It is the peak KW, not the average KWH, which matters !

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BUFFALO GEOTHERMAL HEATING™

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NY-GEO

Heat Pump Assessment Study – an EPRI Report

New York ISO
Independent System Operator

Load Forecasting Task Force
December 19, 2022

- TRNSYS simulates the behavior of transient systems

- Model home 2,600 sqf house in Albany
- Average COP was 2.30 at design conditions in Albany
- At -3°F the COP was 1.12 (incl. supplemental heat)
- Supplemental power is required when demand exceeds 6 kW.
- 17.53 KW peak demand

Field study confirms NYISO modeling (Cadmus Study)

- *Average Heating Performance, COP 2.25*
- *Average Outside Air Temperature, 17.2 °F*
- *Average Site-Metered Demand, 2.77 kW*
- ***Maximum Site-Level Demand (2-min interval), kW 17.25***
- “Note that electric resistance demand is not included in the calculation of ducted system performance shown in this table.”

- https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/PPSER/Program-Evaluation/Residential-ccASHP-Building-Electrification-StudyAugust-2022.pdf

Field study confirm NYISO modeling (Hudson Valley Study)

- *Average Heating Performance, COP 2.1*
  - the average efficiency was about 63% of the rated efficiency

- *All sites used supplement heat*
- *Peak demand was not measured*

- https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/PPSER/Program-Evaluation/22-08-Hudson-Valley-Heat-Pump-Pilot-Project-complete.pdf

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 Pot

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

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

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

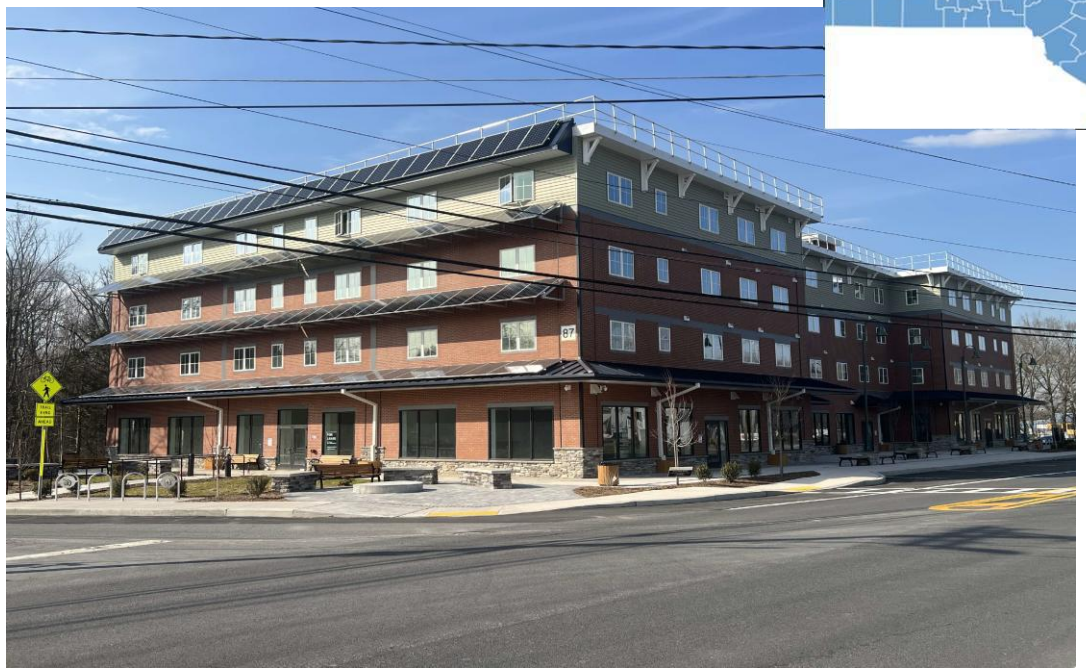
- Without the hot water load
- Without Process heat
- Without EV charging

NYISO issued the *2021 – 2040 System & Resource Outlook (NYISO Powertrends 2023)*

