Aligning GHP Value with Required Thermal Investments

Moderator: John Ciovacco / *Aztech Geothermal, LLC*

Panel: Jens Ponikau / *Buffalo Geothermal*
Mark Kleinginna / *Emergent Urban Concepts*
Jared Rodriguez / *Emergent Urban Concepts*

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

Jens Ponikau CGD

President, New York Geothermal Energy Organization

Buffalo Geothermal LLC

02-27-2025

BUFFALO GEOTHERMAL HEATING™

www.BuffaloGeothermalHeating.com

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 Pot

Update May 2019

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

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

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)

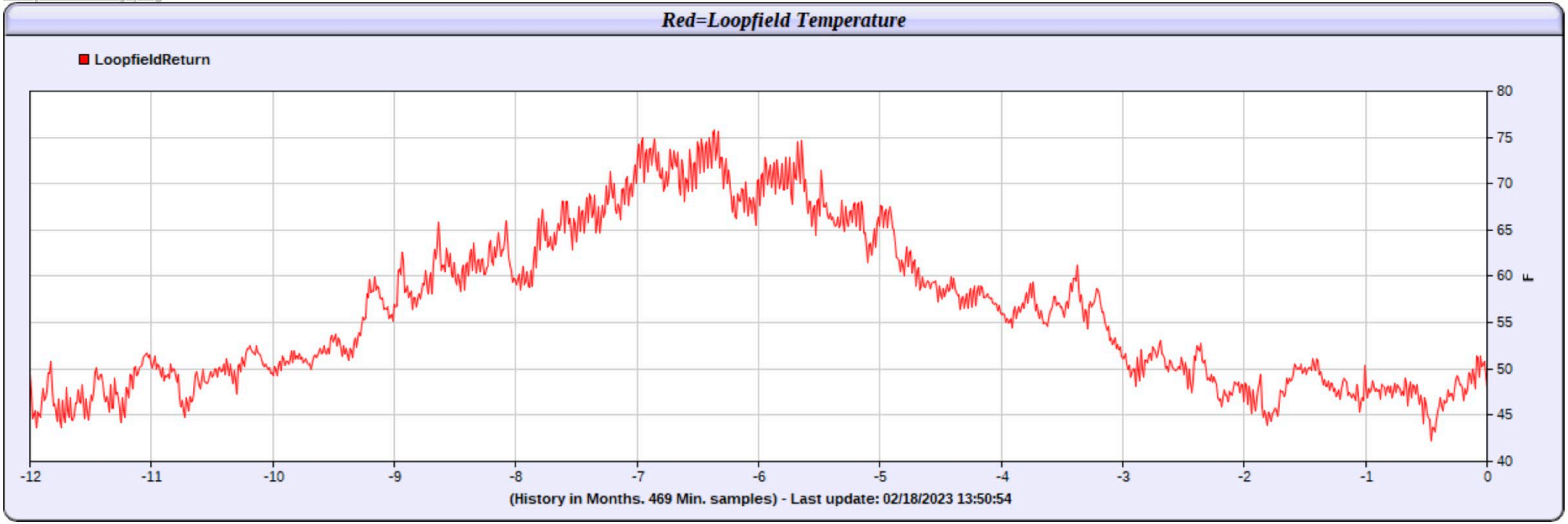
6 Retail spaces at Ground Flr (7,540sf)

