

HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE

MEETING MINUTES

October 27–28, 2015

Holiday Inn Capitol – Washington, DC

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DAY 1 – October 27, 2015

1. Hydrogen and Fuel Cell Technical Advisory Committee Business

1.1. Welcome New Members

Chairman Novachek welcomed the four new members of the Hydrogen and Fuel Cell Technical Advisory Committee (HTAC): Dr. Kathy Ayers, Ms. Anne Gobin, Mr. Drew Kodjak, and Mr. Morry Markowitz.

1.2. Recognize Departing Members

Chairman Novachek recognized and thanked the departing members for their service: Mr. Robert Rose, Dr. Robert Shaw, Dr. Alan Lloyd, and Mr. Anthony Eggert.

1.3. Approval of October 27–28 Meeting Agenda

The draft agenda was approved as the final agenda for the October 27–28, 2015, HTAC meeting.

1.4. Approval of Vice Chair

Chairman Novachek introduced Mr. Charles Freese as the Vice Chairman. Chairman Novachek introduced Dr. Tim Lipman as the leader of the 2015 Annual Report.

1.5. Public Comment Period

Mr. Markowitz presented a brief slideshow on the first National Hydrogen & Fuel Cell Day, which occurred on October 8, 2015.

2. Introductory Remarks and Discussion: David Friedman, Principal Deputy Assistant Secretary, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

Mr. Friedman thanked HTAC for its work in advancing hydrogen and fuel cell technologies. He stated that HTAC's work has had a tangible impact on Department of Energy (DOE) decision making, and that HTAC is setting an example for other DOE technical advisory committees. Mr. Friedman thanked Chairman Novachek for taking over as Chair and acknowledged Mr. John Hofmeister for his service as the former Chair. He also thanked the four departing members for their service and contributions, and welcomed the new members. Mr. Friedman emphasized the importance of safety for the market success of alternative fuel vehicles, and stated that he saw good progress in establishing hydrogen safety standards while he worked at the National Highway Traffic Safety Administration (NHTSA). He explained that part of his responsibilities at DOE involve addressing market barriers, and is looking forward to HTAC insights on this topic. He praised Fuel Cell Technologies Office (FCTO) Director Sunita Satyapal for her commitment and for the Office's ongoing practice of active project management. In light of HTAC's concern about the future of the fuel cell electric vehicle (FCEV) federal tax credit, he noted that the Administration backs continuing the tax credits and that, as a result of HTAC recommendations, DOE is working to better communicate the need for continuing the tax credits to the public. Mr. Friedman also noted that DOE's grid modernization efforts include fuel cells in the mix of options, in part because of a recommendation from HTAC.

He acknowledged the challenging budget environment, and noted that DOE's proposed 10% increase to the fiscal year (FY) 2016 Fuel Cell Technologies Office budget reflects support for this research area. He also recognized HTAC's recommendation for DOE to increase its public recognition of and outreach on the benefits and status of hydrogen and fuel cells. He noted that DOE was pleased to support the first National Hydrogen and Fuel Cell Day and is continuing to identify ways to communicate the importance of fuel cells. He also pointed to the recently published DOE Quadrennial Energy Review (QER) and Quadrennial Technology Review (QTR) reports, which prominently feature hydrogen and fuel cells, and place them among the technologies that must be pursued for future energy and environmental security. He said he would like to see a future in which light-duty vehicles use batteries and fuel cells, and he noted the importance of continuing to invest in these technologies. He encouraged HTAC members to engage in reviewing the planned update of the DOE Hydrogen and Fuel Cells Program Plan, and looks forward to their comments on the draft document.

Discussion

Mr. Friedman solicited discussion on three questions: (1) How can we (DOE and others) keep hydrogen moving forward toward the goal of reducing greenhouse gas emissions 80% by 2050? (2) Where do hydrogen and fuel cell electric vehicles (FCEVs) stand in relation to plug-in electric vehicles (PEVs)? (3) How do stakeholders find the balance between not overpromising on hydrogen's status or benefits and continuing to advocate for progress on hydrogen and fuel cell technology development?

- Ms. Dunwoody noted that progress has been made in light-duty vehicle infrastructure in California, including with retail hydrogen stations. She reported the recent achievement in which five Mercedes F-Cell vehicles were driven from southern to northern California, and fueled back-to-back at a retail hydrogen station (paying with a credit card) in less than 25 minutes. She noted that the other vehicles sectors (e.g., heavy duty, freight, off-road, ships, and airplanes) will also be important to meeting California's zero-emission goal, and she expects the newly developed Mobile Source Strategy to inform many plans. She thanked DOE for working with California to address challenges in advancing hydrogen and fuel cell applications. She reported that California sees both PEVs and FCEVs as important strategies for meeting its goals. She acknowledged that there are still opportunities to better promote FCEVs to increase public and policymaker understanding and support.
- Mr. Markowitz suggested that efforts by DOE to improve the perception of hydrogen are low in cost and high in impact. He encouraged DOE to continue its efforts to communicate on the progress, status, and benefits of hydrogen. He said that DOE can play an important role in enhancing perception by participating in hydrogen efforts and events and pursuing communications efforts.
- Mr. Kodjak emphasized the importance of developing infrastructure to support FCEVs and stationary fuel cell applications. He also noted hydrogen's potentially important role in energy storage, as more renewables come onto the electric grid in the U.S. and other countries, noting that this could provide benefits for the power industry as well as a source of

- low-cost hydrogen. He said that fuel cells are especially promising for the heavy duty vehicle sector, where they offer the greatest hope for decarbonizing the sector.
- Mr. Friedman acknowledged that with an 80% GHG reduction goal, it must be a renewable hydrogen future—and that this creates both tension and opportunities with the established energy industry. He recognized that fueling infrastructure is a critical challenge for hydrogen and fuel cells going forward, as well as the need to move to renewable hydrogen production.
 - Ms. Gobin stated that the biggest challenge of moving towards a zero-emission future in her state is economics. She said that the economics are difficult in terms of getting buy-in for alternative vehicle fleets, and that it is hard to get the consumer engaged when there is a big price difference for the vehicles and the fuel. She also encouraged DOE to work with its Clean Cities partners to help them understand the value proposition for hydrogen and fuel cells, beyond simply reducing petroleum consumption.
 - Mr. Friedman agreed that cost is critical. He urged the Committee to consider opportunities to change both the reality and perception of the value proposition for FCEVs, such as financial tools to spread out first cost or different ways to value the features of hydrogen and fuel cells.
 - Commissioner Scott agreed that accelerating the path to drive down costs is very important. She recognized the magnitude of the necessary changes in order to reach zero-emission targets, and the limited time to make those changes. She also discussed how California is trying to balance getting more renewable hydrogen online and standing up the retail fueling industry.
 - Dr. Ayers said the direction of federal R&D funding is more of an issue than the availability of funding, and suggested that more cohesive projects are needed, instead of disparate projects. She stated that targeted funding to certain focus areas is needed, as opposed to funding for many smaller projects. She also pointed to the flexibility and agility of Germany's R&D program, and their ability to shift and focus resources on industry-identified problems. She also cited Germany for its manufacturing R&D capabilities, which provide full-scale, industrial quality production lines on which companies can conduct R&D.
 - Mr. Friedman said that the Secretary of Energy agrees on the need for higher-impact projects and wants to see more progress in investments at scale that can have transformational impacts. Mr. Friedman stated that this can be a challenge because DOE still wants to support existing projects, but that there are certainly ways to leverage DOE investments and make sure that projects are working together to have an impact at scale.
 - Dr. Thompson pointed out that much of the progress on fuel cell and hydrogen cost reduction was achieved when there was more funding in research and development (R&D), and that the trend on cost reduction progress has flattened along with flattening funding levels. He noted the importance of academic and basic R&D in developing ground-breaking concepts.
 - Mr. Friedman said that the Secretary of Energy agrees and sees innovation as a critical piece of future efforts to address energy and environmental security. He observed that research, development, and demonstration (RD&D) has been underinvested in, and there is growing public and private sector interest in reinvigorating R&D to address the big challenges we are facing.

