Partners in Project Green

A Program of Toronto and Region Conservation Authority

Energy Leaders Consortium

Decarbonizing Industry with Lukas Glaspell
Trane Technologies Toronto

April 20, 2023

We respectfully acknowledge that we are situated on the Traditional Territories and Treaty Lands, in particular those of the Mississaugas of the Credit First Nation, as well as the Anishinaabe of the Williams Treaty First Nations, the Huron Wendat, the Haudenosaunee, and the Metis Nation.

As stewards of land and water resources within the Greater Toronto Region, Toronto and Region Conservation Authority appreciates and respects the history and diversity of the land and is grateful to have the opportunity to work and meet on this territory.

Additional Resources

- yrnature.ca/acknowledging_land
- edgeofthebush.ca
- native-land.ca
- Text 1-855-917-5263 with your City and Province to learn whose traditional territory you're on
(standard text messaging rates may apply)

Agenda

Time	Activity
1:00pm – 1:10pm	Introduction
1:10pm – 1:40pm	Decarbonizing Industry with Trane Technologies
1:40pm – 2:00pm	Question & Answer Period

Introduction

Upcoming ELC Sessions & PPG Events

Date	Topic
May 27th 9am-1pm	**PPG Members only tree planting** – at Claireville Conservation Area, limit 10 people per company (in-person)
May 30th 1:00pm-4:30pm	**Financing Net-Zero: Incentives** – learn about the funding available for Conservation and Demand Management (CDM) programs (in-person or virtual)
May 11th 1:00pm-2:30pm	**Member Roundtable** – Trillium Health Presentation (virtual)
June 15th 8:30am-12:30pm	**Site Visit** – Sheridan College Meeting & Tour (In-person)
July 13th Time TBD	**Educational Session** – Reducing Scope 3 with CarbonZero (virtual)

Please contact Julia Kole if you are interested in hosting an ELC Site Visits or presenting at a Member Roundtable this year

Updates and Reminders

- **Direct Current**: a quick newsletter for ELC members
- **PPG & CarbonHound Pilot**: survey coming soon!
- A request for Member Spotlights & Case Studies
- Opportunities for PPG outreach at your events

Today's Speaker

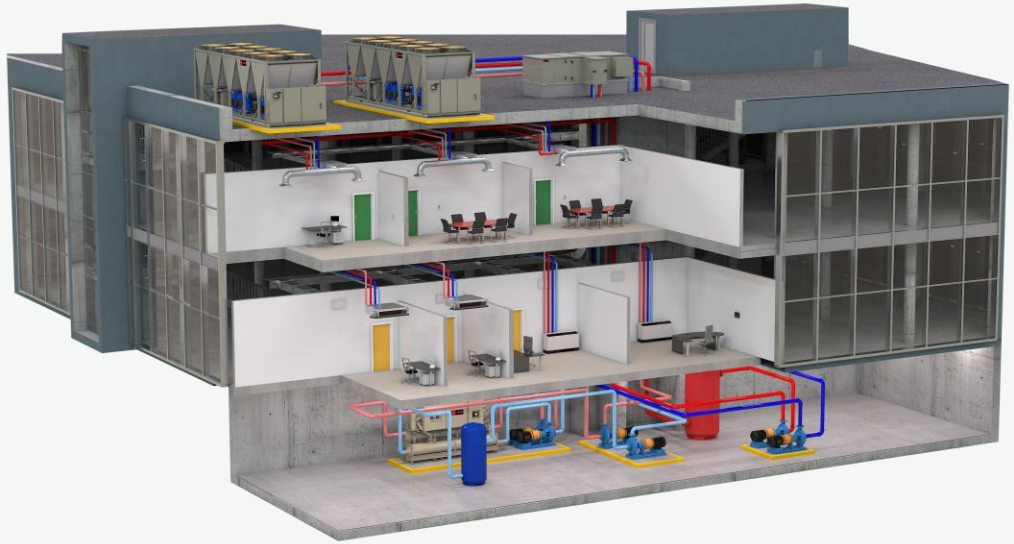
Lukas Glaspell, Trane Technologies Toronto

Lukas.Glaspell@trane.com

- Account executive with the Trane Technologies Toronto
- Leverages BAS, supplies equipment, optimizes HVAC operations for clients
- Key project to note: working with Noventa Energy to extract waste heat from public sewer systems and utilize it for building heating

Trane Technologies Toronto

Electrification of Heat: Produce building heat with low, to no carbon!



2023

TRANE TECHNOLOGIES

Lukas Glaspell

Key Decarbonization Terms

De-carbonization
Any process that removes carbon in the atmosphere or prevents carbon from being emitted

Carbon Dioxide Equivalent (CO_2e)
Includes CO_2 and other greenhouse gasses

Greenhouse Gasses
Gasses that trap heat in the atmosphere – CO_2, Methane, CFCs, H_2O

Electrification
Process of replacing fossil fuel-sourced energy with electricity-sourced energy

CO_2 NEUTRAL

CO_2 Released into atmosphere = **CO_2 Removed** from atmosphere

Net Zero

GHG Released into atmosphere = **GHG Removed** from atmosphere

An Occupied Building's Emissions Sources

Direct (Scope 1)
Related to on-site process FF used for heating / refrigerant leak

