Enova

WEBINAR

Sustainable Systems Utilizing Thermal Batteries

September 25, 2024

Agenda

10:00 am – What's New from Enova

Andrew and Chris, Key Account Advisors, Enova Power Corp.

10:10 am – Sustainable Systems Utilizing Thermal Batteries

Stephen Scott, Sustainable Systems Regional Leader, Trane Technologies

10:50 am – Wrap-up

Enova's Key Account Advisors – here to help!

Andrew Bennett

Andrew has been helping businesses find energy solutions for more than 15 years. With a background in engineering technology and energy management, coupled with a data-driven approach, Andrew has the knowledge to solve your tough energy challenges.

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andrew.bennett@enovapower.com

Chris Drygala

Born and raised in Kitchener-Waterloo, Chris has 13 years of experience in energy management and customer service. As a Certified Engineering Technologist with a Sustainable Energy and Building Technology diploma from Humber College, Chris knows the questions you need to ask for the solutions you need.

226-220-2935

chris.drygala@enovapower.com

What's New From Enova:

- **Supporting our Customers**
  - Animal guarding to reduce outages
  - Energy efficiency assessments for commercial offices
  - Power factor analysis and advice
  - High bill leads to energy conservation

- **Empowering our Community**
  - Kitchener Waterloo Humane Society: $5,000
  - Heart and Stroke: $3,000
  - Food Bank of Waterloo Region Drive: In Progress

- **Learning Together**
  - What topics would you like us to present at future webinars?

Sustainable Systems Utilizing Thermal Batteries

Trane Technologies

Sustainable Systems Utilizing Thermal Batteries

Stephen Scott (he/him), P.Eng.| Sustainable Systems Regional Leader - Canada

9/25/2024

Agenda:

1 Define Decarbonization
2 Renewable Energy
3 Electrification of Heat
4 Electricity Rates and Incentives

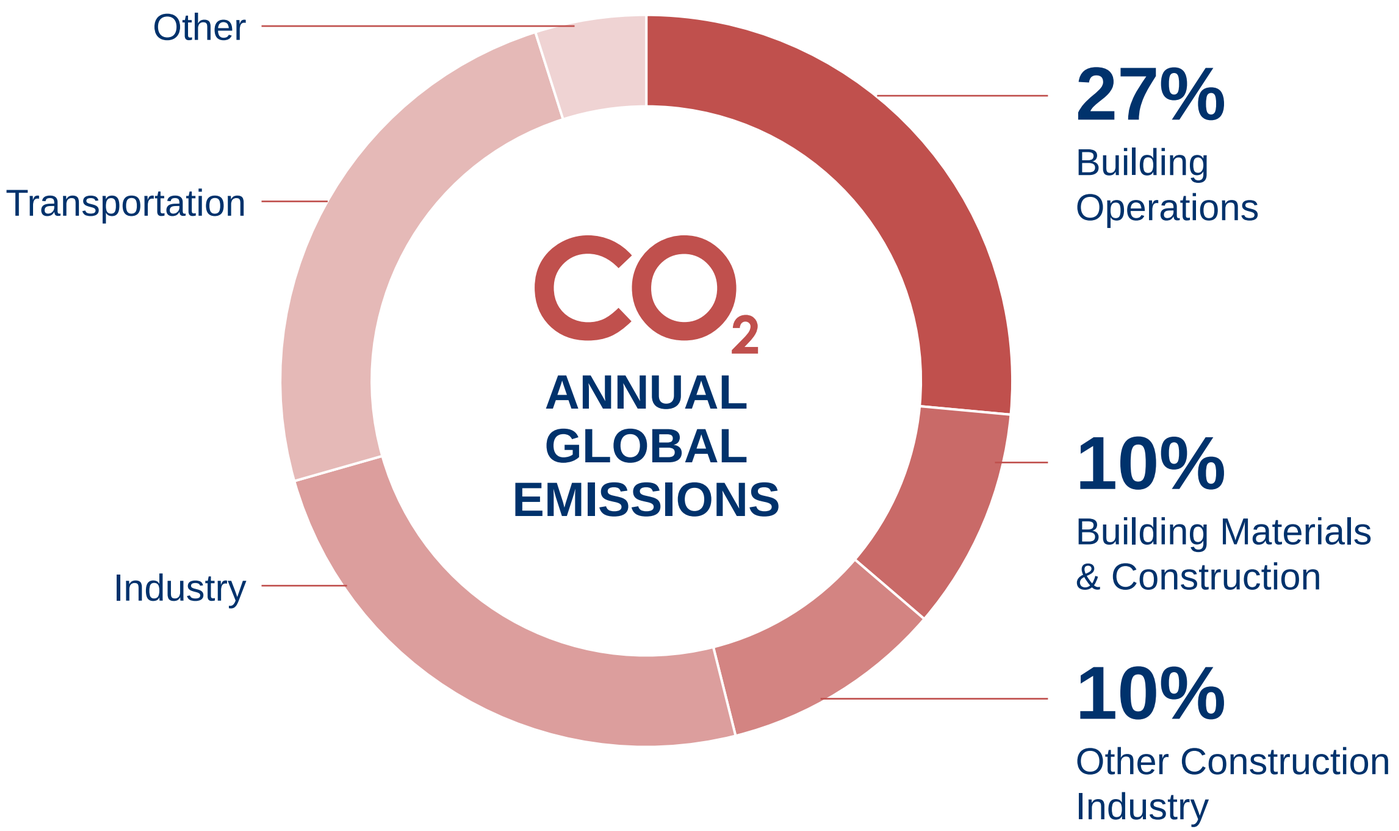
Canada CO2 Emissions Policy Drivers

Source: Government of Canada

- Emissions reduction target of 40 to 45 percent below 2005 levels by 2030 and net-zero emissions by 2050
- Includes $9.1 billion in new investments
- The first Emissions Reduction Plan issued under the *Canadian Net-Zero Emissions Accountability Act*
- National Inventory Report (Canada's official greenhouse gas inventory - Canada.ca published May 2, 2024) as of the end of 2022, emissions are 7.1% below the 2005 baseline.
- Additional targets and plans will be developed for 2035 through to 2050

Decarbonization:
the process of reducing or eliminating carbon emissions

The Built Environment



27%
Building Operations

10%
Building Materials & Construction

10%
Other Construction Industry

Source: https://architecture2030.org/why-the-building-sector/

Understanding Carbon Emissions

3 Categories of Emissions

GHG Emissions & Scope Components

Scope 1
Direct, on-site emissions (usually due to burning fuels) on-site / by fleet

Scope 2
Emissions associated with energy / utility purchases to operate the business (includes electricity and steam)

Scope 3
Emissions from value chain related to all other company activities (not directly controlled by the company itself)

Carbon Footprint

Solutions

Refrigerant Management

Electrification

+

Energy Efficiency

Renewable Energy

+

Embodied Carbon

=

Decarbonization

Decarbonization Space: Crowded, Complex & Fragmented

Province Releases Climate Change Plan for Clean Growth

Minister Wilkinson Releases Canada's Carbon Management Strategy

Canada leads the way on carbon pricing

Pause on carbon tax for heating oil gets thumbs up in N.S.

Port of Montreal embarks on $335M plan with decarbonizc at the forefront

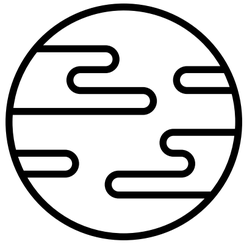
Oil companies can only decarbonize as fast as the rest of the economy says Shell Canada president

B.C. premier reacts to calls to lift carbon tax for home heating

Island of Montreal to ban natural gas in new buildings April 1, 2025

Decarbonization Drivers

ESG / Environmentalism



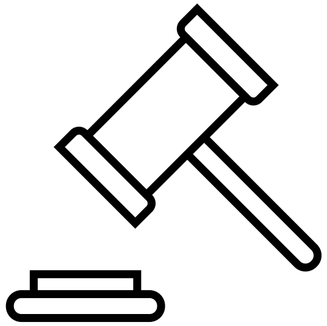
BlackRock

Carbon Disclosure Project

Canadian Securities Administrators

Government Programs (INFC, FMC, CIB, CMHC)

Local Policy



9 of 10 Canadian provinces have adopted greenhouse gas reduction targets to address climate change

NG Bans

Carbon Caps

Stretch Codes

Carbon Tax

Source: Source: https://www.c2es.org/content/canadian-province-climate-policy-maps/#:~:text=At%2Da%2Dglance,provinces%20have%20carbon%20pricing%20programs.

