

# HYDROGEN AND FUEL CELL TECHNICAL ADVISORY COMMITTEE MEETING MINUTES

March 19, 2019

National Renewable Energy Laboratory Conference Room  
901 D Street SW, Suite 930  
Washington, D.C. 20024

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**MARCH 19, 2019**

The Designated Federal Official, Shawna McQueen, commenced the Hydrogen and Fuel Cell Technical Advisory Committee (HTAC or Committee) meeting at 8:05 a.m. Eastern Daylight Time (EDT). Chairman Charlie Freese welcomed HTAC members and opened with an introduction of new and returning members. The full Committee then reviewed and approved the draft agenda.

Presentation summaries and highlights of the discussions that followed are provided below.

**1. Hydrogen and Fuel Cell Competitiveness Subcommittee: Draft Report Summary to HTAC, Hal Koyama, HTAC Member**

>> see full presentation at [https://www.hydrogen.energy.gov/pdfs/htac\\_mar19\\_01\\_koyama.pdf](https://www.hydrogen.energy.gov/pdfs/htac_mar19_01_koyama.pdf)

Mr. Koyama provided an overview of the draft report of the HTAC competitiveness subcommittee. The overview included the subcommittee's charter, team members, the subcommittee's focus areas, evaluation process, and next steps for the draft report. Mr. Koyama discussed report topics including potential projects that could be undertaken to help maintain hydrogen and fuel cell competitiveness in the United States. Methods of tracking U.S. competitiveness were highlighted. Government stimulus programs and involvement in international codes and standards development were highlighted as crucial area for U.S. involvement for maintaining competitiveness. Mr. Koyama concluded his presentation by discussing next steps for the subcommittee report.

***Discussion Highlights***

- Mr. Berube asked how “large” a scale is needed to have an impact on competitiveness.
  - Mr. Koyama responded that deployment of transit buses and long-haul fuel cell trucks and utility-scale hydrogen generation and storage would make a notable impact. He noted that production synergy benefits would likely drive down the cost of fuel cell stacks and membrane electrode assemblies (MEAs) in multiple applications. He also pointed out that truck fleets would have a multi-state impact, fostering infrastructure development in different states.
- Mr. Berube asked whether increased hydrogen and fuel cell technology demand in the United States would lead to U.S.-based manufacturing and services.
  - Dr. Ayers noted that government cost sharing for stations or vehicles could include a requirement for U.S. manufacturing.
  - Commissioner Scott added that some components are really needed just-in-time near the demand location so a U.S. manufacturing base is important. She also noted that the U.S. has particular expertise in software development and is well-positioned to lead in those technologies.
  - Mr. Markowitz commented that vehicle original equipment manufacturers (OEMs) typically build and move manufacturing operations, along with their supply chains, to where they can have the greatest impact on local markets.
- Dr. Powell asked if advanced robotics and the use of advanced manufacturing methods affect the draw of producing in the United States.
  - Ms. Ffolkes remarked that total cost of ownership (TCO) is a key consideration. Availability of skilled resources is also critical for manufacturers and is difficult to find in the United States. Other key factors include landed cost, ease of doing business, and cost of labor.
  - Mr. Leo said that fuel cells are not labor-intensive to build, so incentives for U.S. based manufacturing are key. He noted that the investment tax credit is an example of an effective incentive for U.S. manufacturing.
    - Mr. Koyama agreed that fuel cells are not labor intensive to build, so demand is truly a driver for production.

- Dr. Ayers agreed with Mr. Leo and said that manufacturing is also dependent on availability of expertise in the adjacent area (e.g., qualified MEA suppliers).
- Chairman Freese stated that long haul Class 8 trucks tend to be built in the areas they are used. They also tend to be used in fleets, have centralized refueling, and specified routes.
  - Mr. Marsh agreed that fleet vehicles help to solve the infrastructure utilization problem.
  - Mr. Koyama noted that in addition to “long-haul” routes, heavy-duty short-haul vehicles that do lots of refueling in one area (e.g., in ports, cities) are also a good target.
- Dr. Powell asked about the potential for short-term demonstrations of hydrogen delivery concept opportunities, given that there appear to be synergies with existing renewable energy and hydrogen production.
- Mr. Koyama noted that the subcommittee will evaluate what items can best help advance key hydrogen and fuel cell applications, including the following:
  - Subcommittee recommendations on identifying how to sell into the biggest fuel cell markets in the world while maintaining local supply chains and markets.
  - Government-to-government opportunities to work with nations to accelerate tech development and deployment.
  - Supporting development of codes and standards (C&S) to protect domestic manufacturing and support a global market.
  - Dr. Satyapal remarked that it would be helpful to get ideas on how to combine all the different requirements for fuel cells and hydrogen infrastructure and bundle supply and demand to ramp up scale (investors, demand, manufacturing, incentives, etc.).