Indirect (Scope 2)
Related to off-site electricity production

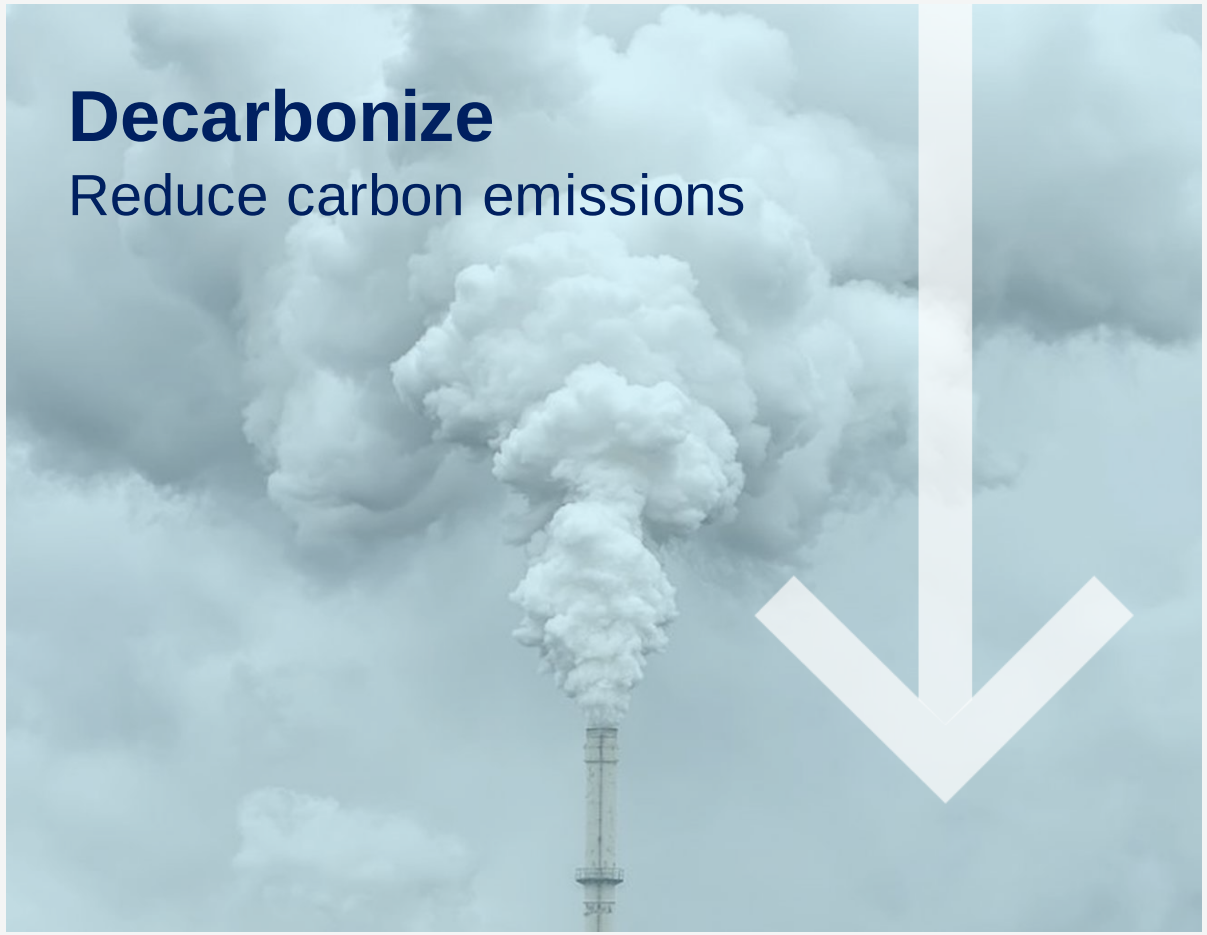
Electric Grid Supply Side
The facilities that generate electricity that can then be transmitted through wires to customer end users

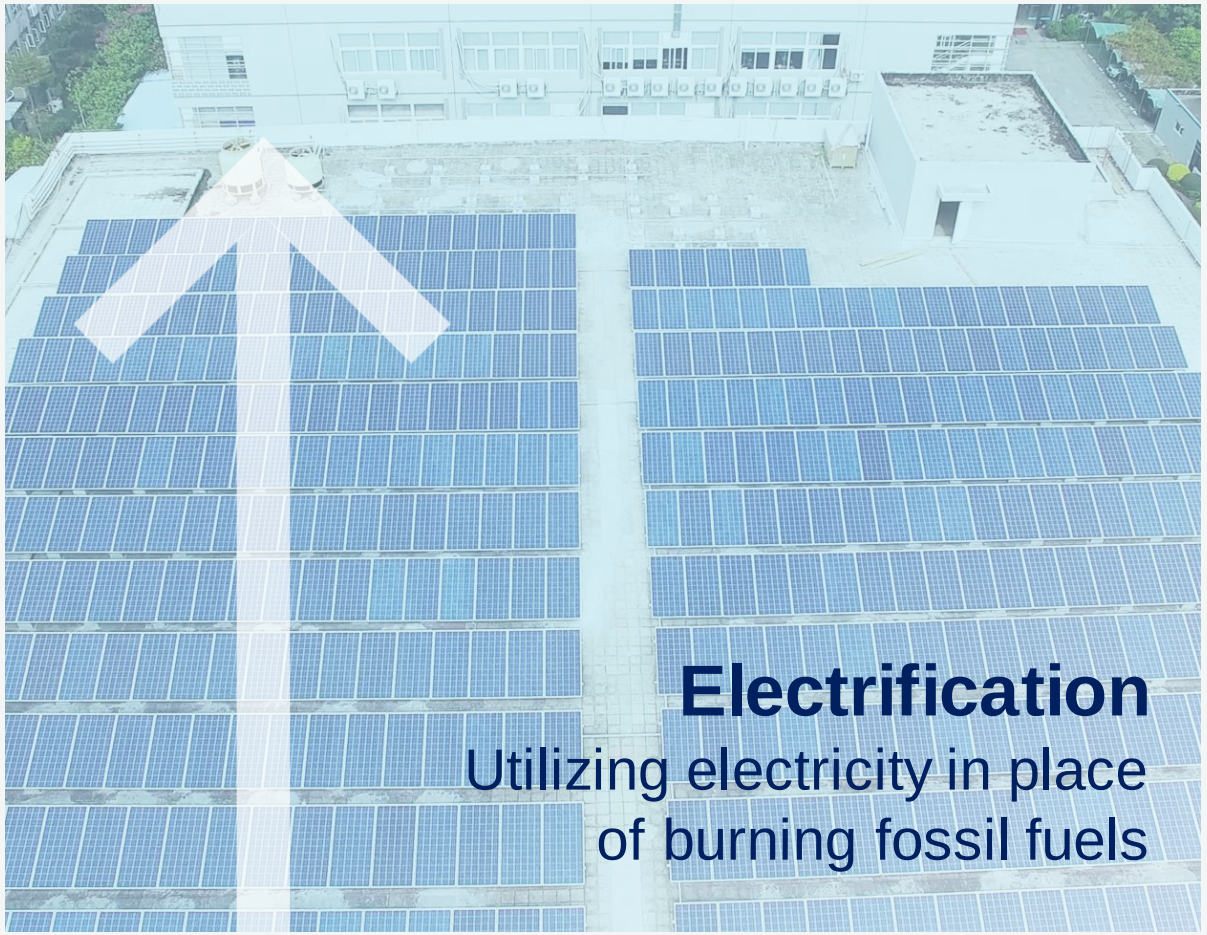
Electric Grid Demand Side
The homes, buildings, and industrial complexes connected to the electric grid that consume the electricity being produced