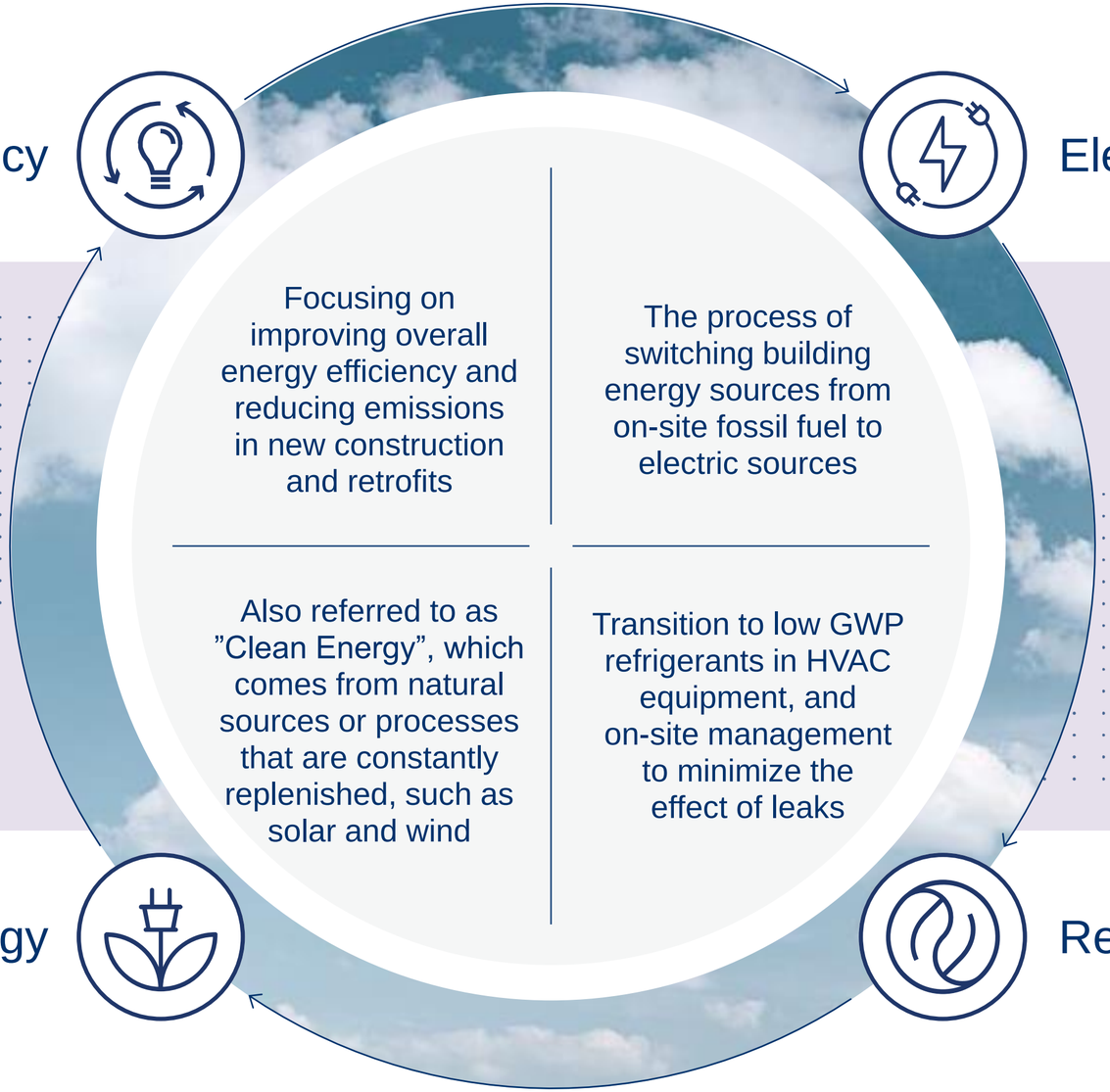
Decarbonizing HVAC Systems

Reducing Indirect Emissions

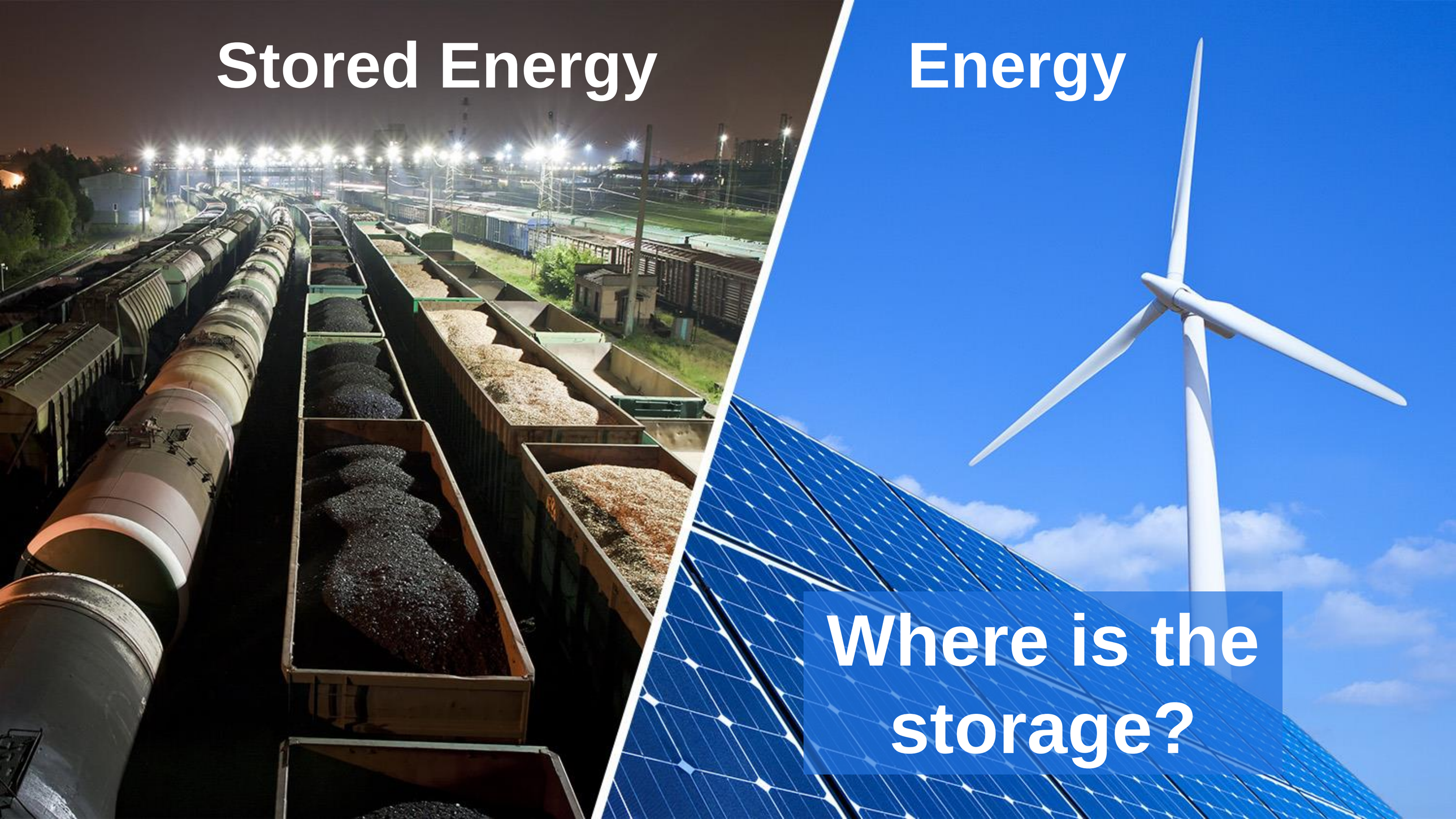
Indirect GHG emissions (AKA Scope 2) are generally associated with emissions step removed a customer's direct operations

Reducing Direct Emissions

Direct GHG emissions (AKA Scope 1) are those that occur from sources directly controlled by the customer

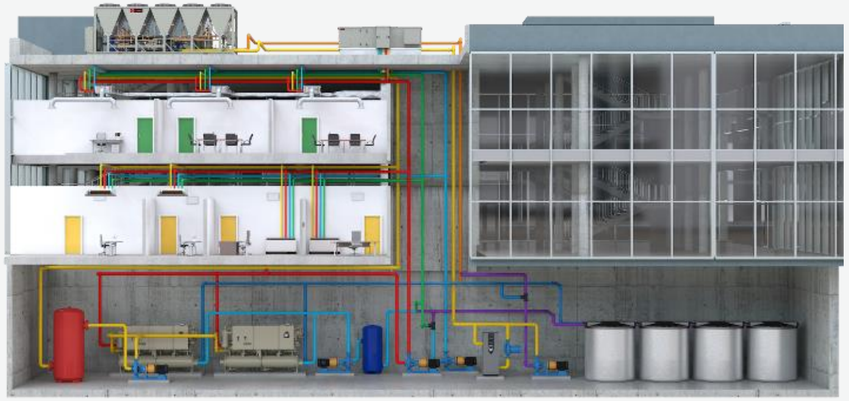


Renewable Energy


Stored Energy
Energy
Where is the storage?

Energy Storage Technologies

Many types of Energy Storage will be needed, on both sides of the electric meter, for renewable energy, Net Zero buildings and the grid to function reliably.



Buildings have Thermal and Electrical Loads

GRID SIDE

- Pumped Hydro
- Compressed Air
- Fly Wheels
- Batteries

Electric Meter

BUILDING SIDE

- Chemical Batteries
- Thermal Mass (passive)
- Thermal Batteries (active)

Trane Thermal Battery™ System

How does it work?

At the heart of the system is the CALMAC Ice Bank®

- Contains water; changes water to ice or ice to water depending on application
- Just one tank has the capacity to cool six homes
- 40-year lifespan

Trane Thermal Battery™ Cooling System

What is it?

