

HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE

MEETING MINUTES – DRAFT

June 3-4, 2010

Marriott Wardman Park Hotel, Washington, D.C.

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JUNE 3, 2010

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

Chairman Walker and Vice-Chairman Shaw called the June 3rd meeting of the Hydrogen and Fuel Cell Technical Advisory Committee (HTAC or Committee) to order at 9:02 a.m. and briefly reviewed the agenda for the day.

Chairman Walker asked members for comments on the minutes from the previous meeting (February 23, 2010). Hearing none, Chairman Walker moved to accept the minutes as written. The Committee unanimously accepted the motion.

1.1. New Committee Members

Several new members to the committee were introduced:

- Peter Bond
- Mark J. Cardillo
- Robert Grober
- Harol Koyama

Biographical information for all current members can be found at:

http://www.hydrogen.energy.gov/advisory_htac.html.

1.2. Subcommittee Reports

There were no subcommittee reports at the time.

1.3. Public Comments

Chairman Walker opened up the floor for public comments, and welcomed Mr. Jeff Serfass from the National Hydrogen Association (NHA) to the floor. Mr. Serfass's presentation focused on the benefits of hydrogen fuel cell technology and the importance of its inclusion in new energy legislation. His remarks included the following:

- The U.S. is falling behind in hydrogen fuel cell technology to other countries, such as Germany, Korea, and Japan. These countries are demonstrating strong government and industry commitment to hydrogen and fuel cell technologies.
- Employing hydrogen fuel cell technology will provide a suite of energy and environmental benefits while creating new jobs. He referred to a recent study that showed that hydrogen fuel cell vehicles "can cut greenhouse gas pollution to 80 percent below 1990 levels by the year 2080, achieve petroleum independence by 2060, eliminate urban air pollution a couple of decades later and save \$25 trillion in oil imports between 2050 and 2100."¹
- The NHA is working with organizations like the U.S. Fuel Cell Council and California Fuel Cell Partnership to provide perspective in energy policy that balances and complements the large amount of support being provided to batteries and their related drive systems.

¹ *The Energy Evolution: An analysis of alternative vehicles and fuels to 2100*, National Hydrogen Association, 2009.

- NHA is advocating extending and expanding tax credits for hydrogen vehicles; expanding tax credits for fuel cell property and hydrogen infrastructure investment; and removing tax constraints on sales to tax exempt entities.
- NHA is working to increase the congressional appropriation for hydrogen and fuel cell programs by 23 percent in FY11, restoring the funding to pre-FY09 levels, and will advocate for investments in hydrogen infrastructure in any stimulus bill.
- In energy climate and jobs legislation, NHA seeks to include a wide variety of pro-hydrogen and fuel cell measures in a new energy bill with equal treatment for hydrogen fueling infrastructure as plug-in vehicle infrastructure.
- Mr. Serfass noted that “DOE leadership has a voice heard around the world,” and called on DOE, and other federal agencies, to increase support for hydrogen and fuel cells. He asserted that we should be emboldened by commitments of the fuel cell industry in spite of waning U.S. government leadership, and conveyed his hope that hydrogen and fuel cells would be given a balanced share of federal attention and funding. He urged HTAC and DOE to be leaders for hydrogen and fuel cells in the world and to work with U.S. industry to develop the jobs and companies within our borders.
- Mr. Serfass also advocated for increased DOE attention in two areas. The first is support for deployment of several hundred fuel cell buses as a commercial entry point for larger deployments of fuel cells and hydrogen fueling infrastructure. Second is increased support for hydrogen as an energy storage option, as hydrogen and fuel cells can provide an expanded array of options for SmartGrid operations and renewable energy storage, which should be researched and developed, so that grid operators and renewable energy integrators have new tools to use.

Questions, Answers, and Discussion

- Mr. van Dokkum asked Mr. Serfass for his guidance on improving the HTAC’s ability to increase support for hydrogen in the administration. Mr. Serfass replied that most important is getting the facts and data to people often, with clear, simple messages about how the suite of hydrogen and fuel cell technologies provides unique benefits in addressing the nation’s energy and environmental problems.
- Chairman Walker asked if there were any more public comments. Hearing none, he closed the public comment period.

2. Remarks from Principal Deputy Assistant Secretary for EERE

Dr. Henry Kelly, U.S. Department of Energy (DOE), Principal Deputy Assistant Secretary for the Office of Energy Efficiency and Renewable Energy (EERE)

Dr. Kelly briefed the Committee on the EERE efforts to advance hydrogen and fuel cell technologies in both the near- and long-term; his remarks included:

- The Secretary asked DOE senior management to take a comprehensive and integrated look at where and how the nation is investing in energy in all sectors. The “STEP project” is an analysis of where the nation’s energy goes, where we can find the highest leverage, and whether our investments are appropriate. The analysis found that hydrogen fits into the equation in many different capacities and serves as an integral part of the planning process for DOE.

- The planning context is driven by the goal of an 83 percent reduction in U.S. greenhouse gas emissions. To achieve this, dramatic changes are needed in the way we both produce and consume energy for transportation and other uses.
- EERE is looking for economically smart ways to deploy hydrogen and fuel cell technologies in the near-term, in application areas like aircraft (for ground power), combined heat and power, and buses, while maintaining a long-term R&D portfolio. He noted the EERE is working on developing Technology Readiness Levels (TRLs), similar to what is used by the Department of Defense, to help balance the R&D portfolio.
- Dr. Kelly described some of the R&D program's achievements to date, including: 1) reducing the cost of PEM automotive fuel cell stacks by 75 percent, from an estimated \$275/kW in 2003 to \$61/kW in 2009; 2) increasing light-duty vehicle fuel cell durability to 2,500 hours or 75,000 miles; and 3) reducing the cost of hydrogen fuel. He noted that DOE is currently re-examining their ultimate hydrogen fuel cost goal, in light of more recent gasoline prices and updated forecasts for competitive fuels.
- EERE has also been making progress on hydrogen and fuel cell demonstrations in the U.S., and is also working closely with European and Japanese partners to share learning.
- On the deployment side, Dr. Kelly noted that the \$42 million was allotted to EERE's Fuel Cell Technologies Program from the American Recovery and Reinvestment Act (ARRA), which is being used to fund twelve deployment projects. Fuel cell manufacturers have also been successful in applying for and receiving tax credits, and he encouraged the industry to continue to apply for existing tax credits and loan guarantees.
- Dr. Kelly concluded by saying that "Hydrogen may provide a very interesting way to both buffer the output of [renewable] resources and move it around in a way that is...much less controversial to build [than conventional power lines]." He stated that he is "encouraged that fuel cells and hydrogen infrastructure are both key parts of our overall national energy program, both in the near- and long-term," and urged HTAC members to continue providing expert guidance to DOE on the associated opportunities, research priorities, and market needs, particularly in consideration of how hydrogen fits into the full energy portfolio for meeting energy and climate goals at the lowest possible cost.

