or roll-out plan than California, and if there are any lessons that can be learned.

  - Mr. Wimmer said that they do have a plan, but they are also struggling with funding, decisions on where stations are going, and moving from an R&D mode to actual commercial stations.

- Mr. Eggert pointed out that one of the expressed concerns of California legislators is putting in money and being left holding stranded infrastructure. He noted that the "chicken and egg" problem is turning into a "game of chicken" between the funders and the OEMs. He asked if Mr. Wimmer had any thoughts about how to increase the policymakers' confidence that the cars will be there – is there a way to make this more concrete than through the use of press releases?

  - Mr. Wimmer replied that Toyota has people in southern California that are constantly talking about what they are doing, but that the analogy to a game of chicken is probably accurate, and unfortunate. He suggested that at some point the two groups will need to trust that we can work together to make this happen, because without communication and coordination, it's not going to succeed.

3.2. Common Fuel Cell Project, William B. Craven, General Manager, Regulatory Affairs, Daimler

Mr. Craven described the Common Fuel Cell Project, a collaborative effort by Daimler, Ford, and Nissan to develop a common fuel cell electric system. He stated that the project will also seek to define global specifications and component standards; achieve economies of scale through higher volumes; accelerate the commercialization of FCEVs; and offer a clear signal to suppliers, policy makers, and the industry in terms of further development of hydrogen infrastructure. He noted that the project features key fuel cell markets and players, as well as collaboration across three continents. He stated that this cooperation establishes the technology on a significantly broader basis, and offers many other benefits, such as creating several hundred new jobs in the fuel cell supplier industry. Mr. Craven described the packaging of the fuel cell system under development, noting that the significantly more compact dimensions will enable it to fit into the engine compartment of a conventional vehicle. He also described the Automotive Fuel Cell Cooperation Corporation (AFCC), a joint-venture private company owned by Daimler, Ford, and Ballard that seeks to make automotive fuel cells a reliable and affordable solution in the 2015 timeframe. He explained that in February 2008 all of Ballard's automotive assets and resources were transferred from Ballard Power Systems to AFCC, and that Ford had exclusive rights to the patents for five years, and after that time Ballard could seek other automotive partners. In March 2013, Ballard announced a partnership with Volkswagen, to which VW has committed $100 million dollars. He observed that with this partnership, all of the German car companies are now well invested in fuel cell vehicle technology, which is good for the industry. Mr. Craven concluded with a slide describing Daimler's fuel cell car, bus, and van deployments around the world.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_3_craven.pdf

Questions, answers, and discussion with both speakers

- Dr. Lloyd asked how Mr. Craven viewed the future for fuel cell buses.
    - Mr. Craven replied that Daimler is producing buses, but only in Europe for now. They decided that the buses still need engineering support, and they do not want to spread that capability out all over the world. He noted that Daimler makes Citaro buses, Freightliner trucks (18 wheelers), and also has a school bus company in the U.S. They view buses and commercial vehicles as exciting for the future, especially since developing the fueling infrastructure is easier.
- Mr. Kaya asked both speakers if they had suggestions for the role of government in addressing the gap between early adoption and early markets, especially suggestions that do not simply involve funding, which is limited.
    - Mr. Wimmer replied that it is important to get government support of the technology, and H2USA is a good example of that. It is essential that we move from public funding of these stations to private funding, so we need to get the

venture capitalists and the business community interested and willing to invest. To do that, DOE and other government entities have to make a much stronger, positive statement supporting the technology in more public forums.

- Mr. Craven agreed, noting that the outgoing Secretary of Energy's negative remarks about hydrogen and fuel cells put forth a confusing message to Germany, which was part of Daimler's decision not to deploy FCEVs in 2014. He noted that it is very encouraging that DOE has signed on to H2USA, and this has sent positive signals to the market.

- Mr. Flood asked whether the automakers have considered investing in the early infrastructure themselves.
  - Mr. Craven replied that this is not a likely option in the U.S., though in Germany Daimler is helping to finance 20 fueling stations, mainly because of the close working relationships between the German government and German companies.

- Mr. Eggert noted that both automakers are using 700-bar storage tanks on their vehicles, and asked if they considered this storage method appropriate and/or adequate for the long-term—and, if not, how far down the path 700-bar tanks can carry vehicles in terms of commercial deployment.
  - Mr. Wimmer stated there is not a developed technology that can provide the 300-plus mile range to replace the current 700-bar tanks. He noted that Toyota is comfortable with the current costs and performance of the hydrogen tanks.
  - Mr. Craven agreed, noting that vehicle and component design has to stop at some point so that the industry as a whole can standardize. He expects that there will be better technologies down the road, but current vehicles will have the range and fill-times that will satisfy today's customers. He stated that he expects 700-bar tanks to be the standard for many years, though work on other technologies will continue.

- Dr. Satyapal reported that the United States will be taking on the role of Vice Chair of the International Partnership for Hydrogen and Fuel Cells in the Economy, and Japan will be the next Chair. She noted that Germany plans 50 stations by 2015 and has allocated about $52 million in government funding to support the build-out. Japan plans 100 stations by 2015, with roughly $53 million of support from the government side. In California, there is potentially $20 million per year for three years and plans for stations. She asked if the speakers could comment at what point in time the car companies will decide whether to focus deployments on Europe, Japan, or other places as opposed to California.
  - Mr. Wimmer noted that Toyota does have a start-production date. Once the vehicles are in production, the company will decide where to deploy based on the infrastructure in those regions around the world. Prior to that, we cannot talk specifically about volumes or our decision criteria.
  - Mr. Craven replied that Daimler will certainly be deploying in Germany before California. That is the company's home, and they are very focused on

greenhouse gas reduction, getting infrastructure in, and getting the electricity from renewable fuel to make the hydrogen, rather than from natural gas. German society is also more passionate than we are here in the United States about making this happen.

