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New Jersey Energy Master Plan
October 12, 2018

WRITTEN COMMENTS OF FUELCELL ENERGY, INC.

FuelCell Energy, Inc. ("FCE") is pleased to submit these written comments concerning many of the topics included in the Notice of Stakeholder Meetings on New Jersey's Energy Master Plan.

Introduction and Background

FCE is in its 50th year of operation, headquartered in Danbury, Connecticut with its global manufacturing facility located in Torrington, Connecticut. We currently have over 300MW of stationary fuel cells installed, in backlog or under award on three continents with many more projects under development. Our clean, efficient fuel cells have generated over 8 billion kWh of power. Our products, projects and Company reduce emissions, improve the resiliency of energy infrastructure, provide tax revenue and create and retain jobs, and we are ready to expand in New Jersey.

We appreciate New Jersey's thoughtful approach to the development of its clean energy strategy and its attention to the input of all of the various stakeholders. In these comments, we will provide our view on many of the discussion points solicited in the notices of stakeholder meetings. For ease of reference, we will use the headings contained in the stakeholder meeting notices.

At the outset, we note that the smartest, most secure clean energy strategy is a properly implemented "all of the above" strategy in which a diverse portfolio of clean energy resources with their attendant strengths and benefits are employed and valued to ensure the lowest possible emissions at the lowest possible cost while advancing grid reliability and resiliency and smart land use policy to support the Governor's 2050 100% clean energy goal. In crafting such a smart, sustainable and secure clean energy policy, it is important to note that there is no single perfect solution and that "clean energy" is not necessarily synonymous with "zero carbon." We respectfully suggest that it is important to evaluate and consider all of the various attributes of a generation resource:

manufacturing process, installation, operation, decommissioning, disposal, land use impacts, need for and impact of transmission, contributions to grid resiliency and reliability and local economic benefits. Smart policy is balanced policy.

CLEAN AND RELIABLE POWER

Fuel cells are a perfect complement to more traditional, intermittent clean energy resources to help balance the resource mix and ensure robust, resilient, secure, clean power. Fuel cells emit negligible NOX, SOX and particulate pollutants – which are leading causes of issues such as acid rain and respiratory ailments - that is because in a fuel cell there is no combustion. Power is efficiently produced from fuel through a chemical reaction. While fuel cells do emit a small amount of carbon dioxide, it is only a fraction of the carbon dioxide emitted by traditional grid generators because of the inherent efficiency of direct power conversion without combustion. As compared to the most efficient combined cycle natural gas plants currently under construction in the Northeast, our SureSource fuel cells emit 7 to 20% less carbon dioxide, depending on configuration, 80% less NOX, 99% less SOX and greater than 99% less particulate pollution. A table comparing these emissions appears below:

	758 MW NGCC	758 MW SureSource4000 Distributed projects	758 MW SureSource3000 Distributed projects with heat recovery	Avoided Impacts
Local Impacts (Noise, high stacks, plume, land use, etc)	Significant	Minimal	Minimal	**Reduced local impacts**
T&D losses	Typical of central generation, ~5%*	Reduced by distributed generation	Reduced by distributed generation	**Reduced loss instead of increased loss**
CO_2 GHG emissions	779 lb/MWh* 2.7 MM Tons/year	725 lb/MWh 2.5 MM Tons/year	600 lb/MWh 2.1 MM Tons/year	**0.2 to 0.6 million Tons/year avoided CO_2**
NOX emissions	0.057 lb/MWh 195 Tons/year	0.01 lb/MWh 34 Tons/year	0.01 lb/MWh 34 Tons/year	**160 Tons/year avoided NOX**
SOX emissions	0.012 lb/MWh 40 Tons/year	0.0001 lb/MWh 0.3 Tons/year	0.0001 lb/MWh 0.3 Tons/year	**39 Tons/year avoided SOX**
Particulates	0.045 lb/MWh 155 Tons/year	0.00002 lb/MWh 0.1 Tons/year	0.00002 lb/MWh 0.1 Tons/year	**155 Tons/year avoided PM**

Fuel cells emit 7 – 20% less CO2, 80% less NOX, 99% less SOX, and >99% less particulate pollution compared to the best available natural gas combined cycle

Unlike renewable zero carbon resources, fuel cells provide steady continuous clean power, avoiding the need for combustion backup diesel generators or peaking generation to solve intermittency issues or batteries that carry their own end of life disposal issues.

