Reducing Peak Demand Impacts

How to Increase and Accelerate Load Flexibility

NATIONAL BUILDING DECARBONIZATION FORUM | APRIL 2024

April 18, 2024

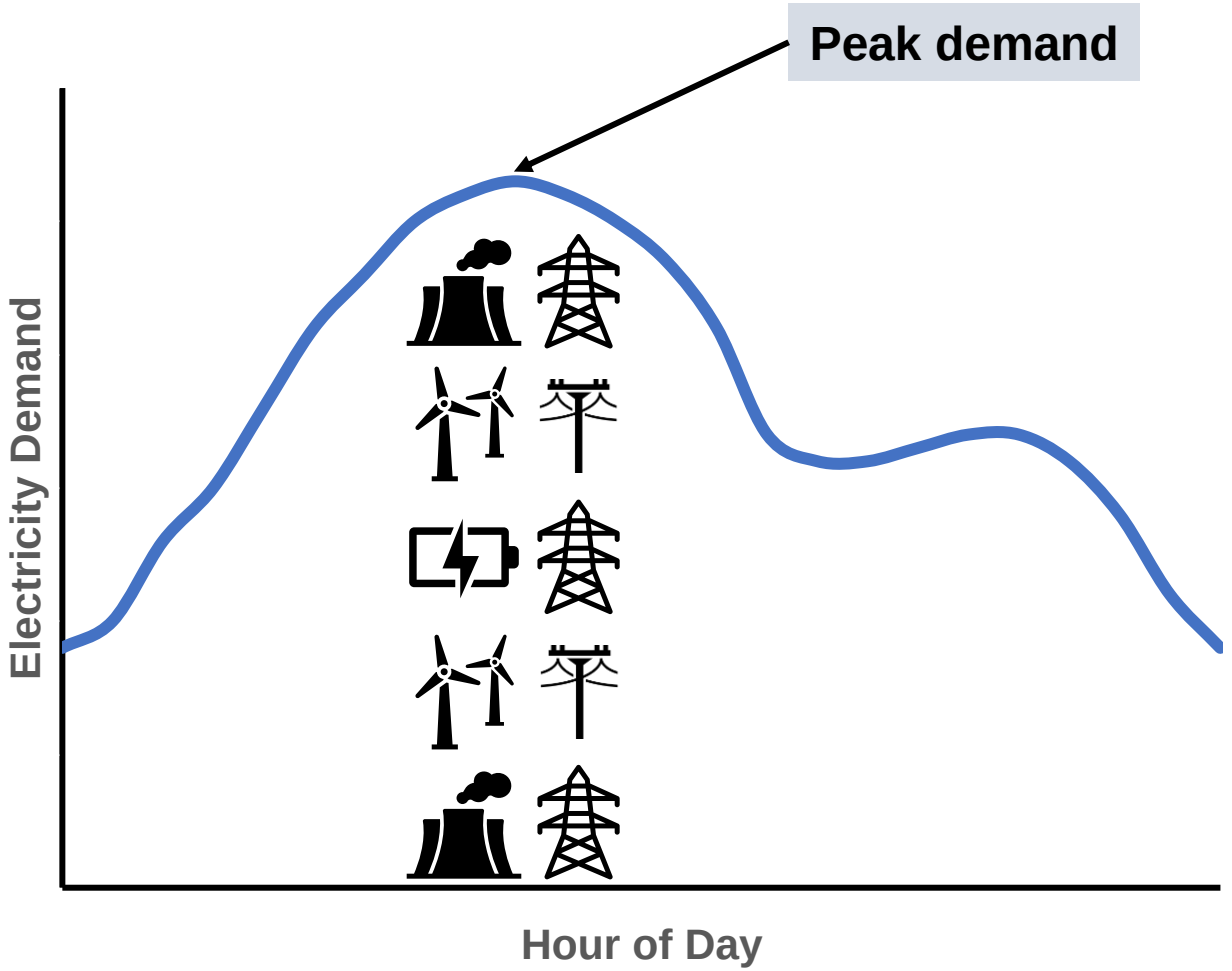
Agenda

1. Panelist Presentations
2. Moderated Q&A
3. Participant Discussion
4. Final Thoughts

What is peak demand?

Peak demand is when electricity use on the grid is at its highest.

Electric grids must be built to meet peak demand.



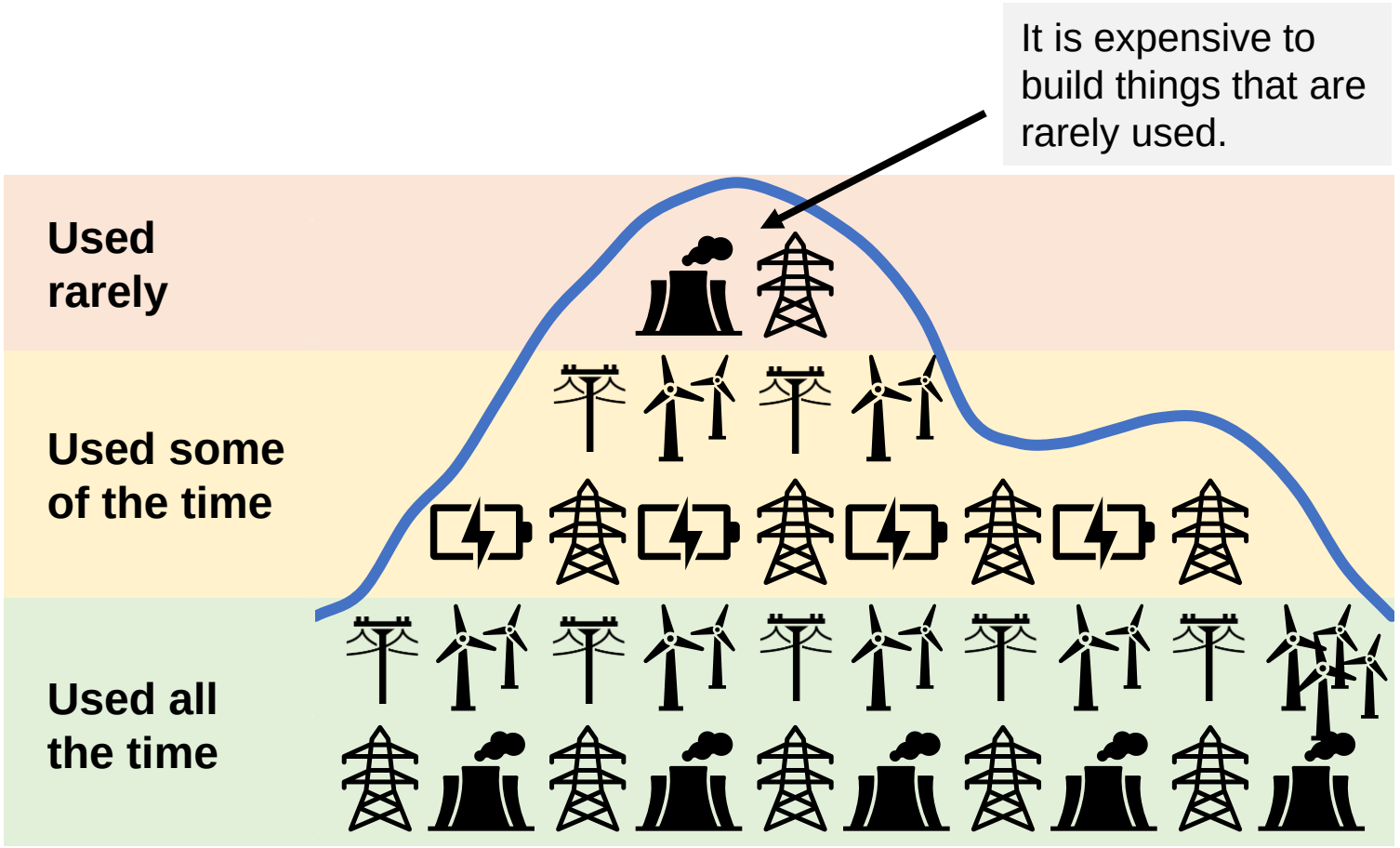
Why do we care about peak demand?

It’s all about…

the money…

the materials…

and the people..