Questions, Answers, and Discussion

- Chairman Walker asked Dr. Kelly why it seems that the administration is picking winners and losers in the light-duty vehicle market now, since it appears that the focus of DOE vehicle infrastructure investments is in battery-charging for electric vehicles. He noted that the amount of money being spent is close to or more than what the National Research Council suggested would be necessary to fund hydrogen infrastructure that would support 75 or 80 percent of the American population. Dr. Kelly answered that the investments are largely driven by the priorities written into the Recovery Act, which places emphasis on funding battery manufacturing, electric vehicle manufacturing, hybrid manufacturing, and incentives for purchasing electric vehicles. He noted these investments should not be made to the exclusion of hydrogen and other potential infrastructures, adding that with limited resources the Department is focusing on hydrogen and fuel cell investments with nearer term market potential (such as fork lifts, CHP, and buses). Mr. Walker followed up, pointing out that ARRA's focus on vehicle electrification did not exclude investments in hydrogen infrastructure for fuel cell electric vehicles. His impression is that the administration made a conscious decision to support battery infrastructure.

- In response to a question from Dr. Lloyd about the balance of EERE's R&D portfolio, Dr. Kelly replied that, considering the overall EERE budget, spending for hydrogen and fuel cells is in proportion to what is being spent on other transportation technologies.
- Mr. Friedman expressed his support for the DOE's effort to develop an energy plan that starts from ground zero. He noted that it would be helpful for DOE to articulate this plan in a very visible way to the broader community (including the public and investors), and suggested that DOE describe what the energy plan looks like in the near-, mid- and long-term, how and why the different technologies fit in at different points in time, and how the near-term portfolio sets up the longer-term technologies and goals. This kind of plan would, he said, be very helpful in avoiding "silver bullet energy policies" and in assuring industry and investors that there is a future for a variety of new technologies, even if they aren't the technology that is the most ready for commercialization right now. He added that the onus is on the hydrogen and fuel cell industries to show where they are ready for scale up. Dr. Kelly replied that DOE's bottoms-up "STEP" analysis will be released publicly and includes a lot of detail on assumptions. The report is being reviewed within DOE now, and the hope is that the report will be updated annually with opportunities for public input and comment. Dr. Kelly also reported that EERE will be establishing a public advisory board to oversee all of EERE, which will take inputs from the various statutory advisory boards already in existence, such as HTAC. EERE is also hiring a Chief Technology Officer to further open up the overall planning process to public input.
- In a follow-up question, Mr. Friedman asked if the Committee would get a chance to review the STEP report before it is published. Dr. Kelly replied that this first report is only being reviewed internally, though many of the assumptions have been publically vetted and the report was crafted using inputs from a variety of public documents, such as technology roadmaps and workshop results. Mr. Friedman also asked if the DOE planned to produce a four-page version of the report that conveys the key messages and is easy to read and understand for a lay audience. Dr. Kelly said that he would make this suggestion. Dr. Kelly also noted that they are working on developing web-based tools for the report to allow readers to drill down from a succinct overview of the results to the underlying assumptions and primary data sources.
- Mr. Eggert noted that a number of analytical studies, conducted by UC Davis and others, indicate that a relatively modest investment will meet the needs of a limited roll-out of hydrogen vehicles over the next five plus years in California. He said that California recently announced a \$19 million solicitation for hydrogen infrastructure, but would like to leverage this funding by partnering with DOE or others. He asked Dr. Kelly the best way to engage with DOE on this over the next several years. Dr. Kelly responded that speaking with the Fuel Cell Technologies Program representatives is the best way to start discussing partnerships.
- Dr. Ogden reported that she attended the 2010 World Hydrogen Energy Conference, and that many countries, including Germany, Norway, Korea, and Japan, are or soon will be deploying hydrogen fueling infrastructure to support hundreds of fuel cell vehicles in focused urban locations. She asked whether DOE is in communication with the government partners in these programs and whether this is being considered as a future path in the U.S. Dr. Kelly responded that DOE does consider it important to learn from these efforts and that DOE communicates with representatives from these countries. He asked HTAC members to let him know if there are particular people or programs they think DOE should be in contact with.
- Mr. Rose noted that DOE seems uncomfortable with the idea of providing financing for hydrogen fueling stations. He asked Dr. Kelly for his opinion on what other government or private funding sources might be available to build hydrogen stations for cars that could come to market in the

next five to ten years, assuming the infrastructure is available to fuel them. Dr. Kelly answered that building transportation infrastructure is not part of DOE's core mission, though DOE does fund commercial-scale demonstrations to increase understanding of how technologies work.

- Dr. Shaw asked for guidance on the most useful thing HTAC could do to advise, support, and inform DOE's senior management. Dr. Kelly noted that DOE is concerned it might be missing some new near-term applications for hydrogen and fuels cells (such as ground power support for aircraft, for example) or neglecting some connections with other industries or communities that could advance the technology (e.g., advanced materials, etc.). Other topics of interest include hydrogen as a facilitator for storing and moving energy from intermittent renewable sources and its role in addressing other electric transmission challenges. Dr. Shaw noted that HTAC has discussed possible themes to take on as part of its annual activities, one of which is hydrogen as a potential enabler of renewable energy. Dr. Kelly agreed this would be a good area for HTAC to explore, and DOE would be interested in the Committee's findings on whether and how hydrogen can be an enabler and what DOE should be doing to support it.
- Mr. van Dokkum asked whether senior DOE officials are concerned about HTAC's perception that the U.S. is losing its leadership position in hydrogen and fuel cells and heading towards being a technology follower, with the consequential loss of manufacturing jobs and revenues. Dr. Kelly replied that U.S. market share of new energy technologies is a matter of intense concern for DOE. He noted that policies and incentives can provide a big role here, such as we have seen with the feed-in tariff in Europe that provided a significant incentive for PV and wind producers to locate manufacturing operations locally. Comprehensive energy legislation would also help to provide some certainty for producers in the U.S.

3. DOE Program Presentations

Mr. Richard Farmer, DOE-EERE; Ms. Jennifer MacDonald, DOE-CFO; Michael Mills, DOE-EERE

3.1. Mr. Richard Farmer, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Fuel Cell Technologies Program

Mr. Farmer updated the Committee on activities and progress of EERE's Fuel Cell Technologies Program (FCT), including a program overview, discussion of the hydrogen cost target revisions, and recent technical achievements. His presentation addressed the following topics:

- How the Fuel Cell Technologies Program contributes to national energy, economic, and security goals
- State of the hydrogen and fuel cell industries today
- Key challenges facing the widespread commercialization of hydrogen and fuel cells
- DOE R&D program budget history and FY 2011 budget request
- Reasons and methodology for hydrogen cost target revision
- Progress and accomplishments in the R&D programs for fuel cells, hydrogen production, hydrogen delivery, hydrogen storage, technology validation, education, safety, codes & standards, and systems analysis
- Interagency collaboration on early market deployments
- Recovery Act funding for fuel cells (more than \$40 million for 12 projects to deploy up to 1,000 fuel cells)
- Independent assessments completed in 2010 (electrolysis cost assessment and stationary fuel cell status and targets)

- Federal interagency collaborations and partnerships with outside organizations, both domestic and international

