NECHPI
NORTHEAST CLEAN HEAT AND POWER INITIATIVE

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Ms. Samantha Meserve
Deputy Director, Renewable and Alternative Energy Division
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Boston, MA 02114

RE: 2020 APS Minimum Standard Review Comment

Dear Ms. Meserve,

The Northeast Clean Heat and Power Initiative (NECHPI) respectfully submits the following comments in response to the 2020 APS Minimum Standard Review. MA DOER has solicited comments to several stakeholder questions. To assist in the APS review, DOER hired an independent consultant, Daymark Energy, LLC, to undertake an assessment of the APS program.

DOE states that the primary areas of focus of the review include, but are not limited to:

- an examination of the costs and benefits of the program to ratepayers,
- an examination of the effectiveness of the program in meeting the energy and environmental goals of the Commonwealth, and
- an evaluation of whether the Minimum Standard or its rate of increase should be adjusted.

These comments address Stakeholder Questions with a particular focus on the three primary areas identified above by MA DOER. In addition, we comment upon several aspects of the Daymark Report that are relevant to understanding the benefits and costs of Combined Heat and Power (CHP) systems. We urge DOER to revisit some of the more controversial assumptions pertaining to CHP that are foundational to key conclusions reached about CHP in the Daymark assessment as well as to conduct a comprehensive analysis of the full suite of CHP net benefits as they compare to other APS eligible technologies and systems.

Appropriately designed CHP technologies and systems are tested, proven, reliable, and clean, 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 APS is a smartly designed incentive scheme insofar as higher payments are made to the most efficient resources.

There are several assertions in the Daymark Alternative Portfolio Standard Review that are highly controversial. We urge that DOER revisit the empirical basis for the following claims:

- that there are no CO_2 savings from CHP,
- the capital costs of CHP systems assumed by the Daymark report,
- the Operations and Maintenance costs of CHP systems assumed in the report,
- the expected years to payback assumed in the report,
- the level of incentive that the CHP systems would receive from other (Non-APS) programs, that assumed in the report, and to provide a more comprehensive picture, and
- list the full suite of environmental, societal, ratepayer, jobs and economic development benefits provided by CHP vis-à-vis other qualifying APS technologies.

The decision to prioritize resource technologies or continue CHP's full participation in the Alternative Portfolio Standard (APS) must be made on the basis of full and accurate information. The information provided by Daymark in the Alternative Portfolio Standard Review, with respect to CHP, is an insufficient basis for making decisions on CHP's role in the program. The report uses electric and natural gas emissions factors that are different from those used by the utilities and prescribed by the Massachusetts Department of Environmental Protection. The Daymark report uses a natural gas emissions factor that considerably overstates on-site combustion emissions, and an electric emissions factor that understates emissions from grid electricity. Both of these work to the detriment of CHP and do not describe its actual environmental benefit.

The Daymark report also assumes a total capital cost of CHP facilities that are not congruent with the experiences of sites that have invested in CHP. We urge that decisions on the continued economic support of CHP be made based on actual project data over the last 5 to 10 year period. This should include verified empirical information on initial capital costs and ongoing operations and maintenance (O&M) costs.

The incentive structure for CHP in the APS is 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 CO_2 emissions and criteria pollutants, which is the goal of the APS. Any revision to the AEC market of APS eligibility should accurately account for the prior and ongoing achievements of program participants. We will address our concerns with how the Daymark report does this in answering the following questions posed by the Massachusetts DOER.

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1. **What are the benefits of the APS program to ratepayers, including but not limited to economic, environmental, and societal benefits?**

CHP systems participating in the APS program provide a suite of benefits to ratepayers. They reduce the emission of CO_2 and other criteria pollutants, as well as providing on-site electric and thermal resiliency. To enter into the record empirical information. We suggest as one resource examining the benefits that are quantified for CHP projects that have received the Mass Save incentive. Several of the CHP benefits are measured and verifiable. The DOER could include the suite of CHP benefits that are identified by projects obtaining the Mass Saves incentive. In addition, we urge that DOER utilize program information on CO_2 reductions from CHP from Mass Saves funded projects. Another, albeit anecdotal, data resource are the several US EPA CHP Award winning projects based in Massachusetts that have self-certified significant CO_2 reductions as well as dozens of Massachusetts businesses that have made public statements on the CO_2 reductions from their CHP investments.