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Breakout 3B

REDUCING PEAK DEMAND IMPACTS

How to Increase and Accelerate Load Flexibility

April 18, 2024 | 10:30 AM - 12:00 PM

Robyn Wark
BC Hydro

Mathieu Lévesque
Dunsky Energy + Climate

Scott Huffmaster
Trane Technologies

Julia McNally
Toronto Hydro

How to Increase and Accelerate Load Flexibility

NATIONAL BUILDING DECARBONIZATION FORUM | APRIL 2024

Mathieu Lévesque, Senior Consultant

dunsky Energy + Climate

April 18, 2024

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ACCELERATING THE CLEAN ENERGY TRANSITION

ANALYSIS + STRATEGY

BUILDINGS **MOBILITY** **INDUSTRY** **ENERGY**

20 Years

50+ Dedicated Professionals

800+ Projects across **32** States & Provinces

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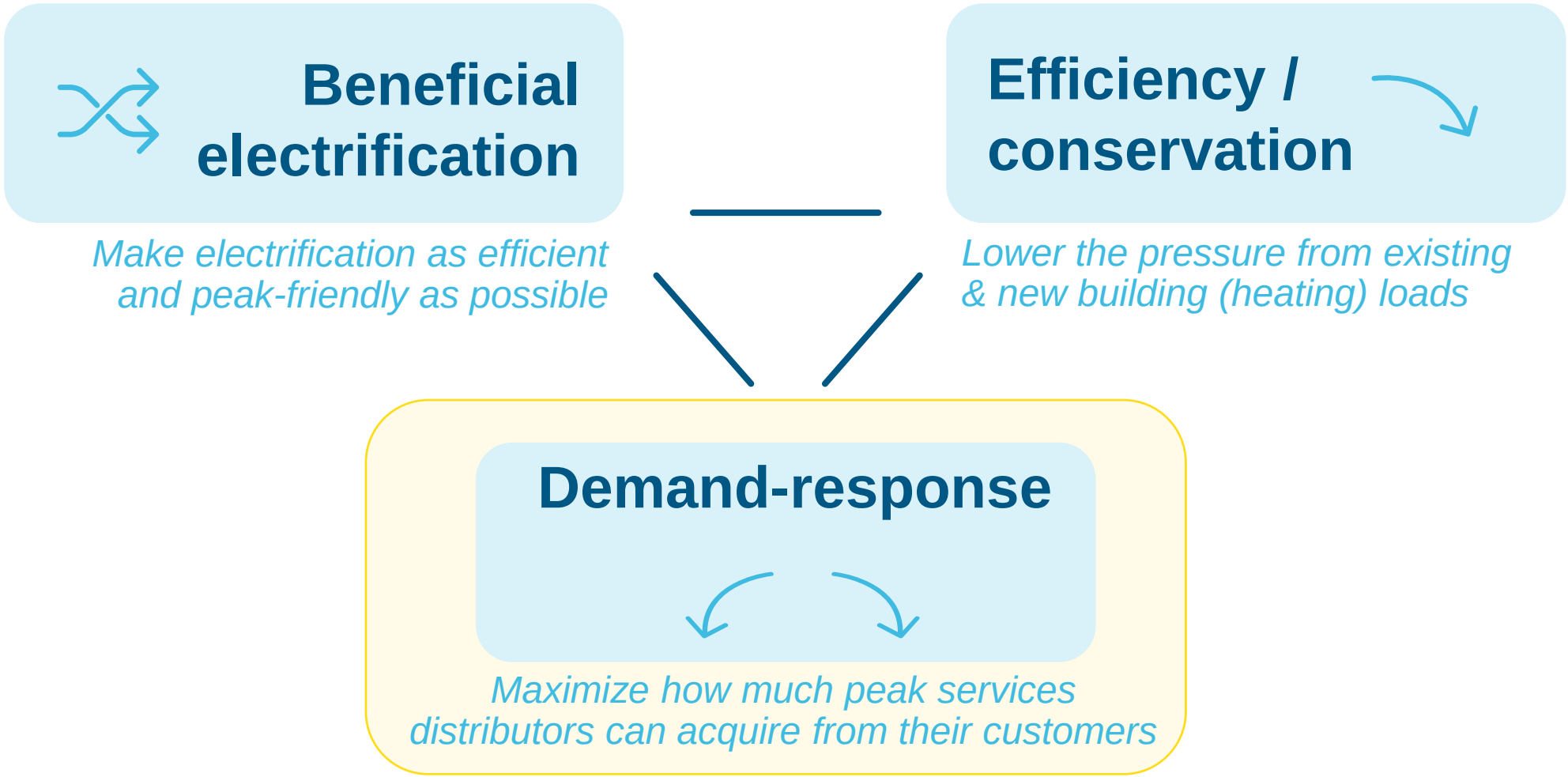
ACCELERATING THE CLEAN ENERGY TRANSITION

ANALYSIS + STRATEGY

BUILDINGS | **MOBILITY** | **INDUSTRY** | **ENERGY**

GOVERNMENTS | UTILITIES | CORPORATE + NON-PROFIT

The **Three Pillars** of Peak Management



Demand-Response: **breaking the barriers**

DR is typically...

Not considered in planning processes, and when DERs are, they are viewed as a "load modifier“ not a resource

Not valued / not eligible for participation or compensation for *all* the benefits they contribute to across the complete system

Not coordinated across the system; with the operations, dispatch and interoperability between T&D systems restricting ability to extract the full value out of DERs.

Solutions

Planning for DERs

Enabling DR

Integrating DR

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Demand-Response: **breaking the barriers**

Planning for DERs

- **Potential Assessment:** comprehensive *(all DERs)* and granular *(temporally and geographically)*
- **Evaluation Frameworks:** value *all* benefits when assessing DR cost-effectiveness relative to traditional infrastructure investments

Enabling DR

- **Pricing signals / compensation:** time-of-use rates, critical peak pricing**,** DR participation rewards
- **Programs:** equipment subsidies (controls, storage, smart charging…)
- **Procurements**: manual DR, BYOD, automated DR, DR aggregators, capacity auctions
- **Regulations:** DR-ready *equipment*, DR-ready *buildings*

Integrating DR

- **Pilots and demonstration** projects to build confidence
- **Constant engagement** required for continued participation
- **Grid modernization investments** to orchestrate DR

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Thank you!

How Toronto Hydro is Addressing Electrification Peak

Preparing for Grid Modernization and Expansion

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Julia McNally, Director of Climate Action

TORONTO HYDRO®

April 18, 2024

Agenda

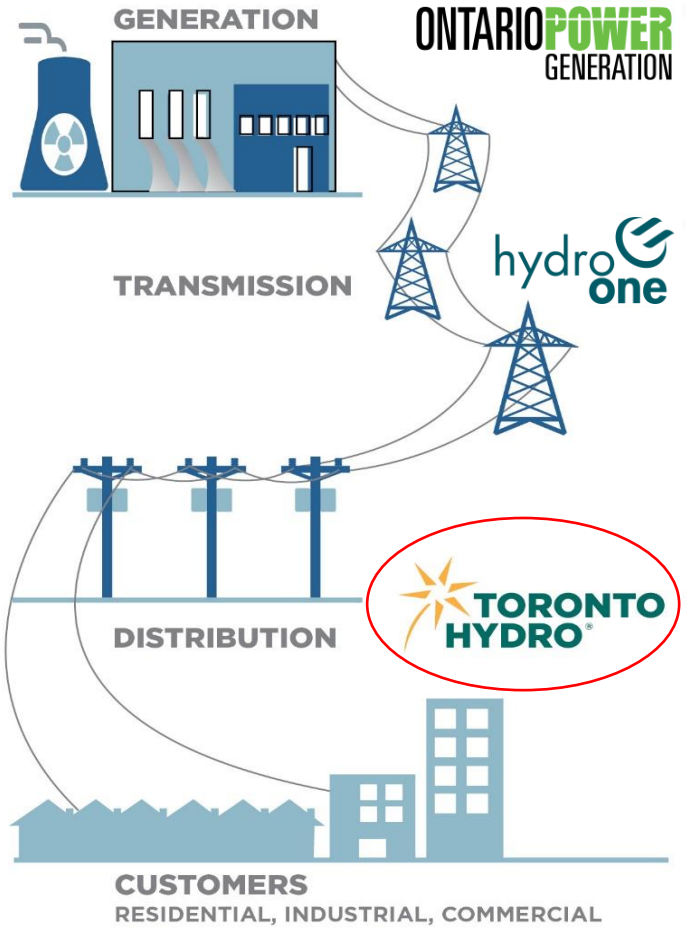
1. Who is Toronto Hydro?
2. Electrification Preparation
3. We Are Ready
4. Demand Management
5. Looking Forward

Photo credits: School of Cities

Who is Toronto Hydro?

Ontario's electricity system

There are three main components to all electricity systems: generation, transmission and distribution.



ONTARIO POWER GENERATION

In Ontario, almost half of the electricity is generated by **Ontario Power Generation (OPG)**. This provincially-owned organization has generating stations across Ontario that produce electricity from hydroelectric, nuclear, gas, biomass and solar sources.

hydro one

Once electricity is generated, it must be delivered to cities, towns and rural areas. This happens through high-voltage transmission lines that serve as highways for transmitting electricity. **Hydro One** supplies electricity to Toronto Hydro and owns 30,000 circuit kilometres of transmission lines across 98% of Ontario.

NOTE: Toronto Hydro essentially plugs into Hydro One's electricity feed. That means if an issue arises with Hydro One equipment, it can disrupt the flow of power to Toronto Hydro customers, resulting in a power outage. This is referred to as a "loss of supply."

TORONTO HYDRO

Toronto Hydro is responsible for the last step of the journey: distributing electricity to residential, industrial and commercial customers in Toronto.

OPG, Hydro One and Toronto Hydro operate independently from one another and are solely responsible for maintaining their individual sections of the overall electricity system.