Electricity Consumption
The total amount of electricity used over a given period of time ("billing period")

Electricity Demand
The RATE at which electricity is consumed during any single moment in time

Heat Pumps, Heat Pumps, Heat Pumps – Chiller/Heaters





Electrification refers to the process of replacing technologies that use fossil fuels (coal, oil, and natural gas) with technologies that use electricity as a source of energy

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

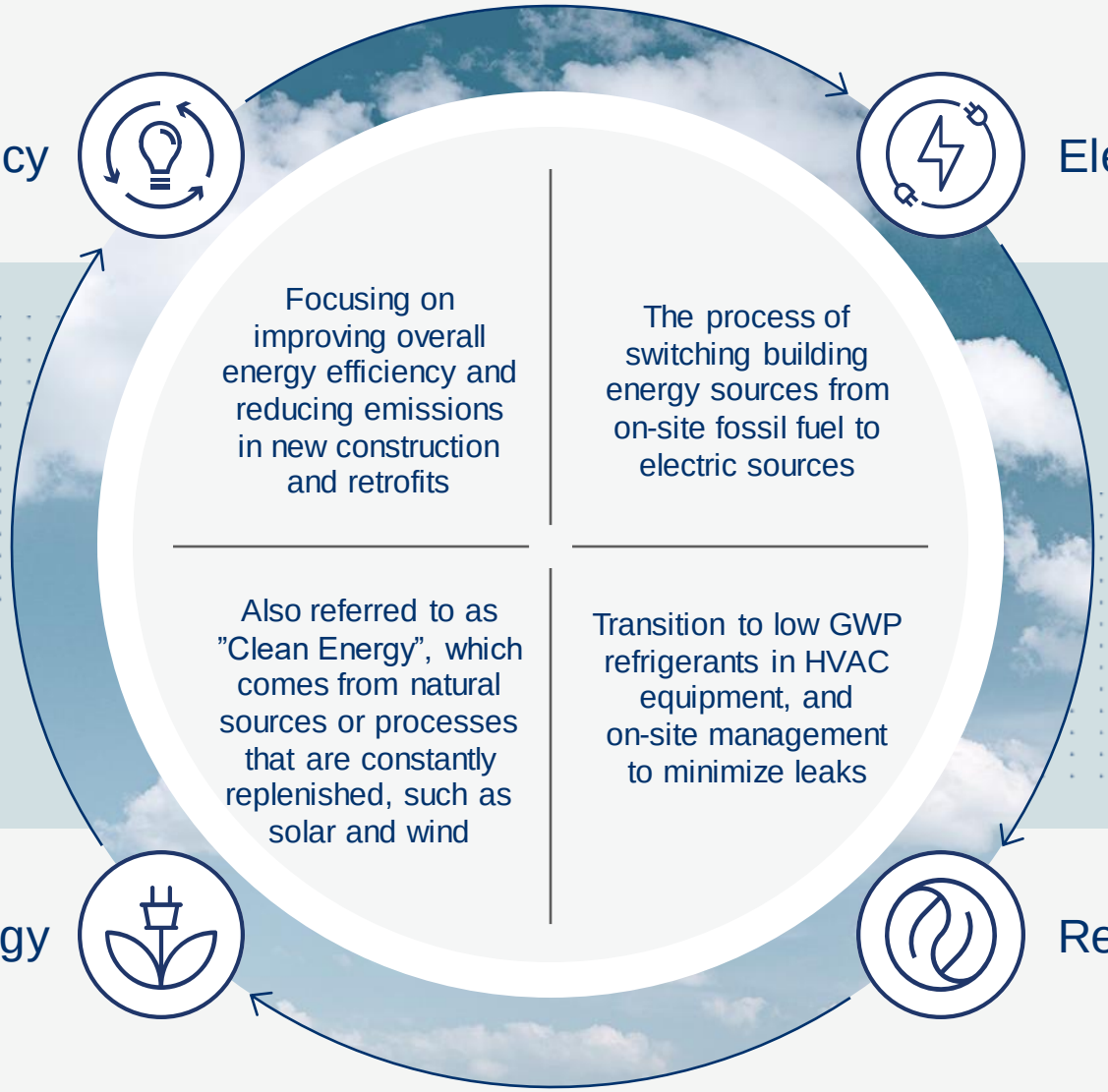
+

Embodied Carbon

=

Decarbonization

Pillars of Decarbonization



Reducing Indirect Emissions

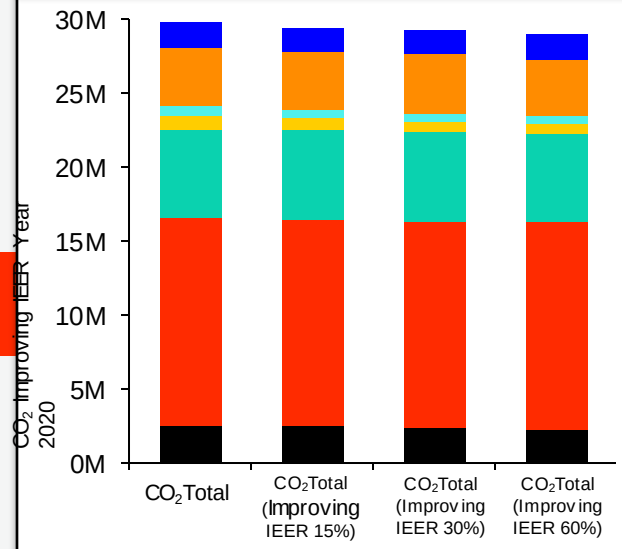
Indirect GHG emissions (AKA Scope 2) are generally associated with emissions one step removed a customer’s direct operations

