



Via Electronic Mail  
July 28, 2021

Michelle Turner, Administrative Secretary  
Efficiency Maine Trust  
168 Capitol Street, Suite 1  
Augusta, Maine 04330-6856

RE: Comments from Dandelion Energy on the Efficiency Maine Trust Triennial Plan V (Fiscal Years 2023-2025)

Dear Ms. Turner,

Thank you for the opportunity to comment on the Efficiency Maine Trust's (Trust's) Draft 2023-2025 Triennial Plan and share more information about the potential of geothermal energy in Maine.

Dandelion is one of the leading residential geothermal companies 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 a small fraction of the heating and cooling market. Historically, this is due to higher up-front costs, limited consumer awareness, and low state incentives. Dandelion, through a combination of rapid technological innovation and economies of scale, is working to overcome the awareness and cost barriers. In the past year, Dandelion has expanded from its headquarters in New York into Connecticut and Vermont, and will expand into Massachusetts later this year as a direct result of increased state incentives for GSHPs in those states.

Dandelion applauds the Trust's leadership in electrifying home heating and the significant progress made towards its 100,000 air source heat pump deployment goal. Electrification efforts are all the more important given that over 400,000 households in Maine<sup>1</sup> are heated with fuels such as oil and propane. Nationally, Maine ranks 1st in terms of percentage of total households that use propane and fuel oil for heating.<sup>2</sup>

There is an untapped opportunity for GSHPs to play a larger role alongside ASHPs in electrifying heating in Maine. GSHPs typically serve as whole system replacements, entirely eliminating the need for delivered fuels such as fuel oil or propane in a home. Accelerating the adoption of GSHPs will provide significant grid benefits and reduce system peaks while giving Maine homeowners the opportunity to replace their existing fuel oil and propane heating systems with the most efficient, clean electric technology that will have the greatest reduction on their annual bills in the long-term.

### **Summary of Recommendations**

While the existing \$3,000 per project incentive for GSHPs offered by the Trust provides a good starting point, this incentive alone is not enough to encourage widespread adoption of geothermal energy, particularly among middle class homeowners, which are a primary target of Dandelion.

Dandelion recognizes that the Trust faces restrictions in terms of how much funding can be spent currently on heat pumps and statutory obligations to hit ASHP heat pump deployment targets. To drive increased market demand for GSHPs and increase the potential pool of funding for beneficial electrification, we respectfully encourage the Trust to take the following actions:

- 1. Move from a per-project funding model to a per-ton funding model for GSHPs, where incentives increase as the capacity of the system increases.**
- 2. Set the incentive amount to at least \$2,100 per standard heating ton for residential GSHP systems in line with nearby states such as Vermont.**
- 3. Seek legislative approval to extend the energy efficiency surcharge on electricity and natural gas to heating oil and propane and use revenue generated to provide an increased pool of funding for propane and oil-to-GSHP conversions.**

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<sup>1</sup> US Census, American Community Survey, [House Heating Fuel](#), Maine 2019 Data

<sup>2</sup> US Census, American Community Survey, [House Heating Fuel](#), National 2019 Data

## BACKGROUND ON DANDELION AND GEOTHERMAL

### 1. How Ground Source Heat Pumps Work:

GSHPs work by collecting heat from the ground, where it remains a constant 55 degrees Fahrenheit year round, and transferring it to heat your home. In the summer, the system works in reverse, collecting heat from the home and transferring it to the ground. The GSHP systems installed by Dandelion serve as complete replacements for heating and cooling systems in the house, allowing homeowners to remove existing boilers and furnaces. Dandelion installs residential geothermal in two steps. First, we drill vertical holes underground and insert buried pipes filled with fluid (called ground loops) that are used to transfer heat between the home and the ground. We then connect these loops to the interior of the home. Second, we install a heat pump inside the home that exchanges and concentrates heating energy between the home and the loops (for a deeper explanation, please visit: [dandelionenergy.com](http://dandelionenergy.com)). The system life is estimated at up to 25 years for the heat pump and 50+ years for the ground loop.<sup>3</sup>