- Toronto Hydro is a distribution company
- We distribute electricity to approximately 793,000 customers in Toronto
- **Role of Toronto Hydro:** help reduce building emissions and prepare the grid
- **Role of OEB and IESO:** focus on upstream to accommodate load

TORONTO HYDRO

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Electrification Preparation

- After years of investment, we have a robust system with available capacity
- A fundamental shift—the energy transition—is underway
- Continued investment is needed to meet customer demands while addressing challenges (e.g., deteriorating infrastructure, extreme weather events)
- Toronto Hydro's 2025–2029 Investment Plan outlines investments required to expand, modernize and sustain the foundations of a safe and reliable grid to serve current and future electricity needs
  - Keeping our grid in good condition
  - Preparing the grid for growth
  - Modernizing our grid and operations

TORONTO HYDRO

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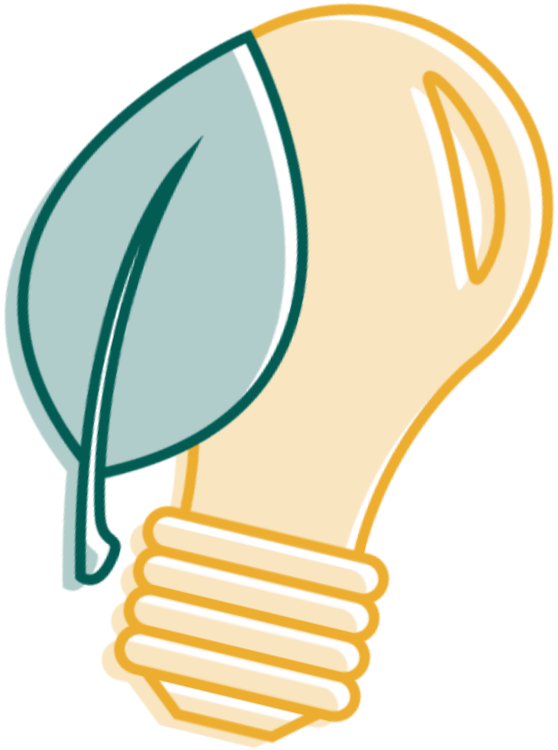
We Are Ready

- Our job is to provide electricity when and where customers need it
- We build our grid to meet peak needs
- Through an integrated planning process to determine required investments, Toronto Hydro modelled grid impacts of future peak demand scenarios
  - Completed with a new tool—Future Energy Scenarios model
- Toronto Hydro's Investment Plan would accommodate a range of possible energy transition scenarios in the next decade, among other measures
- Our transformation is anchored by six strategic priorities:

Intelligent grid	Energy storage	Transportation electrification	Customer experience	Process automation	Business growth

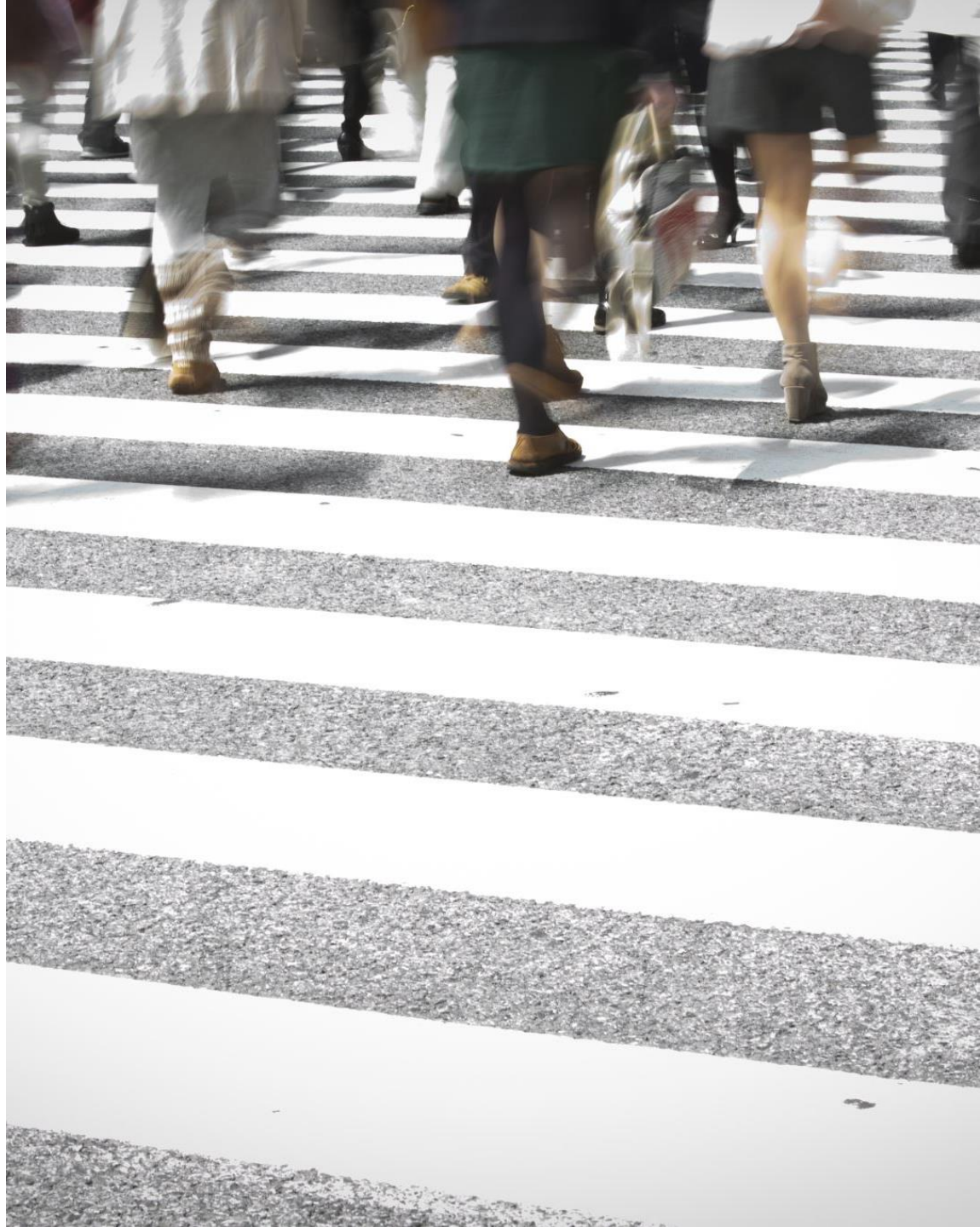
Demand Management

- Toronto Hydro is familiar with using demand side management and non-wires solutions to manage peak demand
  - **Peaksaver Plus:** Residential program ran until 2017—provided homeowners with thermostat to temporarily reduce electricity use when city demand was high
  - **Etobicoke Demand Response:** This project targets two at-capacity transformer stations in Etobicoke to examine how Toronto Hydro can meet peak demand without building more infrastructure
  - **Climate Action Team:** Promotes efficient electrification and existing programs
  - **Smart Electric Vehicle Charging:** Partnering with Elocity and Plug'n Drive to increase understanding of smart EV charging



Looking Forward

- Moving forward, there is work to do
- The growth of EVs and heat pumps are expected to flip Ontario back to a winter peaking jurisdiction
- Toronto Hydro is excited to prepare for big changes in the electricity sector



Thank you!

Photo credits: blogTO

TORONTO HYDRO

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Reducing Peak Demand Impacts:

Increasing Load Flexibility in British Columbia

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Robyn Wark, Manager, Market Transformation

BC Hydro
Power smart

April, 2024

BC Hydro
Power smart

69%
Large hydro

19%
IPP hydro

5%
Biomass

3%
Wind

<1%
Solar

2023/24 - 2025/26 Service Plan (Feb 2023).
Gas is approximately 1.4%

Growing electrical demand

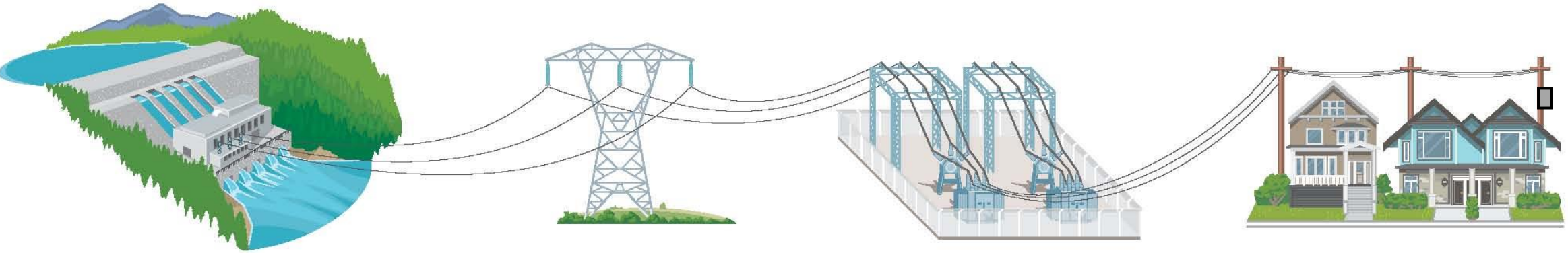

Call for Power 2024


$36 Billion 10 year Capital Plan

Build off 40+ years of Energy Efficiency programming

Include CAPACITY in the conversation

Capacity issues can be at any scale



Generation:
Electricity is generated by BC Hydro and independent power producers.