We feel that the conclusion that CHP has no CO_2 emission benefit has been reached in error. It is our understanding that the Daymark report used the 2017 NE ISO All LMU Time-Weighted emissions rate of 654 lbs. CO_2/kWh for their assumption of offset grid emissions. The Time-Weighted marginal emission rate is assumes that when there are multiple marginal resources within a time interval, they split the load equally. However, when more than one resource is marginal, the system is typically constrained and marginal resources likely do not contribute equally to meeting load across the system. The NE-ISO added a new method for calculating marginal emission rates for 2018, which incorporates the percentage of system load a marginal unit can serve. This method, referred to as the Load-Weighted LMU approach, is based on the assumptions used by the ISO New England Internal Market Monitor (IMM) to report the percentage of the total system load that can be served by marginal units of a particular fuel or unit type. The 2018 Load-Weighted emissions rate is 745 lbs. CO_2/kWh.

Further, the EPA and Massachusetts DEP recommend using the eGRID Non-Baseload emissions rate for the NE ISO, which is used to calculate CO_2 savings from Mass Save projects. The eGRID 2018 Non-Baseload emissions rate for the New England subregion is 931 lbs. CO_2/kWh. Using either 745 lbs. CO_2/kWh or 931 lbs. CO_2/kWh has a drastic effect on the potential CO_2 savings of CHP systems, certainly making them non-zero.

On counting CHP emissions, Daymark utilized a lifecycle emissions rate for natural gas CHP of 158.1 lbs. CO_2/MMBtu. However, none of the eGRID emissions estimates discussed above include lifecycle emissions, only combustion emissions. A comparable emissions rate for CHP would be 116.9 lbs. CO_2/MMBtu. Combined with the corrected grid emissions rates, CHP can provide substantial CO_2 savings.

CHP systems also provide savings in the wholesale energy and capacity markets, and by decreasing energy imported from outside Massachusetts, keeping dollars in the state economy. CHP systems can reduce transmission and distribution costs, both for reduced capital expenditure in congested areas and in reduced O&M costs, benefiting ratepayers and increasing grid reliability. Investing in CHP also provides direct and secondary economic benefits to the state economy through industry design and construction jobs, as well as service jobs.

We suggest that the FULL picture of the benefits of CHP, in the APS program, vis-à-vis all other qualifying technologies out to recognize (in addition to CO_2 reductions) these important ratepayer and societal benefits

The CHP component of the APS program provides a suite of benefits to ratepayers that include the following:

- Reduction in criteria pollutants,
- Reduction in CO_2 (greenhouse gas) emissions,
- Power and Thermal Energy **resiliency** for appropriately designed CHP systems,
- Economic multiplier benefits (importing less energy) keeping dollars in MA economy,
- Local job creation, direct industry jobs, service jobs,
- Critical infrastructure support including health-care, hospitals, research, pharmaceuticals, key supply chain products and services,
- Energy and capacity savings,
- Reduction in utility transmission and distribution (T&D) capital costs benefiting ratepayers,
- Reduction in utility T&D operating and maintenance costs benefiting ratepayers, and
- Reduction in local T&D congestion, enhancing the network reliability.

2. What are the costs of the APS program to ratepayers, including but not limited to economic, environmental, and societal costs?

The costs of the APS program to ratepayers are the increased cost of electricity that accrue as a consequence of the Alternative Portfolio Standard (APS) obligation. This is true for electric (or natural gas) utility programs that provide incentives to accelerate the market penetration of renewable energy, clean energy or energy efficiency technologies and systems. A fair accounting of the costs of the APS program must take into account the offsetting APS program benefits described in the answer to Question 1 above.

3. **Do you believe the APS program should prioritize technologies which provide the most benefits, such as greatest greenhouse gas emissions reductions?**

The APS should prioritize technologies that provide the most cost-effective benefits, that is, quantified benefits delivered on a dollar-per-benefit basis. Further, the APS program should *comprehensively* assess the entire suite of benefits provided by the different technologies that are eligible for the APS. Not all eligible technologies deliver the same set of benefits. The APS program might prioritize greenhouse gas reductions but should not ignore, for example, resiliency benefits, or avoided T&D capital costs, or reductions in local grid congestion

The APS program already prioritizes CHP projects based on their total efficiency, and therefore by their greenhouse gas emissions reductions. This is shown in the table below.

Depends on the sale price per AEC and the HHV net electrical and thermal efficiency of the system – this example based on a gross value of $19 per AEC.

EFFICIENCY			c/kWh
Electric	Thermal	Overall	
0.25	0.35	0.6	1.48
0.3	0.3	0.6	1.8
0.25	0.4	0.65	1.85
0.3	0.35	0.65	2.08
0.3	0.4	0.7	2.45
0.25	0.45	0.7	2.3
0.35	0.4	0.75	2.83
0.25	0.5	0.75	2.75
0.3	0.5	0.8	3.38

Source: The Massachusetts APS Incentive for CHP, Massachusetts DOER 2016

While the State might determine that the greatest greenhouse reductions should be prioritized it would be imprudent to ignore important ratepayer and societal benefits that are provided by CHP and, not necessarily provided at the same level or at the same cost, as other qualifying APS technologies.

