Thermal Energy Networks-
A Realistic Path to Reduced Mountain Town Emissions

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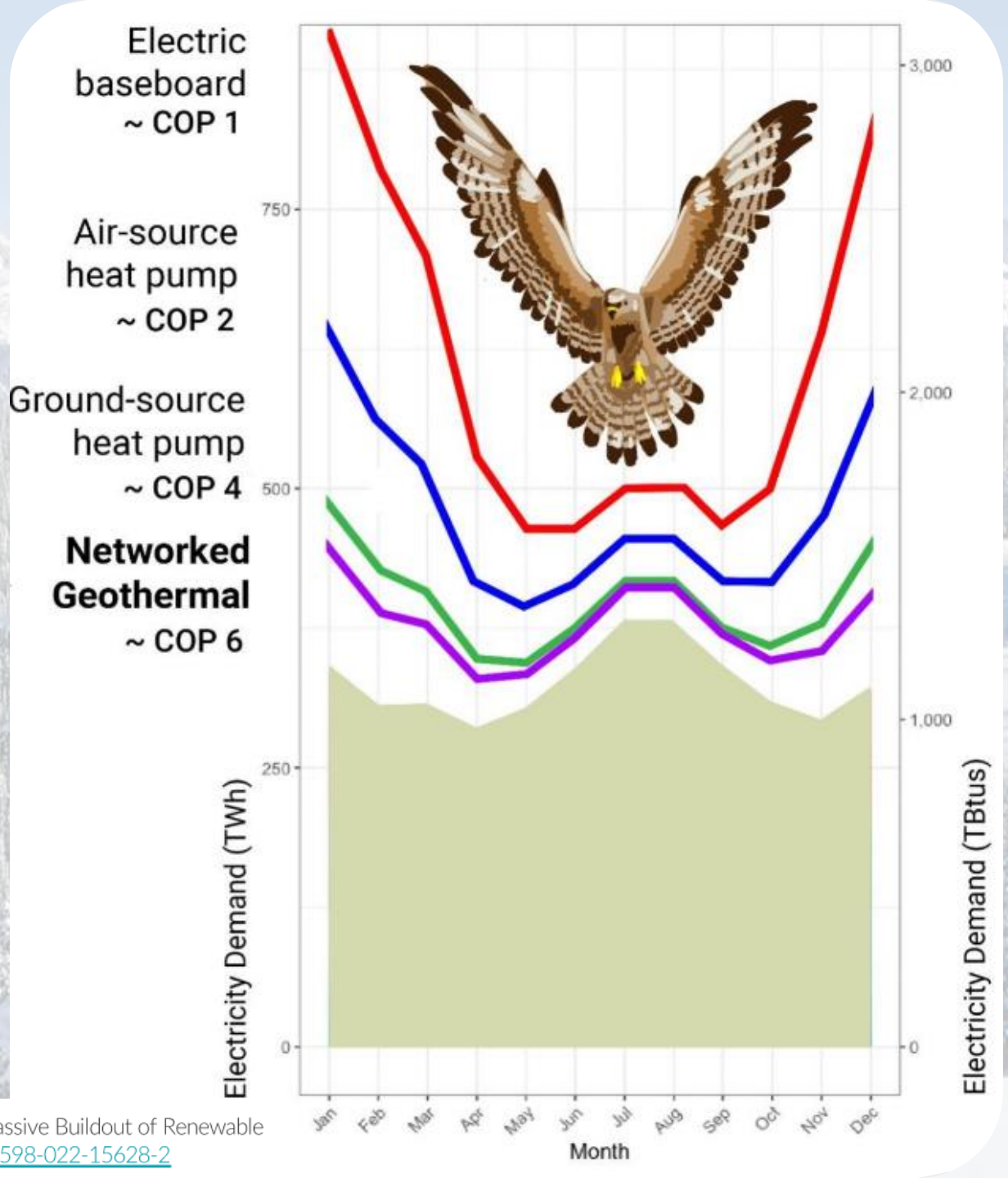
Grid Decarbonization

- The Falcon Curve
- Electrification and EVs
- Mountain Towns have unique challenges
- The last 10% will be the hardest



Buonocore, J. J., Salimifard, P., Magavi, Z., & Allen, J. G. (2022). Inefficient Building Electrification Will Require Massive Buildout of Renewable Energy and Seasonal Energy Storage. *Scientific Reports*, *12*(1), 11931–11931. https://doi.org/10.1038/s41598-022-15628-2

Thermal Energy Networks (TENs)

