

# HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE

## MEETING MINUTES

April 21-22, 2015

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## DAY 1 – APRIL 21, 2015

Chairman Hofmeister opened the meeting, welcomed the Under Secretary for Science and Energy, Dr. Franklin (“Lynn”) Orr, and asked the HTAC members to introduce themselves.

Dr. Satyapal provided an introduction for Under Secretary Orr, noting that his position serves as the principal advisor to the Energy Secretary and Deputy Secretary on science and energy. The position was created by Secretary Moniz to better integrate the U.S. Department of Energy’s (DOE’s) applied and basic science activities. She described his prior experience in academia, government, and non-profit organizations, and his educational background in chemical engineering.

### **1. Introductory Remarks and Discussion, Dr. Franklin Orr, Under Secretary for Science and Energy, U.S. Department of Energy**

Under Secretary Orr spoke on the importance of external advisory committees like the Hydrogen and Fuel Cell Technical Advisory Committee (HTAC), and thanked members for volunteering their expertise and for their informative reports to DOE. Dr. Orr discussed the integral place of energy in society, and the importance of managing the interactions between our energy systems and the natural systems of the planet, including climate and water. He pointed to the administration’s commitment to significant greenhouse gas emission reductions by 2025, the immense challenge this will present, and the need to address the problem from many different angles. Dr. Orr explained his perspective on the President’s “all of the above” energy strategy as one that pursues investments in a broad portfolio that spans all the primary energy resources, timescales for applications, and stages of discovery, research and development. He emphasized DOE’s continuing commitment to hydrogen and fuel cell R&D, and DOE’s interest in HTAC’s suggestions on the R&D portfolio, international collaboration, hydrogen infrastructure, and building public awareness.

Dr. Orr reported that the Fuel Cell Technologies Office (FCTO) recently hit a major milestone in achieving 500 patents developed from FCTO-supported R&D. He also described a number of the program’s other key R&D, technology demonstration, and technology deployment accomplishments. Dr. Orr remarked on the steep increase in real-world use of fuel cells, noting that this may prove to be an important transition. He recognized that challenges still exist but noted that many successful technologies also had to overcome difficult hurdles, and they did so by offering an improved service to consumers. Dr. Orr noted that the H<sub>2</sub>USA public-private partnership is largely focused on solving the hydrogen vehicle fueling infrastructure barriers, and mentioned several DOE tools and activities launched in support of H<sub>2</sub>USA, including two modeling tools, HRSAM (Hydrogen Refueling Station Analysis Model) and H2FAST (Hydrogen Financial Scenario Analysis Tool). Dr. Orr also mentioned a broader DOE effort, the Quadrennial Technology Review (QTR), which evaluated more than 60 energy technologies and will help inform the Department’s portfolio decisions going forward. Dr. Orr commended the level of coordination and collaboration achieved between DOE’s Office of Basic Energy Science and the Fuel Cell Technologies Office, noting that this is a “poster child” for the kind of collaboration desired between the applied and basic science programs. Finally, he encouraged members to continue providing input on budget priorities, key technical challenges, and RD&D opportunities, and on DOE’s role in transitioning technologies to the marketplace.

#### ***Discussion***

- Dr. Shaw suggested that the biggest issue for building a successful hydrogen fueling infrastructure is achieving the necessary vehicle density. He asked for Dr. Orr’s opinion on whether the U.S. would implement large tax incentives (at the scale being offered in Japan and some European countries) to help make fuel cell electric vehicles (FCEVs) more affordable for mainstream consumers.

- Dr. Orr noted that DOE's role is to work on reducing cost from the technology side and to make it possible for policymakers to see the path to commercialization. He also shared his belief that such a tax policy would be unlikely in the current budget environment.
- Ms. Dunwoody pointed out that California is offering a \$5,000 incentive to consumers who purchase or lease an FCEV, but the Federal tax credit for FCEVs expired at the end of 2014. She noted that this places FCEVs at a disadvantage, since battery electric vehicles (BEVs) still receive a federal tax incentive. Ms. Dunwoody also expressed appreciation for DOE's RD&D to date, noting that DOE's work has been instrumental in bringing the technology to the point where it is now. She noted that California currently has hundreds of real-world customers driving and fueling FCEVs, and continuing support from DOE on overcoming real-world challenges is essential. She specifically commended DOE's support for the H2FIRST [Hydrogen Fueling Infrastructure Research and Station Technology] project, which she said is bringing engineering from the lab into the real world for customers.
- Dr. Lloyd asked Dr. Orr what he found to be the biggest accomplishment of the Hydrogen and Fuel Cell Program so far, and whether he thinks there are any niche opportunities for basic research to have a big payoff in the near term.
  - Dr. Orr replied that he was impressed with how fast some of the technologies are moving down the learning curve on costs. He noted that ultimately the technologies will need to compete on cost, so this is a positive feature of the portfolio. In terms of research, he pointed to the opportunity for scientific research in materials-by-design to speed innovations on advanced catalysts and hydrogen storage materials.
- Mr. Rose expressed his hope that hydrogen and fuel cells will re-emerge as a leadership item for the Department, given the Program's successes in R&D and in multiplying the impacts of early technology demonstrations. He noted that this is a real success story for DOE.
- Mr. Freese relayed that GM thinks of hydrogen as an energy carrier, not a fuel. He stated that one of the often overlooked aspects of hydrogen is the way it cuts across different sectors of the economy and the energy complex. He noted that there may be opportunities for DOE to cultivate these cross-cutting opportunities (e.g., distributed power generation, grid stability, renewable energy storage), which could also bring additional budget to bear.
  - Dr. Orr noted that DOE recognizes the complex interconnections of the energy system and has placed a big emphasis on cross-cutting initiatives, like grid modernization, cyber security, and advanced manufacturing.
- Dr. Shaw pointed out that DOE's work in solar technology did not start having a big commercial impact until China developed large scale fabrications and manufacturing techniques that brought costs down. He expressed his concern that America will fall behind other countries in the race to commercialize hydrogen and fuel cell technologies, and a big competitive opportunity will be lost.

## **2. Quadrennial Technology Review Overview, Austin Brown, National Renewable Energy Laboratory**

Mr. Brown began with an overview of the purposes of the Quadrennial Energy Review (QER) and the Quadrennial Technology Review (QTR). He provided an outline of the 2015 QTR Chapters, highlighting chapters 4, 6, and 9, which contain content on hydrogen and fuel cell technologies. Mr. Brown provided an overview of energy in relation to transportation in the United States, as presented in the QTR, as well as the QTR's presentation of the status of fuel cell technologies and hydrogen production in the United States. He noted hydrogen's value as an energy carrier that can be derived from multiple sources, including renewable and low-carbon sources. Mr. Brown discussed goals to reduce the cost of hydrogen, specifically achieving a delivered and dispensed cost of <\$4/gge. He presented a chart of metrics comparing hydrogen and fuel cell technologies against other fuels, showing petroleum use and greenhouse gas emissions. Regarding stationary fuel cells, Mr. Brown provided an overview of the status and challenges as outlined in Chapter 6 of the QTR.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr21\\_15\\_brown.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr21_15_brown.pdf)

