JOINT FUEL CELL PARTIES:
NATIONAL FUEL CELL RESEARCH CENTER; BLOOM ENERGY;
DOOSAN FUEL CELL AMERICA; LG FUEL CELL SYSTEMS
Comments on Fuel Cell Net Energy Metering Program Second Public Workshop:
Greenhouse Gas Emission Standards
December 22, 2017
Request for Comments Issued November 28, 2017

The Joint Fuel Cell Parties (National Fuel Cell Research Center, Bloom Energy, Doosan Fuel Cell America, and LG Fuel Cell Systems, Inc.) submit these comments to the California Air Resources Board (CARB) regarding the Fuel Cell Net Energy Metering (NEM) Program Greenhouse Gas (GHG) Emission Standards.

I. Introduction

GHG-reducing stationary fuel cell technology is a unique technology needed to complement and manage the increasingly high penetration of intermittent solar and wind power generation in California. Together, stationary fuel cell power, solar power, and wind power are the cornerstones for achieving California's 40% GHG emissions reduction goal by 2030, and simultaneously mitigating CO_2, criteria air pollutants, and short-lived climate pollutants – co-benefits which are all direct or indirect goals of California's statewide Integrated Resource Planning efforts.[1]

The Joint Fuel Cell Parties (Joint Parties) thank CARB staff for the work to develop a GHG emission reduction standard for the Fuel Cell NEM Program. In the following comments, the Joint Parties offer requests for refinements to the proposal put forth in the November 2017 workshop on this topic, and look forward to continued productive conversations with staff to ensure that an accurate standard is set.

II. Comments

A. Key Considerations

1. <u>Development of a CARB methodology</u>

The Joint Parties strongly encourage the California Air Resources Board to adopt the most technically accurate methodology for estimating the marginal energy resource mix that would be displaced by fuel cell systems operating under the NEM tariff, as

[1] *Final Report: SGIP 2014-2015 Impacts Evaluation Report*. Submitted by Itron to SoCalGas and the SGIP Working Group, September 29, 2016. http://www.cpuc.ca.gov/General.aspx?id=7890

provided by statute. The Joint Parties have previously recommended using the avoided cost calculator as a resource for hourly emissions data, and would like to clarify that the recommendation was not to exclusively use the avoided cost calculator to calculate the GHG emission standard. The CARB fuel cell NEM website refers to "Marginal Annual Emissions in the Avoided Cost Calculator" and the "Long-Run Marginal Emissions Rate" tab. Because the tab did not exist in June 2017 when the Joint Parties submitted comments and, given that the rate is explicitly designed and designated as a long-run marginal emissions factor, the Joint Parties find that this "Long-Run Marginal Emissions Rate" is not applicable to the fuel cell annual standard.

The Joint Parties have encouraged use of the hourly marginal generation resource mix in the avoided cost calculator, together with regularly updated data from balancing authorities, as a method to accurately account for renewable power marginal contributions and grid dynamics. Based on CARB's expertise, the Joint Parties do not encourage this as a substitute for a methodology developed by CARB. Rather, the Joint Parties request that CARB calculate the fuel cell GHG emission standard by leveraging the data on hourly generation heat rates available in the avoided cost calculator, and without the RPS adjustment.

Role of renewable resources in the resource mix

The Joint Parties strongly recommend that CARB use grid operations data and analyses as described above to accurately account for the hourly contribution of renewable power generators to the marginal resource mix. The Joint Parties oppose the use of the factor that scales with the renewable portfolio standard that is included in the avoided cost calculator methodology for the purpose of the fuel cell NEM annual GHG standard. This factor does not account for the dynamics of renewable power generation on the grid at a specific time, nor does it accurately reflect the contribution of this factor to power generation on the margin and therefore is not applicable to the fuel cell standard.

Fuel cell systems do not preclude the building of renewable solar and wind power plants. On the contrary, controllable and dynamic fuel cell power generation is required to facilitate, manage, and expand the deployment of intermittent solar and wind resources.[2,3,4]

[2] *Dispatch of Fuel Cells as Transmission Integrated Grid Energy Resources to Support Renewables and Reduce Emissions* (2015). Applied Energy, Vol. 148, pp. 178-186 (Brendan Shaffer, Brian Tarroja, and Scott Samuelsen).

[3] *Exploration of the Integration of Renewable Resources into California's Electric Systems Using the Holistic Grid Resource Integration and Deployment (HiGRID) Tool* (2013). Energy, Vol. 50, pp. 353-363 (Josh Eichman, Fabian Mueller, Brian Tarroja, Lori Schell, and Scott Samuelsen).

[4] *Solar Power Variability and Spatial Diversification: Implications from an Electric-Grid Load Balancing Perspective* (2013). International Journal of Energy Research, pp. Vol. 37, No. 9, pp. 1002–1016 (Brian Tarroja, Fabian Mueller, and Scott Samuelsen).

The decision to install renewable power generation is primarily made today on the basis of applicable policy framework (e.g., GHG reduction goals) and lowest cost of energy.[5] Since the cost of solar power (especially) and wind power have dropped significantly in recent years, more and more of these resources will be adopted and installed regardless of fuel cell generating capacity. Fuel cell technology is therefore substituting for the higher emitting, combustion-based load following and peaker-plants on the grid today.

Even so, the fuel cell NEM policy calls for an annual standard based on the operation of the grid during each year. The procurement of renewables in the future does not impact how that grid operates today. The annual standard will include renewables that are currently operating.