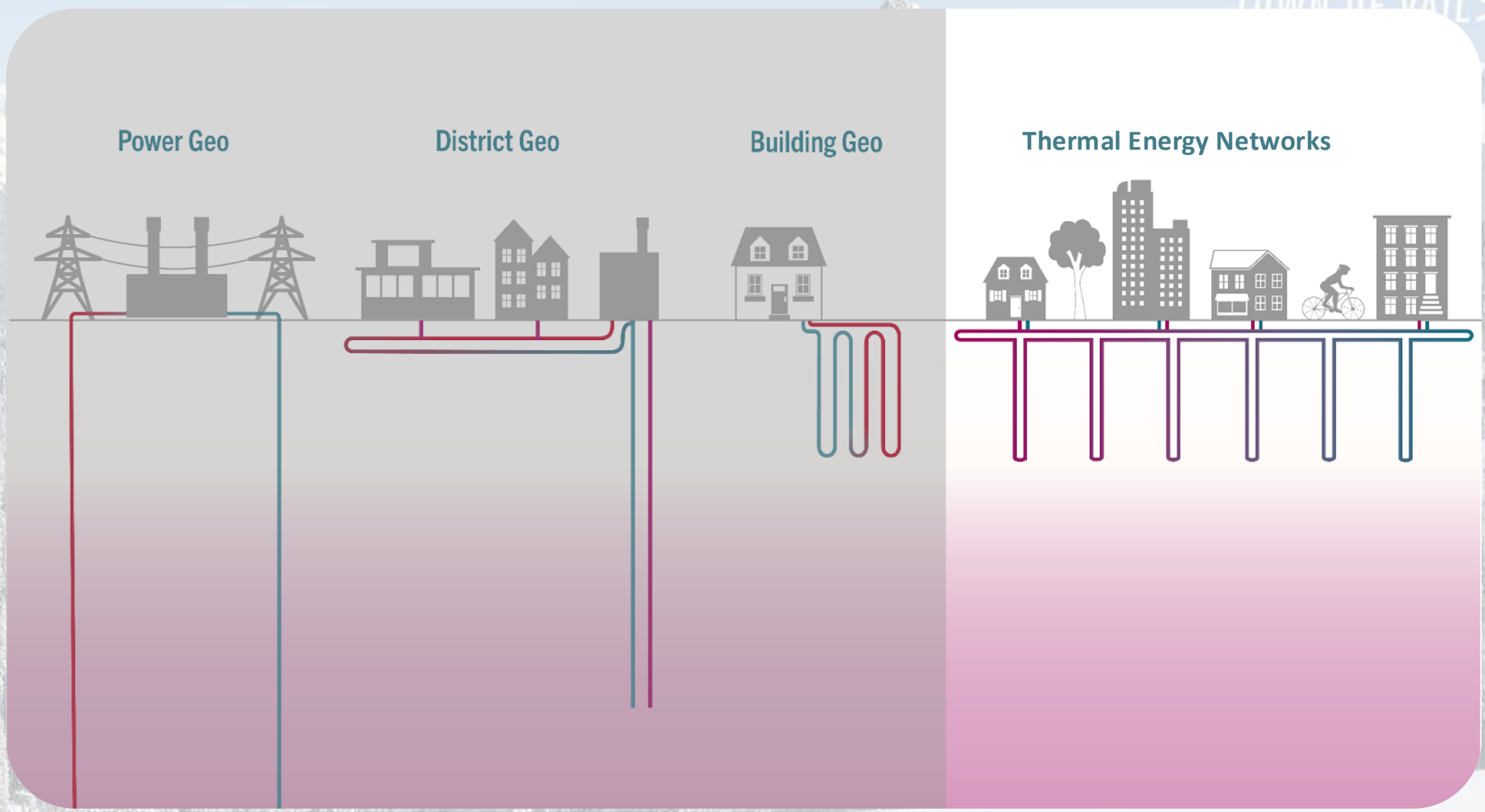
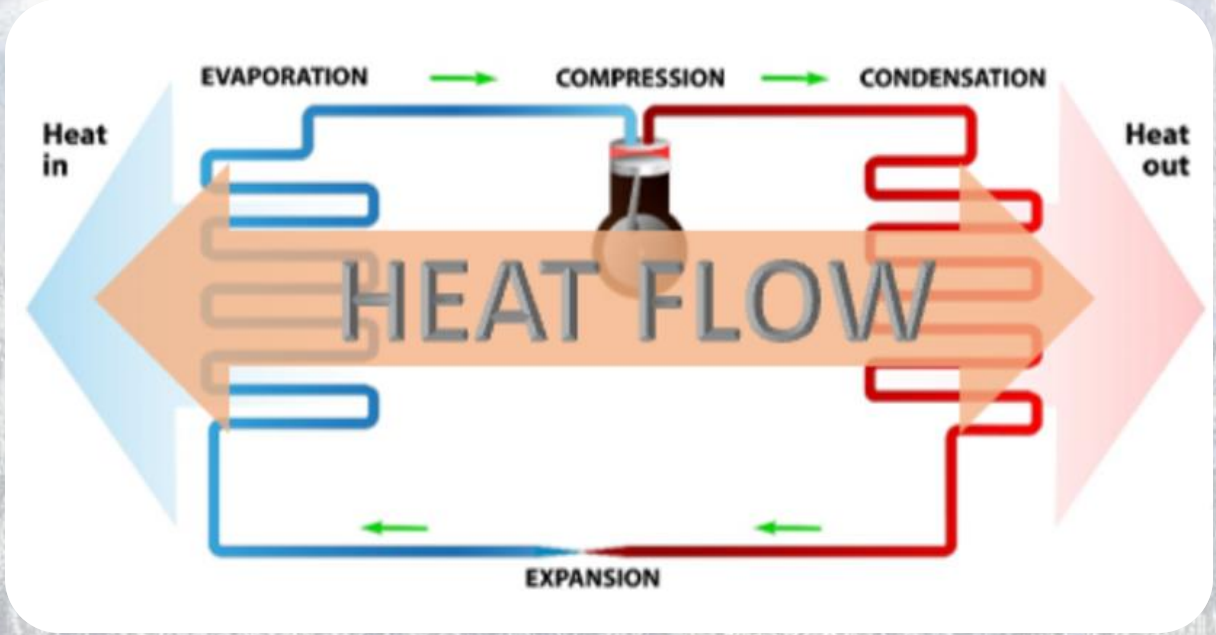
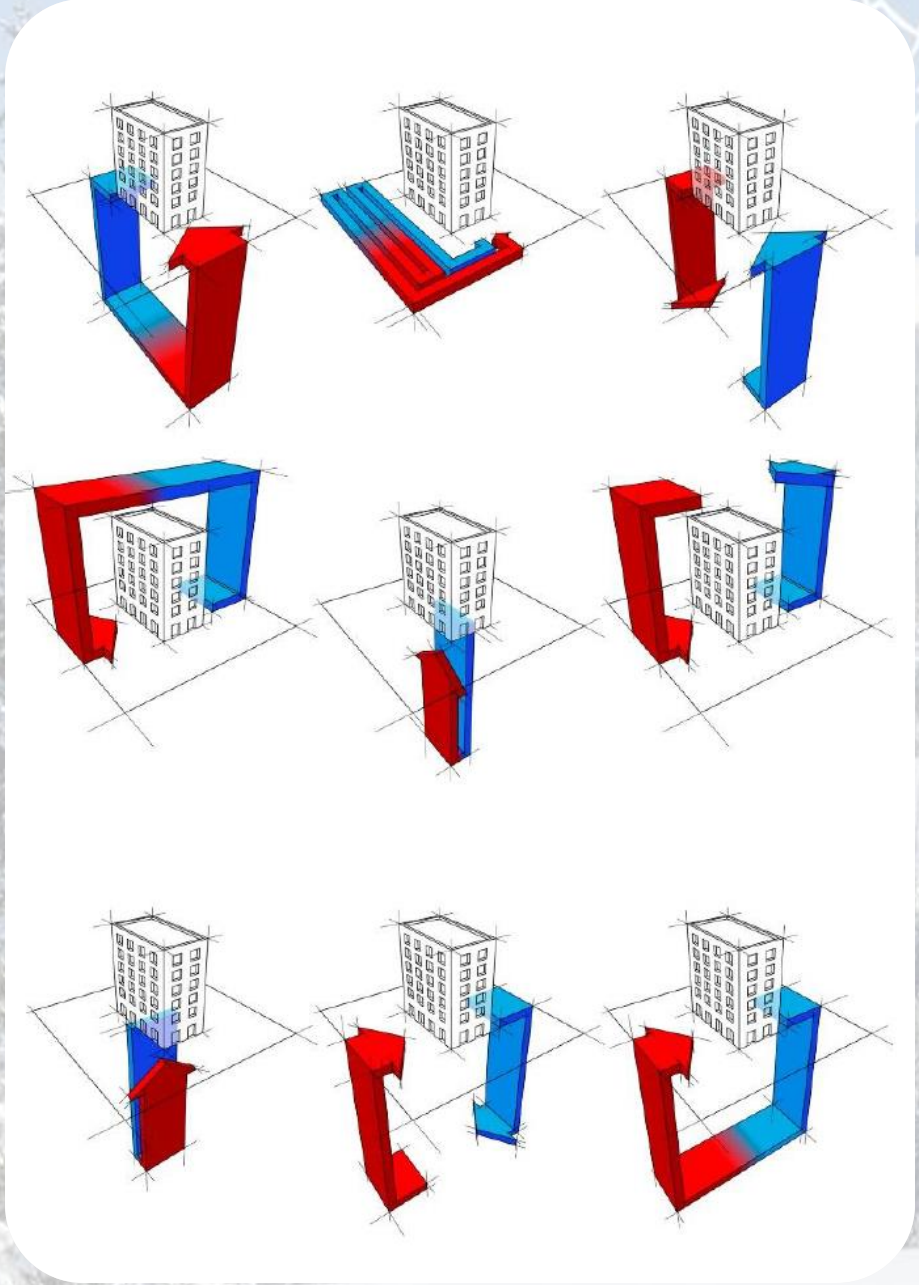