- *"The Outlook* concludes that unprecedented levels of investment in generation will be necessary to reliably deliver sufficient energy to meet future demand.
- *The Outlook* concludes that by 2040 New York's grid would need the following to reliably meet the goals of the CLCPA and expected peak demand:
  - **111-124 GW of generating capacity,** or roughly three times the current capacity connected to the system.
  - **27-45 GW of this capacity** must be from non-emitting resources capable of performing like today's fossil fuel-fired generation fleet depending on the scenario. **It is especially important to note that commercially available technologies to provide dispatchable, non-emitting supply do not exist at scale at this time. "**

Requirements for Future Heating System

- 1) The heating system's efficiency and capacity must operate independent of the outside temperature
- 2) It must cover the full load without supplement resistance heat.
- 3) It must not only reduce the heating but also the significantly the cooling load.
- 4) It must make all the domestic hot water without electric resistance heat.



ZerOPlace

New Paltz NY

Mixed use, Net-Zero Energy Building:
63,320sf (2020 Completed)

46 Residential Apts (55,780 sf)

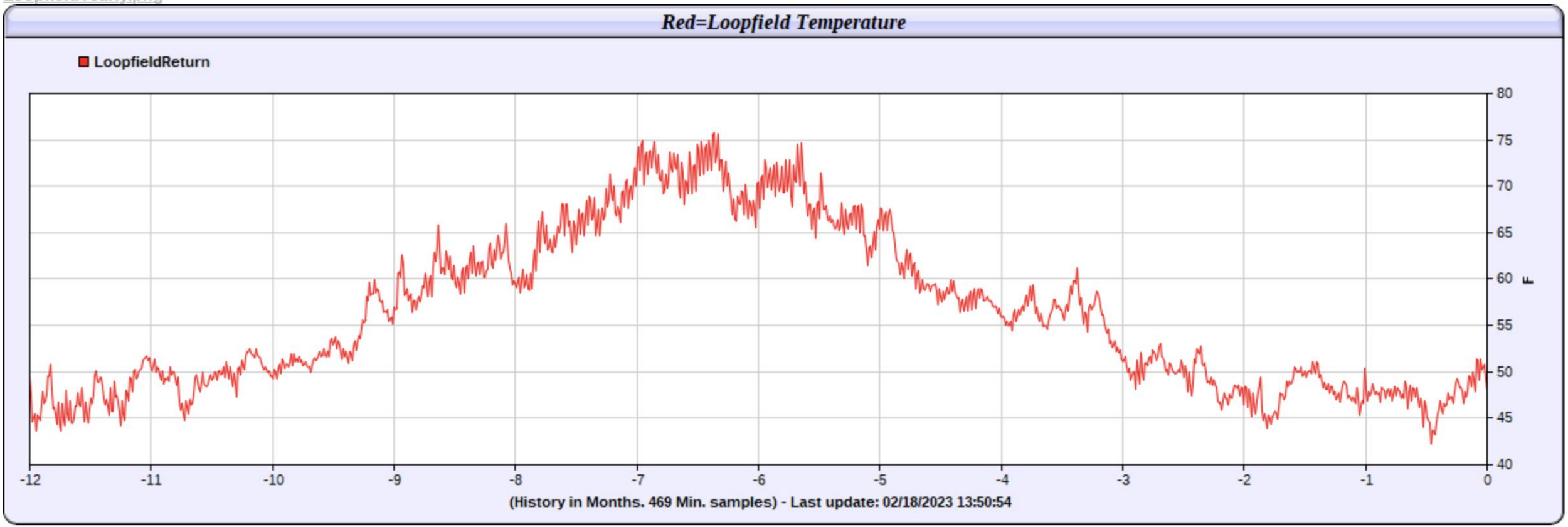
6 Retail spaces at Ground Flr (7,540sf)

https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/Research/Other-Technical-Reports/24-37-ff.pdf