Fuel cell systems, with virtually zero emission of criteria pollutants, enable continuous power generation in the most restrictive of air quality permitting regions, and provide firm power generation to areas of significant grid congestion, thereby avoiding the need for additional centralized and peaking generation capacity, and associated transmission and distribution infrastructure. In addition, in as much as these fuel cell systems use renewable fuels, they contribute to additional GHG reductions and to renewable portfolio standards. Pless et al.[6] thoroughly analyzed the economics of investment in distributed energy resources that included natural gas (NG) and renewable (RE) power generators, and concluded that "The findings consistently suggest that NG-RE hybrid distributed systems are more favorable investments in the applications studied relative to their single-technology alternatives when incentives for renewables are available."[7] This economic argument bolsters the technical argument that distributed fuel cell systems can operate dynamically to complement intermittent renewable energy systems.

2. <u>GHG emission standard should be updated every three years as mandated</u>

In the November 28 workshop, CARB proposed a period of five years for updating the GHG emission standard. This assumes that the standard is only needed for each year that a new project can be interconnected under the NEM tariff, through 2021. Chaptered Assembly Bill 1637 mandates that the State Air Resources Board *"shall establish a schedule of annual greenhouse gas emissions reduction standards for a fuel cell electrical generation resource for purposes of clause (iii) of subparagraph (A) of paragraph (3) of subdivision (a) and shall update the schedule* ***every three years***

[5] Afanasyeva, Svetlana, Breyer, Christian, Engelhard, Manfred, The Impact of Cost Dynamics of Lithium-Ion Batteries on the Economics of Hybrid PV-Battery-Gas Turbine Plants and the Consequences for Competitiveness of Coal and Natural Gas-Fired Power Plants, 10th International Renewable Energy Storage Conference, March 15-17, 2016.

[6] Pless, Jacquelyn, Arent, Douglas J., Logan, Jeffrey, Cochran, Jaquelin, Zinaman, Owen, Quantifying the value of investing in distributed natural gas and renewable electricity systems as complements: Applications of discounted cash flow and real options analysis with stochastic inputs. Energy Policy, volume 97, pp. 378–390, 2016.

[7] *Id.*

with applicable standards for each intervening year."[8] The Joint Parties urge CARB to follow this mandate in the GHG emission standard that it determines for two reasons. First, releasing updates to the standard in three-year increments will allow for more accurate estimates of the grid mix at that time. Second, because the tariff will be available to a customer for the life of a project (often more than ten years), this standard will need to be updated every three years for the duration of all projects interconnected under this provision, beyond 2021.

3. **Rollover of GHG emission reductions**

   While fuel cell generation systems operate over many years, system efficiencies are typically not flat. Instead they can follow a saw-tooth performance characteristic with an efficiency profile that slowly degrades over time, and then benefits from spikes in efficiencies as system components are replaced. The Joint Parties request that, recognizing the way that fuel cells operate, if a fuel cell system provides a reduction in emissions beyond the required standard for a given year, these additional emission reductions should accumulate and be available for compliance in future years. This concept is similar to the banking across compliance periods that is allowed for procurement under the Renewable Portfolio Standard program and for emissions reductions under Cap and Trade. Similar to these programs, allowing this for fuel cell systems has the benefit of encouraging early action in GHG reductions beyond the level of the standard, which is critical to the State's ability to meet its near-term GHG reduction goals, while also accommodating the distinctive operational profile of fuel cell systems.

4. **CARB authority for regulating emissions**

   The Joint Parties recommend that CARB, as the expert in the operation of fuel cells and regulation of emissions, should establish and enforce the guidelines for how fuel cell systems meet the GHG standard. The Joint Parties believe that CARB does indeed have the statutory authority under which to do this. Public Utilities Code Section 2827.10 (b)(1) states that CARB is to establish "greenhouse gas emissions reduction standards for a fuel cell electrical generation resource." The specific reference to the fuel cell as the resource to achieve the mandated GHG reductions provides authority in describing how fuel cell systems will meet the standard provided.

III. Conclusion

Establishing an accurate GHG standard for the net energy metering of fuel cell systems is critically important to the near-term and long-term market for fuel cell systems. A GHG

[8] Assembly Bill No. 1637, CHAPTER 658: *An act to amend Sections 379.6 and 2827.10 of the Public Utilities Code, relating to energy.* [Approved by Governor September 26, 2016. Filed with Secretary of State September 26, 2016.]

standard defined and enforced by CARB will assure and confirm the utilization of the superior benefits of the GHG-reducing features of fuel systems versus the mix of all other technologies that would have otherwise been used to provide the energy services of power, heating, and cooling. An accurate GHG standard can also support and facilitate the evolution of fuel cell systems to make them increasingly GHG emissions-free, particularly if the standard is updated every three years. The most accurate methodology to establish such a GHG emissions standard is to use and build upon the significant previous scientific research and development that has already occurred to determine the marginal resource mix. The methodology used by CARB to establish the GHG emissions standard should assess the annual hourly (all 8760 hours of the year) marginal resource mix based upon data from balancing authorities in the appropriate year, as described above.

The Joint Fuel Cell Parties appreciate the opportunity to comment on the development of a Fuel Cell Net Metering GHG Standard through the above recommendations to facilitate this evolution.

Sincerely,

/s/ *Jack Brouwer*

Dr. Jacob Brouwer, Associate Director
National Fuel Cell Research Center
Professor of Mechanical and Aerospace Engineering
University of California, Irvine

/s/ *Rodger McKain*

Rodger McKain
Senior Consultant
LG Fuel Cell Systems, Inc.

/s/ *Derek Hildreth*

Derek Hildreth
Head of North American Sales and Strategy
Doosan Fuel Cell America

/s/ *Erin Grizard*

Erin Grizard
Senior Director, Regulatory and Government Affairs
Bloom Energy