- Dr. Lipman noted the importance of ensuring safety as hydrogen and fuel cell vehicles roll out, and asked whether DOE should be doing more to prepare first responders and others for how to deal with inevitable accidents.
 - Mr. Freidman said that NHTSA has been engaged in this space for some time. He recognized that it is important to ensure first responders know how to handle situations and remain safe, and that drivers and passengers are safe. He highlighted the importance of keeping NHTSA engaged, and said he would follow up on DOE's efforts in this area.

3. U.S. Department of Energy Updates and Discussion

3.1. DOE Leadership Updates: Reuben Sarkar, Deputy Assistant Secretary for Transportation, Office of Energy Efficiency and Renewable Energy (EERE) *(via phone)*

Mr. Sarkar thanked Chairman Novachek and the new members. He discussed some of the high-level crosscutting activities among EERE Offices, including (1) the EV Everywhere Grand Challenge, (2) the Optima project, (3) discussions on the changing landscape of transportation modalities and consumer behavior and how that may impact future transportation technologies and fuels, (3) various advanced materials manufacturing initiatives, which will compress the time it takes to accelerate new materials (e.g., non-PGM catalysts or synthetic or bio-produced fuels) into the market from discovery all the way through manufacturing and commercial deployment. Mr. Sarkar also noted that DOE is in the process of re-envisioning the Clean Cities Program to achieve even more success in the future by focusing on the broader goal of greenhouse gas abatement rather than simply petroleum fuel reduction. He concluded by asking for HTAC feedback on the following topics:

- A "big idea" that could be taken on as a multi-lab initiative, e.g., on a hydrogen-economy concept and how to create an energy ecosystem that can scale hydrogen production and use in different applications
- Policy that is enabling for hydrogen and FCEVs; what policies overseas or in the United States have helped?
- The tractionable items that DOE can work on with end users, e.g., ZEV states
- DOE's proposed plans for re-inventing the Clean Cities program
- Ways to better communicate hydrogen and fuel cells' importance in decarbonizing our transportation system, and
- Comments and feedback on the draft of the updated DOE Hydrogen and Fuel Cells Program Plan (to be provided by DOE in the next couple of months).

Discussion

- Ms. Gobin expressed support for the effort to re-envision Clean Cities, and said that shifting the metric from petroleum reduction to a bigger picture view, including greenhouse gas and criteria pollutant reduction, would be a big improvement.
- Mr. Kaya was encouraged to hear that DOE hopes to take a more proactive role in the policy arena and in collaborating with states, and noted that many innovative policies originate at the state level. He recommended that DOE connect with the National Organization of State

Energy Officials (NASEO) and its Executive Director, since they are active in this arena and have recently formed a standing subcommittee on transportation.

3.2. DOE Program and Budget Updates: Dr. Sunita Satyapal, Director, Fuel Cell Technologies Office, Office of Energy Efficiency and Renewable Energy

Dr. Satyapal provided an overview of FCTO, including its mission, key goals, impact, and activities. She noted FCTO's focus on developing early markets to drive down costs, enable economies of scale, and develop emerging infrastructure. She also described FCTO's efforts to quantify the impact of federal investments. She explained that costs must continue to go down and performance must continue to be improved in order to increase fuel cells' competitiveness. Dr. Satyapal described key recommendations to DOE from HTAC, which involve (1) increasing visibility for hydrogen and fuel cell technologies, (2) building on lessons learned from California infrastructure development efforts as well as international and state coordination, (3) supporting fuel cells for grid resilience and storage, and (4) securing budgetary support. She also detailed DOE's responses and activities related to these recommendations. She reviewed the Hydrogen and Fuel Cells Program's budget for FY 2015 and FY 2016. She discussed the Program's strategy for continuing to advance hydrogen and fuel cell efforts. She also highlighted a few areas of interest where FCTO could benefit from HTAC's input: (1) reviewing the draft of the updated Hydrogen and Fuel Cells Program Plan, (2) increasing outreach/awareness and state collaboration, and (3) relaunching the H₂ Energy Storage (Enabling Renewables) Subcommittee.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- There was no discussion, in light of time constraints.

4. ARPA-E Activities: Dr. Eric Rohlfling, Deputy Director for Technology, Advanced Research Projects Agency – Energy, U.S. Department of Energy

Dr. Rohlfling gave an overview of the Advanced Research Projects Agency – Energy (ARPA-E), describing how the agency works to overcome long-term and high-risk technological barriers in the development of energy technologies. He noted that ARPA-E supports both (1) *open programs* that encourage the development of potentially disruptive new technologies and (2) *focused programs* that prioritize R&D topics by their potential to make a significant impact in ARPA-E's mission space. He noted that the ARPA-E portfolio covers a substantial range of projects. Dr. Rohlfling described the Reliable Electricity Based on Electrochemical Systems (REBELS) program, an ARPA-E focused program on intermediate temperature fuel cells (ITFC), highlighting its role in advancing distributed generation (DG) systems. He stated that the REBELS program's vision is for intermediate temperature range fuel cells (roughly 200°C–500°C) that will enable new chemistries, materials, and functionalities. He presented on the three categories of projects currently included in the REBELS program, as well as the projects and performers in each category: (1) small (1-50kW), cost-effective, efficient, reliable DG ITFC power systems; (2) dynamic response ITFC (fuel cell with integrated battery mode for faster response to transients); and (3) ITFC with fuel production (fuel cell with

ability to convert natural gas to liquid fuels). Dr. Rohlfling also described ARPA-E's recent "Bridging Renewable Electricity with Transportation Fuels" workshop held to gather input on a possible new ARPA-E focused program aimed at replacing fossil fuels with zero-emission rechargeable fuels.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Mr. Koyama asked how ARPA-E measures progress on an annual basis, given the long-term nature of the research efforts.
 - Dr. Rohlfling stated that the agency tracks things like commercial start-ups and the funding they are receiving, commercial product launches, patents, industry cost sharing and follow-on funding, but that the broader question of how an advanced research agency should measure success is still being explored.
- Mr. Leggett asked about the evolution of working with the private sector going forward.
 - Dr. Rohlfling replied that this varies from sector to sector. He said there has been traction in energy storage, but that other areas are much more challenging. He reported that ARPA-E engages with the venture capital community and foundations and has had some success, but conceded that the program is structured to bring technologies from concept to prototype, and that bridging the valley of death (to bring technologies to scale) is very challenging.
- Mr. Leggett asked whether the requirement in Category 1 of the ITFC effort for the fuel input to be methane, not hydrogen, is due to the lack of infrastructure.
 - Dr. Rohlfling replied that yes, the lack of infrastructure is the principal reason.
- Dr. Thompson asked whether there has been an effort to explore the basic science that led to the concepts being proposed to ARPA-E, or conversely, the new questions or issues that arise as a result of ARPA-E research. He asked whether that information is gathered and fed back to DOE or others to "prime the pump" for future science and engineering efforts
 - Dr. Rohlfling replied that this type of systematic analysis and feedback would be worthwhile, but that so far little time has been able to be allocated to it. He noted that he has seen some good feedback loops forming between ARAP-E projects and the DOE Office of Science's Energy Frontier Research Centers.

