Energy Storage Value of Geothermal

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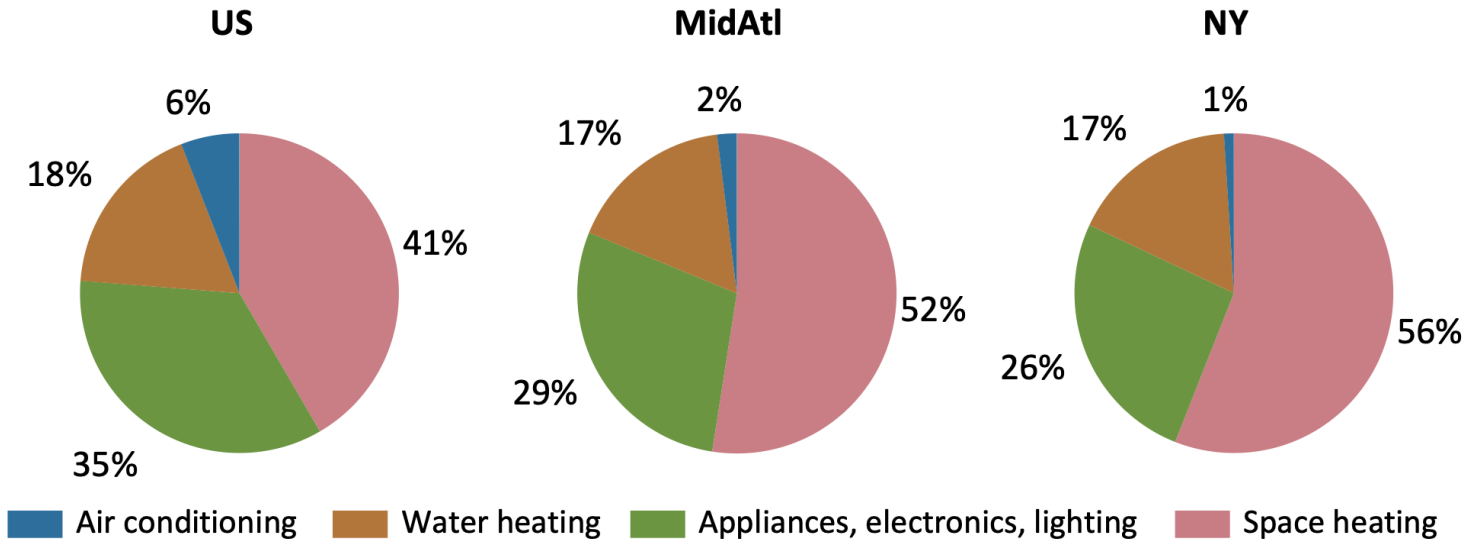
Buffalo Geothermal

Fossil fuels are used mainly for Heating/Hot Water (North Eastern U.S.) in Buildings



CONSUMPTION BY END USE

Since the weather in New York is cooler than most other areas of the United States, space heating (56%) makes up a greater portion of energy use in homes compared to the U.S. average, and air conditioning makes up only 1% of energy use.

https://www.eia.gov/state/print.php?sid=NY

Significant different winter peak performance between technologies (Brattle Report Rhode Island)