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- Mr. Friedman requested clarification of the baseline hybrid vehicle's fuel economy compared to a conventional gasoline internal combustion engine vehicle. Mr. Joseck said the program will provide this information to the committee and that the fuel economy numbers in the analysis are the most recent from the EPA.
- Mr. Farmer noted that the oil price used in the hydrogen cost target analysis was the Energy Information Administration's "High Oil" case, in order to be consistent with the methodology used by the program when it developed its original cost target. He explained that this choice, among others (such as real-world vs modeled fuel economy), is being discussed with stakeholders as it reviews the cost target revision methodology. He suggested that the HTAC members may wish to receive a more detailed briefing on the cost target methodology; he noted that the program has put together a briefing on the subject that it has presented in several webinars. This presentation could be provided to HTAC for review, or given in a webinar. Chairman Walker agreed and suggested that the next meeting agenda include time to brief and discuss HTAC on the assumptions used in the hydrogen cost target analysis.
 - Dr. Shaw seconded, noting that he has questions about the analysis assumptions and the results indicated to date. Dr. Shaw suggested that interested members of the HTAC do a full-day "deep dive" on the hydrogen cost target analysis before the next HTAC meeting, in order to better understand the numbers and provide feedback to the process before the cost target is finalized. He suggested that invitees include outside experts who have performed similar analyses, such as Sandy Thomas. Mr. Farmer agreed to work with Dr. Shaw and others on the best process for accomplishing this, whether by webinar, teleconference, or meeting.
 - Dr. Satyapal commented that the program is still gathering feedback on the cost target, and that some HTAC members have already participated in webinars that have targeted members of the hydrogen production and delivery communities, oil and gas companies, and automakers. She noted that DOE would like to finalize the revised target by the end of FY10 (September 30, 2010), so if they can get HTAC's feedback in the next couple of months that would be ideal.
 - Mr. Novachek asked if DOE had looked at how they might address the cost of carbon if cap and trade legislation were enacted. Mr. Farmer said that they did look at in a sensitivity analysis, but they will not be including those results because there is currently no national carbon policy
- Mr. Joseck agreed to provide Mr. Rose with the Argonne National Lab-generated chart showing battery-miles driven in PHEV-10 vehicles.
- Dr. Bond asked Mr. Farmer for the rationale behind the drop in funding for FY11. Mr. Farmer responded that the Fuel Cell Technologies Program funding request is lower than FY10 because the program has met some critical R&D targets and the Hydrogen Storage Centers of Excellence are reaching their planned conclusion.

3.2. Ms. Jennifer MacDonald, U.S. Department of Energy (DOE), Office of the Chief Financial Officer (OCFO), Budget Process Overview

Ms. MacDonald presented an overview of the DOE budgeting process, and addressed the following topics:

- Budget calendar
- Budget process, including the roles and responsibilities of the Office of Management and Budget (OMB), DOE, White House, and Congress
- Congressional budget process and calendar
- Status of DOE appropriations bills
- Federal debt and deficit spending

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- Mr. Rose asked Ms. MacDonald how DOE decides, in the absence of specific direction from Congress, how and when to spend funds during a Continuing Resolution (CR). Ms. MacDonald explained that during a lengthy CR, funding for each program is calculated by prorating what the program was appropriated the last fiscal year (e.g., if the program received \$120 million for the year, it would get \$10 million in funding per month during the CR).
- Dr. Hicks asked about the status of DOE's reauthorization bill. Ms. MacDonald responded that DOE is split between several different authorization and appropriations bills. DOE's defense-related activities fall under an annual defense authorization bill. The EERE reauthorization is "piecemeal;" the two big EERE authorizations from the past few years have been Energy Policy Act of 2005 and the Energy Independence and Security Act of 2007. Some programs have also been reauthorized through other bills, such as the American Reinvestment and Recovery Act and the 2008 Farm Bill. She noted that funding can be and is appropriated without an authorization, but that the authorizing legislation can change the policies regarding how or where the funds are spent.

4. Update of GM Fuel Cell Vehicle Program

Charles E. Freese V, Executive Director Diesel Engineering, General Motors

Mr. Freese presented an update on GM's development of alternative fuel vehicles. He emphasized that, historically, it has taken at least 50 years for our economy to switch from one energy carrier to another and 50-60 technology learning cycles to achieve the ultimate cost reduction and performance optimization that has been achieved in today's conventional vehicles. To meet goals for reducing petroleum consumption and greenhouse gas emissions, while simultaneously satisfying customer demands for vehicle performance, comfort, driving, range, etc., a diverse set of transportation fuels and advanced propulsion technologies will be needed—there is no "silver bullet." Work to develop and introduce these technologies must be done now, in order to get through the learning cycles and achieve the economies of scale necessary for cost reduction. For this reason, GM is working to develop advanced gas and diesel ICE and hybrid vehicles, as well as battery and fuel cell electric vehicles. Other topics covered in his presentation included:

- Challenges for personal mobility and the automotive industry
- Worldwide trends in vehicle ownership and energy use

- Progression in fuel use over time towards fuels with higher hydrogen-to-carbon ratios
- Energy portfolio scenarios, 2010-2050
- Development of “green” vehicle technology at GM
- Challenges to introducing advanced vehicle technology
- Cycles of learning in GM’s fuel cell stack development, evolution of GM fuel cell vehicles to date, deployments of fuel cell Chevy Equinox, and real-world driving and fueling experience
- Key challenges for fuel cell vehicles
- GM’s cost and durability targets for Gen 2 and 3 FCVs in 2015
- Hydrogen fueling infrastructure needs and status, domestic (especially Hawaii and California) and international, with Germany developing as a key early market for hydrogen FCVs and fueling infrastructure
- Potential for hydrogen as a renewable energy storage medium
- OEM fuel cell programs and competitive landscape
- Conclusions: 1) hydrogen fuel cell technology is commercial-ready; 2) hydrogen fueling infrastructure is achievable – must establish momentum; 3) stable government policy is key to infrastructure and vehicle programs.

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- Mr. Kaya asked Mr. Freese specifically what policy incentives would help companies like GM over the long-term. Mr. Freese replied that the biggest barrier is the “chicken-and-egg” problem associated with vehicles and fueling infrastructure. The German Memorandum of Understanding and subsequent H2 Mobility Initiative addresses this by bringing all stakeholders to the table in a collaborative effort to advance a step-wise development of hydrogen infrastructure along with deployment of hydrogen FCVs. The collaborative effort of automakers, energy companies, infrastructure providers, and government has established clear goals and a framework for action that spans budget cycles and political elections, providing a sense of stability for investors. He suggested this same sort of strategy could be deployed in the U.S., beginning with states like Hawaii, California, and New York.
- Mr. Eggert noted that it is important to communicate the path to profitability for FCVs so that policymakers and others understand that the vehicles will not require a perpetual subsidy. He asked for Mr. Freese’s opinion on when he expects GM’s FCV technology could be in a true series production that could cover its variable costs. Mr. Freese responded that FCVs could become cost neutral by 2025, though that does not imply they (or any other alternative fuel vehicle) will be cost-equal with ICEs.
- Mr. Rose inquired about the learning cycles and cost curves of FCVs and at what level costs begin to significantly diminish for the company. Mr. Freese answered that the Generation 1 learning cycle requires about 5,000 to 10,000 vehicles in order to ramp up the supplier base; test out durability, reliability, etc.; and identify what scale-up issues may arise. The goal is to move to Generation 2 as quickly as possible, to prove out technologies and systems and to bring costs down.
- Dr. Friedman asked Mr. Freese what other policy incentives, besides MOUs, might be needed to help incentivize companies to produce and deliver FCVs and infrastructure in the U.S. Mr. Freese replied that fleet buyers, such as the government or large companies, could incentivize OEMs to produce FCVs, or there could be government subsidies or loan

guarantees or partnership structures that help the infrastructure providers put the infrastructure in place. Other policies like tax credits for vehicle buyers and zero-emission vehicle mandates would also be enablers. He does not believe that one set of policies will fit all needs, but rather the policies need to begin with an MOU as a collaborative mechanism and framework for action. In response to a question from Dr. Shaw, Mr. Freese noted that, timing wise, the 2015 commercial launch date for FCVs is aggressive, and additional incentives would likely not speed up that process.