FCE's SureSource fuel cells are between 47 and 60% electrically efficient, beating traditional average grid efficiency of roughly 35%. We can achieve greater than 80% efficiency in a combined heat and power mode.

Due to their ultra-clean profile, fuel cells operating on natural gas are included in the highest tier of clean energy portfolio standards in Connecticut, New York, Pennsylvania, Delaware, Indiana, Maine, New Hampshire, Ohio, Oklahoma, West Virginia and Puerto Rico. In addition, South Korea is the largest global market for fuel cells with over 200MW installed. The Korean clean energy portfolio standards, which include fuel cells operating on natural gas, were promulgated to reduce carbon emissions and develop local manufacturing of clean energy generation products to accelerate economic growth.

FCE's carbonate fuel cell technology is also capable of cutting edge applications that represent the future of clean energy, like carbon capture. Our carbonate fuel cells have the ability to take in flue gas directly from coal and natural gas power plants or other industrial applications, and concentrate and remove up to 90% of the carbon, while also removing up to 70% of the harmful emissions of NOX, which causes acid rain and smog. In the process of capturing carbon, our carbonate fuel cells actually produce electricity, thus adding to the revenue stream, as opposed to other carbon capture technologies that consume a substantial amount of electricity and add cost. We have been working on this new application for our technology as part of a joint agreement with ExxonMobil right here in New Jersey, creating jobs and investment in the state. The work we are doing with Exxon has significant global implications for reducing CO2 emissions from two thirds of the world's sources.

FCE has also developed a way to combine its fuel cell with a natural gas turbine at natural gas gate stations, using the let-down process to generate additional electricity. Natural gas is typically transported long distances through pipelines at high pressure. In order to distribute the gas to homes and businesses, the pressure must be reduced at the gate station. As the pressure is reduced, the gas cools. To prevent it from freezing, the gate station typically uses a gas-fired burner to generate heat. This methodology loses energy in the pressure reduction process and the burner emits pollutants. FCE's unique fuel cell energy recovery generator uses a turbo-expander in the let-down process to generate additional electricity, while the heat recovered from the fuel cell takes the place of the gas-fired burner to keep the gas from freezing.

For all of the foregoing reasons, in addition to the benefits fuel cells offer as described below, fuel cells should be included in the definition of clean energy resources.

CLEAN AND RELIABLE TRANSPORTATION

FCE is working to develop hydrogen fuel infrastructure to enable the deployment of hydrogen-powered emissions free vehicles. In California, we recently signed a contract with Toyota to install one of our trigeneration carbonate fuel cells at the Port of Long Beach that, in addition to producing electricity and heat, will also produce hydrogen to fuel Toyota's hydrogen vehicles coming into the port. According to the U.S. Energy Information Administration, power generation is no longer the biggest source of greenhouse gas emissions in the United States – transportation is. Local deployment of fuel cell power can be utilized to advance hydrogen production and electricity for vehicle charging, thus reducing not only grid emissions but transportation emissions as well. And we can do this while providing base load power to the grid or resilient power to industry. The Port of New York and New Jersey offers a similar opportunity to apply cutting edge technology that reduces emissions.

New Jersey's transportation policy should not only focus on electric vehicles, as they are not the best fit for all consumers, but should include fuel cell vehicles. Similarly, any programs offered for electric vehicle chargers should also be offered for hydrogen filling stations and infrastructure.

SUSTAINABLE AND RESILIENT INFRASTRUCTURE

In addition to clean power generation, fuel cells offer unique resiliency and infrastructure benefits that are not achievable via more traditional intermittent clean energy resources. We believe that the most secure power is distributed generation – power generated near where it is consumed, that does not need to be transmitted over long distances. With respect to the benefits of resiliency, fuel cells have a proven record of generating reliable, consistent energy for sites in need of high-quality primary power such as data centers, hospitals, university campuses, military bases, and other critical sites, often displacing older, inefficient diesel backup generators. With their islanding capability, fuel cells form the backbone of microgrids and our installations have seamlessly transitioned to microgrid mode when the rest of the electric grid has gone dark. In an era of increasingly severe storms and hurricanes, our fuel cells can provide vital infrastructure benefits to New Jersey's electric grid.