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

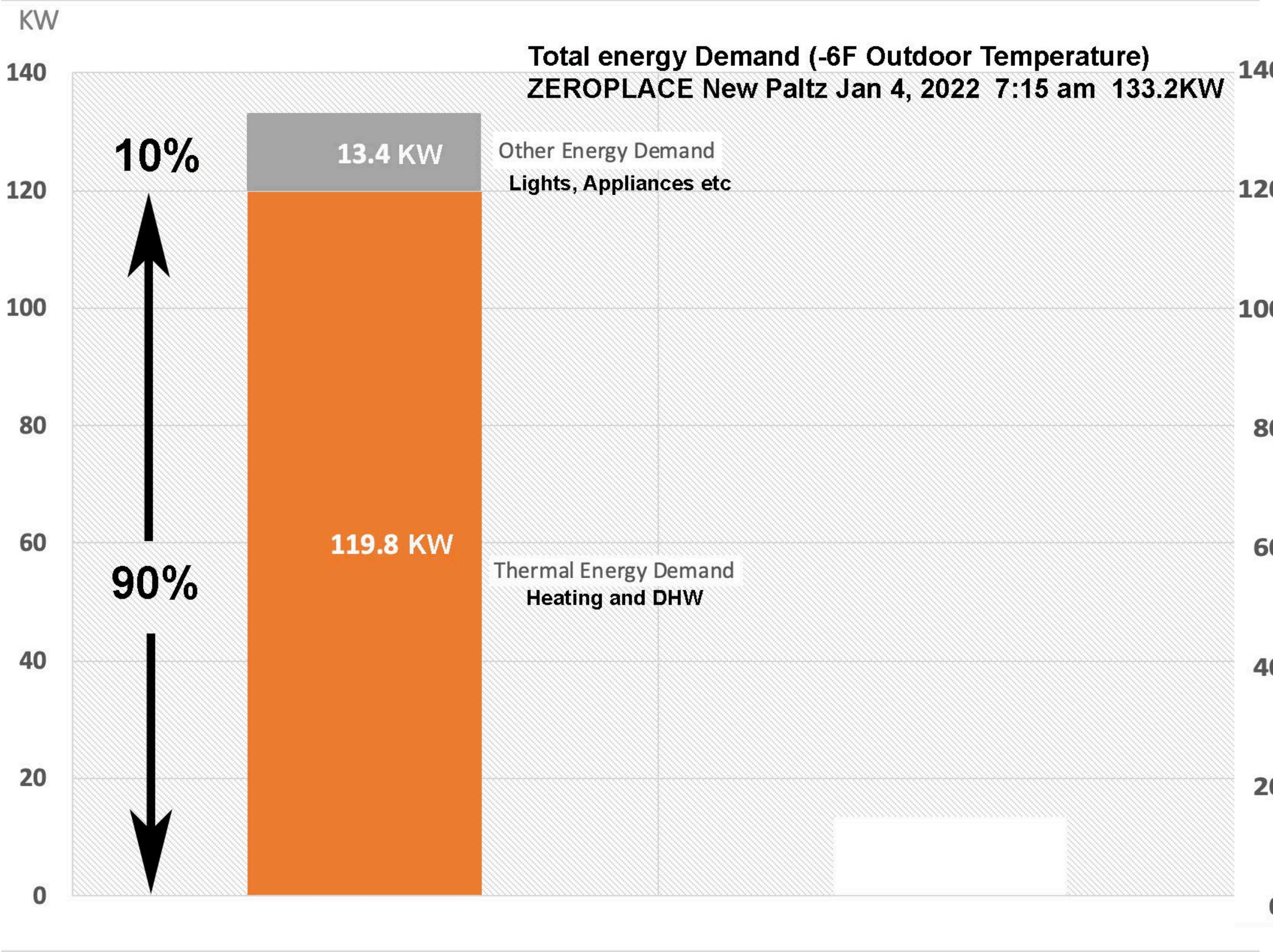
LoopfieldYearly.png

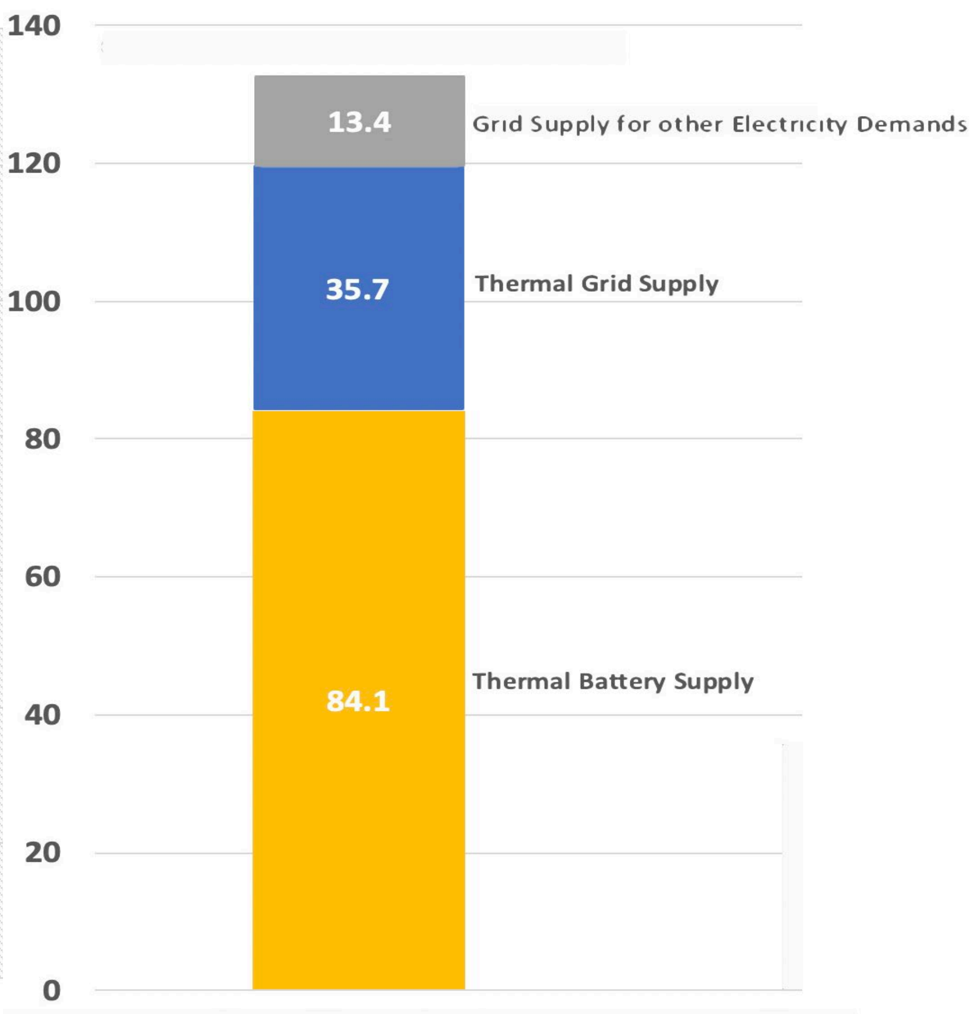


Peak Demand Energy Use

(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
    - 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)

