



Department of Energy
Washington, DC 20585

September 10, 2013

Mr. John Hofmeister
Founder and Chief Executive Officer
Citizens for Affordable Energy
1302 Waugh Dr., No. 940
Houston, TX 77019

Dear Mr. Hofmeister:

Thank you for your letter transmitting the Report of the Steering Committee of the Hydrogen Production Expert Panel. The Department appreciated the opportunity to participate at the Expert Panel event held in May 2012 in Arlington, VA, highlighted by Secretary Chu's Keynote talk at the kick-off session. We commend the team of experts you convened, and welcome the Committee's recommendations for improving the hydrogen production programs at the Department of Energy based on the experts' input. We offer the responses enclosed with this letter to address the major recommendations.

The Department shares the Committee's view on the strategic importance of hydrogen as an affordable, domestic, low-carbon energy carrier, and the Administration is committed to funding research and development (R&D) of hydrogen production technologies as part of the President's all-of-the-above energy strategy. Our Fuel Cell Technologies (FCT) Office continues to make advances in hydrogen and fuel cell technology. Cutting edge R&D has resulted in more than an 80 percent reduction in the cost of automotive fuel cells since 2002 and the doubling of fuel cell durability since 2006. Support from the Department has also resulted in advances in hydrogen production technologies. For example, the capital cost of electrolyzer stacks has been reduced by more than 80 percent in the last decade. The Department looks to continue this level of progress through sustained inter- and intra-agency collaboration and funding of hydrogen production R&D.

While the Department has made considerable progress, as the Committee points out in its Report, there is still more work to be done, particularly in the area of hydrogen production. Hydrogen is already an important industrial chemical commodity and can be produced inexpensively today by steam reforming of natural gas. Demand for hydrogen is growing and market opportunities are increasing as some of the auto companies plan the deployment of hydrogen-fueled vehicles in the next several years. Widely available, low cost natural gas offers a significant opportunity for the near-term commercial viability of hydrogen technologies. For the long term, however, more work is needed to develop practical production pathways with low- or zero-carbon emissions, such as direct



solar water-splitting through innovative photochemical, thermochemical, or biological technologies.

In line with the Report recommendations, we recognize the need to leverage partnerships to reach our goals. To that end, the Department recently created a DOE-wide Fuel Cells “Tech Team” to facilitate greater coordination among DOE offices and programs, including the Offices of Science; Energy Efficiency and Renewable Energy; Fossil Energy; Nuclear Energy; and ARPA-E. We are also continuing to address hydrogen and fuel cell needs with our partners from industry, academia and the National Laboratories. Just this past month, the Department launched H₂USA—a new public-private partnership focused on advancing hydrogen infrastructure to support more transportation energy options for U.S. consumers, including fuel cell electric vehicles.

Your work in establishing the Hydrogen Production Expert Panel and in formulating its recommendations to enhance DOE’s hydrogen production programs is greatly appreciated. We look forward to receiving input from HTAC as it continues in its advisory role. Thank you again for your recommendations and your dedicated service to this department. Please feel free to contact Dr. Sunita Satyapal, Director of the Fuel Cell Technologies Office, at (202) 586-2336 if you have any questions.

Sincerely,



Dr. David T. Danielson
Assistant Secretary
Energy Efficiency and Renewable Energy

Enclosure

Responses to HTAC Hydrogen Production Expert Panel Recommendations

The HTAC subcommittee's recommendations included in the transmittal of the Hydrogen Production Expert Panel Report will be taken into consideration as the Department continues to evaluate and implement its hydrogen and fuel cell activities. Specific recommendations are addressed below.