## ***Discussion***

- Vice Chairman Novachek asked Mr. Brown if he had any perspectives to share on FCEVs vs BEVs after working on the QTR.
  - Mr. Brown noted that much of the technology between the vehicles is shared, so there is significant opportunity for crosscutting research. Also, BEVs and FCEVs may be best suited for different drive cycles and different consumer needs, and the transportation system may evolve to a model that includes many more choices in fuels and technologies than we have today. He also noted that FCEVs offer the opportunity to significantly reduce greenhouse gas emissions in a relatively short time.
- Mr. Leggett observed that the U.S. population is newly and increasingly empowered to play a participatory role in their fuel selection process, which provides a lot of options and opportunities both for policymakers and investors. He pointed to the new capabilities that have been enabled by the natural gas economy, and suggested thinking more about how to take that a step further to a hydrogen economy. He also recommended that DOE focus more on explaining *why* new technologies are needed.
  - Mr. Brown agreed that human decision making and consumer choice has and will play a large role in technology successes (and failures) and this needs to be better incorporated into R&D decision making and portfolio analysis.
- Dr. Lloyd commended the QTR analysis on greenhouse gas reduction potential, but noted that criteria pollutants such as NO<sub>x</sub> and particulate matter are also important.
  - Mr. Brown agreed, and noted that they had also received this feedback from other sources, and are working to include more analysis on criteria pollutants and water use in the QTR.
- Ms. Dunwoody applauded the QTR for considering not just passenger vehicles, but also goods movement and other types of vehicles. She suggested that the QTR infrastructure analysis should also consider very large capacity fueling stations for applications like shipping ports. She also asked if the QTR considers other climate change pollutants, like methane and black carbon.
  - Mr. Brown stated that the intention of the life cycle analysis is to include all of the climate pollutants, but they are still working on nailing down data sources. He noted that the current analysis does include methane losses from natural gas operations.
- Mr. Koyama asked if there was analysis showing where the biggest cost drivers were for bridging the gap between today's low-volume fuel cell systems costs and the projected high volume costs.
  - Dr. Satyapal replied that this analysis is available, and noted that the cost drivers differ at low and high volumes (e.g., catalyst cost at high volume vs. membrane cost at low volume).

### **3. DOE Updates and Discussion, Reuben Sarkar, Deputy Assistant Secretary for Transportation, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy**

Deputy Assistant Secretary Sarkar noted several positive trends for hydrogen and fuel cells: building momentum in the fuel cell industry, slight increase in the DOE fiscal year 2016 budget request, and increased recognition of the Program from DOE senior leadership. Mr. Sarkar recalled his recent trip to the Memphis International Airport, to see the world's first fuel cell airport ground support equipment (GSE), a fleet of 15 vehicles being operated at the FedEx airport hub. He was impressed by how easily the diesel-powered GSE could be retrofitted to run on hydrogen-powered fuel cells, and how much diesel the vehicles are expected to displace (nearly 175,000 gallons over two years). He cited this project as a great example of early fuel cell deployments that can help build traction in the market, grow the supply chain, and provide new hydrogen fueling infrastructure.

He reflected on his job as manager of the sustainable transportation research portfolio, and noted that while the metrics for greenhouse gas and petroleum use reductions are important, equally important are metrics like total cost of ownership, return on investment, and payback periods, which are key drivers for consumer behavior. He is currently conducting an analysis on these metrics, for low, mid, and high vehicle volumes, and hopes to share the results with HTAC at their next meeting. He noted that different technologies may be best suited for different transportation niches, but an FCEV is so far the only "no compromise" vehicle that satisfies fast-fill, long-range, and zero emissions. Mr. Sarkar explained that this is why an "all of the above" strategy is important; it allows for different technologies to provide their benefits along different timelines in a complementary way. Mr. Sarkar also

highlighted the Program’s increased focus on advanced materials and manufacturing R&D, which will be aimed at reducing the time it takes to get new materials to market (from discovery through manufacturable, fully-qualified hardware).

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr21\\_15\\_sarkar.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr21_15_sarkar.pdf)

### **Discussion**

- Dr. Shaw expressed his support for the analysis Mr. Sarkar is conducting, noting that the transition from low volumes of FCEVs and hydrogen stations to high volumes is a big challenge.
- Mr. Kaya commended DOE’s interest in incorporating consumer behavior into their analysis and forecasting. He asked how DOE plans to gather and use this kind of information.
  - Mr. Sarkar noted that DOE recognizes that it needs to do a better job in this area in order to improve the accuracy of their forecasts. However, decision science is not a key part of the Department’s current skill set, so they are still working on how to bring this into the analysis arena.
- Mr. Rose asked whether the idea of “hydricity” – or having hydrogen as a central energy carrier, as an enabler for multiple energy sources and technologies – has come up at the national lab “big ideas” summits.
  - Mr. Sarkar replied it has come up in the transportation working group meetings leading up to last year’s summit, but it has not yet been brought to the summit itself. Dr. Satyapal noted that a presentation touching on this subject will be presented by Josh Eichman (National Renewable Energy Laboratory) later in the HTAC meeting.
- Ms. Dunwoody noted that one of the market challenges is convincing companies (like freight delivery companies, refrigeration truck fleets, or bus fleets) that the technologies are reliable, and that their mission-critical operations will not suffer if they use them. She noted that in California, there are reliability problems with the older hydrogen fueling stations, and while she hopes this will be solved as new-generation stations are built, it is still a problem for some FCEV users.
  - Mr. Sarkar replied that part of FCTO’s next funding opportunity announcement includes development of mobile refuelers, which could be deployed to stations that are temporarily down.
- Dr. Shaw suggested that a mobile refueler could also deliver hydrogen to individual users as needed, similar to how grocery stores deliver grocery orders.
- Chairman Hofmeister urged DOE to boost its consumer education efforts, saying that this would be necessary to achieve larger market penetration.
  - Mr. Sarkar agreed, and noted that he is working to better incorporate commercially available fuel cell technologies into the messaging delivered by the Clean Cities coalitions.

#### **4. DOE Updates and Discussion, Sunita Satyapal, Director, Fuel Cell Technologies Office, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy**

Dr. Satyapal began by covering the scope of HTAC in their role of advising the Secretary of Energy on the implementation of EPAct. She emphasized HTAC’s role in supporting the first two areas of Title VIII of the Energy Policy Act of 2005 (EPAct): to enable and promote comprehensive development, demonstration (RD3), and commercialization of hydrogen and fuel cells with industry; and to enable critical public investments in building strong links to private industry, universities, and National Labs. She then spoke on some of the recommendations that HTAC has provided to DOE in the past including the need to apply stronger commitment to and support of fuel cell electric vehicle (FCEV) deployment, and for investment in infrastructure. Dr. Satyapal continued with an overview of DOE’s hydrogen and fuel cells research, development, demonstration, and deployment program, followed by FCTO’s current collaborations and partnerships. Regarding DOE’s fuel cells technology programs, Dr. Satyapal presented recent focus areas, targets, and standards for R&D. She then illustrated the impacts of this technology investment on commercial products and job creation. Following this, Dr. Satyapal presented FCTO budget figures, national and international infrastructure activities, an overview of H<sub>2</sub>USA’s accomplishments, recent funding announcements, the HTAC Manufacturing Subcommittee’s

recommendations and DOE's responses, and outreach efforts by FCTO. She concluded with some next steps and key activities for FCTO and HTAC.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr21\\_15\\_satyapal.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr21_15_satyapal.pdf)