Dr. Powell briefly discussed the draft 2018 HTAC Annual Report. He asked that HTAC members review the draft report and provide feedback during the afternoon discussion.

**2. Welcome from Energy Efficiency and Renewable Energy (EERE) Senior Management and Sustainable Transportation Updates: Michael Berube, Acting Deputy Assistant Secretary for Transportation, EERE, DOE**

Mr. Berube noted that a fundamental disruption in the transportation industry is happening now, enabled by technology (e.g., mobility as a service, automation and connectivity, electrification and e-fuels, and increasing globalization). He pointed out that with trucks and buses, operating and driver costs are at least equal to the initial cost of the vehicle. He also noted that hub-and-spoke delivery systems are gaining favor as a way to better utilize drivers and keep up with the increasing demand for short-haul package delivery. Air quality concerns are also a factor driving technology change in the heavy duty sector.

**3. Fuel Cell Technologies Office Updates, Sunita Satyapal, Director, Fuel Cell Technologies Office, EERE, DOE**

>> see full presentation at [https://www.hydrogen.energy.gov/pdfs/htac\\_mar19\\_02\\_satyapal.pdf](https://www.hydrogen.energy.gov/pdfs/htac_mar19_02_satyapal.pdf)

Dr. Satyapal presented FCTO updates since the last HTAC meeting. The presentation included an overview of the HTAC scope, program updates, recommendations, and next steps. Dr. Satyapal highlighted accomplishments of FCTO, current and future partnerships, HTAC impact, as well as input areas requested from the Committee going forward, including how to actionize the recent partnerships DOE has established through its memoranda of understanding (e.g., with the U.S. Army and the state of Michigan).

***Discussion Highlights***

- Mr. Marsh inquired about the 2020 budget and, if it has been decreased, what should HTAC do to communicate the value of fuel cells to the executive branch.
  - Mr. Berube noted that FCTO budget was not reduced as much as other areas, signifying continued support for fuel cells.
- Ms. Ffolkes asked if there is a way HTAC can help promote the value proposition of fuel cells across industries. She noted that more funds are needed to drive a critical mass to achieve economies of scale, and there is a need to demonstrate the value proposition of bundling demand in real applications.
- Mr. Markowitz remarked that HTAC has a mandate to communicate to DOE's Secretary and other senior leaders on priorities, funding needs, etc. He also noted the importance of communicating the significant investments already made by industry, DOE and other governments around the world, which have brought the technology to where it is today.

#### **4. Hydrogen Activities and Stakeholder Interest, Brittany Westlake, Electric Power Research Institute (EPRI)**

>> see full presentation at [https://www.hydrogen.energy.gov/pdfs/htac\\_mar19\\_03\\_westlake.pdf](https://www.hydrogen.energy.gov/pdfs/htac_mar19_03_westlake.pdf)

Dr. Westlake provided an overview of EPRI's work and interest in energy storage, distributed generation, technology innovation, grid flexibility needs, and how hydrogen can serve as a potential solution to challenges with the grid. She discussed the role that hydrogen can play in economically, safely, and reliably competing with alternatives for utility investment. Dr. Westlake closed by highlighting EPRI publications relevant to hydrogen and fuel cell technologies.

##### ***Discussion Highlights***

- Chairman Freese asked how hydrogen and fuel cell energy systems needs and opportunities should be communicated to utilities.
  - Dr. Westlake suggested showing the value of these technologies through demonstrations with utilities that are documented in case studies, and helping them determine how to do safety reviews, planning, comparative analysis, etc. She noted that utility planning and procurement staff need to understand the total cost of ownership (including end-of-life) in comparison to other available technologies.
  - She noted that funding opportunity announcements (FOAs) and demonstration projects are useful engagements with industry. In addition, partnering with local technical colleges to help train workforce could be helpful.
- Mr. Novachek commented about pumped hydro energy storage in relation to reversible fuel cell energy storage. He suggested that seasonal storage application research is looking at three-month time horizons. He noted that so far only pumped hydro has demonstrated "unity" in cost-benefit analyses. Mr. Novachek suggested that reversible fuel cells may be a valuable option for energy storage and be competitive with pumped hydro. He referenced an EPRI study underway by Mathew Pellow and Josh Eichman entitled "Valuation of Hydrogen on the Electric Grid."
- Mr. Irvin emphasized that energy storage is a large unknown for utilities since utilities haven't traditionally been in the business of storing energy. He indicated that utilities don't know what energy storage technologies exist or how to make all of the technologies work together. He suggested that utilities need to be told (in simple terms) what the energy future looks like and what utilities need to do to transform their systems to meet energy storage needs.

