Re-Adding Ground-Source Heat Pumps to the New Driscoll School Project

STM - October 5, 2021
Warrant Article 2

Updated 9/20/2021 AM

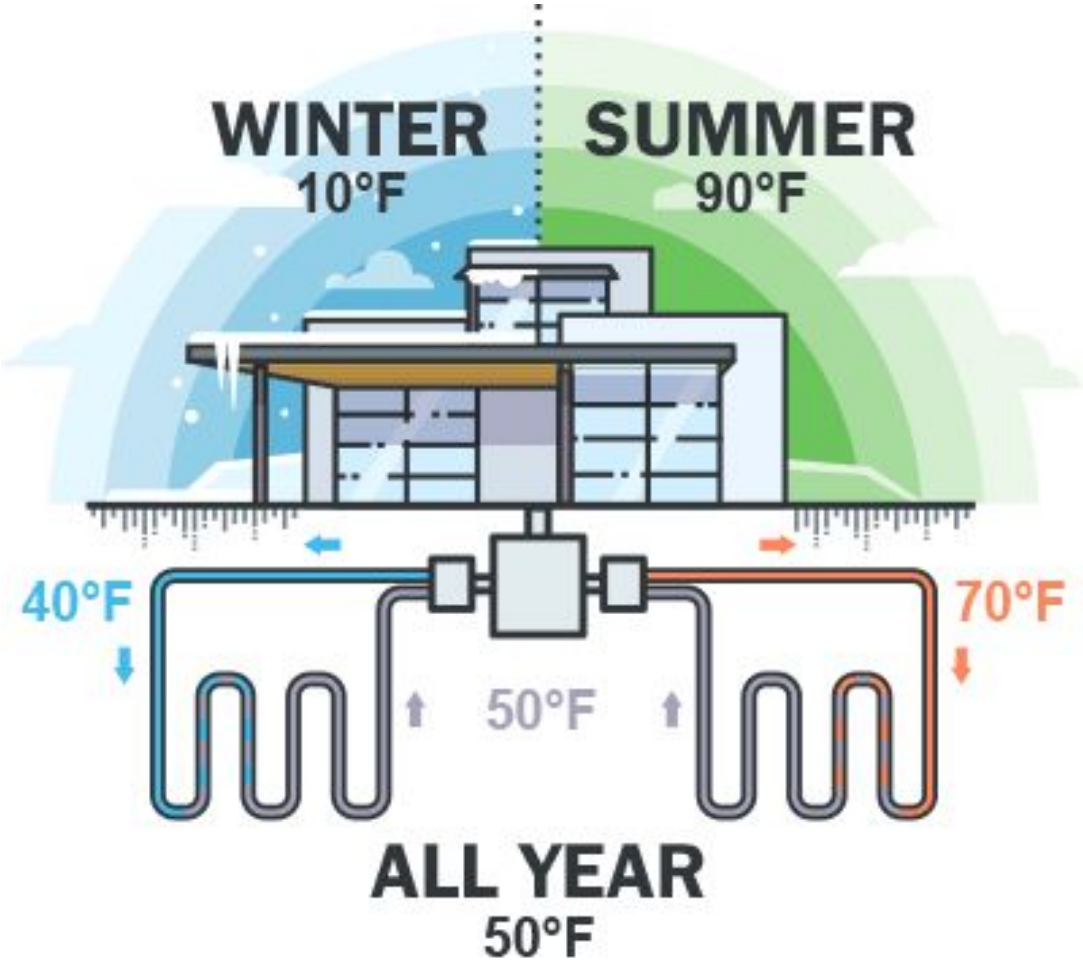
Why We Should Vote Yes on WA2

- For an **added investment of $4.8 million**, we can change the heating and cooling system of the new Driscoll from air-source heat pumps (ASHP--the current Base Bid) to **ground-source heat pumps (GSHP)**
- This change is projected to **cut the building's electricity consumption by 25%** each year and **cut its monthly demand by 44%** on average—significant sustainability improvements
- This change is **expected to pay for itself (and more)** over the building's expected useful lifespan—potentially up to 5x, and partially in real-time

In sum: to reduce BOTH cost AND carbon emissions over the project's life span!

What is a GSHP?