- HTAC member Dr. Joan Ogden asked if her perception is correct, that it is very important to the automakers that California pass the legislation funding the $20 million of infrastructure development for each of the next 3 years.
    - Both speakers replied that it is very important.
- Mr. Rose asked Mr. Craven about whether Daimler's partners in the Common Fuel Cell Project, Ford and Nissan, have set commercialization dates for FCEVs.
    - Mr. Craven responded that he could not speak to that question.
- Chair Hofmeister asked whether the speakers' companies had someone in the role of "fuel guru of the future," with the responsibility of looking at the multiplicity of prospects. He noted that the natural gas revolution in the U.S. is huge, and there are groups organizing now across the U.S. to turn natural gas into a transportation fuel. He wondered whether the car companies' fuel gurus recognize that natural gas could displace oil before hydrogen does. He added that natural gas works very nicely in an internal combustion engine with a flex-fuel design, and it can be turned into gasoline. He wondered whether the automakers could envision a day that Germany, Japan, and maybe some other countries (e.g., Korea and China) go for hydrogen fuel cells because they can get a whole lot more hydrogen than they can oil or natural gas, whereas the U.S. becomes an "anomaly." He questioned whether there is enough market volume in those countries for the automakers to pursue FCEVs as an option.
    - Mr. Wimmer remarked that Toyota is looking at the full range of alternative fuel technologies. He noted that they have energy groups in each region around the globe that are trying to understand the policies, the consumer demand, and the issues around fuels, energy resources, and security needs. He noted that Toyota's research labs are developing technologies to fit with what we view as the future in different regions around the world, and are prepared to provide vehicles to meet the regional preferences that ultimately emerge.
    - Mr. Craven replied that all OEMs have a fuels group, and every company, including Daimler, will be working on all technologies that they feel have a place in the future. At the end of the day, the customer will buy it or not buy it, based on many factors, some of which we can't foretell. If global warming makes an impact sooner than we think, there could be a big change. Methane may not be able to reach the maturity in the transportation sector that many think it could, due to future challenges with methane production, transportation, and so on. Some countries will develop some technologies sooner than others. Germany could potentially be regional, based on many factors. He noted that those in HTAC who are skeptical about the commercial potential of FCEVs are welcome to visit Daimler. He explained they would have the members sign non-disclosure agreements and show them what we are working on and where money is being spent.

4. Transportation Sector Reports

4.1. Transitions to Alternative Vehicles and Fuels: Report of the NRC Committee, David Greene, Corporate Fellow, Energy and Transportation Science Division, Oak Ridge National Laboratory

Dr. Greene discussed a report from a National Research Council (NRC) Committee entitled *Transitions to Alternative Vehicles and Fuels*, presenting an overview of the report's tasks and findings, the predicted progress of key technologies to 2050, and key results for FCEVs. The NRC Committee was charged with evaluating and reporting on the potential for how the on-road light-duty vehicle fleet can reduce its petroleum use by 50% by 2030 and by 80% by 2050, as well as reduce its greenhouse gas emissions by 80% by 2050. In addition, the Committee was tasked with assessing the cost and performance of vehicle and fuel technology options that can help meet the goals, identify barriers that hinder their adoption, and suggest policies or programs to achieve the goals. Dr. Greene shared several key findings from the Committee's report, including that multiple pathways will be needed; improved efficiency is essential to the success of the other pathways; and new, non-petroleum fuel infrastructure and new vehicles that capture the required market share must be developed. Other conclusions of note were that while early market success of FCEVs and PHEVs requires temporary subsidies, the total benefits exceed the costs by an order of magnitude. He noted that federal policy is required to drive these changes and provided some policy suggestions from the report, including a call for the continuation of government-supported R&D.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_4a_greene.pdf

Questions, answers, and discussion

- Mr. Eggert asked what "strategies" were used to promote both FCEVs and PHEVs in the scenario that produced close to 88% reduction in greenhouse gas emissions and 100% reduction in petroleum use by 2050 (shown in slide 21).
    - Dr. Greene replied that the strategies included (1) putting in some hydrogen stations before the FCEVs come to market; (2) vehicle subsides, which decrease over time; (3) fuel tax increases indexed to increases in average vehicle efficiency; and (4) strict fuel economy and emission standards for automakers.
- Mr. Novachek asked for clarification on the chart shown in slide 22—whether the net present value of subsidies for PHEVs and FCEVs (the purple line on the bottom) includes the cost of the hydrogen infrastructure that would be necessary.
    - Dr. Greene replied that it *does* include the cost of the early hydrogen infrastructure that would need to be deployed before a consumer will buy an FCEV.
- Dr. Ogden and Dr. Shaw commented on the agreement between this NRC report and other reports (NRC 2005, McKinsey and Co., and the National Hydrogen Association) that have concluded that hydrogen FCEVs are required to meet greenhouse gas reduction goals of 80% or more, and that a portfolio approach is needed.