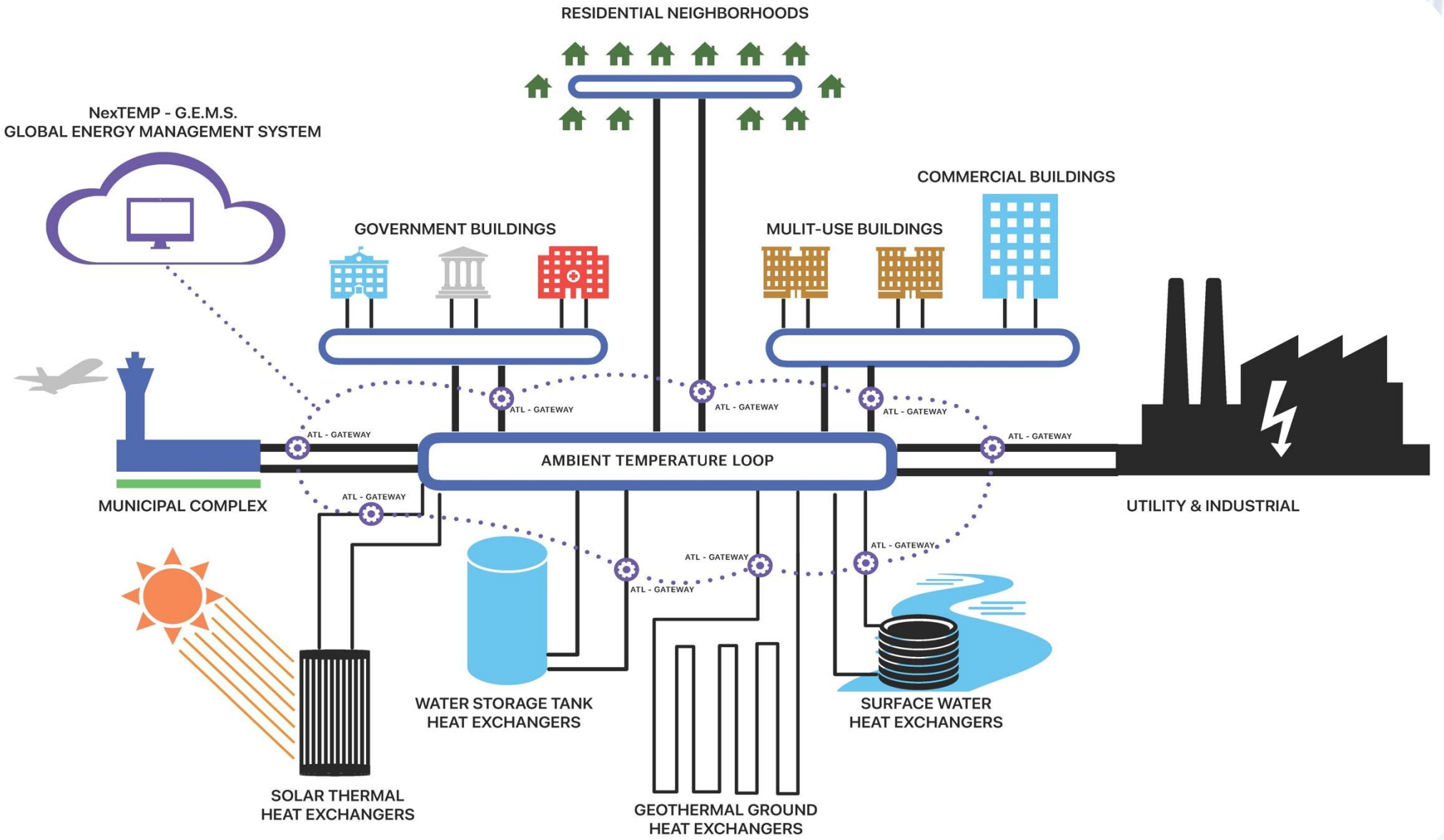
Image Credit: HEET

Heat Pump Systems

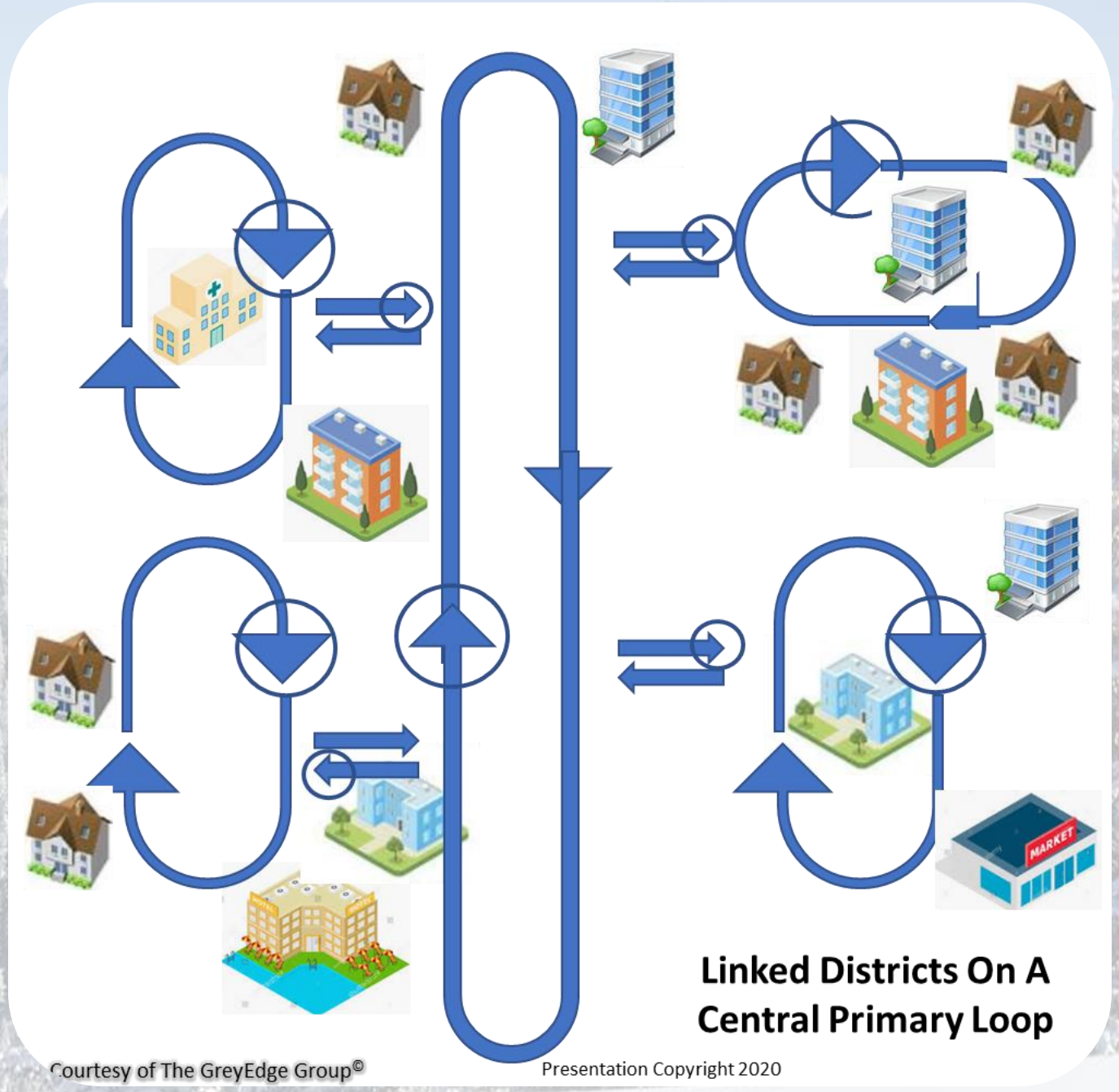




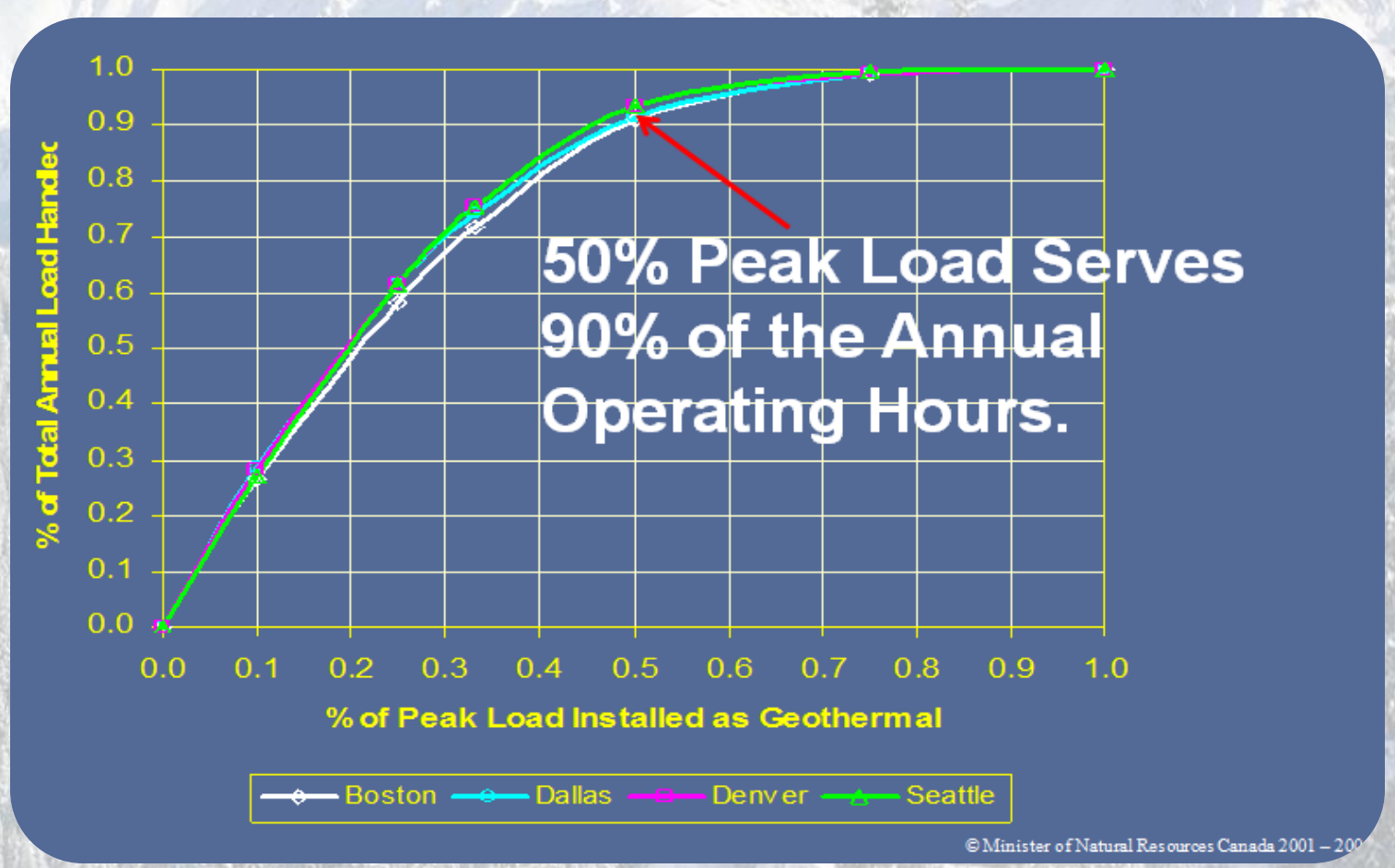
The Ambient Temperature Loop



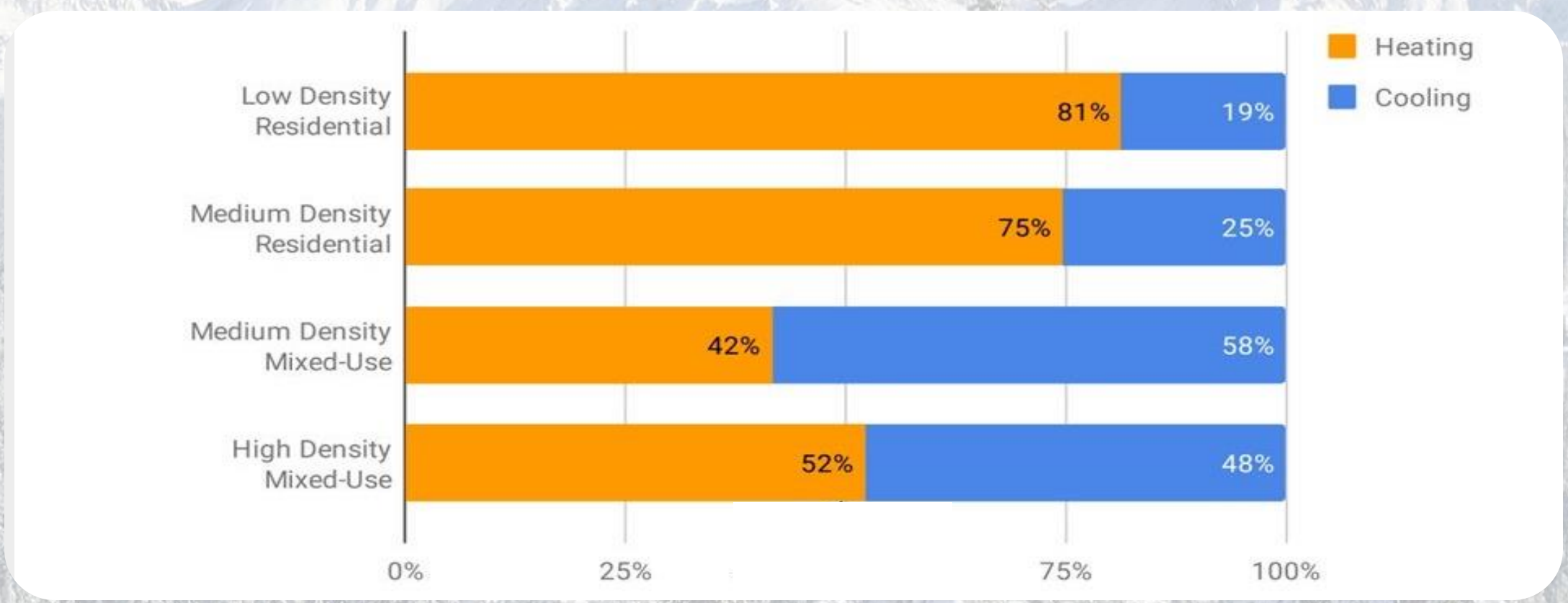
ATL Microgrids



Hybrid Systems – The 50/90 Rule



The Value of System Diversity



