Assembly Bill 1637 (Low, 2016), which became effective January 1, 2017, extended the CPUC's fuel cell net energy metering (NEM) tariff through 2021. The NEM program was designed to continue market growth and encourage the deployment of on-site fuel cell electrical generation and enable microgrid applications that improve grid reliability while ensuring that fuel cells continue to contribute to the reduction in greenhouse gas (GHG) emissions, the reduction of NOx, SOx and pollutants, and attainment of Air Resource Board's (ARB) Distributed Generation Certification Program requirements for criteria pollutants.

Fuel cells have played and can continue to play an important role in helping California achieve its ambitious GHG and criteria pollutant reduction goals while keeping reliable baseload power connected to the California electric grid. Recent power interruptions in California have wreaked havoc on businesses and residents, costing millions of dollars. Multiple articles and news reports have focused on microgrids that kept the power on when the grid was shut down, and two of the four microgrid installations highlighted in one article are powered by FuelCell Energy fuel cells.[1] Onsite generation and microgrid applications significantly reduce the risk and devastation associated with high voltage power lines across California. Enabling deployment of fuel cells through the NEM tariff will not only keep the lights on, but will also benefit disadvantaged communities where both criteria air pollutants and GHG emissions are highest, as compact urban sites with high energy intensity loads are the perfect profile for fuel cell applications.

The NEM tariff applies to on-site, behind the meter installations. For these types of installations at universities, hospitals, industrial facilities and wastewater treatment plants, FuelCell Energy (FCE) deploys its combined heat and power (CHP) or cogeneration system for the highest overall efficiency and greatest emissions reductions. FuelCell Energy installations also provide the service assurance California residents depend on from hospitals, universities, waste water treatment plants and industrial facilities that contribute to stable employment across California.

The CHP feature of the FCE systems enable GHG reductions 24/7 from energy intensive thermal systems, i.e. industry boilers, by displacing natural gas usage. The combination of reducing GHG's and clean air emissions make FuelCell Energy systems a good fit for improving a site's environmental footprint, especially in disadvantaged communities with high polluting facilities operating 24/7. Improving the environmental footprint of these "high polluting facilities" is essential to these communities as they offer high paying employment opportunities for thousands of Californians.

However, the standard being proffered by the ARB will stifle fuel cell deployment and make financing fuel cell installations practically impossible, thus negatively impacting California's clean energy goals. Fuel cell efficiency varies over the life of a project, declining slightly over years of operation and returning to the original level when stacks are refurbished. The annual declining standard could result in a fuel cell project that meets the standard in the first year of installation falling out of the standard as the standard gets stricter. As most fuel cell projects have a 20 year life, it is impractical to think that any financier will finance such a project knowing (1) that the project will be unable to meet the standard in

[1] See It's Dark in California but the Message is Clear: More Microgrids Needed- https://microgridknowledge.com/microgrids-california-power-outages/ , which spotlights FCE's installations at The University of California San Diego and the Santa Rita Jail.

later years and (2) when the standard has only been issued for the first three years, and it is anybody's guess what the standard will be in the future. This will certainly chill investment in clean and energy and fuel cell projects, and make it more difficult for California to achieve its broader clean energy goals.

The standard as promulgated directly threatens two critical fuel cell projects for FCE - one of which is in construction (5.0MW Bolthouse Farms CHP project in Bakersfield) and one of which is commercially operable (2.8MW Tulare CHP project) - that have interconnected under the NEM tariff. These projects were contracted for, construction commenced and the Tulare CHP project completed in good faith on the practical assumption that the standard would not be designed to exclude the vast majority of fuel cells from participation under the NEM tariff. Implementation of a standard that will terminate these projects from the NEM will lead to severe economic consequences for offtakers and financiers, and will have the likely unintended consequence of discouraging investment in California clean energy projects. In addition to simply being impracticable, FCE submits that the standard proffered by ARB fails inasmuch as it does not account for heat recovery in fuel cell systems and employs a marginal emission rate that does not fairly compare fuel cell emissions to the generation being displaced by fuel cells, namely IOU cogeneration systems, thermal plants and diesel generators. Ample data supports FCE's position that fuel cells are far cleaner than the generation systems they displace.