4.2. The Transition to Electric Drive Vehicles in California: The Role of the ZEV Requirements, David Greene, Corporate Fellow, Energy and Transportation Science Division, Oak Ridge National Laboratory

Dr. Greene presented on the results of a study that modeled the effects of the zero emission vehicle (ZEV) mandate and related polices in California and developed a framework for efficient policy for a transition to electric drive vehicles. The study was conducted by the Howard H. Baker Jr. Center for Public Policy at the University of Tennessee for the International Council on Clean Transportation (ICCT). Dr. Greene explained that this study examined the question of transitioning to alternative vehicles from a net present value context. The project produced the Light-duty Alternative Vehicle and Energy Transitions (LAVE-Trans) model, which was also used to estimate costs, benefits, and impacts in the NRC's *Transitions to Alternative Vehicles and Fuels* study. He detailed the LAVE-Trans model's development, parameters, and limitations, as well as different scenarios in which it was run for battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), and FCEVs. He discussed some of the modeling results, including:

- If only California and the Section-177 states (15 states that chose to adopt California's air-quality standards in lieu of federal requirements) implement ZEV mandates and the only early hydrogen infrastructure built is the 68 stations in California, FCEVs would not succeed in the rest of the U.S., and they would struggle along in California.

- But, if only 50–100 hydrogen stations are built outside of California and the Section-177 states, a "tipping point" is reached, and FCEVs are successful both in California and the rest of the U.S., exceeding the market penetration of both BEVs and PHEVs.

- If the U.S. follows California with a 5-year lag, there is a sustainable nationwide transition (with FCEV market penetration leading BEVs and PHEVs), GHG and oil goals are met, and benefits outweigh costs by an order of magnitude.

He concluded with several additional inferences from the study, including: (1) subsidies are needed for an extended period (until 2025 or 2030); (2) we must do more than "internalize the externalities" – there must be some active market intervention to break the transition barriers; (3) early hydrogen infrastructure is critical; (4) FCEV market potential exceeds that of BEVs, which exceeds that of PHEVs; and (5) what happens elsewhere in the global market strongly affects the U.S.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_4b_greene.pdf

Questions, answers, and discussion

- Dr. Ogden commented on the LAVE-Trans model's attempt to estimate changes in monetized consumer utility as the market evolves (slide 22), and the factors that contribute to utility (e.g., diversity of choice, fuel availability, perceived risk, etc.).

- Dr. Greene explained that very little is known right now about how these factors evolve and interact to affect the market, and he agreed with Dr. Ogden that this is a great area for future research.

- Dr. Lipman asked whether the basic price of gasoline is endogenous in the LAVE-Trans model (also used in the NRC report).

  - Dr. Greene replied that there was debate about how to handle this in the NRC report, but in the end they agreed not to do anything to index the price of gasoline. He noted that the NRC report committee considered, but later rejected incorporating a policy that would put a floor on the price of gasoline. He explained that the ICCT report explored the effect of gasoline prices by looking at the EIA's low-, reference-, and high-oil-price scenarios. He noted that they were surprised to find it did not make much of a difference in the market transition to the EVs since they do not use much oil in the first place. He added that a global market transition away from oil-based transportation would, however, likely require policy that would allow the alternatives to compete with falling gasoline prices.

5. Update from Ohio Fuel Cell Coalition, Patrick Valente, Executive Director, Ohio Fuel Cell Coalition

Mr. Valente presented on Ohio's fuel cell industry, the Ohio Fuel Cell Initiative, the Ohio Fuel Cell Coalition, fuel cell applications in Ohio, and fuel cell successes in Ohio. He described Ohio's competitive advantage for fuel cells, including in the areas of technical support, business support, fuel cell integrators, and supply chain. He detailed Ohio's Fuel Cell Initiative, and noted that a state program called the Third Frontier had granted $90 million, which leveraged more than $300 million in industry investment. Mr. Valente discussed several success stories of fuel cell applications in Ohio, including Crown Equipment Corp., which is a world leader in fuel cell forklifts and was estimated to have 1,500 fuel-cell-powered lift trucks in the market by the end of 2012. He also noted instances of universities partnering with the private sector to advance fuel cell technology and education. Mr. Valente remarked that the state of the industry looks bright, noting that fuel cells are one of the fastest-growing clean energy sectors. But, he said, continued investment would be key to maintaining this positive momentum. He closed with a mention of the upcoming Fuel Cell Seminar and Exposition, which will be held in Ohio in October.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_5_valente.pdf

Questions, answers, and discussion

- Chair Hofmeister asked how utilities are engaged or support the fuel cell activities in Ohio.

  - Mr. Valente replied that the next speaker would speak more directly to that question, but he said that some utilities are not enthusiastic about the renewable portfolio standards (RPS), while others are more supportive.

6. LG Fuel Cell Systems Overview, Mark Fleiner, CEO, LG Fuel Cell Systems

Mr. Fleiner gave an overview of LG Fuel Cell Systems (LGFCS), including its vision and mission, history, products and technology, and market rationale and opportunity. He noted that a group of LG companies acquired a 51% ownership stake in Rolls-Royce Fuel Cell Systems, Inc. in June of 2012, and that the business focus remains on the commercialization of a megawatt (MW)-scale natural-gas-fueled fuel cell power system for stationary power generation. He detailed the company's 1 MW solid-oxide fuel cell system, discussing its reliability, performance, durability, cost, functionality, and challenges. He described the system's four primary subsystems: (1) fuel processing; (2) a small turbo generator to pressurize the generator module; (3) the generator module, which has long cylinders of fuel cells in the middle; and (4) controls and power electronics where the DC voltage is converted to AC voltage. The goal is to package the entire system in such a way that it can be installed and commissioned in a short period of time.