Reducing Direct Emissions

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

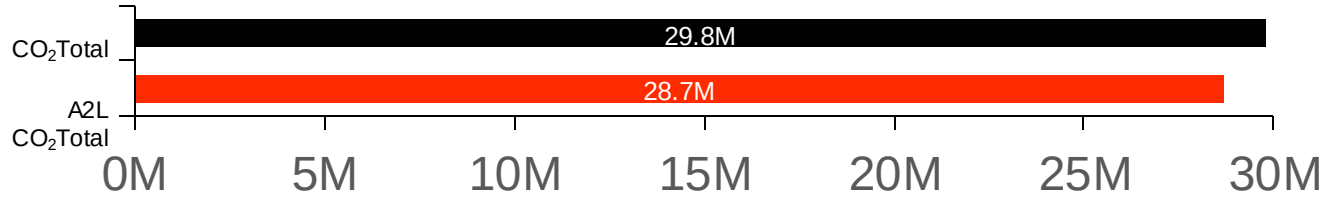
Gas to Heat Pump Conversion Impact to GHG Reduction

EFFICIENCY IMPROVEMENT



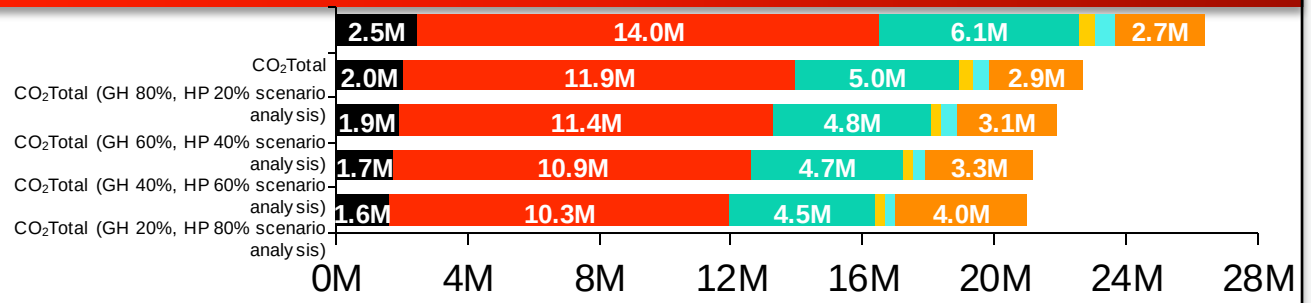
Increasing IEER to eFlex (variable speed) equivalent across all product families reduces CO_2 equivalent by ~3% (1M Tons annually)

REFRIGERANT CHANGE



Converting from R410A to R454B is nearly 80% reduction in GWP yielding a ~3% (1M Tons annually) reduction in CO_2 equivalence

CONVERSION OF GAS HEAT TO HEAT PUMP



Even a 20% conversion on Unitary gas heat to heat pumps would yield ~16% reduction in CO_2 equivalence

Voyager III Voyager II Precedent Intellipak with Symbol Intellipak II Intellipak I