12 Month Annual Entering Water Temperatures 2/18/2022 -2/18/2023 Thermal Battery Zero Place

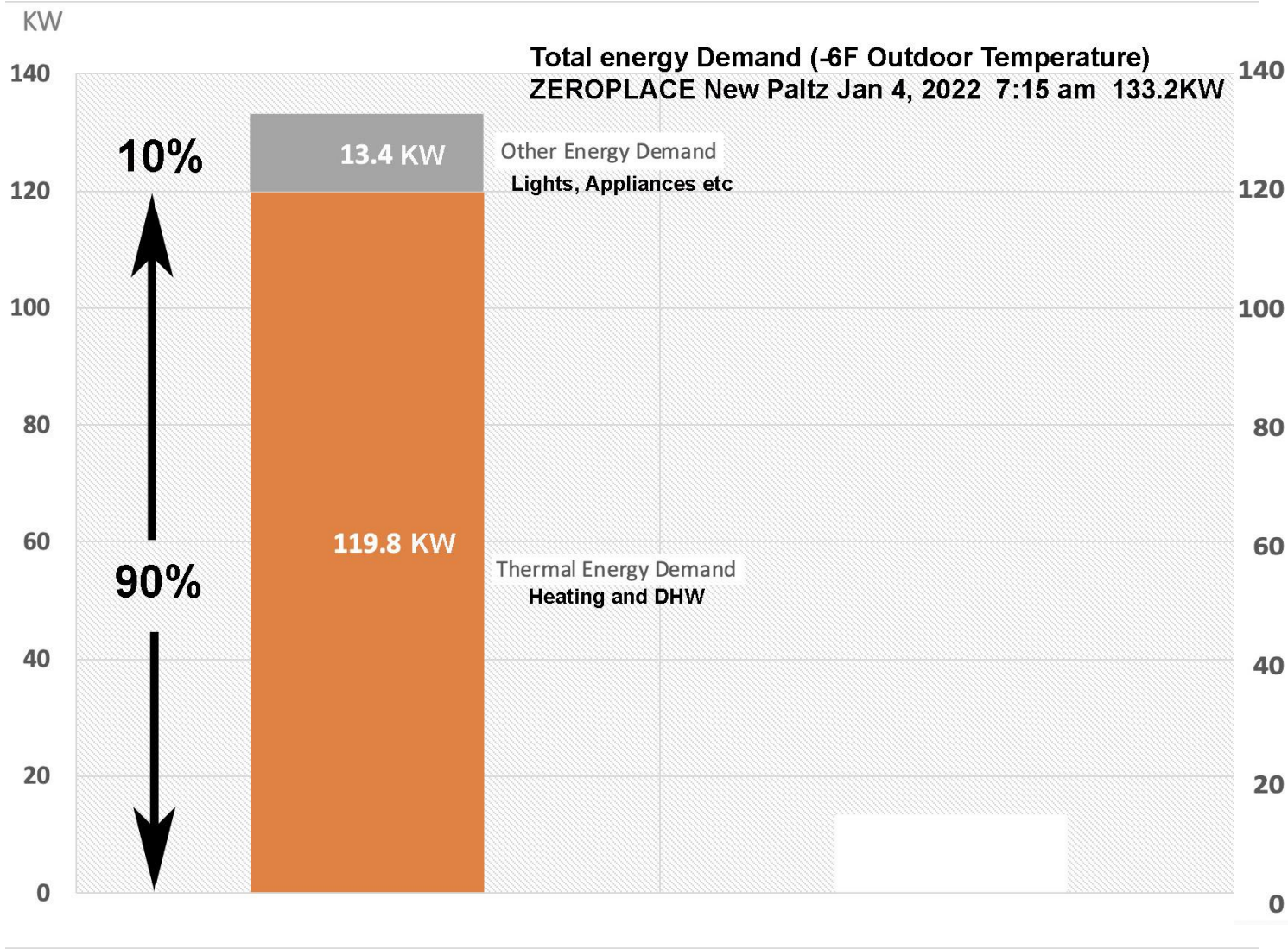
- Heating up the ground
  - Storing summer A/C rejection in the ground
  - Reusing it in the winter