We suggest consideration of a table of benefits, as demonstrated by the illustrative table below, addressing the level of and the delivered cost of a suite of ratepayer and societal benefits provided by the following APS qualifying technologies.

a. The unit cost to ratepayers and society generally per unit of greenhouse gas emissions reductions, and
b. Additional ratepayer and societal benefits that are provided in a widely varying range unit costs

Qualified Technologies	*Avoided CO_2 per MWh*	*Avoided T&D Capital Expense per MW*	*Avoided T&D O&M Expense per MW*	*Resiliency Benefit per MW*	*Other Benefits*
CHP and Fuel Cells					
Natural Gas CHP	XX	XX	XX	XX	XX
Digester Gas CHP	XX	XX	XX	XX	XX
Natural Gas Fuel Cell	XX	XX	XX	XX	XX
Thermal Technologies					
Solar Thermal – Small	XX	XX	XX	XX	XX
Solar Thermal - Intermediate	XX	XX	XX	XX	XX
ASHP - Small	XX	XX	XX	XX	XX
ASHP – Intermediate	XX	XX	XX	XX	XX
GSHP - Small	XX	XX	XX	XX	XX
GSHP - Intermediate	XX	XX	XX	XX	XX
Biofuels Aggregations					

Example of Benefits Table for comparison of APS Qualified Technologies

5. Is the current APS minimum standard and the annual rate of increase adequate? Please include details and any data supporting why or why not, where possible.

Given the recent collapse in the price of Alternative Energy Credits (AECs) it is apparent that there is an egregious imbalance between the supply of, and the demand for, AECs. On the supply side, there has been a significant increase in technologies eligible to supply the market. On the demand side, there has been no countervailing reaction to the rapid increase in supply.

This has created a drop in prices from the $20 - $22/MWH range to ~ $5/MWH. The volatility considerably blunts the market incentive impacts of the APS program. It is imperative that this be corrected.

6. Do you anticipate a growth or decline in the supply of AECs in the APS program over the next 5 years? 10 years? If so, how would you quantify this increase in growth rate? Please include details and any data supporting your conclusions.

We expect a growth in the supply of AECs in the APS program over the next 5 years and 10 years. We urge that MA DOER revisit the assumptions made in the Daymark report on the expected annual rate of growth in AECs supplied by CHP systems. The projection of CHP supply in the Daymark report is significantly biased by the addition of two extraordinarily large projects (Kendall Square 216 MW and MATEP 68 MW). Removing these two systems, that together account for nearly 70% of the MWs of that installed CHP capacity eligible for the MA APS program presents a more accurate picture of what future CHP additions are likely to be over the next 5 to 10 years. With these two projects removed and based on the history of project additions, the projected CHP annual installed capacity additions is likely to be in the 10-15 MW range per year.

7. Are there modifications to the APS program that could be made to reduce the volatility of the APS market?

Yes, there are several potential modifications that to APS program that could be made to reduce the volatility of AEC prices, and reducing volatility ought to be a primary objective of this proceeding. Volatility in the APS market significantly blunts the incentive benefit of the program, and the efficacy of the APS as a tool for accelerating renewable and clean energy investments is hampered by market volatility.

In the short term, we suggest that the APS adopt a price floor. This would put a lower bound on the projections that investors and financiers utilize when considering a qualified APS investment.

We then urge the Massachusetts DOER to adopt a market correction mechanism that would adjust the market demand to the market supply by scaling the obligated purchase requirement of AECs to their availability. As all technologies continue to proliferate in the AEC market a market correction mechanism, rather than an arbitrary “set and forget” annual percentage increment that takes effect irrespective of market demand and supply conditions, will ensure greater market stability.

8. Has the APS incentive had an impact on the decision of system owners to invest in APS eligible technologies? Why or why not.

Yes, the APS incentive is important for end user sites interested in investing in CHP. At one time, with the AECs returning approximately $20/MWH, this additional revenue stream helped end-user sites at hospitals, nursing homes, large multifamily complexes and manufacturing sites to invest with the confidence that a significant amount of the O&M costs of CHP would be covered by the AECs.

As noted above, properly designed and configured CHP systems can offer a significant resiliency benefit that is not provided by most other qualifying APS resources. According to the U.S. Department of Energy's Combined Heat and Power Installation Database[1] there are CHP facilities serving critical infrastructure including

- Nursing Homes SIC 8051
- Hospitals SIC 8062
- Wastewater Treatment SIC 4952
- Correctional Facilities SIC 9223
- Colleges/Universities SIC 8221

The investments at facilities of this type, providing critical services that are clearly in the public interest, are supported by the additional revenue streams from the APS program. We urge MA DOER to consider this resiliency benefit as well as other benefits identified in the answer to Question 3, as you evaluate the continuing role of CHP in the APS program.