$11,364/KW Cost for Grid Capacity versus Geo = $4,161/KW for Grid Avoidance (37%)

Examples of grid capacity costs

$ 350,000 Thermal Ground Battery (Zero Place New Paltz ,NY) 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 $4,728/KW = $355,022

- 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

- **Total = $955,740 for 84.1 KW = $11,364/KW**

ZeroPlace Loop Field Thermal Energy Delivery avoided 24h storage capacity

Monetary Value @567/kWh*

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

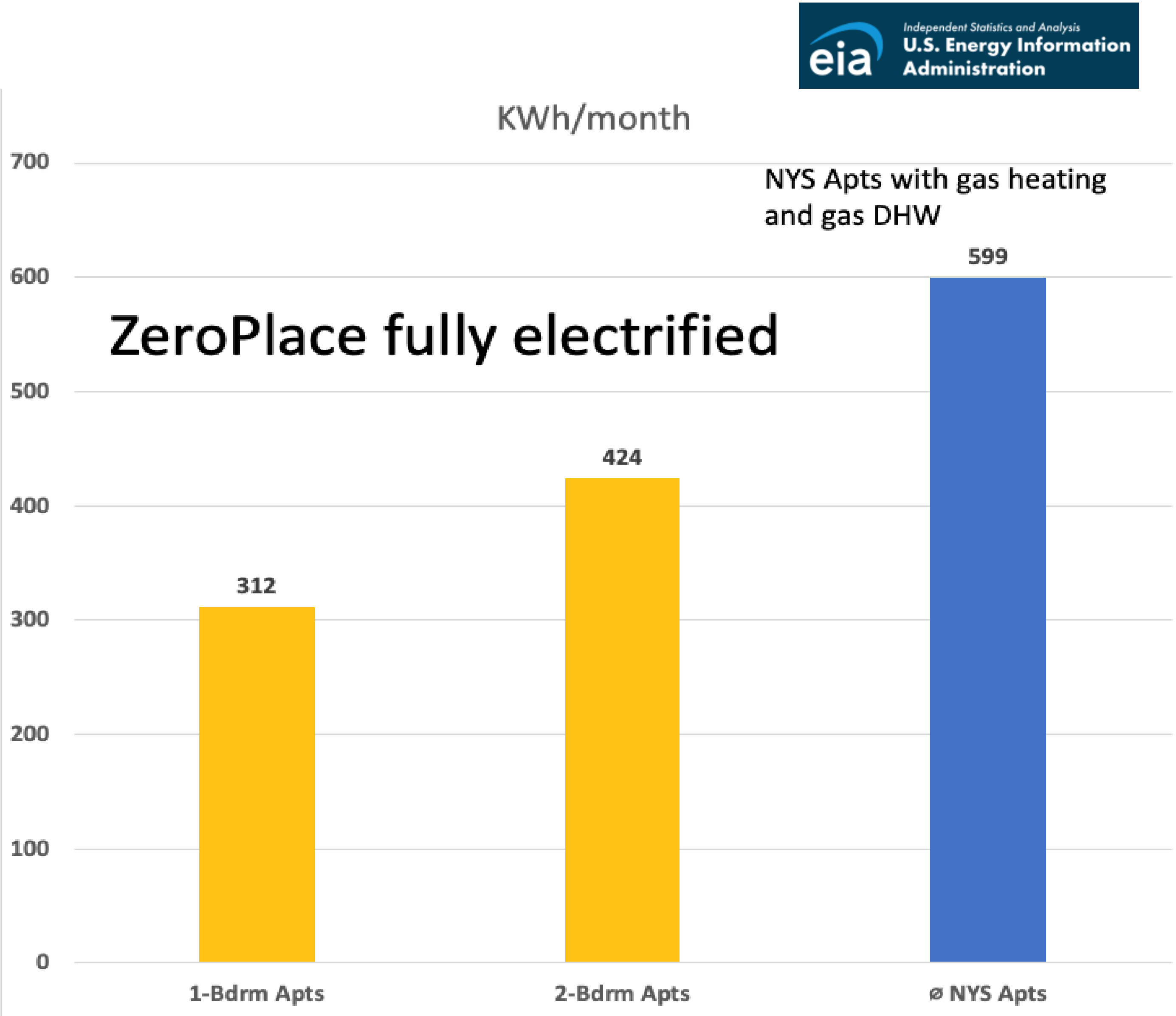
*"Among projects awarded NYSERDA incentives, average total installed costs for non-residential, retail projects averaged $567/kWh for installations occurring in 2022 and 2023"
Case 18-E-0130 – In the Matter of Energy Storage Deployment Program.
New York's 6 GW Energy Storage Roadmap Policy Options for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

Cost of the entire Loop Field at ZeroPlace (Thermal Battery) $350,000

Grid of the future

- No solar capacity at 7 am in the winter morning
  - Need storage
- Wind generator (supply) capacity at $1,200/KW
  - 74 instances in 2020 when NYCA wind fleet output remained below 100 MW for more than 8 consecutive hours (NYISO Power Trends 2021)