Electrification Products

Heat Pumps

Light Commercial

Split Systems

Packaged Terminal

Rooftop Unit

Large Commercial

VRF

Rooftop Unit

Water-Source Heat Pump

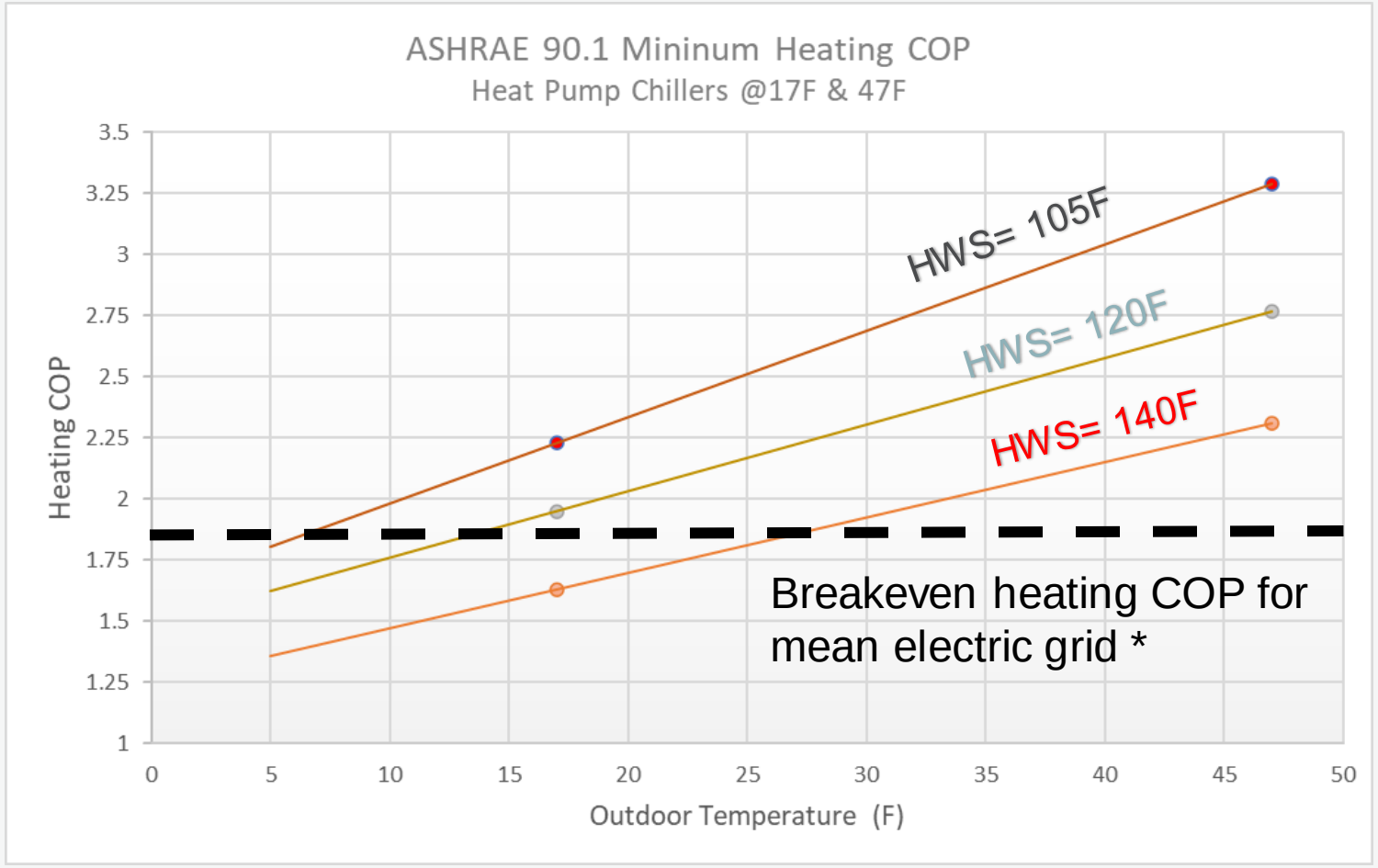
Applied/Hydronic

Air to Water

Water to Water

Domestic Hot Water

Hot Water Supply Temperature, Outdoor Air and COP



** Heat pump powered by 884lbCO2e/MWH grid vs 90% eff natural gas hot water heater*

1%

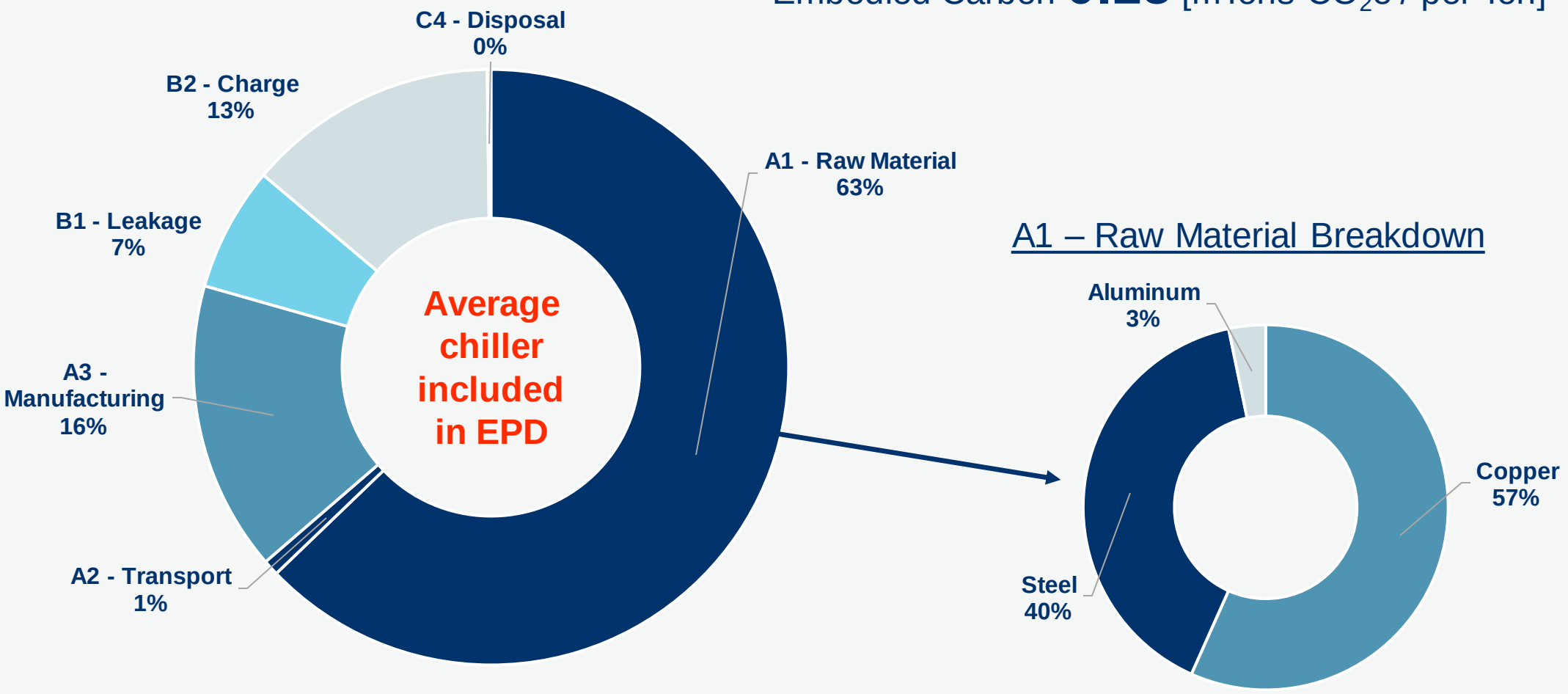
1% penalty per 1°F above 105°F

140°F hot water requires 35% more peak power and annual heating energy than 105°F

What About Embodied Carbon?