5. A Venture Capitalist's Look at Hydrogen Station Economics: Dr. Robert Shaw, Aretê Venture Management

Dr. Shaw discussed hydrogen station economics from a venture capitalist's perspective. He described and contrasted the economics of hydrogen refueling stations using a simple ("farmer's math") model and a more complex model developed by DOE (known as H2FAST). He also discussed challenges for achieving viable hydrogen station economics, including ensuring that total capital costs are less than \$1 million, keeping operating costs below \$100,000 a year, increasing gross sale margins to at least \$3/kg, and achieving strong vehicle density. He recommended that future station efforts focus on innovative station design work, involving modular, mass-producible designs. He suggested a contest similar to the H2 Refuel H-Prize to identify an innovative design. He also suggested that government grants support efforts to gather cost data for operations, monitoring, and maintenance in early

stations. He encouraged efforts to reduce hardware costs, investigate ways to reduce the cost of home production systems, and provide incentives to encourage consumer adoption of FCEVs in rapidly growing numbers. He concluded that hydrogen refueling stations could be sufficiently economically attractive to draw private capital interest, if critical targets are met. However, he noted that the slow rollout of FCEVs introduces challenges for achieving vehicle density targets. He stressed the importance of attracting private investments for hydrogen refueling stations, and the need for data to help convince venture capitalists about stations' actual performance.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Dr. Ogden expressed some reservations about the assumptions of 200 kg/day, noting that assuming a cluster strategy for stations could justify 400kg/day and lead to a more optimistic view.
 - Dr. Shaw noted his model has every station built to start at 200kg/day, with the modular capacity to expand to 600kg/day. He said that at 100,000 vehicles the internal rate of return would be favorable.
- Mr. Koyama asked what the current cost is for 200 kg/day stations, noting that the model calls for a target cost of less than \$1 million.
 - Dr. Shaw replied that \$1.4 million–\$3.5 million are the best estimates.
- Mr. Koyama asked how much of the \$1 million is allocated to compression, and whether compression is the biggest technical hurdle.
 - Mr. Shaw stated that this question is difficult to answer. He said there are many different schematics, and the allocation depends on the number of stages and the pressure on delivery. He also noted that compressors can have failure problems.
 - Dr. Satyapal encouraged HTAC members and others interested in station costs to read the *H2FIRST Reference Station Design Report* (http://energy.gov/sites/prod/files/2015/04/f22/fcto_h2first_reference_station_design_report_april2015_0.pdf), which presents near-term station cost results and discusses cost trends of different station types.

6. Hydrogen Stations in the Northeast U.S.: David Edwards, Air Liquide

Mr. Edwards discussed future possibilities for hydrogen, such as in sustainable communities and interconnected environments, as well as the importance of refueling infrastructure planning to support growth in FCEVs. He stated that FCEVs could play an important role in future transportation solutions, and that flexible infrastructure solutions and social acceptance are needed. He described efforts to retrofit an existing gasoline refueling station to add hydrogen refueling capabilities, including meeting permitting and code requirements. He also discussed two business models—one for modular additions to retail gas stations and one for “behind the fence” fleet stations. Mr. Edwards reported that Air Liquide has built more than 60 hydrogen stations worldwide and is planning to open 15 additional stations in the United States. He asserted that the future of hydrogen production is on-site production. He also described Air Liquide’s “Blue Hydrogen” efforts, which produce renewable hydrogen from biogas, and how Blue Hydrogen enables a sustainable supply.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Chairman Novachek asked whether gasoline will also be sold at the retrofitted Air Liquide stations.
 - Mr. Edwards replied that yes, space for the hydrogen fueling system is leased from a gasoline station owner. He noted that Air Liquide has found that it is competing for space at gas stations with services such as car washes and larger convenience stores.
- Chairman Novachek asked whether there are differences in permitting for hydrogen by itself versus stations that feature hydrogen and gasoline.
 - Mr. Edwards replied that there are not dramatic differences in the permitting.
- Chairman Novachek inquired about who owns the hydrogen stations.
 - Mr. Edwards noted that this is often a complex arrangement, since there may be multiple parties involved (e.g., property owner, gasoline station franchisor, station owner, and station operator). He stated that Air Liquide has found that working with a regional franchise that wants to offer hydrogen at multiple sites can be easier.
- Dr. Lipman noted the importance of fuel quality monitoring and asked whether Air Liquide is developing low-cost monitoring systems.
 - Mr. Edwards replied in the affirmative but stated that these systems are not being used on Air Liquide's first generation stations that dispense hydrogen delivered from the existing infrastructure of the steam methane reformers (which is very high-quality hydrogen, and is monitored at the SMR plants). He noted that with on-site generation, this issue will have to be addressed.
- Dr. Thompson asked what the cost is of hydrogen produced.
 - Mr. Edwards answered that the cost ranges from \$4/kg to \$40/kg, depending on the source and location.
- Dr. Thompson noted that in urban areas, the footprint of gas stations is small, and there is not much space for hydrogen.
 - Mr. Edwards replied that one probably wants to introduce these technologies in larger, higher-use stations, such as stations near rest stops or off-ramps, as opposed to urban stations.
- Mr. Kaya asked how long it will take for on-site generation to be commercially viable, and what hurdles need to be overcome.
 - Mr. Edwards replied that Air Liquide is generating hydrogen on-site at some stations, but these systems are considered to be at a prototype demonstration level, and are not intended to be commercially viable yet. He noted that technology costs need to come down and it might be two or three generations before on-site generation becomes the commercially viable. He also stated that delivered hydrogen will likely continue to beat out on-site generation at locations that are near an SMR facility, and the viability of on-site generation will depend on the site.

7. Hydrogen Safety, Codes and Standards Activities: Will James, DOE Fuel Cell Technologies Office, and Nick Barilo, Pacific Northwest National Laboratory

Dr. James first discussed the Safety, Codes and Standards sub-program's history, objectives, activities, and accomplishments. He stated that the sub-program works in the areas of R&D, codes and standards support and implementation, and outreach. He discussed how DOE's support has significantly sped up the development process for several codes and standards. He also noted that the sub-program's continuous codes and standards improvement efforts encourage the safe and rapid growth of hydrogen fueling infrastructure. In addition, he described the sub-program's international collaborative activities.

Mr. Barilo then discussed the objectives, activities, and accomplishments of the Hydrogen Safety Program (managed by the Pacific Northwest National Laboratory [PNNL]), noting that it consists of the Hydrogen Safety Panel, safety knowledge tools, and first responder training resources. He highlighted the Hydrogen Safety Panel's efforts in reviewing projects, producing white papers, developing safety knowledge tools and best practices, and conducting outreach activities. He also discussed efforts to make the Panel more broadly available to maximize its impact. He stated that the Hydrogen Tools portal provides a centralized web-based location for current hydrogen resources, such as best practices and lessons learned, as well as forums for stakeholders to discuss relevant topics. He described the Hydrogen Safety Program's first responder training efforts, including the online training, hands-on training, and national training template resources.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Ms. Dunwoody asked whether the Safety Panel is developing a communications plan for responding to incidents.
 - Mr. Barilo replied that there was significant discussion on this topic at the Panel's April stakeholder meeting. He reported that the Panel agreed that more discussion among a larger group is needed to determine who will provide the messaging, how it will be deployed, and other considerations. He noted that the Panel itself would be a good asset for fact finding in the event of any incidents.
 - Mr. Markowitz noted that H2USA might want to consider focusing on this issue with its member groups.
- Mr. Freese noted hydrogen and fuel cell systems have so far been very safe in the field, which speaks to the proactive safety measures, codes, and standards that have been developed. He asked whether DOE has considered bringing in a third party from a completely different industry to stress test hydrogen and fuel cell systems from a fresh perspective. He pointed to DOE's experience looking at safety systems in the nuclear arena, and suggested that experts from this arena might be able to provide some useful insights.
- Dr. Satyapal stated that DOE has been putting greater emphasis on safety, codes, and standards. She said that DOE's incident database has no attribution, and she noted that it is important to encourage people to submit information, including the states. She also encouraged addressing the "near-misses" and sharing information with operators, technicians, etc., and not just managers. She suggested that HTAC consider establishing a Safety Subcommittee that could include outside experts and advisors, for example members from the

Occupational Safety and Health Administration, Federal Emergency Management Agency, DOE Nuclear, Department of Defense, refinery industry, automotive industry, and so forth.