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Ownership Models

Public Entity

Utility

3rd Party

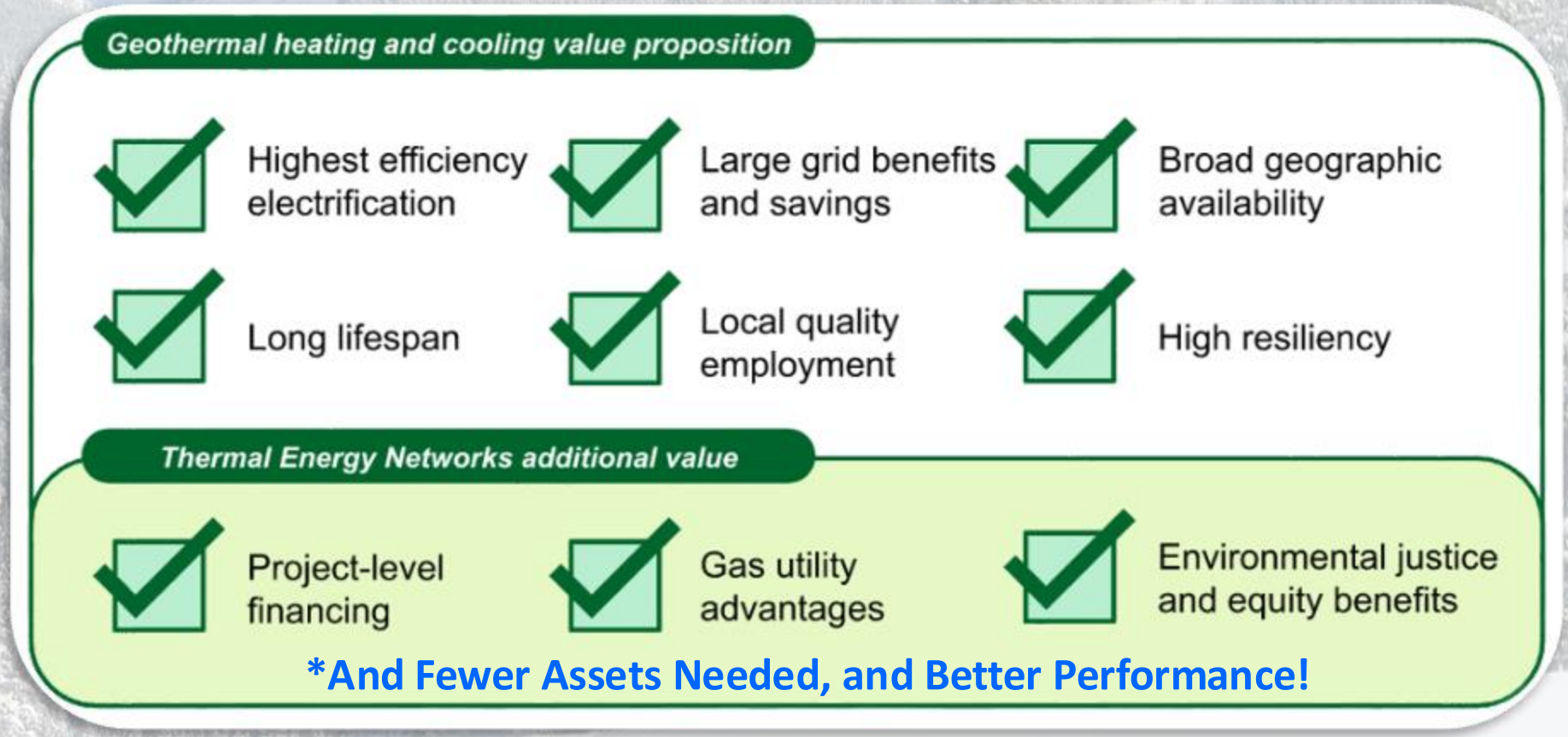
Finance

Own

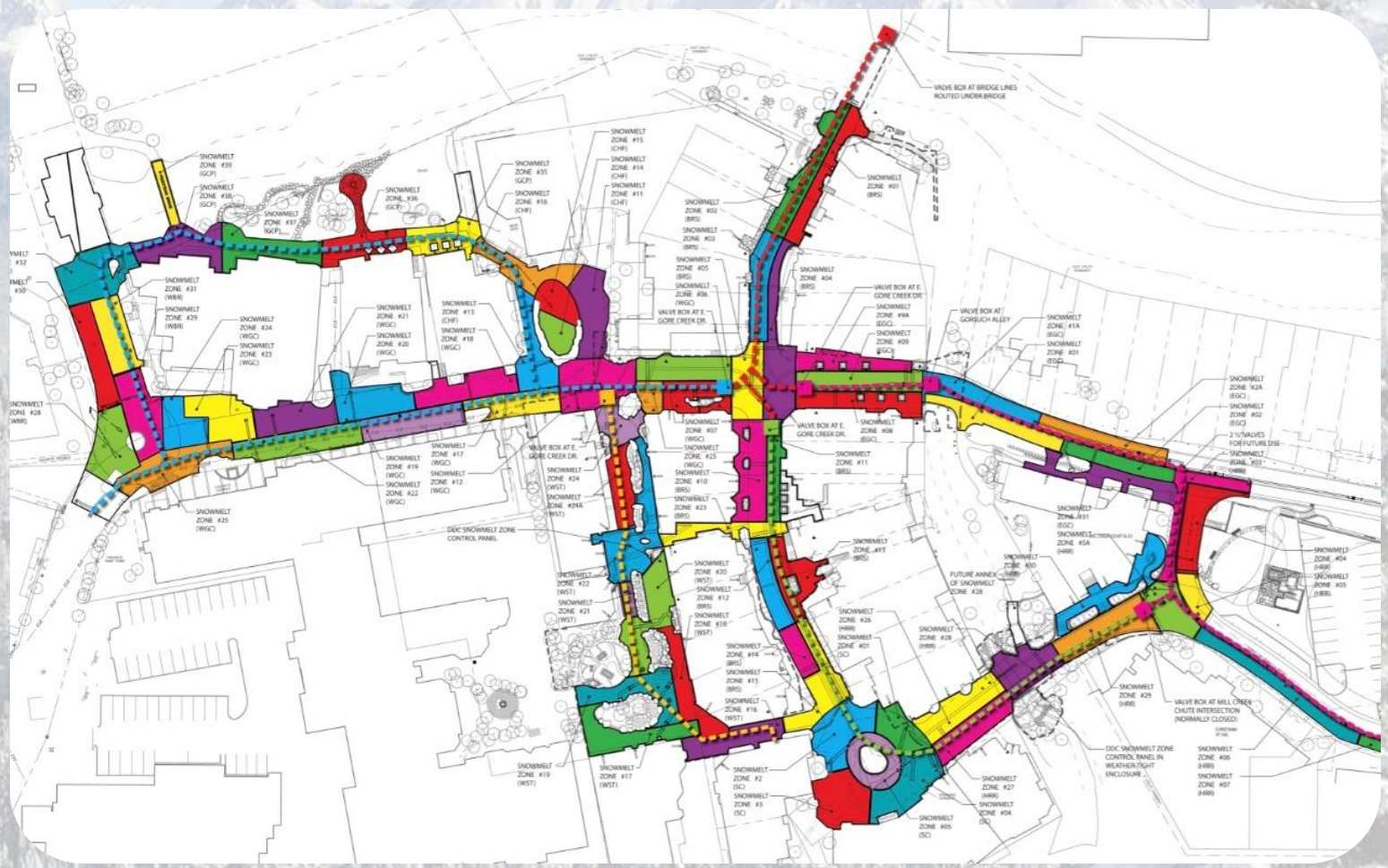
Operate

DOE Pathways to Commercial Liftoff: Geothermal Heating and Cooling

"The cost of these boreholes is high, but because the overall cost of the project is already high and it allows the entire project to claim at least 30 percent on the ITC credit, the cost of the borehole field can be partially or completely offset, **making the GHP installation the lowest-first-cost installation as well as the most energy efficient and best for decarbonization**."