He described the fuel cell architecture as an integrated planar, solid oxide fuel cell. Each cell is created by screen-printing the catalyst active areas on a flat, ceramic porous "tube" through which fuel flows in a serpentine pattern. A 60-cell tube is about 60 watts. Six 60-cell tubes (rated at 60 W each) are stacked to create "bundles," which are rolled up into "strips" and then into a "block." One 250-kW generator module includes about 12 blocks. He noted that the company has progressed enough with its ceramic architecture and material design that they are working now to find commercial suppliers (with four being considered). Mr. Fleiner described the market rationale for LGFCS's work, noting the robust market for new distributed power generation technologies and the dynamic regulatory environment that is making central power production more difficult. He stated that initial applications for the LGFCS system could be distributed generation or grid/substation support.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_6_fleiner.pdf

Questions, answers, and discussion

- Mr. Novacheck asked if the system can load-follow, i.e., operate between 40% and 100% without that being considered a "cycle."
    - Mr. Fleiner replied that their system starts to get a little bit unstable below 50%, so the operating range is between 50% and 100%.
- Mr. Koyama commented on the architecture of the LG fuel cell system, and asked how robust it is to failures of one or more strips.
    - Mr. Fleiner replied that they can isolate problems at a strip level today, and turn off the fuel supply to a strip within a block. He noted that the goal is to be able to isolate a bundle.
- Mr. Fleiner added that LG's experience with screen printing for LED and LCD televisions has been very valuable.
- Mr. Lipman asked for the dimensions of a single tube.
    - Mr. Fleiner replied that they are roughly 11 inches long, three inches wide, and one- eighth of an inch thick.

- Dr. Shaw asked about the system's cycle life.
    - Mr. Fleiner replied that they are still conducting R&D and system testing, but current tests have shown that for about the first 25 cycles, the system will come back to almost its original start-up power output. But after that it starts to degrade pretty rapidly.
- Dr. Thompson asked about properties of the materials they are working with and what research they have done in the area of fuel processing.
    - Mr. Fleiner responded that they did get some DOE support on the fuel reforming side and also on materials research. He noted that they worked with Oak Ridge National Laboratory to test the strength of their ceramic material under system operating conditions.
- Dr. Shaw asked about their intention to target the distributed generation market, and how that will work if their system essentially has to run continuously (as a baseload system).
    - Mr. Fleiner replied that their target market is not buildings, but utility companies, where they can be hooked directly to the grid. They will use the heat to drive up their electrical efficiency rather than provide combined heat and power to a building.
- Mr. Novachek asked about the system life and what percent of the total system cost the fuel cell stack is.
    - Mr. Fleiner stated that the system life is 20 years, and their target for putting a commercial product on the market is three years. The stack is around 25% to 30% of the total system cost.
- Dr. Satyapal said DOE is increasingly interested in reducing the flaring of natural gas, and asked if they had looked into that as an opportunity.
    - Mr. Fleiner said that they had not studied it closely; but it would depend on the gas composition, and he would look into it.

7. Status of HTAC Reports and Subcommittee Activities

7.1. Hydrogen Enabling Renewables Working Group, Frank Novachek, Subcommittee Chair

Mr. Novachek began by thanking two of the Working Group's subject matter experts, Sandy Thomas and Darlene Steward. He noted the subcommittee presented the findings, conclusions, and recommendations of their work at the last HTAC meeting. He briefly reviewed these with the HTAC members in his presentation.

At the last meeting, HTAC agreed to the development of two white papers and a Summary Report. The Working Group Summary Report has been written, and the draft was delivered to the HTAC members for review and discussion. Mr. Novachek proposed the following close-out process for the group's activities:

1) Seek approval from HTAC on the Summary Report today.

2) Complete the quality check of the white papers; once they are finalized, they will be sent to HTAC members and comments will be requested within a month.

    a. If there are no comments that materially change the Summary Report, the work of the Working Group will be complete and the final products will be submitted to HTAC as approved, sometime in the June-July timeframe.

    b. Comments that require material changes to the Summary Report will be brought to the attention of HTAC before the report and white papers are finalized.

Mr. Novachek brought HTAC's attention to the Working Group's recommendation that the concept of "power-to-gas" energy storage systems be further investigated. This idea came up too late in the group's process to fully explore, but it appears to have some potential and is being deployed in Europe. The majority of the group's members feel that it makes sense to investigate whether it's worth pursuing further, and if so, to evaluate the system-wide benefits of such a system on U.S. markets. He added that the Working Group's recommendation for EPRI to lead the follow-up study with support from relevant teams at DOE and NREL came from HTAC members and not from the NREL staff who supported the work of the subcommittee. He asked if any HTAC members disagreed with that particular recommendation. The suggestion was made to make the recommended performers more general, i.e., "…involving utility industry representatives and national labs…," and Mr. Novachek agreed to make that change.

Mr. Novachek asked for any further comments on the Working Group's Summary Report or the process he proposed for close-out of the group's activities. Chair Hofmeister suggested that they prepare a cover letter to transmit the Working Group's outputs to the appropriate DOE officials (including Assistant Secretary Danielson and the new Secretary of Energy), and Mr. Novachek agreed to work with him on that. Dr. Shaw also agreed to help in reviewing or revising the letter. No further comments on the Summary Report were provided. Chair Hofmeister invited a motion to approve the Summary Report and the close-out process proposed by Mr. Novachek. The motion was moved and seconded, and passed unanimously.