- A Ground-Source Heat Pump uses electricity to move heat between building and ground.
- It operates like an air conditioner or freezer.
- Heats and cools a building in a highly efficient manner.
- Relies on moderate ground temperature



The Up-Front Investment

- **Add $4,779,293 to project cost**, with **no material delay** expected in project completion timing (might add ~1 month to field readiness)
  - Driller cost = $2.96mm
  - Added sitework = $621k
  - Added HVAC equipment = $373k
  - Added plumbing work = $63k
  - Mark-ups (10% sub, insurance, etc.) = $438k
  - Save $8,000 in electrical work
  - Added design cost = $30k
  - Added contract allowance costs = $50k
  - Contingency = $250k

The Direct Economic Pay-Back

- **Somewhat lower projected maintenance costs:** ~5% reduction (~$3k per year in current dollars, but grows over time with inflation)

- **Materially lower projected capital replacement costs:** ~60% reduction (~$36k per year in current dollars, but grows over time with inflation)

- **Markedly lower projected electricity costs:** ~52% reduction (~$244k per year in current dollars, but grows over time with inflation)

- **Also adds a revenue stream:** sale of Alternative Energy Certificates (AECs)

Who Ran the Numbers?

- Garcia Galuska DeSousa Consulting Engineers (GG&D) projected the electricity usage and demand figures.
- The project team, led by Jonathan Levi Architects and Left Field LLC, projected the maintenance and capital repair/replacement savings.
- Deputy Town Administrator Melissa Goff provided the bond financing schedule.
- Scott Englander TMM-6 refined the electricity cost and savings analysis.
    - Scott is a career energy consultant who advises clients in electricity market economics, regulatory policy, and energy procurement

This Change Will Pay for Itself--and Then Some

- Projected savings fully **pay back the additional capital investment in approximately 20 years** (using 3.0% discount rate)
    - PSB and project team had estimated 28-43 year payback period before Scott Englander did a deeper dive on projected electricity rates; they are updating their calcs now
    - Regardless, even using the project team's most recent calculations, the investment is completely returned roughly halfway through the anticipated building service life--and the annual savings continue for the remainder!

- And that's **before factoring in any offsetting revenue from sale of Alternative Energy Certificates**—which would shorten the payback period and improve economics over system life cycle if realized

Projected Difference in Annual Electricity Demand

	Electricity Consumption (kWh)			Electricity Demand (kW)		
Month	**Base**	**GSHP**	***Savings***	**Base**	**GSHP**	***Savings***
January	183,271	107,365	*75,906*	2,840	374	*2,467*
February	155,626	101,340	*54,286*	1,681	378	*1,303*
March	135,834	94,010	*41,824*	1,689	369	*1,319*
April	108,048	83,575	*24,473*	1,615	347	*1,268*
May	82,853	83,977	*-1,124*	433	421	*12*
June	70,209	66,422	*3,787*	505	474	*31*
July	41,208	37,205	*4,003*	274	230	*43*
August	39,242	35,333	*3,909*	247	207	*40*
September	80,937	74,708	*6,229*	475	448	*28*
October	81,918	80,068	*1,850*	340	328	*12*
November	103,332	89,852	*13,480*	1,461	349	*1,112*
December	160,823	83,396	*77,427*	1,654	359	*1,294*
Total / Average	**1,243,301**	**937,251**	***306,050***	**1,101**	**357**	***744***

Today's marginal emissions rate for New England generation: 0.719 lb C02/kWh →

*Switch to GSHP could **eliminate 100 metric tons of CO2 emissions per year** at today's emissions rate*

Bonding the Capital Cost Makes The Right Choice Even Clearer

Project Year	Bond P+I Payment (3.0% int.)	Total Annual Projected Savings	Annual Budget Impact	Cumulative Budget Impact	Discounted Annual Impact (3.0%)	Discounted Cumulative Impact
1	$384,000	$0	-$384,000	-$384,000	-$372,816	-$372,816
2	$376,800	$0	-$376,800	-$760,800	-$355,170	-$727,986
3	$369,600	$299,160	-$70,440	-$831,240	-$64,463	-$792,449
4	$362,400	$307,729	-$54,671	-$885,911	-$48,574	-$841,023
5	$355,200	$316,548	-$38,652	-$924,563	-$33,341	-$874,364
6	$348,000	$325,623	-$22,377	-$946,940	-$18,740	-$893,104
7	$340,800	$334,962	-$5,838	-$952,778	-$4,747	-$897,851
8	$333,600	$344,572	$10,972	-$941,805	$8,662	-$889,189
9	$326,400	$354,462	$28,062	-$913,743	$21,507	-$867,682
10	$319,200	$364,640	$45,440	-$868,303	$33,812	-$833,870
15	$283,200	$420,150	$136,950	-$369,759	$87,903	-$497,806
19	$254,400	$470,669	$216,269	$374,524	$123,335	-$55,630
20	$247,200	$484,233	$237,033	$611,557	$131,240	$75,610
21	$0	$498,193	$498,193	$1,109,750	$267,803	$343,413
25	$0	$558,229	$558,229	$3,250,452	$266,613	$1,411,636
50	$0	$1,140,429	$1,140,429	$23,907,912	$260,140	$7,989,531
75	$0	$2,341,247	$2,341,247	$66,232,904	$255,068	$14,424,518