5. German Infrastructure Agreement Overview

Mr. Ian Stuart Williamson, Air Products, H₂ Mobility Consortium

Mr. Williamson presented information on the H₂ Mobility initiative as the centerpiece of the commercialization plan for hydrogen FCVs in Europe. Mr. Williamson explained that the overall H₂ Mobility plan includes three main projects, (1) demonstrating performance across the hydrogen and electric vehicle value chain (January – June 2010), (2) H₂ Mobility: developing a German FCV implementation plan, as the first market for the vehicle (June – December 2010) and (3) planning a rollout across Europe (December 2010 – Q3 2011). Participating companies are able to take part in any or all of the three phases of the commercialization plan, as well as exit the projects at any time (without reimbursement of consulting fees). Specific deliverables are defined for each project. There are 31 companies from Europe, Asia and the U.S. participating in the first project, which is gathering and evaluating performance-based information on the range of alternative fuel vehicles and hydrogen production and delivery scenarios. The participating companies share information in a “clean room,” managed by McKinsey and Company, and information is presented back to the consortia members so as to protect the source’s identity. Currently, the data and reports being generated in the first project are not public; a public report may be issued in the future if all members agree. The ultimate goal of these efforts is to achieve the buy-in, and funding, from government, industry, and the public that is necessary to deploy a hydrogen fuel cell transportation system in Europe. For this reason, all three projects will work with an independent consulting firm (McKinsey) to develop fact-based information that is well-vetted and agreed to by all.

Other topics addressed in Mr. Williamson’s presentation included:

- Types and numbers of companies participating in Project One, which is a confidential study (9 auto companies, 4 electrolyzer companies, 3 gas companies, 2 utilities, 5 oil companies, 4 suppliers and equipment manufacturers, 2 non-governmental organizations, and 2 government agencies)
- H₂ Mobility project in Germany – Is open to any company that wants to participate and is an open, public process
 - Commitments by car companies, energy companies, and infrastructure providers (so far 11 companies have joined)
 - Organization
 - Phases of implementation
 - Station roll-out schemes for Germany
- Planning objectives for a European rollout

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- Dr. Ogden asked if the data from the initial report would be made public in any capacity. Mr. Williamson responded that any one company can veto the report, or any particular data, from being made public if they feel the information included is too sensitive. He noted that a summary version of the report may also be released, but that it may not include much detail.
- Mr. Rose asked whether the initiative is being timed to affect future funding of the Joint Technology Initiative (JTI), which is currently funded through 2015. Mr. Williamson noted that the results could impact future funding of JTI, but that full deployment would require commitments that would extend “far beyond” the framework of JTI, which is set up as a demonstration program.
- Mr. Eggert asked Mr. Williamson about the decision making process the partnership would use to decide to build a hydrogen fueling station, specifically what kind of information is needed to be confident that it is a worthwhile investment. Mr. Williamson replied that the infrastructure would be owned by the joint venture. He expects that the decision making process would be driven by a) where the OEMs want to roll out vehicles; b) supportive municipal governments in those locations; and c) agreement by oil companies and/or infrastructure providers that this represents a good location.
- Dr. Lloyd asked Mr. Williamson for his comments on 1) the feeling about fuel cells in Europe outside of Germany; 2) why BMW is not a partner in H2 Mobility given its historical interest in hydrogen; and 3) whether buses are part of the H2 Mobility project. Mr. Williamson replied that (1) Germany has the strongest car industry in Europe so is the natural leader -- some other countries are not as enthusiastic, but the initiative will try to pull them along; 2) BMW is currently not a partner, but may join soon; and (3) fuel cell buses are not part of the project – the focus is light duty fuel cell vehicles and 700-bar fueling infrastructure for consumer vehicles. A separate project (funded by JTI) will focus on fuel cell buses.
- In response to several questions from Dr. Shaw about the stability of long-term political support for the initiative from the EU and the potential for global information sharing on strategies for reducing carbon emissions, Mr. Williamson noted that Germany has supported the hydrogen and fuel cell program through multiple administrations from different political parties. He also noted that the EU is unified in its commitment to reducing greenhouse gas emissions. This commitment, and the penalties in place if carbon reductions are not met, will continue to be a driver for clean energy. He noted that many of the companies participating in the study are global, and their decision on whether or not to make the study public is not nationalistic, but related to business concerns. He also explained that a legal framework was established at the outset of the partnership so as to avoid antitrust concerns, and that detailed data are not discussed in meetings.
- Mr. Novachek asked whether any special incentives (such as preferred vendor status for a period of time) are being offered to participants. Mr. Williamson responded that at this point in time there are no unique incentives for participating, other than access to the information that is generated. He noted that the current plan is for open and fully competitive solicitations for building the fueling stations.

6. Solid Oxide Fuel Cell Updates

Mr. Sam Tam, DOE-FE; Mr. Hossein Ghezel-Aygah, Fuel Cell Energy, Inc.; and Mr. Mark A. Perna, Rolls-Royce Fuel Cell Systems (RRFCS)

6.1. Samuel Tam, U.S. Department of Energy (DOE), Office of Fossil Energy, Division of Clean Coal Energy Research, Director

Mr. Tam briefed the Committee on the Solid State Energy Conversion Alliance (SECA) program, a partnership of government, industry and the scientific community developing solid oxide fuel cells (SOFCs) for stationary, transportation and military applications. His presentation included:

- DOE's Advanced (Coal) Power System program goals
- SECA mission and goals, program structure, industry teams and program partners, budget history, technology status and development timeline, cost reductions curves, ongoing R&D, and remaining technical barriers
- Management of intellectual property through non-exclusive licenses
- Ongoing testing and demonstration of SECA technology, such as Delphi auxiliary power units for trucks and SOFCs in unmanned undersea vehicles (Navy)

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- See Discussion 6.3.

6.2. Hossein Ghezel-Aygah, Fuel Cell Energy, Inc. (FCE)

Mr. Ghezel-Aygah briefed the Committee on Fuel Cell Energy's involvement with the SECA partnership's development of integrated gasification (solid oxide) fuel cell (IGFC) systems. Fuel Cell Energy is developing large-scale coal-based power plants and natural gas distributed generation systems that use SOFC. The SECA program objectives are to develop large scale (>100MW) coal-based SOFC systems that (1) achieve at least 50% electrical efficiency (HHV); (2) meet DOE metrics for power output, degradation, etc.; (3) have a factory cost under \$700/kW (\$ 2007); (5) capture more than 90% of carbon from coal syngas for sequestration; and (6) reduce water consumption.