#### **5. Energy Storage Days of Service Sensitivity Analysis for Batteries and Hydrogen, Michael Penev, National Renewable Energy Laboratory**

>> see full presentation at [https://www.hydrogen.energy.gov/pdfs/htac\\_mar19\\_04\\_penev.pdf](https://www.hydrogen.energy.gov/pdfs/htac_mar19_04_penev.pdf)

Mr. Penev presented an overview of hydrogen and fuel cell technologies' role in energy storage. His analysis focused on a comparison of hydrogen energy storage versus battery energy storage. Topics of discussion included storage system schematics, system efficiency, storage/discharge profiles, hydrogen energy storage co-production opportunities, and short-duration vs. long-duration storage leveled technology costs. He closed by stating that long-duration hydrogen energy storage has the potential to be more economical and more efficient than battery energy storage. He noted that hydrogen co-production with energy storage could offer additional economic storage cost benefits.

### ***Discussion Highlights***

- Dr. Azevedo asked if using a solar photovoltaic system without rectifiers can improve efficiency.
  - Mr. Penev noted that key savings are likely through capital cost reductions.
- Mr. Leo inquired if round-trip efficiency shortcomings can be overcome above the 13-hour threshold for breaking even.
  - Mr. Penev said that evaluating self-discharge is critical to evaluating round-trip efficiency. He noted that the project team needs to look at degradation rates as well. They will consider a few key parameters that can help lower the break-even threshold.
- Chairman Freese asked why hydrogen off-take as a high-value fuel was not the starting point for the analysis.
  - Mr. Penev replied that they are trying to compare energy storage on an apples-to-apples basis (vs. batteries), and this would change the value of hydrogen as a service to the grid. He also mentioned that it depends where the hydrogen off-take occurs in the grid.
- In response to a question about the timeframe needed by utilities for energy storage (hours, days, weeks?) Mr. Irvin re-emphasized that utilities do not know the answer to the energy storage challenge or even how to think about developing energy storage. He noted that most utility assets are operating at roughly 50% capacity, indicating under-utilized capital. He said that if industry could develop better energy storage solutions, utilities could operate their assets at higher capacities.
  - Dr. Powell remarked that seasonal storage, in addition to diurnal storage, is a strong opportunity. He emphasized the need to model to evaluate them both.

### **6. Overview of Hydrogen-Related Activities, Michael Pesin, Deputy Assistant Secretary, Advanced Grid R&D, Office of Electricity, DOE**

>> see full presentation at [https://www.hydrogen.energy.gov/pdfs/htac\\_mar19\\_05\\_pesin.pdf](https://www.hydrogen.energy.gov/pdfs/htac_mar19_05_pesin.pdf)

Mr. Pesin presented on the DOE's Advanced Grid R&D programs, as well as Office of Electricity's key priorities for North American grid resiliency, energy storage, and transmission. The presentation indicated electricity interdependencies for critical infrastructures in the U.S., as well as the importance of protecting these infrastructures from potential threats.

Q&A was deferred for remarks from Assistant Secretary Simmons.

### **7. Brief remarks from Assistant Secretary Daniel Simmons, EERE, DOE**

Assistant Secretary Simmons provided brief remarks to the HTAC members over a working lunch. He remarked upon the progress of hydrogen and fuel cell technologies and commended HTAC and its mission. He commented that the EERE budget for 2020 is estimated to be in the same range as it is currently. He emphasized how significantly energy systems have changed in the past 10 years, i.e., the dropping cost of LEDs, wind power, solar power, and battery packs. Mr. Simmons stated that transformational technologies cannot be predicted and that we need flexibility to capitalize on these changes as they evolve. He reinforced the need to focus on energy affordability, energy integration, and energy storage technologies, adding that no energy technology is negatively impacted by improving the

energy storage capabilities of today and highlighting the importance of energy storage as a key opportunity area for hydrogen utilization and integration.