COP ASHP = 1.3, GSHP (Geo) =3.6

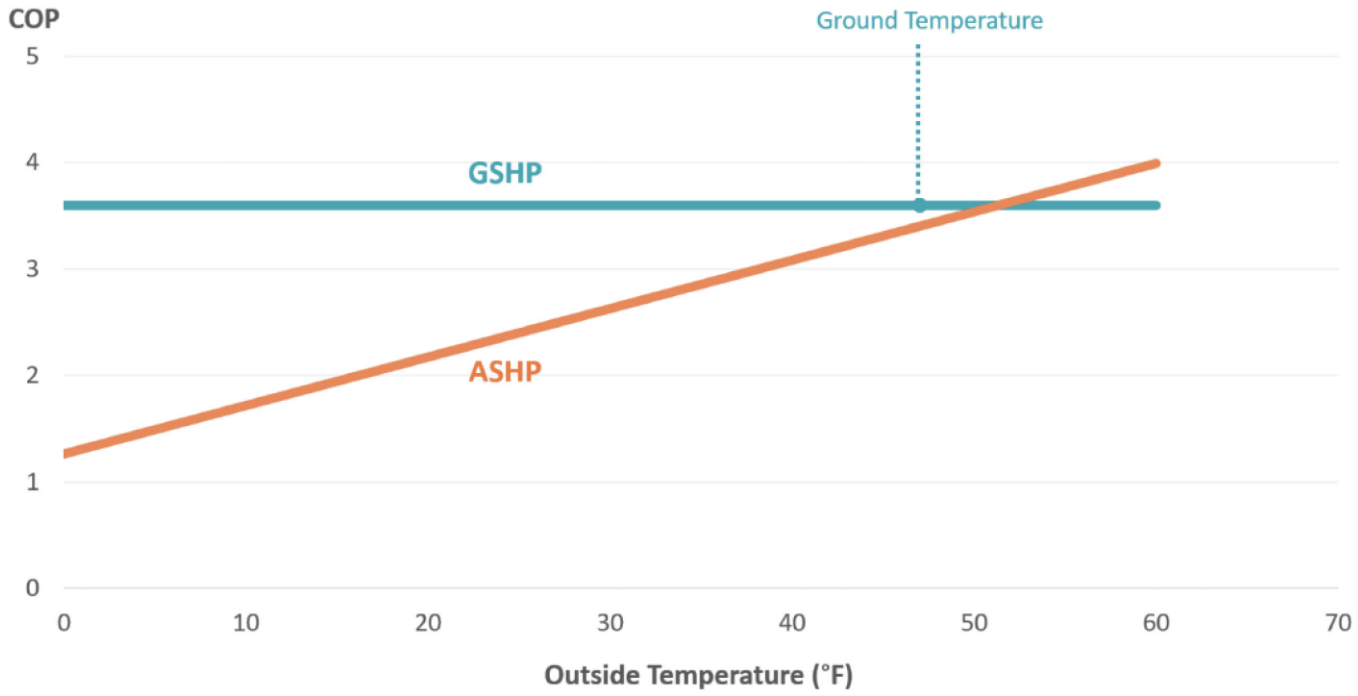


FIGURE 9: RELATIONSHIP BETWEEN OUTDOOR TEMPERATURE AND HEAT PUMP EFFICIENCY (COP)

New Efficiency: New York Analysis of Residential Heat Pump Potential and Economics

Final Report | Report Number 18-44 | January 2019

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

Table 4-3. 2018 Statewide Residential and Commercial Thermal Load (Space Heating and Cooling)

End Use	Statewide Residential & Commercial Load (TBtu)
Space Heating	557
Space Cooling	221
Total	778

New Efficiency: New York

Analysis of Residential Heat Pump Pote

Table 2.2 - FLH Appropriate for Use with GSHP Nominal Capacity	
Albany	1,345
Binghamton	1,534
Buffalo	1,415
Massena	1,469
New York (LGA)	1,222
Poughkeepsie (Newburgh)	1,350
Syracuse	1,412

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Statewide weighted average EFLH = 1,321