Chair Hofmeister and Dr. Satyapal thanked Mr. Novachek and all the members and contributors to the Working Group for their work. Dr. Satyapal also reported that the Secretary nominee (Dr. Moniz) is very interested in energy storage, there is a grid integration tech team that has been formed across DOE, and there is roughly $80 million budgeted specifically for grid-integration-related issues. She noted that the whole area of reliability and renewables is coming to a forefront. The Fuel Cell Technologies Office is supporting the wind-to-hydrogen project at NREL along with analysis work that is looking into where this strategically makes sense. DOE is also keeping tabs on the 1-megawatt scale demonstrations in Ohio and Canada, and the demonstrations in Germany. She told HTAC that she could arrange for a briefing from DOE's Grid Integration Tech Team if it would be helpful, to get a broader perspective of what options DOE has been exploring for energy storage, and where hydrogen and fuel cells might fit in.

7.2. Hydrogen Infrastructure Subcommittee Report, Robert Rose

Mr. Rose observed that one of the challenges faced by the subcommittee was keeping ahead of events. He noted that this area is a (rapidly) moving target. He reviewed the recommendations of the Subcommittee, as stated in the presentation, and asked for questions or comments from the group.

Chair Hofmeister noted that HTAC had approved the Working Group's report at the November HTAC meeting, subject to minor revisions and updates by Subcommittee Chair, Dr. Kathleen Taylor, Mr. Robert Rose, and other subcommittee members. The task today is to focus on the final wording of the recommendations and seek final approval of the subcommittee's report (distributed to HTAC members in the pre-reading materials) subject to minor proofreading revisions. He asked that any minor revisions be submitted to Mr. Rose within a week. Comments and suggestions from HTAC members include the following:

- Dr. Bond stated that he had some wording suggestions for the recommendations, but the essence is fine.
- Dr. Lipman suggested that the phrase "the requirement" in recommendation number four be made more specific to better define the requirement.
- Chair Hofmeister noted that the report really does not stress that the private sector has to take a massive role in moving infrastructure out; the recommendations are very government centered, and he felt this would be a tough sell in today's environment.
- Mr. Eggert stated that he likes the third recommendation, which says "DOE support for state level hydrogen initiatives would accelerate deployment…," but he did not see much detail on what types of support would be valuable.
- Chair Hofmeister followed up by proposing a new infrastructure subcommittee be created to address next steps, especially issues facing the build-out of retail infrastructure, since automakers have made it very clear that they will not bring vehicles if the infrastructure is not there. And this needs to happen in the next two to three years, so there is some urgency around this issue. He suggested that the new subcommittee, as advisors to the Secretary, take these broad-based recommendations and drill down to some more precise, specific recommendations.
- Dr. Ogden agreed, and suggested that the first recommendation be amended to say "Emphatic support by the U.S. government for FCEVs and the associated required infrastructure will give…." She would like to see the recommendations a little stronger on the coupling of infrastructure and vehicles.
- Chair Hofmeister agreed, and suggested that they include some of these key points in their cover letter transmitting the report to DOE.

Dr. Shaw moved that HTAC proceed with the proposal to allow Mr. Rose to finalize the report of the current subcommittee with the minor revisions suggested today and proofreading edits. The motion was seconded and unanimously approved.

7.3. HTAC Annual Report, Joan Ogden, Subcommittee Chair

Dr. Ogden noted that the draft report has been circulated for review to HTAC members and asked for any comments. Minor wordsmithing or proofreading revisions should be provided to Dr. Ogden via email, along with any suggested photos for inclusion in the report, within one week.

Chair Hofmeister asked for recommendations for the cover letter to the Secretary; he offered the initial suggestion that the letter should encourage enhanced and sustained high level support as articulated by current DOE leadership for the hydrogen program. The following additional suggestions were offered by the Committee:

- Dr. Shaw: Express continuing concern, reflected in previous letters, that we are losing our competitive position as a nation in this space.
- Mr. Rose: State the critical importance for DOE to support hydrogen and fuels cells and strategic technology investments (the industry is very fragile now).
- Dr. Shaw: Need to understand that this is a long haul—we cannot expect immediate ROI or market uptake.
- Mr. Eggert: State three things: (1) Rhetoric is important; (2) the majority of investments are coming from the private sector and will likely continue (automakers provided a memo to the California Senate Transportation Committee that showed they've invested more than $9 billion in fuel cells to date); and (3) reference the NRC report's tally of the total public and private cost—in the net present value calculation that David Greene talked about—which is about a trillion dollars.
- Dr. Ogden: Include the NRC finding that the benefits are an order of magnitude higher than the costs, over the long run.
- Dr. Thompson: Provide an indication of materially what has happened since the DOE Hydrogen and Fuel Cells Program budgets were decreased—what are the consequences of not investing?
    - Chair Hofmeister noted that this was a political decision, and the role of HTAC is not to be political. He suggested this be rolled into the discussion on losing national competitiveness.
- Dr. Bond: State that the amount of carbon per mile goes down by a factor of two when you use hydrogen from natural gas in a fuel cell electric vehicle (FCEV), as opposed to using natural gas directly in an internal combustion engine.
- Dr. Shaw: Since the letter will be going to a new Secretary, it should include an introduction of what HTAC is all about.

Mr. Eggert will send to HTAC members a copy of a memo provided by the automakers to the California Senate Transportation Committee that tallied up the total investment today on the auto side, which is over $9 Billion.