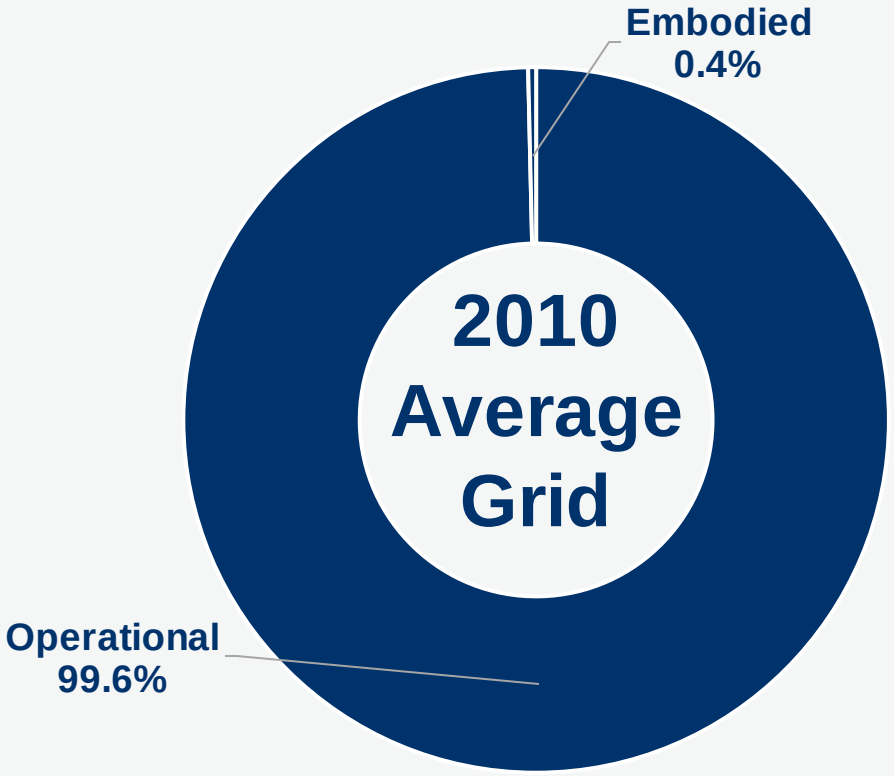
Hydronic Heat Pump Chiller

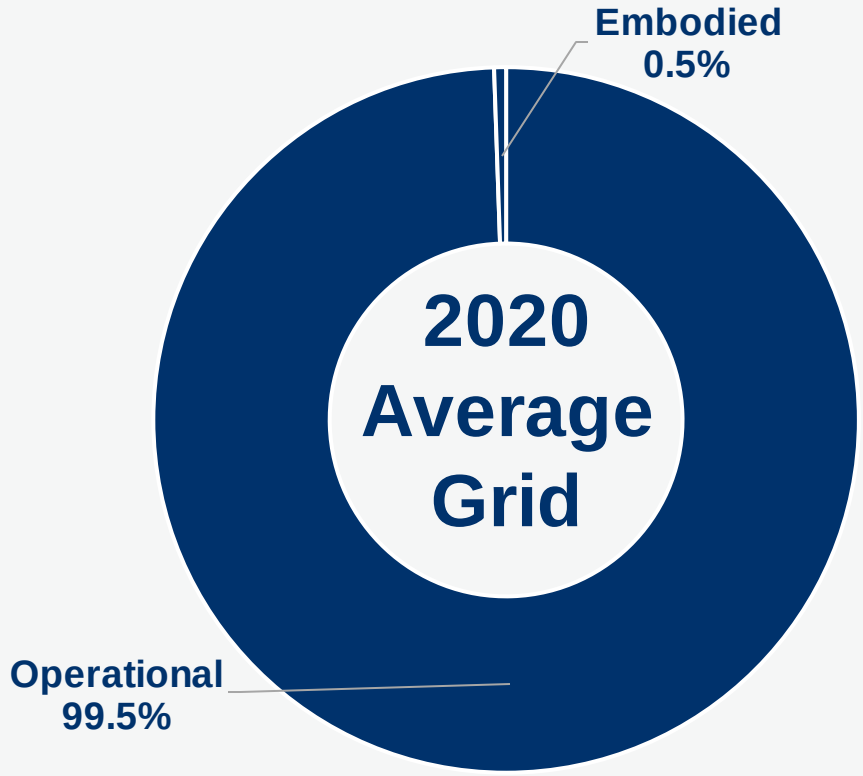
Embodied Carbon **0.15** [mTons CO_2e / per Ton]



Source: Trane EPD.

Operational Emissions vs Embodied Emissions





	mTons CO_2e
Embodied	0.15
Operational	40.9

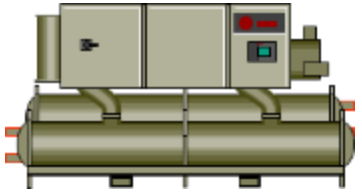
	mTons CO_2e
Embodied	0.15
Operational	27.2

Per Cooling Ton

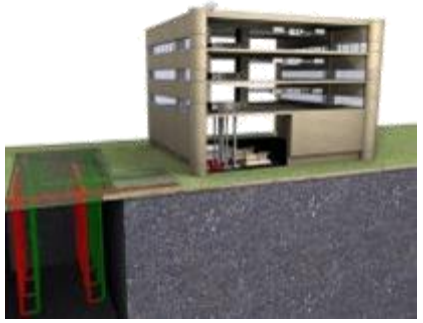
Source: Trane EPD.

