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Samantha Meserve
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Massachusetts Department of Energy Resources
100 Cambridge St. Suite 1020
Boston, MA 02114

RE: 2020 APS Minimum Standard Review Comment

Dear Ms. Meserve:

The University of Massachusetts ("UMass") welcomes the opportunity to provide comment on the Alternative Energy Portfolio Standard ("APS") Program review being conducted by the Massachusetts Department of Energy Resource ("DOER").

UMass is a five-campus public research university system renowned for its academic programs, research, and adherence to its public service mission. UMass provides access to high-quality, affordable education to almost 74,000 undergraduate and graduate students across five campuses located in Amherst, Boston, Dartmouth, Lowell, and Worcester. As a public university, UMass has an obligation to the people of the Commonwealth to effectively manage and control its energy costs. As a public agency of the Commonwealth, UMass has an obligation to advance the policy goals of the Commonwealth including reducing greenhouse gas emissions from institutional operations per Executive Order 484.

Over the last 15 years, UMass has been able to significantly reduce greenhouse gas emissions from campus operations despite substantial growth in student enrollment and gross building square footage across the five campuses. Since 2005, UMass' total emissions from campus operations have fallen by over 20% while enrollment increased by over 40% and total gross building square footage across all campuses has increased by nearly 50%. This progress on reducing emissions despite the institution's growth has been enabled by a mix of fuel switching for campus heating, consistent investment in energy efficiency, and the adoption of onsite renewable electricity generation.

A key driver of UMass' emissions reduction has been the adoption of high-efficiency combined heat and power ("CHP") cogeneration plants at three of the five campuses. In 2009, UMass Amherst completed a new central heating plant with 15.5 megawatts ("MW") of electric cogeneration capacity that replaced the campus' 80-year old coal-burning power plant. In 2012, UMass Medical School in Worcester expanded and upgraded the campus' 35-year-old central heating and cooling plant, installing a new high-efficiency 7.5-MW gas-fired combustion turbine and heat recovery steam generator with advanced emissions and control systems. In 2015, UMass Dartmouth completed a new central heating and cooling plant with 1.6 MW of electric cogeneration capacity that replaced the campus' 40-year-old oil-burning central plant. These three CHP systems are registered as APS Alternative Generation Units and produce Alternative Energy Certificates ("AECs"), which provide an important revenue stream for UMass to help reduce energy budgets and to fund ongoing investment in energy efficiency measures and alternative energy systems on campus[1].

In addition to helping the University reduce its emissions footprint, CHP cogeneration has significantly improved utilities service reliability and resiliency on campus. UMass Amherst hosts technical intensive research activities that require uninterrupted utilities service with rigorous power quality standards. UMass Medical hosts a 400-bed hospital including critical care facilities, where service reliability is a must. The CHP cogeneration systems at UMass Amherst and UMass Medical are configured to island and maintain uninterrupted electrical service should the local power grid experience an outage, enabling each campus to continue operating without disruption to critical research and health care activities.

UMass is proud of the efforts the University has taken to date to help reduce emissions from campus operations while enabling high standards of utilities service reliability for a growing institutional footprint. However, this progress is not sufficient to meet the Commonwealth's long-term emissions goals. Executive Order 484 calls for all public agencies as a whole and, to the greatest extent feasible individually, to reduce emissions by 25% by fiscal year 2012, 40% by 2020 and 80% by 2050 relative to a fiscal year 2004 baseline. Despite highly efficient CHP processes at three of the five campuses, UMass will not be able to achieve future Executive Order 484 emissions

[1] For example, UMass Amherst used AEC sale proceeds to fund the installation of a behind-the-meter 1.32 MW/4 MWh lithium ion battery system on campus in 2019. UMass Amherst was awarded an Advancing Commonwealth Energy Storage ("ACES") grant from MassCEC for the battery system as part of the Commonwealth's flagship energy storage demonstration program.

targets without transitioning its energy sources and infrastructure to further decarbonize campus operations.

