

Solar[®] Turbines

A Caterpillar Company

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Massachusetts Department of Energy Resources
100 Cambridge Street, Suite 1020
Boston, MA 02114

Attention: *Ms. Samantha Meserve, Deputy Director*
 and
 Ms. Darchelle Petion, Program Coordinator

Reference: *APS Straw Proposal Comment*

Dear Ms. Meserve and Ms. Petion,

Solar Turbines Incorporated (Solar) respectfully submits this letter which contains our comments on the Straw Proposal of Changes to the Alternative Energy Portfolio Standard (APS) regulations (225 CMR 16.00).

Solar is an American manufacturer of power generation equipment founded in 1927 and is a world leader in industrial combustion gas turbines from 1 MW to 23 MW. Solar has sold more than 16,000 combustions gas turbine systems with over 3 billion operating hours experience. These systems provide clean, efficient, and reliable power for base-load electricity, combined heat & power (CHP), standby power, and mechanical drive applications. Solar has over 4,000 combustion gas turbine packages installed for electrical power generation and CHP in North America; all of which were manufactured in the USA. In 1981 Solar was purchased by Caterpillar Tractor Co. (now Caterpillar Inc.) from International Harvester Company. Solar is a wholly owned subsidiary of Caterpillar Inc.

Since the 2009 implementation of the Massachusetts APS program Solar has supplied and/or installed the following combustion (natural gas) turbine based CHP or power generation plants in the Commonwealth of Massachusetts:

- 8 MW CHP - public university medical center in Worcester MA
- 5 MW CHP - paper plant in western MA
- 3.5 MW CHP – paper plant in north central MA
- 16 MW CHP – district energy plant for multiple medical facilities in Boston MA
- 8MW CHP – private university in Cambridge MA

- 4.5 MW CHP – public university medical center in Springfield MA
- 4.5 MW CHP – manufacturing facility in Worcester MA (in progress)
- 8 MW CHP – manufacturing facility in Boston MA
- 44 MW CHP – private university in Cambridge MA
- 16 MW Power Plant – utility in Nantucket MA

All of the CHP plants listed above are resilient sources of power generation which provide a number of critical public and private facilities with clean energy below the annual carbon emission of the MA electric grid.

Based on the information provided above we believe that Solar is a valid stakeholder to the APS review process, as such we have respectfully provided the enclosed comments for your review and consideration. Our comments are summarized as follows:

- Congratulate MA DOER for changes in the Alternative Compliance Payment (ACP) and the increase in the APS percentage requirement that will support prices and reduce volatility;
- Formally document our continued support of MA DOER's Greenhouse Gas (GHG) reduction goals;
- Respectfully remind MA DOER that high efficiency, environmentally superior and economically advantageous CHP has historically delivered, and will deliver for years ahead, significant GHG reductions;
- Request that the MA DOER consider that CHP provides emissions reductions that promote GHG reduction goals often in a more cost-effective manner than other alternative qualifying technologies;
- Recognize that CHP provides a host of uncompensated benefits, including resiliency for critical infrastructure in time of emergencies, reductions in transmission and distribution (T&D) capital and operating expenses, and facilitating the higher levels of penetration of intermittent renewables on the grid;
- Urge MA DOER to support a technology neutral approach to meeting the GHG reduction targets. It is imperative that MA DOER employ a framework that does not choose particular technologies, rather one that fairly rewards on the basis of measured, verified GHG reductions;
- Stress the over-arching importance of fair, measured, and verified payment for performance, utilizing methodologies, protocols, and best practices as understood and accepted by unbiased, arms-length experts like the U.S. Environmental Protection Agency (US EPA);
- Note that MA DOER's assessments in this proceeding must take account of future needs for distributed energy flexible resources (DEFER) that will be essential to grid reliability

and stability for years into the future, and;

- Advise MA DOER that zero carbon CHP is a DEFR that exists today. A variety of forms of renewable and low/no carbon CHP run today, and with accelerated technology research, will deliver faster, better, cheaper zero carbon CHP options for decades to come.

As noted above, CHP is a proven way to provide reliable, efficient, resilient, and clean local energy generation. The State of Massachusetts was a national innovator in the development of the Alternative Portfolio Standard that has rewarded high efficiency, environmentally superior energy technologies including CHP. The incentive structure for CHP in the APS was particularly well designed and effective in promoting the public interest. Because it rewards systems more per kWh the higher their efficiency, it has driven installed systems to become more and more efficient. This has generated greater societal benefits through the reduction of CO₂ emissions and criteria pollutants, which is the goal of the APS. Any revision to the AEC market or APS eligibility should accurately account for the prior and ongoing achievements of program participants. We support many of the important structural changes to the AEC market in the DOER Straw Proposal, but also strongly urge the DOER not to abandon its methodology of rewarding CHP based on its actual performance.