Report Recommendations:

- *The DOE should establish and leverage existing technology working groups to clearly define the specific research advances needed for each technology in order to drive funding strategies and competitive solicitations, similar to the pathway followed for proton exchange membrane (PEM) fuel cells.*
- *All pertinent offices and programs within the DOE (including Basic Energy Sciences [BES], Energy Efficiency and Renewable Energy [EERE], and Advanced Research Projects Agency-Energy [ARPA-E]), should develop a cohesive plan to provide consistent and longer-term (10-15 years) guidance and support for: 1) interdisciplinary research and development of hydrogen production from renewable resources, 2) detailed analyses of hydrogen production systems, and 3) demonstrations of electrical energy storage from intermittent renewable resources via hydrogen production.*
- *Communications between EERE, BES, and ARPA-E, as well as other DOE Offices (such as FE and NE) and non-DOE agencies (such as NSF) should be strategically enhanced to foster scientific and technology advances.*
- *Metrics should be defined to characterize progress of these efforts towards established goals and objectives.*

Response:

The Department agrees with the recommendations and will continue to foster intra- and inter-office coordination to leverage research, development, and technology demonstration across basic science and applied R&D offices. For example, DOE's Fuel Cell Technologies (FCT) Office convenes a bimonthly meeting with representatives from the FCT, BES, Fossil Energy (FE), and Nuclear Energy (NE) Offices to communicate and coordinate hydrogen and fuel cell research activities. The Department's hydrogen and fuel cell activities are further informed by participation in groups such as the Hydrogen and Fuel Cells Interagency Working Group and the Interagency Task Force which bring together staff from EERE, FE, NE, and BES, as well as other agencies in the federal government. Additionally, collaboration exists between FCT and BES in which expertise is shared through active participation in workshops, working groups and reviews, such as the Hydrogen and Fuel Cells Program Annual Merit Review.¹ Inter-office collaboration is being further developed through technology-specific working groups, including those related to photoelectrochemical, biological, and thermochemical hydrogen production. These working groups continually strive to define and refine

¹ http://www.hydrogen.energy.gov/annual_review12_proceedings.html

quantitative and impactful technological metrics for benchmarking R&D progress toward goals and objectives of the DOE Hydrogen and Fuel Cells Program.

In addition, a new DOE-wide Fuel Cells “Tech Team” was established in November 2012 that can help address external stakeholder recommendations, such as those provided by HTAC. This new Team, comprised of senior staff from EERE, BES, FE, NE, and ARPA-E, is well positioned to address the Expert Panel’s recommendation to formulate funding strategies based on research needs for all of the near-term and long-term hydrogen and fuel cell technologies. This Tech Team’s initial meeting included the Under Secretary of Energy, the Director of the Office of Science, the Director of ARPA-E, and the Assistant Secretaries from EERE, FE, and NE, and is indicative of the senior level interest within the Department. With guidance from the Tech Team, as well as external input, DOE looks to develop a cohesive plan that includes interdisciplinary R&D over the long term, covering both basic and applied activities. As one example, a joint funding opportunity announcement to be co-sponsored by the FCT Office and the National Science Foundation is currently under development.

Report Recommendations:

- *The government and industry should work together to inform the public and financial communities of the benefits of hydrogen as an energy carrier, thereby dispelling widely held misperceptions regarding near-term commercialization prospects.*
- *Public-private partnerships and/or clusters should be established to create well-defined plans for infrastructure roll out, establish appropriate incentives, and promote uniform safety regulations, codes, and standards.*
- *Incentives should be established to accelerate the production of hydrogen from all resources for transportation applications. Given the availability of large and accessible natural gas resources in the United States at historically low prices, hydrogen production using steam methane reforming technology represents an attractive near-term transitional approach.*

Response:

The Department recognizes that collaboration with industry can help accelerate and strengthen our work. Under the U.S. DRIVE Partnership,² the Department strives to further strengthen the technology base of the U.S. auto industry through cooperative R&D with major automotive industry stakeholders. Energy companies in the Partnership provide valuable input through staff-level technical teams to identify barriers and R&D needs for widespread adoption of hydrogen and fuel cell technologies, including infrastructure.