To evaluate how UMass can achieve the emissions and energy goals set forth in Executive Order 484, the University's five campuses have initiated long-term strategic planning studies to evaluate energy infrastructure and purchasing options to reduce absolute campus emissions from current levels while maintaining service reliability across electrical, heating, and cooling systems. While these studies are in differing stages of completion and have varying scopes of evaluation depending on each campus' location and operational needs, there are common findings and themes that have emerged across the studies.

First, opportunities for increased energy efficiency and conservation remain, especially for older campus buildings. These generally take two forms – (1) conversion to newer more efficient lighting, motor and monitoring and control technologies and (2) building envelop improvements to reduce heating and cooling energy use.

Second, the studies are producing the common conclusion that the campuses will not be able to continue purchasing and consuming conventional pipeline natural gas at current levels indefinitely if the long-term emissions goals in Executive Order 484 are to be achieved. The thermal energy produced from gas-fired boilers and CHP systems today will need to be transitioned over time to alternative heating systems and/or sources, which may include air-source heat pumps, ground-source heat pumps, biogas, liquid biofuels, or other new technologies still to be developed.

Third, transitioning to these alternative energy systems and sources will require much higher capital investment compared to the cost of maintaining the campuses' energy status quo, as the campuses' existing standalone gas-fired boilers (in the cases of UMass Lowell and UMass Boston) and gas-fired CHP (in the cases of UMass Amherst, UMass Dartmouth, and UMass Medical) were generally installed in the last 10 to 15 years and have substantial remaining useful life.

Lastly, any transition to decarbonized district energy systems will take years to complete based on the massive infrastructure changes required and to avoid disrupting the University's core educational mission, and in UMass Medical's case core health care mission. Consequently, a phased transition process will rely heavily on CHP cogeneration at UMass Amherst, UMass Dartmouth, and UMass Medical as the energy platform serving as the bridge between UMass' current energy infrastructure and UMass' future energy infrastructure while maintaining high standards of utilities service reliability for the University's operations.

Based on these findings, UMass sees three primary issues with the APS' current state and Daymark Energy Advisors' conclusions presented in its APS Review dated October 30, 2020. The first issue relates to the treatment of existing CHP cogeneration systems as DOER considers resolving current supply-demand imbalance in the AEC compliance market. The other two issues relate to APS-eligible renewable thermal technologies. It is clear that the APS could serve as an important funding source to help facilitate UMass' transition to decarbonized thermal energy production and distribution systems on campus. However, as the APS is currently structured there are two key obstacles that will inhibit and delay the adoption of APS-eligible renewable thermal technologies if they are not addressed by DOER. These issues are summarized below and detailed in the following sections.

First, in its APS Review Daymark recommends that DOER considers reducing the role of CHP in the APS as a potential policy lever to address AEC supply-demand imbalance. If DOER elects this option, existing CHP cogeneration systems should be grandfathered into the APS and AECs generated by CHP should not be treated differently from AECs generated by APS-eligible renewable thermal technologies. The University has made significant investments in its CHP systems to support the Commonwealth's energy goals of increasing energy efficiency, improving service reliability and resiliency, and reducing the need for conventional fossil fuel-based power generation. Changing APS qualification standards for existing CHP systems would be poor policymaking. It would create uncertainty for end users whether investments in APS-eligible renewable thermal production and distribution technologies may face similar eligibility questions in the future, should new thermal technologies emerge that the Commonwealth wants to support.

The second issue relates to who owns the emissions attributes and emissions reduction claims associated with APS Renewable Thermal Generation Units. As currently written, 225 CMR 16.00 does not allow an end user that adopts an APS-eligible renewable thermal technology to claim credit for the emissions reduction produced by the technology <u>if</u> the end user sells the AECs generated by an APS Renewable Thermal Generation Unit. This restriction will inhibit and delay the adoption of renewable thermal technologies by end users across the Commonwealth. End users are unlikely to adopt renewable thermal technologies without external financial support due to the capital cost requirements and in certain cases operating cost premiums to their existing energy systems. To address this economic challenge, end users could sell the AECs produced by a APS Renewable Thermal Generation Unit, as the Program intends, but by doing so would not be able to claim any of the emissions benefits or in the case of UMass claim the institution has met the

emissions goals set forth in Executive Order 484. By handcuffing end users' ability to use the APS incentives to facilitate the funding and adoption of renewable thermal technologies, this restriction will serve as a major obstacle for end users adopting APS Renewable Thermal Generation Units.

