NATIONAL FUEL CELL RESEARCH CENTER

University of California, Irvine
Irvine, California 92697-3550
(949) 824-1999

September 10, 2018

VIA ELECTRONIC FILING

Honorable Kathleen H. Burgess
Secretary
New York Public Service Commission
Three Empire State Plaza
Albany, NY 12223-1350

Re: CASE 18-E-0130 - In the Matter of Energy Storage Deployment Program

Dear Secretary Burgess:

Please accept these comments on behalf of the National Fuel Cell Research Center in response to the July 17, 2018 Notice Soliciting Comments on the New York State Energy Storage Roadmap and Department of Public Service (DPS)/ New York State Energy Research and Development Authority (NYSERDA) Staff Recommendations (Roadmap) filed in this case on June 21, 2018.

Respectfully Submitted,

_____/s/_____

Dr. Jack Brouwer
Director
National Fuel Cell Research Center
University of California, Irvine
Irvine, CA 92697-3550
Tel: 949-824-1999 Ext. 11221
E-mail: jb@nfcrc.uci.edu

CASE 18-E-0130 - In the Matter of Energy Storage Deployment Program

NOTICE SOLICITING COMMENTS ON THE NEW YORK STATE ENERGY STORAGE ROADMAP AND DEPARTMENT OF PUBLIC SERVICE (DPS)/NEW YORK STATE ENERGY RESEARCH AND DEVELOMPENT AUTHORITY (NYSERDA) STAFF RECOMMENDATIONS

(Issued July 17, 2018)

Opening Comments of the National Fuel Cell Research Center

I. Introduction

The National Fuel Cell Research Center ("NFCRC") facilitates and accelerates the development and deployment of fuel cell technology and fuel cell systems; promotes strategic alliances to address the market challenges associated with the installation and integration of fuel cell systems; and educates and develops resources for clean energy stakeholders around the world. The NFCRC is working with LG Fuel Cell Systems Inc.; Bloom Energy; Doosan Fuel Cell America; and FuelCell Energy.

II. Comments

The NFCRC appreciates the opportunity to provide comments on the New York State Energy Storage Roadmap ("Roadmap") and share learning from recent experiences in California and other jurisdictions. The NFCRC comments focus on recommendations for technology diversity and appropriate resource valuation and rate structures that are key to a successful long-term energy storage implementation plan for New York.

A. New York State Should Include a Diverse Portfolio of Storage Technologies in the Roadmap.

The goals outlined in the Roadmap[1] cannot be achieved with a single energy storage technology. To meet New York's objectives to create a clean energy economy and innovation and to address climate change with increased renewable energy on the grid, the need for storage technologies of durations in excess of six hours becomes vital. This is evidenced by a recent U.S. Department of Energy Federal Opportunity

[1] Case 18-E-0130, In the Matter of Energy Storage Deployment Program, *New York State Energy Storage Roadmap and Department of Public Service / New York State Energy Research and Development Authority Staff Recommendations ("Roadmap")*, June 21, 2018 at. 4.

Announcement seeking storage solutions with durations of 10 to 100 hours and numerous recent studies forecasting that long-duration storage will be essential to the integration of high fractions of renewables.[2] Lithium ion (Li-ion) technology is not likely to alone be suitable for addressing this need due to a fixed power-to-energy capacity ratio that is also typically greater than one (i.e., a 10 MW Li-ion battery typically can deliver less than 10MWh of energy). There are additional resource concerns regarding global lithium and cobalt supplies, given the dramatically growing demand for Li-ion technology in transportation and many other applications. The limited supply is already leading to increased lithium and cobalt commodity prices, and NFCRC research suggests that the storage requirements of renewable utility grid networks will far outstrip global lithium and cobalt reserves if it were to all be served by Li-ion batteries.[3] In addition to varying applications and end users, the customer-sited use cases in the Roadmap should include diverse energy storage technologies as well. Only significant deployment of technology that meets a range of necessary use cases will realize the goal of enabling the energy storage market in New York.

B. Dependence on a Single Storage Solution Creates Risks to Ratepayers and the Grid.

As noted above, dependence on a single storage solution creates risk of supply shortages of necessary materials and also creates a risk for the lack of deployable and cost-effective solutions to meet storage functions that are not easily provided by Li-ion

[2] U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E) Funding Opportunity Announcement *DE-FOA-0001906: Duration Addition to Electricity Storage (Days).* Available on-line at https://arpa-e-foa.energy.gov/#FoaIdc931d71c-1e66-4fea-8a27-91860bcd781d July 2, 2018.