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8. Clean Energy Manufacturing Initiative, Elizabeth Wayman, Director, Clean Energy Manufacturing Initiative, Office of Strategic Programs, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

Ms. Wayman gave a presentation on the Clean Energy Manufacturing Initiative. She first described how the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy (EERE) is advancing sustainable transportation; renewable electricity generation; and energy savings in homes, buildings, and manufacturing. She then detailed the Clean Energy Manufacturing Initiative (CEMI), noting that it will increase U.S. competitiveness in the manufacturing of clean energy products and increase U.S. manufacturing competitiveness across the board by increasing the energy efficiency of manufacturing processes. She remarked that the CEMI represents an increased commitment to manufacturing across EERE. She gave examples of how the Initiative is providing benefits in the areas of (1) manufacturing R&D, (2) facilities for manufacturing innovation and demonstration, (3) energy productivity resources, (4) competitive analysis, and (5) partnerships and engagement. She then led a discussion on competitive analysis, competitiveness drivers in the fuel cells and hydrogen industry, critical R&D for U.S. competitiveness in the hydrogen industry, and other critical support for U.S. competitiveness.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_9_wayman.pdf

Questions, answers, and discussion

- Mr. Triompo and Chair Hofmeister expressed concern that the use of fuel cells for stationary power generation would be overlooked as the FCT Office moves under the newly formed Sustainable Transportation division within EERE.
    - Dr. Satyapal responded that the FCT Office has and will continue to work with other programs and offices within DOE on cross-cutting technologies. Groups such as the Grid Integration Tech Team and newly formed Fuel Cells Tech team help facilitate such interdepartmental coordination.
- Dr. Shaw suggested that Ms. Wayman and her team examine past manufacturing initiatives and use them as a starting point for the CEMI.
- Dr. Shaw also stated that two main issues in manufacturing are achieving high yields and efficient supply chain performance.
- Mr. Eggert added that materials and scalability during transition from low to high volume manufacturing are also key cost drivers.
- Ms. Wayman asked if yield and waste concerns could be mitigated through better metrology and process control.
    - Mr. Triompo responded in the affirmative, adding that quality and process controls must be examined.

- Ms. Wayman asked for opinions on the best way to address the shared risks of scale-up and specifically whether collaboration was possible given intellectual property concerns.
    - Mr. Triompo stated that there could be plenty of areas for collaboration.
    - Mr. Flood stated, "I'm not sure I necessarily agree."
- Mr. Eggert asked if the competitive analysis was publically available and the extent to which it includes policy factors.
    - Ms. Wayman said that the analysis would be openly accessible. Findings from the analysis will be published in a series of journal articles and NREL technical reports. Furthermore, once the analysis is complete and has been vetted by industry, DOE will seek recommendations for policy and investment strategy.
- Dr. Ogden commented that the team should not overlook the scale-up potential for hydrogen production technologies, for example electrolysis.
- Mr. Flood stated that efforts should be focused on the handful of components and materials that all fuel cells have in common, such as membranes. He added that inconsistent demand adds to manufacturing costs.
- Chair Hofmeister added that manufacturing overhead contributes significantly to cost.
- Mr. Kenny (of Sprint) stated that grid deterioration needs to be addressed in the long term.
    - Ms. Wayman responded that DOE has a Grid Integration Initiative.

9. Update from Sprint on Backup Power Fuel Cells, Kevin Kenny, Network Engineer, Core Development and Engineering Standards, Sprint

Mr. Kenny provided an update on Sprint's American Recovery and Reinvestment Act project—"Use of 72-Hour Hydrogen PEM Fuel Cell Systems to Support Emergency Communications." He described how the project supports job retention and creation in several industries/businesses and supports DOE goals by introducing hydrogen fuel cell technology to new areas. He reported on progress in the three key phases of the project, which has led to 260 fuel cell installations: (1) Site Survey, (2) Pre-Construction, and (3) Installing and Commissioning. Mr. Kenny also described the challenges to installing fuel cell backup power units on rooftops, which represent a large, but untapped, customer base. He proposed several R&D concepts to address the challenges, including development of modular (smaller, lighter) fuel cell systems, lightweight hydrogen storage tanks, ground-level refueling receptacles, and high-capacity urban delivery vehicles.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_10_kenny.pdf

Questions, answers, and discussion

- Chair Hofmeister asked what technology the fuel cells used by Sprint replace.

- Mr. Kenny stated that the incumbent technology is largely diesel powered generators.

- Mr. Koyama asked what would be needed to increase the deployment of fuel cells.
  - Mr. Kenny responded that they would like to be able to deploy fuel cells on rooftops, but cost and fixed design are barriers.

- Mr. Flood stated that fire codes make it very challenging to put a generator on a rooftop. There may be an opportunity to work with code and permitting officials to make fuel cells more competitive by easing their rooftop installation.

- Mr. Kenny suggested DOE address the challenge of delivering hydrogen to rooftops.

- Dr. Shaw asked if Sprint would have installed fuel cells without ARRA funding.
  - Mr. Kenny replied that they had installed fuel cells before ARRA funding was received.

- Dr. Shaw asked if Sprint intends to continue installing fuel cells now that ARRA funding has ended.
  - Mr. Kenny stated that Sprint is committed to using renewable technologies and has allocated money toward such.

- Dr. Shaw asked how fuel cells compare to other renewable technologies such as photovoltaic (PV) cells.
  - Mr. Kenny said that the footprint for PV is too large for their placement on most rooftops.

- Dr. Thompson asked if hydrogen reformers could solve many of the supply problems that Mr. Kenny faces.
  - Mr. Kenny stated that there aren't a lot of available options. He mentioned Ammonia and Chlorine, and then state some of the positive aspects of using a "methanol-water setup." But, he added, it's difficult to compete with the convenience of diesel, which can easily be stored in central locations and staged in advance of storms. He added that they are currently investigating the use of water-and-powder mixtures to produce low pressure hydrogen onsite.