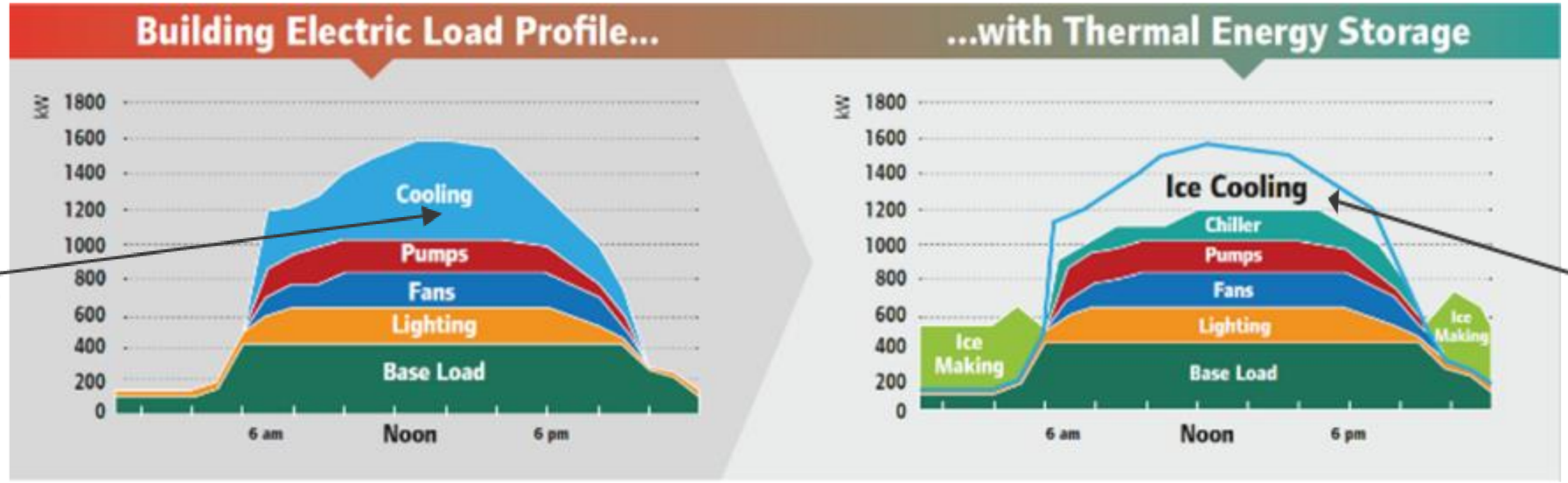
- A Trane-controlled chiller plant enhanced with thermal energy storage.

What does it do?

- Chiller plant operates like a battery, charging Ice Bank® energy storage tanks (filled with water) when excess or inexpensive energy is available.
- And discharging when demand or cost is high, or when the utility asks for the discharge to occur.

Shift Building Demand by Cooling with Thermal Batteries™

Air-conditioning can account for over 40% of the summer peak-day load



Reduced need for peaking plants & other redundant grid infrastructure

Thermal Batteries™ meet grid challenges

- Addressing **critical** utility/grid peaks
- Avoid **expensive** and **high-emission** peaker plants
- Supporting **advanced grid services** and **demand response**