Transmission:
Electricity is moved from where it is produced to where it is used.

Substations:
Voltage is reduced at substations to provide power suitable for use in homes and businesses.

Distribution:
Low-voltage electricity is provided safely to neighbourhoods and businesses.

Pilots and trials in grid-constrained areas

Trials and pilots for FLEXIBILE LOAD

Behavioural

Direct control

Distributed Energy Resource Management System (DERMS)

Industrial loads

Future devices

EV chargers

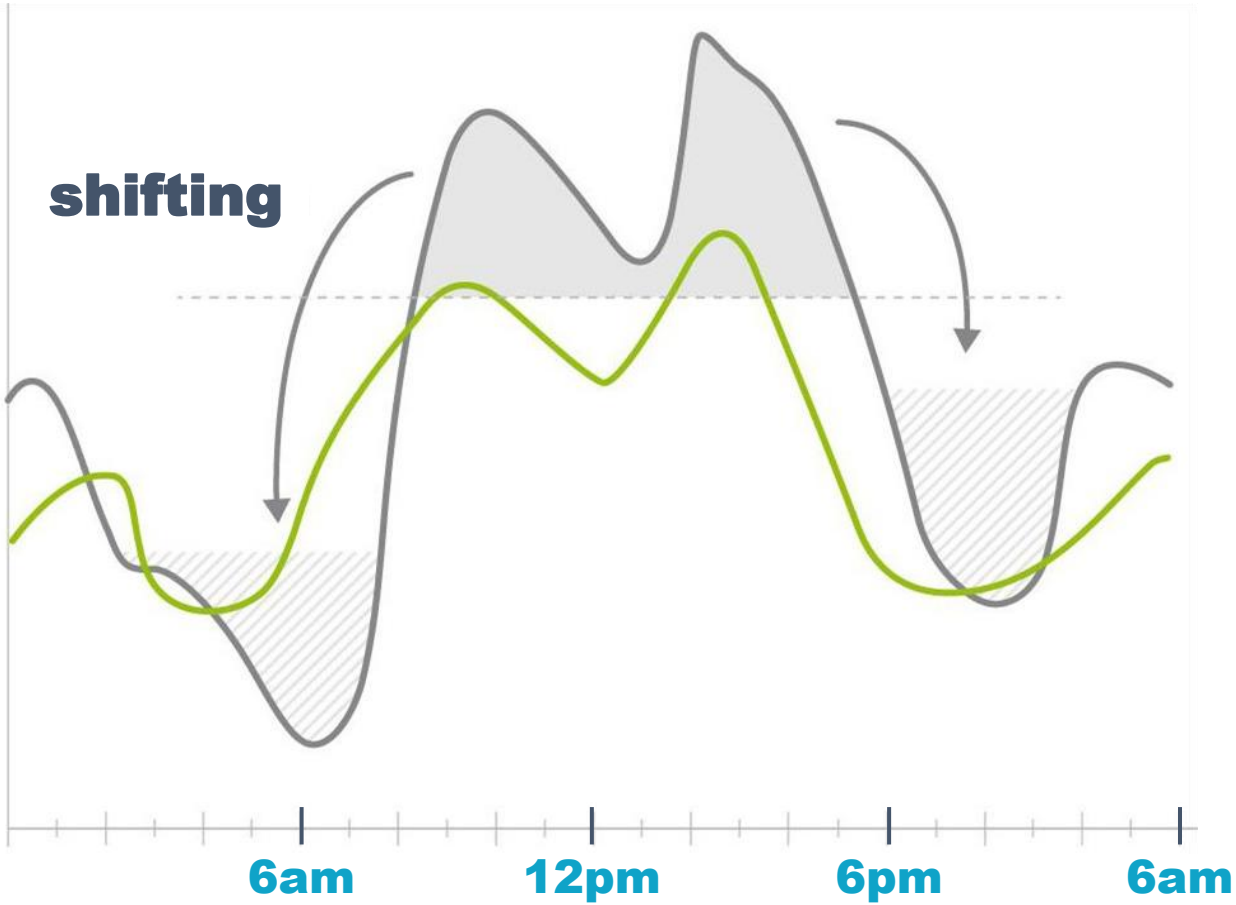
Future devices

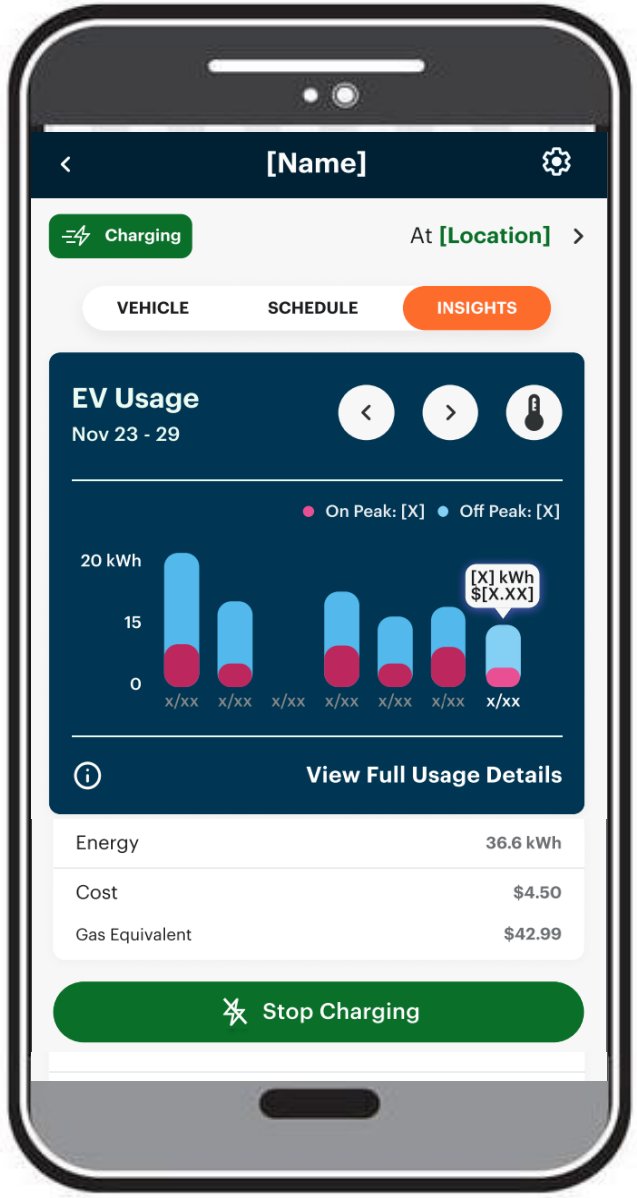
Water heaters

Thermostats

BC Hydro
Power smart

Residential Peak Saver (Launched 2022)
Behavioural program - Load shifting