The third issue relates to Daymark's projection of end user adoption of APS Renewable Thermal Generation Units over the next 10 years without DOER action to resolve AEC oversupply and price suppression in the APS compliance market. Daymark estimates AEC supply will grow from 3 million AECs in 2020 to over 7 million AECs in 2030, with 70% of the new expected AEC supply coming from APS Renewable Thermal Generation Units. This projection does not appear to account for near-term oversupply and price suppression being exacerbated by the addition of significant new AEC supply from CHP in 2020/2021. With significant AEC price suppression and the concern about emissions attribute ownership described above, we believe this projection of continued renewable thermal technology adoption is overly optimistic.

1. **In its APS Review, Daymark recommends that DOER considers reducing CHP qualification in the APS as a potential policy lever to address AEC supply-demand imbalance. If DOER elects this option existing CHP cogeneration systems should be grandfathered into the APS and AECs generated by grandfathered CHP systems should not be treated differently than AECs generated by APS-eligible renewable thermal technologies.**

The APS was established to incentivize the adoption of alternative energy technologies that contribute to the Commonwealth's clean energy goals, including increasing energy efficiency, improving service reliability, and reducing the need for conventional fossil fuel-based power generation. The CHP cogeneration systems installed at UMass achieve these three objectives.

UMass has made significant investments in implementing its CHP cogeneration systems to help advance the Commonwealth's energy goals. Changing APS qualification standards for existing systems would be poor policymaking and would create uncertainty for end users throughout the Commonwealth whether investments in APS-eligible renewable thermal technologies could face similar eligibility questions and stranded cost risks in the future should new thermal production and distribution technologies emerge that the Commonwealth wants to support. Renewable thermal technologies could very well see major advancements in the coming years, making this a real concern for end users should the wrong precedent be set by DOER.

Similarly, AECs generated by CHP cogeneration systems should not be treated differently than AECs generated by APS-eligible renewable thermal technologies. 225 CMR 16.00 states that one unit of credit shall be equivalent to the APS Alternative Generation Attribute associated with one megawatt-hour of electrical energy output. This definition is rightly the basis of the APS, enabling a compliance structure and trading currency across a range of thermal production and distribution technologies. Useful thermal energy delivered to end users should remain the common basis for measuring AEC generation and should be compensated equally across all eligible generation sources.

In its APS Review, Daymark notes that DOER has a variety of policy levers at its disposal to address AEC supply-demand imbalance, including altering the required APS obligation, modifying resource eligibility requirements, adjusting the Alternative Compliance Rate, and implementing varying AEC multipliers for specific technologies so that a particular technology produces more or less AECs. With the development of and market for alternative thermal production and distribution technologies advancing and changing rapidly, UMass recommends that DOER avoids putting its thumb on the scale of particular technologies through differentiated compliance obligations, Alternative Compliance Payment Rates, or AEC production multipliers.

That being said, there is clearly an AEC supply-demand imbalance that needs to be resolved. UMass does not offer commentary at this time on how DOER should address this imbalance. Whatever DOER decides, UMass strongly recommends against changes that negatively impact existing systems, including the three CHP systems that are currently operational at UMass campuses.

2. The current definition of Generation Attribute in 225 CMR 16.00 will inhibit and delay the adoption of APS-eligible renewable thermal technologies and therefore should be revised by DOER.

In 225 CMR 16.02, Generation Attribute is defined as "a non-price characteristic of the energy output of a Generation Unit including, but not limited to, the Unit's fuel type, emissions, vintage and APS eligibility." The inclusion of "emissions" in this definition is fundamentally problematic for end users like UMass that are considering adopting APS-eligible renewable thermal technologies. The term should be removed from the definition of Generation Attribute.