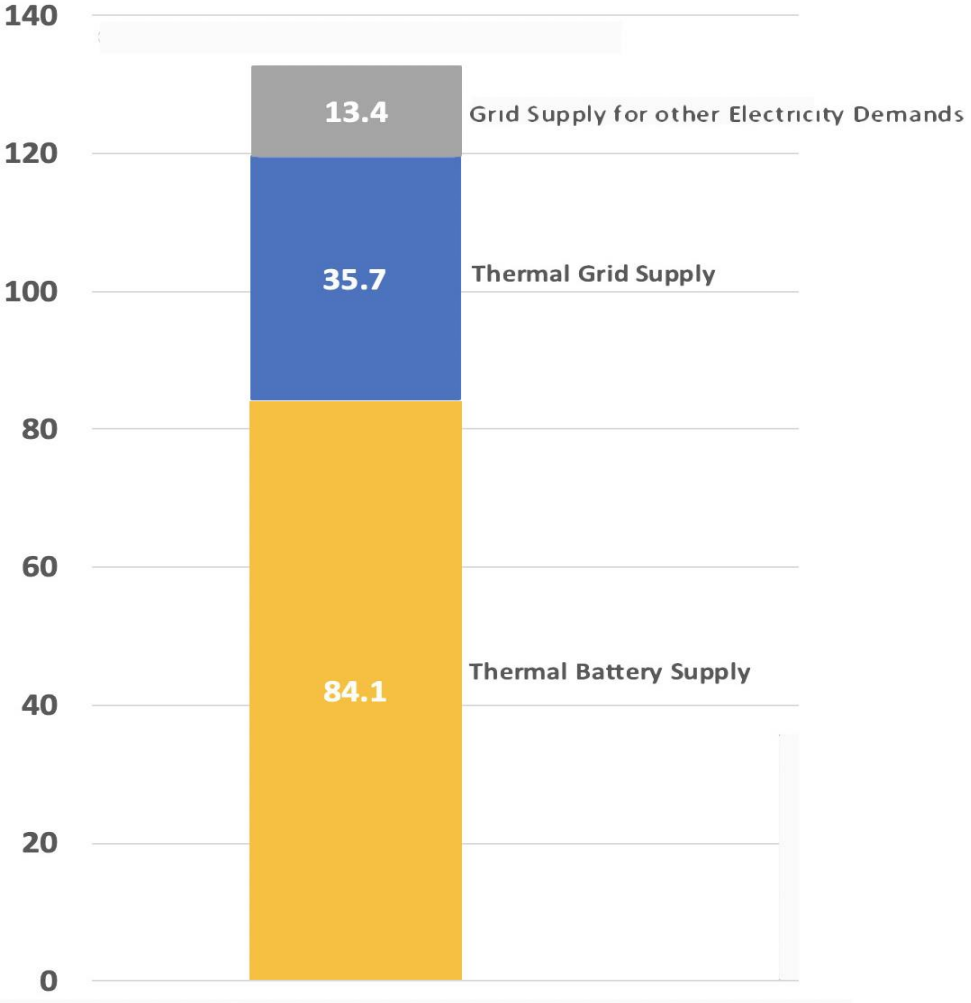
LoopfieldYearly.png



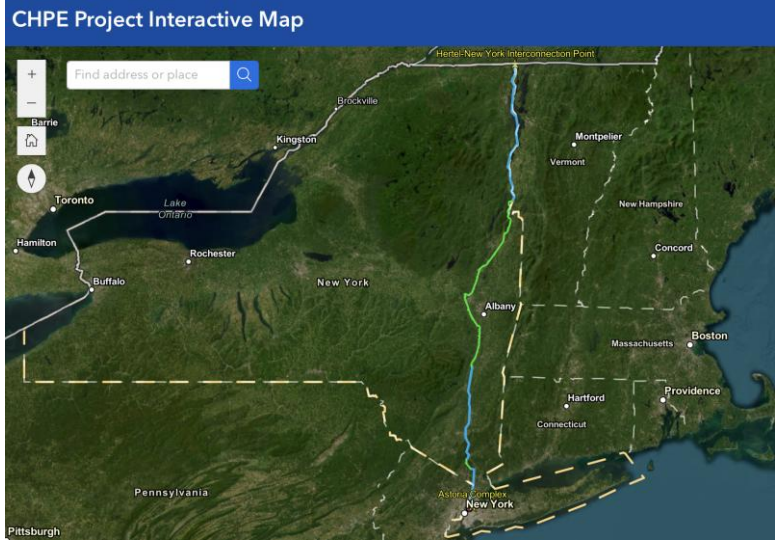
Peak Demand Energy Use
(15 min utility demand)