- Dr. Lipman noted that high-pressure gas releases are dynamic incidents and they make a lot of noise, which people may be surprised by. He asked if DOE is considering developing some virtual tools to help people (especially first responders) be better prepared for what to expect during different types of incidents.
 - Mr. Barilo responded that last year’s stakeholder meeting featured discussion on this issue and considered the use of tabletop props, video, and virtual reality training. He said that DOE hopes to collaborate with HyResponse (the European hydrogen emergency response training program for first responders) team on some virtual reality tools and in-person training programs for U.S. first responders.

8. Working with States: AnnaMaria Garcia, Director, Weatherization and Intergovernmental Programs Office, Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy

Ms. Garcia discussed the Weatherization and Intergovernmental Program’s (WIP’s) methods of working with state and local governments, noting that these strategies could be leveraged to advance fuel cell deployment. She shared WIP’s mission, role, “pillars,” activities, and key partners. She discussed state and local governments’ capabilities to quickly deploy technologies, and that state and local governments can effectively work with each other to broaden networks and increase access to the commercial sector. She explained that the DOE State Energy Program might provide a model for how WIP and FCTO could work together, and described a number of available financial mechanisms available to states (including Revolving Loan Funds and Qualified Energy Conservation Bonds). She discussed some potential drivers for WIP/FCTO collaborative actions, including (1) recent environmental regulations (e.g., Clean Power Plan, zero emission vehicle standards, and new ozone standards) that increase states’ need for planning, evaluation, measurement, and verification of energy efficiency and renewable energy solutions; (2) key sectors in which WIP is already active that could include fuel cells (e.g., wastewater treatment, state infrastructure, and energy assurance/distributed generation); and (3) WIP’s involvement in a number of projects to develop clean energy and economic development regional or state/local roadmaps. She encouraged HTAC to identify key barriers to fuel cell adoption that require state and local government action or policies to overcome.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Ms. Gobin noted that much of the WIP (and state-level) block grant type funding is directed towards buildings and weatherization. She discussed challenges of adding zero-emission vehicles to state and municipal fleets (and associated infrastructure), an investment that does not provide a near-term payback, and asked whether DOE has resources to help make this cost-neutral for states.
 - Ms. Garcia responded that the Revolving Loan Funds would be available for this kind of activity, noting that it is the largest tool available in the WIP portfolio. She volunteered to have further discussions on whether WIP can help identify some relevant resources.

- Commissioner Scott asked whether WIP’s loan-loss reserve programs look at deploying established technologies or incentivizing new technologies. She noted that with California’s loan-loss reserve program for charging infrastructure, financial institutions are not comfortable with the technology, and are unsure about the cost and economics.
 - Ms. Garcia replied that WIP’s loss-loan reserves are created by the state governments, so they put in place the requirements, but she added that typically the technologies must be commercially available. She suggested that the problem experienced in California could perhaps be solved by better communicating the value proposition. She noted that one of WIP’s activities is to document state-level case studies that explain what was done and communicate the value proposition, and she offered to help find examples that could be useful for particular discussions.
- Chairman Novachek asked whether WIP is deploying the Combined Heat and Power (CHP) initiative.
 - Ms. Garcia replied that WIP is working in tandem with the Advanced Manufacturing Office, which serves as the lead on CHP programs. She added that WIP has worked with states on developing CHP action plans, and that Minnesota is very active.
- Dr. Satyapal asked for an overview of the process for using the revolving loan fund to get funds to support building a hydrogen station.
 - Ms. Garcia stated that the process is really handled at the state level. She explained that WIP facilitates the development of the programs, but that the state and local governments run them. She said that WIP would be willing to help identify where capital is available in a given state.

9. California Hydrogen Stations and Fuel Cell Vehicle Deployment Update: Tyson Eckerle, Office of Governor Jerry Brown, Business and Economic Development (GO-Biz)

Mr. Eckerle gave an overview of California’s hydrogen refueling station network, presenting a map of the 53 currently funded stations and delineating how many are in each stage (e.g., property acquisition, permitting, construction, commissioning, and opening) of the development process. He then detailed the process of progressing through the stages. He noted that generally the time for permitting has been going down, and the “planning approval” process (getting approval from the city or municipal planning board) usually take the most time. He reported that the Governor’s Office has drafted a permitting guidebook that describes lessons learned in California (*Zero Emission Vehicles in California: Hydrogen Station Permitting Guidebook*) which will be available soon. He stated that while current network development is largely on track, there is a need for larger stations and innovative funding mechanisms because fuel cell electric vehicle (FCEV) deployment is expected to accelerate after 2018 faster than previously projected. He highlighted how DOE engagement has led to direct benefits by making commercial sale of hydrogen possible, with the Hydrogen Station Equipment Performance Device (HyStEP) and the hydrogen fueling standard. Mr. Eckerle presented three top-level needs for DOE to consider: (1) economical on-site hydrogen quality monitoring, (2) liquid hydrogen setback distance reduction, and (3) commercial large-scale renewable hydrogen production. He also discussed the need to determine what is necessary for other states to replicate these efforts.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Commissioner Scott stated that DOE-supported research to drive down the cost of components and fuel is another key need.
- Ms. Dunwoody identified large-scale fueling stations for heavy-duty fleets as another need. She said that tools like HyStEP are lacking for a heavy-duty station, and that this is an area in which government should be putting more focus.
- Mr. Eckerle stated that the Hydrogen Safety Panel has provided significant benefits for California.
- Mr. Kaya asked for thoughts on replication in other states. He asked what drivers will motivate people to come together with industry to move efforts forward in other states.
 - Ms. Dunwoody noted that, in addition to funding, making this type of change required the dedication of many staff resources throughout California organizations and agencies.
 - Commissioner Scott observed that there may be lessons learned from Germany and Japan in terms of models on how partnerships with industry are formed and sustained.
- Mr. Freese described Japan's efforts with stationary fuel cells to standardize balance-of-plant components across manufacturers, in order to bring down costs. He stated that there might be a similar opportunity with hydrogen fueling station components. He asked Mr. Eckerle whether he sees more potential in this space.
 - Mr. Eckerle replied that he definitely sees potential here, not just for components, but for best practices on station design and operation as well. He noted that DOE could provide significant assistance in this area, especially on the international level since stations are being built all around the globe. He also stated that synergies in the supply chain would be welcomed.
- Chairman Novachek highlighted the importance of this work and stated that ensuring success in California is paramount. He asked whether California has defined target performance metrics for the new stations in terms of reliability or other factors.
 - Mr. Eckerle stated that H2 Logic reports 99% uptime for its stations in Europe, so it's hoped that California's stations will be in the 95%–99% uptime range.
 - Commissioner Scott said that California has targeted a 100 station backbone network and for retail consumers to have a seamless experience when they fuel, but that there are no formal metrics for defining success.
 - Ms. Dunwoody added that the closest definition of success for stations is the specific metrics in each solicitation. She noted that it is difficult to set broad goals, because many stations are run by companies with only a few stations. She said that the baseline is for stations to meet the specifications in their grant agreements with the California Energy Commission. She added that these specifications are changed and updated with new solicitations to reflect learning and stakeholder input, and noted that DOE's analysis of data gathered by the NREL Secure Data Center will be helpful in understanding and modifying future station requirements.