12. Is there any additional information you believe DOER should consider in its 2020 APS Minimum Standard Review?

Please see the list of CHP site testimonials in Appendix 1 that have brought proven benefits to the State of Massachusetts and value the support the State has given them in their installation and operation of CHP. Please also see the calculations of CHP vs Grid CO_2 emissions presented in Appendix 2.

Sincerely yours,

John Moynihan

John Moynihan
Chair, NECHPI Board of Director

1 U.S. Department of Energy Combined Heat and Power Installation Database | Facilities in MA (icfwebservices.com)

Appendix 1 – Company Testimonials

Please find the following supporting demonstrations and testimonials of CHP systems operating in Massachusetts.

EPA Energy Star CHP Award

University of Massachusetts Medical School, Worcester Campus — Worcester, Massachusetts

Recognizing the importance of highly efficient and resilient energy production, the UMass Medical School (UMMS) relies on CHP to help power its Worcester, Massachusetts campus, which hosts over 7,300 employees and 2,900 visitors daily. This Energy Star CHP Award recognizes UMMS's third and most recent CHP expansion: the addition of a 7.5 MW natural gas-fired Solar Turbines combustion turbine generator, with the assistance of Waldron Engineering & Construction.

With an efficiency of 73 percent, the new CHP unit requires approximately 20 percent less fuel than conventional separate electricity and steam production. The reduced fuel use **avoids emissions of more than 21,000 tons of carbon dioxide annually**, equal to the emissions from the generation of electricity used by more than 2,800 homes. Moreover, by generating electricity on site, the system strengthens the regional transmission and distribution infrastructure.

The expanded power plant generates up to 90% of the campus's electricity needs. Because the plant's electrical output is responsible for less carbon pollution than grid-supplied electricity, the facility receives substantial payments through Massachusetts' Alternative Portfolio Standard program with the assistance of their representative, Green Harbor Energy. The plant reduces the facility's cost of energy services by approximately $3 million annually.

Medical Area Total Energy Plant (MATEP) LP

This award recognizes the Medical Area Total Energy Plant (MATEP) LP for the superior efficiency of its 46 MW CHP system that produces steam, chilled water, and electricity for the Longwood Medical and Academic Area (LMA).

A key driver for the development of the CHP system was to increase energy reliability by decreasing dependence on the local utility—particularly important because of the critically important missions of the medical facilities it serves. The MATEP system is designed to operate and remain fully functioning during a power outage, thus ensuring that critical operations at the hospitals and research centers served by MATEP can continue without interruption in the event of disruption to the local power grid. Located in Boston, Massachusetts, the LMA is home to five hospitals as well as numerous biomedical and pharmaceutical research centers and Harvard Medical School-affiliated teaching institutions. The LMA includes more than 1,800 patient beds and serves 103,000 inpatients and more than 2.4 million outpatients per year.

Two natural gas-fired combustion turbines equipped with heat recovery steam generators power the CHP system, producing up to 360,000 pounds of steam per hour and 24 MW of electricity. The steam is used in steam turbines to generate an additional 22 MW of electricity and also to heat water for space heating and other uses. In addition, several chillers use part of the steam output to produce chilled water for space cooling.

With an operating efficiency of 75 percent, the CHP system requires approximately 24 percent less fuel than supplying electricity from the grid and producing steam with a boiler. **The system also prevents emissions of air pollutants, including an estimated 117,500 tons of CO_2 emissions annually,** equal to that from the generation of electricity used by more than 13,000 homes.

MATEP is owned by Morgan Stanley Infrastructure Partners and Veolia Energy North America, a partner in EPA's CHP Partnership.

University of Massachusetts Amherst

In December 2008, the University of Massachusetts Amherst began operation of a 14 MW CHP system. The system represents a major milestone for the university and is part of a multi-year initiative to reduce fuel consumption and minimize its environmental footprint. Activities ranging from the replacement of old light fixtures to the $133 million investment in the CHP system are the reason the university has reduced overall energy consumption by 21 percent since 2004.

A 10 MW Solar combustion turbine, a heat recovery steam generator, a 4 MW steam turbine and three natural gas-fired boilers replace the university's nearly 80 year-old coal-fired boilers. The CHP system produces nearly all of the electric and steam demand for a campus comprising over 200 buildings and nearly 10 million gross square feet of building space. Interestingly, a unique and environmentally progressive characteristic of the system has little to do with energy conservation; 160,000 gallons of treated effluent per day from the local wastewater treatment plant is used to generate steam. The effluent replaces the drinking water that would typically be used by such systems.