### ***Discussion Highlights***

- Mr. Markowitz emphasized the current potential of the industry and the amount that U.S. industry and government has invested in technology development. He noted that other countries, most notably China, are now aggressively investing and urged action to maintain U.S. competitive position as fuel cells enter the market.
- Dr. Powell noted that comments on affordability are well-received and asked Mr. Simmons to elaborate on how the affordability discussion provides guidance into future energy industry technological advances.
  - Mr. Simmons replied that the importance of an all-of-the-above approach is key. The U.S. needs policies that foster opportunity and level the playing field while enabling open competition (e.g., auto OEMs vying for market share in electric vehicles).
- Mr. Marsh stressed the need for continued hydrogen and fuel cell policy support from the U.S. government. He noted that numerous Chinese companies have approached Plug Power to buy its technology. He indicated that many investors are not interested in investing in U.S. hydrogen and fuel cell companies, since China is believed to be the leader of hydrogen and fuel cell technologies. Mr. Marsh stressed that national level policy support is needed to ensure that foreign investors do not take over the U.S. hydrogen and fuel cell industry.
- Dr. Azevedo commented that given the increasing complexity of the energy system, the U.S. may need to evaluate prices, consumption, etc., year-to-year to better understand the direction of the energy industry.

### **8. Hydrogen Fuel Cells for Unmanned and Autonomous Vehicles, Karen Swider-Lyons, U.S. Naval Research Laboratory (NRL), Department of Defense (DoD)**

>> see full presentation at [https://www.hydrogen.energy.gov/pdfs/htac\\_mar19\\_06\\_swiderlyons.pdf](https://www.hydrogen.energy.gov/pdfs/htac_mar19_06_swiderlyons.pdf)

Dr. Swider-Lyons presented on the U.S. Naval Research Laboratory's (NRL's) hydrogen and fuel cell research conducted on unmanned systems. She presented on the advantages of hydrogen and fuel cell technologies for unmanned vehicles. She discussed the current advances made at NRL on utilizing fuel cells for unmanned vehicles, and their respective evaluation methodologies. The presentation focused primarily on the energetic and economic advantages of unmanned air vehicles and unmanned undersea vehicles (UUVs).

### ***Discussion Highlights***

- Dr. Powell asked about Dr. Swider-Lyons' view on aviation applications for fuel cells.
  - Dr. Swider-Lyons responded that hydrogen propulsion is not a new idea for aviation applications. She noted that quick refueling does provide a unique opportunity and advantage over battery-operated systems that require a battery to be swapped out.
- Dr. Thompson noted that the data presented is for single flights and asked if there is data on how fuel cells are performing under repeated use.
  - Dr. Swider-Lyons replied that fuel cells are reliable, and they have only once lost a fuel cell because it overheated in the summer.
- Dr. Thompson asked what NRL is currently doing with the prototype vehicles that they developed.
  - Dr. Swider-Lyons responded that they are investigating applications for the Navy. She noted that NRL develops prototypes and demonstrations, but will not manufacture or transition anything. NAVSEA and other DoD offices can help transition technology from the appropriate company or lab.
- Mr. Koyama asked if there are applications for commercial fuel cells in full-size subs.

- Dr. Swider-Lyons replied that the U.S. Navy will likely always use nuclear power given the long distances to be traveled. She noted, however, that submarines are not being built fast enough to replace retiring vessels. The Navy is using UUVs to fill the gap. She emphasized that the Navy needs cheaper, smarter systems and fuel cells provide an opportunity.

## **9. U.S. Army Ground Vehicle Systems Center – Overview of Hydrogen and Fuel Cell Activities, Kevin Centeck, U.S. Army Ground Vehicle Systems Center (formerly TARDEC)**

>> see full presentation at [https://www.hydrogen.energy.gov/pdfs/htac\\_mar19\\_07\\_centeck.pdf](https://www.hydrogen.energy.gov/pdfs/htac_mar19_07_centeck.pdf)

Mr. Centeck provided an overview of fuel cell research and development projects at the U.S. Army's Ground Vehicle Systems Center (formerly known as the Tank Automotive Research, Development and Engineering Center or TARDEC). The presentation included an overview of the Center's mission, recent and ongoing hydrogen and fuel cell projects, and hydrogen infrastructure/generation evaluations relevant to U.S. Army deployments. The presentation included the U.S. Army's user assessments of the Chevy Colorado ZH2 fuel cell vehicle and their evaluation processes of the vehicle's acoustic and thermal signature, and their safety evaluation of its hydrogen tank. Mr. Centeck discussed hydrogen generation techniques considered by the U.S. Army and their relative benefits. He closed his presentation by discussing operational considerations for producing and transporting hydrogen fuels in the field.