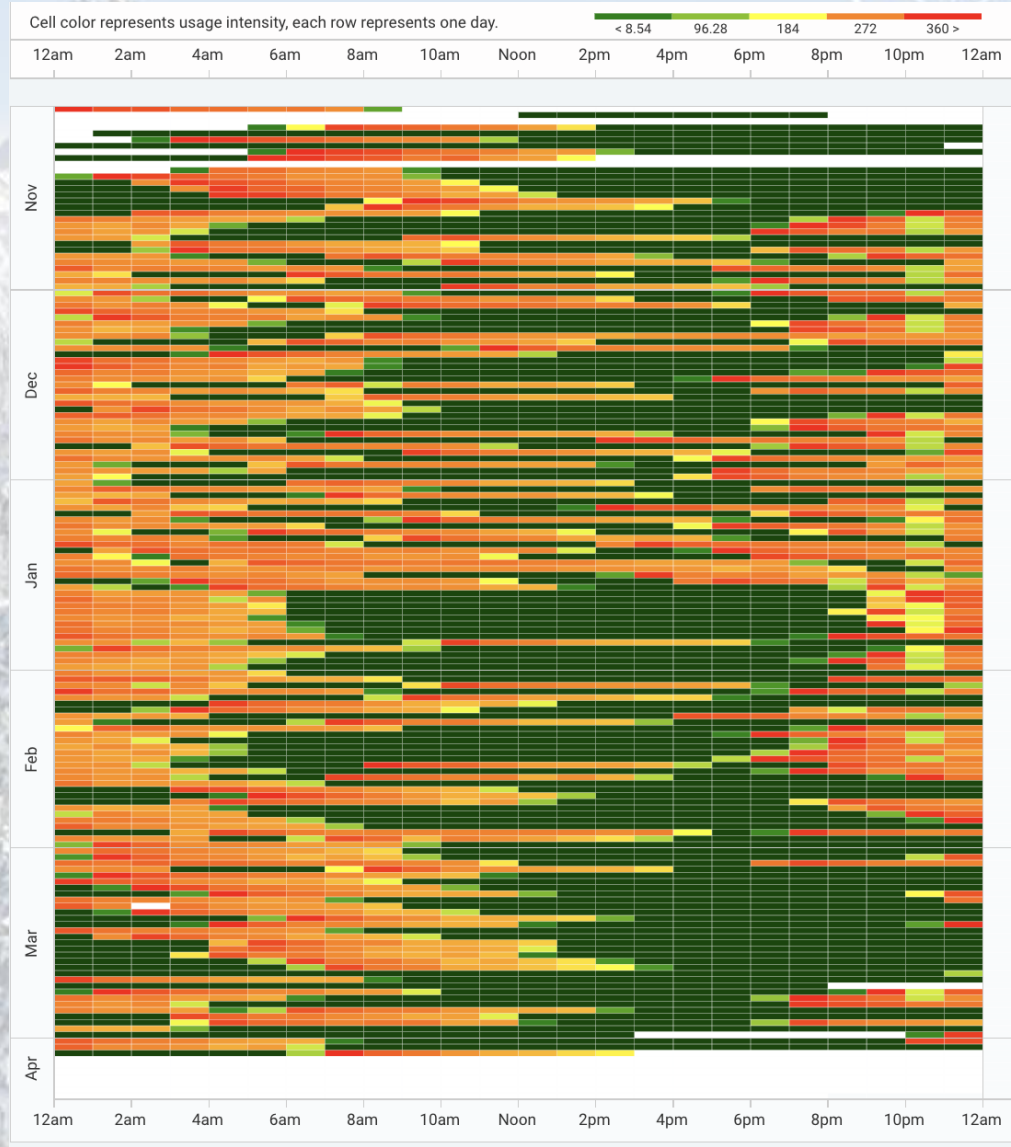
The Vail Decarbonization Challenge



- Largest snowmelt in North America?
- System performance a must!
- Peak load is late afternoon or snow events, so during peak or random
- Snowmelting is highly energy intensive
- Electric resistance is expensive
- Buildings are also part of the puzzle.