Mr. Ghezel-Aygah's presentation also featured:

- SECA coal-based IGFC development timeline, R&D team, fuel cell technology status, cell manufacturing technology status, cell fabrication and scale-up status, stack scale-up timeline and progress, and stack performance and modeling
- Comparison of SOFC powerplant efficiency and water consumption versus competing technologies
- Stack cost analysis and cost reduction pathway
- Baseline system power island schematics

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- See Discussion 6.3.

6.3. Mark A. Perna, Rolls-Royce Fuel Cell Systems (RRFCS)

Mr. Perna presented on a DOE-EERE funded project to develop an external fuel processor for SOFC systems. Rolls-Royce Fuel Cell Systems (RRFCS), a division of Rolls-Royce Energy, is a manufacturer of SOFCs and is developing a 1MW SOFC stationary power generator for distributed generation applications. The system will use an external fuel processor because it uses only pipeline-provided natural gas and air to provide all the gas streams needed by the SOFC and eliminates the need for on-site storage of hydrogen and nitrogen. He noted that the fuel processor system could also be modified to use bio-gas, digester gas, or landfill gas as those products are available. His presentation also addressed:

- RRFCS SOFC manufacturing facility
- 1MW SOFC generator product vision
- Project timeline, budget, partners, objectives, and milestones
- Overview of fuel processor subsystems and results for synthesis gas subsystem testing

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- Mr. Novachek asked whether an SOFC power plant could be turned down. Mr. Tam replied that turndown (e.g., to 50% capacity) could be achieved by turning off some of the modules, since the plant would be comprised of many fuel cell stacks/modules.
- In response to questions to Mr. Ghezel-Ayagh about the data he presented on IGFC system costs, he responded that FCE has met and exceeded yearly cost reduction goals. He also clarified that the cost figures were for the complete power island, not just the fuel cell stack.
- Dr. Ogden asked Mr. Ghezel-Ayagh if the IGFC system could be used for biomass gasification as an alternative to coal. He and Mr. Tam agreed that the SOFC being developed should be able to handle syngas from any source (biomass, natural gas or coal), and that the 250-MW project is looking at testing other fuel sources, such as coal-biomass mixes. Mr. Tam noted that with large power plants, it would be difficult to obtain sufficient biomass supply, but the system can be scaled down to suit smaller applications.
- Dr. Shaw noted that the research priorities for coal-based IGFC described by Mr. Tam seem to be the same as those described more than 20 years ago, and asked Mr. Tam to clarify what progress has been made. Mr. Tam responded that the priorities are the same, but they are making year over year progress in particular areas, such as gas seals. Dr. Shaw commented that it may be helpful to be more specific about the progress made in the six priority R&D areas in future presentations.
- Mr. Rose asked about the timeline – 2013 for full-scale demonstration of IGFC modules and 2020 for pre-commercial demonstration of full system, and whether the budget is sufficient to meet that timeline. Mr. Tam replied that the FY 2011 request is \$50 million and he cannot comment beyond that on future budgets. He believes that funding levels consistent with past appropriations will be sufficient to meet the timeline goals.

7. Overview of IPHE/CAFCP Infrastructure Workshop and Follow-on Activities

Ms. Catherine Dunwoody, Executive Director, California Fuel Cell Partnership (CaFCP)

Ms. Dunwoody briefed the Committee on a recent workshop co-sponsored by the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE), CaFCP, National Renewable Energy Laboratory, and DOE. Her presentation included:

- Overview of CaFCP and the CaFCP 2009 Action Plan and 2010 Progress Report for hydrogen fueling station and FCV roll-out in California, geared towards meeting the needs of 1000s of passenger FCVs in the 2013-2015 timeframe and tens of thousands in the 2016-2018 timeframe. A key focus of CaFCP is enabling the build-out of sufficient infrastructure by 2015 to support the early deployment phase.
- Results of a 2009 survey of automakers on FCV roll-out plans (both passenger vehicles and buses)
- Retail-ready stations in development in California
- Results and lessons learned from a fuel retailer focus group conducted by CaFCP to explore what would encourage retailers to install hydrogen fueling at stations when vehicle numbers are low
- Overview of the IPHE Infrastructure Workshop and key ideas from the workshop
- Continuing dialogue with and feedback from organizations like SIGMA (a trade association of large motor fuel marketers and chain retailers) to build on lessons and ideas from the focus group and workshop and to learn directly from fuel retailers. She noted that this direct communication is necessary to understand their needs and to uncover issues like the need to develop a Renewable Identification Number (RIN) for hydrogen from renewables and to include hydrogen in the Platts database.

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- Chairman Walker asked Ms. Dunwoody if there was any discussion about placing fueling stations at vehicle dealerships using incentives like one- or two-year capital depreciation schedules. He also asked how fuel retailers might react to this new competition. Ms. Dunwoody explained that the question of placing fueling stations at car dealerships or the use of specific depreciation schedules was not specifically posed at the workshop; however, she assumes that short-term depreciation would be very attractive. The fuel dealers CaFCP has talked to are very concerned about competition from non-traditional fuel retailers like grocery chains and big box stores, and one of the reasons they are interested in hearing about hydrogen is that they want to stay competitive and offer new fuels that enter the market.
- Mr. Eggert commented that one of the most salient points of this exercise was to realize that ultimately the hydrogen fueling infrastructure information has to be boiled down to a form that is consistent with station operators' current business practices. He asked for more detail on the characteristics of the starter station concept. Ms. Dunwoody responded that the key factors to starter stations are lower cost and smaller footprints. There is a sense that station owners might be interested in installing cutting edge fueling technologies if the investment costs are not too high and the installation is not going to take away from the footprint of their existing business.

- Dr. Schultz asked Ms. Dunwoody if the focus group had been informed about the greater efficiency of FCVs, so that a hydrogen price of \$6/kg is actually equivalent to \$3/gallon (or less) on a miles-driven basis. She replied that this was explained to the retailers; their main concerns were the up-front cost and the lack of certainty about demand. Ms. Dunwoody also noted that the retailers were surprised at the large margins applied to the hydrogen price in the model hydrogen station scenarios, since most gasoline stations sell gas for just a few more cents than what they buy it for and make their money via the convenience stores, car washes, etc. on the site. This may be an area that needs re-thinking in the hydrogen station modeling community, since most current models are aiming to recover capital costs solely through the sale of hydrogen.
- Dr. Lloyd asked Ms. Dunwoody if the focus group considered that hydrogen dispensing would not be subject to a lot of the expensive vapor recovery and spillage control regulations associated with gasoline. Ms. Dunwoody replied that they did not specifically discuss those regulations. She noted that the retailers did express concern with any underground hydrogen storage scenarios, since that could subject other underground storage at the stations to scrutiny.
- Dr. Shaw commented that it might be worthwhile to consider the idea of placing hydrogen stations at shopping malls that are co-located with vehicle dealerships. He also asked whether the workshop or focus group participants considered the idea of forming something like the Rural Electrification Administration to provide no- or low-cost loans to companies that want to build hydrogen fueling stations when demand and revenues are low. Ms. Dunwoody replied that the focus group and workshop participants did discuss the difficulty of obtaining financing, and that anything that would make it easier to obtain and lower the cost of financing would be helpful.
- Dr. Shaw also noted the efforts of Tom Sullivan, the founder of SunHydro, a company dedicated to building privately-funded solar-powered hydrogen fueling stations along the east coast. He surmised that other wealthy Americans may also be willing to make these kinds of investments in hydrogen fueling infrastructure if they are made aware of the benefits and opportunities. Ms. Dunwoody noted that having plans in place like the CaFCP's Action Plan provides a "roadmap" for people interested in investing by showing where stations are needed and where FCVs are expected to be.
- In response to a question from Dr. Ogden about the effectiveness of regulatory incentives, Ms. Dunwoody commented that the fuel retailers were very interested in whether hydrogen has a RIN, since they will be required by law (under the Renewable Fuel Standards regulations) to sell more and more renewable fuel (as certified by the assignment of a RIN). It appears that current regulations do not address hydrogen in the RIN classification system, and this needs to be addressed.
- Mr. Rose commented that he thinks some of the issues brought up in Ms. Dunwoody's presentation underscore the importance of developing a National Energy Strategy so that businesses have a clear understanding of the direction the nation is taking and can invest accordingly.