- Dr. Lloyd suggested that Mr. Kenny reexamine the environmental benefits of fuel cells over diesel, as diesel fuel produces greenhouse gases and has been recognized as a carcinogen.

- Mr. Triompo suggested that fuel cells be used for baseload power for cell towers, incorporating byproduct of natural gas reforming for heat.

- Dr. Satyapal thanked Mr. Kenny on behalf of DOE for his work on fuel cell deployments and willingness to share information.

10. Naval Power & Energy S&T: Hydrogen & Fuel Cells, Dr. Richard Carlin, Department Head, Sea Warfare and Weapons Department, Office of Naval Research, U.S. Department of Defense

Dr. Carlin first described the Department of the Navy's (DON's) energy goals, which include energy-efficient acquisition, sailing the "Great Green Fleet," reducing non-tactical petroleum use, increasing alternative energy ashore, and increasing DON-wide alternative energy use. He then detailed elements of the Navy's power and energy science and technology activities, e.g., the use of alternative energy technologies in unmanned air vehicle power systems, such as adapting the Ion Tiger Fuel Cell Propulsion System to the Scan Eagle. Dr. Carlin also described how the Hawaii Sustainable Energy Research Facility is working to characterize and optimize the performance of polymer electrolyte membrane fuel cell energy systems for use in harsh environments. He also discussed the Navy's power and energy science and technology efforts in areas such as expeditionary power, non-tactical General Motors FCEVs and hydrogen infrastructure, fuel-efficient shipboard fuel cells, and anaerobic digestion for dilute waste systems. He described the Asia Pacific Technology and Education Program, noting that it promotes sustainability through alternative energy research, technology development, and education, as well as provides a clean technology workforce by linking energy education and research institutes with clean technology companies.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_12_carlin.pdf

Questions, answers, and discussion

- Dr. Shaw stated that if fuel cells are going to be used for military applications, we need to consider the security issues and ensure that the United States maintains a strategic advantage with the technology.
    - Dr. Carlin stated that they are aware of this and issues of potential critical material shortages.
- Chair Hofmeister asked if other countries are using fuel cells in military applications.
    - Dr. Carlin stated that the United States leads in the use of fuel cells for unmanned systems.
- Mr. Rose stated that in 1991 the Department of Defense identified fuel cells as a strategic technology.
- Mr. Flood asked about the use of fuel cells in non-nuclear submarines.
    - Dr. Carlin said that methanol-powered fuel cells are used by other countries to power their non-nuclear submarines.

11. Beyond Demonstration: The Role of Fuel Cells in the U.S. Department of Defense's (DoD's) Energy Strategy, Stu Funk, Program Manager, Energy and Climate Change, LMI

Mr. Funk gave a presentation on a Defense Logistics Agency (DLA)-sponsored report entitled *Beyond Demonstration: The Role of Fuel Cells in DoD's Energy Strategy*. He first described DLA's hydrogen and fuel cell research and development program and pilot projects. He then discussed the report, noting that it analyzes how fuel cells can help meet DoD's power needs in the near term. The report also assists DoD in establishing priorities and taking actions that reflect important issues, such as the potential energy, environmental, and economic benefits of fuel cells. The report concludes that DoD should evaluate and acquire fuel cell systems for

distributed power generation, backup power, and unmanned vehicles, and Mr. Funk described some of the benefits fuel cell systems could provide in those applications. He also shared some of the report's recommendations to DoD, including that the agency should (1) support, monitor, and evaluate fuel cell research, development, and demonstration projects; (2) consider fuel cells in planning and designing facilities, acquisition of backup power systems, and designing and procuring unmanned vehicles; and (3) develop and implement procurement models that support consideration of fuel cell options.

>>*the full presentation is available at:*
http://www.hydrogen.energy.gov/pdfs/htac_apr13_11_funk.pdf

Questions, answers, and discussion

- Chair Hofmeister asked how the number of people in the military working on fuel cells compares to the research, development, design, and demonstration being performed by civilians.
    - Mr. Funk stated that even within the military, most of the people dealing with daily fuel cell facility issues are civilians. He added that the workforce was accommodating to the fuel cell lift trucks, and would have liked to continue using them had the economics worked out.
- Mr. Eggert asked if Mr. Funk had a sense of how material handling demonstration activities contributed to the development of a commercial marketplace for fuel cells.
    - Mr. Funk stated that he does believe demonstration projects have had a positive impact on the commercialization of fuel cells, especially in helping to identify issues with the technology that need to be addressed.
    - Dr. Satyapal stated that the Office did receive positive feedback from industry regarding the partnership with DoD and deployment of fuel cell lift trucks, especially with regards to safety, codes and standards issues.
- Mr. Funk added that after the indoor hydrogen fueling station was installed at Susquehanna, DoD created a UNIS-5 Facilities Criteria prohibiting the installation of indoor fueling.
- Mr. Eggert asked how DoD's strategic efforts regarding fuel cells align with that of the FCT Office.
    - Mr. Funk stated that the LMI report was a concept document, and to his knowledge, it has not yet evolved into a formal DoD-wide strategy. He added that, within DoD, the ONR probably has the most defined roadmap for the use of fuel cells.
- Mr. Rose asked if any fuel cells are being purchased by DoD through the regular procurement process.
    - Mr. Funk stated that he does not know of any, however, there could be some on the GSA schedule.
    - Mr. Koyama stated that he has sold fuel cells for backup power to the U.S. Army in Germany through the procurement process.