### **Discussion**

- Mr. Rose drew attention to slide 6, which highlighted accomplishments of DOE's RD3 program, and noted that there seems to be more emphasis on "tech-to-market" activities in the program rhetoric. He observed that the Program is still strong on R&D, despite budget cuts, but contended that more funding is needed in future budgets for the "demonstration and deployment" areas, noting that many of the accomplishments shown for these areas in slide 6 come from projects and activities funded more than 5 years ago.
  - Mr. Sarkar noted that the American Reinvestment and Recovery Act of 2009 provided funds for many of the demonstrations and deployments featured in slide 6. Dr. Satyapal added that the Program is currently funding some demonstrations, including those for fuel cell ground support equipment, delivery vans, and garbage collection trucks.
    - Mr. Rose agreed, but noted that those demonstration projects are for a relatively small number of units.
- Ms. Dunwoody again expressed appreciation for DOE's support of the H2FIRST project, which she said is helping to solve problems relating to real-world operation of these technologies. She asked if DOE is thinking about the next steps, and providing budget to support emerging near-term needs, such as issues that may arise with back-to-back fills at hydrogen stations.
  - Dr. Satyapal replied that one key issue they hear over and over again is making sure that vehicle demand matches hydrogen availability. Mobile refuelers and small modular hydrogen stations could be used to meet hydrogen demand in early stages, and then moved out to other regions as the vehicle market picks up and demand grows. She also pointed to new DOE activities focused on building the supply chain for components like hydrogen dispensers and nozzles, as well as ongoing activities to support the qualification of hardware and conduct quantitative risk assessment to ensure science-based codes and standards. She spoke to the Program's need to balance near- and long-term activities, but noted that support for California's efforts is a high priority.
- Vice Chairman Novachek noted that the subject of national technology leadership sometimes comes up, and asked how important this really is. He asked Dr. Satyapal if this is something HTAC should be considering as they make their recommendations to DOE.
  - Dr. Satyapal noted that the issue of manufacturing competitiveness is one of the Department's key initiatives, so this is an area of importance.
- Mr. Freese referenced slide 18 of Dr. Satyapal's presentation, which shows infrastructure activities in Japan and Europe, noting a common strategy in these countries to build critical mass in a few urban locations and build out infrastructure from there. He expressed concern that in the U.S., activities in the states referenced on slide 17 could dilute efforts in California, by drawing away the limited number of FCEVs that are in production.
  - Dr. Satyapal noted that this is an issue being addressed by H<sub>2</sub>USA working groups, and that DOE is supporting projects in states that have shown a big interest in hydrogen with active and engaged stakeholder groups.

### **5. Office of Science Activities in Energy Storage, Harriet Kung, Director, Office of Basic Energy Sciences, U.S. Department of Energy Office of Science**

Dr. Kung started by introducing the organizational role of Basic Energy Sciences (BES) within the Department of Energy. She explained that BES has benefited from strategic planning and program development over the years, and showed a timeline of BES's involvement with the BES Advisory Committee (BESAC). Dr. Kung then went over some BES research activities including its core research projects and the accomplishments of its Energy Frontier Research Centers over the past several years. Dr. Kung provided an overview of the role of its scientific user facilities; facilities that are free to researchers, and noted that these facilities currently support over 16,000 users. Dr. Kung presented examples of companies engaging in research at BES Light Source Facilities, Neutron

Scattering Facilities, and Nano Science Research Centers. Next, Dr. Kung provided an overview of BES's FY 2016 Budget Request, noting the need to balance their major focus areas. Dr. Kung highlighted the increase of computational materials science research; coordination of basic and applied research; and BES's continuum of research, development, and deployment. Finally, Dr. Kung provided an overview of several BES projects including some applicable to hydrogen production and storage, and presented some BES communications materials.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr21\\_15\\_kung.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr21_15_kung.pdf)

### ***Discussion***

- Due to time and schedule limitations, Chairman Hofmeister asked HTAC members to submit questions directly to Dr. Kung via email.

## **6. Hydrogen Energy Storage Activities, Jeff Reed, Southern California Gas Company**

Dr. Reed began with some information on Southern California Gas Company (SoCalGas) and an overview of energy storage activities. He then spoke on the predicted impact of high renewable penetration on the California electric grid, and potential for gas storage within the natural gas grid, noting that the extent of this system allows for physical separation of energy storage input and the point of delivery. Next, Dr. Reed illustrated the power-to-gas concept and its components. He presented two project summaries: one on methanation and grid modeling, and one on hydrogen production and blending. Finally, Dr. Reed listed some key challenges and issues for energy storage including the need for "least-cost-best-fit" analysis of storage technologies in the market; that power-to-gas-to-power may not be the optimal use of stored hydrogen, even though policy frameworks tend to assume this model; and the need for improvements to system efficiency and cost.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr21\\_15\\_reed.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr21_15_reed.pdf)

### ***Discussion***

- Dr. Shaw asked, regarding a chart showing a methanation process, whether the hydrogen could be stored and fed into a fuel cell as an alternative to the methanation step.
  - Dr. Reed responded that this comparison will be better understood later in the summer. He noted that this would likely be case-dependent, and that they would probably end up using both approaches, which is why Germany is looking at both hydrogen blending and methanation.
- Mr. Rose asked about the water use with this process.
  - Dr. Reed responded that this system is fairly modest in its water consumption. He stated that, if you were to store enough power in either one of these systems to power a home for a year, and they supplied the water, you would only increase their water use by about one percent.
- Dr. Lipman asked how much hydrogen can be stored in a natural gas field with the existing pipelines without leakage and embrittlement.
  - Dr. Reed responded that their analytical work says zero to 20 percent. He noted that most people are comfortable with 5 percent levels.
    - Dr. Lipman stated that even 5 percent would be a massive amount of storage.
      - Dr. Reed responded that, though there will be examples where transporting hydrogen in the gas pipelines makes sense, the methanation pathway is also worth looking into since it makes the hydrogen completely fungible with conventional gas.
- Vice Chairman Novachek asked if SoCalGas has done any studies on using geological storage to store pure hydrogen.

- Dr. Reed stated they have not done any studies, but some European studies have found that typical porous rock formations are not good as good at storing hydrogen as salt formations. He noted that this will be looked into more in parallel projects on pipeline hydrogen blends.
  - Dr. Satyapal added that Sandia National Laboratories recently published a paper looking into storage in four different formation types.

