aee WORLD
ENERGY CONFERENCE & EXPO

Decarbonizing in Cold Climates

TRANE

Case Studies of Using Thermal Energy Storage for Heating in Large Buildings

SEPTEMBER 18, 2025

Agenda

Heating Challenges

Natural Gas Bans

Thermal Energy Storage

- Thermal Battery Storage-Source Heat Pump System (SSHP)
- How It Works
- Capacity for Heating
- Tax Credits

Case Studies

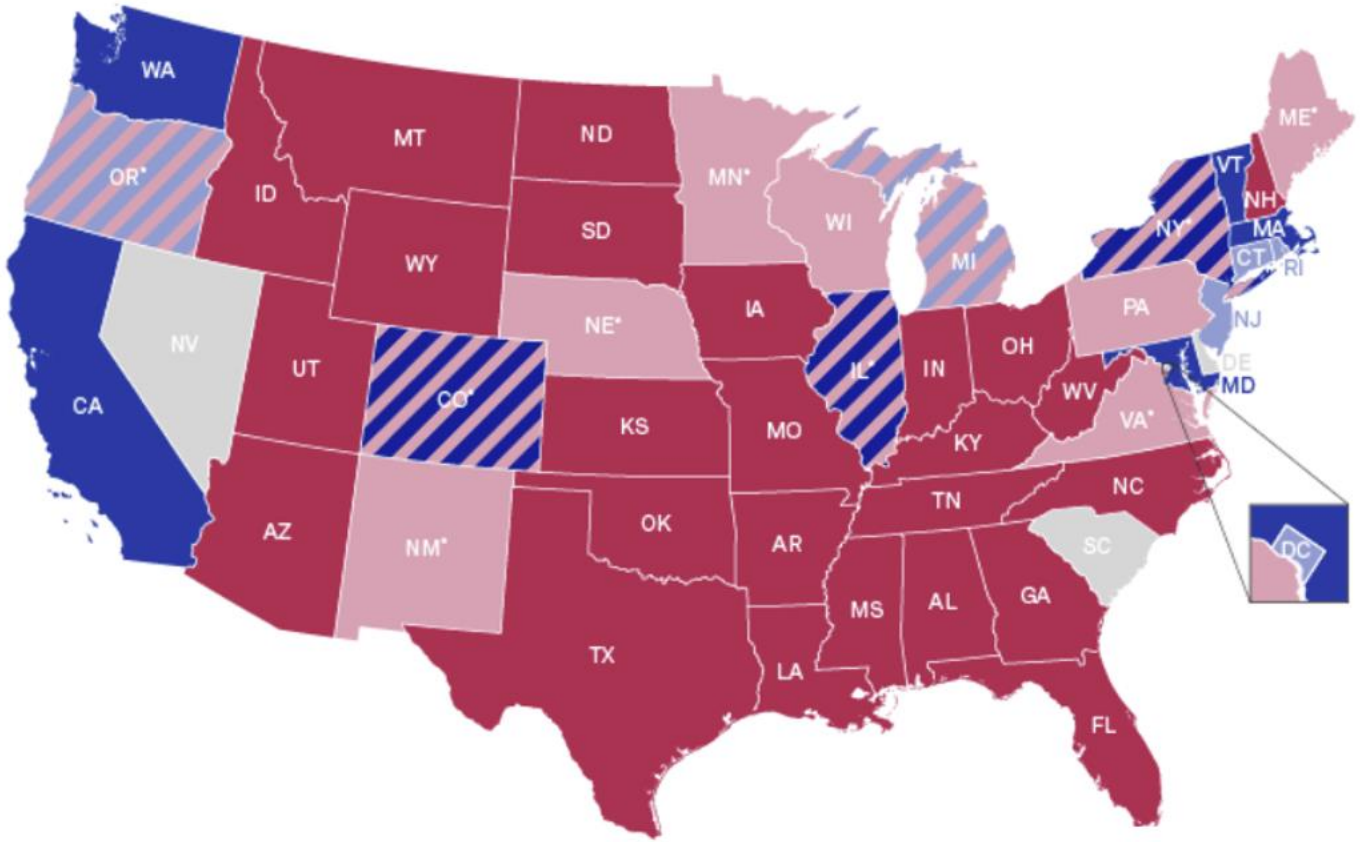
Questions

Presented by Alan Clayton

Sustainable Systems and Commercialization Leader

Heating Challenges in Cold Urban Cities

State and Local Restrictions on Natural Gas Use in Buildings and Bills to Prohibit Gas Bans