BTU to Watt conversion factor = 3.412

Heating load = 557 TerraBTU

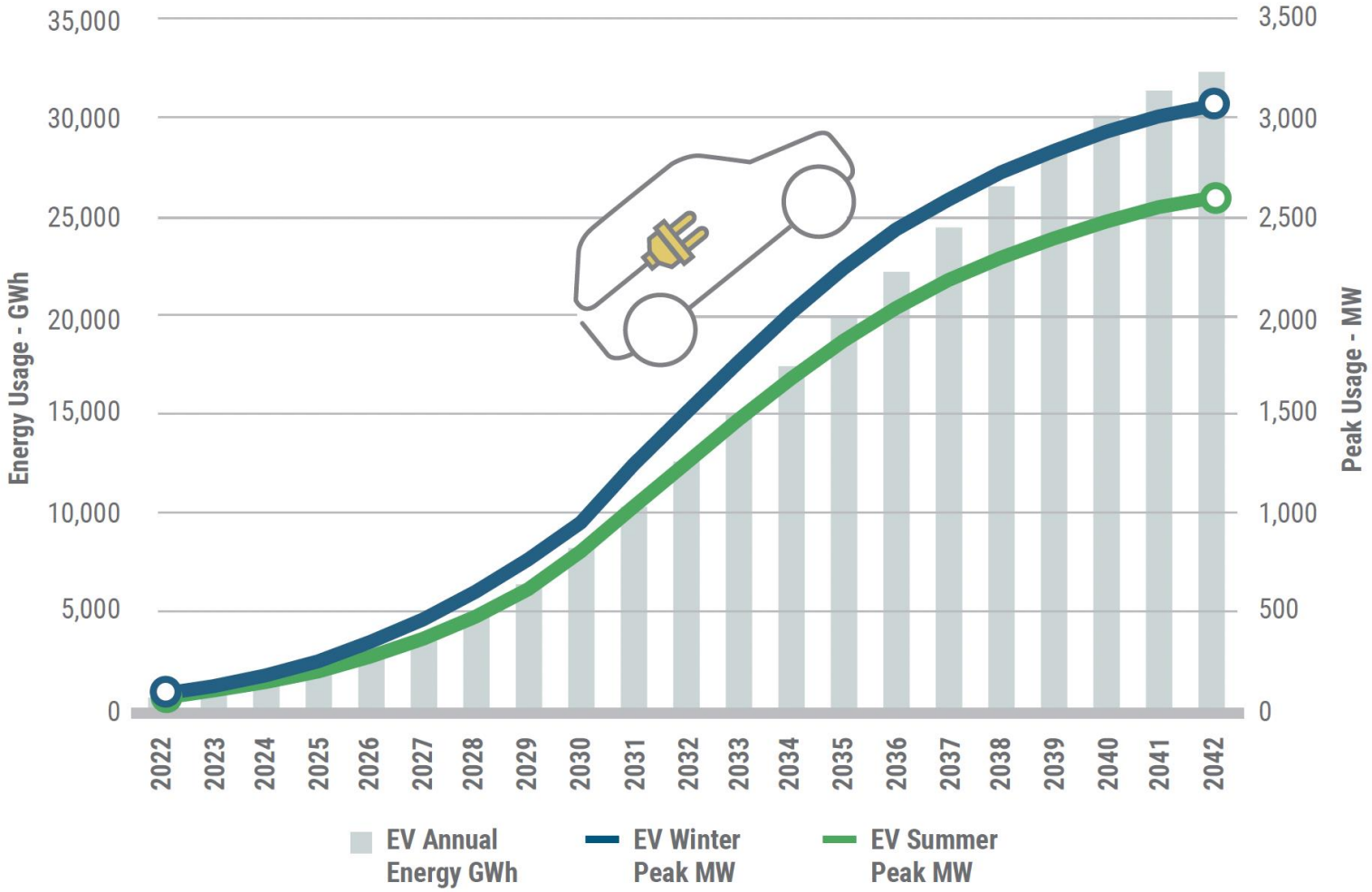
Peak Load = 557,000 Giga BTU/(3.412 x 1,321)