225 CMR 16.07(1) states the total annual sales of each Retail Electricity Product sold to Massachusetts End-use Customers by a Retail Electricity Supplier, under contracts executed or extended on or after January 1, 2009, shall include a minimum percentage of electrical energy sales

with APS Alternative Generation Attributes. APS Alternative Generation Attribute is defined in 225 CMR 16.02 as "the Generation Attribute of the energy output, or the equivalent of such output as provided in 225 CMR 16.05(1)(a)2.b., 225 CMR 16.05(1)(a)3., and in 225 CMR 16.05(1)(a)6.b. of a specific APS Alternative Generation Unit that derives from the Generation Unit's production of APS Alternative Generation."

Based on the definition of Generation Attribute, retail electricity suppliers that acquire and retire AECs to demonstrate compliance with the APS technically own the emissions attributes associated with the production of those AECs. In other words, if an end user installs an APS Renewable Thermal Generation Unit, produces AECs from the Unit's delivery of useful thermal energy to the host facility, and sells those AECs to a retail electricity supplier, the supplier has the right to claim (or assign the claim to its retail electric customers for which it has retired the AECs) the emissions reductions the end user has realized in its own Scope 1 and Scope 2 emissions inventory from the adoption of the APS Renewable Thermal Generation Unit.

This poses a conundrum for the AEC seller, the end user hosting the APS Renewable Thermal Generation Unit in most cases, on multiple fronts. First and foremost, if the end user is a public agency like UMass and cannot claim credit for reducing its emissions to make progress towards future emissions goals set forth in Executive Order 484, UMass would have to avoid the APS entirely and could not use the Program as a tool to help reduce the substantial cost of transitioning the campuses' existing energy infrastructure to decarbonized alternatives. This would defeat the purpose of including renewable thermal technologies in the APS and would be an inefficient outcome for Massachusetts ratepayers and taxpayers.

Second, producing a change in ownership of the emissions attribute with the AEC sale opens a Pandora's box for emissions accounting. There is no standardized methodology for an AEC buyer or seller to calculate the emissions attributes of an AEC. This means it is unclear what a change in ownership of the emissions attribute actually means for the AEC buyer and seller.

To illustrate this emissions accounting problem, it is helpful to draw a parallel between the accounting associated with RECs with that associated with AECs. Consider a common situation today where a UMass campus has installed solar PV generation on its campus under a long-term agreement and where the developer/owner of the generation or the campus' local electric utility (in the case of SMART) retains the RECs. In this case, the accounting is straightforward and standardized. The RECs and therefore emissions attributes from the generation flow to the developer/owner or utility, and the campus uses the electricity generated behind its meter to offset

grid purchases it would otherwise have made. For emissions accounting purposes for the campus, the electricity generated from the solar PV facility is treated as "system power" and assigned the emissions attributes of that source of electricity. This assignment is possible because the sources that make up system power are well-defined each hour over the life of the solar PV plant and its emissions attributes now are measured, albeit after-the-fact.

Contrast this to the case of AECs. If a UMass campus sells the AECs associated with the operations of its CHP cogeneration system, it is no longer able to include in its greenhouse gas inventory the emissions from the cogeneration plant. Instead, the campus must assign to its inventory the emissions that would have occurred but for the development of the cogeneration plant, just as it does with the REC example noted above. The problem is that there is no "system power" equivalent. Instead, each AEC producer must develop its own baseline measure of emissions. While this may be possible to a reasonable degree of accuracy in the first year or even first few years of operation of the cogeneration plant, it is simply not possible over the life of that plant. For example, the UMass Amherst CHP cogeneration plant displaced coal when it came on-line in 2009. It is inconceivable that UMass would still be burning coal in the same boilers over a decade later, let alone a decade from now. And yet, DOER's current regulation necessitates making this assumption, or in the alternative, some other equally uncertain and ambiguous default or baseline scenario.