**Figure 1: How Geothermal Works**



### 2. Energy, Peak, and Emission Benefits of Geothermal Energy:

GSHPs are recognized by the U.S. Environmental Protection Agency as one of the most efficient and comfortable heating and cooling technologies currently available.<sup>4</sup>

<sup>3</sup> DOE, [Geothermal Heat Pumps](http://www.energy.gov/geothermal-heat-pumps)

<sup>4</sup> US EPA, ENERGY STAR: [Geothermal Heat Pump Website](http://www.energy.gov/geothermal-heat-pump-website)

All of Dandelion's products exceed Energy Star Tier 3 requirements, which for closed-loop, water to water means they have an EER 17.1 and a COP of 3.6.<sup>5</sup> On average, a 2,500 SQFT oil home in Portland, Maine that is replaced with a Dandelion geothermal system for heating and central A/C would eliminate up to 202 Metric tons of CO<sub>2</sub> in heating and cooling over the 25 year lifetime of the heat pump.<sup>6</sup>

Given that there are still around 400,000 oil and propane homes in Maine, 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 eliminate close to 3 million Mt of CO<sub>2</sub> per year that comes from residential fuel oil and propane usage.<sup>7</sup>

At scale, a national analysis by the Oak Ridge National Laboratory found that switching all buildings to GSHPs could reduce yearly CO<sub>2</sub> emissions by 356.3 million Mt, and reduce yearly U.S. energy costs by \$49.8 billion<sup>8</sup>.

In applying its cost benefit test to GSHPs in New York, NYSERDA has found three significant areas of benefit beyond energy savings:<sup>9</sup>

- The value to ratepayers of reducing systemwide peak electric load.
- The so-called "inverse cost shift" effect, which can result in heat pump customers paying for more than their fair share of fixed electric grid costs, reducing burdens on other ratepayers.
- The societal value of reducing greenhouse gas emissions ("carbon value")

For electric utilities, GSHPs offer significant grid benefits by increasing baseload demand without meaningfully increasing seasonal peaks. This is in contrast to technologies such as ASHPs, which provide electrification benefits, but also increase peak usage. A study by the Brattle Group found that fully electrifying New England's heating sector using GSHPs would only minimally impact peak demand and leave energy prices unchanged, whereas switching to ASHPs would nearly double the peak and increase electricity prices by up to 20%.<sup>10</sup>

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<sup>5</sup> ENERGY STAR® [Program Requirements for Geothermal Heat Pumps](#), Version 3.1,

<sup>6</sup> Emissions coefficients localized for Maine, see [Dandelion Air Environmental Impact](#) for more info on calculation,

<sup>7</sup> Efficiency Maine Trust, [Beneficial Electrification: Barriers and Opportunities in Maine](#), Page 14,

<sup>8</sup> Oak Ridge National Laboratory, [GeoVision Analysis Supporting Task Force Report: Thermal Applications— Geothermal Heat Pumps](#), Page 1,

<sup>9</sup> NYSERDA, [New Efficiency: New York - Analysis of Residential Heat Pump Potential and Economics](#), Page 58,

<sup>10</sup> The Brattle Group, [Heating Sector Transformation in Rhode Island: Pathways to Decarbonization by 2050](#), Pages 30-31

As seen in Table 1 below, Dandelion estimates that, in Bangor, Maine, a 5 ton GSHP system would have a peak impact of 3.69 KW, while the peak impact of top-of-the-line ASHP alternatives such as a Mitsubishi Hyper Heat Mini Splits would be 76% greater, at 6.50 KW.