Electrified Systems – Heat Sources

Ambient Air



Cooling Load
(Heat Recovery)



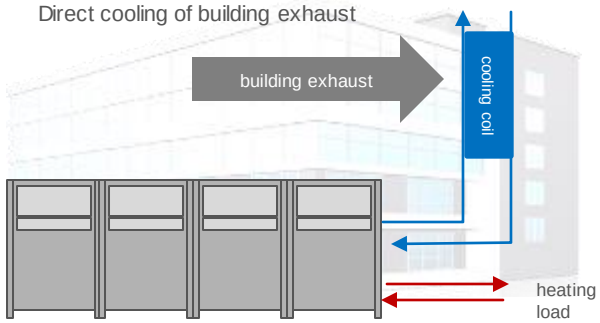
Geothermal
loop

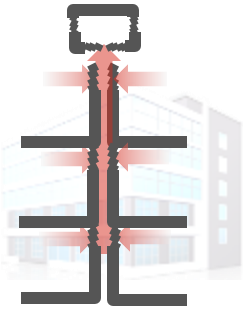
Lake,
river, pond

Storm and
sewer

Thermal energy
storage battery

"Storage Source
Heat Pump"

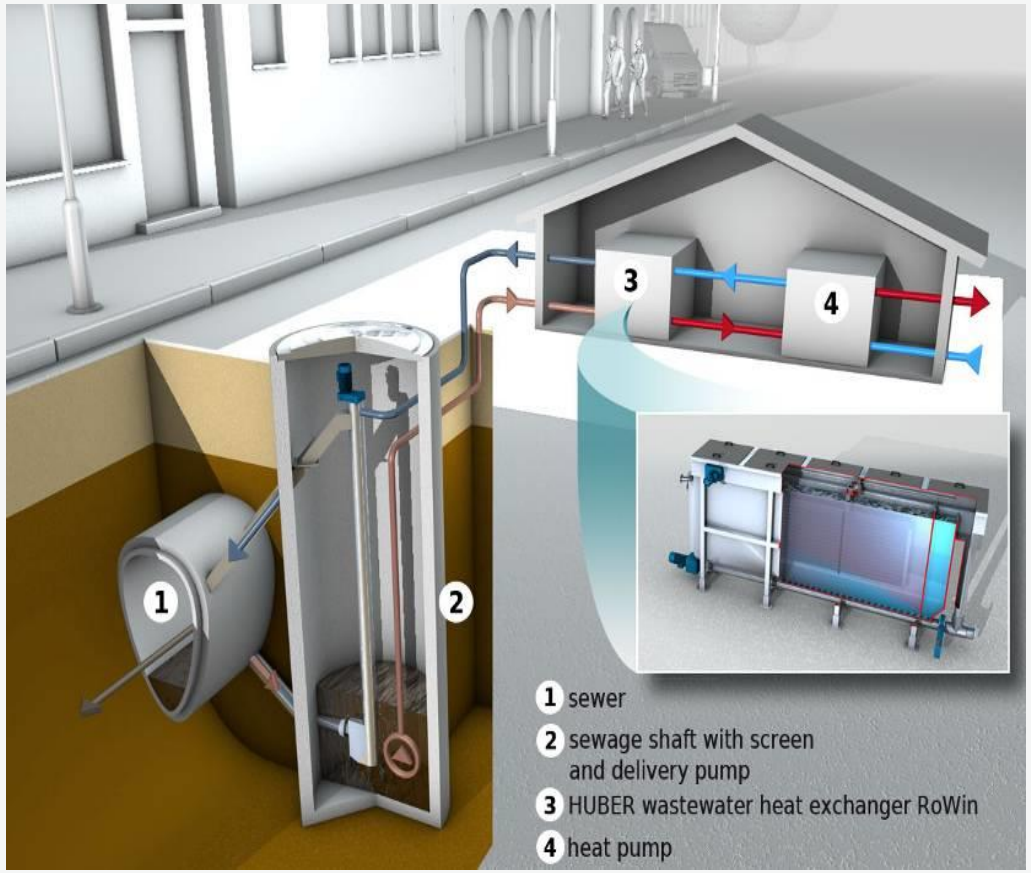




Exhaust
air coil

Largest in the World--Thermal Energy of 19MW

Topic	Details
GHG Reduction	– Over 8,400 $mtCO_2e$/year
Water Saving	– Over 43,000 m^3/year
Location	– Toronto, Canada
WET™ Project Details	– Largest Raw Wastewater Energy project in the world – 19 MW of thermal energy supply – Integrated into existing HVAC infrastructure – Phase 1 – 60% of peak demand/ 90% of total – Wetwell diameter – 35 feet – Wetwell depth – 165 feet – Looking to expand the system to do entire hospital