- Chairman Novachek asked Mr. Eckerle what issues are most worrisome regarding the deployment hydrogen stations in California, and how HTAC could help.
 - Mr. Eckerle noted the importance of customers having a good experience. He also stated that assuring hydrogen quality is a big issue that will require further work, and that any efforts to lower prices would be helpful. He identified finding property as another challenge and said the codes and standards work is of paramount importance.

DAY 2 – October 28, 2015

1. H2FIRST Activities: Chris Ainscough, National Renewable Energy Laboratory, and Joe Pratt, Sandia National Laboratories

Dr. Satyapal started by providing some background on the Hydrogen Fueling Infrastructure Research and Station Technology (H2FIRST) project, which was launched in fiscal year 2014 and is co-led by National Renewable Energy Laboratory and Sandia National Laboratories. She noted that there has been a strong push from the Energy Secretary and EERE leaders to strengthen interactions among DOE national laboratories and industry, and to increase multi-laboratory collaboration to leverage capabilities and avoid stove piping. She explained that H2FIRST has been highlighted as a very good example of a multi-laboratory project that is working directly with industry to solve both near- and long-term problems and have a direct and tangible impact. She thanked Chris Ainscough and Joe Pratt for their efforts in getting the project going quickly, as well as the industry and state-level partners for their efforts to support the project.

Mr. Ainscough described the goals and activities of H2FIRST, explaining that H2FIRST seeks to (1) ensure that early FCEV customers have a positive fueling experience and (2) advance hydrogen fueling station technology. He explained that H2FIRST includes technical work in support of H2USA to enable the deployment of commercial hydrogen fueling stations in the United States, and that the project's principal investigators work directly with H2USA's Hydrogen Fueling Station Working Group to identify needs and ensure relevance and impact of the H2FIRST activities. Mr. Ainscough detailed the project's efforts to address five key issues facing hydrogen refueling stations: (1) developing a reference station design to address the problem of the uniqueness of stations, (2) advancing in-line contaminant detector efforts to address fuel contamination, (3) utilizing HyStEP to reduce delays in the station acceptance process, (4) pursuing tube trailer consolidation efforts to reduce the cost of hydrogen compression, and (5) utilizing meter benchmarking to increase the accuracy of metering.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Ms. Dunwoody characterized this work as being critical for bringing vehicles to market in California.
- Commissioner Scott remarked that the capital costs for hydrogen stations listed in the presentation are lower than the actual capital costs they have experienced in California, and

- she asked about the timeline for getting to these lower costs. She also asked about a timeline for the compressor project, and when they think a lower-cost compressor will be available for use in the field.
- Mr. Ainscough replied that total capital costs are hard to model because each station and location is different. He added that NREL's cost information came from the station it built, so he has confidence in those figures. He said that the compressor project has a two-year timeline for getting smaller compressors tested in a full fueling system.
 - Mr. Pratt stated that the reference station costs are supposed to represent today's costs, but he recognized that they are estimates based on best available data at the time. He said that H2FIRST hopes to refine the estimates for the Phase 2 reference station since the project will be receiving data from the California Energy Commission.
 - Mr. Koyama suggested that the best way to detect problems with hydrogen coming in from a reformer is through a fuel cell, which will indicate the presence of any problems pretty quickly. He asked whether using a small electrochemical cell might be a way to continuously monitor the quality of hydrogen coming out of the station.
 - Mr. Ainscough stated that a number of projects are currently exploring this sort of strategy.
 - Mr. Koyama asked whether station reliability and durability are measured and reported.
 - Mr. Ainscough replied that H2FIRST does measure component and system reliability as part of the Hydrogen FCEV Learning Demonstration project, and noted that compiled data products are available online at http://www.nrel.gov/hydrogen/cdp_topic.html. He said that depending on the data, one-third to one-half of the maintenance events relate to the compressor, and that he has seen up to two-thirds of the maintenance costs relate to the compressor.
 - Mr. Koyama noted that the hydrogen costs presented were for delivered liquid or gaseous hydrogen and asked if they had costs for on-site steam methane reforming (SMR) or electrolysis stations.
 - Mr. Ainscough replied that in Phase 2 H2FIRST will look at both modular and conventional ("stick-built") station builds for both SMR and electrolysis.
 - Mr. Markowitz asked why the lowest-cost station has the highest per-kilogram cost contribution.
 - Mr. Ainscough responded that this is because that station is a connector station in a lower usage area. The lower station utilization has a major impact on hydrogen cost.
 - Dr. Lipman asked why the requirements for the in-line contaminant detector specify detection levels of one order of magnitude above SAE International 2719 levels.
 - Mr. Ainscough noted that this detector is not meant to replace testing to meet SAE 2719 requirements, which may only happen twice a year. Rather, the in-line detector is meant to detect "canary species" that will alert the operator that there may be a problem. He explained that there is not currently a cost-effective in-line sensor technology that would allow detection of all the possible contaminants at the SAE 2719 levels.
 - Dr. Thompson asked about the source of the cost figure for installed detectors.

- Mr. Ainscough replied that all of these cost figures came from H2FIRST's discussions with industry stakeholders (station operators, etc.). He reiterated that the cost figures are not a representation of what is available—they are a representation of what the industry stakeholders need.
- Dr. Thompson asked whether there are regional variations in these costs.
 - Mr. Ainscough replied that there are not major regional variations in the equipment costs, though property/leasing costs will vary. He acknowledged that there are shipping costs, and noted there are a small number of suppliers that supply North America.
- Dr. Thompson asked what happens when a contamination is found in the station.
 - Mr. Ainscough replied subject of how to determine the source of contamination and chain of custody has been discussed internally, but that it has not yet been resolved.
- Mr. Koyama asked about the sources of the contaminations, and whether they come from upstream in the supply chain or downstream.
 - Mr. Ainscough replied that the source varies, and that some contaminations come from upstream while others come from a source on-site.
- Ms. Dunwoody remarked that perhaps it would be helpful to have guidelines for station operators on what to do if contamination is suspected or detected.
 - Mr. Ainscough agreed and raised the issue of how to communicate this issue to the public.

2. Integrated Regional Technical Exchange Centers: Pat Valente, Ohio Fuel Cell Coalition

Mr. Valente described the Ohio Fuel Cell Coalition's Integrated Regional Technical Exchange Centers project, noting that it seeks to facilitate the development of a robust supply chain for fuel cell and hydrogen systems that will accelerate mass production, reduce the cost, and improve the performance and durability of these systems. He reported that these efforts will accentuate the identification of critical opportunities in the hydrogen and fuel cell supply chain where the United States can achieve or maintain a competitive advantage. He explained that the project is developing a national technical exchange network that will increase the distribution of component specifications to suppliers and provide a national database of suppliers' capabilities. He noted that the network will facilitate national interaction. He also discussed efforts by the project's working groups to establish a consensus on standard specification for components and assist suppliers and OEMs in the application of Design for Manufacturing and Assembly for the development of standardization. Mr. Valente described how the project is addressing the barriers currently hindering the adoption of hydrogen and fuel cell systems, as well as discussed the project's collaborators, proposed work schedule, and approach. He noted that the project focuses on a two-way technology transfer between OEMs and suppliers.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Mr. Koyama asked whether the group is working on a prioritized list of components, or whether there is interest in such a list, and whether there are targets associated with these components.
 - Mr. Valente replied that there is no formal list, but that one will be developed in the future.
 - Mr. Valente also confirmed that membrane electrode assemblies (MEAs) are included.
- Ms. Dunwoody suggested pursuing a similar supply chain effort for hydrogen fueling station equipment.