While fuel cells may offer lower emissions reductions per rated kW compared to pure renewables, the 24x7 operation of fuel cell systems means they typically avoid more emissions than intermittent renewables, and they provide reliable capacity that is ready to serve during grid outages.

- Statutes and investor owned utility (IOU) tariffs include CHP systems with the published tariffs including heat recovery equipment in the fuel cell definition.
- Comparison to cogeneration systems under contract to IOUs is more appropriate emissions standard, especially since the IOU cogeneration systems are meeting their GHG reduction goals.
- CEC data and staff reports prove that thermal plant heat rates are increasing year over year, and this increase must be included in the emissions standard.
- FCE plants greatly reduce GHG emissions and criteria pollutants, when compared to combustion power plants and diesels.
- FCE plants have a minimal environmental footprint. The compact design, simple maintenance, low sound and ultra-low emissions deliver direct benefits the local community. FuelCell Energy's fuel cell plants are 95% recycled and placed right back into the supply chain fully delivering on the circular economy.

SCE, PG&E, SDG&E (IOU's) Fuel Cell NEM Tariff Definitions Include Heat Recovery Equipment

Each of the IOUs' Fuel Cell NEM tariffs includes a specific definition that recognizes CHP (emphasis added): an *"Eligible Fuel Cell Electrical Generating Facility: A Generating Facility used to produce electricity by a fuel cell, that meets all applicable safety and performance standards in accordance with the Utility's Electric Rule 21 and pursuant to PU Code Section 2827.10 includes*

1) *an integrated power plant system containing a stack, tubular array, or other functionally similar configuration used to electrochemically convert fuel to electric energy;*
2) *an inverter and fuel processing system where necessary, and*
3) *other plant equipment**, including heat recovery equipment necessary to support the plant's operation or its energy conversion**."*

The FCE systems meet this definition and "include[s] heat recovery equipment". Since the FCE CHP feature is required for the behind the meter site integration and energy conversion, the CHP aspect of the fuel cell systems (as applicable) must be included in the emissions standard.

FCE believes this can be accomplished by using the State Average Heat Rate when fuel cell systems are sited with their "included heat recovery equipment necessary to support plant's operation of its energy conversion".

FCE proposes that a separate table in the CARB regulation establishing a CHP system emissions standard and recognizing the benefits of CHP be included.

Comparison of FCE CHP Systems to Reported Cogeneration Heat Rate in CEC's Thermal Efficiency of Gas-Fired Generation in California: 2018 update (CEC 2018)

As discussed above, the CHP feature of the FCE systems is included in the already published tariffs. FCE believes that CHP must be taken into consideration as part of this proposed regulation to fully comply with the definitions and the already established tariff. The proper GHG comparison is the FCE CHP system heat rate and the reported Cogeneration heat rate (CEC Thermal Efficiency report as referenced in the CARB Staff ISOR; https://ww2.energy.ca.gov/almanac/electricity_data/Thermal_Efficiency_reports.html)

The CEC's Thermal Efficiency Report Table 1, page 5 lists the 2017 Cogeneration heat rate as 11,929 Btu/kWh (11.9 MMBtu/MWh). The reported Cogeneration heat rate has increased over 1% per year (4% total) between 2014 through 2017.

The Table 1 below includes the CEC Thermal Efficiency Report heat rates and calculated year over year increases. The CEC data based Cogeneration Heat Rate is increasing each year. This increase should be accounted in FCE's request to compare fuel cell CHP directly to Cogeneration Heat Rates in the regulation.