## **7. Energy Storage Activities at NREL, Josh Eichman, National Renewable Energy Laboratory**

Mr. Eichman began with an overview of hydrogen energy storage (HES) pathways and opportunities for power-to-gas in the U.S. He then presented some NREL storage analysis activities for fiscal year 2014 including electrolyzer response capabilities in electricity markets, and optimization models to quantify the value of stored hydrogen in electricity markets. He presented several examples of results from these models and lessons learned on the role and impact of stored hydrogen in electricity markets. Mr. Eichman showed some of the results from the Electrolytic Hydrogen Production Workshop at NREL, held to discuss and share information on RD&D needs for enabling low-cost, effective hydrogen production from all types of water electrolysis systems. He then provided an overview of the Clean Energy Dialogue, a bilateral collaboration between the U.S. and Canada, for which NREL hosted a 2014 workshop on barriers, policy and next steps for encouraging HES. Mr. Eichman continued with NREL's storage analysis activities for fiscal year 2015, including plans to hold a follow-up workshop that will focus more on the technical issues associated with HES and power-to-gas, and expanding the analysis of HES to other locations and timeframes. He also spoke about a proposed CARB-DOE-NREL analysis project on developing specific cases for power-to-gas systems in California, and NREL's ongoing work with SoCalGas.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr21\\_15\\_eichman.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr21_15_eichman.pdf)

### ***Discussion***

- Mr. Freese asked if, since hydrogen can be stored for long periods of time, if it would make sense to store hydrogen for longer periods as arbitrage against seasonality in gasoline prices.
  - Mr. Eichman replied that they had looked at this in relation to the fluctuation of electricity prices, and essentially the volatility isn't high enough (in current markets) for this to make sense, since you would be losing revenue on the stored hydrogen. He said that they had not evaluated the arbitrage value for fuel, but they could look into it.
- Vice Chairman Novachek asked if they had looked at the potential of a reversible fuel cell, since it has the benefit of sharing the electrolyzer and fuel cell in one capital cost increment.
  - Mr. Eichman said they have looked at this informally, and it looks favorable, but they have not been able to run tests on a unit to explore issues around ramp rate or degradation with rapid load changes.

## **8. H2FAST (Hydrogen Financial Analysis Scenario Tool), Marc Melaina, National Renewable Energy Laboratory**

Dr. Melaina began by introducing the goals and functions of the H2FAST analysis tool. He described the goal of H2FAST as informing investment decisions by providing end-users an industry-grade tool to explore the financial aspects of hydrogen projects, including one hydrogen station, multiple hydrogen stations, or broader hydrogen infrastructure network developments. He presented the different versions of the tool including H2FAST: Web, H2FAST: Excel, and H2FAST: BCS-Vis (Business Case Scenario Visualization). He explained that the Web version was developed for end-users requiring a simple, first-cut analysis, while the Excel version allows more detailed and elaborate spreadsheet analyses. The BCS-Vis tool can be applied to the entire hydrogen fuel supply chain to evaluate the financial implications of infrastructure development at the city, region, or national levels. Dr. Melaina displayed the types of inputs that could be provided to the Web version and presented some example

cases. For H2FAST: Excel, Dr. Melaina presented a summary of its capabilities and a description of the interface. Next, he presented the H2FAST Business Case Scenario (BCS) tool and showed several visualizations from the model.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr21\\_15\\_melaina.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr21_15_melaina.pdf)

## **Discussion**

- Dr. Bond asked if the models have been validated to see if the results represent reality.
  - Dr. Melaina noted that the users have great latitude on the inputs, so it would depend on how realistic that input data is. He noted that the default values in the Web tool are the values and assumptions used in DOE's Hydrogen Refueling Station Analysis model (HR-SAM), which has undergone industry vetting.
- Ms. Dunwoody congratulated NREL on the tool's user friendly interface and ease of use. She noted that the H2FAST models builds on prior work (Scenario Evaluation and Visualization Analysis [SERA], HR-SAM, and other H2A models) so it incorporates a lot of industry vetting.
  - Dr. Melaina confirmed that the H2FAST tools build upon previous cost analysis and don't make any "new" calculations. He explained that the main goal of this effort was to package the analytic capability in a more user friendly way and provide greater access for people to get financial results. He also noted that the reviewers of the Beta version included both people familiar with hydrogen projects and ordinary financial analysts who didn't know anything about hydrogen.
    - Dr. Satyapal added that feedback from industry users, who have run the models using their own input data and assumptions, has been very positive.
- Commissioner Scott noted that the tool may be useful for the California Energy Commission as it evaluates next steps for hydrogen infrastructure.
- Chairman Hofmeister asked if the tools accounts for the cost of real estate, construction costs, permitting costs, etc. for someone wanting to build a new station.
  - Dr. Melaina replied that all of those sorts of upfront costs are included in the cash flow analysis, and are included as inputs in the spreadsheet model.

## **9. ITM Power: Energy Storage, Clean Fuel; Geoff Budd; ITM Power**

Mr. Budd began with an overview of ITM Power and his team, highlighting their focus on clean fuel, energy storage, and renewable heat. Regarding energy storage, he stated that energy storage is required to minimize renewable energy curtailment and provided an overview of power-to-gas (P2G) for energy storage. He described the value of P2G to the electric grid, natural gas grid, and national economy, including the ancillary services it provides for balancing power supply and demand. Mr. Budd then presented some features and testing results of ITM's PEM electrolyzer stack platform. Next, Mr. Budd presented on several ongoing P2G projects in Germany and their pipeline of upcoming projects, which includes storing hydrogen for use as a chemical feedstock (for urea production). Following this, Mr. Budd showed ITM's involvement in hydrogen refueling stations (including an existing and planned renewable hydrogen station in California), some key features of ITM's electrolyzer systems, and the Rotherham hydrogen mini grid system at the Advanced Manufacturing Park (incorporating a wind turbine, electrolyzer, and hydrogen dispensing unit.) Finally, he discussed the rationale for power-to-gas hybrid systems, and strategies for implementing energy storage and clean fuels.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr21\\_15\\_budd.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr21_15_budd.pdf)

## ***Discussion***

- Chairman Hofmeister asked if ITM considers the utility their customer, supplier, or both.
  - Mr. Budd replied that mainly they are viewed as a customer, but it is really a partner relationship at this point since there are still a lot of questions to be answered about how to optimize the system.
- Commissioner Scott noted that when renewables need to be curtailed, it's not only wasted money and energy, it's not achieving the clean air and climate change goals that you are trying to meet. She asked whether the regulatory system presents a problem since it may not capture all of the value that these systems provide.
  - Mr. Budd agreed and noted that this issue has been raised in many forums discussing the potential of hydrogen storage and P2G: that regulators need to create a level playing field on which storage can compete with other flexibility options.