3. Fuel Cell and Hydrogen Opportunity Center: Robert Rose, Breakthrough Technologies Institute

Mr. Rose described a new DOE project being led by James Madison University/Virginia Clean Cities program to build and market a comprehensive national database of hydrogen and fuel cell components and suppliers. He noted that the project focuses on components for fuel cells as well as refueling stations. He stated that the initial database is being populated, and that a survey is being developed for the hydrogen and fuel cell industry's input. He explained that the remaining challenges are in identifying and selecting a manageable list of components and suppliers, securing participation from industry partners, facilitating coordination with fuel cell and hydrogen vendors, and developing a marketing strategy so that the database and website become self-sustaining. Mr. Rose detailed the proposed future work. He also solicited feedback from HTAC on a number of questions related to developing the database, such as ideas for increasing participation of suppliers and developers, and what components or subsystems to include.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Mr. Koyama responded to the question on top priorities for components or subsystems to include in the database. He stated that gas diffusion layers (GDLs) are the top priority for stationary power, and that MEAs are also big drivers. He also mentioned molded plates, cathode air supply, and standardizing the mix in the MEA.
 - Mr. Freese agreed that GDLs are a key issue. He also mentioned catalysts, the compressor expander, and hydrogen storage tanks as important cost factors. He stated that sensors would also lend themselves to commonality across manufacturers. From an automotive perspective, he noted that OEMs are going to develop MEAs, electrodes, and bipolar plates in-house.
 - Mr. Rose asked whether Mr. Freese's or Mr. Koyama's companies publish expected component performance characteristics.
 - Mr. Freese replied that his company has a sourcing document that is supplier-by-supplier.
 - Dr. Satyapal noted that DOE gets feedback from OEMs, and that FCTO's Multi-Year Research, Development, and Demonstration Plan (MYRDDP) has targets for many of the components.

- Mr. Rose said that the project hopes to establish a specification sheet for the main components. He said that the project is also interested in obtaining data—perhaps even cost data—from laboratories that are working on cost reduction and are familiar with the state of the art.
 - Mr. Rose encouraged HTAC to provide feedback on the top priorities for the database in the post-meeting survey that will be circulated.
 - Dr. Ayers said that many of the components are similar, but that her company needs suppliers to tweak them for the particular requirements of their electrolysis systems, and it is important to understand which suppliers are willing and able to do that. She noted that this is especially important for GDLs and catalysts.
 - Dr. Lipman remarked that for stationary fuel cells, fuel reformers are also important, and that they are semi-custom-made today. He also identified power electronics—including power conditioning and inverters—as high-cost items.
 - Mr. Koyama commented that his company struggles with finding high-tech component suppliers that are willing and able to create industrial commodity-type components at the necessary cost and durability levels. He said that it would be helpful to seek out industrial suppliers that can provide this service.
- 4. H2USA Update: Morry Markowitz, Fuel Cell & Hydrogen Energy Association; Karen Hall, Fuel Cell & Hydrogen Energy Association; Bob Wimmer, Toyota; Joel Rinebold, Connecticut Center for Advanced Technology, Inc.; and Bill MacLeod, Hyundai**

Mr. Markowitz described the membership, goals, and recent activities of H2USA. He noted that H2USA has experienced significant growth in terms of the number and representation of members. He explained that H2USA seeks to help build the infrastructure needed for deployment of FCEVs across the United States. Mr. Wimmer discussed the Market Support and Acceleration Working Group’s recent efforts, which include outreach events, representing H2USA at an International Code Council meeting, and developing the next draft of the H2USA Action Plan. Mr. Rinebold stated that the Locations Roadmap Working Group is engaged in developing the Northeast Regional Fuel Cell Vehicle Fleet Deployment Action Plan, developing a national roadmap document with NREL, and reviewing the H2USA Action Plan. Mr. MacLeod described the Investment & Finance Working Group’s recent efforts related to analysis, tool development, and outreach to the investment community. Ms. Hall described the Hydrogen Fueling Station Working Group’s recent efforts, which include providing updates on sensitivity analysis work and facilitating station improvement and deployment through H2FIRST projects. Mr. Markowitz also stated that building a fueling station network in the Northeast will be more complicated than in California because there are more governments to engage.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- Dr. Lipman asked whether the top market regions for FCEVs were identified solely by population, or whether economic and environmental criteria were also considered.

- Mr. Rinebold responded that a combination of demographic and market material was used.
- Commissioner Scott asked Mr. MacLeod whether H2USA is finding increased interest from the financial/investor community, and whether the community's questions are being answered.
 - Mr. MacLeod reported that the meetings working group members have set up with members of the investment community have given H2USA the opportunity to answer preliminary questions, and that H2USA expects to maintain contact to answer new questions and walk potential capital sources through the process. He said that H2USA is optimistic because FCEVs are a strong product with a great value proposition.
- Chairman Novachek asked whether the industry stakeholders that H2USA has worked with have made any suggestions for additional target metrics that they would like to see.
 - Mr. MacLeod reported that he doesn't know of any gathered through the Financing Infrastructure Working Group.
 - Mr. Leggett said that an overlay of the incentives by region or state on the fueling side would be helpful for financiers and would help people better understand how the incentives line up with the economics.
 - Mr. MacLeod replied that H2USA does share a description of state and federal incentives with potential capital sources.

5. 2015 Annual Report: Tim Lipman, HTAC

Dr. Lipman reviewed the structure of the 2014 HTAC Annual Report and asked the Committee to consider whether to continue with that format or to do something different. He also asked members to consider the target audience(s) and whether they are being effectively reached. He described resources for the 2015 report, including the DOE market review report, the fuel cell industry review reports put out by E4tech and 4th Energy Wave, and various media and industry announcements. Dr. Lipman reported that information is already being collected and compiled for the 2015 report. He noted that HTAC members will be asked in November for their input on key items to include, and that members wishing to take on larger input/editing roles are welcome to do so. He reported that the draft initial report target is December 15, 2015, and the draft full report target is February 1, 2016, with a final draft target of April or May. He then solicited feedback on key questions for the 2015 HTAC Annual Report, such as identifying additional dissemination mechanisms for the report and how HTAC can make the report even better.

>>See full presentation at https://www.hydrogen.energy.gov/htac_meeting_oct15.html.

Discussion

- With respect to the question about the appropriate target audience(s), Mr. Koyama suggested that Congress should be a key target audience this year, since the authorizing legislation for HTAC (Title VIII of the 2005 Energy Policy Act [EPACT]) specifically defines a goal to “enable a commitment by automakers no later than year 2015 to offer safe, affordable, and technically viable hydrogen fuel cell vehicles in the mass consumer market.” He also suggested looking at the language of the legislation and reporting on technical progress since

it was enacted and what could or should come next in terms of technology or market development.