### ***Discussion Highlights***

- In response to a question from Dr. Thompson, Mr. Centeck said that the Army is doing mechanical modeling/analysis of the ballistics testing to determine safety and that some of the results will likely be publicly available.
- Commissioner Scott noted that in comparison with hydrogen storage tank punctures, the dangers of current diesel fuel tank punctures are much higher.

## **10. DoD Hydrogen Fuel Cell Activities, Chris Colquitt, General Motors**

>> see full presentation at [https://www.hydrogen.energy.gov/pdfs/htac\\_mar19\\_08\\_colquitt.pdf](https://www.hydrogen.energy.gov/pdfs/htac_mar19_08_colquitt.pdf)

Mr. Colquitt presented HYDROTEC, a fuel cell research collaboration between General Motors (GM) and the U.S. Army. He discussed the collaboration objectives, evolution, and GM's fuel cell manufacturing investment with Honda. Mr. Colquitt presented on strategies and methods developed in consultation with GM and the Army for reducing convoys and associated risks. He presented ongoing fuel cell vehicle research, and the required hydrogen infrastructure for implementing these products commercially. He also presented future research projects in hydrogen generation and distribution, advanced vehicular systems, and scalable fuel cell arrays.

### ***Discussion Highlights***

- Mr. Irvin asked about commercial applications and how the infrastructure findings translate back to industry.
  - Mr. Colquitt noted that their systems are only prototypes and suggested that translation to the commercial infrastructure industry is limited. He said that they are currently focused on solving military problems.
- Dr. Thompson inquired if any test marketing or prototypes were taken to auto shows and the kind of consumer response they are getting.
  - Mr. Colquitt responded that they have participated in joint shows and have had some press attention. He said that Jay Leno drove a prototype.

- Mr. Koyama asked for the range projected for these fuel cell vehicles, pressure of hydrogen, and how much sulfur is present.
  - Mr. Colquitt noted that different ranges of sulfur are found in JP-8 and desulfurization is important for fuel cell applications. He said that hydrogen tank pressure is 700 bar.
- Dr. Powell asked whether unmanned, less-armored vehicles were being considered to achieve a lighter weight vehicle. He also asked whether the military is looking at other fuel sources besides JP-8.
  - Mr. Colquitt replied that while other fuel sources are certainly technical possibilities, the military is focused on JP-8 since currently it's a "one fuel" military.
- Dr. Rogers commented that fuel cells are transformational and the military will need to figure out how to integrate hydrogen and fuel cells into its operations. He noted soldiers have been very positive about FCEVs at a user level, but fueling infrastructure is a problem. He noted the high cost (and risk) of delivering JP-8 fuel to active military operations, and suggested that new technologies such as hydrogen and fuel cells present opportunities to address these challenges.

## **11. Overview of Codes and Standards Activities, Carl Rivkin, National Renewable Energy Laboratory**

>> see full presentation at [https://www.hydrogen.energy.gov/pdfs/htac\\_mar19\\_09\\_rivkin.pdf](https://www.hydrogen.energy.gov/pdfs/htac_mar19_09_rivkin.pdf)

Mr. Rivkin presented an overview of national codes and standards deployment and outreach for hydrogen and fuel cell technologies. He presented the approach and strategy to integrated safety research and safe hydrogen technology deployment. Mr. Rivkin discussed current collaborations to help achieve maximum impact for code development. He presented accomplishments including implementing safety, codes and standards for multiple projects, outreach tools development, component failure analyses, feedback processes, and the development of a standard permit checklist for use by code officials and station developers. He closed by discussing proposed future work for addressing safety issues to enable deployment of H2@Scale technologies.