## **DAY 2 – APRIL 22, 2015**

### **1. US Clean Energy Hydrogen and Fuel Cell Technologies: A Competitiveness Analysis, Patrick Fullenkamp, Global Wind Network**

Mr. Fullenkamp presented on an analysis project being led by the Global Wind Network (GLWN) to assess the global competitiveness of hydrogen and fuel cell technologies. He identified GLWN's partners on the project and described the project's key products: (1) a global competitive analysis of hydrogen and fuel cell systems and components, and (2) an annual assessment of the status of global hydrogen and fuel cell markets (for each of the years 2014-2017). Mr. Fullenkamp provided details on the project's schedule, tasks, and deliverables. He explained that the global competitiveness analysis will identify five high-value hydrogen and fuel cell technology components and conduct detailed cost analysis in three global regions for an apples-to-apples comparison. The outcome will identify global cost leaders, best global manufacturing processes, key factors determining competitiveness, and opportunities for cost reduction. The annual market analysis will report on number of hydrogen and fuel cell units shipped, size (MW) and application, by country.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr22\\_15\\_fullenkamp.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr22_15_fullenkamp.pdf)

## ***Discussion***

- Chairman Hofmeister asked who the customer is for this study.
  - Mr. Fullenkamp responded that the customer is the Department of Energy's Fuel Cell Technologies Office and the National Renewable Energy Laboratory (NREL).
- Dr. Shaw asked how long this study will take.
  - Mr. Fullenkamp noted that the competitiveness analysis will be a two year project and that the annual reporting of market volumes will be a four year project, from 2014 to 2017.
- Dr. Thompson asked if any part of this has already been done.
  - Mr. Fullenkamp replied that one of the project partners, Strategic Analysis, has already developed some Design for Manufacturing and Analysis (DFMA) models, but these will be refined and expanded for the global analysis.
- Mr. Koyama asked whether the focus of the study is just PEM fuel cells
  - Mr. Fullenkamp confirmed this.
- Mr. Koyama asked about applications for this study.
  - Mr. Fullenkamp replied that it is primarily for automotive applications.
- Mr. Koyama recommended looking at commonalities and overlaps between the stationary power and automotive sectors.

- Vice Chairman Novachek asked how this project is addressing confidentiality issues.
  - Mr. Fullenkamp stated that the suppliers are informed that this information will not be shared publicly. He added that data presented in the charts will be aggregated so that specific supplier information is not revealed.
- Dr. Satyapal provided some background information on the project, stating that EERE Assistant Secretary David Danielson requested this analysis from all of the offices under his management. She explained that NREL was a key player in developing the approach and methodology for the analyses completed for wind and lithium-ion batteries, so FCTO issued a competitive solicitation for this work but required the awardee(s) to work with NREL to ensure consistency in the study's methodology. She added that the initial focus is on automotive PEM technology since Strategic Analysis already has some high and medium volume manufacturing cost results from their DMFA models. Dr. Satyapal noted that input from the HTAC Manufacturing subcommittee has been helpful in shaping the scope for the project, and requested that HTAC provide periodic feedback on the project's methodology and results.
- Dr. Satyapal added that FCTO is funding two additional analysis projects that will be focused more on the supply chain and matching the supply chain with the developers. She hopes to integrate the three projects.
- Dr. Shaw commended the team selected for this project. He raised concerns about the confidentiality surrounding innovative designs for systems and component technologies and whether this will pose difficulties for this type of analysis, especially when trying to establish a "standard" design for cost analysis of a rapidly developing technology like fuel cell stacks.
  - Mr. Fullenkamp stated that the team will be examining patent applications and holding discussions with OEMs to develop and vet the design(s) that will be used in the analysis.
- Dr. Satyapal pointed out that the project will also be looking at hydrogen storage tanks, which will be simpler for the purposes of this analysis. Dr. Lloyd suggested that there be a checkpoint with DOE at some point in this study to verify that the most relevant information is being targeted and gathered.
- Vice Chairman Novachek suggested that the project team ask suppliers and OEMs for projected costs as well as current costs, since advances in manufacturing scale and technology can have a big impact in a short time. Mr. Fullenkamp agreed.
- Dr. Shaw noted that one of the major limitations on larger-volume FCEV production is the lack of OEM experience with mass producing fuel cells.
  - Dr. Satyapal pointed out that some high-volume manufacturing facilities exist in Japan for making fuel cells for stationary power, and that information learned from mass-producing batteries can be used here.
- Chairman Hofmeister asked if the analysis will investigate and report on government's role in building or sustaining competitiveness in the countries being examined.
  - Mr. Fullenkamp responded that this is part of the project scope, and the study will identify this kind of national, regional, state, or local funding.

## 2. Discussion: Hydrogen and Fuel Cell Manufacturing

Chairman Hofmeister asked the Committee to discuss anything new or different in manufacturing that the Committee should be thinking about with regards to hydrogen and fuel cell manufacturing, or any suggested follow-on efforts to the HTAC Manufacturing Subcommittee's report or the ongoing work in the administration's Clean Energy Manufacturing Initiative.

- Mr. Koyama reminded the Committee of several recommendations for further attention in the Manufacturing Subcommittee's report, including scale-manufacturing needs for stationary power components, and identifying and focusing on components that are most important for competitiveness in the United States.
- Dr. Shaw noted that stationary fuel cell manufacturing is becoming more automated, and that eventually this entire process would have to become automated. He noted that the Committee might be in a position to query the automotive companies about their issues with large scale manufacturing and feed back to DOE. He also

suggested gathering lessons learned from the stationary fuel cell side that could be applied to large-scale automotive fuel cell manufacturing.

- Dr. Satyapal noted that the HTAC could choose to re-form a Manufacturing Subcommittee and that anyone (including outside experts) can be added to the subcommittee without a nomination process. She added that DOE could present to HTAC (or the subcommittee) on two new supply chain projects, which may help boost U.S.-based manufacturing of membrane electrode assemblies (MEAs), catalysts, and alkaline exchange membranes (AEMs).
- Dr. Shaw suggested setting up a meeting of the manufacturing subcommittee and other relevant experts to discuss hydrogen and fuel cell manufacturing issues and needs.
  - Dr. Satyapal replied that the advice from this kind of meeting is welcome under the scope of the Federal Advisory Committee Act, and she could try to arrange for the two supply chain projects to make a presentation, if desired.
- Dr. Thompson asked about the proprietary nature of these technologies, and how to overcome the issue of sharing this information between groups.
  - Dr. Satyapal responded that in reporting from these types of projects there is usually a proprietary report and a version that can be disseminated.
- Mr. Rose noted the importance of HTAC providing its input early enough in the process to be helpful to the projects as they develop.
- Chairman Hofmeister asked whether HTAC should reconvene a Manufacturing subcommittee. He asked if Mr. Koyama could again lead the subcommittee.
  - Several HTAC members responded in affirmation, and Mr. Koyama agreed to helping with the subcommittee.
  - Chairman Hofmeister asked HTAC members to let Mr. Koyama know if they are interested in supporting the Manufacturing subcommittee.
  - Dr. Shaw noted that the subcommittee had help from outside experts in the past, such as Hydrogenics, Versa Power, and NREL.
  - Chairman Hofmeister asked Dr. Satyapal to submit to Mr. Koyama the scope of DOE's advisory needs on this subject, to help the subcommittee define its "charge."
  - Dr. Satyapal suggested that the subcommittee be formed soon and proceed with scheduling a telephone conference to get a briefing on the two supply chain projects that are underway.
  - Dr. Shaw asked for a hardcopy of the projects' scopes when they are available for distribution to the subcommittee.