90% of the entire energy load of the building was DHW and heating (Thermal Load)





Examples of grid capacity costs



- The Champlain Hudson Power Express (CHPE)
  - 1.2 Gigawatt capacity
  - $6 Billion costs
  - $ 5,000 /KW for transmission line only
    - This does not include cost of power or distribution
    - Contract is only for the summer, since Quebec needs it for the winter heating

- Off-Shore wind $3 billion for 810 MW capacity (Empire Wind 1, Jan 2025)
  - $ 3,708/KW (capital cost)
  - Plus $9.3 billion to operate and finance it over 25 years (Net Present Value $1,020/KW)
    - https://newatlas.com/energy/nyc-3-billion-offshore-wind-farm/

- The utility distribution costs $2,500-$3,500 per KW capacity
  - Pan-Am building in Buffalo NY (new build 150 apartments) required additional feeder line due to air source heat pumps ($5M = $33,000 per apartment)

ZeroPlace Loop Field Thermal Energy Delivery avoided 24h storage capacity

Monetary Value @567/kWh*

Peak Day (Feb 4)		1,706.81	kWh	$ 967,762

*"Among projects awarded NYSERDA incentives, average total installed costs for non-residential, retail projects averaged $567/kWh for installations occurring in 2022 and 2023"
Case 18-E-0130 – In the Matter of Energy Storage Deployment Program.
New York's 6 GW Energy Storage Roadmap Policy Options for Continued Growth in Energy Storage.pdf