With an operating efficiency of nearly 75 percent, the CHP system requires approximately 18 percent less fuel than the separate production of thermal energy and electricity. Based on this comparison, **the CHP system prevents an estimated 26,600 tons per year of CO_2 emissions**, equivalent to the emissions from more than 4,600 passenger vehicles.

EPA is proud to recognize the outstanding pollution reduction and energy efficiency qualities of this project with a 2011 ENERGY STAR® CHP Award.

Bridgewater Correctional Complex Cogeneration Plant
(Awarded ENERGY STAR CHP Award October 1, 2009, at 2009 CHP Partners Meeting)
The Bridgewater Correctional complex consists of 785,000 square feet of living and working space on 14,900 acres. In 2006, the Commonwealth of Massachusetts Department of Correction began operating a 1,500 kW CHP system to support those facilities and an inmate population of over 2000 people.

The CHP system utilizes a Kawasaki natural gas-fired combustion turbine to generate nearly 80 percent of the complex's annual electricity demand. Equipped with Kawasaki XONON combustors, the NO_X emissions from the turbine are low enough to meet NO_X emission requirements without the need for add-on pollution controls.

Otherwise wasted heat is recovered from the turbine exhaust and used to produce steam to support the daily heating, cooking, cleaning, and domestic hot water needs of the complex. Operation of the CHP system also allowed the Department of Correction to shut down an old and more-polluting diesel engine generator.

With an operating efficiency of approximately 67 percent, the CHP system requires approximately 17 percent less fuel than typical onsite thermal generation and purchased electricity. Based on this comparison, **the CHP system effectively reduces CO_2 emissions by an estimated 3,600 tons per year.** This reduction is equivalent to the annual emissions from 600 passenger vehicles.

EPA is proud to recognize the outstanding pollution reduction and energy efficiency qualities of this project by presenting the **Commonwealth of Massachusetts Department of Correction** with a 2009 ENERGY STAR CHP Award.

Massachusetts Institute of Technology

- College campus and research Facility   44 MW Gas Turbines
- “The CUP’s efficiency and environmental gains will result from the installation of new and upgraded equipment as well as the switch to natural gas and the elimination of fuel oil use (except for emergencies). State-of-the-art emissions controls will contribute to the improvements. Starting in 2020, regulated pollutant emissions are expected to be more than 25 percent lower than 2014 emissions levels, and greenhouse gas emissions will be 10 percent lower than 2014 levels, offsetting a projected 10 percent increase in greenhouse gas emissions due to energy demands created by new buildings and program growth.”

Erving Industries, INC. (Erving Massachusetts)
- Pulp and Paper 6.36 MW Gas turbine
- “The CHP system is responsible for reducing carbon dioxide (CO_2) emissions by 21.6 million lb/yr and reducing grid-purchased electricity by 39 million kWh/yr.”

Boston Scientific Marlborough Campus (Marlborough Massachusetts)
- Research Facility 555 kW
- ”Boston Scientific evaluated the site and determined CHP was a good option because it would both save money and reduce the company’s carbon footprint.”

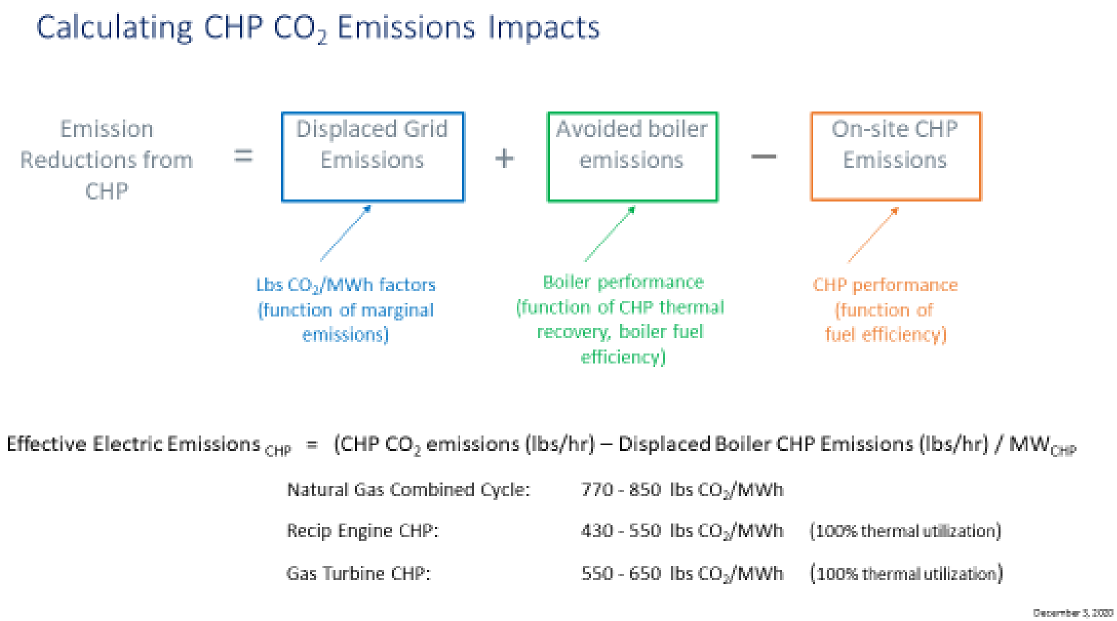
Cape Codder-Resort & Spa (Cape Cod, Massachusetts)