State/local-level gas restrictions & building electrification mandates

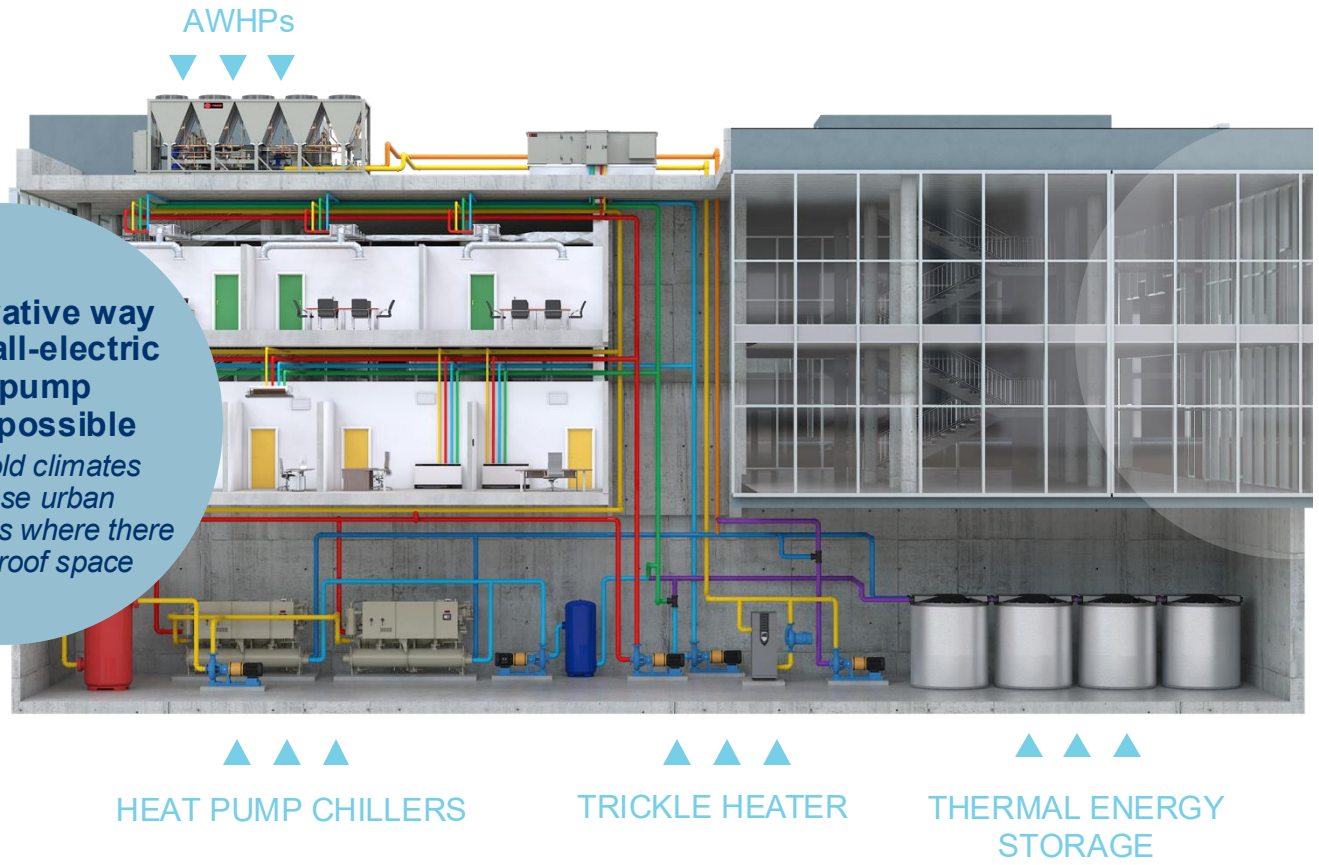
Adopted
In development

Legislation prohibits statewide or local gas bans & building electrification mandates

Passed
In development

Source: S&P Global Commodity Insights 2023

Thermal Battery™ Storage-Source Heat Pump System (SSHP)



An innovative way to make all-electric heat pump heating possible

even in cold climates and dense urban environments where there is limited roof space

Energy Efficient
Reclaims excess heat from the building using it to heat when needed.