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

The ultimate thermal energy battery

- 1) The geothermal loop field stores all the thermal energy of the building 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 stores all the energy it needs (Distributed Energy Resource = DER)
- 3) It stabilizes below 30F, since
  - It is making ice around the boreholes, which releases a large amount of heat due to the phase change
  - During absolute peak time it becomes a phase change technology
- 4) It reacts instantaneously to energy input and output
  - Not a single BTU (Watt) is lost
  - All the energy rejected goes into the ground, or extracted comes out of the ground.
- 5) Capacity never gets depleted
- 6) 200+ years life expectancy

Danger

- The All-Electric Building Act (AEBA) provides an exemption from the all-electric building requirement, “when electric service cannot be **reasonably** provided by the grid.”
- The Department of Public Service has written a white paper that proposes an 18-month threshold for reasonableness.[1]
- If the electric utility estimates that it will take 18 months longer to complete the electric grid upgrades necessary to serve an all-electric building as compared to serving the same building through the electric/fossil fuels infrastructure, then, the AEBA exemption applies.

Conclusion

- The ground is capable of supplying 70% of the needed generating capacity for heating and DHW, over 123 GW in NYS
- Geo system installation can achieve immediate passive house standard
  - Even in retrofit installations without significantly improving the envelope
- Geo is the only choice we have to reliable 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 !

Unlocking the Electric Capacity Value of the Thermal Energy Network

Mark Kleinginna

NY-GEO

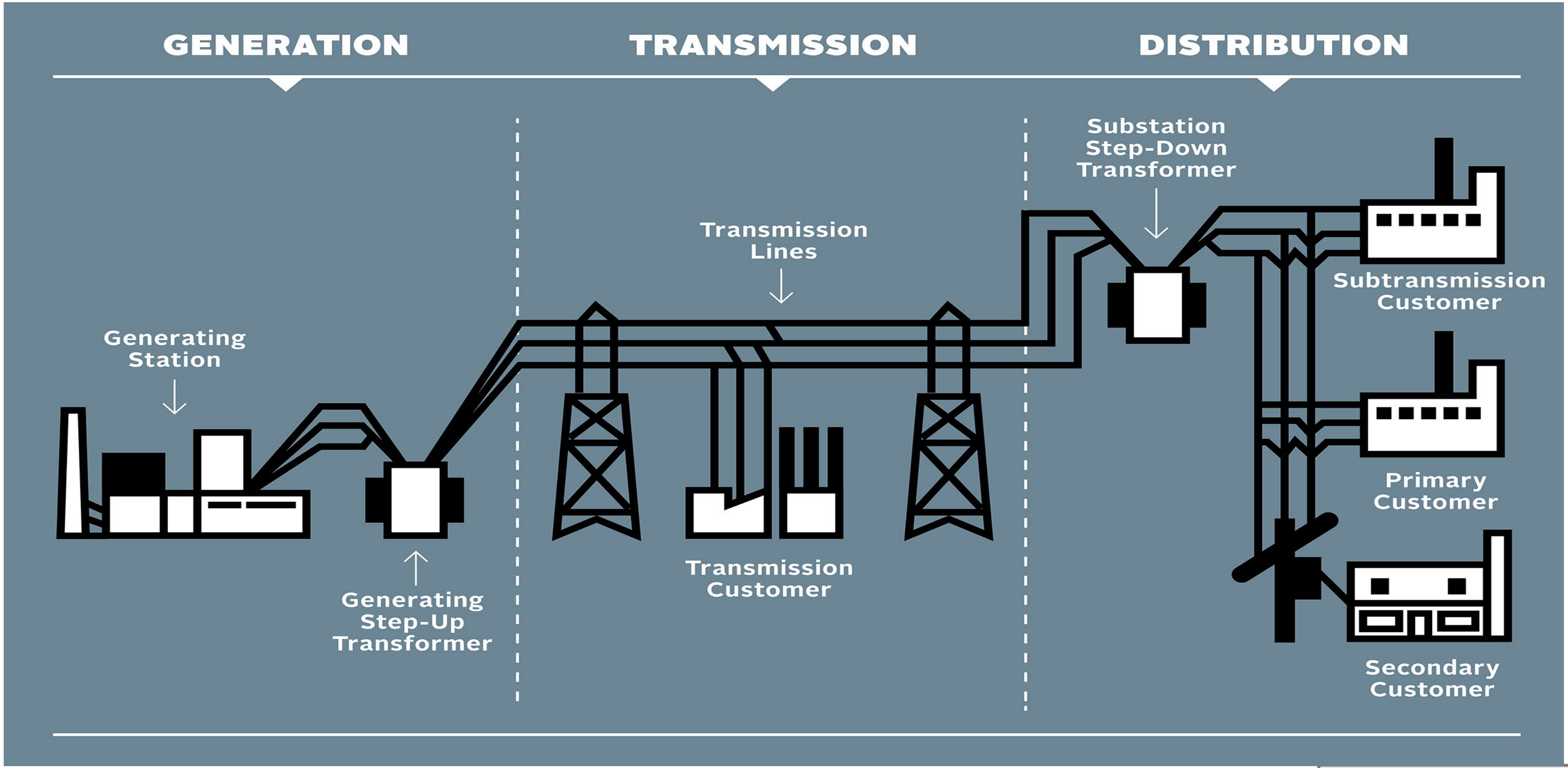
April 24,2025

EMERGENT URBAN CONCEPTS

Mismatch in Financial Recovery for Value Provided

- As we have seen from Jens’ presentation, there are major capacity benefits of ground source heat pump deployment to the electric grid at each functional level:
  - Generation,
  - Transmission,
  - Distribution
- **We also know that we have NOT been able to capture these benefits to the electric grid as developers of TENs projects**

EMERGENT URBAN CONCEPTS



EMERGENT URBAN CONCEPTS

What is the Source of the Cost Recovery Mismatch?