- Hotel 525 kW
- "The Cape Codder Resort & Spa has taken a measurable step towards a more positive impact on the environment, citing a 70% reduction in their carbon footprint after installing CHP."

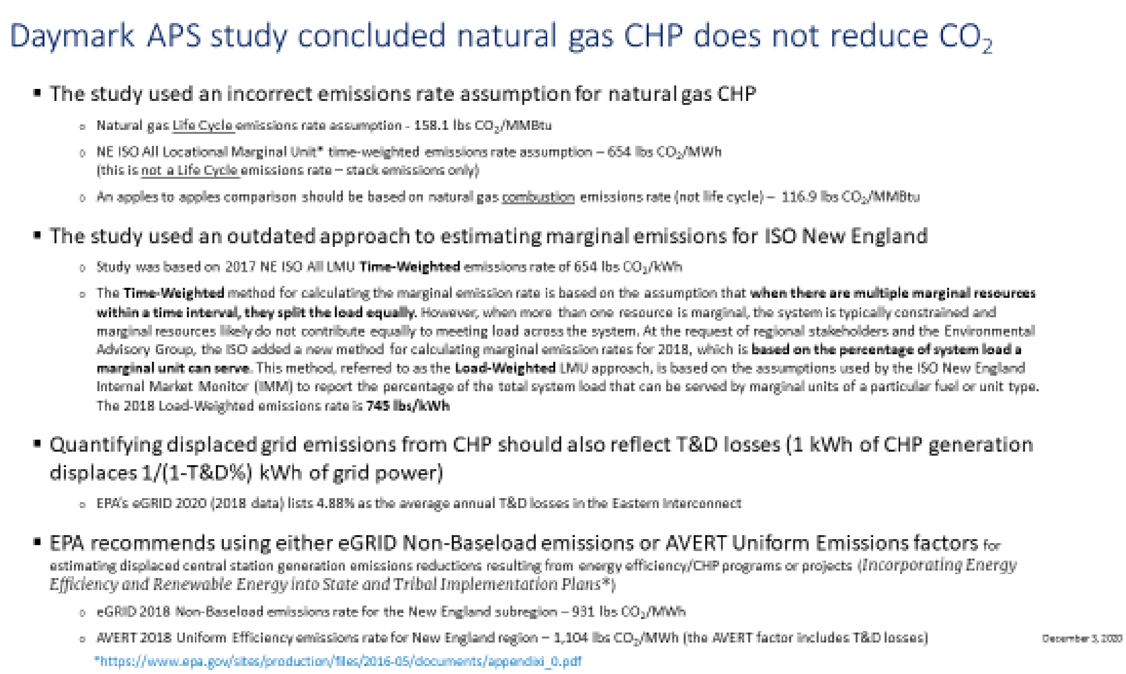
Seaman Paper (Otter River, Massachusetts)

- Pulp and paper 283 kW
- "30% NOx reduction and 95% SO2 reduction"

Appendix 2 – Comparative CO_2 Emissions of CHP and NE ISO



Source: Entropy Research, LLC. Bruce Hedman December 1, 2020 Bruce Hedman *bhedman.entropyresearch@gmail.com*