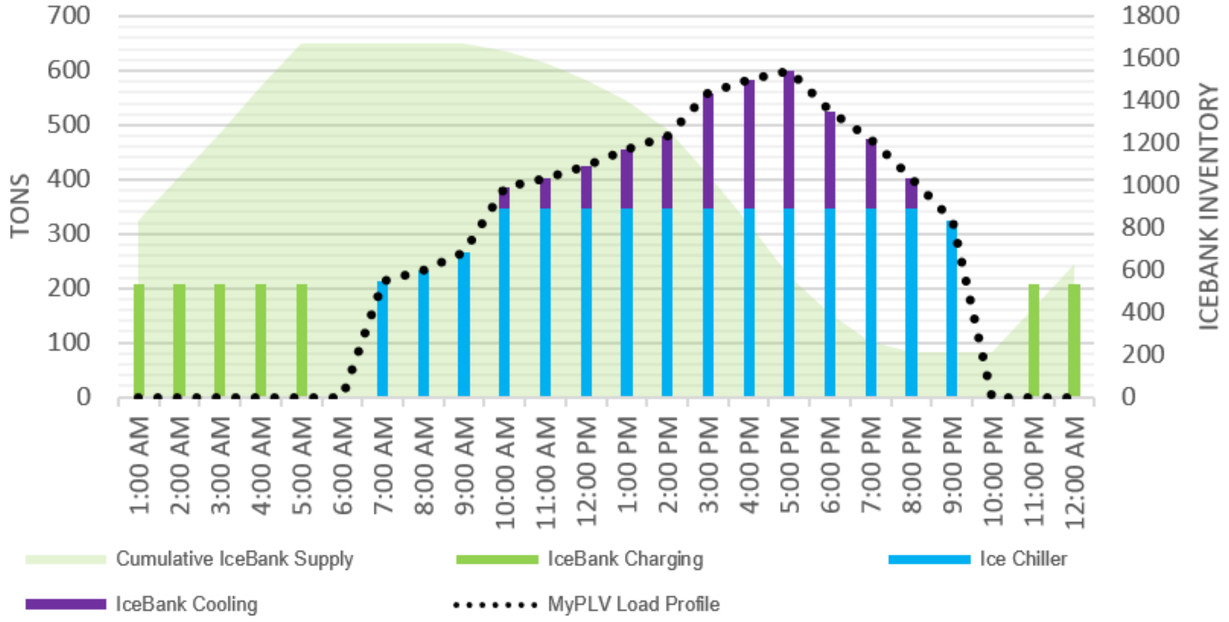
Partial or Full Storage for Cooling

Partial Storage – ~60% chiller, 40% ice

Reduced chiller, tank and electrical distribution sizes and costs

Similar to conventional chiller plant first costs without incentives

Now lower first cost with utility rebates / incentives

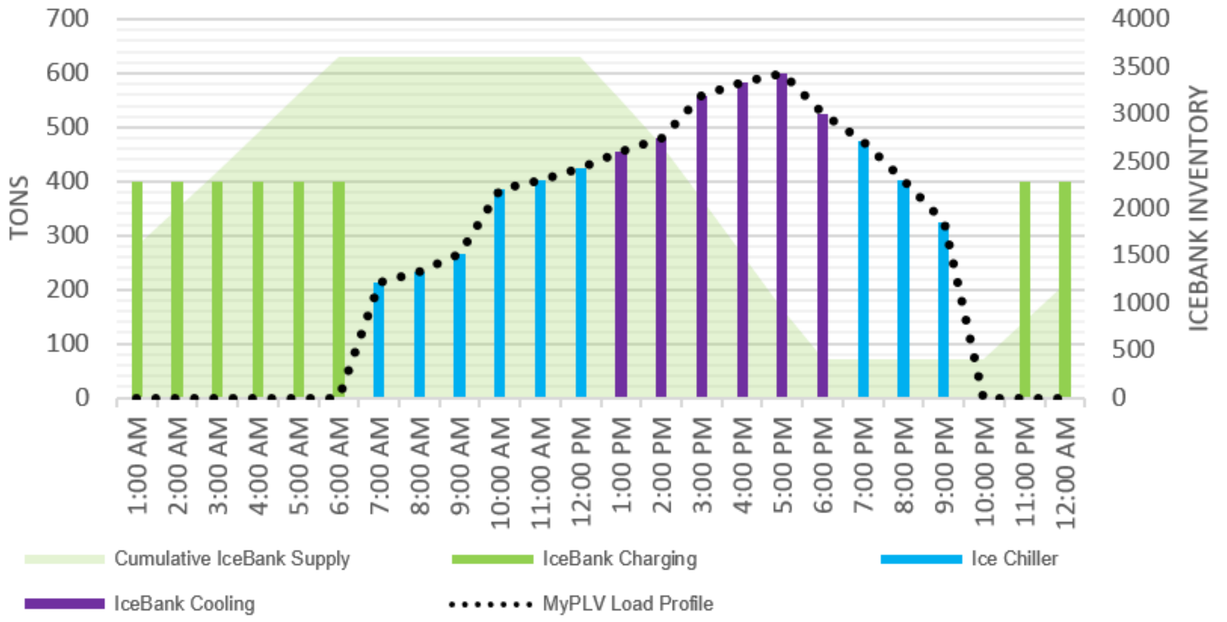


Full Storage – 100% chiller, 100% ice

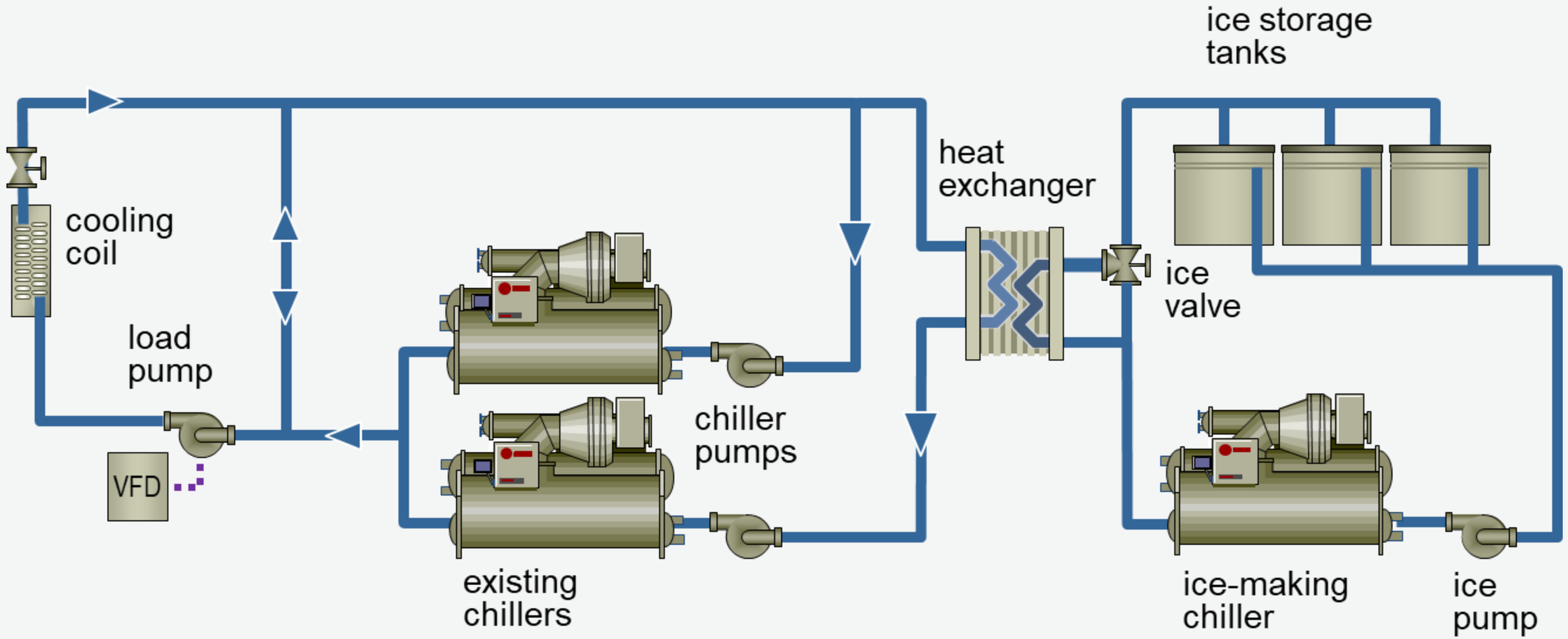
Increased redundancy and dispatch capacity

Requires **Time of Use (TOU)** and/or **high demand charge (Global Adjustment)** utility rates

Makes more sense with **utility rebates / incentives / Demand Response**

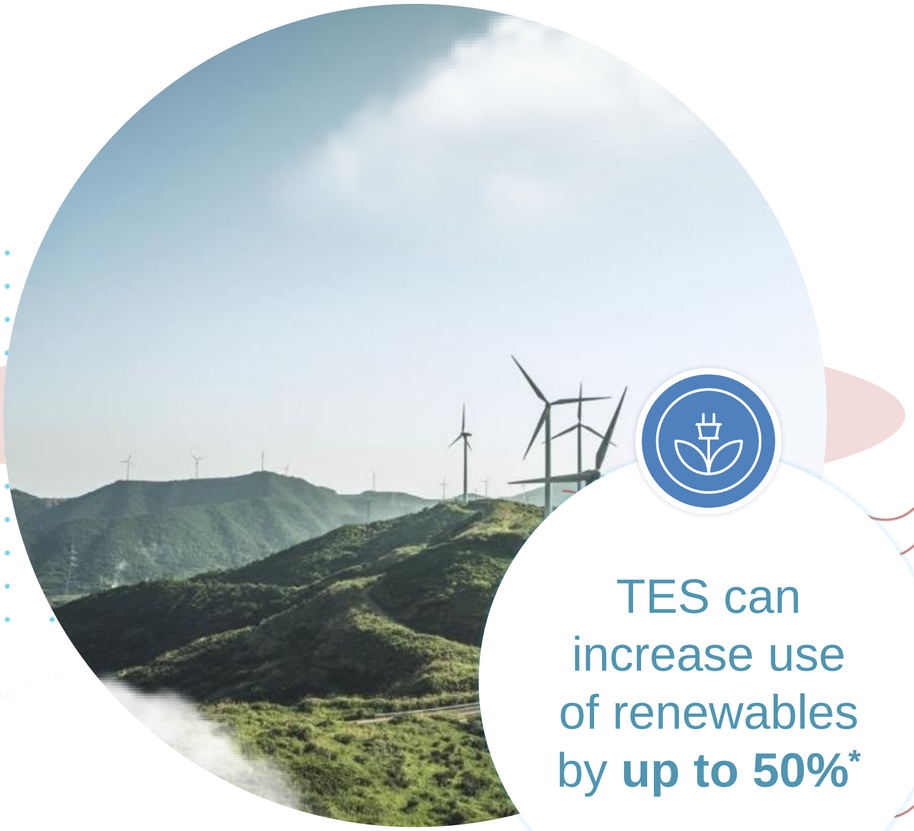


Adding THERMAL STORAGE to a Large Chiller Plant



More Flexibility, Less Money

- Provides demand flexibility and can reduce reliance on grid (thus reducing costs)
- Enables renewable energy and decarbonization
- Assure reliable heating & cooling with redundancy
- Incentivized by utility programs, potential tax incentives and local funding programs



TES can increase use of renewables by **up to 50%***

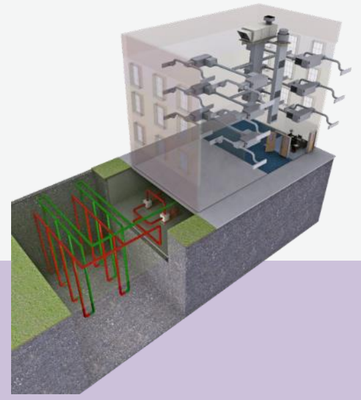
* Source: ASHRAE RE-1607.2018

Electrification of Heat

Assess and Implement Electrification Solutions

Ground Source Heat Pumps

The best overall efficiencies with options for distributed or centralized systems.

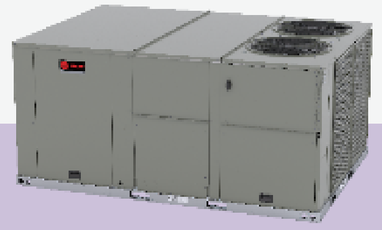


VRF Systems

Electric VRF heat pumps and heat-recovery systems offer versatile electric zoned heating and cooling

Packaged Units and Split Systems

The simplest path to retrofitting existing buildings. Effective heating with integrated heat pumps and hybrid systems.



Chiller-Heater Systems

Chillers can provide cooling as well as heating by configuring them with heat recovery or heat pumps. Heat recovery is a common, extremely efficient first step to electrification.

Storage Source Heat Pump Systems

Thermal energy storage provides operational flexibility by capturing and storing reclaimed energy to heat the building efficiently and can optimize heat pump capacity.

Heat pumps can be several times more efficient than other forms of electric heating

Heating in Cold Urban Cities

Replace gas boilers with electric
- Resistance heat will exacerbate winter peaking

GSHP restricted by underground infrastructure

ASHP limited by ambient
- Electric reheat supplemental
- Defrost derating
- Limited roof space