### ***Discussion Highlights***

- Mr. Leo asked about involvement in international standards like International Electrotechnical Commission (IEC).
  - Mr. Rivkin responded that they are involved to a certain extent, noting he attended the last Canadian Hydrogen Code Installation meeting to ensure NFPA 2 and Canadian codes are aligned. He is also monitoring what the ISO group is developing in terms of fueling station standards to avoid developing conflicting requirements.
- Dr. Satyapal noted that feedback from industry was essential for creating the standard permitting checklist and getting it published in NFPA 2. She noted that numerous companies participated in this collaborative effort and she asked HTAC members to help publicize the availability of the checklist, which can be accessed at <https://h2tools.org/sites/default/files/NFPA%20202016%20Edition%20Code%20Compliance%20Checklist%20Draft%20040219%20wo%20code%20text.pdf>
  - Mr. Rivkin added that DOE could arrange a briefing on the features of the checklist to any interested organization.

## **12. HTAC Business and Discussion of Other Key Items**

### ***Suggestions for Future HTAC Meeting Topics***

Committee members suggested the following topics for future HTAC meetings:



- Heavy-duty and medium-duty fuel cell vehicle applications. Specifically, the differences in requirements vs. light-duty fuel cells.
- Update from Nikola on their vehicles and fueling infrastructure.
- Theme on infrastructure optimization, including infrastructure models for other applications (besides forklifts and light duty vehicles), updates on what other countries (Asia, Europe) are doing, new approaches (e.g., liquid carrier project with US and Japan), policies/incentives that are working (or not), etc.
  - DOE can help with organizing this; and by next HTAC meeting there will have been another Hydrogen Ministerial meeting and another IPHE meeting
  - Dr. Scott noted that California could also have some lessons to share, since the state's current station buildout includes a number of different options for hydrogen production and delivery.
- Update on the Hydrogen Council Roadmap and other H2 Council activities/studies (e.g., study on global policies).
- Dr. Powell suggested the topic of other/novel hydrogen energy carriers.
  - NOTE: DOE presented a webinar in December 2018 on Hydrogen Carriers for Bulk Storage and Transport of Hydrogen – the webinar recording and slides are available at <https://www.energy.gov/eere/fuelcells/downloads/hydrogen-carriers-bulk-storage-and-transport-hydrogen-webinar>
- Mr. Novachek suggested updates from CRADA projects and H2@Scale activities.
- Mr. Markowitz noted that there will be ISO representatives coming to the Fuel Cell Seminar, so it may be possible to get an update on international codes and standards activities from one of them.

### ***Next HTAC Chair Discussion and Voting***

Vice Chairman Powell confirmed his acceptance of the nomination to serve as the HTAC Chair, which follows the normal HTAC procedure to transition the Vice Chair position to Chair at the end of the Chair's term. Dr. Powell left the room for the HTAC discussion and vote. HTAC members then voted unanimously in favor of selecting Dr. Powell as the next HTAC Chairman. The Committee agreed that the transition would occur after the November 2019 meeting, to accommodate for the October 2017 HTAC meeting that was postponed during Chairman Freese's term. Chairman Freese will lead the November 2019 HTAC meeting following which Dr. Powell will assume the HTAC Chairman role.

- **ACTION:** Dr. Powell will work with the HTAC Leadership subcommittee to select a Vice Chairman by the time of the November meeting.

### ***Reviews of HTAC Annual Report and Competitiveness Report***

#### **2018 Annual Report Review**

Chair: Joe Powell. Members: Frank Novachek, Nick Irvin, Henry Aszklar, Kathy Ayers, Hal Koyama, Charlie Freese, and new member: Marie Ffolkes.

- Dr. Powell asked about a reasonable deadline for deliverables, and Chairman Freese replied that the report is typically delivered in July/August.
- Dr. Powell suggested a July 10, 2019 delivery date for the final draft. He asked for feedback on the current report, including any gaps.
  - Mr. Novachek said he liked the draft, but noted a gap on stationary power.
- Chairman Freese suggested capturing dashboard elements or benchmarks that are of interest in the Annual Report to help measure progress and make updates in the future easier. He noted an HTAC goal to have a 2020 dashboard to measure progress on HTAC's scope as related to what's laid out in the Energy Policy Act, and HTAC has not yet delivered on this.
  - HTAC discussed the possibility of including a dashboard of top "x" metrics to include in the report that would be tracked or reported each year (e.g., # of MW of electrolyzers deployed; # of stations; # of states; # of companies, etc.). Mr. Novachek noted that the original dashboard idea proposed to HTAC was for internal use, to track HTAC activities against what was scoped for it in EPACT.