**Table 1: GSHP vs ASHP performance in Bangor, Maine**

Heating	Ground Source	Mitsubishi Hyper Heat Mini Splits**
	Enertech YT 060	HSPF-11
Average annual COP	4.01	2.66
Annual electricity use	8,216 KWh	12,386 KWh
Design day COP	3.92	2.23
Peak electric demand	3.69 KW	6.50 KW

\*\*Model # MXZ-3C30NAHZ2 (qty 2); modeling does not account for defrost cycle

Portland, ME Weather Data

OATmax	84.0
OATmin	-2.0
OATavg	45.0
Deep earth temp	49.0

Assumed loads:

Peak cooling load	32,000 BTU/h
Peak heating load	48,700 BTU/h

LoopLink energy model

(bin method per IGSHPA RLC manual):

Annual Heating Energy	112,412,354 BTU
Annual Cooling Energy	20,612,360 BTU

### **3. Dandelion's History, Target Customer, and Job Creation Potential:**

Dandelion's goal is to drive down system costs and bring geothermal to the mass market. Dandelion's software-guided system design and smaller drilling rigs allow 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 fuel oil or propane, which we can easily and cost-effectively convert to geothermal using a single 4 or 5 ton heat pump system.

Dandelion is headquartered in New York State. Since launching in 2017, we've created over 135 jobs, 75% of which are either drilling or HVAC installation jobs. To service new markets, we typically open new warehouses and train new drilling crews and installers, resulting in an average of 50 jobs per warehouse and multiple warehouses per state. Just as the solar industry retrained local contractors, the geothermal industry does the same for the HVAC contractors and for oil, gas, and water well drillers. This extends to our leadership team. Dandelion's VP of Drilling, Jason Smith, transitioned to geothermal after 18 years in the oil and gas industry due to tremendous growth potential in the geothermal industry.<sup>11</sup>

Meaningful per-ton incentives for GSHPs have been present in the New York market since Dandelion's inception and are one of the main reasons Dandelion decided to establish its headquarters there. The presence of stable, per-ton incentives and a focus from NYSERDA and the utilities on increasing awareness among consumers for GSHPs have allowed Dandelion to scale and continue to drive down costs that will result in lower prices for customers in the future. For example, in 2017, Dandelion was paying nearly twice as much on average per heat pump. With increased demand in New York, 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.

In late 2020, Dandelion entered Connecticut following an increase in state incentives for geothermal and has expanded its footprint there in 2021. Earlier this year, Dandelion started serving Vermont following the introduction of per-ton incentives by Green

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<sup>11</sup> Eletrek, [This Fossil-Fuel Exec Jumped to Geothermal. He Tells us Why](#)

Mountain Power<sup>12</sup> and is preparing to enter Massachusetts following the recent introduction of per-ton incentives to Mass Save.<sup>13</sup> Dandelion is now actively considering what markets to enter next, including Maine. The policy environment will be a major driver of our decision.

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 we're able to offer in New York, Connecticut, and Vermont with adequate state incentives.

#### **DETAILED EXPLANATION OF RECOMMENDATIONS:**

- 1. Move from a per-project funding model to a per-ton funding model for GSHPs, where incentives increase as the capacity of the system increases.**
- 2. Set the incentive amount to at least \$2,100 per standard heating ton for residential GSHP systems in line with nearby states such as Vermont.**

While the current \$3,000 per project incentive offered by the Trust helps reduce system costs for GSHPs, it is not high enough by itself to encourage the meaningful transition from fossil sources to GSHPs for residential heating and cooling, particularly for the middle class homeowners targeted by Dandelion. With a \$3,000 incentive level, Dandelion is not in a position to enter the Maine market and effectively serve its target customer base.

Dandelion has found market success when it can offer financing options that allow customers to see savings on day 1 based on the expected reduction in energy bills.

Under Dandelion's standard 4.99%, 20 year financing option, this begins to occur in Maine when incentives are increased to at least \$2,100 per standard heating ton, or ~\$8,600 for a standard 5 ton system,<sup>14</sup> driving monthly loan costs down to approximately \$138. This incentive amount would be \$5,600 more than the current per-project \$3,000 incentive for a 5 ton system.

This \$8,600 investment per 5 ton system would result in between \$41,000 - \$50,000 in energy savings for a homeowner over a 25 year period based on historical fuel oil

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<sup>12</sup> GMP, [News Release](#), 5/19/21

<sup>13</sup> Mass Save, [Electric Heating and Cooling Equipment](#)

<sup>14</sup>Nominal ratings for GSHPs are based on cooling capacity; a 5 ton system typically has ~80% heating capacity or 4 tons

prices.<sup>15</sup> Each year, this same homeowner would save \$1,650 to \$2,000+ on purchasing fuel oil.