= 123.58 Giga Watt

- Without the hot water load
- Without Process heat
- Without EV charging

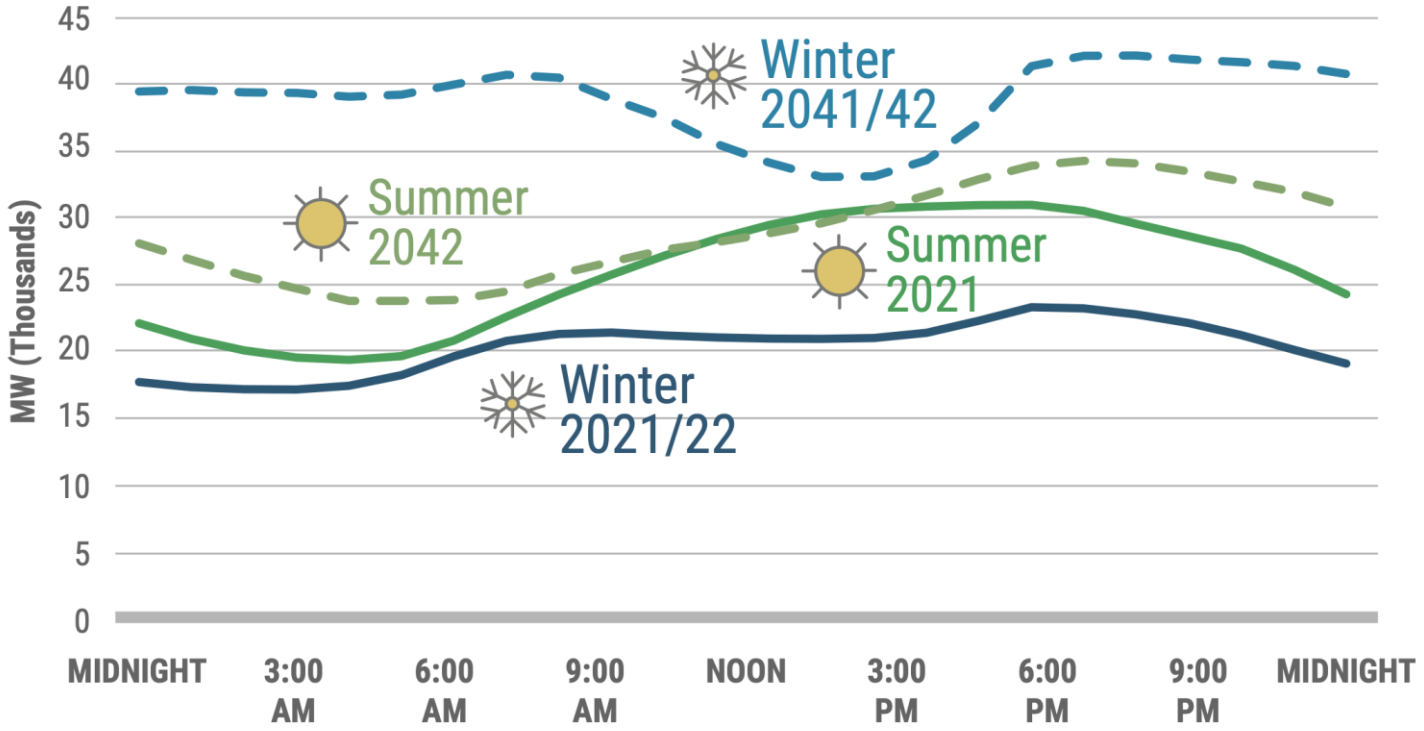
Electric Vehicle Peak Dwarfs Heating Peak

Figure 8: **Electric Vehicle Energy and Peak Impacts - Baseline Forecast**



Where Grid planning is wrong…..

Figure 3: **2021 New York Control Area (NYCA) Bulk Electric System 2021 Actual and 2042 Forecasted Winter/Summer Load Shapes**



NYSERDA Geothermal Heat Pump Study 2017 Peak Thermal Load Occurs Between 7 - 8 am