CHP has the ability to efficiently and cost-effectively reduce emissions while providing ancillary services to the electrical grid including resiliency and reliability. Additionally, as the grid evolves to support additional renewables in furtherance of GHG reduction mandates, CHP can be leveraged to provide valuable grid services in applications that go beyond baseload power and to enable deeper renewable energy integration. Given the importance of CHP today, and the potential role of CHP in a clean energy future, we urge MA DOER to continue providing incentives for CHP facilities. Additionally, in any revisions to the current incentive structure, we recommend DOER adopt a technology-neutral framework that compensates technologies capable of cost-effectively reducing emissions with fair, measured, and verified payment for performance. Doing so is essential to realizing the greatest amount of carbon reduction in the fastest and least expensive manner in Massachusetts.

Changes to the Percentage Requirement and the Alternative Compliance Payment

We applaud the DOER's decision to increase the ACP as well as to increase the percentage requirement. Revisions to the program increase the obligation of load serving entities to secure 7.5% of load initially in 2023. That requirement increases over time at 0.25% per annum. The policy commitment to increased electrification is sure to provide an additional stimulus to demand over time.

High Efficiency, Environmentally Superior, Resilient CHP Demonstrably Delivers GHG Reductions.

Solar fully supports the GHG reduction goals of Massachusetts and avidly embrace the roadmap to statewide decarbonization across all sectors. For that very reason we urge that MA not abandon CHP as long as it continues to deliver measured, verified GHG reduction benefits. In its consideration of the future of the MA APS there should not be an arbitrary phase out of applications, systems and technologies that are demonstrably delivering GHG reductions. Instead, the guiding principle should be to create an incentive structure that rewards empirically verifiable GHG reductions, preferably in the most cost-effective manner.

Further, high efficiency, environmentally superior, and economically advantageous CHP has historically delivered significant GHG reductions and will continue to do so for years ahead. CHP end users state that their confidence that CHP is beating the grid each and every day. Some of our customers have publicly stated that when their CHP no longer beats the grid emissions that they will turn it off. This is exactly the type of behavior that the MA DOER ought to be incenting with its policy.

CHP Meets GHG Reduction Goals in a Cost-Effective Manner

We ask that in its deliberations, the MA DOER promote GHG reduction goals with attention paid to the cost-effectiveness of the various qualifying technologies. In particular, we would urge that technologies and systems delivering GHG reductions at an attractive price point not be abandoned prematurely and/or arbitrarily.

Under the MA APS as it operates today there are a number of alternative qualifying technologies. Across this spectrum of qualifying technologies, there is a range of total societal cost of GHG reductions. This range can be determined with some significant precision based on empirically verifiable measurement and transparent methodology. MA DOER should perform the requisite analysis to determine which qualifying technologies are capable of delivering the most cost-effective reductions in GHG emissions. Accordingly, technologies that promote GHG reductions at the lowest societal cost should continue to be incentivized.

Ancillary and Uncompensated Benefits of CHP

When comparing alternatives of reasonable equivalence for meeting GHG reduction goals, MA DOER ought not to lose sight of the variability in significant positive ancillary benefits that are achievable across the various qualifying technologies. For instance, in addition to reduced emissions, CHP provides a host of often uncompensated benefits. Properly designed and operated CHP provides resiliency for critical infrastructure. There are countless examples in

MA, the Northeast, nationally and internationally of hospitals, colleges and universities, water / wastewater treatment plants and other recognized critical infrastructure sites implementing CHP as a resiliency measure. As MA anticipates and plans for greater frequency of adverse weather events the value of resiliency is undoubtedly increasing and that value accelerates at a greater rate into the future.

Furthermore, CHP has mitigated the impacts of many natural disasters and emergencies by keeping critical facilities operating and running with minimal interruption. CHP at multifamily buildings and campuses have historically provided heating/cooling/power support for vulnerable and low-income populations in time of emergencies, thereby partly mitigating the disproportionate impact that outages have on low-income populations. The operation of CHP during outages of extended duration permits vulnerable seniors, many of whom are unable to evacuate, to shelter in place.

CHP has also been used to meet distribution needs instead of spending ratepayer dollars on traditional grid infrastructure. For instance, more than a decade ago, in a series of nationally innovative pilots, the State of Massachusetts and the utilities experimented with the utilization of strategically located DERs to reduce T&D capital costs and operating expenses. Leveraging learnings from innovations in MA, RI and elsewhere, Con Edison developed the successful Brooklyn Queens Demand Management (BQDM) program to delay investments in the grid, including a \$1.2 billion substation upgrade. An ongoing Non-Wires Alternatives (NWA) program was built upon these foundational programs.