- The thermal network is treated as a resource which provides primarily a heating/cooling function
- This means that cost comparisons are developed as comparisons at the residential or commercial meter based on unit heating costs
- The actual benefits of GSHP's and their networks are not fully realized by developers because the lower electric demand benefits are spread over the entire electric rate base in the form of slower design day demand growth
- **The electric grid is an economic "FREE RIDER"**

EMERGENT URBAN CONCEPTS

Simplified Example of fully and fairly allocating Electric Distribution Costs

Residential ASHP Installation	
Annual Heating Consumption (kWh):	15,000
Electricity Rate ($/kWh):	0.25
Annual payment for new heat pump (20 year life	2,808
Annual heating cost ($)	6,558
Difference Between ASHP and GSHP (before allocation of incremental distribution)	(907)
Increased Demand due to lower COP (kW)	12
Annual Demand Cost per kW ConEd	436
Increased Demand Cost for Residential Customer ($)	5232
Total Heating Cost	11,790
Difference Between ASHP and GSHP fully and fairly loaded	4,325

Residential GSHP Installation	
Annual Heating Consumption (kWh):	9,000
Electricity Rate ($/kWh):	0.25
	5,216
Annual heating cost ($)	7,466
Increased Demand due to lower COP (kW)	0
Annual Demand Cost per kW ConEd	436
Increased Demand Cost for Residential Customer ($)	0
Total Heating Cost	7,466

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What is happening here?

- One of the main reasons we know that we are not capturing the electric capacity value of GSHP is because we see TENs developed at campuses which are able to internalize the free rider problem because they are responsible for increased electric demand or the installation or upgrading of electric distribution substations
- The ASHP installation is a "free rider" because it does not have to pay the full cost of increased demand on the system
- In reality the entire electric system is a "free rider" on the TEN as the value of lower peaks is spread very thinly across the entire rate base
- (The costs shown in the simplified example calculation are underestimated because they are based on "embedded" costs not actual "build-out" or "marginal" costs and only look at distribution)

EMERGENT URBAN CONCEPTS

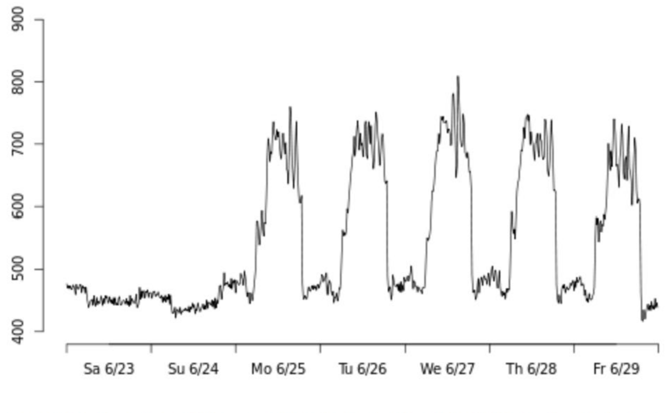
How do we make the “Free Rider” pay?

- There are pathways to making the TEN receive the appropriate compensation from the electric grid for the capacity it provides
  1. Wholesale Capacity Markets already exist to compensate demand response and energy efficiency resources
  2. Wholesale Transmission Markets publish Open Access Transmission Tariffs (OATT) which provide price signals to load serving entities
  3. Non-Wires Alternatives (NWA) have already been used by distribution utilities to incentivize lowering peak loads to avoid adding expensive new distribution infrastructure

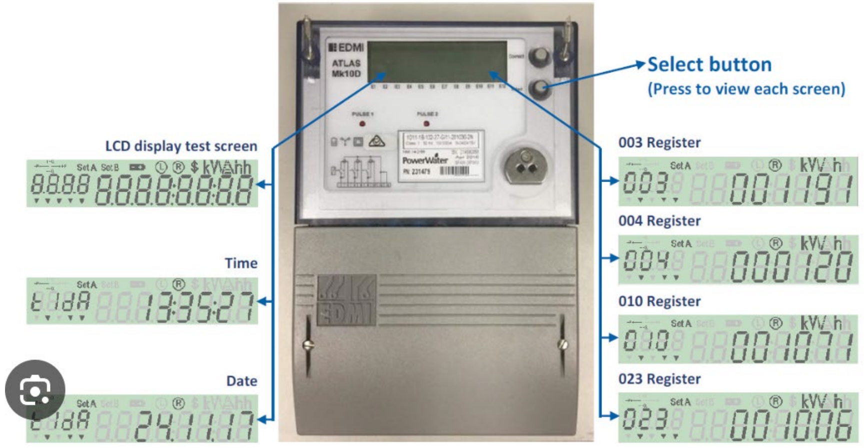
EMERGENT URBAN CONCEPTS

What do we need to do to make this money available to the TEN developer?