Table 1: **CEC Reported Cogeneration, State Average Heat Rate (with & without cogeneration)**

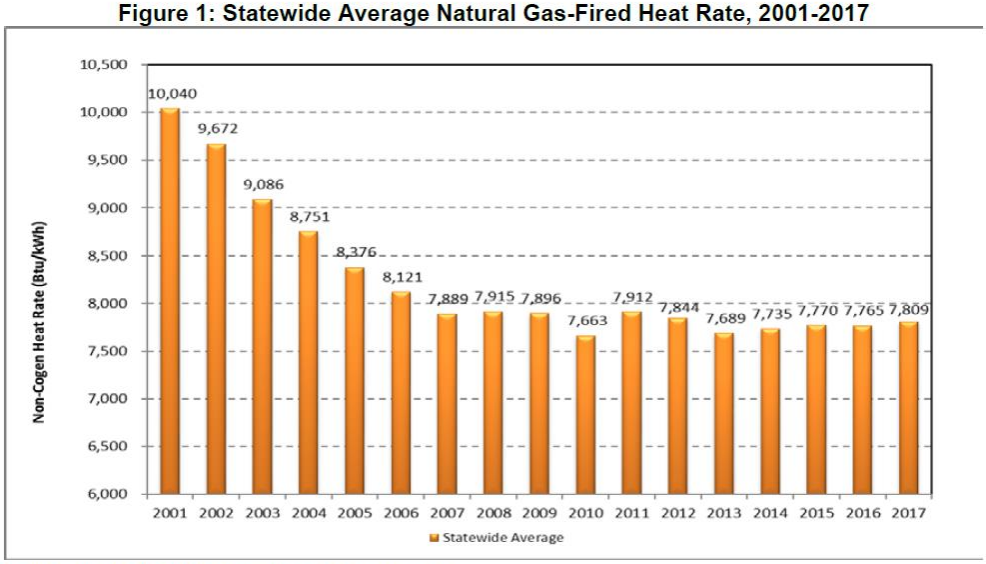
	Cogeneration		State Average		State Average w/o Cogen	
	Heat Rate Btu/kWh	Year over Year % Increase	Heat Rate Btu/kWh	Year over Year % Increase	Heat Rate Btu/kWh	Year over Year % Increase
2014	11,445	N/A	8,552	N/A	7,735	N/A
2015	11,461	0.14%	8,557	0.06%	7,770	0.45%
2016	11,621	1.40%	8,683	1.47%	7,765	-0.06%
2017	11,929	2.65%	8,817	1.54%	7,809	0.57%

The state also has reported data on the GHG reductions attributed to Cogeneration. PG&E, SCE and SDG&E completed their procurement of 3000 MW of CHP capacity in 2018 as required by the QF/CHP settlement (https://www.cpuc.ca.gov/General.aspx?id=5432). The program as reported by the IOUs has achieved approximately 93% of the targeted GHG reductions. These reductions have been achieved with heat rates significantly higher than FCE system heat rates.

Expected Increase in Combined Cycle Heat Rates Due to Operations Integrating Renewables

The CEC Thermal Efficiency Report (Page 3) shows the trend for the non-cogeneration heat rate (Btu/kWh). "Figure 1" below is copied and pasted from the CEC report.

Figure 1: Statewide Average Natural Gas-Fired Heat Rate, 2001-2017



Source: QFER CEC-1304 Power Plant Data Reporting

"The small increases in the system wide average heat rate for 2014 through 2017 as shown in Figure 1 are the result of natural gas-fired power plants adjusting their power output to accommodate fluctuations in available renewable generation within California's electrical grid.

There are, however, practical limits to the state's ability to reduce its system wide heat rate. The primary factor is related to how often the fleet of gas-fired power plants operate over their available hours. Cycling or ramping refers to gas plants altering output levels, including shutdowns and restarts, in response to changes in system load and the availability of renewable generation on the electrical grid. Cycling results in increased fuel consumption during those periods when a plant is not operating at the highest efficiency level, a result of the large temperature and pressure changes that take place in plant equipment. For those power plants designed to operate most efficiently at constant output levels, cycling leads to greater wear and tear and reduced lifespan of the equipment, along with reduced thermal efficiency. Studies have found that cycling results in a ***1 percent permanent degradation*** *in the heat rate of a generating unit over four to five years.* (N. Kumar, P. Besuner, S. Lefton, D. Agan, and D. Hilleman. National Renewable Energy Laboratory. July 2012. Power Plant Cycling Costs. https://www.nrel.gov/docs/fy12osti/55433.pdf.)" (emphasis added).

As renewables integration continues, natural gas power plant cycling will continue to degrade the heat rate (i.e., increase heat rate). This fact from the CEC staff report proves that the natural gas heat rate will not decrease year to year as assumed by the ARB declining standard, but rather increase.