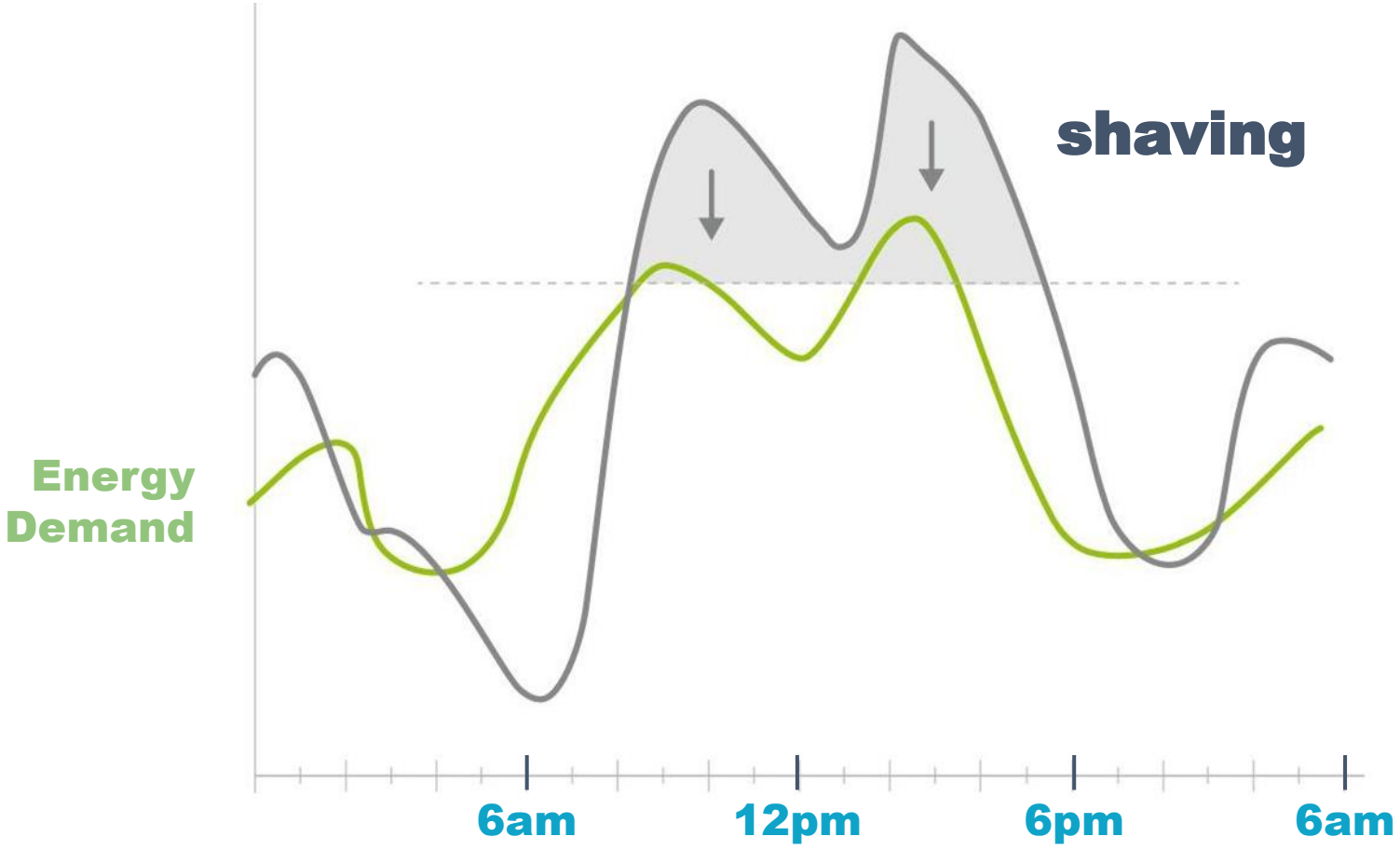


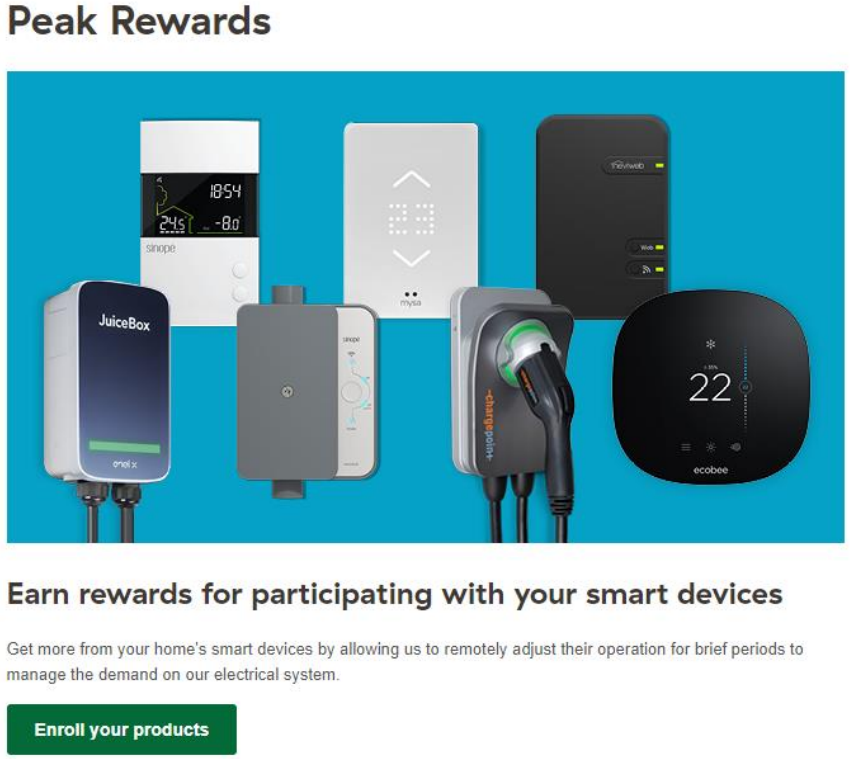


- Request customers turn down usage during a 3 hour event. Notice 24hrs in advance.
- Reward - $3 if successful in reducing energy use by 20% using previous 5 days as baseline.
- 33,000 customers signed up to date. 2024 target - 75,000 customers

BC Hydro
Power smart

Residential Peak Rewards (Launched 2022)
Demand Response - Peak Shaving



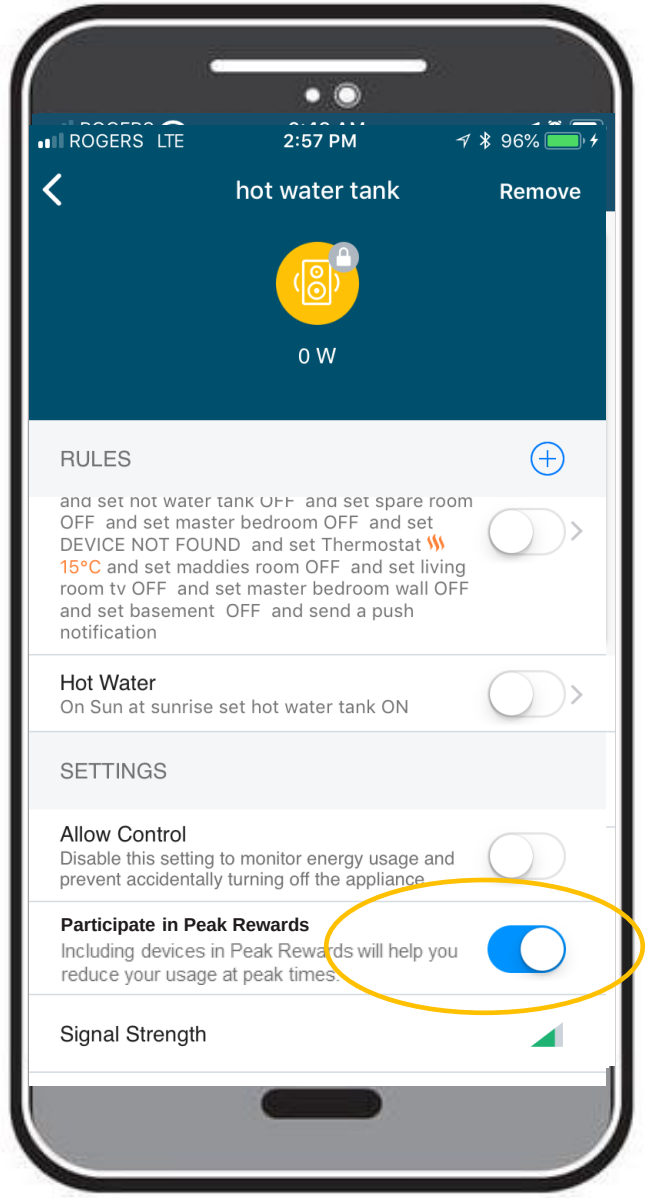


- Agreement to allow BC Hydro to turn down devices by preset amount when needed
- Reward - $50 for season (Nov-March)
- 8,000 customers signed up to date – EV chargers, smart thermostats, water heaters, batteries.