**3. H<sub>2</sub>USA Update: Morry Markowitz and Karen Hall (Fuel Cell & Hydrogen Energy Association [FCHEA]), Bob Wimmer (Toyota), Marc Melaina (NREL) and Bill MacLeod (Hyundai)**

Mr. Markowitz began by reviewing the goals of H<sub>2</sub>USA and its organizational structure. He noted that Charlie Freese is now the chair of the Operational Steering Committee, and talked about the 2015 timeline that was established and key deliverables for 2015. He noted that H<sub>2</sub>USA is now up to 40 participants, after starting with DOE and several automotive OEMs. Mr. Markowitz highlighted the diverse number of participants that are now taking part in H<sub>2</sub>USA. He noted that H<sub>2</sub>USA now accepts individuals as participants through associate level participation, and invited HTAC members to join..

Mr. Wimmer then presented on the H<sub>2</sub>USA Market Support and Acceleration Working Group, and explained that they are reaching out to a number of stakeholder groups. He highlighted the Codes and Standards task team, which meets monthly, and noted the group's efforts to establish hydrogen fueling in the DC metro area.

Ms. Hall spoke regarding the Hydrogen Fueling Station Working Group. She noted its mission of developing widely-deployed hydrogen stations in the US. She then reviewed their recent activities on hydrogen fueling

stations including the current focus on the Station Reference Design Report; their work with H2FAST for station implementation; the regulations, codes and standards joint task group which is focusing on identifying opportunities that there might be to influence the buyer code at the state and regional level; and an upcoming webinar that is planned on modeling tools.

Dr. Melaina presented on the Locations Roadmap Working Group. He highlighted key activities by the working group including OEM automaker FCEV scenario projections, coordination with NESCAUM, national projection analysis/modeling at NREL, and development of a northeast FCEV/H2 deployment plan.

Mr. MacLeod spoke on the Investment and Finance Working Group. He noted key activities, including identifying and developing investor incentives, developing tools to help investors evaluate opportunities, and conducting outreach to education the investment community.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr22\\_15\\_Markowitz.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr22_15_Markowitz.pdf)

### **Discussion**

- Mr. Lipman asked when meetings of H<sub>2</sub>USA are held.
  - Mr. Markowitz replied that most meetings are scheduled during events that members typically attend anyway, such as the Annual Merit Review (AMR).
- Mr. Rose asked about the lack of oil industry participants.
  - Mr. Markowitz responded that the group actively tries to recruit oil and gas companies. They were trying to recruit two of these companies and neither ultimately joined. He noted recent success in recruiting an organization to represent the natural gas industry.
- Dr. Shaw asked Dr. Melaina about efforts to determine vehicle density as a guideline for station placement.
  - Mr. Markowitz noted that, in answering questions, that they should be careful to not provide answers that would violate anti-trust laws.
  - Dr. Melaina stated that they are laying the groundwork for these determinations with data based on existing vehicle registrations and regional household income with relevant purchase history.
- Mr. Leggett asked how much detail is available regarding deployment demographics.
  - Dr. Melaina responded that, at some point, they would have to look at stations at a more granular level to look at other variables that affect station demographics.
- Commissioner Scott asked when the draft will be released for public comment.
  - Dr. Melaina responded that he would have to check the project management spreadsheet for this.
- Commissioner Scott asked what kind of information is provided when talking to outside groups about H<sub>2</sub>USA and its activities, and how the information is being received/perceived.
  - Mr. Wimmer responded that the approaches and responses vary depending on the organization being addressed. He stated that they generally talk about the core strategy of H<sub>2</sub>USA, with material tailored for the particular group being addressed, and respond to questions.
- Dr. Lloyd asked about the responses received from environmental groups and about what H<sub>2</sub>USA does to reach out to foundations that provide funding in this space, but have been reluctant to fund hydrogen fuel cell technologies.
  - Mr. Wimmer noted that H<sub>2</sub>USA was very active on Earth Day at the National Mall. He added that when renewable hydrogen pathways are explained to environmental groups they are typically fairly receptive.
  - Mr. Markowitz added that some foundations are very targeted in their focus and getting them on board is nearly impossible. He stated that they had sent out letters to organizations such as the Sierra Club, the National Wildlife Federation, and the Environmental Defense Fund. He also noted that in the past several years, there has been a softening in the tone of anti-fuel cell vehicle positions.

- Dr. Shaw suggested having a strong message out to the solar community on the link between solar energy and production of hydrogen.
  - Mr. Markowitz noted that FCHEA coordinates closely with solar and wind groups when lobbying for common issues such as production and investment tax credits.. He added that members of all these organizations belong to a group called the Business Council for Sustainable Energy.
- Dr. Shaw suggested that a key message with environmental groups should be the “factor of 2” reduction in CO<sub>2</sub> emissions per mile with hydrogen from natural gas as compared to gasoline.
  - Mr. Markowitz stated that a core H<sub>2</sub>USA message is that hydrogen represents the “all-of-the-above” technology that uses all fuel sources from natural gas to renewables.

#### **4. Office of Electricity (OE) Energy Storage Activities, Imre Gyuk. Office of Electricity Delivery and Energy Reliability, U.S. Department of Energy**

Dr. Gyuk began with an introduction to energy storage. He presented the federal role in creating a new industry, noting the importance of creating grants, establishing venture capital, and cost-share projects. He also listed notable state involvements in investing in energy storage. Dr. Gyuk presented a TRL/CRL chart showing how DOE OE maps energy storage projects, and showed OE’s American Recovery and Reinvestment Act stimulus funding for energy storage projects. Dr. Gyuk then explained the role of power systems and energy systems in energy storage for frequency regulation or renewable smoothing. Dr. Gyuk showed two examples of ARRA energy storage projects: (1) a 20 MW frequency regulation for in Hazelton, PA; and (2) a 30 MW / 40 min battery plant for smoothing and frequency regulation in No-Trees, TX. Dr. Gyuk provided an overview of the role of energy systems in peak-shaving, load shifting, and ramping. He then presented the example of the Southern California Edison / LG Chem, lithium-ion 8 MW battery plant for wind integration in Tehachapi, CA. As an example of cost-competitive energy storage, Dr. Gyuk presented a mixed acid v/v redox flow battery system being designed at Pacific Northwest National Laboratory, as well as an ionic liquid flow battery being developed at Sandia National Laboratories (SNL) along with advanced membrane technologies. Dr. Gyuk then spoke on energy storage for emergency preparedness, citing efforts in Vermont, Washington state, the Puget Sound Grid Project, and the Hawaii Electric Company. He went on to provide an overview of the economics of energy storage, and tools available to the industry including the SNL Energy Storage System Analysis Laboratory, the DOE International Energy Storage Database, and the Grid Energy Storage Safety Initiative.

>>see full presentation at [http://www.hydrogen.energy.gov/pdfs/htac\\_apr22\\_15\\_Gyuk.pdf](http://www.hydrogen.energy.gov/pdfs/htac_apr22_15_Gyuk.pdf)

#### **Discussion**

- Dr. Shaw asked what the cycle life and the cost/kWh is for the double acid flow battery discussed in Dr. Gyuk’s presentation.
  - Dr. Gyuk responded that the cycle life is indefinite, and that the battery membrane can be changed out if it wears out at around 10 years or so. He noted that the cost has been brought down to about \$300/kWh. He added that this is just for the system and not the installation or connection.
- Mr. Rose asked about the next steps for DOE with respect to the flow battery project, and how hydrogen fits in with energy storage and other kinds of advanced demand and response options.
  - Dr. Gyuk stated that the next steps are developing more cost-effective systems and working on power electronics. He added that there needs to be continued efforts on demonstrating the various business cases and on safety and reliability programs. Regarding the interaction between the flow battery R&D and hydrogen fuel cells, he stated that the main connection might be the use of similar membranes.
  - Dr. Lipman added that there might be similarities in manufacturing and that there is a hydrogen bromine flow battery in which the chemistry on the hydrogen side is similar to that of an electrolyzer. He suggested more communication between the fuel cell and flow battery R&D communities.