8. Mr. Michael Mills, U.S. Department of Energy (DOE), Office of Energy Efficiency and Renewable Energy, HTAC Operational and Follow-Up Items from Past HTAC Meetings

Mr. Mills reported on questions raised at past HTAC meetings.

- He confirmed that companies that are more than 50% owned by venture capital firms are not eligible for SBIR (Small Business Innovative Research) grant funding. According to the Director of SBIR at DOE, Congress is looking into this issue.
- Mr. Mills also confirmed that HTAC is not required to review the draft Program Plan of the Fuel Cell Technologies Program. He noted that the HTAC may choose to review and comment on it after it is made public, but that the draft is internal to DOE.
- On the process for recognizing departing HTAC members, Mr. Mills stated that he will provide notification, before their last meeting, to any members whose terms are expiring. He also proposed that the HTAC Chairman be granted time on each HTAC meeting agenda to formally recognize any members whose terms are scheduled to end before the next HTAC meeting and provide an opportunity for them to speak. Departing members will also receive letters of commendation from the Secretary of Energy. No objections were raised and this process was accepted by the Committee.

Mr. Mills reported on the nominations for new HTAC Chair and Vice Chair. Robert Shaw was nominated for Chair and Anthony Eggert, Frank Novachek and John Hofmeister were nominated for Vice Chair. Tomorrow's agenda will include time for additional nominations, words from the nominees, and the voting process.

Questions, Answers, and Discussion

- Mr. Rose asked why HTAC members could not comment on the draft Program Plan and be more participatory in its development, since when the members meet as HTAC they are legally DOE employees. Mr. Mills responded that because the meetings and their proceedings are public, and governed by Federal Advisory Committee Act rules, everything that is discussed must be publically available information. That is not to say that everything has to be final, it just has to be at a point where they can publically discuss the information. Mr. Rose followed up by asking if there was a provision for having closed meetings or discussing confidential information. Mr. Mills replied that there is no such provision for closed sessions that he is aware of, but he will consult with General Counsel on the matter.

9. Adjourn

Chairman Walker adjourned the June 3 meeting at 5:09pm.

JUNE 4, 2010

1. Greeting

Chairman Walker called the second day of the proceedings of HTAC to order at 9:32am.

2. Japan Infrastructure Agreement Overview

Mr. Sato, NEDO; Mr. Masnaobu Kitanaka, HySUT

2.1. Mr. Sato, Department Director, Fuel Cell and Hydrogen Technologies Development Department, New Energy and Industrial Technology Development Organization (NEDO)

Mr. Sato briefed the Committee on the Japanese government's framework for R&D projects, commercialization scenario, budgeting of R&D projects, demonstration projects, and roadmap for hydrogen and fuel cell technologies. Highlights from Mr. Sato's remarks include:

- NEDO's mission and approach are based on the necessity of addressing energy and global environmental challenges as well as promotion of R&D and flexible project management.
- The Fuel Cell Commercialization Conference of Japan (FCCJ) is a private sector consortium that was established to study and discuss commercialization of fuel cell technologies. FCCJ recently announced a plan for that commercialization of FCVs and hydrogen stations beginning in 2015.
- Mr. Sato provided the FCCJ's commercialization scenario, which is presented in four phases: (1) technology demonstration, (2) technology and market demonstration, (3) early commercialization, and (4) full commercialization. They project that in 2015, between phases 2 and 3, targeted commercialization to the general public will begin, and by 2025 (between phases 3 and 4) automakers will increase the number of FCVs and hydrogen stations, making them profitable.
- A host of organizations feed into the Japan Hydrogen and Fuel Cell Demonstration (JHFC) project, including NEDO, Japan Petroleum Energy Center (PEC), and The Japan Gas Association (JGA), among others. JHFC houses six working groups that steer each phase of the commercialization process.
- The latest demonstrations of FCVs have shown improved fuel economy in both local and highway driving.
- Mr. Sato provided a list of FCV and hydrogen station milestones with unfixed years to the Committee.

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- See Discussion 2.2.

2.2. Mr. Masnaobu Kitanaka, Division Director, Technical Development Division, Hydrogen Supply/Utilization Technology (HySUT)

Mr. Kitanaka presented the overview of the Japanese program HySUT, its current activities, and barriers to commercialization. HySUT is an industry group whose members include energy suppliers, industrial gas companies, engineering companies, and device companies. Highlights from Mr. Kitanaka's remarks include:

- HySUT is a relatively new program that was established in the summer of 2009 with the objective of moving toward FCV deployment through technology, standards, consumer acceptance, and demonstrations. It is composed of 24 employees, 7 of which are full-time staffers for HySUT (the other 17 double for their own company).
- Mr. Kitanaka presented the next stage of HySUT's demonstration programs for 2011-2015, which included analyzing the user's fueling actions, establishing best locations for fueling stations, meeting international standards, and promotion and educational activities, among others.
- HySUT also has a Hydrogen Highway Project and a Hydrogen Town Project. Both plans were presented to the Committee along with a plan for hydrogen stations central control systems.
- The commercialization challenges of FCVs and hydrogen stations that HySUT seeks to address include: reducing costs through R&D and preparing the social system for hydrogen and fuel cell technologies (e.g., laws and regulations).