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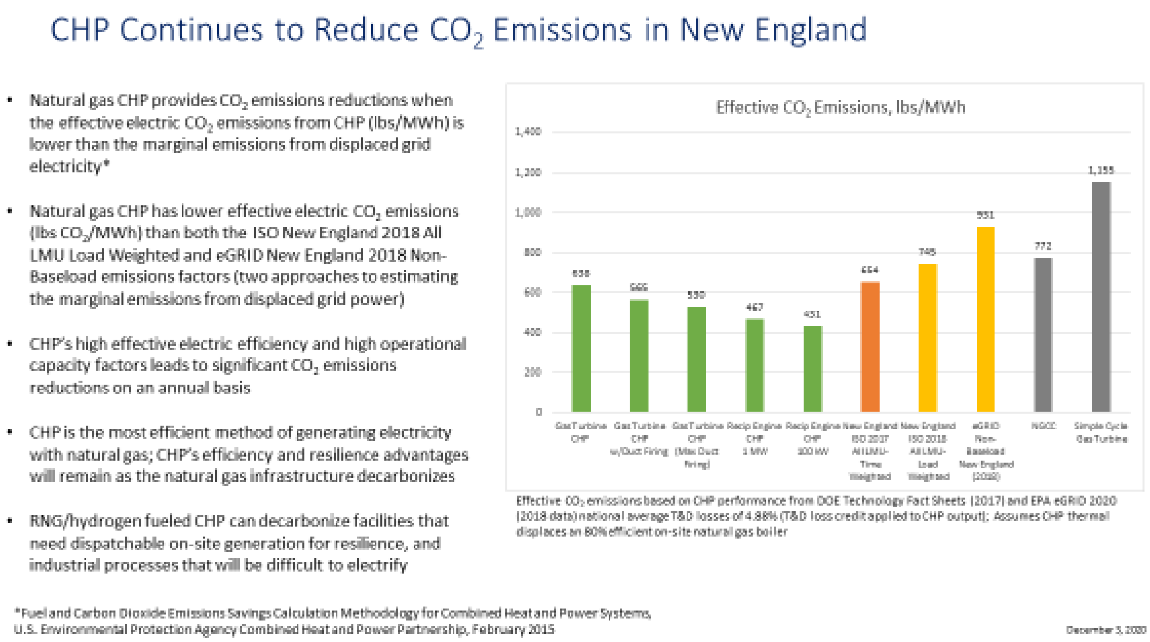

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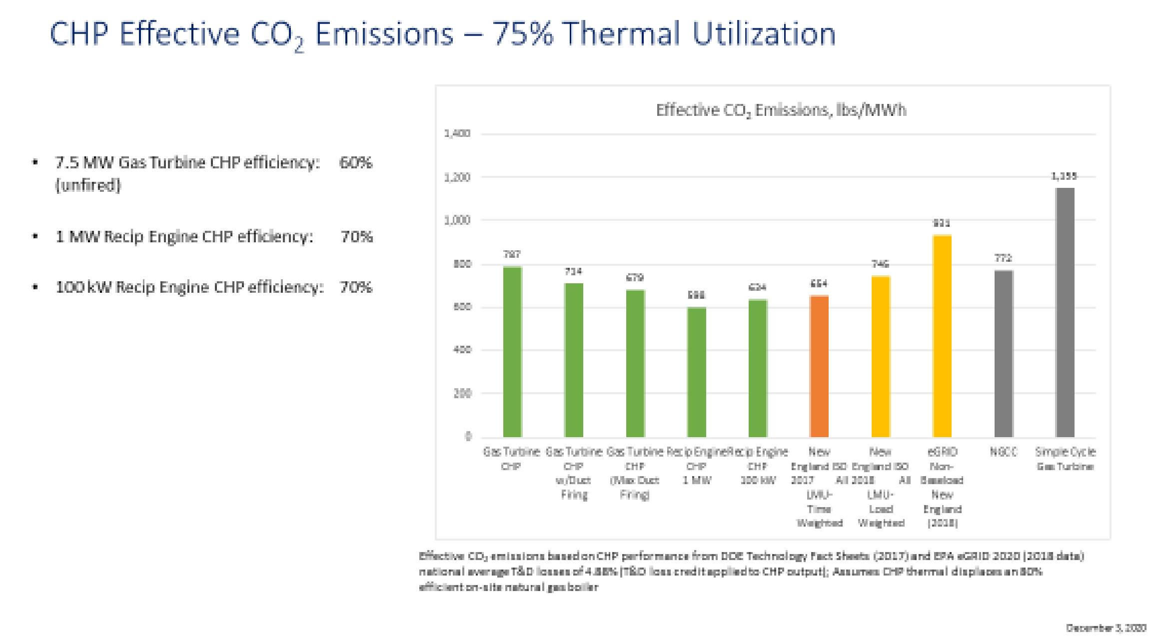