Reliable Operation
Collects and stores heat from air-to-water heat pump operation during favorable conditions enabling heating at **all** outdoor conditions including extreme cold.

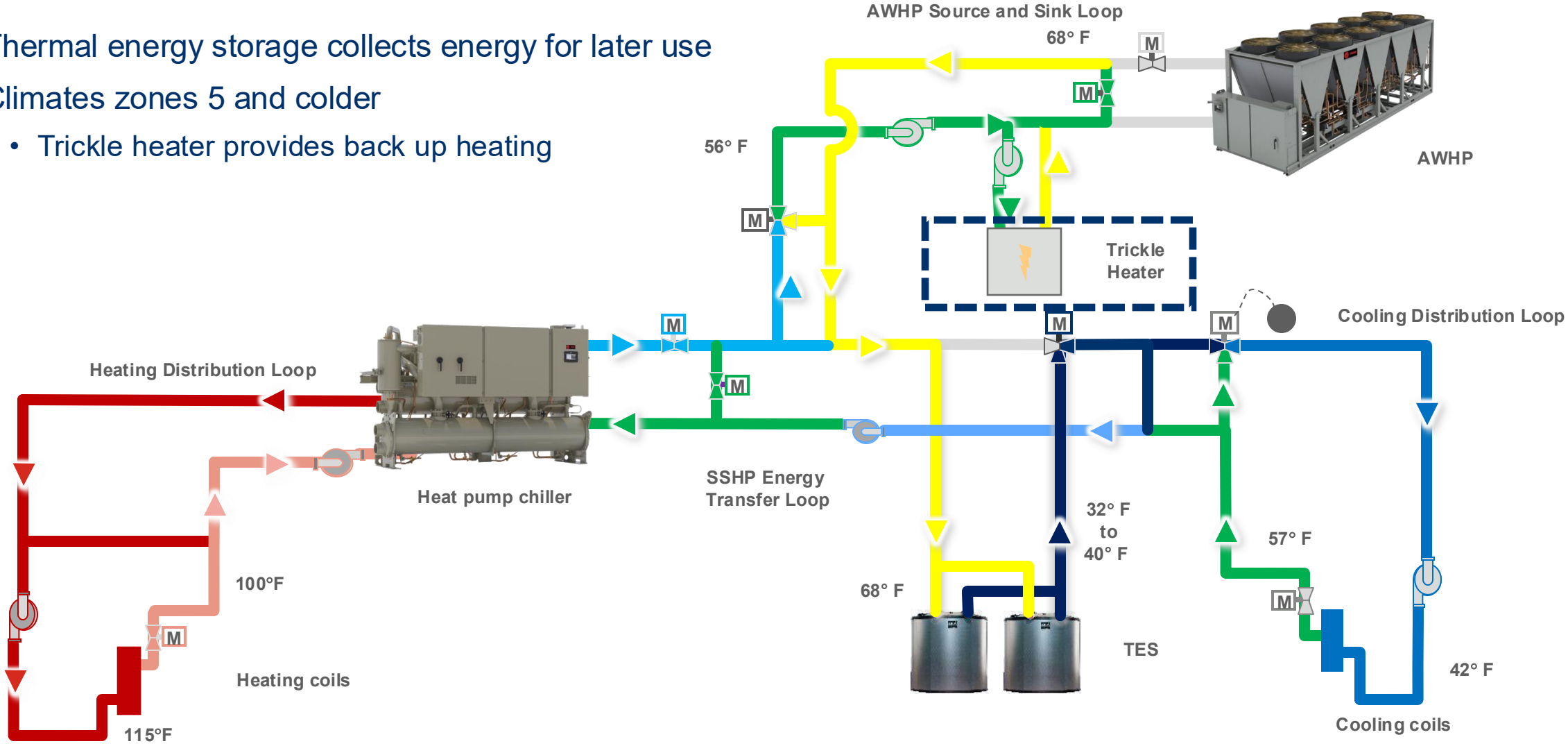
Save Roof Space
Collecting and storing heat over 24-hour period for later use, can help reduce required air-to-water heat pump capacity and cost.