Looked at from the perspective of the buyer of AECs, the situation is even more problematic. An AEC buyer could argue that an AEC purchased from the UMass campus grants it the ability to claim the emissions benefits of the CHP cogeneration plant, i.e., the difference in the campus' Scope 1 and Scope 2 emissions with the cogeneration plant and its reconstituted Scope 1 and Scope 2 emissions had the cogeneration plant not been installed. This begs the question – how is the buyer of the AECs ever going to develop such an estimate? And, if the AECs are sold to different buyers or assigned to retail customers of the buyer (in the case of an electricity supplier), how are these different entities ever going to make sure that each uses the same emissions attributes?[2]

[2] Similarly, an AEC buyer could argue than an AEC purchased from an end user with an APS Renewable Thermal Generation Unit grants it the ability to claim the attribute of the APS Renewable Thermal Generation Unit, the difference in the AEC seller's Scope 1 and Scope 2 emissions with the APS Renewable Thermal Generation Unit and the AEC seller's reconstituted Scope 1 and Scope 2 emissions had the APS Renewable Thermal Generation Unit not be installed.

The notion of reconstituting emissions for thermal production systems is problematic in that it creates the opportunity for arbitrary emissions accounting in the inventory developed by the AEC seller and in the claims by an AEC buyer and could lead to notable inconsistencies between end users' emissions accounting practices and the Commonwealth's emissions accounting practices. Taken together these outcomes would undermine the goals of the APS and the Commonwealth's long-term emissions targets.

It is worth recognizing that other state and federal programs that aim to incentivize the adoption of renewable heating and transportation fuels avoid bundling emissions attributes with the certificates used to track and certify program compliance. For example, New Hampshire's Thermal Renewable Energy Credit Program and Maine's Thermal Renewable Energy Credit Program both define thermal renewable energy credits ("TRECs") as a tradable instrument that represents an amount of useful thermal energy delivered by a qualified production source to an end user equivalent to a unit of electricity (3,412,000 British thermal units). Similarly, Renewable Identification Numbers ("RINs"), the currency and compliance mechanism of the U.S. Renewable Fuel Standard, are tied to each gallon of renewable fuel produced but exclude a bundled emissions attribute associated with the fuel.

Revising the definition of Generation Attribute to exclude emissions attributes does not create a pathway for end users or the Commonwealth to double-count emissions reductions attributed to APS Renewable Thermal Generation Units, so long as AEC sellers are prohibited from selling emissions attributes into another state, regional, or federal emissions compliance program, for example the California's Low Carbon Fuel Standard.

One might think this double-counting concern would be a real issue based on experience with Renewable Energy Credits ("RECs") associated with renewable electricity generation.[3] RECs are fundamentally different from AECs due to design and physics of the electricity grid. New England's electricity market and transmission system are regionally-integrated, and due to the physics of electricity flows electrons generated by renewable generation facilities cannot be individually tracked from the point of production to the point of end use. Furthermore, because certain renewable generation facilities can register and sell RECs into multiple states' RPS programs, RECs need to be a bundled tradeable certificate and emissions attribute. RECs allow each New

[3] A Renewable Energy Credit ("REC") is a tradeable certificate that represents the emissions attribute of one megawatt-hour ("MWh") of electricity generated by a renewable energy source. One REC is produced for each MWh of renewable electricity generated. By purchasing and retiring (i.e., not reselling) a REC, a retail electricity supplier serving an retail load in the Commonwealth can demonstrate compliance with the Renewable Energy Portfolio Standard ("RPS").

England state to clearly understand how much renewable electricity generation is retired and allocated on behalf of its ratepayers due to its RPS requirements. But most importantly, the operations of the electric grid permit a simple-to-calculate, easy-to-measure and generally accepted default, baseline or but for case in the form of system power.

In contrast to a common platform like the power grid where deliveries of energy cannot be individually tracked and validated, useful thermal delivery from an APS Alternative Generation Unit to individual end users can be clearly measured and tracked at a single point of use. Furthermore, because APS Alternative Generation Units and APS Renewable Thermal Generation Units have to be located at end user facilities located in Massachusetts, there is not a potential for double-counting fuel inputs or emissions reduction claims across state lines.