FCE's stationary carbonate fuel cells are well suited for many applications. Our carbonate SureSource fuel cells come in three sizes – 1.4MW, 2.8MW and 3.7MW, are scalable for any project size and are capable of installation in combined heat and power applications and for grid-scale electricity. SureSource systems have been deployed at universities including Central Connecticut State

University, the University of Bridgeport, the University of California at San Diego, San Francisco State University and many others. Our combined heat and power fuel cell systems have been deployed at hospitals including Hartford Hospital and UC Irvine Medical Center and at industrial facilities, including the Pepperidge Farm Bakery and at Pfizer. FCE grid-scale systems generate power at a 15MW fuel cell park in Bridgeport, Connecticut and at a 59MW installation in South Korea, which is the largest fuel cell installation in the world. The 59MW Korean installation is a combined heat and power installation that supplies heat to a local district heating system. FCE's installations form the backbone of several microgrids, including a state-of-the-art microgrid in Woodbridge, Connecticut, that was installed in collaboration with the local utility that connects critical local facilities like police, fire, town hall and the high school with continuous power in times of grid outage, while also supplying heat to the high school. The microgrid at the University of Bridgeport uses our SureSource 1500 fuel cell system to ensure continued power to critical facilities in the event of a storm or grid failure, and allows the University to serve as an emergency evacuation shelter for New York City.

FCE is currently constructing a 7.4MW fuel cell project at a U.S. Navy submarine base, which will ensure the delivery of reliable, round-the-clock power to critical services, helping the Navy to adapt to the dynamic energy security challenges of the 21st century and making it less likely to be the subject of a future base realignment and closure commission (BRAC) determination.

FCE was also recently awarded nearly 40MW of projects on Long Island by PSE&G/LIPA. LIPA needed a source of clean energy in a heavily constrained area with little available real estate. By strategically selecting three fuel cell projects totaling nearly 40MW to connect to targeted substations, LIPA was able to avoid $78 million in transmission upgrades that would have otherwise been required to bring the necessary power to the local area. These projects were awarded via a feed-in tariff, with a power purchase agreement, thus resulting in zero capital outlay by the utility and creating regional resiliency on the network.

Although compact, quiet, unobtrusive and easy to site, our fuel cells are robust industrial power plants with an average availability of greater than 95% that have survived and operated through hurricanes (including Hurricane Sandy), earthquakes, blizzards, and California wildfires. Few clean energy resources can claim such robustness or reliability.

New Jersey should take note of instances of generation deficiency in markets that rely too heavily on intermittent renewables to satisfy clean energy goals. Battery storage to supplement

intermittent renewables is not sufficient to bridge the gaps in generation, thus requiring the most expensive, most polluting and least efficient resources, known as "peakers" to remain available to fill the void. The result is actually higher CO2 and other emissions, as peakers idle all day, waiting to ramp when needed. Since most of these plants were not designed to idle and ramp in this fashion, they are extremely inefficient. Clean baseload fuel cell generation can lessen the reliance on peakers, smooth out the "duck curve,"[1] support utility requirements for capacity and reliability, and also avoid the need for transmission and distribution upgrades.

Fuel cells are quiet, efficient and reliable, and virtually emission free, and unlike intermittent clean energy resources, can be relied on as a sole power source. As a backup power source, in the event of a grid failure, fuel cells generate more energy than higher polluting backup generators such as diesel. With their islanding and microgrid capabilities, fuel cells provide consistent high quality power irrespective of grid disturbances.

