To: The Advisory Board

From: The Zero Admissions Advisory Board

Date: May 13th, 2024

Subj: Ground Source Heat Pumps at Pierce School

This document [summarizes and clarifies a GGD analysis document](https://www.brooklinema.gov/DocumentCenter/View/41891/M82044-Updated-Life-Cycle-Cost-Analysis) created for the Town. Reference should also be made to a [document prepared by the Zero Emissions advisory board for the Select Board, Park and Recreation Commission, Conservation Commission](https://www.brooklinema.gov/DocumentCenter/View/50275/ZEAB-Statement-on-Pierce-Geothermal).

The GGD document has 4 sets of tables that look at 4 scenarios for ground source heat pumps (GSHPs) and water source heat pumps (WSHPs):

1. A like-to-like comparison of the costs of WSHPs (option 2) vs GSHPs (option 3) without any incentives.
2. A like-to-like comparison of the costs of WSHPs (option 2) vs GSHPs (option 3) with Mass Save incentives considered for both options.
3. An apples-to-oranges comparison of WSHPs (option 2) vs GSHPs (option 3) where the GSHP option included a PV installation, but the WSHP option did not, and without any incentives.
4. The same comparison as scenario 3, but with Mass Save incentives.

Scenarios 3 and 4 make cost comparison of WSHPs vs GSHPs difficult since they do not include installation of PV for WSHPs. For simplicity, these two scenarios are ignored when comparing baseline WSHP vs GSHP costs.

The GGD document is not entirely clear and has been misinterpreted more than once. Some clarifications:

1. The “additional capital investment” column is the difference between the numbers in the “gross capital investment” column, not an additional cost for GSHPs.
2. The “total lifecycle savings” column calculates the total savings for GHSPs versus WSHPs over a 50-year lifecycle including all expenses. In scenarios 2 and 4 Mass Save incentives are applied. Federal incentives are not applied in any scenario. In every scenario GSHPs are cheaper over this period even without Federal incentives.

**Massachusetts Incentives**

GSHPs qualify for $2,175,349 in incentives, per the GGD document. The Town is actively pursuing these incentives. These numbers are included in the linked GGD document.

GGD concluded that WSHPs would “likely not qualify for significant utility company incentives” and did not include any such incentives for WSHPs in their analysis. Note that in previous communication GGD suggested that WSHPs might be eligible for some portion of Mass Save path 2 incentives, but concluded in this, their most recent document, that they would not be eligible because they would require supplementary heating.

**Federal Incentives**

None of the above scenarios from the GGD analysis include any [Federal incentives](https://www.whitehouse.gov/wp-content/uploads/2022/12/Inflation-Reduction-Act-Guidebook.pdf) (see page 14), a version of which is shown in the table below.  Federal incentives are stackable with the Mass Save incentives, and depending on how these can be stacked (Federal first vs Mass Save first), the incentives will either total $6.4M (shown below) or $7.1M.

We anticipate meeting the prevailing wage requirements, the domestic cost requirements, and having the penalty for paying with tax-exempt bonds. We are showing the lower value of $6.4M in this document since it is the more conservative number.

There are no Federal incentives for WSHPs.



The Town, led by the Building Committee, is working on both the Mass Save and Federal incentives, and has hired an advisor to ensure that the Town receives these incentives.

**Estimated Capital Costs**

This section summarizes the capital costs more clearly than the GGD document and includes Federal incentives.  It does so without considering the costs of PV since that does not provide a like-to-like comparison of WSHP and GSHP costs.



As is shown in the table above, once all available incentives are considered, GSHPs have the lower estimated initial capital costs, with an estimated savings of about $2.3M over WSHPs.

**Estimated Running costs and Environmental Impact**

From a running cost perspective, again using the first two sets of tables, the running costs of GSHPs (option 3) would be $135,127 cheaper per year than those of WSHPs (option 2). Again, PV is not considered since the GGD document does not provide a like to like comparison.

From an emissions perspective the annual savings for option 3 over option 2 would be 291,857Kwh per year, the same as the amount of carbon sequestered by (at least) 127 acres of forest.   The Town is committed to zero emissions by 2040.

The cost of electricity is expected to remain largely stable over the next 25 years, [per research by NREL](https://www.nrel.gov/docs/fy22osti/78224.pdf). Should the cost of electricity increase, the case for GSHPs would be stronger since they use less electricity than WSHPs, and the Town would save more money. The emissions savings would remain the same.



**Estimated Lifetime Savings**

In the second table the lifetime savings for GSHPs vs WSHPs are calculated as $3,628,336.

This estimate considers initial capital costs; Mass Save incentives; annual maintenance; 20-, 30- and 40-year maintenance; and electricity running costs.

It does not consider Federal incentives estimated at $6.4M. The estimated total lifetime savings for GSHPs vs WSHPs including all incentives would be $9,979,682.



**Conclusion**

From an initial capital expenditure perspective and a lifetime cost perspective, in a like to like comparison, GSHPs are cheaper than WSHPs once all incentives are considered; and they are cheaper to run; and they are better for the environment.