- **ACTIONS:**
  - Mr. Novachek (with help from Noah Meeks/Southern Company) will draft a populated example “internal” dashboard/matrix for review by the HTAC
  - Marie Ffolkes will provide input on relevant metrics to include on a dashboard/matrix for the HTAC Annual Report.
  - Mr. Leo will review stationary applications covered in the report and identify gaps to be addressed.
  - Commissioner Scott will provide California updates for the report.
  - Dr. Powell will work with DOE to develop a list of technical accomplishments to include in the report.
  - Mr. Koyama will review Annual Report and provide input to Dr. Powell on status in Japan.
  - DOE can provide inputs on status versus targets, as needed.
  - Mr. Irvin will identify appropriate sections in the report and the dashboard/matrix to include energy storage considerations and metrics.
  - Ms. Ffolkes will provide input on relevant metrics to include on a dashboard/matrix.
- It was noted that a public HTAC conference call is needed to finalize changes, including any recommendations to the Secretary, and hold a vote to accept the report as final for delivery to DOE. If a cover/transmittal letter to the Secretary containing recommendations to DOE is to be prepared, it should also be discussed during the public conference call.

### **HTAC Competitiveness Report Review**

Chair: Hal Koyama. Members: Kathy Ayers, Frank Novachek, Morry Markowitz, Levi Thompson, Dan Nocera, Paul Leggett, Gary Flood (consultant), Andy Marsh, Henry Aszklar

- Mr. Koyama reviewed Recommendation #4 and suggested change to text regarding DOE’s role in international codes and standards: change “jeopardizing” to “disadvantaging.”
- Mr. Koyama reviewed Recommendation #3 for DOE to make initial assessment of U.S. competitiveness vs. other key countries. Dr. Satyapal remarked that this might be outside the scope of what DOE is able to do.
  - Chairman Freese asked how to operationalize this.
  - Members suggested investigating the possibility for developing a competitiveness assessment through an existing DOE MOU or state partnership, or as part of the Hydrogen Council work. Dr. Satyapal and Commissioner Scott will follow up on this.
- Mr. Marsh commented that existing studies do not include private investment by region. Information on how much funding was raised in EU, China, etc., would be useful. Banks usually track these transactions.
- Members suggested forming a subgroup to coordinate with the Hydrogen Council US Roadmap and policy study teams (including financial industry analysts to raise awareness).
- Members noted that FCTO discontinued funding for its annual market reports in 2017, which were described as valuable resources. Members agreed to include in the Competitiveness Report a recommendation for DOE reinstate the market report as an annual activity, to support decision making on where technology investments would best be spent.
- Mr. Koyama reviewed Recommendation #2 regarding stimulating demand for U.S.-made fuel cell and hydrogen products in and outside of the U.S. in order to support a domestic market and industry base.
  - The Committee discussed various options, including: (1) DOE-hosted workshop for investors/financial analysts, etc. (Mr. Aszklar offered to assist with this); (2) improving access to/information on the DOE Loan Program as a cost sharing opportunity; (3) partnering with states; (4) good ideas on cluster models that would bring together all the necessary players; (5) work with Hydrogen Council to engage on this topic.
  - Chairman Freese suggested performing a “pre-mortem analysis” to anticipate causes for possible market failure and generate possible solutions.
- The Competitiveness Report was ratified by the HTAC members as edited.

## ***HTAC Subcommittee Planning***

Members discussed membership and planning for other subcommittees, with actions and members recorded as follows.

### **HTAC Leadership Subcommittee**

- Chair: Charlie Freese (HTAC Chairman). Members: Levi Thompson, Marie Ffolkes, DOE-FCTO (DFO and FCTO Director).
- **ACTION:** Vice Chairman Powell (HTAC Chair-elect, term to begin following the November 2019 HTAC meeting) will work with the Leadership Subcommittee to select his HTAC Vice Chair by the November meeting.

### **Potential future HTAC subcommittees:**

#### **HTAC Subcommittee on DoD Collaboration**

- Lead: Paul Rogers. Members: Charlie Freese
- **ACTION:** Dr. Satyapal will set up a call with Dr. Rogers and Chairman Freese to identify a specific topic that might be appropriate for HTAC subcommittee action and discuss at next HTAC meeting to assess HTAC support.