ENVIRONMENTAL JUSTICE

State policy must of course take into account the land use impacts of clean energy resources. FCE's SureSource fuel cells are quite easy to site, occupying less than an acre of land per 10MW installed, as compared to approximately 70 acres per 10MW of solar installed. An example of a fuel cell installation right next to a solar installation is depicted below:

[1] The "duck curve" refers to the over-generation of solar energy during the day, with a drastic drop off in the evening hours. *See* https://www.energy.gov/eere/articles/confronting-duck-curve-how-address-over-generation-solar-energy

Our capacity and availability factors exceed 90%, providing steady, reliable power irrespective of weather. Fuel cells are easily sited in dense, urban areas like many areas of New Jersey, providing power directly where the load is, thus avoiding the need for transmission. And our projects contribute to the remediation and restoration to the tax rolls of brownfields. Fuel cell projects can provide voltage stability and avoid the need for costly transmission and substation upgrades. And we are cost competitive to the grid in regions such as California and here on the East Coast. The cost effectiveness of our fuel cell installations is greatly enhanced when thermal use, resiliency and reliability are included in the evaluation.

FCE's 15MW fuel cell park in Bridgeport, Connecticut is a model for utility scale deployment of fuel cells in urban environments. The project is in the heart of a distressed, urban community, and required the remediation of a long-vacant and polluted urban brownfield, restoring it to the tax rolls. At completion, this project became the largest property taxpayer on a per square footage basis in the city. At the Bridgeport project, the fuel cell acts as an engineered cap on the brownfield. The plant serves three local substations via dedicated underground feeders and displaces power from a local coal burning plant that can actually be seen from the fuel cell site. This project is routinely visited by utility representatives and policymakers from around the world and could easily be replicated in New Jersey.

Fuel cells are the perfect clean energy solution for dense, urban communities where large tracts of open space are not available, where smaller tracts of brownfields are ripe for project re-development, where emissions are highest, where sales taxes and local property taxes are needed and where backup power is critical. This type of power is the most secure power, inasmuch as it is generated where it is consumed and does not need to be transmitted over long distances, where it is susceptible to interruption. Fuel cells also contribute to local infrastructure development, as they support the expansion of infrastructure into underserved areas, bringing in gas lines that can displace resources that contribute more criteria pollutants, such as home heating oil and backup diesel generators.

Any clean energy program should also take into account the environmental impact and full lifecycle of clean energy resources, including ultimate disposal. FCE has already put in place measures to deal with end of life recycling of our product, with more than 93% of the content of our fuel cells recycled at end of life. Unlike most battery and solar technologies, our fuel cells do not end up in

landfills, leaking lead or cadmium as they degrade.[2] The International Renewable Energy Agency estimates that solar panel waste in landfills could reach 78 million metric tons worldwide by 2050.[3] Recent news reports have noted the difficulties in disposal of renewable energy technologies at end of life. Germany, for instance, reportedly had to manage 54,000 tons of waste from rotor blades from decommissioned wind turbines in 2014 alone.[4]

With respect to siting concerns, FCE respectfully suggests that New Jersey study Connecticut's siting model, which places exclusive jurisdiction for siting of all energy and telecommunications infrastructure in one statewide agency (the Siting Council), whose members are appointed by a diverse range of stakeholders. This single agency is then able to balance infrastructure needs and environmental justice concerns while avoiding typical NIMBY ("Not in My Backyard") and BANANA ("Build absolutely nothing anywhere near anything") outcomes.

ECONOMIC DEVELOPMENT

FCE would like to note that we already contribute to the New Jersey economy, and we eagerly look forward to expanding our contributions. We are proud to be a U.S. company that sources approximately 85% of its supply chain domestically. New Jersey is among our top 10 supply states, and in 2016 New Jersey ranked number 6. We also ship our products globally from the New Jersey port, which amounts to approximately $3 million per year in direct and indirect spend. We would like to expand our product deployment in the New Jersey market, where we know we can make meaningful, valuable and cost-effective contributions to New Jersey's energy, environmental and economic development goals.

In addition to the foregoing, the installation of fuel cell projects will create local construction and long term operations, maintenance and service jobs. This is in addition to the research and development jobs noted above.

