December 4th, 2020

RE: 2020 APS Minimum Standard Review Comment

Dear Ms. Meserve,

Thank you for the opportunity to comment on 2020 APS Minimum Standard Review

Dandelion is the leading residential geothermal company in the United States. We provide high-efficiency, ground source heat pumps (GSHPs) and are on a mission to democratize the geothermal market and enable any homeowner to afford and install a geothermal system and see instant energy bill savings. Harnessing the thermal energy in the ground beneath our feet, geothermal systems are the most efficient, reliable, and lowest carbon approach to electrifying home heating and cooling.

The geothermal industry is where solar and wind were 15 years ago. Customer adoption is just beginning to accelerate. Despite the high efficiency and tremendous potential of GSHPs, they currently account for only a small fraction of the heating and cooling market. This, historically, is due to higher up-front costs, low consumer awareness, and inadequate state incentives. Dandelion, through a combination of rapid technological innovation and economies of scale, is working to overcome the awareness and cost barriers.

Over 18.5 million households are heated with oil and propane nationwide[1], including around 750,000 in Massachusetts[2]. Nationally, Massachusetts ranks 3rd in terms of oil customers[3]. Massachusetts homeowners with dirty and expensive heating fuels, like oil and propane, should be offered adequate incentives to replace old systems with GSHPs as it is the most efficient, clean electric alternative that will have the greatest reduction on their annual bills in the long-term.

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[1] EIA, Residential Energy Consumption Survey, 2015, https://www.eia.gov/consumption/residential/data/2015/hc/php/hc1.1.php

[2] US Census, American Community Survey, House Heating Fuel, 2018 Data, https://data.census.gov/cedsci/table?q=B25040%3A%20HOUSE%20HEATING%20FUEL&g=0400000US25&tid=ACSDT1Y2018.B25040&hidePreview=true

[3] US Census, American Community Survey, House Heating Fuel, 2018 Data, https://data.census.gov/cedsci/table?q=B25040%3A%20HOUSE%20HEATING%20FUEL&g=0100000US.04000.001&tid=ACSDT1Y2018.B25040&hidePreview=true

Dandelion is in the midst of evaluating which markets to enter next. To date, we have entered the New York and Connecticut markets, but have not yet entered Massachusetts due to the uncertain policy environment. From a market potential standpoint, Massachusetts is a great match for Dandelion's product given the number of oil and propane customers in the Commonwealth. However, the presence of stable incentives such as the Alternative Energy Portfolio Standard (APS) also play a large role in our ability to invest, build warehouses, and hire employees in the Commonwealth over the long-term.

In these comments, we will respond to questions asked as part of the APS review and respectfully make recommendations to ensure adequate Alternative Energy Certificate (AEC) levels, which will enable Dandelion and other geothermal providers to enter the market, create a new wave of good-paying clean energy jobs, and significantly lower the energy bills and carbon footprint of Massachusetts households and businesses.

Summary of Dandelion's guiding principles to encourage residential GSHP growth in the Commonwealth:

1. **Prioritize Making the Economics Work for Oil and Propane Customers:** Ensure that AEC prices incentivize oil and propane customers to switch to renewable heating and cooling. We agree that a meaningful AEC price should reduce system costs to provide net benefits to these customers in 7 years, as noted by the study.

2. **Ensure Stable and Predictable AEC Credit Amounts of at least 75% of the ACP Price:** A number of policy levers are explored in the study to address the current supply-demand balance. The primary goal in any of these actions should be to establish AEC price stability and predictability over time so customers can determine payback periods and can confidently take out loans to finance a system if they so choose. So long as AEC credits trade at 75% of the ACP price or higher, homeowners and contractors will be able to forecast long-term value with sufficient certainty.

3. **Update APS well requirements for small GSHP units to support innovation:** Ensure that APS well requirements allow for the adoption of innovative new products, configurations, or designs so long as they follow industry standards and use industry accepted methods and materials. This will allow the industry to scale and drive down costs for homeowners over time.

Background on Dandelion energy:

Dandelion's goal is to bring geothermal to the mass suburban market. Dandelion's software-guided system design and smaller drilling rigs allows us to right-size systems and offer geothermal to middle class homeowners on smaller lots than what is accessible by traditional geothermal installers. Dandelion also offers a financing option for customers without the ability to put down money upfront for a geothermal system, which approximately half of our customers select. While we install geothermal systems in homes of all sizes, our ideal customer has a 1500-3000 SQFT home currently heated by oil or propane, which we can easily and cost-effectively convert to geothermal using a single 4 or 5 ton heat pump system.

Dandelion made New York our first point of market entry for two primary reasons. First, there are nearly 1.5 million residential buildings still dependent on expensive oil heating systems. Second, New York's incentives and targets for GSHPs have created a friendly regulatory environment for geothermal energy to grow and thrive. Dandelion recently entered Connecticut following an increase in state incentives for geothermal and is actively considering entry into Massachusetts. The level of state incentives in place will have a significant influence on if and when Dandelion enters the market.

Dandelion Responses to Individual questions:

Question #3: "Do you believe the APS program should prioritize technologies which provide the most benefits, such as greatest greenhouse gas emissions reductions?"

As stated in the 2020 review document, the APS program intent is to "incentivize relatively cleaner, more efficient technologies across the energy spectrum.[4]" Dandelion believes it should do so in service of helping the Commonwealth achieve its committed environmental goals in the most cost-effective way possible while providing direct benefits to residents.