[3] Tirado, Nuria, "Resource, recycling and waste challenges for storage resources in a 100% renewable economy," Senior Thesis – Chemical Engineering, B.Sc. advisor: Jack Brouwer, Escola d'Enginyeria de Barcelona Est – Universitat Politècnica de Catalunya, University of California – Irvine, Balsells Mobility Program, 2018.

technology. The desired resiliency stated in the Roadmap[4] will be inhibited by deployment of only one storage technology, especially one that is vulnerable to some forms of attack (e.g., electromagnetic pulse). Finally, the required flexible resources[5] to meet grid capacity constraints can be accomplished by installation of energy conversion devices that are fueled (e.g., fuel cells fueled by gaseous fuel), but cannot be provided by Li-ion battery energy storage that could have a limited state of charge at any given moment in time.

C. Analysis Should Appropriately Value Diverse Energy Storage Technologies and Broad Environmental Attributes.

Governor Cuomo has set forth a 1,500 MW storage mandate[6] as part of New York's Clean Energy Jobs and Climate Agenda. Beyond short-duration energy storage, the Roadmap should consider other means of energy storage to meet the State's storage mandate. Hydrogen is a relatively versatile energy carrier that can be transported and stored in very large quantities (terawatt hours with geological storage) and over long durations (up to months and years) with no self-discharge. Devices like electrolyzers and fuel cell systems that convert electrical energy to hydrogen and later return the energy to the grid, have benefits and services listed in the Roadmap[7] including abilities to provide load following, power quality, ancillary services, and siting flexibility. In addition, both the production and conversion of hydrogen under these circumstances is completely free of criteria pollutant and greenhouse gas emissions. This paradigm also allows siting of the electricity consuming (hydrogen production) facilities in locations that are disparate from

---

[4] Roadmap at 5.
[5] *Id.*
[6] https://www.governor.ny.gov/news/governor-cuomo-unveils-20th-proposal-2018-state-state-new-yorks-clean-energy-jobs-and-climate
[7] Roadmap at 5.

the electricity production (hydrogen consuming) facilities. For example, electrolyzers could be sited in the desert where excess solar or wind power is available, while the fuel cells could be sited in the city near major loads.

These attributes are not fully valued in present resource valuation methodologies because the relevant market structures are nascent and because methods are not fully developed for assessing the total value to the grid of a long-lived, utility-owned resource of this type. Specifically, in the Roadmap *Section 4.1.4: Carbon Reductions Benefits and Shaping the E Value in the VDER Value Stack*, the NFCRC recommends expanding the "E" value to include these local air quality benefits and reduction of criteria air pollutants, in addition to valuing greenhouse gas emissions reduction.

Additionally, the unique energy storage features of hydrogen energy storage should not preclude its inclusion in fulfilling the mandate (e.g., disparate points of charging and discharging interconnection). Furthermore, electrolytic hydrogen resources can be dispatched for vehicle fuel production or for pure electric storage functionality. Electric utility procurement valuation methodologies, however, do not account for the potential cost optimization of economic dispatch to either fuel or power. Such use cases cross jurisdictional boundaries, but should be considered both viable and desired in the same manner as vehicle electrification is being considered. In fact, using electrolytic hydrogen in fuel cell electric vehicles is exactly electrification of transportation with inherent storage.

D. The Utilities Should Procure a Minimum Amount of Non-Lithium Ion Technologies with Technological Features that Differ from Li-ion Batteries.

The NFCRC believes that New York should target no less than 75 MW (approximately 5% of the total 1,500 MW mandate to the immediate deployment of MW scale projects of innovative, long-duration storage technologies. This deployment would enable DPS, NYSERDA and the utilities to evaluate the usefulness of such long-duration technologies in a period of time that just precedes their significant need for these technologies. The Commission should also allocate no less than 5% of the total mandate to storage technologies that can offer specific and desirable technological features that are different than Li-ion batteries. These features could include energy storage technologies that can: (1) transmit and distribute energy without any additional investments in electric transmission and distribution infrastructure; (2) consume electricity in locations disparate from electricity production; (3) store energy for seasons without self-discharge; and (4) produce fuels that can be used in various transportation and industrial applications.

Energy storage technologies with these features are being evaluated in other power markets. As an example, the Ontario Independent Electricity System Operator (IESO) recognizes a Type 3 class of energy storage technologies that only withdraw electricity from the grid like other loads but convert it into a storable form of energy or fuel that is subsequently used in an industrial, commercial, or residential process or to displace a secondary form of energy.[8] Accordingly, the IESO recognizes electrolyzers as Type 3 energy storage devices because they use surplus electricity to produce hydrogen that can displace fossil fuels in other markets.