Higher Supply Water Temperature
Sourcing energy from a stable thermal energy storage source enables up to 130F.

Lowers Costs
Storing thermal energy for later use provides flexibility to use lower-cost electricity. Thermal energy storage can frequently qualify for up to 40% tax credit help reducing overall system costs.

How It Works

- ✓ Thermal energy storage collects energy for later use
- ✓ Climates zones 5 and colder
  - Trickle heater provides back up heating



Capacity for Heating

1 Thermal Energy Storage Tank

- 8’ 6” Tall x 7’ 6” Dia.
- 1,655 Gal of Water = 13,786 lbs.
- 13,786 lbs. x 144 Btu’s/lb. ~2,000,000 BTUs

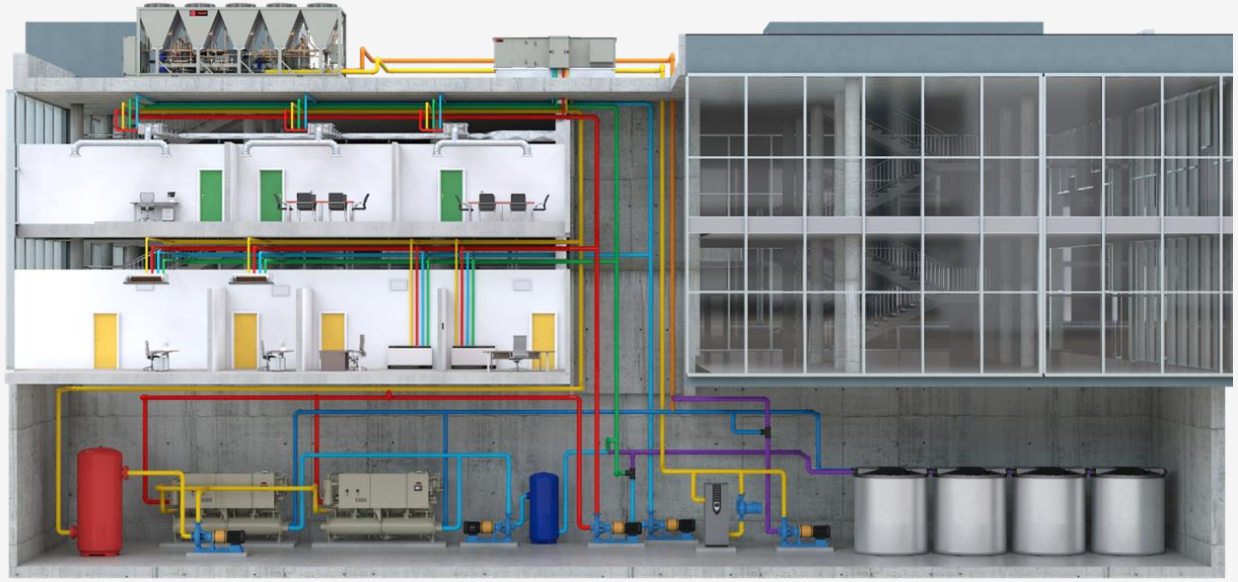
2,000,000 BTUs =
~14 Gallons of Fuel Oil
~20 Therms of Natural Gas
~160 Ton-hrs

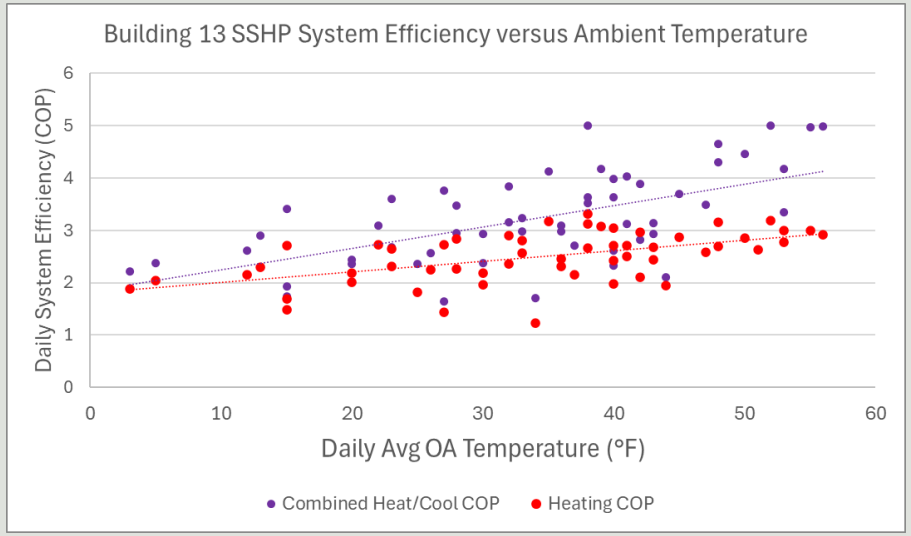
44 Thermal Energy Storage Tanks in NYC Building