Undoubtedly, CHP has demonstrated its ability to improve resiliency, mitigate the impacts of a disaster, provide reliability during grid outages all while delivering energy cost savings, greater efficiencies, and reduced emissions. Moreover, with the progression of time, CHP is becoming an ever more dynamic asset serving the grid while also enabling the penetration of higher levels of intermittent renewables. As the grid evolves, there is an increased need to ensure the stability and reliability of the electric power system. Importantly, according to the DOE, there is significant potential for CHP systems to support grid modernization by providing grid reliability, customer resilience, energy efficiency, locational value, affordability, and emissions reductions. Given this potential, the CHP industry, its key upstream and downstream suppliers, and the US DOE, are in various ways pursuing product and process innovations making CHP an ever more flexible resource.

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program was built upon these foundational programs. The CHP industry, its key upstream and downstream suppliers, and the US DOE, are in various ways pursuing product and process innovations making CHP an ever more flexible resource. With the progression of time CHP is an ever more dynamic asset serving the grid and enabling the penetration of higher levels of intermittent renewables.

When comparing alternatives of reasonable equivalence for meeting GHG reduction goals, MA DOER ought not to lose sight of the variability in significant positive ancillary benefits that are achievable across the various qualifying technologies.

Technology Neutrality

In all of its determinations NECHPI urges that MA DOER employ a framework that supports a technology neutral approach to meeting the GHG reduction targets. Stated alternatively, a guiding principle should be incenting the desired outcomes, not choosing particular technologies or systems. Solar fully embraces the need to aggressively address the existential threat society faces with climate change. Essential to mitigating climate change is to fundamentally transform the generation, transmission, delivery and consumption of electric power and thermal energy in our buildings, offices, homes, factories and businesses. If CHP provides measured, verified GHG reductions that advance this imperative it should be compensated.

Utilize Methodologies, Protocols and Best Practices of Trusted Experts

Fair, measured, and verified payment for performance is vital to realizing the greatest amount of carbon reduction in the fastest and least expensive manner in Massachusetts. Key to this is utilizing methodologies, protocols and best practices as understood and accepted by unbiased, arms-length experts like the U.S. Environmental Protection Agency (US EPA).

The US EPA Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans (SIPs and TIPs) provides overall guidance on how to estimate and account for emission reductions from energy efficiency and renewable energy policies and programs, including CHP. Specifically, Appendix I: Methods for Quantifying Energy Efficiency and Renewable Energy Emission Reductions provides a detailed discussion on the approach to quantify avoided or displaced electric generating unit emissions from energy efficiency and renewable energy programs and projects, including the use of the eGRID non-baseload factors as a first cut estimate of displaced marginal grid generation emissions.¹

¹ <https://www.epa.gov/statelocalenergy/quantifying-multiple-benefits-energy-efficiency-and-renewable-energy-guide-state>

Additionally, the US EPA provides additional and updated guidance on accounting for offset grid emissions in their publication Quantifying the Multiple Benefits of Energy Efficiency and Renewable Energy: A Guide for State and Local Governments. In particular, Part 2 Chapter 4 provides methodology for quantifying the emissions benefits of energy efficiency and renewable energy programs and projects, including an introduction to AVERT as a more accurate approach to estimating displaced marginal generation emissions.²

Third, US EPA's June 2021 Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems provides US EPA's guidance on calculating fuel and CO₂ emissions savings from CHP based on applying the guidance from the above three documents to CHP projects specifically.³

CHP provides a significant CO₂ savings relative to current Massachusetts grid emissions. The NE-ISO Load-Weighted Marginal Unit (LMU) marginal emission rate for 2018 was 745 lbs. CO₂/kWh, and the eGRID Non-Baseload emissions rate for the ISONE, which is used to calculate CO₂ savings from Mass Save projects, is 931 lbs. CO₂/kWh. According to a 2019 study by ICF, *As the Grid Gets Greener, Combined Heat and Power Still Has a Role to Play*, CHP emissions are estimated at 652 lbs. CO₂/kWh when accounting for offset boiler emissions. Using either 745 lbs. CO₂/kWh or 931 lbs. CO₂/kWh, CHP provides a significant CO₂ savings, and will until marginal grid emissions are drastically reduced.⁴

This savings relative to marginal grid emissions, combined with CHP's high capacity factor, leads to significant CO₂ savings, even compared to the same MW of installed wind and solar. According to a study by Entropy Research, LLC. 10 MW of CHP with an 85% capacity factor can provide 33,533 tons of CO₂ savings compared to eGRID non-baseload emissions on an annual basis. For comparison, the same study found that 10MW of solar with an average capacity factor of 26.1% saved 17,159 tons of CO₂ annually, and 10MW of wind with an average capacity factor of 37.4% saved 24,501 tons of CO₂ annually.