As the report also notes, "small renewable thermal systems achieve emissions reductions for the lowest cost"[5]. Dandelion believes that the APS should continue to focus on incentivizing small renewable thermal systems, given the significant decarbonization potential that remains in the Commonwealth and the direct impact on residents. For example, on average, a 2,500 SQFT oil home in Westchester, NY that is

[4] Daymark Energy Advisors, ALTERNATIVE ENERGY PORTFOLIO STANDARD REVIEW 2020 https://www.mass.gov/doc/alternative-energy-portfolio-standard-review/download
[5] Ibid 4

replaced with a Dandelion geothermal system for heating and central A/C saves, 421,250 lbs of CO2 in heating and cooling over the 25 year lifetime of the heat pump[6].

Given that there are still around 750,000 oil and propane homes in the Commonwealth, which have the potential to switch from dirty, expensive fuels to clean, affordable, renewable heating and cooling, the aggregate carbon reduction potential is enormous. Converting all these homes to geothermal could save over 5.4 million tons of CO2 per year[7]. Focusing on this market will provide Dandelion and other residential geothermal contractors with a large enough target market to expand and scale, and allow system costs to fall over time.

For example, in 2017, Dandelion was paying nearly twice as much on average per heat pump. With increased demand in New York and following new incentive structures, Dandelion obtained access to scaled pricing and direct-sourced contract manufacturing. In 2019 we were able to bring on a second manufacturing partner at similarly competitive prices because of our growing order volume. As scale continues to increase, heat pump prices should become even more competitive than they are today, driving costs for homeowners down further.

Question #9: “How could the APS program be improved to better influence residential or commercial purchasing behaviors?

When customers select geothermal, they do so not simply because of the health and greenhouse gas benefits, but also because the economics work for them. In the event that they choose a financed option, they’re looking for savings on day one, which Dandelion is able to offer with adequate state support.

The number one thing this program can do to influence residential behavior is to provide a meaningful, predictable AEC price over time. This will allow contractors such as Dandelion to confidently calculate payback period for their customers. It also allows customers to make the choice either to purchase the system outright, or take out a loan to finance it, which around half of our customers currently select. We view an ACP price of 75% or higher as a sign of a healthy market with proper credit supply and demand.

As the authors note, “it may be challenging to design the APS so that it provides the right incentive for all technology comparisons, unless the comparison technology is

[6] Dandelion Air Environmental Impact, https://dandelionenergy.com/environmental-impact
[7] Uses Dandelion Air Environmental Impact estimates (link above) based on an average Westchester, NY home and applies this to all fuel oil and propane homes in the Massachusetts market

taken into account.[8]" Dandelion believes the APS should focus first and foremost on achieving a 7-year payback period for oil and propane customers, which are the market segments that Dandelion believes have the greatest immediate potential in addition to the highest carbon impact.

Question #10: "Are there currently eligibility criteria in the APS program that you believe are a barrier to participation in the program? How would you address these barriers?

The current APS requirements for vertically bored closed-loop systems are very rigid. In their current form, they prevent installers from innovating on system design to improve performance and reduce costs for homeowners.

For example, one of the areas of innovation that Dandelion is pursuing is understanding enough about the thermal conductivity in each area we drill in to be able to install the correct amount of footage based on the geology. The requirement specifying that there has to be 150 feet per 12,000 BTU/hr of heating load limits the ability to make drilling more efficient for homeowners that don't need that amount of bore because they are located in an area with geology that's more thermally conductive. Borehole lengths are also a function of the thermal conductivity of the grout used and the geometry of the ground loop.

To date, the average bore lengths for Dandelion systems in New York have been closer to 125ft. We estimate that adhering to Massachusetts' requirements could add $2,000 or more in installation costs per system, and would limit additional cost-savings in the future.

Similarly, the requirement specifying that there must be at least 15 feet of separation between closed-loop bore holes prevents Dandelion from modifying system design to accommodate smaller lots, where software modeling permits it. This tends to disproportionately impact less affluent homeowners with smaller lots, for whom a couple feet could mean the difference between system eligibility and ineligibility.

Our goal in suggesting improvements is to provide flexibility for installers to improve system performance and design while keeping bad actors from using rule of thumb design to create ineffective systems. The requirements should allow for the adoption of innovative new products, configurations, or designs so long as they follow industry standards and use industry accepted methods and materials.

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[8] Daymark Energy Advisors, ALTERNATIVE ENERGY PORTFOLIO STANDARD REVIEW 2020 https://www.mass.gov/doc/alternative-energy-portfolio-standard-review/download, page 16

We recommend updates to the below following language found in the online APS' requirements for Small GSHP Generation units[9]:

Current language
All GSHP units must...

- *have a minimum depth of 150 per 12,000 Btu/hr if vertically bored closed-loop systems*
- *have a grout conductivity equal to or greater than anticipated earth conductivity of the drill site up to 1 Btu per hour-foot-degree Fahrenheit if closed-loop system*
- *have at least 15 feet of separation between closed-loop bore holes*

Proposed language:
We would recommend replacing these specific system requirements with the following:

All GSHP units must…

- *Be designed using software that satisfies the criteria in CSA C448.2-16, Section 7.1.5.*
- *Maintain a minimum entering water temperature of at least thirty degrees Fahrenheit and a maximum entering water temperature of no more than 90 degrees Fahrenheit.*
- *Be built using approved ground loop methods and materials per CSA C448.0-16, Chapter 5.*

Conclusion

Dandelion thanks the Massachusetts Department of Energy Resources for allowing us to provide comments on this review process and for evaluating opportunities to improve APS incentives for GSHPs in the Commonwealth. Continuing to provide meaningful and predictable state incentives for GSHPs will allow Dandelion to confidently enter the market and make long-term plans to dramatically increase our footprint in Massachusetts.

[9]Massachusetts Department of Energy Resources, Qualifying Ground Source Heat Pump in the APS, https://www.mass.gov/service-details/qualifying-ground-source-heat-pump-in-the-aps

Sincerely,

Michael Sachse

CEO

Dandelion

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