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion (Both Kitanaka & Sato)

- Dr. Friedman thanked Mr. Sato for putting dates to the deployment of FCVs. In addition, he asked to clarify that by 2025 FCVs would account for 5-10 percent of the vehicle sales, and would that be fast enough to replace gasoline engines by 2040. Mr. Sato responded that Dr. Friedman did interpret the graph correctly, but the ability to replace gasoline engines with FCVs by 2040 is dependent upon how quickly FCVs pick up in the market.
- Dr. Lloyd asked how the Japanese government was able to get oil and gas companies involved in the hydrogen fueling and FCV deployment processes. Mr. Kitanaka said that HySUT was formed at the guidance of the Japanese government, though they are exploring incentives for concrete actions to deploy infrastructure.
- Mr. Kaya asked Mr. Sato two questions, (1) is their hydrogen derived from natural gas and refinery products and (2) do they have a program for renewable production of hydrogen? Mr. Sato said that NEDO is exploring coal gasification, coal with carbon capture and sequestration, along with renewable production of hydrogen such as solar and wind power. In the future NEDO is looking at electrolysis from water and other new energy sources.
- Mr. Kaya asked Mr. Sato how Japanese policies for hydrogen and fuel cells stays consistent when their government frequently changes? Mr. Sato said that in Japan METI is responsible for devising and implementing energy plans, so they have been able to maintain institutional memory in that way. Another way policy stays consistent is that the Japanese budgeting cycle works in such a way that budgeted funds are fixed for five-year increments.
- Dr. Schultz asked Mr. Sato what proportion of hydrogen in the long-term will come from coal, renewables, and nuclear. Mr. Sato responded that they do not have exact figures on the proportions of sources for producing hydrogen.
- Dr. Shaw asked Mr. Sato when corporations who participate in FCCJ will begin to make serious financial commitments to this technology. Also, once those commitments are made, are there any sanctions for failing to meet those commitments? Mr. Sato responded that financial commitments are proprietary and cannot be disclosed or some companies do not want to disclose specifics once a public commitment is made. At this moment, according to

Mr. Sato, no corporations have made a commitment, however NEDO has made sure that the 2015 goal will be met.

- In a follow up question, Dr. Shaw asked both Mr. Sato and Mr. Kitanaka what the probability was of meeting the 2015 and 2025 goals. Mr. Sato said that in terms of technology, NEDO is fairly confident that they can reach the projected milestones. Mr. Kitanaka reaffirmed that the scenario presented was put together by the FCCJ, so he believes that the targets are reliable.
- Mr. Rose asked Mr. Sato if NEDO had already submitted information to the Department of Finance to proceed with Phase 2 of the project, and if so is the money to be invested in Phase 2 greater than Phase 1? Mr. Sato responded that the budgeting request to the Department of Finance will be made officially in August, and they are still in the process of discussing how much money the government should invest in this project compared to the industry cost share. Ideally, they hope that the budget will be greater for Phase 2.
- Dr. Ogden asked Mr. Sato if NEDO saw a place for rolling out FCV passenger cars and when do they believe this will happen. Mr. Sato said that the roadmap was developed based on introducing other types of electric vehicles to reduce carbon dioxide emissions by 80 percent by 2050. Mr. Kitanaka responded that it is important to make passenger vehicles, either electric vehicles or FCVs, that help reach the carbon dioxide reduction goal. Ultimately whether FCVs enter the market as fleet vehicles or as passenger cars is up to the car manufacturers.
- Mr. Eggert asked Mr. Sato if there are any government standards or requirements for either the vehicle or fuels industry to compel investment in hydrogen and fuel cell technologies. Mr. Sato replied that while he is not directly involved in many of these aspects, he believes that the Ministry of Land, Infrastructure, and Transportation will be involved in creating similar programs to facilitate the development of fuel cell vehicles. Mr. Kitanaka also responded that they expect to see an increase of government incentives for infrastructure for FCVs as they move toward the 2015 milestone.
- In a follow up question, Mr. Eggert asked Mr. Kitanaka if they are anticipating success in their regulation relaxation and how that affects the permitting process in Japan. Mr. Kitanaka answered that he believes it is important to convince the regulatory agencies to relax the cost of regulation in an effort to reduce the overall cost of hydrogen fuel. Mr. Sato also noted that they would like to work with the cabinet office that reviews regulations in order to relax regulations for hydrogen and fuel cell vehicles.

3. Analysis of a "Cluster" Strategy for Introducing H2 vehicles and Stations in Southern California

Dr. Joan Ogden, Institute of Transportation Studies, University of California, Davis

Dr. Ogden briefed the Committee on a study she did in conjunction with Dr. Michael Nicholas at the University of California, Davis that analyzed a clustering strategy for the commercialization of hydrogen fueling stations and FCVs. Highlights from Dr. Ogden's presentation include:

- The clustering strategy identifies initial FCV-adopting communities and places two (1 mobile, 1 fixed) hydrogen stations within that region, ultimately reducing the time from home to fueling station. In addition, this study found that it would be most beneficial to also place eight connector hydrogen stations along commonly traveled routes in between the identified clusters.
- Stakeholders identified each of these 4 to 12 clusters throughout the Los Angeles (LA) Basin as early market sites. As more FCVs are rolled out, more stations will be needed. Professor Ogden

provided specific details of the number of stations needed between 2009 and 2017 in relation to the number of FCVs deployed.

- Using the cluster approach instead of a random placement of hydrogen stations reduced the overall time to fueling station, usually less than 4 minutes to a local or “home” station and less than 6 minutes to a diversion station. If a few connector stations are added, diversion times further decrease.
- The study further analyzed the economics of building hydrogen fueling stations. Some of assumptions that included in the economic analysis include future fixed station estimated costs of \$2 million for site preparation, permitting, engineering, utility installation, and equipment; during 2012-2014 equipment costs would be twice the cost of H2A “current tech”; and for 2015-2017 two cost cases were analyzed, high and low. Additional utility prices were assumed and are provided in the presentation.
- The initial capital investment into hydrogen fueling stations would cost approximately \$170 million to build 40 stations by 2015. By 2020-2025 the total investment can be recouped if the hydrogen is sold at \$10/kg. After 2017, if demand for hydrogen fuel continues to grow, hydrogen could be produced in large onsite SMR stations and be price competitive with gasoline.
- The study also found there are several options for renewable hydrogen production, which would meet California’s requirement for 33% renewable sources for hydrogen production.

>> see full presentation at http://www.hydrogen.energy.gov/htac_meeting_june10.html

Questions, Answers, and Discussion

- Dr. Ogden confirmed that the scale in her graph regarding the investment in hydrogen fueling stations was measured in total dollars, not dollars per year.
- Mr. Eggert asked Dr. Ogden if there was an assumed rate of return in the assumptions used in the “cost” of hydrogen stations. Dr. Ogden confirmed that the assumed rate of return was 15 percent.
- Dr. Friedman asked Dr. Ogden how the fueling industry reacted to the price of \$10/kg. Dr. Ogden replied that they did not think the price was too unreasonable because it is about 8 Euros per kilogram in Europe currently. Dr. Ogden continued that the industry was more concerned with whether or not there was a long-term business case for the hydrogen fueling stations.
- In a follow up comment, Dr. Friedman noted that there would need to be incentives or mandates for early adopters. Dr. Ogden agreed and stated that this was an aspect they considered for the study.
- Mr. Rose asked Dr. Ogden what the study used for kilograms per fill. Dr. Ogden replied that they used an average of four-to-five kilograms per fill scenarios and that as the price of gasoline is projected to rise to \$4 per gallon in 2025. This would make the hydrogen fuel cost competitive with liquid fuels.
- Dr. Friedman suggested that Dr. Ogden run an analysis using a lower gasoline price to determine the size of an incentive that may be needed to catalyze early adopters.
- Mr. Rose asked Dr. Ogden for clarification about the concept of area-wide travel. Dr. Ogden clarified that diversion travel time is throughout the whole LA Basin, while home station travel time is within a specific cluster.
- Mr. Rose noted to Dr. Ogden in a follow up comment that drivers tend to be brand loyal to their gasoline, which may continue with hydrogen stations, so an analysis on travel time to specific brand stations would be helpful.