For the reasons described above, UMass asks DOER to revise 225 CMR 16.02 to make it clear that AECs are a tradable instrument that exclude any bundled emissions attribute. To remedy this issue DOER could simply strike "emissions" from the definition of Generation Attribute in 225 CMR 16.00. With this change, Generation Attribute would be defined as "a non-price characteristic of the energy output of a Generation Unit including, but not limited to, the Unit's fuel type, vintage and APS eligibility." This change would remove a significant obstacle for end users to leverage the APS as a means to fund decarbonization of energy infrastructure and to be confident that they can take credit for the emissions reductions resulting from the adoption of renewable thermal technologies. Without such a change, each entity in the Commonwealth that has sold AECs will need to revise its greenhouse gas inventories retroactively to the date the APS-eligible facility came on-line. If DOER does not make the change, then it must address this fundamental problem and provide explicit guidance to all AEC sellers with respect to how to measure and report their Scope 1 and Scope 2 emissions.

3. **In its APS Review, Daymark appears to be underestimating near-term AEC oversupply conditions and price suppression in the APS compliance market. As a result, Daymark is likely overestimating adoption of APS-eligible renewable thermal technologies between 2020 and 2030.**

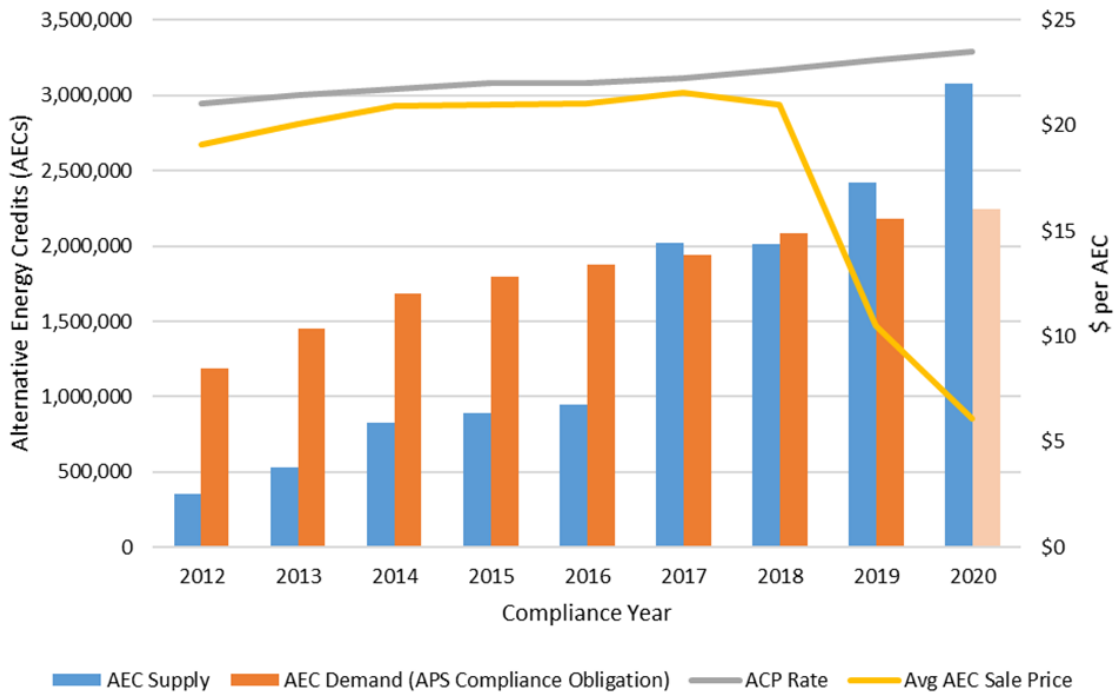
In its APS Review dated October 30, 2020, Daymark Energy Advisors concludes that if business as usual continues under the APS, AEC supply will quickly out pace demand: "the baseline supply and demand analysis indicates that supply will quickly exceed demand and this imbalance will

worsen as additional installations of renewable thermal, combined heat and power, and other technologies come online." Daymark goes on to state that "the current incentive levels under the APS are not adequate to support the adoption of many renewable thermal technologies." This dynamic of AEC price suppression from oversupply despite the need for external funding to increase adoption of renewable thermal technologies is at odds with achieving the Commonwealth's emissions goals.