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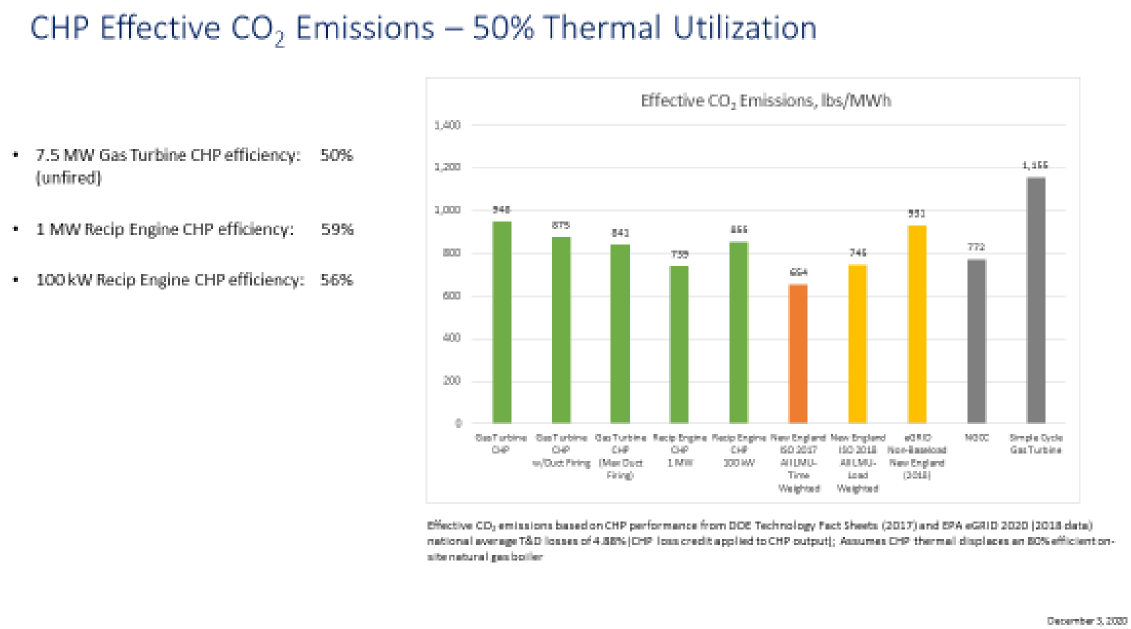

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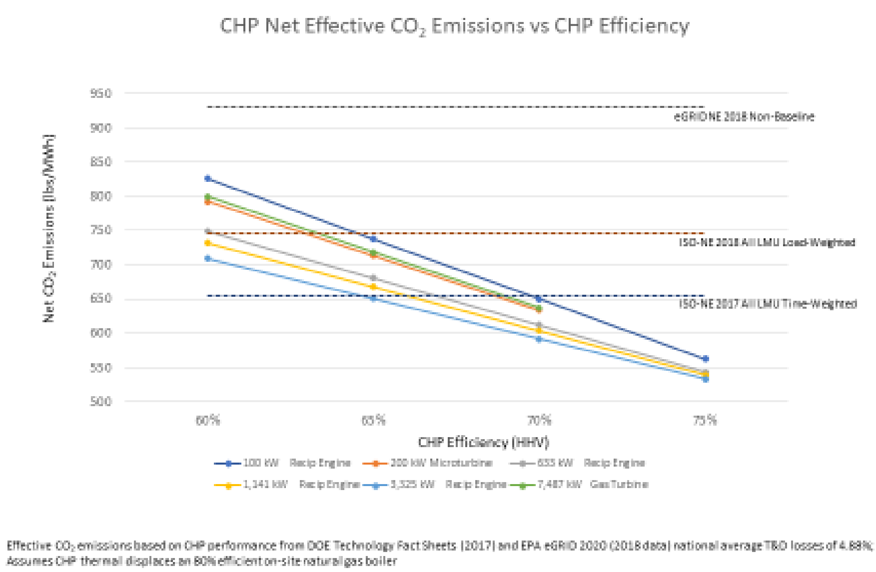

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CHP Net Effective CO_2 Emissions vs CHP Efficiency

Effective CO_2 Emissions Rate (lbs/MWh)		100 kW Recip Engine	200 kW Microturbine	633 kW Recip Engine	1,141 kW Recip Engine	3,325 kW Recip Engine	7,487 kW Gas Turbine	ISO-NE LMU 2017 Time-Weighted	ISO-NE LMU 2018 Load-Weighted	eGRID NE 2018 Non-Baseload
CHP Electric Output, kW		100	200	633	1,141	3,325	7,487			
Electric Efficiency (HHV), %		27.0%	29.8%	34.5%	36.8%	40.4%	29.2%			
Thermal Output, MMBtu/hr		0.67	0.90	2.78	4.32	10.67	36.3			
Net Overall Efficiency (HHV), %	60%	826	793	749	732	709	800	654	745	931
	65%	738	713	680	668	650	718	654	745	931
	70%	650	633	612	603	592	637	654	745	931
	75%	562		543	539	533		654	745	931
	80%	474		474	474	474		654	745	931

Effective CO_2 emissions based on CHP performance from DOE Technology Fact Sheets (2017) and EPA eGRID 2020 (2018 data) national average T&D losses of 4.88%; Assumes CHP thermal displaces an 80% efficient on-site natural gas boiler

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