In January 2012, Secretary Chu attended a roundtable meeting in Detroit with executives from the U.S. and global automotive industry where he emphasized the significant

² <http://www.uscar.org/guest/partnership/1/us-drive>

progress that has been made in fuel cell technologies as well as key challenges. As a result of that meeting, *H₂USA*, a public-private partnership has been formed recently to help identify challenges and potential strategies for hydrogen infrastructure.³ There is particular public and private interest in leveraging opportunities for synergy with our current natural gas supply and infrastructure.⁴

Public outreach is an important part of DOE's mission, and our achievements in hydrogen and fuel cell R&D have been accompanied by a strong communication effort. In the last year, the Department has published over 70 news articles (including blogs, progress alerts, and FCT Office news alerts), hosted several public webinars on a range of hydrogen and fuel cell-related topics, and has released a number of press statements promoting the success of the Department's work. Consistent with the above recommendations, we have educated more than 23,000 code officials and first responders, and more than 9,600 teachers, through our coordination with industry and other stakeholders. The Recovery Act deployments have been particularly effective as a catalyst for fuel cell market development. The DOE cost-shared the demonstration of 1,200 units at various locations and is now tracking more than 5,000 orders for fuel cell fork lifts and backup power units at major companies (including Coca-Cola, Sprint, Sysco, FedEx, and others) with no additional DOE funding.

Report Recommendation:

- *Hydrogen is an excellent medium for energy storage and could enable greater penetration of renewables and enhanced grid stabilization. Consequently, the DOE should consider significant investments in both the analysis and demonstration of various hydrogen production and storage technologies.*

Response:

The Department agrees that hydrogen can be a key enabler for energy storage, and appreciates the Committee's recommendations on the R&D needs in this area. Hydrogen's potential role in energy storage and for enabling penetration of renewables into the electricity grid have been the subject of several recent studies funded by the Department. These have included a lifecycle cost analysis of hydrogen for electrical energy storage⁵ and a study of blending hydrogen into natural gas pipeline networks as a means to increase the output of renewable energy systems such as large wind farms.⁶ A "Wind to Hydrogen" demonstration project at NREL has generated valuable data toward these studies.⁷ In addition, the Department has invested \$135 million to establish a state-of-the-art Energy Systems Integration Facility at NREL to focus on research,

³ http://apps1.eere.energy.gov/news/daily.cfm/hp_news_id=384

⁴ Critical hydrogen infrastructure needs and opportunities are highlighted in DOE's *Quadrennial Technology Review*, <http://energy.gov/sites/prod/files/ReportOnTheFirstQTR.pdf>

⁵ Steward, D., G. Saur, et al. (2009). *Lifecycle Cost Analysis of Hydrogen Versus Other Technologies for Electrical Energy Storage*. Golden, CO, NREL: NREL/TP-560-46719.

⁶ Antonia, O.; Melaina, M.W.; Penev, M. *Blending Hydrogen into Natural Gas Pipeline Networks: A Review of Key Issues*. Golden, CO, NREL (in press).

⁷ http://www.nrel.gov/hydrogen/proj_wind_hydrogen.html

development, and demonstration of integrated energy systems. Work at this facility will enable the high penetration of renewables by advancing energy storage technologies—evaluating hydrogen as a key option.

Furthermore, in 2012 the Department established a DOE-wide Grid Integration Tech Team to coordinate efforts to modernize and develop a seamless, cost-effective electricity system capable of meeting the clean energy and capacity requirements of the United States. On the international front, DOE continues to engage in and assess relevant strategies for the United States, such as through the recent workshop entitled “Hydrogen – A Competitive Energy Storage Medium for Large Scale Integration of Renewable Electricity” sponsored by the International Partnership for Hydrogen and Fuel Cells in the Economy, a partnership between the United States, the European Commission, and 17 other countries.⁸ Through such efforts, the Department will continue to assess the viability of hydrogen as well as other energy storage approaches.

⁸www.iphe.net/docs/Events/Seville_11-12/Workshop/Programme/IPHE%20Workshop%20H2_energy_storage_Final_Programme_17_11_2012.pdf