Daymark's observations on AEC oversupply align with UMass' observations of recent market fundamentals. Starting in 2018, UMass has seen a substantial decrease in AEC market prices due to oversupply of AECs, as shown in Figure 1 below[4]. The oversupply condition clearly aligns with DOER's December 2017 changes to 225 CMR 16.00 to include APS Renewable Thermal Generation Units, which essentially doubled AEC supply statewide. Prior to the December 2017 changes, AEC market prices hovered just below the alternative compliance payment rate, with the market supply clearly insufficient to fully meet compliance demand. With the addition of new AEC supply from APS Renewable Thermal Generation Units, market supply now exceeds annual compliance demand, which has resulted in market prices falling by nearly 75% in the last year.

Figure 1. AEC Supply versus Compliance Demand & Indicative AEC Pricing: 2012 – 2022

[4] AEC supply data for 2018 to 2020 is sourced from NEPOOL GIS. AEC supply and demand data for 2012 to 2017 is sourced from DOER's Annual RPS & APS Compliance Reports. AEC prices shown in Figure 1 are averages of indicative market pricing reported in market index publications from sources such as Spectrometer and Amerex.



UMass agrees with Daymark's conclusion that without changes to the APS, AEC supply will continue to exceed market demand. However, in its projections of AEC supply and demand between 2020 and 2030 it appears Daymark is 1) underestimating near-term AEC oversupply conditions (and, as a result, AEC price suppression) and is therefore 2) overestimating end user adoption of APS Renewable Thermal Generation Units. As a result of lower AEC prices and without DOER actions to resolve AEC oversupply and price suppression in the APS compliance market as well as to address the retention of emissions attributes discussed in the prior section, we are concerned that the economic value of new APS-eligible renewable thermal technologies will fall appreciably.

Figures 5 and 11 below are extracted from Daymark's APS Review. Daymark is projecting that AEC supply will grow from 3 million AECs in 2020 to over 7 million AECs in 2030. This translates to average supply growth of roughly 9% per year (400,000 AECs per year) across all APS generation sources. Daymark's projection indicates approximately 70% of this supply growth (275,000 AECs per year) is expected from new APS Renewable Thermal Generation Units with the remaining 30% of supply growth (125,000 AECs per year) expected to come from new CHP units installed in the coming years.