80,000,000 BTUs =
616 Gallons of Fuel Oil
880 Therms of Natural Gas
88 Mlbs of Steam
~7000 Ton-hrs

Tax Credits for Storage Beyond Cooling

- ✓ New Construction / Urban high rises
- ✓ Existing chilled water retrofits
- ✓ Add heat pumps + thermal energy storage + controls
- ✓ Affordable full storage available
- ✓ Reduce operating costs
- ✓ Double / triple dip incentives
- ✓ Earn ITC / 179D / local rebates
- ✓ Opportunity to electrify heating





CASE STUDY

Customer Experience Center at the Advanced Technology Training Center

CHALLENGE

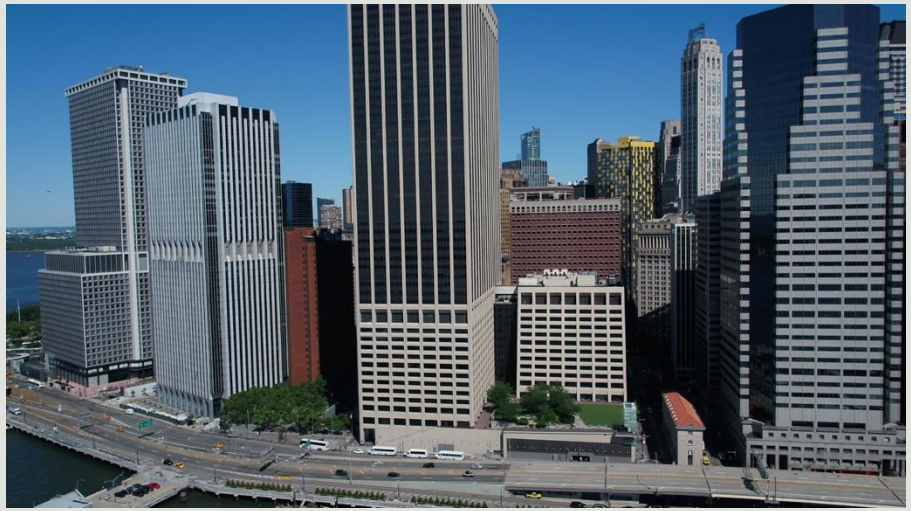
- Update 75-year-old building; 80,000 sq.ft. space while improving efficiency
- Replace outdated steam with electrified heating
- Maintain reliable heating during cold winters

SOLUTION

- World's first storage-source heat pump system
- System includes thermal energy storage and heat pump chillers
- Captures, collects and stores heat for later use
- 125F HW supply at any ambient temperature

RESULTS

- Heating COP 3
- Heating efficiency >250%
- 28% reduction in EUI



CASE STUDY

55 Water Street

CHALLENGE

- Compliance for 3.8M-square-foot building in NYC
- Meet Building Performance Standards
- Avoid fines for exceeding GHG emissions

SOLUTION

- First electrified heating retrofit of an existing thermal energy storage system
- Storage-source heat pump system includes 6.5 MWh of electrical equivalent thermal energy storage, chillers and heat pumps

RESULTS

- 1.2M annual avoidance of fines
- ~20% reduction in EUI
- 14.5M federal incentives including utility rebate ($5.6M)
- NYSERDA grant for engineering
- Completed in one year with no tenant disruption

Questions

Thank you

Scan for additional opportunities to connect with Trane at AEE World