Cost of the entire Loop Field at ZeroPlace (Thermal Battery) $390,000

Examples of grid capacity costs

$390,000 Thermal Ground Battery

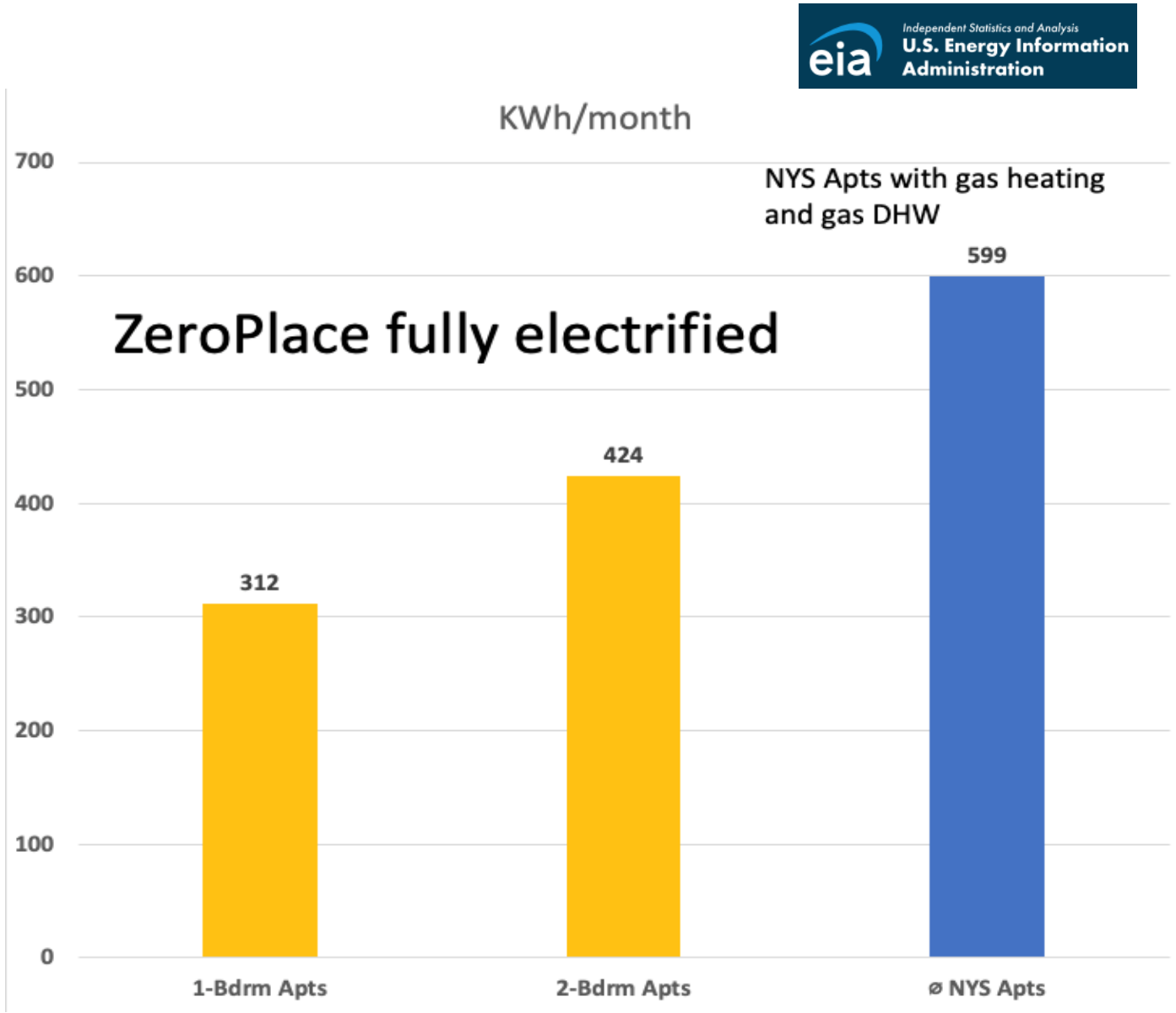
compared to Electric Resistance (COP=1) or ASHP (COP=1.12 (NYISO simulation)

- The Champlain Hudson Power Express (CHPE) transmission line
  - 84.1 KW x $5,000/KW = $420,500
  - ASHP (84.1 KW / 1.12 COP) x $5,000/KW = $375,450

- Electricity generation savings (Empire Wind 1, Jan 2025)
  - 84.1 KW x $4,728/KW = $397,625
  - ASHP (84.1 KW / 1.12 COP) x $5,000/KW = $375,450

- The utility distribution costs $2,500-$3,500 per KW capacity
  - 84.1 KW x $3,000/KW = $252,300
  - ASHP (84.1 KW / 1.12 COP) x $3,000/KW = $225,268

Average electricity usage per Apartment (inclusive of all space conditioning and central DHW)



Heating Peak

Feb 4th 2023, 7:30-7:45 am

- *Outdoor Temp = -6°F*
- *All WSHPs = 29.3 kW*
- *DHW HPs = 2.8 kW*
- *Loop Pumps = 0.45 kW*
- *Building = 43.8 kW*

Cooling Peak

July 28th, 2022 5:00-5:15 pm

Outdoor Temp = ~95°F

All WSHPs = 28.5 kW

DHW HPs = 0.0 kW

Loop Pumps = 0.50 kW

Building = 43.5 kW

Conclusion

- The ground is capable of supplying 70% of the needed generating capacity, over 123 GW in NYS
- Geo system installation can achieve the immediate passive house standard
  - Even in retrofit installations without significantly improving the envelope

- Geo is the only choice we have to reliably deliver sufficient energy for Heating (at any cost) to meet the CLCPA goals; no other technology is available onsite.
  - Automatically dispatched emission-free thermal energy from the thermal ground battery

What we get from the Ground,
we do not have to get from the Grid !