## 5. 2014 Annual Report Discussion

Chairman Hofmeister opened up discussion on the 2014 Annual Report.

- Mr. Rose thanked the 2014 Annual Report subcommittee for their contributions and asked if any of the HTAC members had any comments or concern on the latest draft of the report distributed for review prior to the meeting.
- Chairman Hofmeister thanked Mr. Rose and the rest of the subcommittee members for their work. He relayed Dr. Oge's suggestion that the report itself include recommendations from the HTAC, since she feels it is the most public output from the Committee. He noted that after previous discussions on this topic, the Committee came to a deliberate decision to produce the report as a factual update on technical/market progress for a larger audience, and include specific recommendations to the Secretary of Energy in the cover letter transmitting the report. He relayed Dr. Oge's contention that recommendations would get more attention by being included in a more public document. Mr. Hofmeister conveyed his preference to stay with the Committee's habit of including their recommendations in the cover letter, at least for this year, his last as Committee Chairman. Mr. Rose seconded the suggestion, noting that a different (and more complex) process for producing the report would be needed if it is going to include opinions and recommendations. He also noted that the letter to the Secretary is published along with the Annual Report on the HTAC website. He suggested that the Committee may want to consider formalizing the recommendations in some way by presenting them in a separate document that lists and numbers each recommendation.
- Chairman Hofmeister opened the floor to suggestions for key messages that should be conveyed in the 2014 Annual Report cover letter to Secretary Moniz. He recounted messages that have been included in past cover letters, including recommendations to increase the budget for hydrogen and fuel cell R&D, requests for more personal leadership and positive messaging from the Secretary, the importance of regaining U.S. leadership in the area, and the recognition that other countries are spending more on R&D and are better positioning their industry for success through national policy and planning. He acknowledged Secretary Moniz's efforts to bring more public attention to hydrogen and fuel cells, but noted that many of these issues remain.
- Dr. Lipman suggested prompting Secretary Moniz to apply pressure to restore the expired incentive for fuel cell vehicles.
- Ms. Dunwoody supported Dr. Lipman's suggestion and suggested acknowledging the good work that the Department has done with H<sub>2</sub>USA and in moving towards the requests made by the Committee last year. She suggested making recommendations for specific actions or activities, where possible.
- Dr. Shaw supported the points brought up thus far and suggested (1) emphasizing the Committee's strong appreciation for the work of the Fuel Cell Technologies Office; (2) acknowledging the attendance of senior DOE leadership at HTAC meetings, including Under Secretary for Science and Energy Franklin Orr and Deputy Assistant Secretary Reuben Sarkar; and (3) communicating that commercial application of fuel cell technologies are now starting to take off, and federal government support for commercial acceptance and adoption is important for the success of initiatives in states like California, which is doing the "heavy lifting."
- Mr. Rose noted that the 2017 budget is the last Obama administration budget, and stated that the Obama administration proposal for 2016 includes a \$10,000 per vehicle tax credit, and a permanent extension of the investment tax credit and the wind production tax credit, and this is an opportunity for the Secretary to express support for these efforts.
- Commissioner Scott suggested, noting recent commercial milestones for fuel cell technologies such as Toyota bringing commercial vehicles to market and the establishment of retail hydrogen stations, that the letter should note that this is a different point in the timeline of hydrogen fuel cells.
- Vice Chairman Novachek noted the value fuel cell systems have to a distributed electrical grid, and their capability of making a more resilient grid that is less dependent on transmission. He suggested pointing out

the importance of stationary fuel cell applications and that this might be an opportunity to reinvigorate research on solid oxide fuel cells.

- Mr. Rose noted that hydrogen and fuel cell technologies are very easily integrated into the issues surrounding “breaking down the stove pipes” when it comes to energy issues.
- Dr. Lloyd noted the way Japan looks at hydrogen as a fundamental part of the future energy system. He added that, as the cars are becoming available, it is up to the government to help them succeed.
- Mr. Leggett suggested emphasizing fuel cells in the dialogue on resiliency and energy security.
- Dr. Satyapal cited the Energy Policy Act of 2005 (EPAct), which states that the goals of the program are to (1) enable a commitment by automakers no later than 2015 to offer safe, affordable, and technically viable hydrogen in the mass consumer market; and (2) enable hydrogen production, delivery and acceptance for consumers of model year 2020 hydrogen fuel cell and hydrogen powered vehicles. She noted the importance of mentioning these timeline markers in the 2015 letter.
  - Vice Chairman Novachek added that EPAct also has a section on grid infrastructure for 2015, enabling a commitment not later than 2015 that would lead to infrastructure in 2020.
- Dr. Lipman was appointed as the lead on the Annual Report for 2015.

## **6. Dashboard and Follow Up to 2014 Annual Report Release, Vice Chairman Frank Novachek**

- Vice Chairman Novachek presented to the Committee an outline of the concept for a proposed “dashboard” to track and measure progress on the development of hydrogen and fuel cells in alignment with the language and direction provided in EPAct Title VIII—Hydrogen, which established the HTAC advisory committee. He explained that the dashboard could also be used to help identify problem areas where the HTAC could focus its efforts and serve as a way to communicate the Committee’s assessment of how the United States is doing in the technology development areas that HTAC has been directed to review. He asked for comments and feedback on the dashboard concept developed by him and Mr. Koyama as a starting point for HTAC discussion.
- Dr. Shaw stated that he likes the concept of the dashboard, but noted that dashboards can be constraining in their focus, and can sometimes be cumbersome to communicate and difficult for outsiders to understand.
  - Vice Chairman Novachek agreed and noted that, if adopted, the dashboard could be used only as an internal tool for HTAC, to help identify issues needing their attention. He also noted that the concept, as currently outlined, only includes the “have-to-do’s” as described in EPAct; the HTAC can choose to add other key tracking measures. He suggested the Committee could try out using a dashboard for one or two years, and decide whether to modify, continue, or discontinue its use.
- Dr. Lloyd expressed his support for a dashboard, and noted that the draft dashboard matrix does not include anything related to international efforts and how the U.S. compares, which he feels is important.
- Dr. Satyapal pointed out that EPACT requires an external review of the programs under Section 805 and 808 of EPAct (to be conducted every 4 years by the National Academies). The next review will begin this summer by a National Research Council (NRC) committee. She noted that a framework for tracking the progress of EPAct Title VIII would be a helpful input to the NRC. She asked if the metrics would be “status vs targets” or something else.
- Vice Chairman Novachek agreed that status versus targets might be appropriate metrics for some of the technical areas, and proposed that HTAC set up a summer call to discuss the dashboard concept. He stated that he would forward the document provided to the HTAC Designated Federal Officer, who would send it out to the Committee. He welcomed any feedback from Committee members via email in advance of the call.
- Mr. Rose suggested that every Committee member read EPAct Title VIII, a copy of which has been included in each member’s meeting briefing book. He also noted that there may need to be different dashboards for different hydrogen and fuel cell applications, since progress is so different in each area (e.g., residential, commercial, industrial).