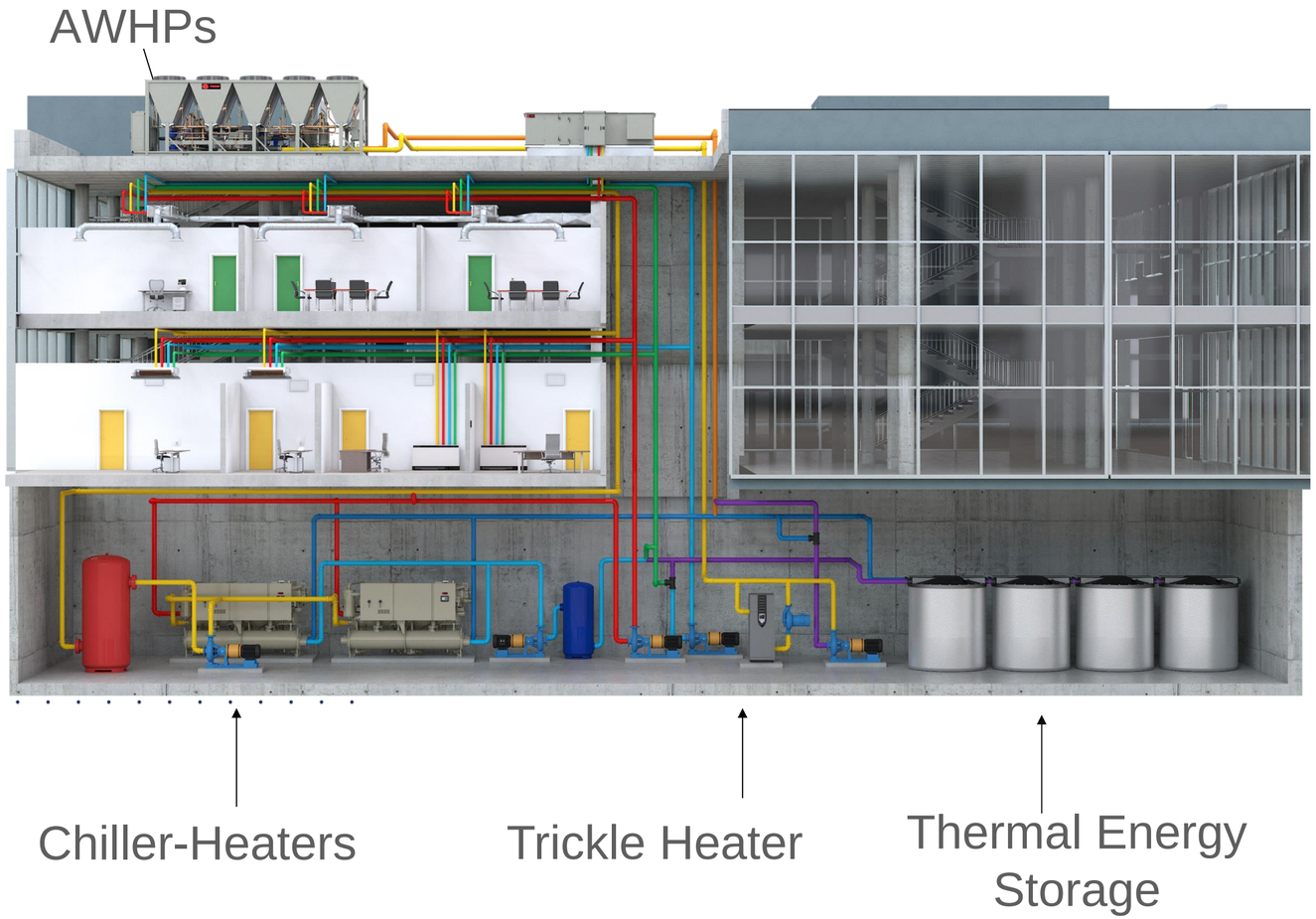
Thermal Energy Storage Tank Capacity

- 1 Tank is 8’-6” Tall x 7’6” Dia.
  - 1655 Gal of Water = 13,786 lbs.
  - 13,786 lbs. x 144 Btu’s/lb. ~2,000,000 Btu’s
  - 2,000,000 Btu’s =
  - ~14 Gallons of Fuel Oil
  - ~20 Therms of Natural Gas
  - ~160 Ton-hrs.
- A New York City project has 44 tanks
  - 88,000,000 Btu’s
  - 616 gal of Fuel Oil
  - 880 Therms
  - 88 Mlbs of Steam
  - ~7,000 Ton-hrs.

There’s a lot of stored energy in the cold water contained in these tanks!

Storage-Source Heat Pump System (SSHP)

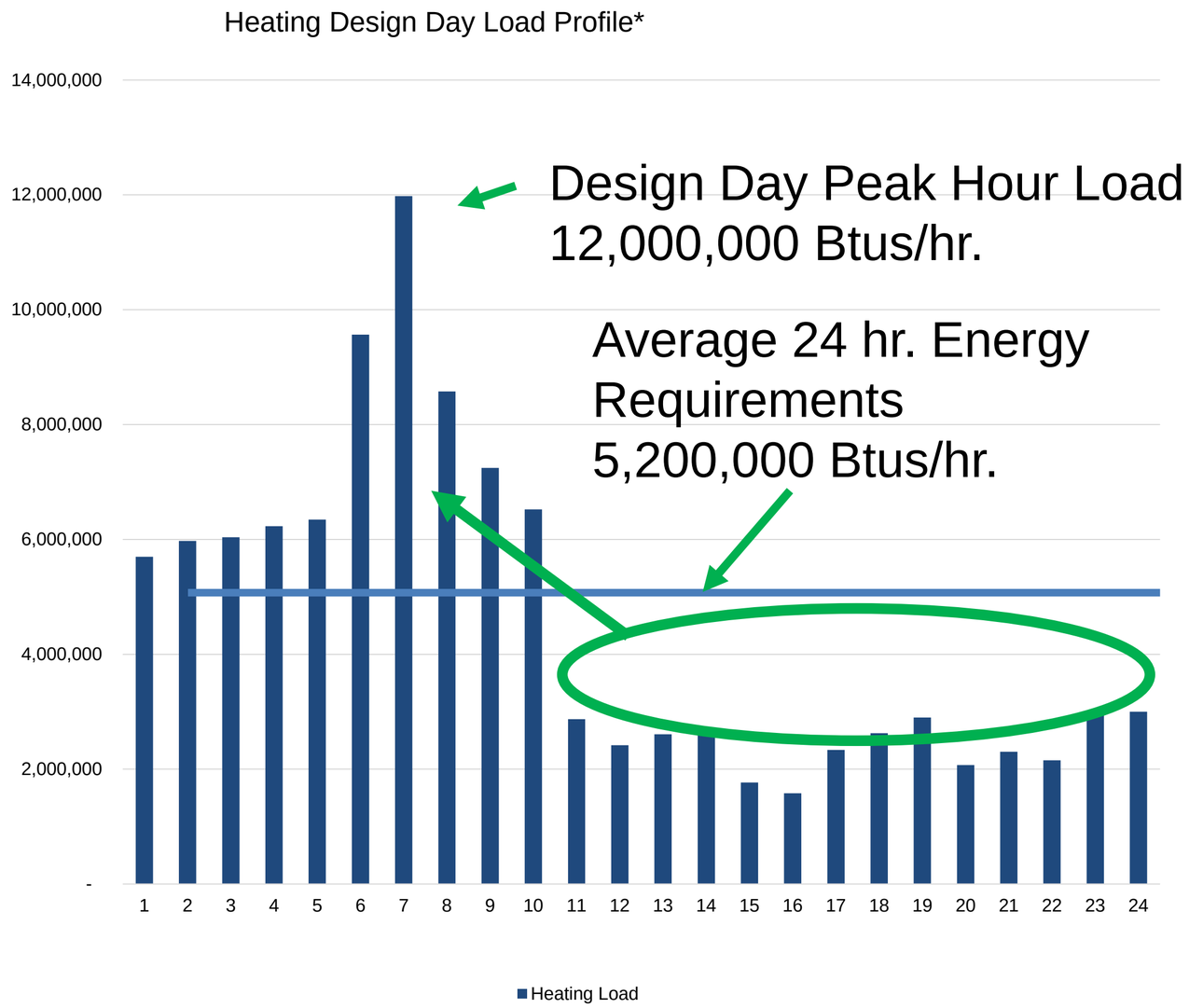
An innovative way to make all-electric heat pump heating possible even in cold climates and dense urban environments where there is limited roof space.



FEATURES

- **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 reduce required air-to-water heat pump capacity and cost.
- **Higher supply water temperatures:** 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 reducing overall system costs.

Storage enables downsizing of AWHP



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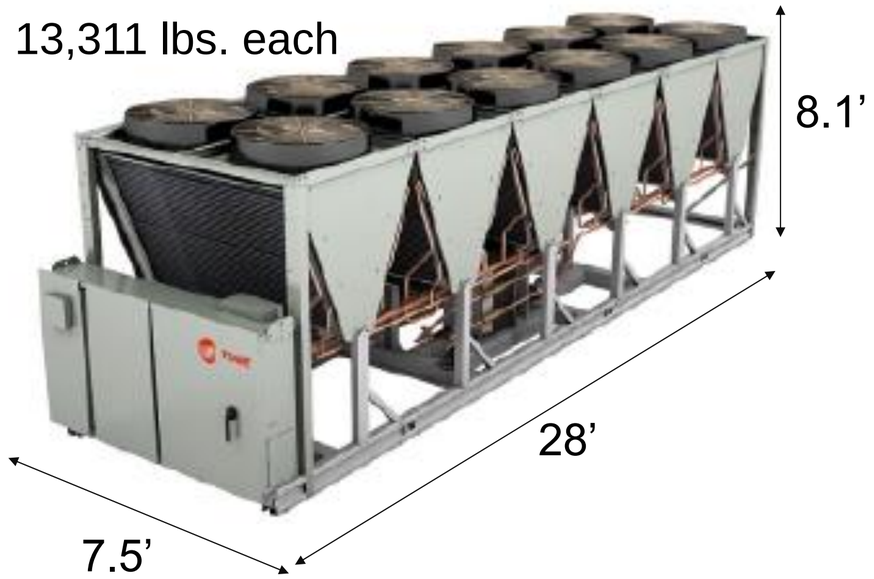
AWHP – 1,295,000 btuh's

Require ~~10~~ units – maybe more to accommodate defrost cycle



* Depending on building type and climate.