- Dr. Carlin asked if DoD would produce lessons learned report on its experience with fuel cells.
    - Mr. Funk stated that they are producing a compilation report that will include analysis of all four demonstration projects.

12. HTAC Business

12.1. New HTAC Subcommittees

- Chair Hofmeister proposed that a manufacturing subcommittee be formed to advise on matters of fuel cell manufacturing excellence. Mr. Koyama offered to lead the subcommittee. Mr. Freese, Dr. Shaw, Dr. Thompson, Mr. Flood, and Mr. Triompo volunteered to join as members. Mr. Koyama will organize a process and define the terms of the subcommittee. It was noted that non-HTAC members can be invited to join the subcommittee.
- Chair Hofmeister proposed that a retail infrastructure subcommittee be formed to advise on matters relating to opening hydrogen retail fueling stations. Mr. Eggert, Dr. Ogden, Mr. Rose, Dr. Lloyd, Mr. Freese, Mr. Taylor, Chair Hofmeister, Dr. Shaw, and Dr. Lipman volunteered as members. It was also noted that non-HTAC members can be invited to join the subcommittee.

12.2. Future HTAC Meetings

- Chair Hofmeister stated that he will send a letter to all committee members asking for ideas for future agenda topics as well as process ideas. For example, he would like feedback on whether or not meetings should include more time for discussion and debate.
    - Mr. Kaya stated that he would encourage more discussion time.
- Topics for future HTAC meetings:
    - Presentations on power-to-gas, for example from Daryl Wilson, CEO of Hydrogenics
    - Presentations from small businesses
    - Updates from U.S. states that have presented in the past (e.g., Connecticut)
    - H2USA
    - The President's Energy Security Trust
    - Hydrogen production
        - Updates on the real market cost of hydrogen, not projected costs
        - Mr. Taylor offered to arrange for a speaker from Air Products
        - An update on longer-term hydrogen production
        - A presentation on state-of-the-art electrolyzer cost and performance

12.3. 2013 Annual Report

- Dr. Thompson stated that he would consider leading the 2013 Annual Report.
- Mr. Kaya volunteered to help with the report.

12.4. Miscellaneous

- Mr. Rose stated that he has been appointed to a congressional advisory committee on EERE exports and invited HTAC members to send suggestions on how the new committee could help U.S. manufacturers reach markets outside the US.

Meeting adjourned at approximately 11:30.

TWENTY-FIRST MEETING OF THE

HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE (HTAC)

PARTICIPANT LIST

April 23-24, 2013

HTAC Members Present

- Peter Bond
- Mark Cardillo (via conference line)
- Richard Carlin
- Anthony Eggert
- Gary Flood
- Charles Freese
- John Hofmeister
- Maurice Kaya
- Harol Koyama
- Timothy Lipman
- Alan Lloyd
- Frank Novachek
- Joan Ogden
- Robert Rose
- Robert Shaw
- David Taylor
- Levi Thompson
- Joe Triompo

HTAC Members Not Present

- Geraldine Richmond
- Kathleen Taylor
- Jan van Dokkum
- Bill Wylam

U.S. Department of Energy Staff - Office of Energy Efficiency and Renewable Energy (some attended via conference line)

- Peter Devlin
- Sara Dillich
- Kathi Epping-Martin
- Rick Farmer
- Monterey Gardiner
- Nancy Garland
- Donna Ho
- Fred Joseck
- Jason Marcinkoski
- Eric Miller

- Dimitrios Papageorgopoulos
- David Sandalow (speaker)
- Sunita Satyapal (speaker)
- Joseph Stanford (Designated Federal Officer for HTAC)
- Erika Sutherland
- Elizabeth Wayman (speaker)

Members of the Public in Attendance

- William Craven—Daimler (speaker)
- Joshua Eichman—National Renewable Energy Laboratory
- Bill Elrick—California Fuel Cell Partnership
- Mark Fleiner—LG Fuel Cell Systems, Inc. (speaker)
- Stuart Funk—LMI (speaker)
- Chris Gearhart—National Renewable Energy Laboratory
- Leo Grassilli—Office of Naval Research
- David Green—Oak Ridge National Laboratory (speaker)
- Thomas Gross—Consultant
- Kevin Kenny—Sprint (speaker)
- Edward Kiczek—Hydrogen Energy Systems
- James Kliesch—American Honda Motor Co.
- Bill MacLeod—Hyundai-Kia America Technical Center, Inc.
- Morry Markowitz—Fuel Cell and Hydrogen Energy Association
- Nicholas Mittica—Hydrogen Energy Systems
- Kathleen O'Malley—SRA International
- Jeff Serfass—California Hydrogen Business Council
- Sarah Studer—AAAS Policy Fellows (working for DOE Fuel Cell Technologies Office)
- Sandy Thomas—Clean Energy Consultant
- Patrick Valente—Ohio Fuel Cell Coalition (speaker)
- Steven Weiner—Pacific Northwest National Laboratory
- Bob Wimmer—Toyota (speaker)

Support Staff

- Judi Abraham— Alliance Technical Services, Inc.
- Kristine Babick—Energetics Incorporated (Day 1)
- Rachel Davenport—Alliance Technical Services, Inc.
- Edwin Donovan—Executive Court Reporters
- Shawna McQueen—Energetics Incorporated (Day 2)
- Lilia Murphy—Alliance Technical Services, Inc.
- Neil Popovich—National Renewable Energy Laboratory
- Tom Timbario—Alliance Technical Services, Inc.