- Annual projected savings exceed annual debt service around Y8-Y10
- Cumulative break-even reached around Y20
- Discounted value of cumulative impact over 75 years is roughly $14 million in the Town's favor!
- Sale of AECs not included here--would add more revenue, speeding break-even point and increasing total long-term value

Multiple Potential Approaches to Paying Debt Service

1. Minor additional taxation, under the December 2019 debt exclusion vote
    - Projected operating cost savings would help ease budget pressure in future years

2. No additional taxation; pay out of operating budget lines that will realize savings from lower electricity, maintenance, and repair/replacement expenses over time
    - May require bridge mechanism for first few years until debt service and projected savings come into balance

3. Further federal infrastructure funding to municipalities also may materialize in the coming year, but we don't have to rely on that

Let's Not Forget the Major Sustainability Pickup

- Projected 25% reduction in electricity consumption and average 44% monthly demand reduction every year over the the service life of the school

- Lowest-impact way to provide effective indoor cooling for the community as climate change continues to increase the severity and frequency of summer heat waves

Could Brookline Get More Carbon Reduction/Climate "Bang for Our Buck" By Using These $$ Elsewhere?

- Wrong question (respectfully)
- As shown above, this is a carbon reduction investment that is reasonably projected to **cost us nothing** over the long term—indeed, to **save us more $$ than it costs**.
- This is the **only** opportunity we'll have within a meaningful timeframe to make this decision for the Driscoll School—it won't be feasible or economical to retrofit a geothermal system in the next year, in 5 years, or in 15 years
- That aside, how much carbon emissions reduction is enough? When have we done enough? Are we even close to that point now? **Given the immediacy and enormity of the climate change crisis, we don't have the luxury of carefully picking and choosing our battles.**

Is the reduction in energy use from switching to geothermal equivalent to purchasing renewable energy?

- Generally yes, but we also need to reduce electrical demand regardless of generation source--which this project does
  - GSHP system uses much less electricity than ASHP system because it draws heat from, and sinks heat to, constant temperature earth (~50° F year-round) rather than drawing heat from cold winter air and sinking heat into already-hot summer air
- Reducing consumption reduces transmission/distribution losses and need for storage to cover cloudy/windless days
- GSHP also drastically reduces max. monthly instantaneous use--which may help reduce need for gas generation used to manage peak New England system loads
- Could use some of the out-year savings to speed Brookline's transition to purchase of 100% renewable source electricity

In Line with Brookline's Green and Fiscal Prudence Values!

- If asked whether society should spend **more** public and private $$ to reduce energy consumption and carbon emissions, most Brookline residents would emphatically say YES!

- This change would allow us to further those goals by spending **FEWER $$!**

- In short, do we want to reduce carbon emissions AND save money?

Alternative Energy Credits

What are they and what do they mean for the Driscoll GSHP?

- Massachusetts Alternative Energy Portfolio Standard (APS), authorized in 2008 under MGL Ch. 25A §11F ½ and 225 CMR 16.00
- Like MA Renewable Portfolio Standard, requires electricity suppliers to procure environmental attributes called Alternative Energy Certificates (AECs)
  - AECs are like RECs, but for thermal & other technologies
  - Standard currently 5.25% of retail sales, increasing annually
  - Penalty for non-compliance: “Alternative Compliance Price” (ACP), currently ~$24, increasing annually; AEC price effectively capped at ACP
  - AECs for compliance years 2023-2024 currently trading at $23-$24
  - DOER has proposed increasing both APS standard and the ACP significantly
- When in heating mode, Driscoll GSHP would mint 5 AECs per renewable MWh produced. Town could sell AECs to aggregators under contract or at spot market prices
  - APS design criteria must be met; metering and independent verification is required. DOER lists approved aggregators and verifiers
- Unlike the Driscoll GSHP, the **ASHP option with supplemental heat would not be eligible**

Summary: Please Support Favorable Action on WA2

- This is our last realistic chance to make this change before we build this public building that will operate for 75 years or more.

- We all agree we need urgent action to reduce energy consumption and carbon emissions. Here's a tailor-made opportunity.

- And this change pays for itself--probably several times over in the projected useful life of the building and system.