Extending the Low Ambient Capabilities

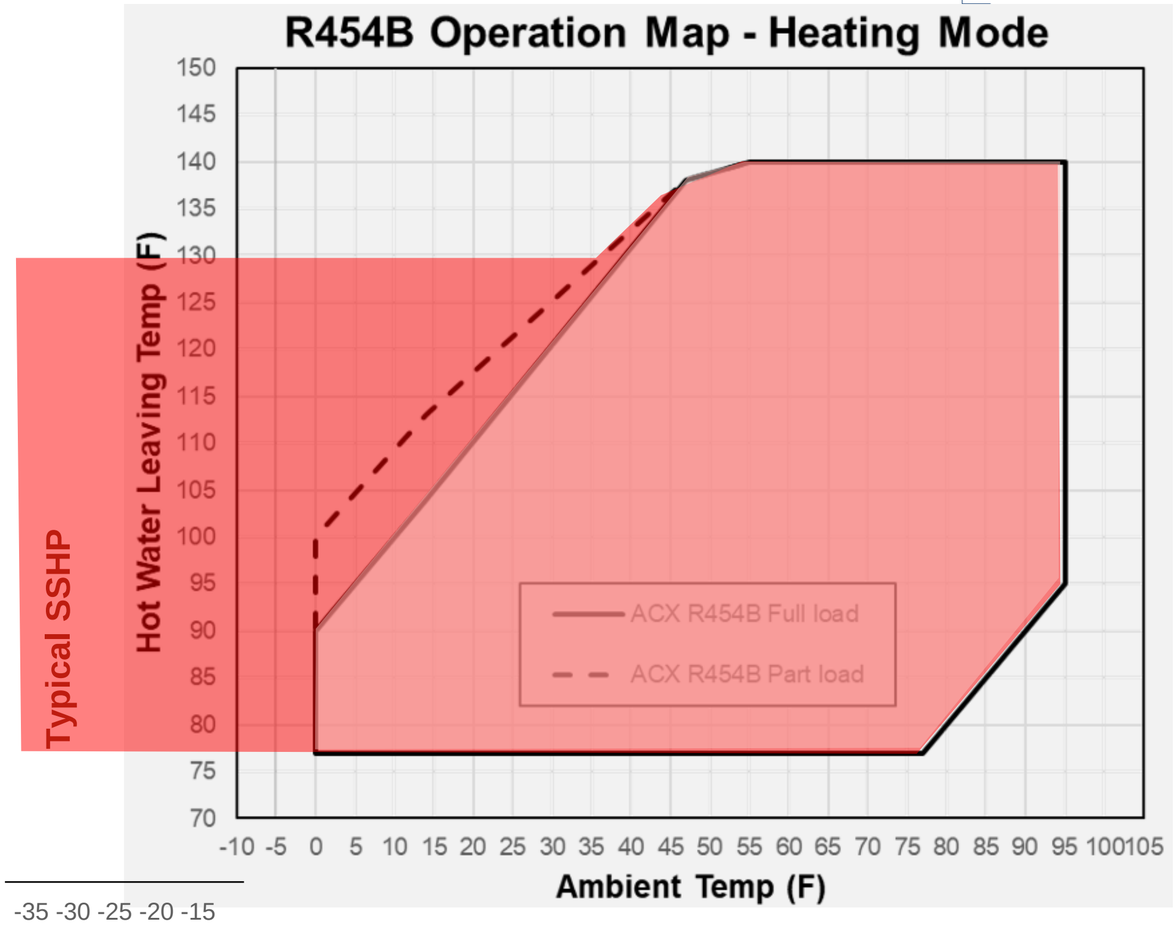
AWHPs have operational limits at low ambient temperature

- Capacity and hot water temperature drop dramatically
- Storage extends the map

Higher hot water temperatures

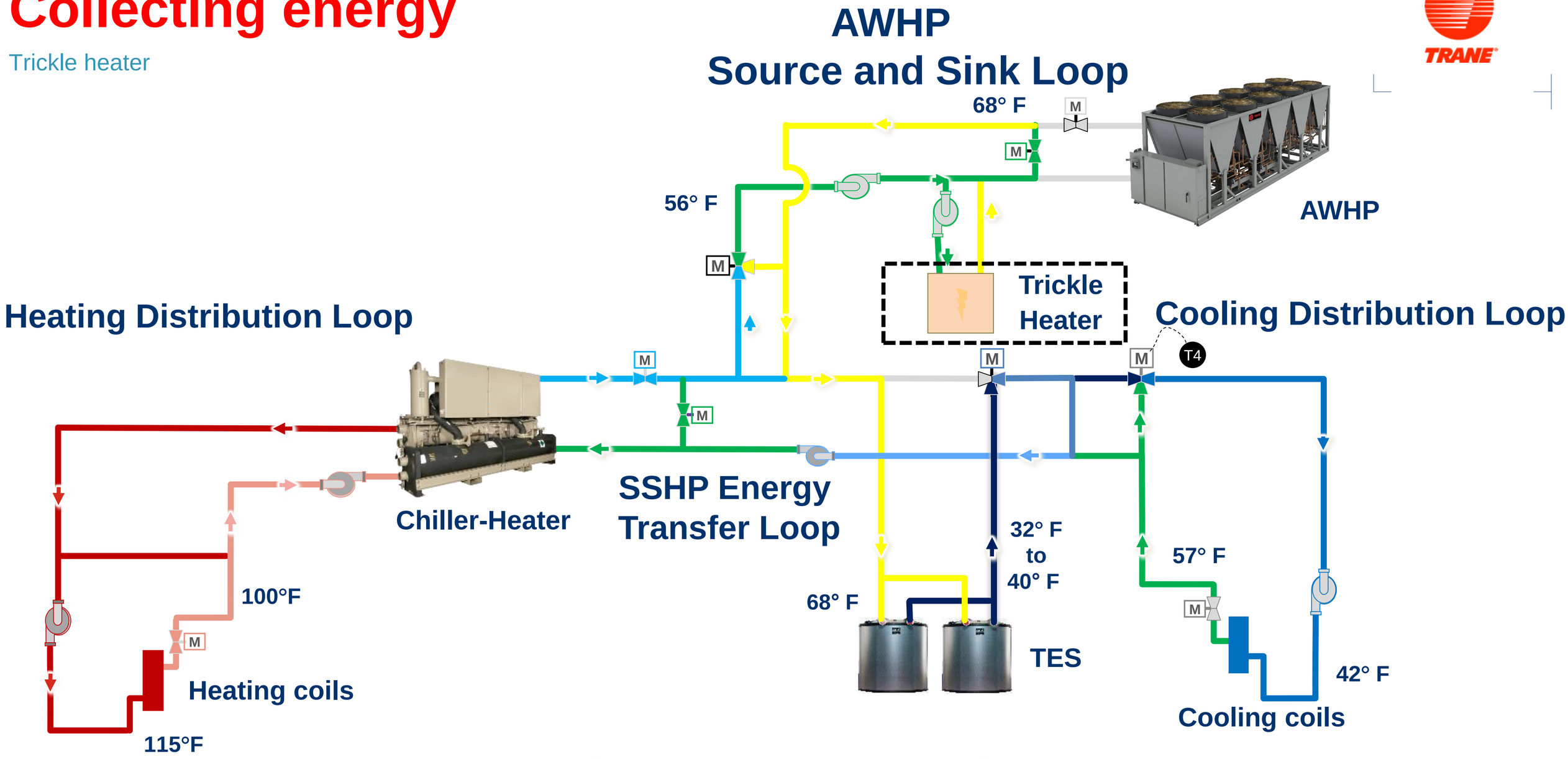
at

Lower ambient



Collecting energy

Trickle heater



Climate zones 5 and colder

Same Profile – Dirty Grid

Compare the exact same load on 2 different grids to show the impact in CO2e
SSHP is 68% CO2e reduction on “clean” grid vs Gas Heat, 26% CO2e reduction vs ASHP!

SSHP - Heating Carbon Estimates — Chicago

SSHP System Total Output Emission Rate: ***1,159,482 lbs CO2e***

	Gas Heat	Electric Heat	Heat Pump
Conventional Systems (lbs CO2e)	***2,168,399***	***3,745,128***	***1,461,513***
Additional Carbon vs. SSHP	***87.0%***	***223.0%***	***26.0%***