For comparison, a standard 5 ton system installed by Dandelion today would also receive \$8,600 in Vermont, and \$10,700 in Massachusetts with current per-ton incentive models. In New York, each utility has the ability to offer its own per-ton incentive amounts, with incentives for a 5 ton system ranging from \$7,400 in National Grid's territory to more than \$24,000 in ConEd's territory.<sup>16</sup>

Dandelion recognizes that a larger per-project incentive used to be provided by Efficiency Maine, which resulted in a higher number of retrofits nearing 100 per year, but did not fundamentally change the market. During the time increased incentives were offered, the market for geothermal service providers was still developing and, as illustrated by the above analysis, the incentive amounts were still not high enough to bring about market transformation.

Dandelion would encourage the Trust to extend these increased incentives to new construction and focus marketing and awareness efforts on targeting builders to adopt geothermal. Due to the nature of new construction, drilling and installation costs for GSHPs are 25-40% lower than they are for retrofits. Because GSHPs provide full heating and cooling load, installing a system during construction can eliminate the need for delivered fuels such as propane or fuel oil from the onset.

**3. Seek legislative approval to extend the energy efficiency surcharge on electricity and natural gas to heating oil and propane and use revenue generated to provide an increased pool of funding for propane and oil-to-GSHP conversions.**

Dandelion recognizes that the Trust has statutory obligations to hit ASHP heat pump deployment targets, strict funding allocations, and a limited pool of funding that can be applied to heat pumps. For these reasons, we are highly supportive of identifying new funding sources to be used for heat pumps, including GSHPs.

Specifically, Dandelion supports the recommendation by the Maine Climate Council's Buildings, Infrastructure, and Housing Working Group to adopt a fuel-neutral funding mechanism<sup>17</sup> and to further allocate a portion of these funds to establishing per-ton incentives for propane and oil-to-GSHP conversions on top of the existing \$3,000 per

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<sup>15</sup> All numbers pulled from EIA, [Weekly Heating Oil and Propane Prices](#)

<sup>16</sup> ConEd historically offered ~\$14,000 for a 5T project, but recently increased incentives to \$6,000 per standard heating ton to accelerate adoption

<sup>17</sup> Maine Climate Council Buildings, Infrastructure, and Housing Working Group, [June 2020 Report](#)

project incentive. The Acadia Center estimates that a new surcharge on delivered fuels could generate anywhere between \$9.4m and \$30.6m annually.<sup>18</sup> As discussed above, this per-ton incentive model has been deployed successfully in a number of Northeastern states, including New York, Connecticut, Vermont, and Massachusetts.

### **Conclusion: Scaling GSHPs in Maine**

Dandelion thanks the Trust for allowing us to provide comments during this planning process and for evaluating opportunities to improve incentives for GSHPs in Maine.

We applaud the Trust for the leadership position it has taken in terms of electrifying homes and driving the adoption of ASHPs. Given the high penetration of fuel oil homes and cold winter climate, the Trust has a similar opportunity to become a national leader in GSHP deployment. As highlighted in these comments, GSHPs offer significant grid benefits and reduce system peaks while giving Maine homeowners the opportunity to replace their existing heating systems with the most efficient, clean electric technology that will have the greatest reduction on their annual bills in the long-term.

The best way for the Trust to encourage the adoption of GSHPs is to provide additional per-ton incentives for propane and oil-to-GSHP conversions. New funding can be accessed by working with the Legislature to extend the energy efficiency surcharge on electricity and natural gas to heating oil and propane customers. This new funding source could ultimately encourage thousands of propane and oil homes per year to convert to GSHPs and help achieve the Trust's goals of reducing GHG emissions, reducing environmental damage from home heating, and promoting sustainable economic development in the state.

Sincerely,

A handwritten signature in black ink, appearing to read 'MS', with a horizontal line extending to the right.

Michael Sachse

CEO, Dandelion

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<sup>18</sup> Acadia Center, [RFI Triennial Plan V Comments](#), 4/9/21