BC Hydro
Power smart

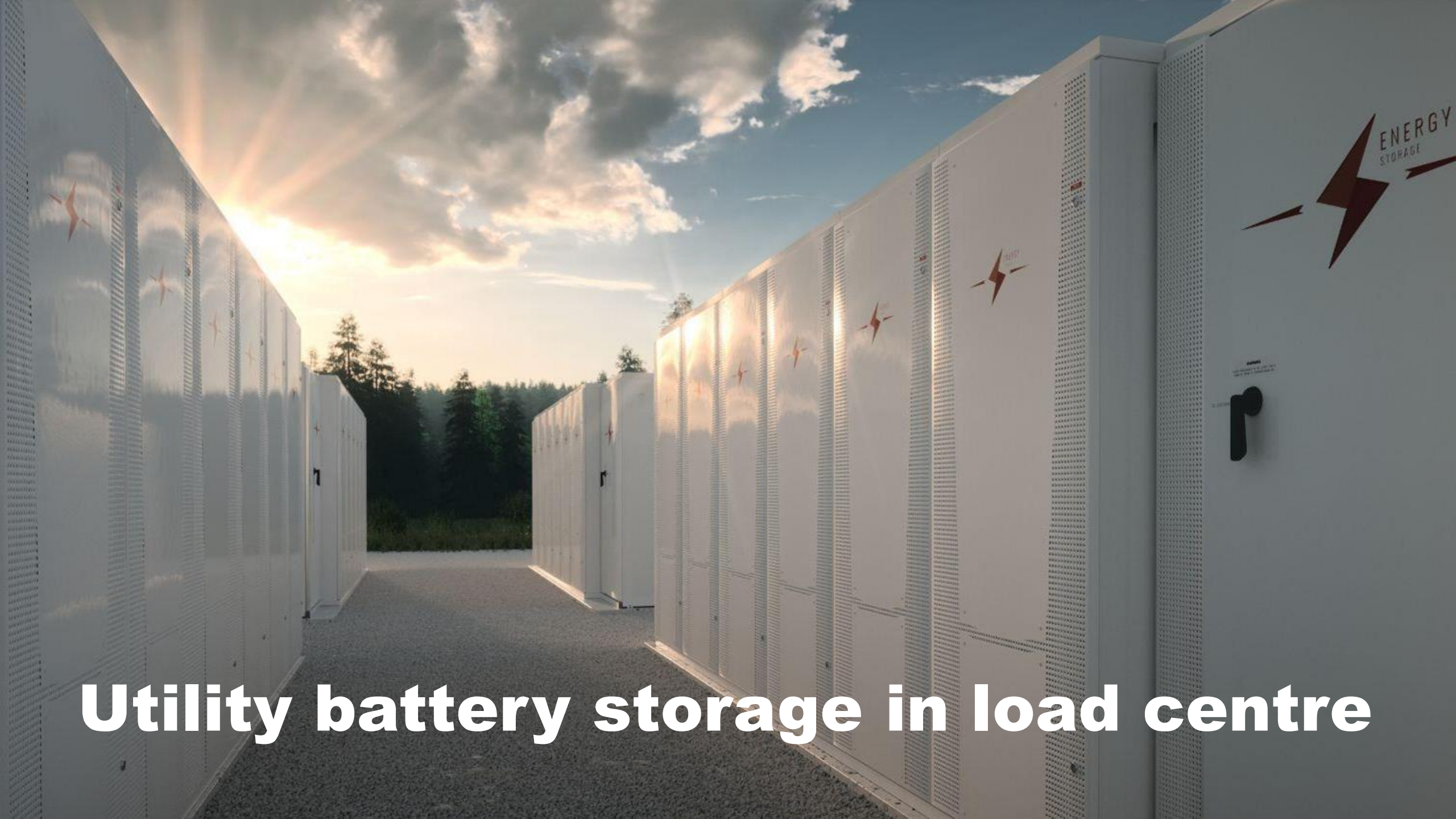
Time of Use Rate - voluntary

Coming this June



Commercial and Industrial Offers

- Businesses
  - Behavioural Demand Response Program (launched 2023)
  - Direct load control (coming soon)
- Industrial Load Curtailment (coming soon)
- Integrated Energy Studies



Utility battery storage in load centre

Thank you!

Robyn.Wark@BCHydro.com

How Thermal Storage can help Canada Achieve Clean Energy Goals!

Thermal Energy Storage Provides Grid Flexibility

NATIONAL BUILDING DECARBONIZATION FORUM | APRIL 2024

Scott Huffmaster

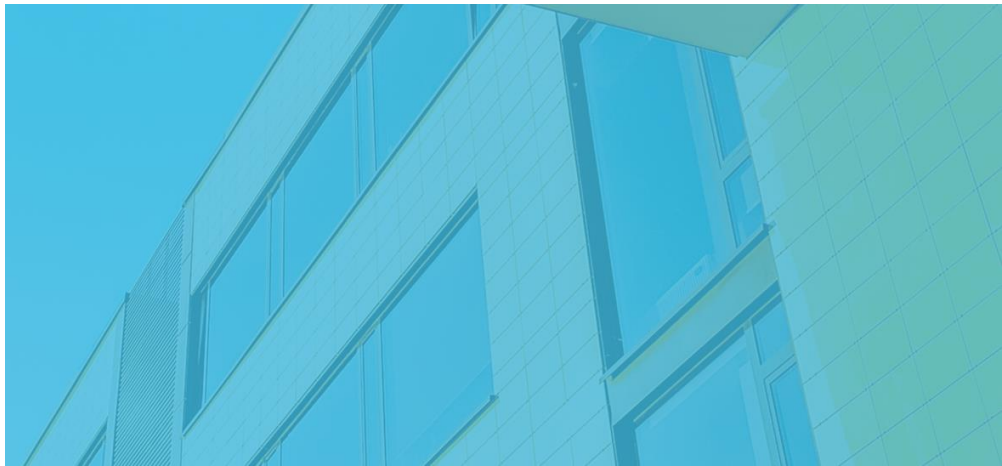
Director of Sales, NA

TRANE | TRANE TECHNOLOGIES

April 18, 2024

Agenda

1. The need for energy storage
2. Using off peak electricity to heat and cool commercial buildings
3. Tools to assess costs, energy savings, and emission reduction
4. Tax credits and utility rebates to encourage storage
5. Goal: Resiliency, flexibility, and affordability



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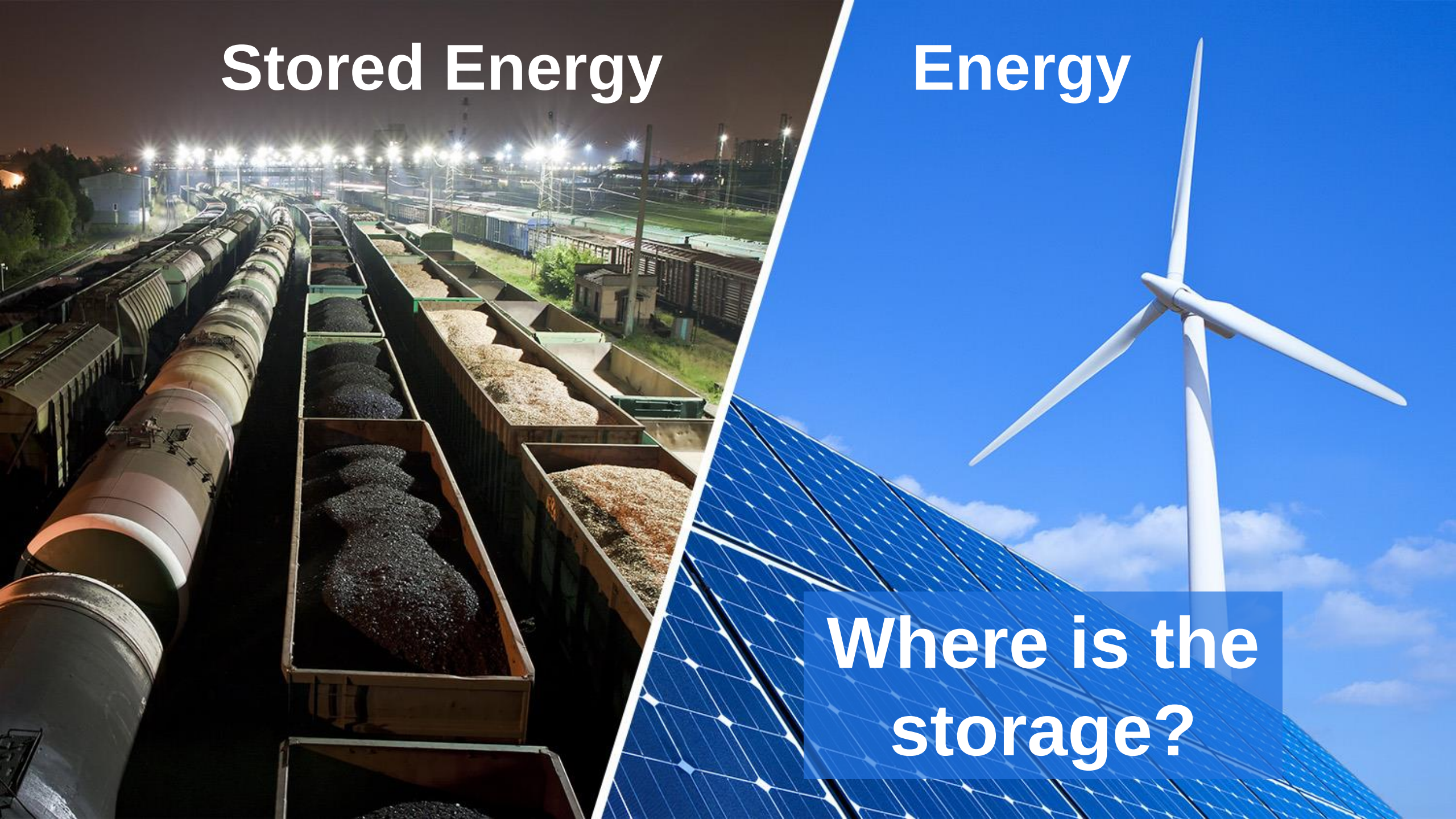
TRANE TECHNOLOGIES


Stored Energy
Energy
Where is the storage?

Pathway to Clean Energy

- Energy storage is essential if we are to achieve 100% renewable energy on the grid.
- Thermal storage often lowest cost energy storage
- US and Canada propose investment tax credits for energy storage
- Game changer!