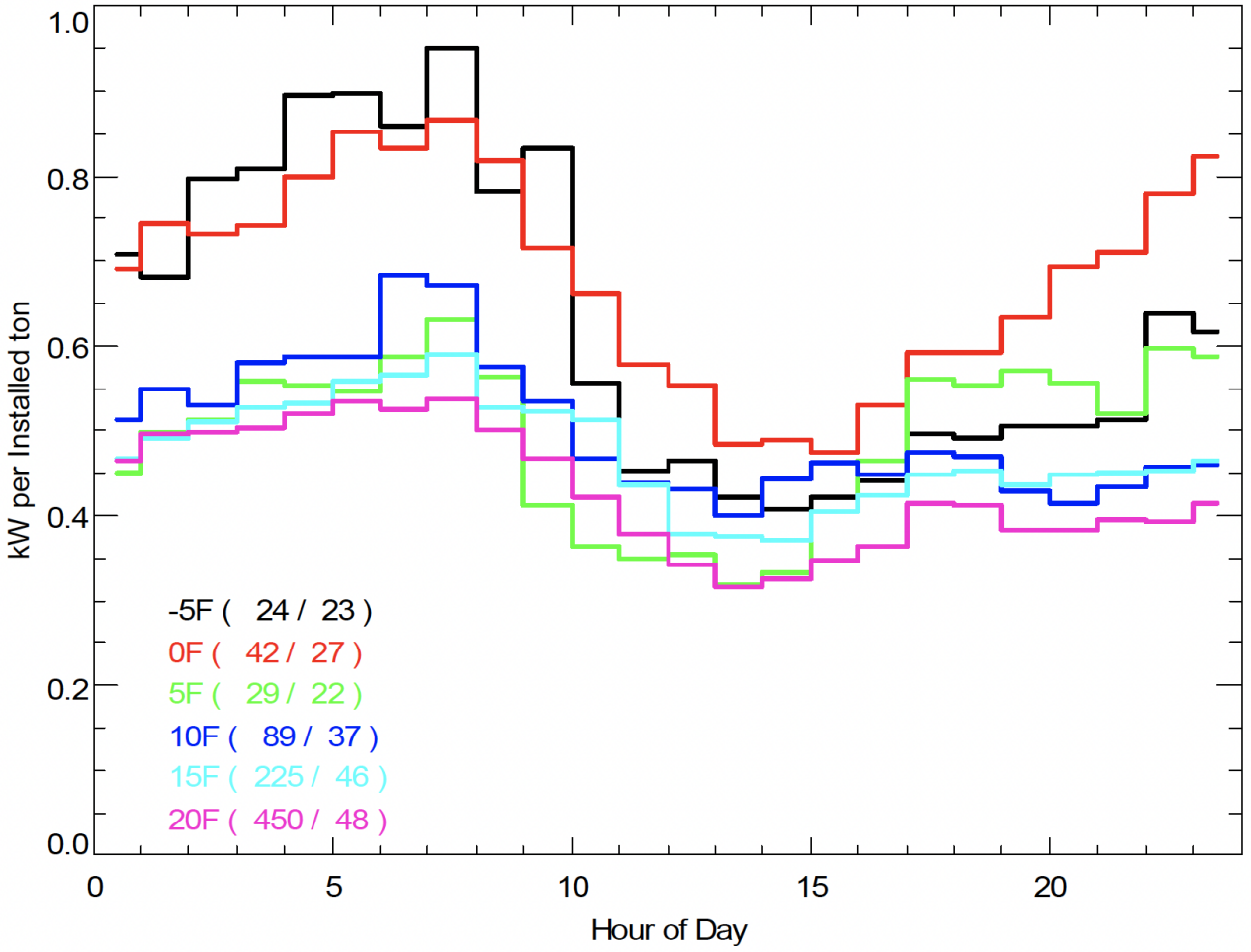
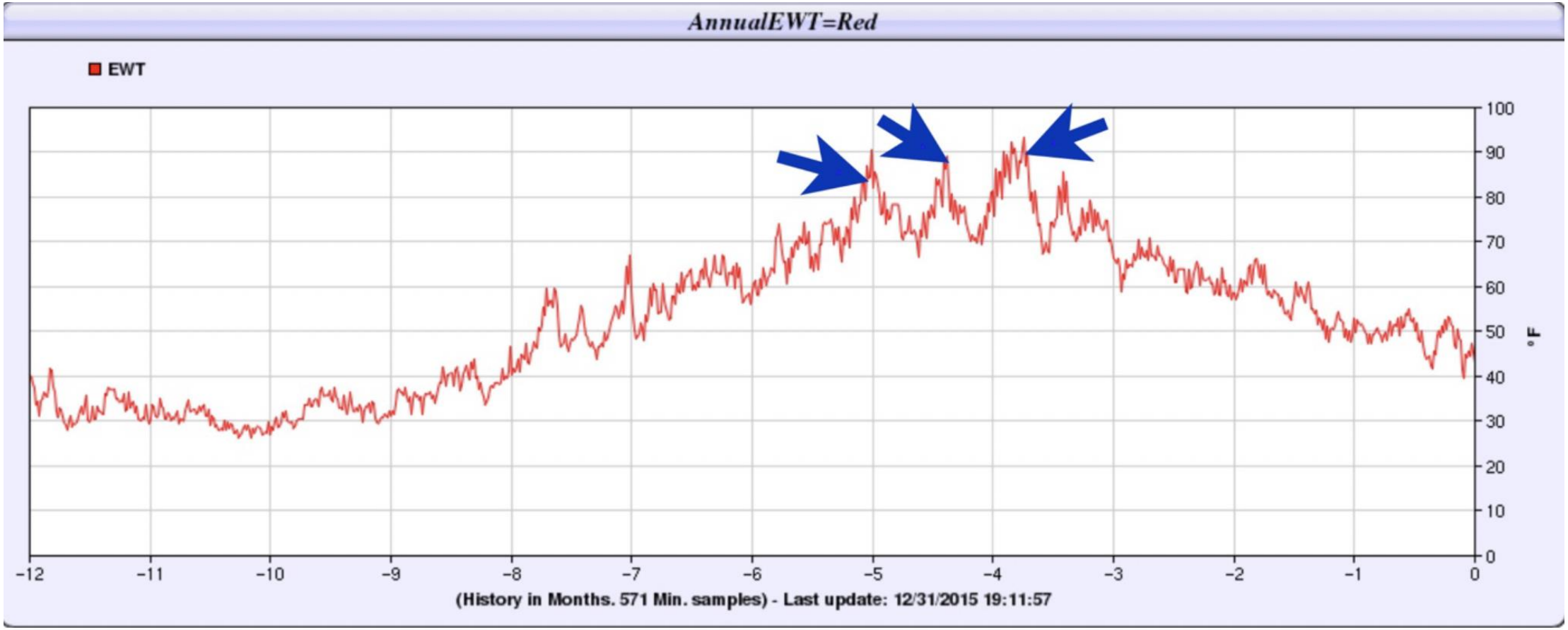