#### **HTAC Subcommittee on Renewable and Clean Energy Integration (including natural gas with carbon capture, nuclear, etc.) into the grid for hydrogen production**

- Co-Leads: Levi Thompson, Joe Powell. Members: Inês Azevedo, Frank Novachek, Tony Leo.
- **ACTIONS:**
  - Dr. Thompson will identify previous Subcommittee reports for reference and update and provide to Dr. Azevedo.
  - Dr. Azevedo will review previous HTAC subcommittee reports and recommend updates / follow-on
  - Dr. Thompson will set up initial phone call to discuss possible scope.

#### **HTAC Subcommittee on Consumer Adoption and TCO for Medium- and Heavy-Duty Vehicles**

- Lead: Inês Azevedo. Members: Charlie Freese, Nick Irvin, Andy Marsh.
- **ACTION:** Dr. Azevedo will set up initial phone call to discuss possible scope.

## ***Feedback on HTAC Meeting Format and Next HTAC Meetings***

- Committee agreed to a format for future meetings, starting around 1:00 pm on the first day and ending at 12:30 or 1:00 pm the second day.
- Currently reserved and planning for one full day in California on November 4, 2019 but DOE will look into changing the timing to a November 4-5 meeting and possibly including a site tour Monday morning.
  - Commissioner Scott offered to assist with identifying potential sites/tours (e.g., fueling station at the Port of Los Angeles).
- Dr. Satyapal noted that the Fuel Cell Seminar starts afternoon of November 5th.
- Spring 2020 HTAC meeting will be March 9-10, 2020 in Washington, DC.

### **13. Closing Remarks**

Connor Dolan of FCHEA showed a brief video showcasing National Hydrogen Day 2018. Following this presentation, Dr. Satyapal emphasized the importance and impact of HTAC and noted that we are at a tipping point for hydrogen and fuel cell technologies, so all input and help is critical and valuable. HTAC's subcommittees and industry engagement are very much appreciated. She also remarked that, based on comments she has received, HTAC is seen as one of the most productive Advisory Committees and she thanked the members for their efforts.

Ms. McQueen adjourned the meeting at 5:40 p.m. EST.

### **HTAC MEETING PARTICIPANT LIST -- March 19, 2019**

#### ***HTAC Members Present***

- Kathy Ayers
- Inês Azevedo
- Marie Ffolkes
- Charles Freese
- Nick Irvin
- Harol Koyama
- Anthony Leo
- Morry Markowitz
- Andrew Marsh
- Frank Novachek
- Joseph Powell
- Paul Rogers
- Janea Scott
- Levi Thompson

#### ***HTAC Members Not Present***

- Henry Aszklar
- Paul Leggett
- Daniel Nocera

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

##### *Office of Electricity*

Michael Pesin (Speaker)

##### *Office of Energy Efficiency and Renewable Energy (EERE)*

- Anthony Belvin
- Michael Berube (Speaker)
- Elizabeth Connelly
- Peter Devlin
- Nancy Garland
- Anthony Gryniewicz
- Fred Joseck
- Maxim Lyubovsky
- Shawna McQueen (HTAC Designated Federal Officer)
- Eric Miller
- Neha Rustagi

- Sunita Satyapal (Speaker)
- Daniel Simmons (Speaker)

*Office of Secretarial Boards and Councils (OSB)*

- Michelle Sneed
- Allison Mills

***U.S. Department of Army Staff***

- Kevin Centeck (Speaker)
- Keith Lane

***U.S. Department of Navy Staff***

*Office of Naval Research*

- Leo Grassilli

***Members of the Public in Attendance***

- Brian Bonner, Air Products
- Chris Colquitt, General Motors (Speaker)
- Theresa Christian, Exelon Corporation
- David Edwards, Air Liquide
- Gary Flood, GSF Consulting
- Kimberly Henderson, McKinsey & Company
- Edward Kiczek, Air Liquide
- Michael Penev, National Renewable Energy Laboratory (Speaker)
- Brian Pivovar, National Renewable Energy Laboratory
- Carl Rivkin, National Renewable Energy Laboratory (Speaker)
- Karen Swider-Lyons, U.S. Naval Research Laboratory (Speaker)
- Thomas Timbario, Alliance Technical Services, Inc.
- Brittany Westlake, Electric Power Research Institute (Speaker)

***Support Staff***

- Judi Abraham, Alliance Technical Services, Inc.
- Rachel Davenport, Alliance Technical Services, Inc.
- Kristian Kiuru, Energetics
- Neil Popovich, National Renewable Energy Laboratory