- Ms. Dunwoody supported Mr. Koyama’s suggestions and asked for clarification on the purpose of the Annual Report. She stated previous versions of the report are great compilations of what is happening in the world of hydrogen and fuel cells, but she wondered whether (if the primary audience for the report is the Secretary of Energy) the purpose should be to describe how well the DOE Hydrogen and Fuel Cell Program is addressing its goals, what kind of impact it’s having on the overarching goal of commercializing technology, and gaps and recommendations for moving forward.
 - Dr. Lipman commented that the HTAC writes a cover letter directly to the Secretary of Energy forwarding the Annual Report, and the letter does contain recommendations and more targeted messaging. He stated that the Annual Report has a much broader target audience.
 - Dr. Satyapal said that the HTAC Annual Report has been recognized in DOE as a valuable product and that it does garner the attention of DOE senior leadership. It is a unique product among the agency’s technical advisory committees and provides value as an independent report that evaluates overall progress and challenges in this space. She noted that Congress is a good additional target audience, and that the Office of Management and Budget and industry are also target audiences. She said that DOE is planning to use Google analytics to track report engagement. She acknowledged that keeping the Annual Report as short as possible is valuable.
- Mr. Markowitz encouraged HTAC to work on a plan to distribute the report to state policymakers and organizations, such as to governors’ offices, NASEO, and the Environmental Council of the States (ECOS), to help these stakeholders better understand this industry.
- Dr. Satyapal stated that a webinar will be used to roll out the report this year, and that coordination to ensure the right audience is targeted will be valuable.
- Dr. Thompson noted the importance of ensuring the report continues to be balanced and based in fact, rather than an advocacy document.
- Mr. Leggett stated that if the target audience is policy makers, it would be useful to consider that they increasingly turn to consolidated media groups or other industry organizations for information, so bringing in some of those groups to the information dissemination effort could be useful. Mr. Leggett volunteered to identify some groups that could be helpful.
- Chairman Novachek asked for clarification on Deputy Assistant Secretary Sarkar’s request for recommendations from HTAC on policy, since DOE cannot advocate for policies.
 - Dr. Satyapal responded that her interpretation is that HTAC’s purview is broader than just technical recommendations, and that it can provide other recommendations if it chooses to do so (aligned with its charter in EPACT 2005).
 - Chairman Novachek stated that several HTAC members have mentioned identifying which international policies are effective and perhaps gleaning some ideas about which policies to pursue.
 - Dr. Lipman suggested that policy recommendations could be included in the letter to the Secretary, and that it might be appropriate to include Mr. Friedman in the review process for the letter.

- Chairman Novachek stated that there are still questions from last year about how to best divide content between the Annual Report and the letter to the Secretary, and that perhaps HTAC should revisit this discussion.
- Dr. Lipman suggested that HTAC could address the policy section last, noting that this could provide an opportunity for HTAC to discuss it at the spring meeting.
- Mr. Rose commended the idea of increasing the audience and improving the Annual Report’s reach. He noted that it is difficult to reduce the length to fewer than eight pages. He encouraged HTAC to produce the report early in the year because the DOE approval process can be lengthy.
- After some discussion about the schedule for drafting and delivering the 2015 Annual Report, it was agreed that March 31 is the target for producing a final draft version—including the letter to the Secretary.
- Chairman Novachek recalled the decision that HTAC as a group cannot present directly to Congress on the report or other topics, since that would be considered lobbying. But HTAC members, as individual citizens, can meet with members of Congress. He asked whether HTAC could address Congress if they were specifically invited to do so, since Congress may want a report on the status of meeting the 2015 target set by EPACT.
 - Mr. Freese agreed that this would be useful and noted that it would be more meaningful for the Committee to address Congress, rather than HTAC members in their capacity as individual citizens.
 - Dr. Satyapal stated that she will follow up with DOE General Counsel and provide a response to HTAC, but there may be concern if it is not in the legislation or the charter of HTAC as part of the HTAC’s duties.
- Mr. Markowitz offered a FCHEA Congressional event as a possible venue for an HTAC representative to speak.
 - Dr. Lipman suggested that having hard copies of the Annual Report might be useful for events such as this, but he expressed uncertainty regarding whether HTAC has a budget for printing the Annual Report, and asked DOE to clarify.
- Dr. Bond asked whether the Secretary of Energy includes the Annual Report in his biennial report to Congress.
 - Mr. Alkire replied that he thinks it has been included as an appendix, but he would check.

6. Additional HTAC Business: Frank Novachek, HTAC Chair

6.1. HTAC Oversight Framework

Chairman Novachek initiated discussion on the “HTAC Oversight Framework,” which Mr. Novachek (with help from Dr. Oge and Mr. Koyama) developed from the authorization language for HTAC in EPACT Section 807, particularly the responsibilities outlined for HTAC, the technology areas that HTAC was asked to look at, and the goals defined for the Hydrogen and Fuel Cells Program.

- Chairman Novachek asked for volunteers to work with him on further developing and fleshing out the framework, and suggested it might be useful in structuring the HTAC Annual Report, informing future HTAC priorities and activities, and gauging Program progress.

- Mr. Koyama, Dr. Bond, and Mr. Freese volunteered.
- The group will hold conference calls and report back to the Committee.

6.2. Review of Secretary Moniz’s Letter in Response to the 2014 HTAC Annual Report

Chairman Novachek stated that Secretary Moniz’s letter to HTAC was thoughtful and positive, and he solicited feedback from the Committee.

- Mr. Leggett noted that there is a specific request from the Secretary to provide feedback on the Hydrogen and Fuel Cell Program Plan, and that HTAC will need a strategy to address that request.
 - Dr. Satyapal stated that DOE anticipates major updates after the new administration is installed in late 2016/early 2017, and that DOE is making some minor updates now to make the Program Plan consistent with the targets defined in their multi-year RD&D plan. She stated that DOE will send the members the interim update before the next HTAC meeting, and she requested their review comments within 30 days after its delivery.
- Dr. Satyapal stated that it was valuable and noteworthy to have a specific request from the Secretary for HTAC to undertake.
- Mr. Kaya remarked that the Secretary’s letter is very positive and attests to the value of HTAC’s input. He agreed that HTAC must be responsive to the Secretary’s request for review of the Program Plan, and suggested some discussion on how to best do so. He observed that the letter touches on some of the priorities of the Secretary’s office, including the recently released Quadrennial Technology Review, and noted that if HTAC structures its input to be responsive to the Secretary’s priorities for making DOE RD&D more impactful, the input will be very well received.
- Chairman Novachek asked whether HTAC should submit a separate letter to the Secretary regarding the Program Plan in order to show responsiveness.
 - Dr. Satyapal responded that it would be better to have one letter rather than two, and Committee members agreed.
- Ms. Dunwoody pointed out that the Secretary also specifically invited input from HTAC on hydrogen energy storage for both grid resiliency and fuel applications, and she asked whether HTAC can help advise or impact DOE’s activities in this area. She noted that sourcing renewable hydrogen and developing storage for renewable power generation will also be an important issue in California.
 - Chairman Novachek remarked that NREL is leading a multi-lab study on the value proposition of hydrogen energy storage opportunities, and that perhaps a reinstated Hydrogen Enabling Renewables subcommittee could review the study’s findings.
 - Dr. Satyapal offered to help set up a presentation to the subcommittee from the study’s principal investigators. She emphasized that receiving a letter directly from the Secretary is noteworthy.
- Mr. Leggett remarked that the letter offers HTAC the opportunity to participate in a bigger dialogue related to the “all of the above” approach, including on grid resiliency as a function of energy security, and suggested this be made explicit in the name of the Enabling

Renewables subcommittee. He stated that HTAC should show that it is ready and willing to discuss how the hydrogen economy or infrastructure can play a role in these efforts.

6.3. Formation of HTAC Subcommittees

HTAC discussed topics for new focus areas/subcommittees. The Committee agreed to form 3 new subcommittees:

1. Safety and Event Response Subcommittee
2. Hydrogen Enabling Renewables Subcommittee
3. Near-Term Fueling Infrastructure Subcommittee

A summary of the discussion around subcommittees is provided below. Chairman Novachek took an action to summarize the charters of each subcommittee and send it to the full Committee (including those not present at today's meeting) and ask for additional volunteers.