- Mr. Eggert commented that Dr. Ogden's sensitivity analysis is really valuable to the Committee's efforts and inquired as to whether Dr. Ogden would conduct further research to analyze these identified sensitivities. Dr. Ogden indicated that she would be conducting further analyses on the sensitivities.
- Mr. Van Dokkum commented to Dr. Ogden that to make this cluster scenario work, OEMs would have to begin to rollout FCVs. Dr. Ogden agreed, stating that working with the California Fuel Cell Partnership to understand when OEMs were likely to rollout FCVs helped them develop appropriate timelines.
- Dr. Bond inquired how the UC Davis study came up with about 600 vehicles per station, instead of the 2,000 vehicles per station that the Japanese projected. Dr. Ogden replied that they developed the number based on a station dispensing approximately 3,000 gallons of gasoline (present day situation), which converts to about 1,500 kilograms of hydrogen per day and ultimately about 300 cars pass through each day. After FCVs become more prevalent, stations could increase in size and capacity, but initially a 1,000 to 1,500 kilogram per day station is assumed. Mr. Rose offered that at the early phases these size stations are all that would be needed to satiate the demand.
- Dr. Cardillo asked Dr. Ogden to estimate the price per mile of hydrogen since he feels the \$10 per kilogram price could discourage consumers. Dr. Ogden replied that an FCV gets roughly twice the fuel efficiency compared to a gasoline-powered vehicle. As a result, \$10 per kilogram would translate in to approximately \$5 per gallon of gasoline. This study was conducted based on the type of FCVs currently being demonstrated in Southern California, such as the Honda FCX Clarity, which get between 55 and 75 miles per kilogram.
- Mr. Hofmeister commented that the fragmentation of the fuel retail marketplace is an issue that will need to be addressed moving forward. He suggested that the best mechanism to use for developing fueling stations would be to make a deal, in terms of numbers of stations, through the branded companies with some incentive, which they could use to incentivize their retail distributors. Dr. Ogden agreed that this might be the best way to approach fuel retailers since three-quarters of the fuel distributors in California are independently owned.
- Dr. Taylor asked Dr. Ogden about average fill-up time at a station because customers expect zero wait time to a fill their tanks. Dr. Ogden replied that the study used data from the various stations that currently exist, as well as the H2A model which suggests an average fill time of 3 to 5 minutes.

4. Election of New Leadership Positions

- Dr. Bond asked Chairman Walker what the procedure would be since none of the nominated HTAC members have two years left to serve on the Committee and their leadership positions are for a two-year period. Chairman Walker deferred to Mr. Mills, who stated that the elected member might continue in their leadership upon approval of DOE. If renewal of the term is not granted, the issue will then have to be considered by the Committee at their next meeting.
- Election for HTAC Chair: Robert Shaw
Chairman Walker acknowledged the nomination of Dr. Robert Shaw for Chair of the Committee and opened up floor to additional nominations. Hearing none, he asked for a vote for Dr. Shaw as Chair of HTAC. Dr. Shaw was unanimously voted in as the Committee Chair.
- Vice-Chair: Frank Novachek
Chairman Walker acknowledged the prior nominations for Vice Chair of Mr. Anthony Eggert, Mr. Frank Novachek, and Mr. John Hofmeister. Mr. Eggert and Mr. Hofmeister both declined their nominations, citing other commitments. Chairman Walker opened up the floor for other

nominations for Vice Chair. Hearing none, the Committee unanimously voted Mr. Novachek Vice Chair.

- HTAC Annual Report Chair: Anthony Eggert
Mr. Eggert was appointed as the Chair for producing the 2010 HTAC Annual Report.
- Policy and Planning Committee (PPC) Chair: Bob Rose
Mr. Rose agreed to serve as PPC Chair. Chairman Walker hearing no other nominations, appointed Mr. Rose as PPC Chair.

5. Next Meeting and Other Business

- The next HTAC meeting is on October 14-15 in Washington, DC.

6. Adjourn

Chairman Walker adjourned meeting at 12:37 pm.

**FOURTEENTH MEETING OF THE
HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE (HTAC)
PARTICIPANT LIST
June 3-4, 2010**

HTAC Members Present

- Peter Bond
- Mark Cardillo
- Anthony Eggert
- David Friedman
- Robert Grober
- Janice Hicks
- John Hofmeister
- Maurice Kaya
- Harol Koyama
- Alan Lloyd
- Frank Novachek
- Joan Ogden
- Geraldine Richmond
- Bob Rose
- Ken Schultz
- Bob Shaw
- Kathleen Taylor
- Jan van Dokkum
- Robert Walker

HTAC Members Not Present

- Art Katsaros
- Jim Narva
- Philip Ross

U.S. Department of Energy Staff

Office of Energy Efficiency and Renewable Energy

- Dakota Barden
- Peter Devlin
- Kathi Epping Martin
- Richard Farmer
- John Garbak
- Monterey Gardiner
- Nancy Garland
- Fred Joseck
- Henry Kelly
- Michael Mills
- Antonio Ruiz
- Sunita Satyapal

Office of Fossil Energy

- Mark Ackiewicz
- Samuel Tam

Office of the Chief Financial Officer

- Jennifer MacDonald

Members of the Public in Attendance

- Geoffrey Bromaghim – National Hydrogen Association
- Kristin Deason – NOW GmbH
- Catherine Dunwoody – California Fuel Cell Partnership
- Charles Freese – General Motors
- Hossein Ghezeli-Ayagh – FuelCell Energy, Inc.
- Ed Kiczek – Air Products and Chemicals, Inc.
- Masanobu Kitanaka – The Research Association of Hydrogen Supply/Utilization Technology
- Tomonari Komiyama – Nippon Oil / ENEOS
- Rodger McKain – Rolls-Royce Fuel Cell Systems (US) Inc.
- Kristin Nawoj – Sentech, Inc.
- Monica Nieroda – Partnership for Advancing the Transition to Hydrogen
- Mark Perna – Rolls-Royce Fuel Cell Systems (US) Inc.
- Peter Protopappas – Sentech, Inc.
- Yoshiteru Sato – New Energy and Industrial Technology Development Organization
- Jeffrey Serfass – National Hydrogen Association
- Kazuko Sherman – New Energy and Industrial Technology Development Organization
- George Sverdrup – National Renewable Energy Laboratory
- Makito Takami – New Energy and Industrial Technology Development Organization
- C.E . (Sandy) Thomas
- Ian Stuart Williamson – Air Products and Chemicals, Inc.
- Yasuharu Yoshimori – Nippon Oil USA

Support Staff

- Judi Abraham – Conference Management Associates, Inc.
- Stephanie Byham – Sentech, Inc.
- Josh Gesick – National Renewable Energy Laboratory
- Alicia Jones – Energetics Incorporated
- Melissa Laffen – Alliance Technical Services, Inc.
- Shawna McQueen – Energetics Incorporated
- Matthew Simon – Energetics Incorporated
- Thomas J. Timbario - Alliance Technical Services, Inc.