- **<u>Measure</u>** the ability of the TEN to reduce peak load:
  - <u>Every</u> pilot in <u>every</u> state must mandate that the utility prepare an electric peak reduction measurement protocol which is then vetted and approved by interested parties and staff
  - Every pilot in every state must mandate that the utility who develops the TEN must immediately hang interval meters for all loads (before and after)
  - Make all such measurements transparent to all stakeholders



Interval data provides a detailed view of building operations.



EMERGENT URBAN CONCEPTS

What do we need to do to make this money available to the TEN developer?

Participate with an interested and coordinated voice at the following proceedings in your state:

- Electric Rate Cases
- Gas Rate Cases
- Gas Planning Dockets
- Grid of the Future Proceedings

This is necessary to get GSHP and TENs developments accepted as electric capacity resources and force the FREE RIDER to compensate the asset for its capacity contribution…

EMERGENT URBAN CONCEPTS

Questions?

EMERGENT URBAN CONCEPTS

A Regulatory Framework to Accelerate Resource Efficient Decarbonization with GHPs + TENs

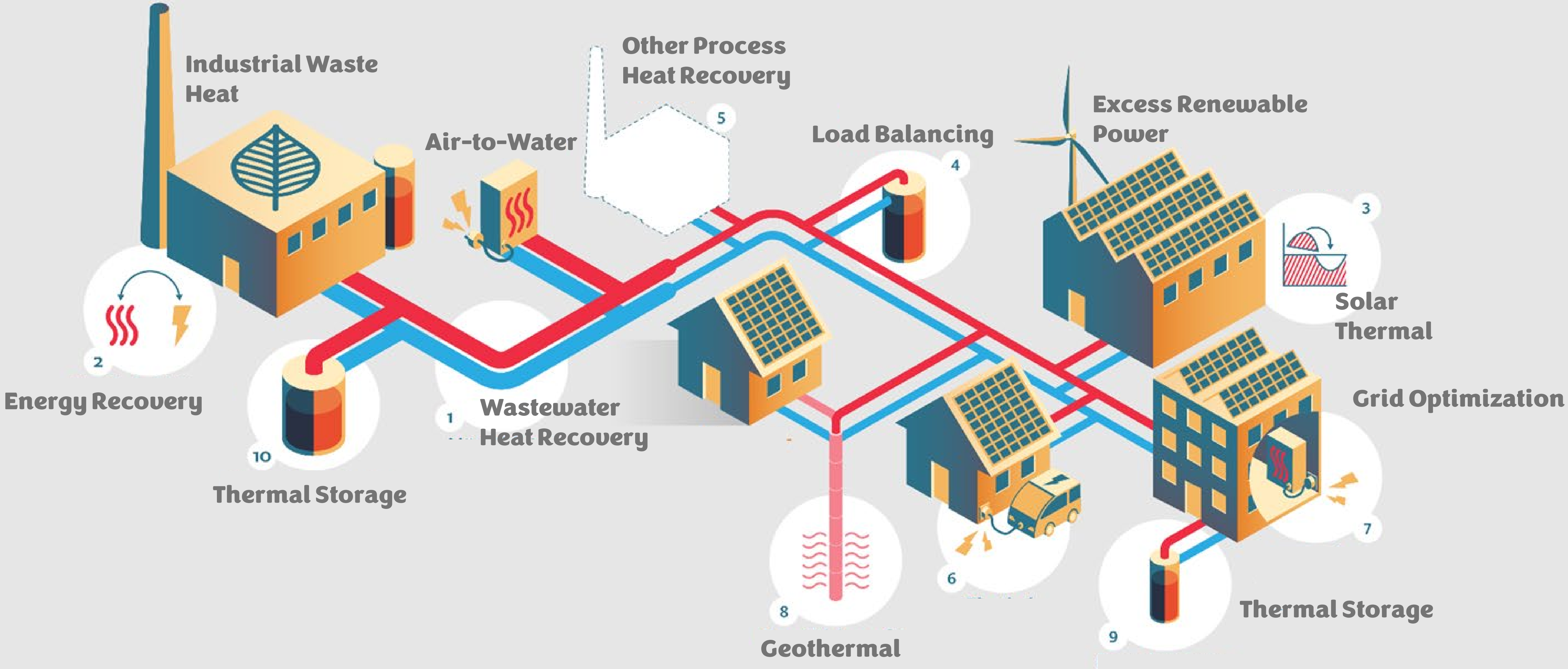
Jared Rodriguez

Emergent Urban Concepts

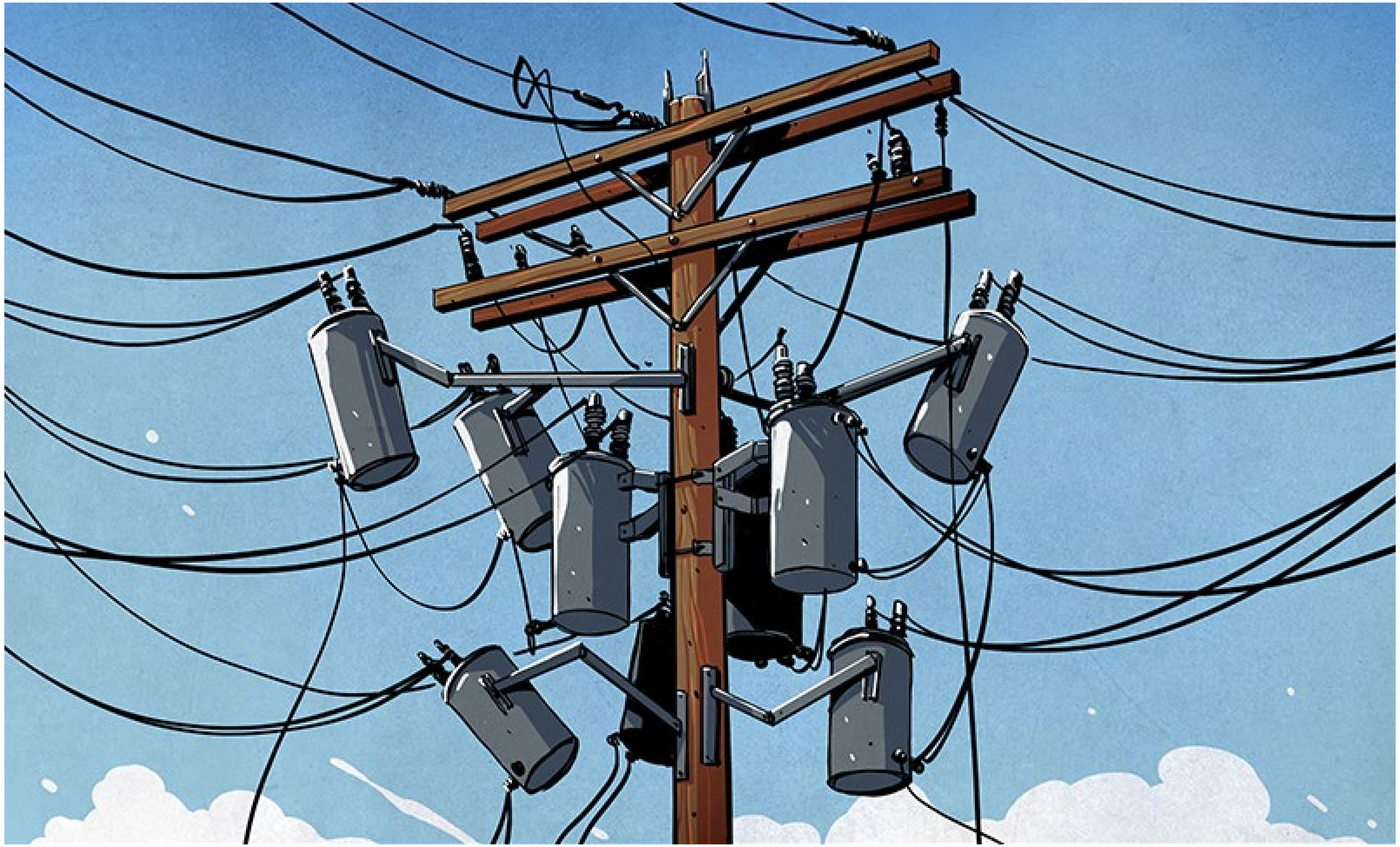
Some Key Questions to Grapple With

- How do we delivery on the promise of affordable decarbonization with GHPs and TENs?
- How do we maintain a competitive landscape and reduce barriers to entry?
- What is the role of merchant thermal energy suppliers?
- Will the regulatory process incorporate best practices? Where do we go from here?
- What is the best way to encourage TENs + GHP growth? What market mechanisms are possible? How do we unlock a market?

How can we appropriately utilize diverse, available, local thermal energy resources to their fullest extent?



Beat the Peak.