Thus a declining standard is not an accurate representation of the real operation of thermal power plants, even to more efficient combined-cycle plants.

A simple way to fix this fundamental flaw and ensure California grid reliability would be to provide that a fuel cell installation that meets the required standard for its first year of commercial operation is eligible under NEM for the duration of the life of the plant.

Extension of Aging Power Plants for Reliability

The operation and renewables integration on the California grid is an on-going process. The recent proposed decision by the CPUC, proposes to keep these "Aging Power Plants" online to support the grid as more renewables are integrated. (CPUC Rulemaking 16-02-007; DECISION REQUIRING ELECTRIC SYSTEM RELIABILITY PROCUREMENT FOR 2021-2023; http://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M319/K349/319349071.PDF)

FCE assumes these plants are in the "Aging" category since the plants listed in the Table 2 below are once-through cooling (OTC) and have scheduled retirement dates of December 31, 2020.

Table 2: OTC Power Plants from CPUC Proposed Decision November 2019

Gas Generation Station	Unit(s)	Power Plant Type	Extension	Approx. Capacity	CEC Reported net MWh	CEC Reported Fuel Use MMBTU	Calculated Heat Rate (Btu/kWh)
Alamitos	3, 4, 5	Steam Turbine	up to 3 years	1,200 MW	686,924	8,629,270	12,562
Huntington Beach	2	Steam Turbine	up to 3 years	200 MW	132,445	1,520,210	11,478
Redondo Beach	5, 6, 8	Steam Turbine	up to 2 years	850 MW	180,635.1	2,522,270	13,963
Ormond Beach	1, 2	Steam Turbine	up to 1 year	1,500 MW	186,016.1	2,218,100	11,924
Moss Landing	1, 2	Combine Cycle	temporary extension	1,020 MW	4,183,625	29,433,380	7,035

Note: Moss Landing is included for completeness even though it is a combined-cycle plant, thus its CEC heat rate category would be Combined-Cycle, not Aging.

These Aging power plants have capacity of 3,750 MW and an average heat rate of 12,482 Btu/kWh using 2018 Operating Year CEC published data. The 2018 average heat rate for the Alamitos, Huntington Beach, Redondo Beach, and Ormond Beach plants are about 4% higher than their 2017 combined average heat rate of 12,104 Btu/kWh using CEC published data for those same plants.

With the potential extension through 2023, the Aging plants will have higher heat rates each year. Again, this supports the CEC staff finding that thermal plant heat rates will increase due to cycling to integrate renewables. This data for Combined Cycle and Aging plants supports FCE's position that the FC NEM standard should be at least a level standard or even increasing, but certainly not declining.

NOx Reductions Compared to CA ISO (EGRID 2016) and Diesel Generators (PSPS events)

FCE systems are able to help disadvantaged communities with air quality, especially those which struggle with air pollution from local industrial facilities. As noted above, FCE's fuel cell systems are able

to run connected to the grid and then can transition to grid independent operation during a grid outage (i.e., Public Safety Power Shutoff (PSPS) event). NOx emissions are near zero in both grid connected and grid independent modes and are much cleaner than the reported utility grid NOx and diesel generators deployed during PSPS events. FCE will enable these industrial facilities to continue their operations, meet California's air standards and continue to provide high paying employment opportunities for thousands in the California communities in which they operate.

Table 3 below compares the FCE NOx emissions factors to the US EPA eGRID 2016 data. (https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid)

Table 3: NOx Emissions Factors and FCE Project Reductions: CA ISO Grid and FCE Systems

	NOx Emissions Factor lb/MWh	Annual NOx Emissions 1.4 MW Project Tons per Year	Annual NOx Emissions 2.8 MW Project Tons per Year
eGRID 2016 for CA ISO	0.500	2.8	5.5
FCE	0.01	0.1	0.1
Annual NOx Avoided by FCE Project (Individual 1.4 MW and 2.8 MW projects)		2.7	5.4
Total NOx Avoided by FCE 20 year Project		54	108

Table 4 below the Diesel Generator and FCE Emissions Factors. The Diesel Generator emissions factor is the averaged emissions factor from the South Coast AQMD certified emergency generator list.