NEWS

Canada introduces 30% refundable investment tax credits for energy storage

By Andy Colthorpe

November 4, 2022

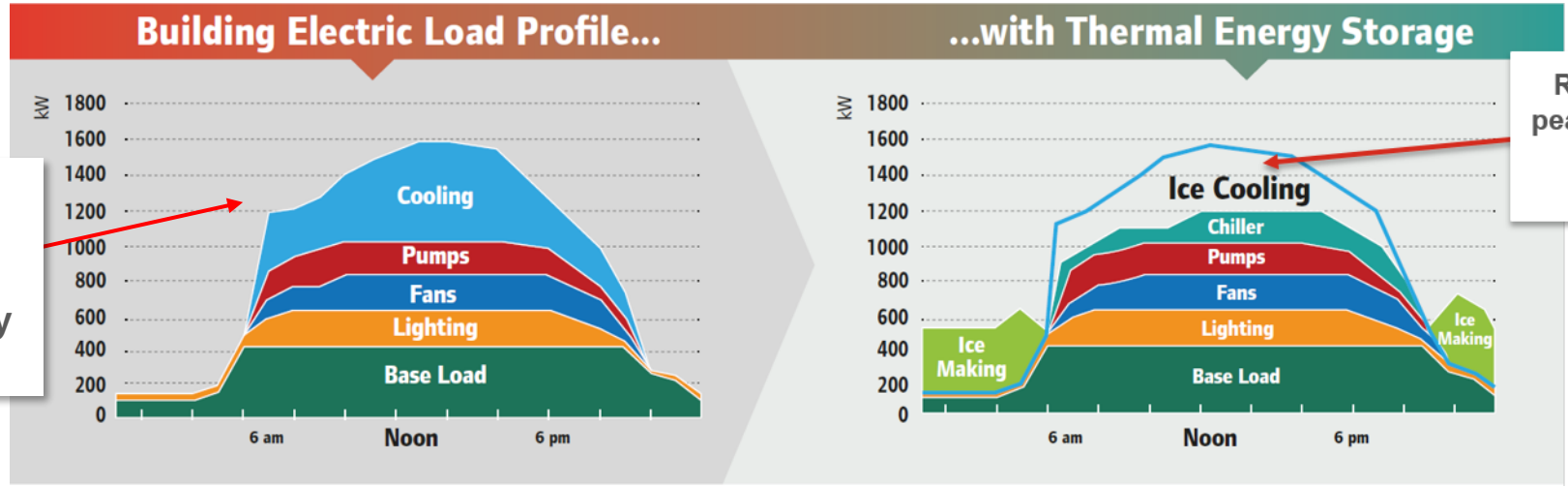
US & Canada, Americas Grid Scale, Connected Technologies Policy

LinkedIn Twitter Reddit Facebook Email

Energy Storage News

Shift Cooling Demand 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**

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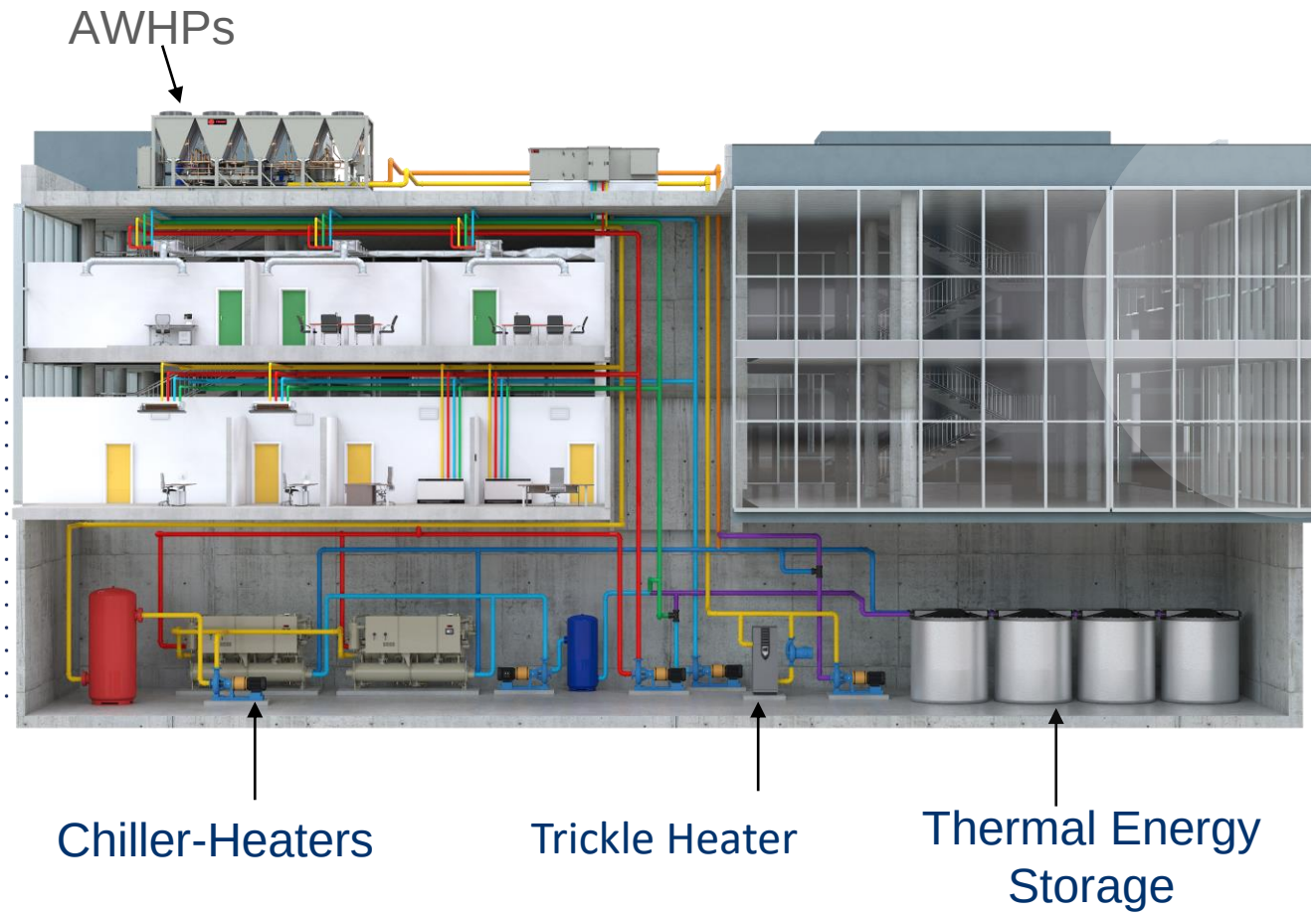
Shift Heating Demand with Thermal Batteries

Storage-Source Heat Pump (SSHP) System

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.

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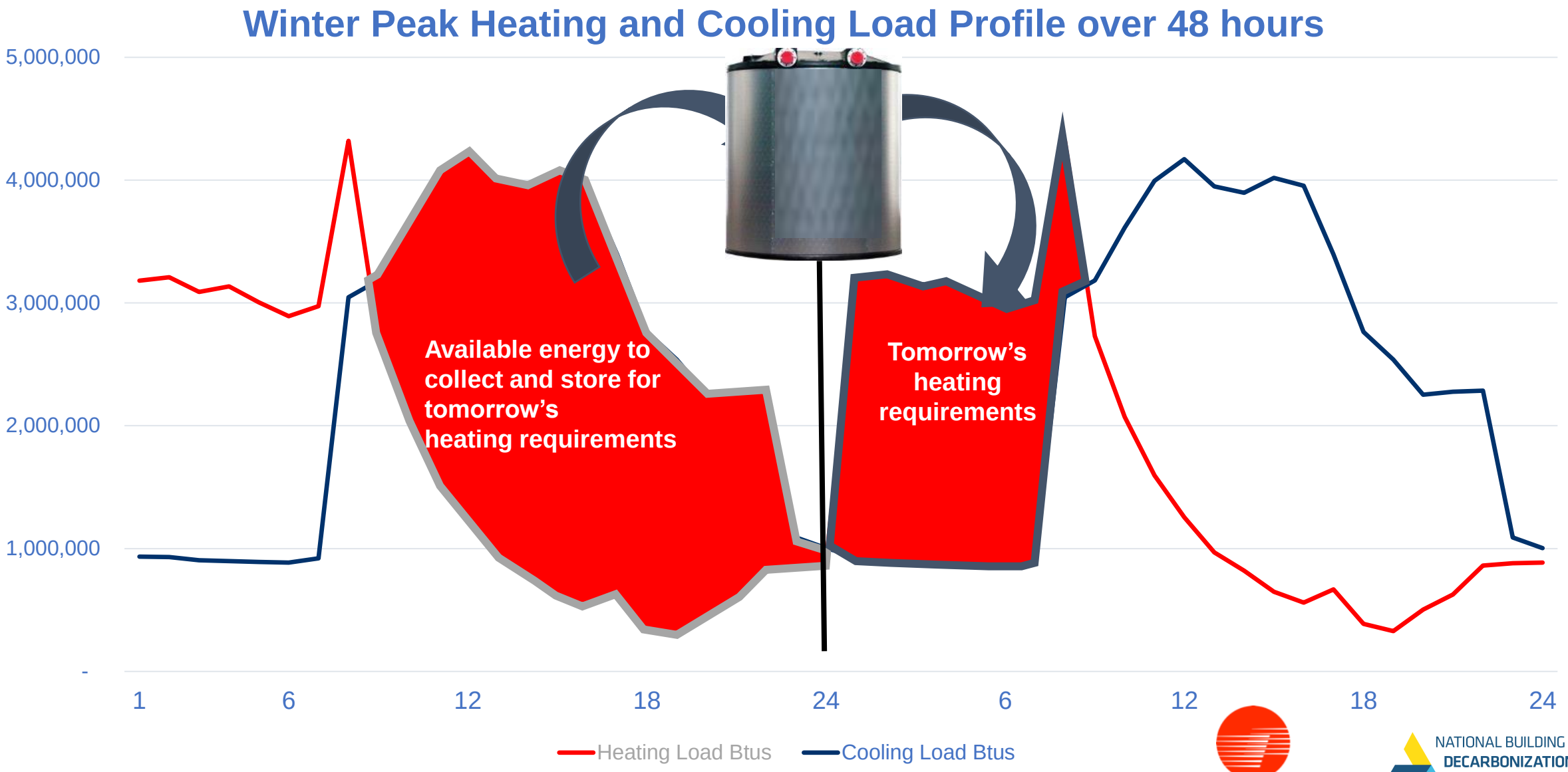
Thermal Balancing of Winter Afternoons