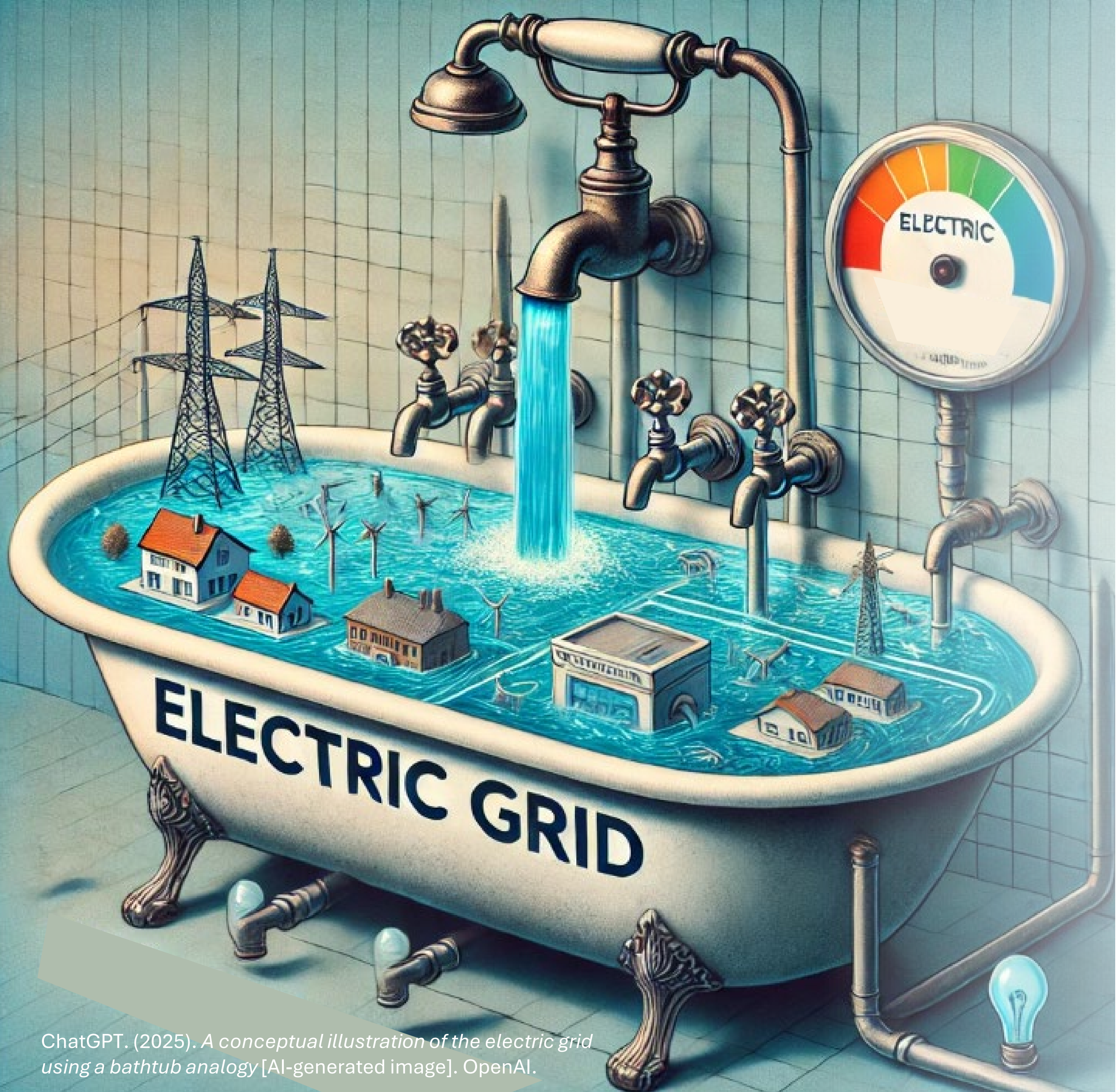


https://hackaday.com/2016/02/22/a-field-guide-to-the-north-american-utility-pole/

The biggest value proposition NYGEO members can provide in a decarbonized future is peak electric demand modulation. Policymakers and regulators must as soon as possible equitably value thermal energy infrastructure and traditional electric network infrastructure.

Let's Assume the Following:

State utility regulatory authorities can and should create and encourage an **open-access common carrier regulatory framework** for **Thermal Energy Networks (TENs).**



ChatGPT. (2025). *A conceptual illustration of the electric grid using a bathtub analogy* [AI-generated image]. OpenAI.

Common Carrier Open Access regulatory frameworks ensure that TENs function similarly to open-access electric and natural gas grids, allowing multiple providers to use the network to supply end-use customers.

Imagine the grid (thermal and electric) acting like a bathtub; energy is put in and taken out in multiple ways . . . and this must be in balance across both infrastructure systems. All system actors must be appropriately compensated for providing this balance.

What We've Done and Should Do in New York:

1. **Define TENs as a Regulated Utility Service**: Establish a clear legal and regulatory classification for TEN distribution operators to ensure standardization and oversight.
2. **Establish a Centralized TENs Market Regulator**: Assign oversight to the **Public Service Commission (PSC)** or a dedicated state entity to monitor compliance, pricing fairness, and customer protections.
3. **Launched Pilot Projects** to guide technical, business and regulatory insights.
4. **Enable Market Competition**: Allow independent third-party thermal energy providers (e.g., waste heat recovery facilities, geothermal operators) to sell thermal energy to customers through TENs.
5. **Exempt Municipalities** (fully) from PSC oversight except for environmental, reliability, health and safety regulations.
6. **Mandate Open Access Requirements**: Require TEN infrastructure to operate on a non-discriminatory basis, allowing third-party thermal energy providers (like you!) and customers to connect freely.
7. **Create a Thermal Energy Cost Recovery Structure**: Develop standardized pricing models that ensure fair access to TEN infrastructure while promoting cost recovery and investment.
8. **Establish Interconnection Standards**: Define technical requirements for third-party thermal energy resource providers to connect to TENs. And develop common operating parameters.
9. **Monetize All Co-benefits of TENs:** bring value associated with avoided electric grid infrastructure, economic development opportunities, gas decommissioning, etc.

Tell the New York State Department of Public Service (NOW!):

- We don't need to expand the grid to meet new building electrification loads.
- Decarbonization can accelerate AND grid reliability can increase, and combustion isn't necessary
- We can avoid high-cost growth scenarios by choosing the obvious least cost solution (hint: thermal energy networks and GHPs)
- We need to mandate the least cost solutions and adequately compensate merchant (thermal energy) suppliers for the value they provide.
- We can value thermal energy resources like we value power generation, transmission, and local distribution efforts to expand the grid. In kW!
- We can unlock a market for thermal energy suppliers (hint: NY-GEO members!) by demanding an open access common carrier regulatory framework.

Grid of the Future
24-00541/24-E-0165

Utility Thermal Energy Networks and Jobs Act
22-01458/22-M-0429

Email me if you want to know more:

jared@emergentgroup.com

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URBAN CONCEPTS

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