SUGGESTED POLICY ENHANCEMENTS

Based on all of the foregoing, FCE respectfully submits that fuel cells offer important contributions to New Jersey's clean energy goals. In order to ensure the deployment of fuel cells as a means to reach these goals, FCE suggests implementation of some small policy enhancements. From

[2] *See, e.g.*, https://www.forbes.com/sites/michaelshellenberger/2018/05/23/if-solar-panels-are-so-clean-why-do-they-produce-so-much-toxic-waste/#164bf4c6121c

[3] http://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA_IEAPVPS_End-of-Life_Solar_PV_Panels_2016.pdf

[4] https://dailycaller.com/2018/07/15/wind-turbine-disposal/

FCE's experience in other markets, the following policy enhancements will provide the catalyst for FCE to deploy its fuel cells into the New Jersey market.

1. Permit Eligible Fuel Cell Systems to Net Meter

Despite the pronouncement in the Electric Discount and Energy Competition Act, codified at N.J.S.A. § 48:3-49 *et seq*., that fuel cells qualify for the renewable portfolio standard, the Board of Public Utilities promulgated regulations limiting such status to only those fuel cells powered by renewable fuel. See N.J.A.C. § 14:8 *et seq*. Without arguing the merits of that determination here,[5] FCE points out that this in effect excludes fuel cells operating on natural gas from benefiting from net metering. This hampers the development of projects and the adoption of fuel cell technology by commercial and industrial customers. For example, many manufacturers run steady shifts Monday through Friday, but not on weekends. Many college and university campuses have limited summer activities, resulting in substantially less load. The inability to net meter effectively precludes the development of beneficial projects at such locations, and limits the available customer base for meaningful installations to facilities that have consistent, 24x7 operations and sufficient load to consume all of the output of our MW-class installations.

Allowing eligible fuel cell systems to net meter will vastly increase the potential customer base for fuel cell installations, and will also help New Jersey offset some of the intermittency effects of the growing solar base. Fuel cell net metering at weekday commercial and industrial locations is the perfect complement to large solar installations, as power will be delivered to the grid during the nighttime hours, when host facilities are closed and solar is no longer producing. A substantial amount of such installations could offset the need for peaking or supplemental generation to smooth out the "duck curve" discussed above.

2. Allow Utilities to Credit Fuel Cells Toward Clean Energy Goals

As demonstrated above, fuel cells contribute significantly to utility grid resiliency, security and provide the cleanest most reliable generation source for modern microgrids. However, for utilities mandated to provide a certain percentage of clean energy to their customers, there is a clear disincentive to consider fuel cells as an option. FCE respectfully submits that New Jersey should consider adding fuel cells to its clean energy mandate. Massachusetts has recently adopted an Alternative Energy Portfolio Standard to complement its Renewable Energy Portfolio Standard to

[5] FCE does however note that there is not a sufficient supply of renewable biogas available to power the number of units that could be deployed. Moreover, the cost of renewable biogas is so high as to make most projects uneconomical, and therefore unlikely to be built.

encompass beneficial energy generation technologies such as fuel cells, combined heat and power, renewable thermal and waste to energy. As previously mentioned, numerous states consider fuel cells in their highest tier portfolio requirements, due to the ultra-clean and reliable generation profile. We believe that New Jersey should follow suit.

Incentivizing utilities to procure grid scale fuel cells will result in more distributed clean energy generation, adding to grid security and reliability in addition to providing more clean energy to New Jersey consumers and businesses.

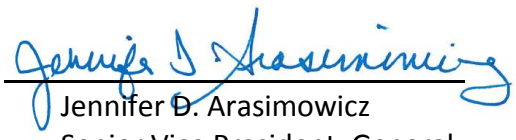
Conclusion

FCE appreciates the opportunity to provide these comments for consideration and urges that these comments be given strong consideration in order to rapidly develop the market for stationary fuel cells in New Jersey and achieve the economic, environmental and energy objectives of the Governor's Energy Master Plan. FCE is hopeful that the policy changes discussed above will be implemented through the Energy Master Plan or other appropriate means so that FCE may deploy its market-leading fuel cell technology for the benefit of New Jersey consumers.

We look forward to continued participation in New Jersey's thoughtful development of an Energy Master Plan, and would be happy to answer any questions or provide additional information.

Respectfully submitted,

FUELCELL ENERGY, INC.

By 

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