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Sample Load Profiles for Storage Source Heat Pump

Building Profile	
City / Location	*Boston (5A), Massachusetts (MA)*
Building Type	*Office*
Chiller Type and Peak Cooling Load	*Water Cooled @ 960 Tons*
Peak Heating Load	*6,150,000 BTU/hr*

SSHP - Energy Savings Summary (Peak Heating and Cooling)			
SSHP System	vs. Chiller+Gas Heat	vs. Chiller+Elec. Heat	vs. Chiller+Heat Pump
Energy Demand Cost Savings	*-$3,466*	*$104,682*	*$50,608*
Energy Utility Rate Savings	*-$4,673*	*$74,250*	*-$13,675*
Annual Operating Cost Reductions	*-$8,139*	*$178,932*	*$36,933*

Conventional System	
Design Cooling Capacity and Demand	
Design Cooling Capacity	*960 Tons*
Design Cooling On-Peak Demand	*720 kW*
Design Heating Capacity and Demand	
Design Heating Capacity (Gas)	*6,150,000 BTU/hr*
Design Heating On-Peak Demand (Gas)	*N/A*
Design Heating Capacity (Electric)	*1,803 kW*
Design Heating On-Peak Demand (Electric)	*1,803 kW*
Design Heating Capacity (AWHP)	*6,150,000 BTU/hr*
Design Heating On-Peak Demand (AWHP)	*902 kW*

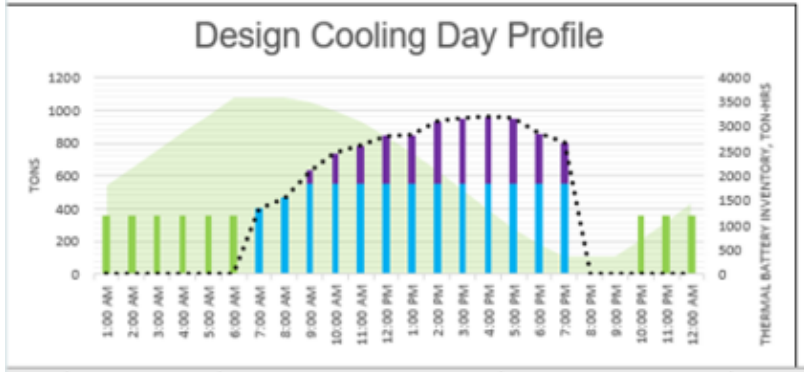
SSHP - Business Case			
SSHP System	vs. Chiller+Gas Heat	vs. Chiller+Elec. Heat	vs. Chiller+Heat Pump
First Cost Premium	*$754,011*	*$153,395*	*-$86,605*
Net Present Value	*-$752,626*	*$1,337,071*	*$383,498*
Internal Rate of Return	*0.0%*	*116.6%*	*Infinite*
Payback Period	*No Payback*	*0 years 10 months*	*Immediate*

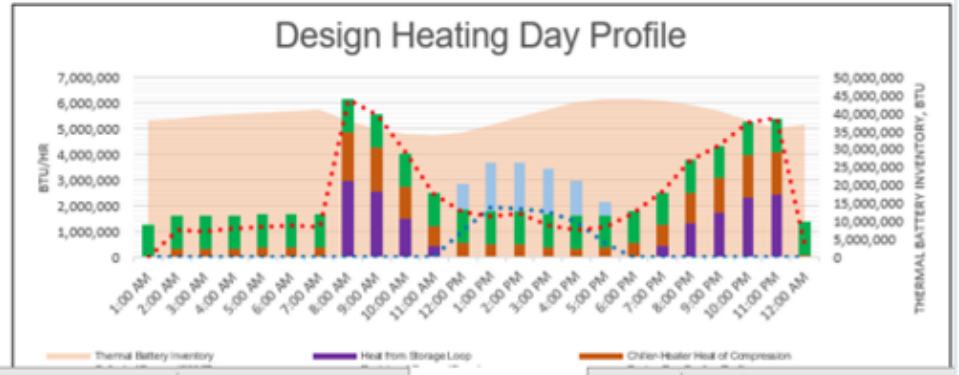
SSHP System	
Chiller-Heater Nominal Capacity	*644 Tons*
Chiller-Heater Heating Capacity	*6,150,000 BTU/hr*
Thermal Battery Energy Storage Capacity	*3,233 Ton-Hrs*
Air-to-Water Heat Pump Nominal Capacity	*553 Tons*
Air-to-Water Heat Pump Capacity	*1,283,962 BTU/hr*
Design Cooling On-Peak Load Reduction	*408 Tons*
Design Cooling On-Peak Demand	*443 kW*
Design Cooling On-Peak Demand Reduction	*278 kW*
Design Heating On-Peak Load Reduction	*0 BTU/hr*
Design Heating On-Peak Demand	*559 kW*
Design Heating On-Peak Demand Reduction	*1,245 kW to 344 kW*

SSHP - Heating Carbon Estimates			
SSHP System Total Output Emission Rate		*1,486,282 lbs CO2e*	
	Gas Heat	Electric Heat	Heat Pump
Conventional Systems (lbs CO2e)	*2,584,429*	*4,800,690*	*1,873,440*
Additional Carbon vs. SSHP	*73.9%*	*223.0%*	*26.0%*

SSHP System Architecture

Storage Farm of 1190C Units	21
Approximate Square Footage	1470
Pump Flow (GPM)	1530
Pump Power (HP)	25
Pipe Size (in)	10





Introduction | Building Input Parameters | Peak Cooling Details | Cooling Only Summary | Peak Heating Details | SSHP Summary | Model

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Status of 30% Investment Tax Credit for Ice Storage?

- Holding our breath!

Still in process

Initially only affects taxable entities, now 15% for tax-exempt

Utilities will cover 50% of the investment after the 30% tax credit is taken

- 30% + 35% = 65%

K12, Local Government, Provincial Government added in March 2023 for 15% tax credit

- Utilities will cover 50% of the investment based on $1,200/kW

Customers will likely wait for clarification and paperwork, but start educating them NOW!

Ice storage for summer peak load reduction

Storage source heat pump for winter energy savings

Ground source heat pump for winter/summer savings

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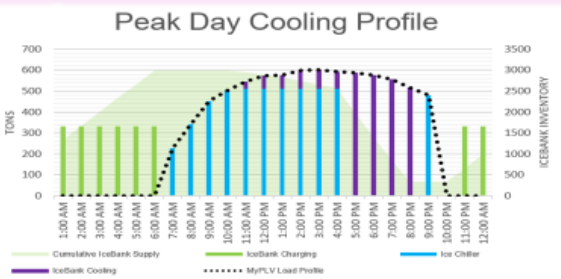
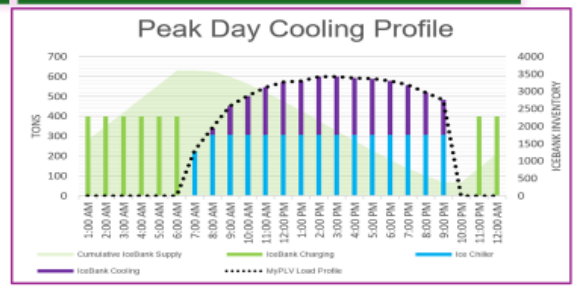
LET'S TAKE A CLOSER LOOK

New Construction Project: 250,000 sq. ft. office building, Toronto

	Conventional	Full Storage 4-8 PM	Partial Storage
Chillers	(2) 300-ton AC	(2) 300-ton AC	(1) 400-ton AC
Ice Storage	N/A	(2,659 ton-hr) $757k	(2,047 ton-hr) $628k
Utility Cost*	$121k	$24k	$85k
First Cost	$900k	$1,657k	$1,228k
Tax Credit (30%)	$0	$(497k)	$(368k)
SaveOnEnergy Incentive	$0	$(578k)	$(430k)
Revised First Cost	**$900k**	**$597k**	**$430k**





* Annual electric utility costs for the chillers.

Thermal Energy Storage

- Provides demand flexibility and can reduce reliance on grid (thus reducing costs)
- Enables renewable energy and decarbonization
- Offers reliable power redundancy and assurance
- Incentivized by utility programs, federal tax incentives, and local funding programs

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Thank you!