The South Coast AQMD has certified certain models/families of equipment as meeting all applicable air quality requirements and have issued permits to the dealer/distributor of these engines. A list of dealers/distributors that are participating in this program is available on South Coast AQMD's website. (http://www.aqmd.gov/home/permits/emergency-generators#Fact1). FCE's fuel cells are markedly cleaner than all of these providers.

Table 4: Diesel Generator and FCE Emission Factors

	Diesel Generator and FCE Emissions Factors		
	NOx lb/MWh	PM lb/MWh	CO2 lb/MWh
Tier 2 Diesel	11.623	0.265	1614*
Tier 3 Diesel	7.935	0.284	1614
FCE System	0.01	0.00002	725**

*Calculated from average diesel generator fuel consumption of 0.072 gallons/kWh

**Assumes FCE CHP system

Table 5 and Table 6 below summarize the emissions reductions (emissions avoidance) during a 48 hour PSPS event where the FCE system switches from grid connected to grid independent operation to maintain the critical facility operation, displacing the need for a much dirtier generator.

Table 5: Emissions Comparison for 1.4 MW Project Operating During PSPS Event

	Emissions for 1.4 MW supplied during 48 hours grid outage		
	NOx lbs	PM lbs	CO2 lbs
Tier 2 Diesel	781	18	108,480
Tier 3 Diesel	533	19	108,480
FCE System	0.67	0.001	48,720*
FCE Reduction	99.90%	99.99%	55%

*pipeline natural gas supplied. Biogas or Biomethane fuel supply would result in higher offset of CO2 emissions.

Table 6: Emissions Comparison for 2.8 MW Project Operating During PSPS Event

	Emissions for 2.8 MW supplied during 48 hours grid outage		
	NOx lbs	PM lbs	CO2 lbs
Tier 2 Diesel	1562	36	216,961
Tier 3 Diesel	1066	38	216,961
FCE System	1.34	0.003	97,440*
FCE Reduction	99.90%	99.99%	55%

*pipeline natural gas supplied. Biogas or Biomethane fuel supply would result in higher offset of CO2 emissions.

FCE calculations use an individual site (1.4 MW or 2.8 MW) for this analysis. Greater emissions savings/avoidance would be achieved with higher MWs of FCE systems deployed.

These emissions reductions are permanent and naturally achieved with the FCE clean electro-chemical power plant. Yet, despite the clear benefit to emissions reductions from fuel cells, the standard proffered by ARB fails to take these points into consideration.

Conclusion

FuelCell Energy has been a participant for many years in California's clean energy programs and has made meaningful contributions to California's emissions reduction goals. However, the standard proffered by ARB threatens continued participation in the California market by clean, reliable base load fuel cells and will result in the continued proliferation of other forms of CHP, to the detriment of the very clean energy goals California is trying to obtain. FCE respectfully suggests that the ARB once again revisit its methodology, taking into consideration the above comments. Absent a revisiting of the standard, FCE respectfully suggests that the standard be set at the appropriate level recommended by ARB and that a fuel cell project meeting the standard at the time of installation be deemed qualified for NEM for the duration of the project in order to provide the certainty needed for planning and financing.

FCE has two critical fuel cell projects, Bolthouse Farms CHP project in Bakersfield and Tulare CHP project in Tulare, that have interconnected under the NEM tariff These projects, based on the above comments, provide emissions reduction and improved air quality, especially for the local disadvantaged communities. FCE respectfully suggests that projects interconnected under the NEM tariff before the establishment of the GHG standards should be grandfathered. Grandfathering fuel cell NEM projects installed before the standard is fair, and it will ensure continued progress toward these important

emission reductions, protect investment and encourage further local clean energy project investment. FCE believes revisiting the standard is also critical to ensuring California continues to have robust industrial manufacturing, reliable continuous power and less reliance on imported power via high voltage power lines.

Respectively submitted,

FUELCELL ENERGY, INC.

By 

Jennifer Arasimowicz
Executive Vice President, General Counsel
Chief Administrative Office & Corporate Secretary