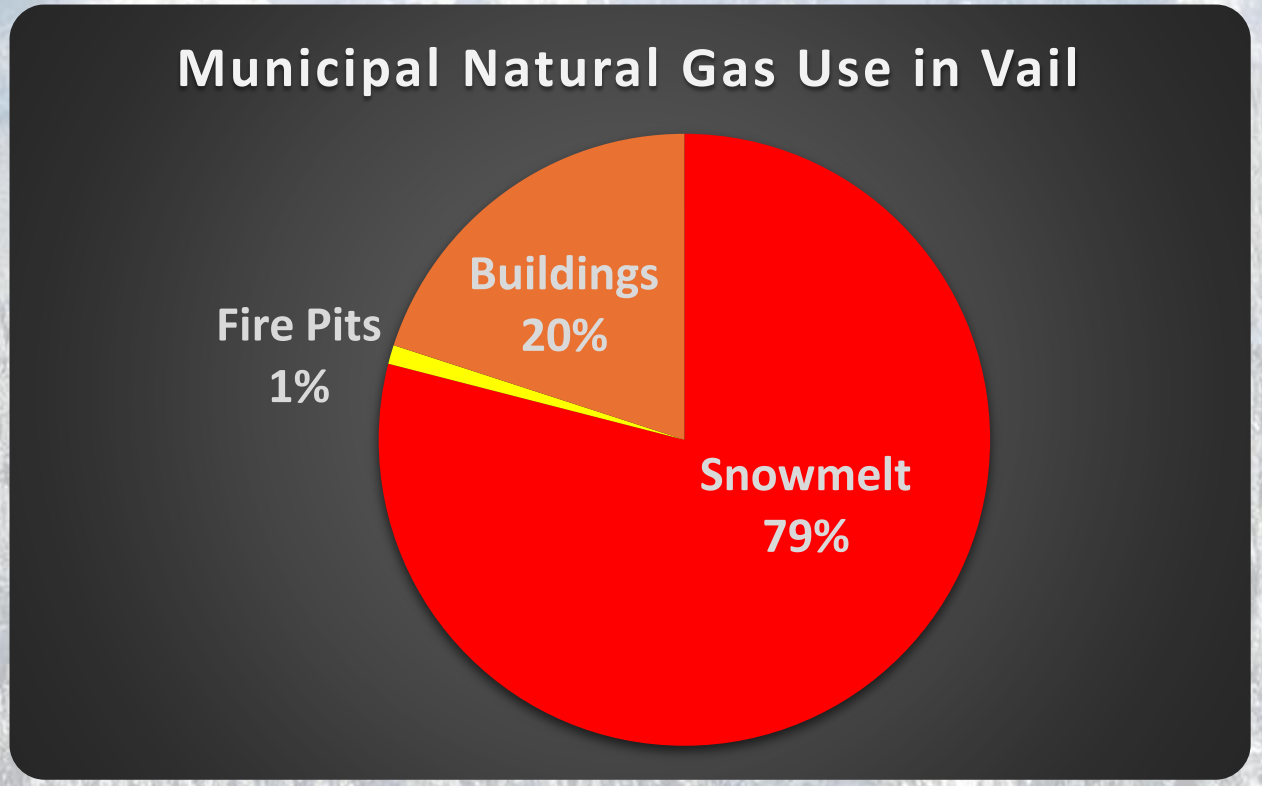
Vail's Decarbonization Journey

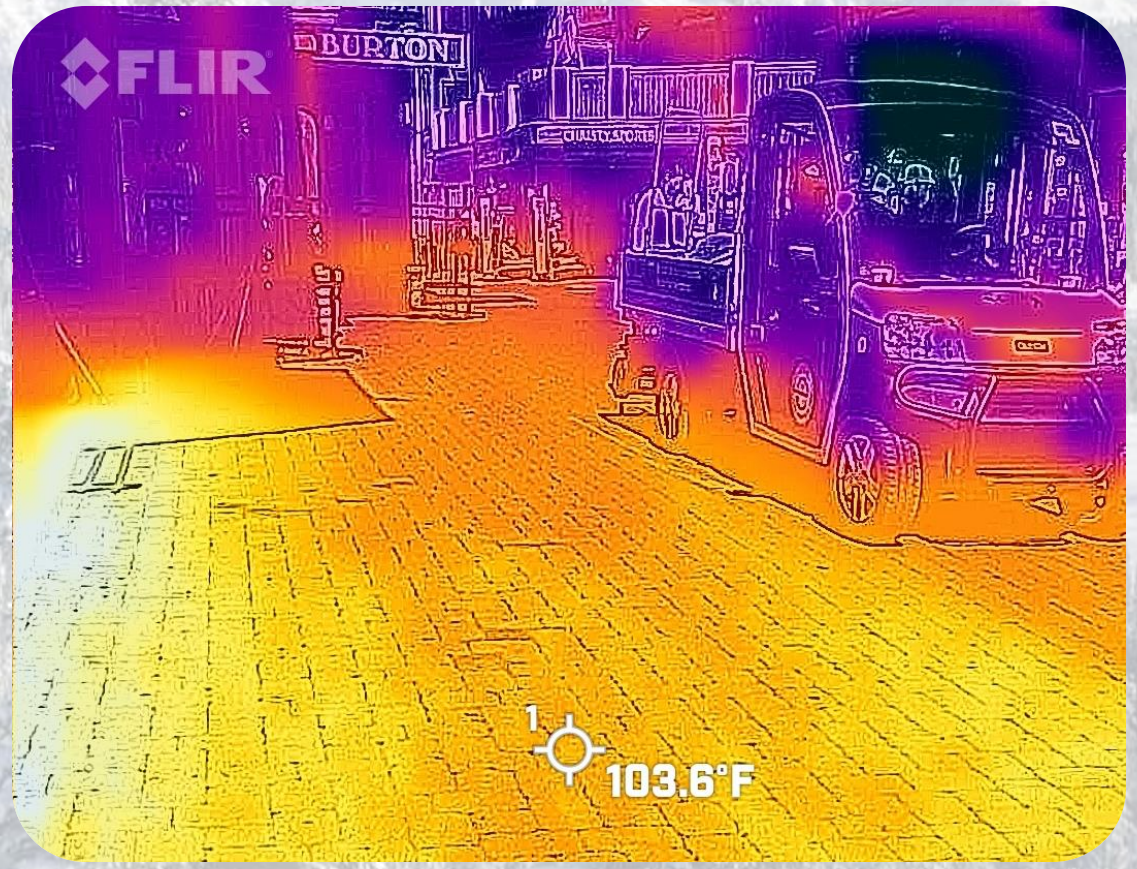
- Vail climate goals (50% by 2030, 80% by 2050)
- Snowmelting 80% of municipal natural gas useage
- Snowmelt creates 6,500 metric tons of C02 annually
- 440 KW electric boiler in 3rd year of operation
- Gas system equal to 7 megawatts
- Electric resistance can work, but at what cost (3.31x)