- Vice Chairman Novachek reminded the Committee of former Senator Dorgan’s recommendation to couple the public release of the next HTAC Annual Report with a public event or with a Senate caucus event. Chairman Hofmeister asked if there were any legal constraints to doing this.
  - Dr. Satyapal replied that the DOE General Counsel raised concerns about HTAC presenting the findings at a Senate or House caucus event, since this could be perceived as lobbying, but there are no restrictions on the public circulation of the report, or for the members, as private individuals, to communicate the report’s findings..
  - Chairman Hofmeister recounted that several members of HTAC had in the past arranged to meet with congressional representatives (including staff) as private individuals, so this is an option for those who are interested.
- Mr. Rose suggested that DOE hold a webinar to review the results of the HTAC Annual Report, perhaps as one of the FCTO’s regular series of webinars.
  - Dr. Satyapal stated that she would get back to the Committee on this.

## 7. Other HTAC Business

- Chairman Hofmeister thanked the Committee for his time as Chairman, and nominated the current Vice Chairman, Frank Novachek, to take over as Chairman when his term expires on June 30, 2015.
  - The motion to elect Frank Novachek as HTAC Chairman, starting July 1, 2015, was seconded and passed by the full Committee.
- Chairman Hofmeister opened the floor to discussion concerning the Vice Chairman, and noted that HTAC members Margo Oge, Hal Koyama, and Charlie Freese have been nominated for this position.
- There was discussion among members about whether to take the vote on a Vice Chairman at the meeting or whether to do it via email poll after the meeting, given the absence of 6 HTAC members, including Mr. Freese and Dr. Oge.
  - Chairman Hofmeister reminded the Committee, and the Designated Federal Officer confirmed, that there is no formal requirement for the HTAC to elect a Vice Chair. The position of Vice Chair is a custom adopted by the Committee, and so the election process is at the discretion of the Committee. He also noted that several Committee members (including himself) had spoken with Mr. Freese and Dr. Oge before today’s meeting, so could faithfully represent their interests in serving in the position of HTAC Vice Chair.
  - The Committee agreed to hear an oral statement from Mr. Koyama about his qualifications for serving as Vice Chair, and asked to be provided with short written statements from Mr. Freese and Dr. Oge following the meeting. They agreed to an electronic vote on Vice Chair, after that HTAC meeting and following receipt of the written statements.
- Mr. Koyama presented his qualifications for HTAC Vice Chair, including his work in the fuel cell industry spanning from automotive fuel cell R&D to stationary power commercialization, and his prior work in grid management. He cited his years of experience serving as an HTAC member, his consistent record in attending HTAC meetings, and his experience in organizing and managing subcommittees for HTAC. He noted his main area of weakness as having relatively less experience with governmental processes.
- Chairman Hofmeister presented on the qualifications for Dr. Oge and Mr. Freese as candidates for Vice Chair. He noted that Dr. Oge, by virtue of her long tenure in the senior management of the Environmental Protection Agency and her service on several other federal advisory committees, is well known in the government and political community. Mr. Freese, as a senior executive in General Motors, has a deep understanding of the issues surrounding hydrogen and fuel cell development and commercialization. Mr. Hofmeister also noted that in his discussions with Mr. Freese about the Vice Chair opportunity, he was enthusiastic about the position and was not concerned about the time commitment, given his new appointment in H<sub>2</sub>USA.
- Dr. Satyapal clarified that Mr. Freese has been elected as Chair of the H<sub>2</sub>USA Operational Committee, not as Chair for the whole of H<sub>2</sub>USA or for any of the four working groups. She believes his term with H<sub>2</sub>USA is for two years, with no restrictions on renewals.
- The HTAC members discussed various attributes of the candidates.

- Chairman Hofmeister requested that HTAC members send suggestions for future HTAC meeting agenda topics to him and Mr. Novachek by email.
- The meeting was adjourned at 1:07 pm.

**TWENTY-FIFTH MEETING OF THE  
HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE (HTAC)**

**PARTICIPANT LIST  
April 21-22, 2015**

***HTAC Members Present***

- Peter Bond
- Catherine Dunwoody
- Charles Freese
- John Hofmeister
- Maurice Kaya
- Harol Koyama
- Paul Leggett
- Timothy Lipman
- Alan Lloyd
- Frank Novachek
- Robert Rose
- Janea Scott
- Robert Shaw
- Levi Thompson

***HTAC Members Not Present***

- Richard Carlin
- Kathryn Clay
- Anthony Eggert
- Joan Ogden
- Margo Oge

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

*Office of Energy Efficiency and Renewable Energy*

- James Alkire (DFO)
- Rick Farmer
- John Gangloff
- Laura Hill
- Fred Joseck
- Jason Marcinkoski
- Eric Miller
- Michael Mills
- Geoffrey Morrison
- Dimitrios Papageorgopoulos
- Reuben Sarkar (Speaker)
- Sunita Satyapal (Speaker)
- Ned Stetson
- Erika Sutherland

*Office of Science*

Harriet Kung (Speaker)

*Office of Science and Energy*

- Franklin Orr (Speaker)
- Noor Khalidi

*Office of Electricity Delivery and Energy Reliability*

Imre Gyuk (Speaker)

***Stakeholders and Members of the Public in Attendance***

- Austin Brown—National Renewable Energy Laboratory (Speaker)
- Geoff Budd—ITM Power (Speaker)
- Connor Dolan—Fuel Cell and Hydrogen Energy Association
- Josh Eichman—National Renewable Energy Laboratory (Speaker)
- Patrick Fullenkamp—Global Wind Network (GLWN) (Speaker)
- Leo Grassilli—Office of Naval Research
- Karen Hall—Fuel Cell and Hydrogen Energy Association/H2USA (Remote Speaker)
- Kristian Kiuru—Energetics, Inc.
- Morry Markowitz—Fuel Cell and Hydrogen Energy Association/H2USA (Speaker)
- William McLeod—Hyundai-Kia America Technical Center/H2USA (Speaker)
- Marc Melaina—National Renewable Energy Laboratory (Speaker)
- Jimmy O’Dea—Office of Senator Brian Schatz (Hawaii)
- Manan Parikh—Member of Public
- Jeffrey Reed—Southern California Gas Company (Speaker)
- Sanjiv Malhatra—SRA International
- Chris San Marchi—Sandia National Laboratories
- Jeff Serfass—California Hydrogen Business Council
- Robert Wimmer—Toyota Motor North America/H2USA (Speaker)

***Support Staff***

- Rachel Davenport—Alliance Technical Services, Inc.
- Janel Folsom—Capital Reporting Co.
- Shawna McQueen—Energetics Incorporated (Day 1)
- Amit Talapatra—Energetics Incorporated (Day 2)
- Tom Timbario—Alliance Technical Services, Inc.