Importance of Mid to Long Term Approach

In addition to the urgent need for immediate carbon emissions reductions, MA DOER's assessments in this proceeding must also take account of future needs for distributed energy flexible resources (DEFR) that can respond to the intermittency of renewable generation, and will be essential to grid reliability and stability for years into the future. Zero carbon CHP is a DEFR that exists today, with a variety of forms of renewable CHP currently in operation. With

² https://www.epa.gov/sites/production/files/2018-07/documents/mbg_2-4_emissionshealthbenefits.pdf

³ https://www.epa.gov/sites/default/files/2015-07/documents/fuel_and_carbon_dioxide_emissions_savings_calculation_methodology_for_combined_heat_and_power_systems.pdf

⁴ https://www.icf.com/-/media/files/icf/white-paper/2019/icf_chp_has_a_role_to_play_august_2019_web_wp.pdf

accelerated technology research, the CHP industry will deliver faster, better, and cheaper on-demand zero carbon power sources for decades to come.

While most of the CHP plants installed operate on natural gas, all of the new Solar equipment is capable of running on hydrogen and biogas fuels in order to further reduce and potentially eliminate carbon emissions. Solar has extensive well proven operating experience with alternative low/no carbon fuels. Solar equipment has been able to operate on hydrogen and biogas fuels for over 35 years and has millions of hours of operating experience on these types of fuels. As such we would highly encourage the MA DOER to help facilitate the introduction of low/no carbon gaseous fuels into the natural gas supply system to further reduce carbon emissions.

Other methods for achieving low or no GHG emissions with CHP include emissions capture and usage, as well as capturing and processing waste that would otherwise generate methane emissions. Increased requirements for food recycling can be much more productively employed in a CHP context, using anaerobic digestors to generate biogas and fertilizer from the food waste, and using the biogas in CHP systems that support the digestion process and other on-site energy needs.

CHP is agnostic to the input fuel source, and low and no-carbon CHP exists today in many configurations with growing applications.

Conclusion

CHP systems participating in the APS program provide a suite of benefits to ratepayers. They reduce the emission of CO₂ and other criteria pollutants, as well as providing on-site electric and thermal resiliency. CHP is a tested, proven, economic, reliable and clean technology that, importantly, exists today and is readily deployable. Utilizing renewable and low carbon CHP can be done, because it has been done, and does not require incubation or development to be implemented at scale.

Solar is committed to supporting Massachusetts' GHG reduction goals, and support many of the changes to the APS in DOER's Straw Proposal. Changes in the Alternative Compliance Payment (ACP) and the increase in the APS percentage requirement that will support prices and reduce volatility, furthering the investment in and deployment of clean power and heating technologies. If deployed in a technology-agnostic manner that provides compensation based on performance and real emissions reductions, Massachusetts can continue to realize GHG reductions and quickly accelerate their rate of reduction.

In summary we would like to congratulate the MA DOER on its positive impact to the environment and the energy sector through the establishment of the APS over 12 years ago. The APS has clearly demonstrated that CHP reduces carbon emissions compared with electrical grid supply combined with traditional thermal energy generation.

As such CHP should continue to be an integral part of the APS until grid supplied electricity and thermal generation can consistently provide resilient energy to critical facilities with measurable lower carbon emissions on a year after year basis. It is therefore very important that CHP emission be accurately compared to standard electric and thermal generation. We submit that CHP carbon emissions continue to be measured against the combination of marginal electrical grid supply and traditional thermal energy generation (boilers, chillers, heaters, etc.).

Finally, we respectfully request that the MA DOER to continue to recognize and promote the high efficiency advantages of CHP which provides a combination of electrical and thermal energy with very low emissions. On site generation provides critical facilities with secure sources of power that can continue to operate during electrical grid power outages. It also provides voltage and frequency support of the electrical grid in constrained areas during time of heavy power usage.

Your thoughtful review and consideration of our comments above is greatly appreciated. Should you require any further information, please contact the undersigned.

Very truly yours,

Solar Turbines Incorporated

A handwritten signature in dark ink, appearing to read 'Johnathan Coleman', is written over the printed name.

Johnathan Coleman, P.Eng.
Principal Engineer and
Senior Account Manager Power Generation