Figure 22. Average Winter Electric Demand Profiles at Various Outdoor Temperatures

Cooling Tower and Heating Plant operating at the same time

Annual Loop Field Temperature (Buffalo, NY) Multifamily Building



The ultimate thermal energy battery

- 1) The loop field stores all the thermal energy of the building in the boreholes for the whole year, enough to provide all the heating energy for the whole heating season.
- 2) It does not need to be connected to other buildings (no district), it makes all the energy it needs. The key is the storage.
- 3) It stabilizes below 30F and does not dip below, since it is making ice around the boreholes, which releases a large amount of heat due to the phase change. It is partly a phase change storage technology.
- 4) It reacts immediately to energy input and output.

If we would have a battery which….

- Provides 75% energy for a home
- On a 6” footprint
- For a 6 month period (winter)
- Recharged by solar in the summer

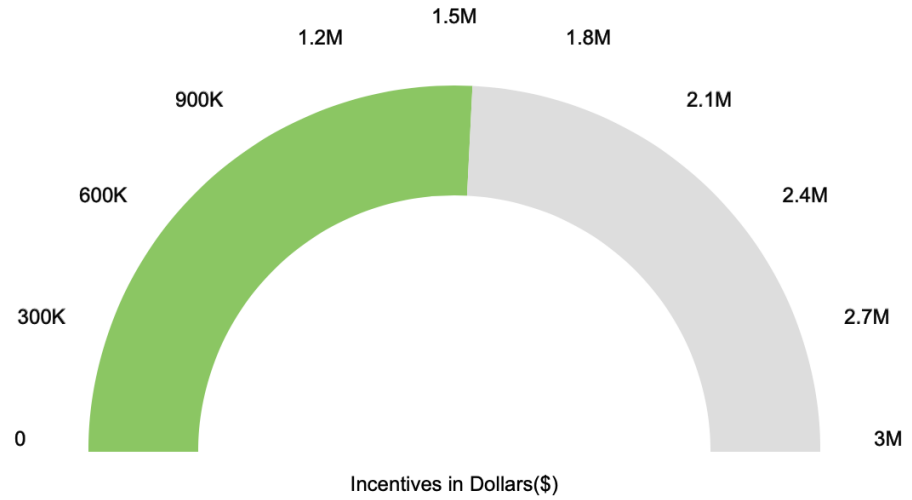
- We would not have a grid anymore!