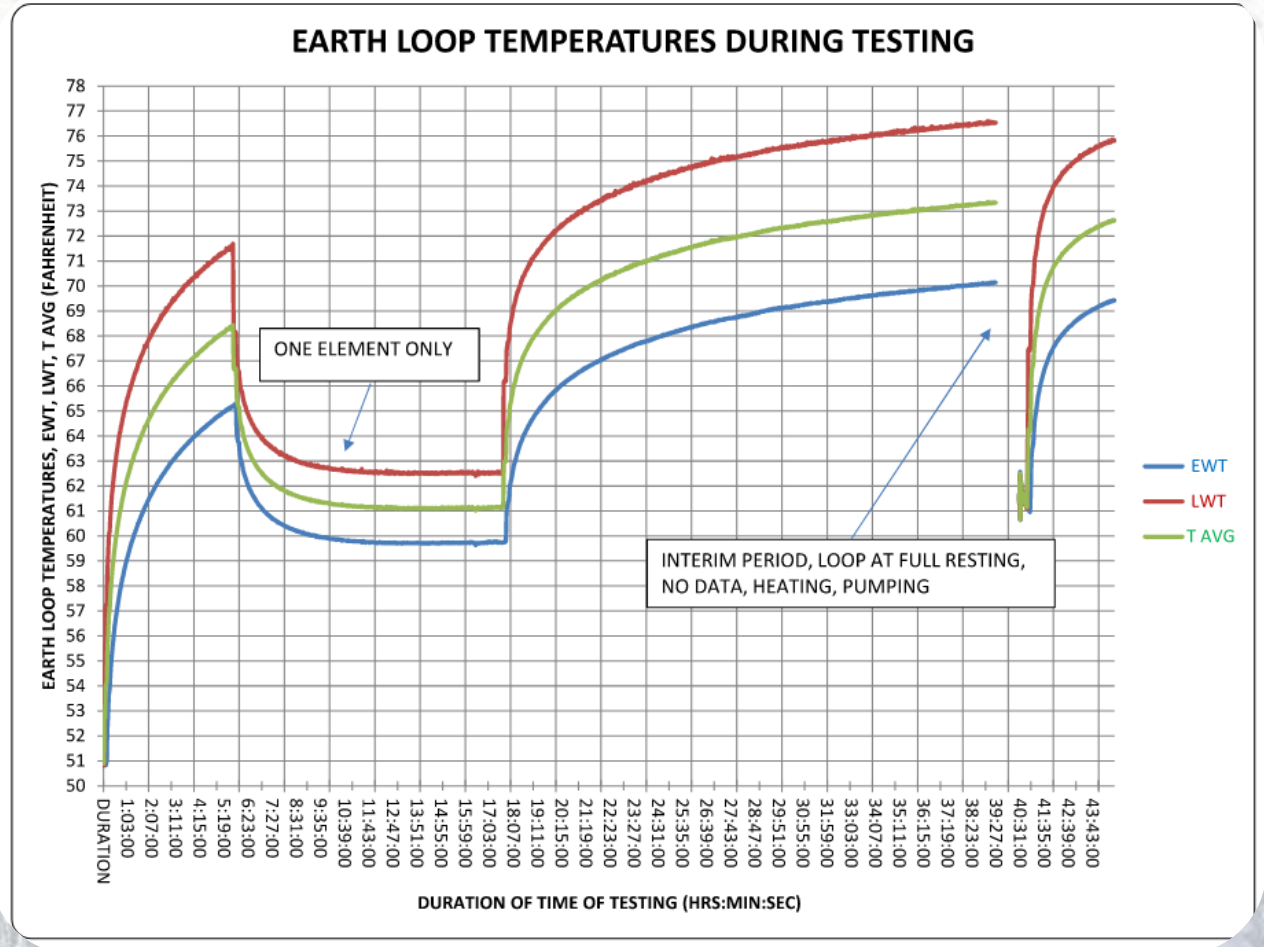
Vail Electric Snowmelt Boiler Heat Map

Energy and Carbon Reduction Potential in Vail





Thermal Energy Network Study- Phase 1



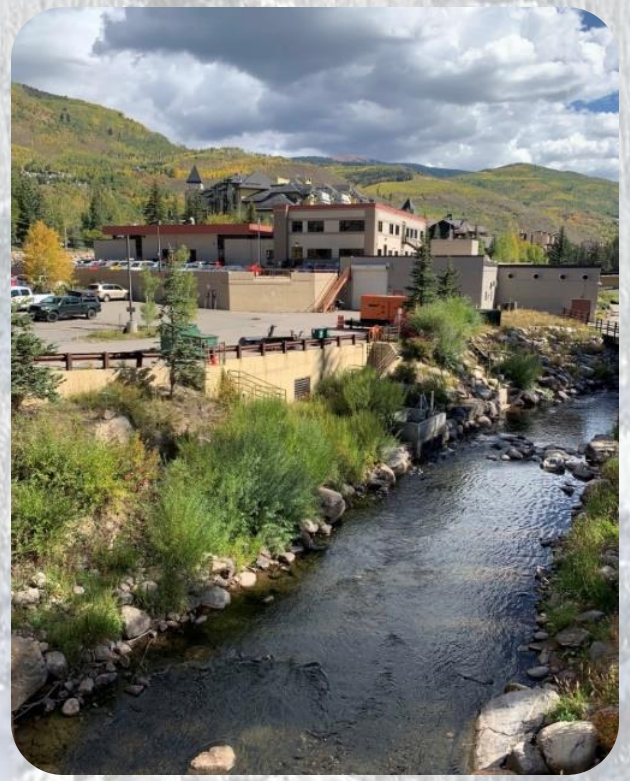
Potential Thermal Management Assets in Vail

Geothermal Energy Grant Program: Phase II Award

Colorado Energy Office – 7 million grant round

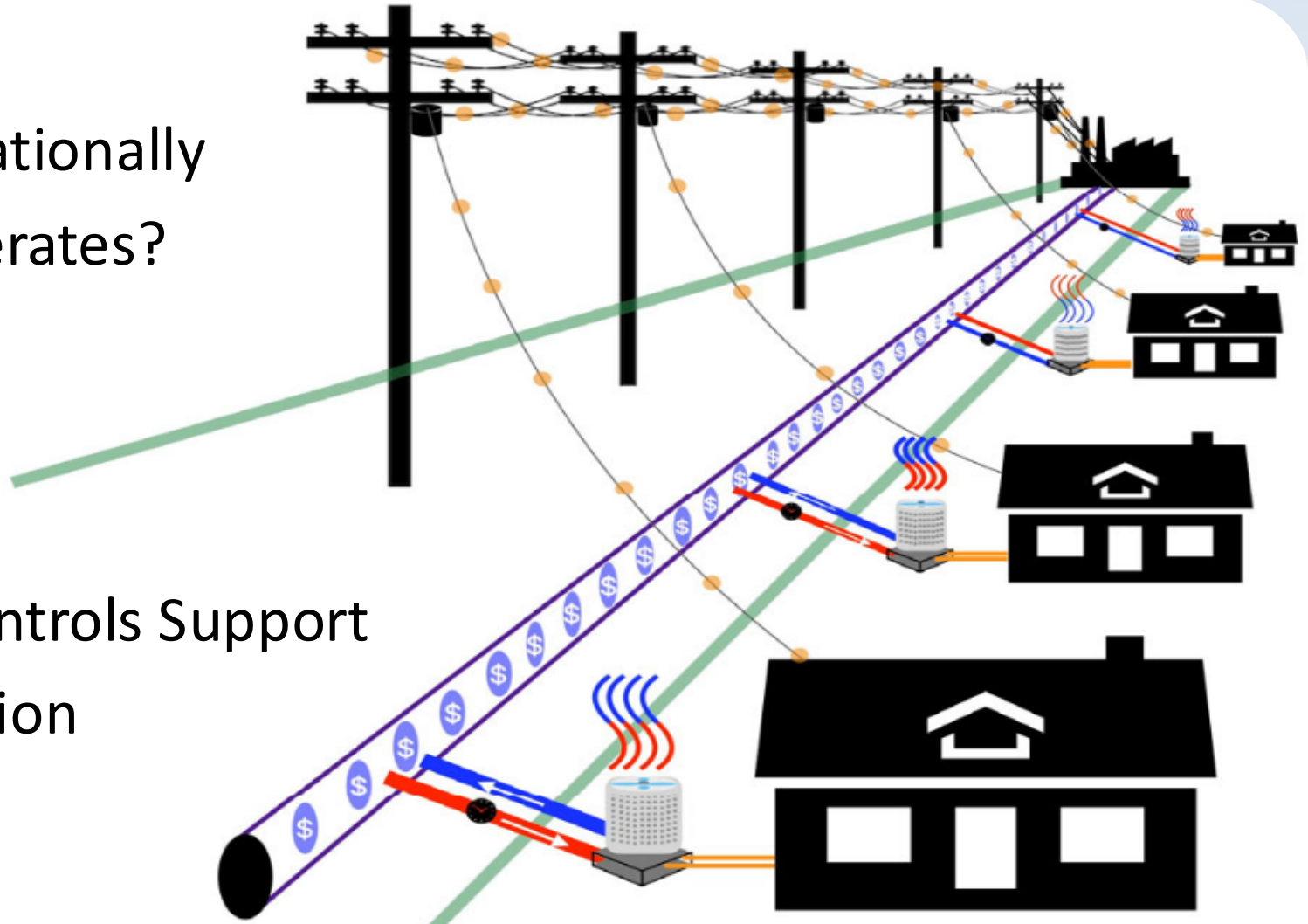
Awarded TOV $250,000 for development of the Civic Area Geothermal Heating District, to include:

- Wastewater treatment plant
- Hotels like the Arrabelle
- Library
- Ice arena
- Lionshead structure snowmelt plant
- Geothermal Wells



The Utility Thermal Energy Network (UTEN) Business Model

- UTEN Conversation Evolving Nationally
- Who Finances, Owns, and Operates?
  - Third Party
  - Municipality or Customers
  - Utility Company
- Design, Commissioning and Controls Support
- Billing and Customer Participation



The Paradigm Shift

- Beneficial Electrification is *the challenge* of our times- The ***last 10% is most difficult!***
- The TEN is a holistic tool to achieve decarbonization in the built environment
- A TEN is a demand response tool that increases power factor of electrical grid
- A TEN offers the highest possible COP for Heating and Cooling
- **In a TEN, liabilities can become assets**

Thank you! Questions and Discussion

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