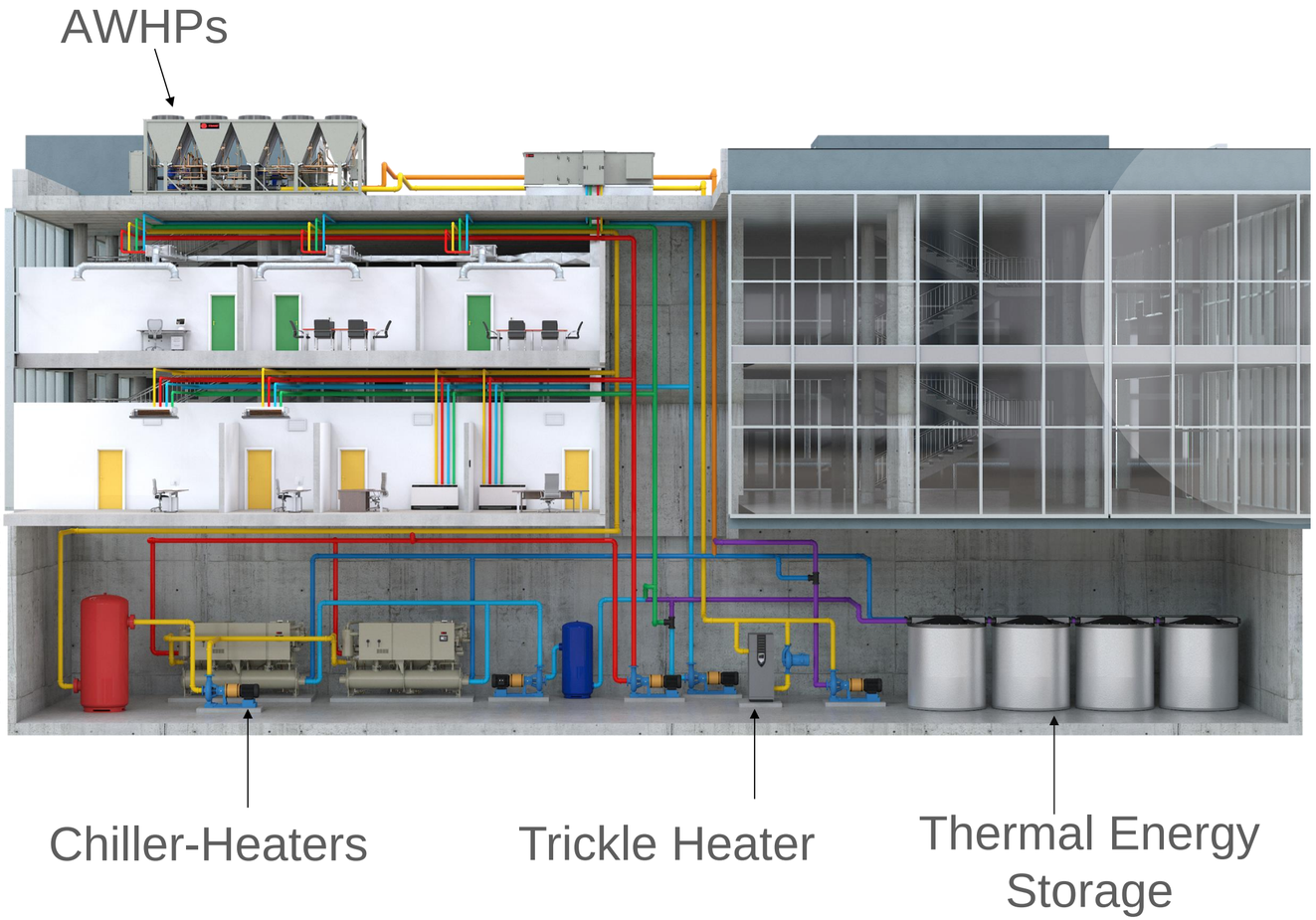
SSHP - Heating Carbon Estimates — Buffalo

SSHP System Total Output Emission Rate: ***604,183 lbs CO2e***

	Gas Heat	Electric Heat	Heat Pump
Conventional Systems (lbs CO2e)	***2,168,399***	***1,951,512***	***761,566***
Additional Carbon vs. SSHP	***258.9%***	***223.0%***	***26.0%***

First SSHP Installation in LaCrosse, WI

Trane Training Center

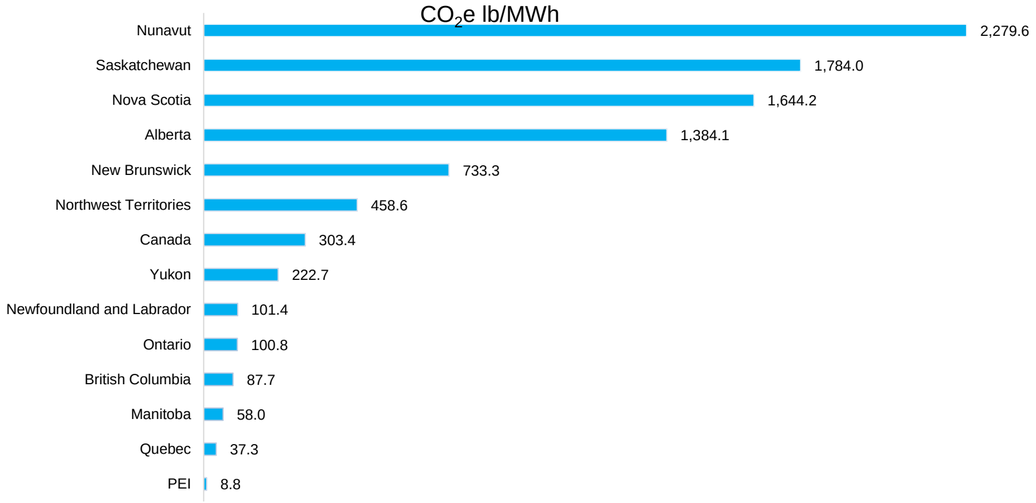


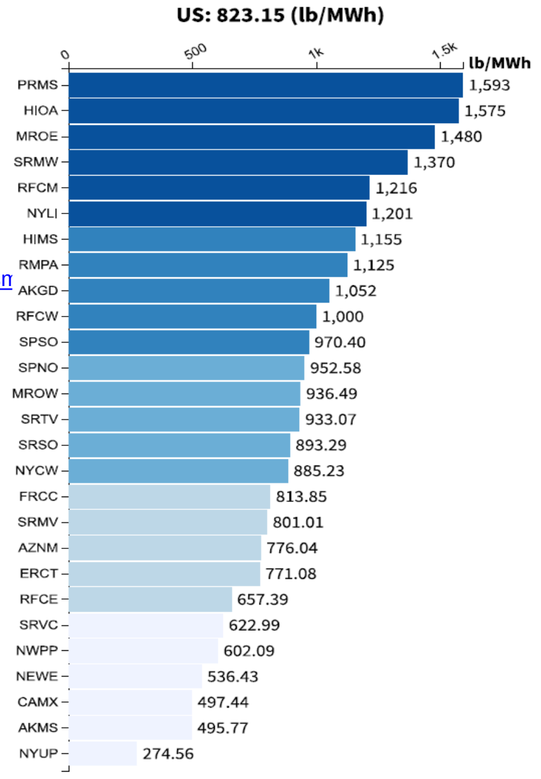
FEATURES

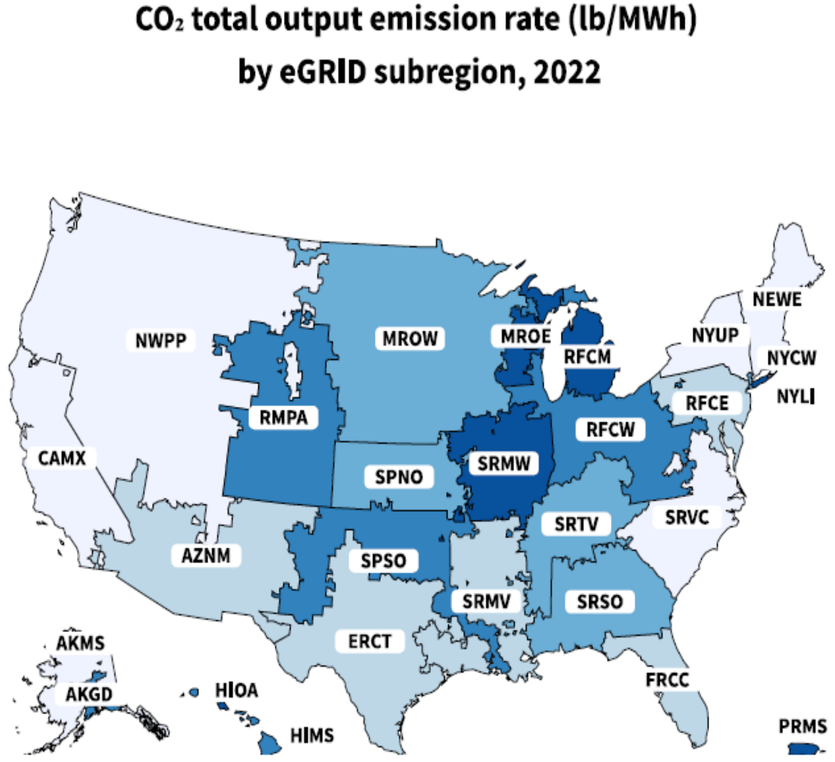
- **80,000 SF Building**.
- **180-Ton Air to Water Heat Pump**
- **Two 110-Ton Heat Recovery Chillers**
- **Seven Ice Storage Tanks-160 ton-hour**
- **Research Project--**optimize controls, address heat recovery options
- Installed November 2023. Mild winter. Offering tours. Consortium of utilities monitoring performance.
- **Recruiting partners to demonstrate technology at other cold locations and accelerate decarbonization**

Electricity Rates and Incentives

Utility Grid Emission Factors Vary Across North America







Sources:
https://www.canada.ca/en/environment-climate-change/services/managing-pollution/fuel-life-cycle-assessm
model/updated-carbon-intensity-electricity.html
https://www.epa.gov/egrid/data-explorer

Commercial Electricity Rates-Medium and Large

Commercial Electricity Rates

(Accounts in Waterloo, Wellesley, and Woolwich)

Electricity Charges

Charge	Cost
Electricity Charge	Hourly Ontario Energy Price or Retailer Price

Transmission Charges

Charge	Cost
Transmission Network (<1,000kW)	$4.1968/kW
Transmission Network (1,000 to 4,999kW)	$4.1912/kW
Transmission Connection (<1,000kW)	$1.1768/kW
Transmission Connection (1,000 to 4,999kW)	$1.1759/kW

Enova Distribution Charges

Charge	Cost
Monthly Service Charge	$125.96/month
Distribution Class A	$7.3618/kW
Distribution Class B (RPP* and non-RPP*)	$7.3008/kW
Disposition of Global Adjustment (applicable for non-RPP customers only)	($0.0008)/kWh
Distribution Class B (WMP*)	$6.5083/kW
Customer Owned Transformer Credit	($0.60)/kW
Low-Voltage Service Charge	$0.2045/kW

Regulatory Charges

Charge	Cost
Standard Supply Service	$0.25/month
Wholesale Market Services Class A *	$0.0055/kWh
Wholesale Market Services Class B *	$0.0059/kWh

*A line loss adjustment factor of 1.0353 is applied to these charges

Hourly Ontario Energy Price

Most Commercial customers have an interval meter and are charged the Hourly Ontario Energy Price (HOEP), or market price, for their electricity consumption. The market price is dynamic and changes hourly based on demand and the availability of supply. To see the most current market prices, please visit ieso.ca.