On an average single family home (4 ton) the loop field, during peak time the borehole delivers around

- 30,000 BTUs/hour of the thermal energy
  - 540,000 BTUs/day
  - 158 KWh/day
- Electric storage is currently $800/kwh installed
  - Tesla Battery currently $7,500/14 kwh plus installation
  - Grid storage is currently $576/KWh
- Value of 24 hour storage capacity $91,000 (158 KWh x $576/KWh)
- Current incentive level for battery storage around $250/kwh
  - Would avoid same amount of electric storage capacity
- For a 6 month period (winter)
- Recharged by solar in the summer

Current Battery Storage Incentives

Long Island Single-Family Residential Incentives - Block 2

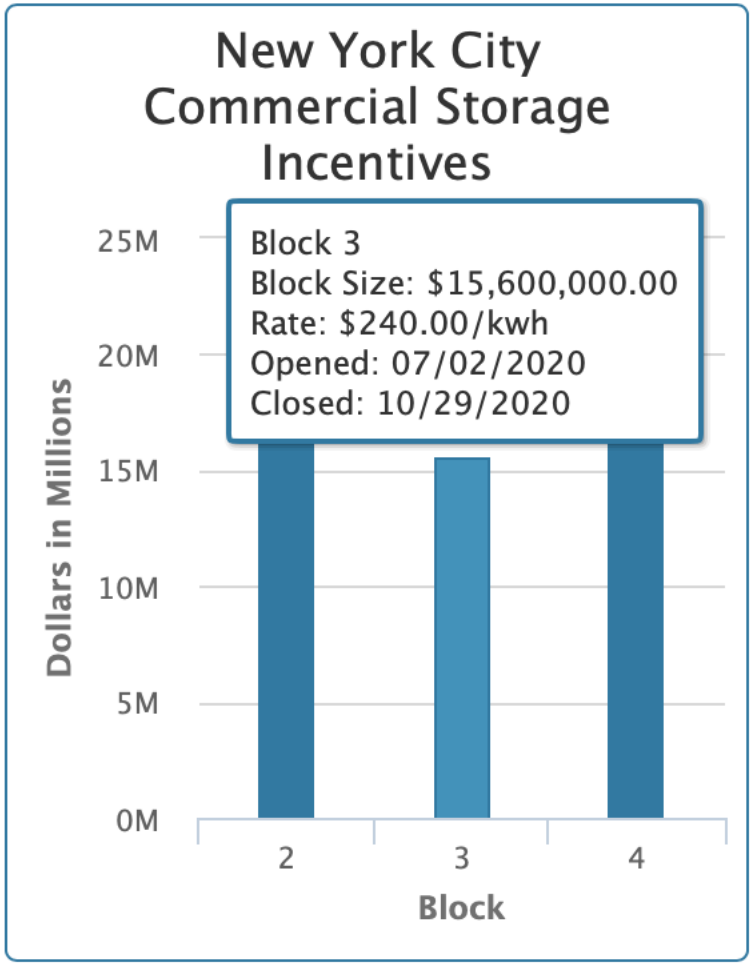


Allocated Budget: $3,000,000

Committed Budget: $1,547,375

Available Budget: $1,452,625

Current Incentive : $250/kWh



On an average single family home, the loop field stores and delivers

- 75% of the thermal energy for a home
  - 98 Million BTU annually
  - 28 MWH of thermal energy storage
- For a 6 month period (winter) = 28.429 MWh

- The upfront cost of geothermal systems is more expensive to install than ASHP, but the value of the energy storage to the grid more than compensates from a system perspective.

Grid of the future

- No solar capacity at 7 am in the winter morning
  - Need storage
- Wind generator (supply) capacity at $1.2B/GW
  - 74 instances in 2020 when NYCA wind fleet output remained below 100 MW for more than 8 consecutive hours (NYISO Power Trends 2021)
- Delivery capacity at $3.6B/GW (3 times the supply rate)
- $250/KWh x 158 KWh = $39,500 per household

Need help with….

- Drilling beyond 500 feet
  - Without a permit
  - Barrier to implementation of geothermal in dense urban environment
  - Especially Retrofits
  - DEC legacy rule