Safety and Event Response Subcommittee Discussion

- Chairman Novachek noted previous suggestions from HTAC members for a subcommittee to develop event response guidelines or communication plans in the event of a hydrogen or fuel cell accident.
- Committee members agreed, and after some discussion on an appropriate name, they decided on the "Safety and Event Response" subcommittee.
- Ms. Dunwoody suggested that the subcommittee facilitate guidance on messaging and coordination among all of the participants at federal, state, local, and industry levels to have a plan in place for responding to an incident.
- Ms. Dunwoody volunteered to lead the subcommittee.
 - Mr. Freese and Dr. Lipman volunteered to serve as members.
 - Dr. Satyapal offered to provide some information resources to the subcommittee and help identify outside experts who could contribute.

Hydrogen Enabling Renewables Subcommittee Discussion

- Mr. Kaya asked whether the subcommittee would focus mostly on grid integration (electricity-based) issues, as it did previously.
 - Chairman Novachek replied that it would likely consider all the hydrogen energy storage opportunities that are being explored, including conversion back to electricity, renewable hydrogen production, supplementing fossil fuel generated natural gas, and the co-production of vehicle fuel. Dr. Ayers noted that ammonia should also be included in the discussion.
- Chairman Novachek volunteered to lead the new Hydrogen Enabling Renewables subcommittee.
 - Mr. Kaya, Commissioner Scott, Dr. Lipman, Mr. Leggett, Dr. Ayers, and Ms. Dunwoody volunteered to serve on the subcommittee.

Near-Term Fueling Infrastructure Subcommittee Discussion

- Chairman Novachek reported the suggestion for HTAC to explore alternative, low capital cost, near-term fueling options to meet the early market demand from a smaller numbers of FCEVs.
- Mr. Koyama suggested that this subcommittee could survey the available technologies, and do some simple analysis on costs and payback.
- Dr. Satyapal said this type of analysis would be good to have, and would not be duplicative of any of DOE's efforts. Commissioner Scott agreed.
- Mr. Koyama volunteered to lead the subcommittee.
 - Dr. Ayers and Mr. Kaya volunteered to serve as members.

Manufacturing Subcommittee follow-on Discussion

- Chairman Novachek reported that at its last meeting HTAC discussed the possibility of restarting the Manufacturing Subcommittee, with a focus on low-cost fuel cell system manufacturing. He noted that the new DOE supply chain projects are addressing some of the issues, but asked Mr. Koyama for additional thoughts.
- Mr. Koyama noted that a number of the recommendations from the previous Manufacturing subcommittee are being addressed. He suggested that the supply chain projects could use some input on priorities and on synergies between transportation and stationary fuel cell components and supply chain needs. Mr. Koyama volunteered to make contact with both of the supply chain projects to see what they need help with, and to discuss offline with Dr. Satyapal if there is a valuable charter for a re-formed Manufacturing subcommittee.
- Dr. Satyapal replied that she would make herself available for such a conversation, and noted that if there is not enough bandwidth to re-form the subcommittee, perhaps interested HTAC members could provide feedback to the DOE supply chain projects via email.

Inventory of Policies Discussion

- Chairman Novachek suggested that Mr. Kodjak present at the next HTAC meeting on the study his organization recently completed on global electric vehicle policies. This could help inform a discussion on whether an HTAC subcommittee is needed to develop some additional recommendations for national policies on fuel cell vehicles.

6.4. Discussion on 2016 HTAC Meeting Schedule

Chairman Novachek presented the results of a survey of HTAC members' availability and initiated a conversation on potential dates and locations for HTAC's 2016 spring and fall meetings.

- Dr. Thompson proposed holding the spring meeting in Detroit to coincide with a hydrogen workshop that may be held the week of April 25, 2016, as part of the annual EcoMarathon.
- Chairman Novachek noted that the Bay Area and Los Angeles have been proposed as other potential locations.
 - Dr. Satyapal noted that national laboratories could serve as hosts.
 - The week of April 5 was mentioned as a possibility for a Bay Area meeting.
- The group decided to hold its spring 2016 meeting in Detroit if the hydrogen workshop is occurring at the EcoMarathon, and in the Bay Area if not.

- Dr. Thompson will report back to Mr. Alkire and Chairman Novachek on whether, when, and where the workshop will occur.
- Dates for the fall meeting (to be held in Washington DC will be re-pollled to be mindful of election day, the Fuel Cell Seminar, and the L.A. Auto Show.
- Chairman Novachek reminded members to send him any suggestions for future HTAC meeting agenda topics.

The meeting was adjourned at 12:41 pm.

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

PARTICIPANT LIST

October 27–28, 2015

HTAC Members Present

- Kathy Ayers
- Peter Bond
- Richard Carlin
- Catherine Dunwoody
- Charles Freese
- Anne Gobin
- Maurice Kaya
- Drew Kodjak
- Harol (Hal) Koyama
- Paul Leggett
- Timothy Lipman
- Morry Markowitz
- Frank Novachek
- Joan Ogden (via telephone)
- Janea Scott
- Levi Thompson

HTAC Members Not Present

- Kathryn Clay
- John Hofmeister
- Margo Oge

U.S. Department of Energy Staff

Office of Energy Efficiency and Renewable Energy

- Principal Deputy Assistant Secretary for Energy Efficiency and Renewable Energy, David Friedman (Speaker)
- Deputy Assistant Secretary for Transportation, Reuben Sarkar (Remote Speaker)
- James Alkire (DFO)
- Peter Devlin
- Richard Farmer
- AnnaMaria Garcia (Speaker)
- Nancy Garland
- Laura Hill
- Donna Ho
- Charles (Will) James (Speaker)

- Ben Klahr
- James Kast
- Jason Marcinkoski
- Eric Miller
- Dimitrios Papageorgopoulos
- Sunita Satyapal (Speaker)

Advanced Research Projects Agency—Energy

- Carlton Reeves
- Eric Rohlfing (Speaker)

Members of the Public in Attendance

- Chris Ainscough—National Renewable Energy Laboratory (Speaker)
- George Bailey—University of Maryland
- Nick Barilo—Pacific Northwest National Laboratory (Speaker)
- Connor Dolan—Fuel Cell and Hydrogen Energy Association
- Tyson Eckerle—Office of Governor Jerry Brown, California (Speaker)
- David Edwards—Air Liquide (Speaker)
- Leo Grassilli—Office of Naval Research
- Karen Hall—Fuel Cell and Hydrogen Energy Association/H2USA (Remote Speaker)
- William McLeod—Hyundai-Kia America Technical Center/H2USA (Speaker)
- Jengsoo Mok—Hyundai Motor Company
- Michael Pacheco—National Renewable Energy Laboratory
- Joe Pratt—Sandia National Laboratory (Speaker)
- Joel Rinebold—Connecticut Center for Advanced Technologies (Remote Speaker)
- Robert Rose—Breakthrough Technologies Institute, Virginia Clean Cities (Speaker)
- Chris San Marchi—Sandia National Laboratories
- Jeff Serfass—California Hydrogen Business Council
- Robert Shaw—Arete Venture Management (Speaker)
- C.E. (Sandy) Thomas—H2Gen Innovations, Retired
- Pat Valente—Ohio Fuel Cell Coalition (Speaker)
- Steven Wiener—Pacific Northwest National Laboratory, Retired
- Robert Wimmer—Toyota Motor North America/H2USA (Speaker)

Support Staff

- Judi Abraham—Alliance Technical Services, Inc.
- Rachel Davenport—Alliance Technical Services, Inc.
- David Jones—Heritage Reporting Company
- Melissa Laffen—Alliance Technical Services, Inc.
- Shawna McQueen—Energetics Incorporated (Day 1)
- Neil Popovich—National Renewable Energy Laboratory
- Dylan Waugh—Energetics Incorporated
- Tom Timbario—Alliance Technical Services, Inc.