Global Adjustment

The global adjustment covers the cost of building new electricity infrastructure in the province, maintaining existing resources, as well as providing conservation and demand management programs. All Ontario electricity consumers pay global adjustment, but it is included in the Time-of-Use, Tiered and Ultra-Low Overnight rates paid by residential and small business customers, so they do not see it as a separate line item.

Visit ieso.ca for information about the HOEP and global adjustment.

Medium Commercial	Price
Published monthly by the IESO for Class B customers	$ per kWh*

Larger Commercial	Price
IESO calculates an amount for Class A customers based on the customer's historical peaks coincident with the five annual provincial	

https://enovapower.com/wp-content/uploads/2024/02/240053-Commercial-Electricity-Rates-for-Waterloo-Woolwich-Wellesley_proof_V2.pdf

Commercial Electricity Rates-Small

TOU Price Periods	Summer (May 1 – October 31)	Winter (November 1 – April 30)	TOU Prices (effective until October 31, 2024) (¢/kWh)
ff-Peak	Weekdays 7pm – 7am Weekends and holidays all day	Weekdays 7pm – 7am Weekends and holidays all day	8.7
Mid-Peak	Weekdays 7am – 11am and 5pm – 7pm	Weekdays 11am – 5pm	12.2
On-Peak	Weekdays 11am – 5pm	Weekdays 7am – 11am and 5pm – 7pm	18.2

For more information on Time-of-Use Pricing, visit oeb.ca.

2024 Tiered Pricing and Thresholds (Effective January 1, 2024 – October 31, 2024)

Tier	Price ¢/kWh
Tier 1 (up to 750 kWh)	10.3
Tier 2 (above 750 kWh)	12.5

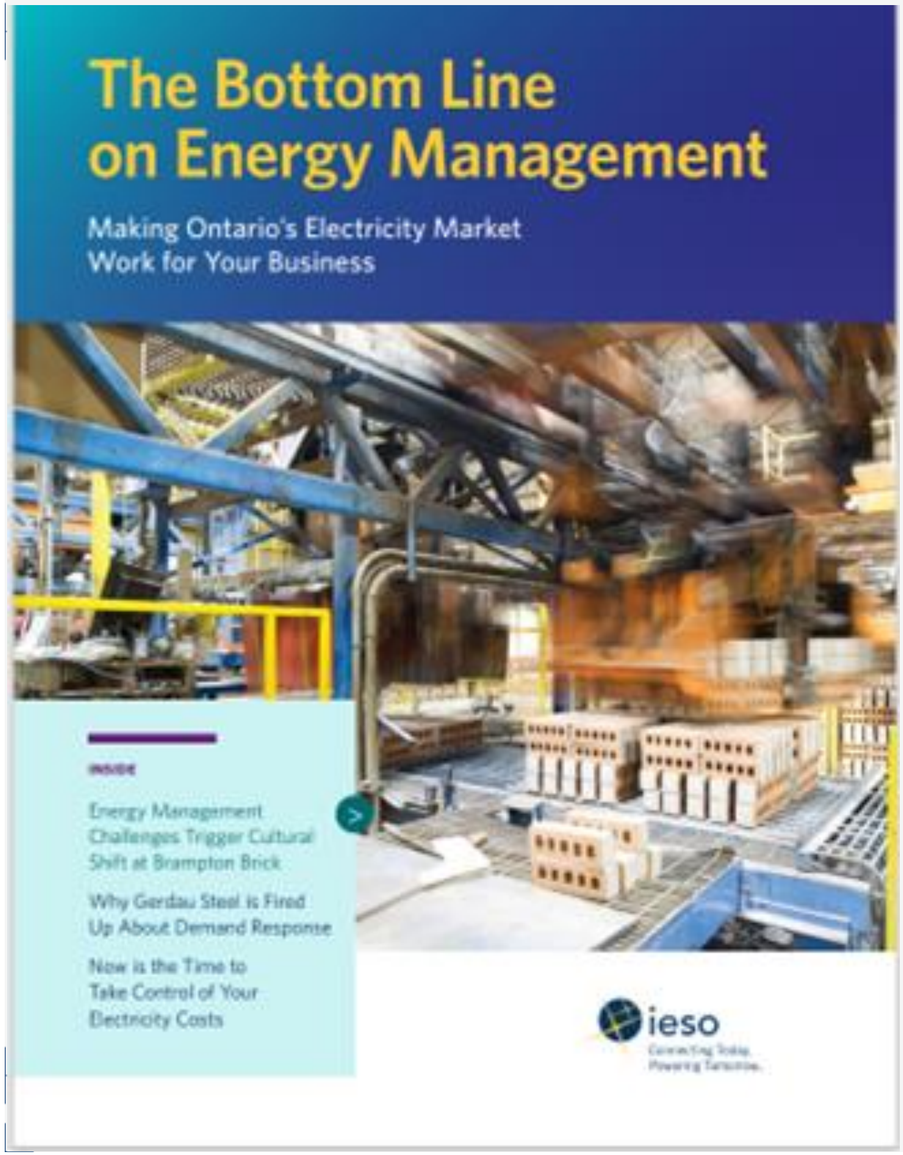
*A line loss adjustment factor of 1.0353 is applied to these charges.

Winter 2023-2024 Ultra-Low Overnight Rate pricing and periods (Effective November 1, 2023 until April 30, 2024)

ULO Price Periods	All Year	ULO Prices (¢/kWh)
Ultra-Low Overnight	Every day 11pm – 7am	2.8
Weekend Off-Peak	Weekends and holidays 7am – 11pm	8.7
Mid-Peak	Weekdays 7am – 4pm and 9pm to 11pm	12.2
On-Peak	Weekdays 4pm – 9pm	28.6

https://enovapower.com/my-account/electricity-rates/

Save On Energy Retrofit Program



What types of projects are eligible?

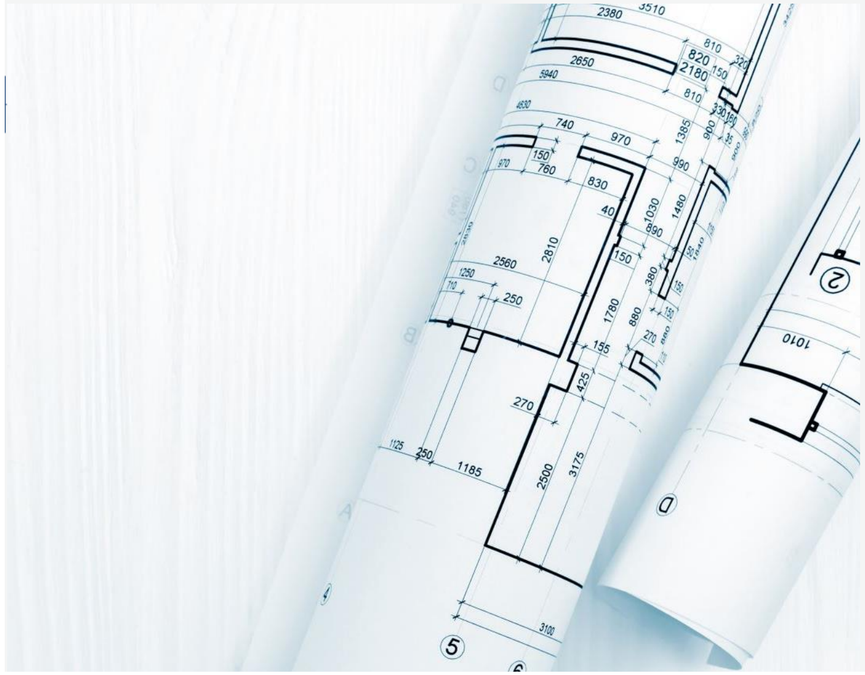
Projects eligible for the Retrofit program are generally those that provide sustainable, measurable and verifiable reductions in peak electricity demand and electricity consumption. Project incentives are available for a variety of products and technologies to continue to help businesses save on energy costs and increase their competitiveness.

Examples of eligible projects include:

- lighting controls
- HVAC redesign
- chiller replacement
- variable-speed drive installations
- custom equipment retrofits

Speak to your Save on Energy representative to find out how the Retrofit program can meet your needs.

No Worksheet for Thermal Storage Projects-Custom



- **Custom Incentive**
- **Summer Peak kW Reduction**
- **Winter Natural Gas Reduction**
- **Submit project notification to Save On Energy as early on as possible in project, <u>before</u> any contracts have been signed.**

Participant Incentives available are:

- $1,200/kW of Demand Savings or $0.13/kWh of Energy Savings for lighting and non-lighting measures (whichever is higher), to a maximum of 50% of the project costs that are directly related to the procurement and implementation of the Engineered Measure. More details are found in Section 5.6 – Project Cost Breakdown.

The-Bottom-Line-on-Energy-Management (3).PDF

Enova