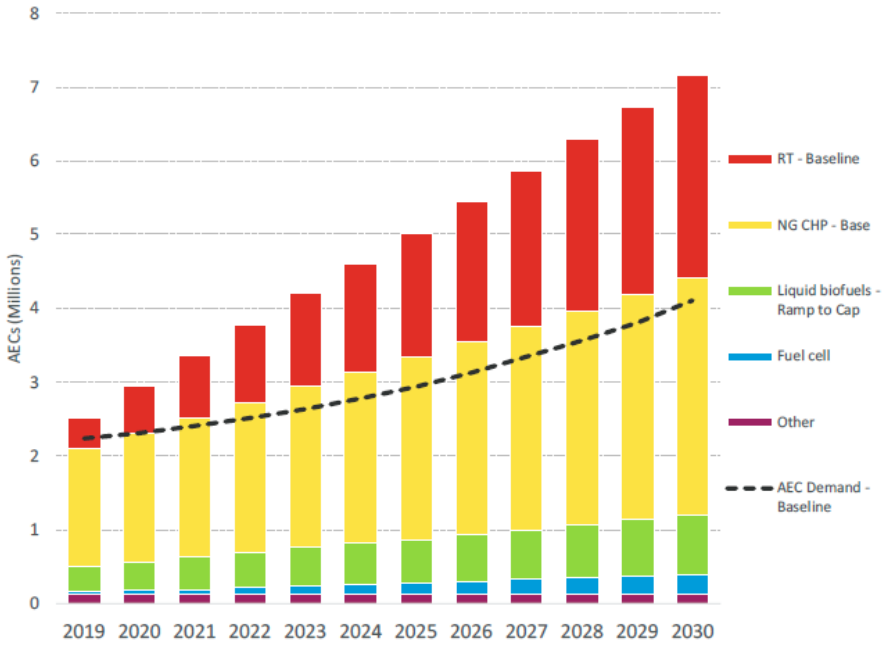


Figure 5: Baseline Supply and Demand

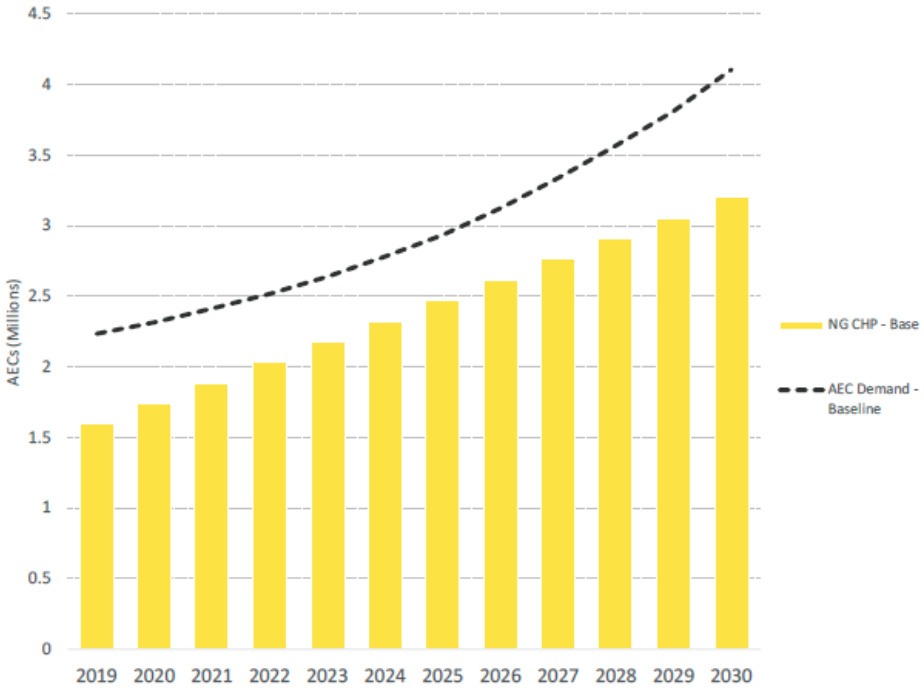


Figure 11: CHP Supply Forecast

Daymark appears to underestimate near-term oversupply conditions in the APS compliance market. In particular, it is does not appear Daymark is fully reflecting the addition of AEC supply from a new 44 MW CHP system coming online in the next year.[5] At this scale of CHP we estimate AEC supply could increase upwards of 400,000 AECs per year once this new CHP is fully online, which is nearly 20% of total statewide compliance demand in 2020.

Daymark's projection in Figure 11 indicates AEC supply from CHP is expected to grow from 1.75 million AECs in 2020 to roughly 2.25 million AECs in 2024. With the addition of AEC supply from known new CHP, statewide AEC supply from CHP could feasibly reach 2.25 million AECs in 2021 or 2022. This will significantly exacerbate oversupply conditions in the AEC market, suppressing AEC prices further from the current historically-low price levels and undermining financial support needed for end users to adopt renewable thermal technologies.

Daymark's projection in Figure 5 indicates AEC supply from APS Renewable Thermal Generation Units is expected to grow from 1.25 million AECs in 2020 to roughly 3.75 million AECs in 2030. This translates to average supply growth of 13% per year. With AEC price suppression and end users' concern about emissions attribute ownership described above, this projection of renewable thermal technology adoption may be overly optimistic.

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[5] https://powering.mit.edu/news/mit-set-upgrade-its-cogeneration-plant-improving-campus-resiliency