[8] IESO Report, Energy Storage, March 2016. Available at: http://www.ieso.ca/Documents/Energy-Storage/IESO-Energy-Storage- Report_March-2016.pdf

Additionally, the U.S. Department of Energy Fuel Cell Technologies Office is conducting a major research program, the H2@Scale Initiative, to explore and evaluate the potential of hydrogen as an energy storage technology with the above features. The H2@Scale initiative is exploring the potential for wide-scale hydrogen production and utilization in the United States to enable resiliency of the power generation and transmission sectors, while also aligning diverse multibillion dollar domestic industries, domestic competitiveness, and job creation.[9]

E. Appropriate Rate Structures are Critical to Reducing GHG Emissions from Storage

A key lesson learned in California is that energy storage has increased greenhouse gas (GHG) emissions in that State. After converting the majority of the California Self Generation Incentive Program to funding energy storage projects, in 2016 the California Public Utilities Commission ("CPUC") released a report showing the increase in GHG emissions that was especially due to the time of use dispatch of short-duration storage projects. The report noted the following:

> "While the evaluation's findings indicate that SGIP is generally helping to reduce system peak demand, customer peak demand and customer bills, a key goal of the SGIP program is to reduce greenhouse gas (GHG) emissions, which is not currently being met. The evaluators believe that this is principally due to rate designs that are misaligned with peak marginal GHG hours, which prevent customers from receiving signals that would lead to GHG reductions. The evaluation also reveals other system performance issues that require attention. These include data availability for residential and certain small non-residential systems, low efficiency and increased system peak demand arising from smaller systems, and renewable integration for all systems." [10]

---

[9] https://www.energy.gov/eere/fuelcells/h2-scale

[10] *2016 SGIP Advanced Energy Storage Impact Evaluation Impacts Evaluation Report.* Submitted by Itron to SoCalGas and the SGIP Working Group, August 31, 2017. Available at: http://www.cpuc.ca.gov/sgip/ at Foreword.

There is also a critically important need to identify the manner by which clean power generation and energy storage are dispatched on the utility grid network. For the most part, clean power generation is today dispatched as a base-load resource due to the financial incentives that promote the 24 hours/day 7 days/week (24/7) continuous operation of the equipment to garner the best rate of return on investment. However, if rate structures were developed to provide a financial incentive for clean power generators to operate dynamically, producing more power during some times of the day and less during others, then the inherent capabilities of clean power generators to operate dynamically would be exercised by those participants fulfilling the storage mandate.

The Advanced Power and Energy Program at the University of California, Irvine has submitted detailed comments to the CPUC Distributed Generation proceeding docket that contain detailed analysis.[11] This analysis concluded that the energy storage systems dispatched by participants in the SGIP program were dispatched in a manner to receive the best rate of return on investment. Because these systems store energy rather than produce power, there are certain times of the day in which they consume electric power and other times of the day in which they produce electric power. These systems have typically been charged at night when time-of-use (TOU) electric rates are low and discharged during the day when TOU rates are high, making energy storage use for energy arbitrage more financially attractive. Additionally, if energy storage systems charge between the hours of 11:00pm and 8:00am and then discharge between the hours of 8:00am and 5:00pm, the result is to shift less renewable power from the night to the day and also exacerbate the potential for renewable power over-generation and

[11] R-12-11-005. *Order Instituting Rulemaking Regarding Policies, Procedures and Rules for the California Solar Initiative, the Self-Generation Incentive Program and Other Distributed Generation Issues*. Comments of the Advanced Power and Energy Program at the University of California, Irvine. June 6, 2016.

curtailment. This unfortunate set of conditions has led to the fact that energy storage systems are today performing a negative function on the grid in California, leading to increased grid dynamics and actually increasing the GHG emissions of the grid.

Finally, there is a critically important need for work on rate structures in order to enable economic operation of both energy storage and clean power generators in a manner that best supports the introduction of more renewables and supports grid reliability, resiliency, and sustainability. The NFCRC strongly supports the Roadmap's recommendations to incentivize charging during periods of high (excess) renewable power generation and discharging during periods of low renewable power generation and high demand (e.g., winter evening peak demand period).[12] Clean power generation rate structures are required to incentivize turn-down of power generation when renewable power generation is high (excess) and ramp-up of power generation when renewable power is low and demand is high. In addition, for both energy storage and clean power generation, rate structures must be developed and implemented that value the ramping capabilities of both technologies and provide utilities with the tools to incentivize and/or introduce these technologies to the markets that value ancillary services (e.g., Volt-VAR support, frequency regulation).

III. Conclusion

The NFCRC appreciates the opportunity to provide comments on the New York State Energy Storage Roadmap and emphasizes the importance of technology diversity, inclusive resource valuation and proper rate structures in energy storage for improved grid reliability, resiliency, and emissions reduction at both the local and regional levels.

---

[12] Roadmap at 31.