Noventa's WET™ system at hospital in Toronto

Noventa™ REIMAGINING ENERGY™

21

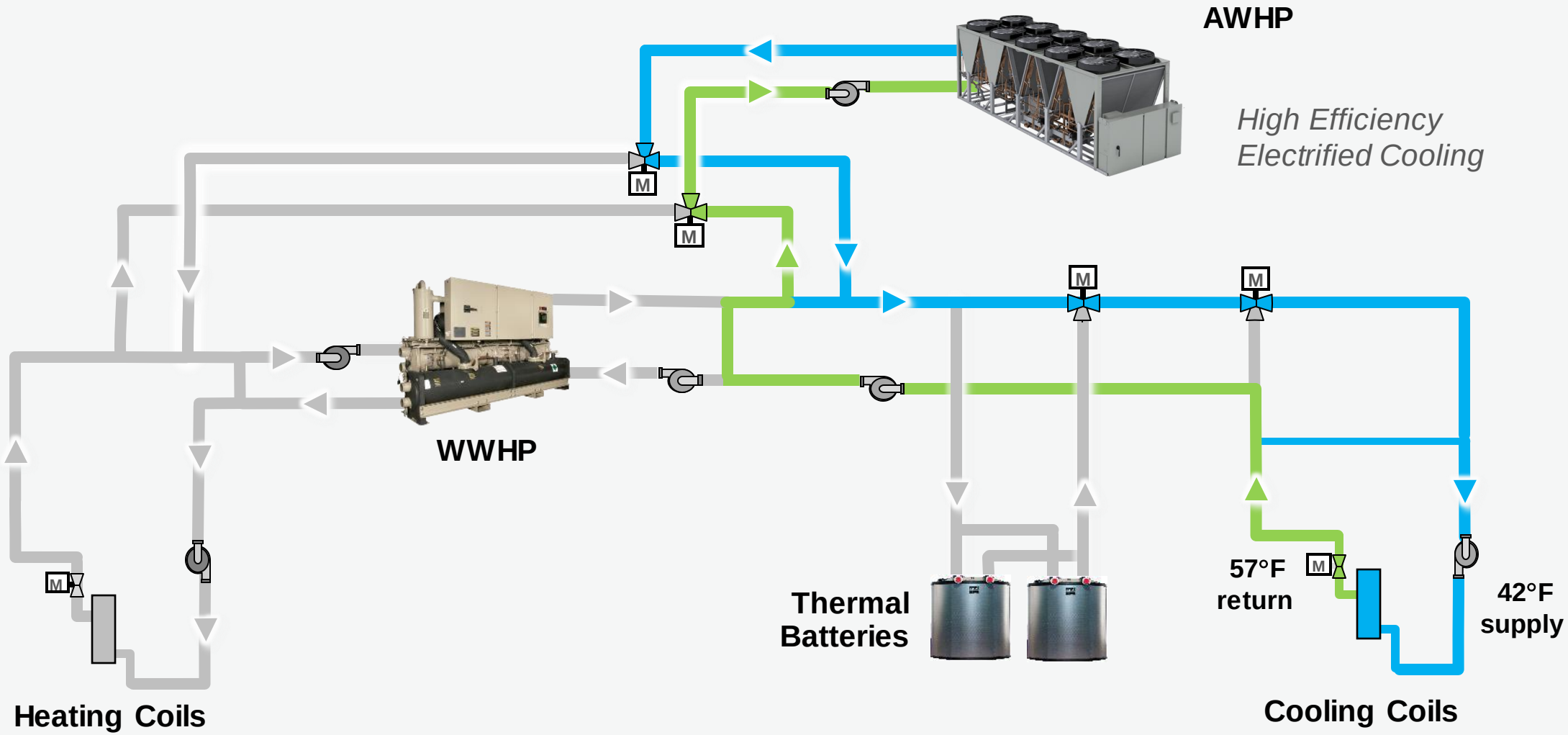
Project Layout

Noventa™ REIMAGINING ENERGY™

22

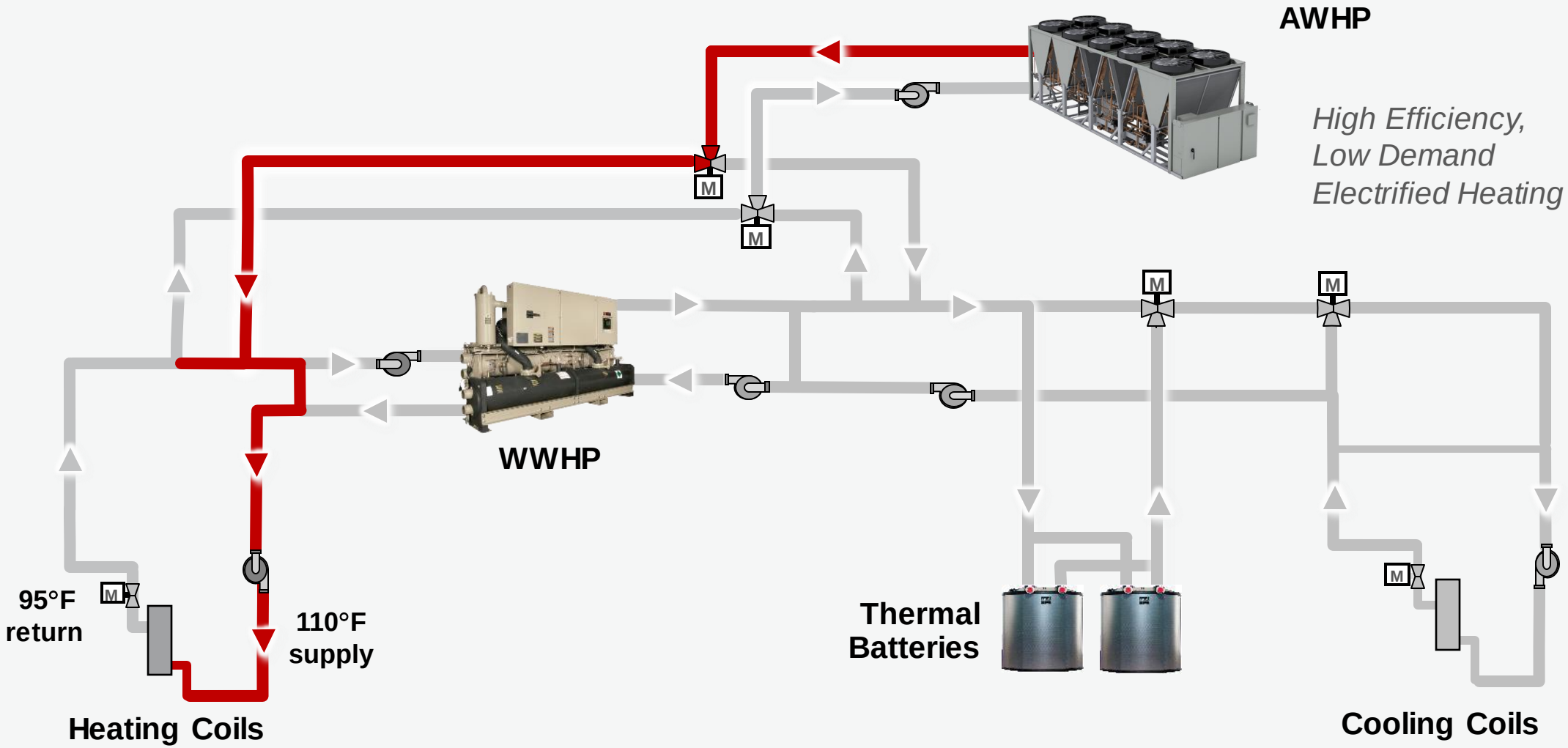
Solving Decarbonization Challenges with Thermal Batteries

Cooling with Air-to-Water Heat Pump



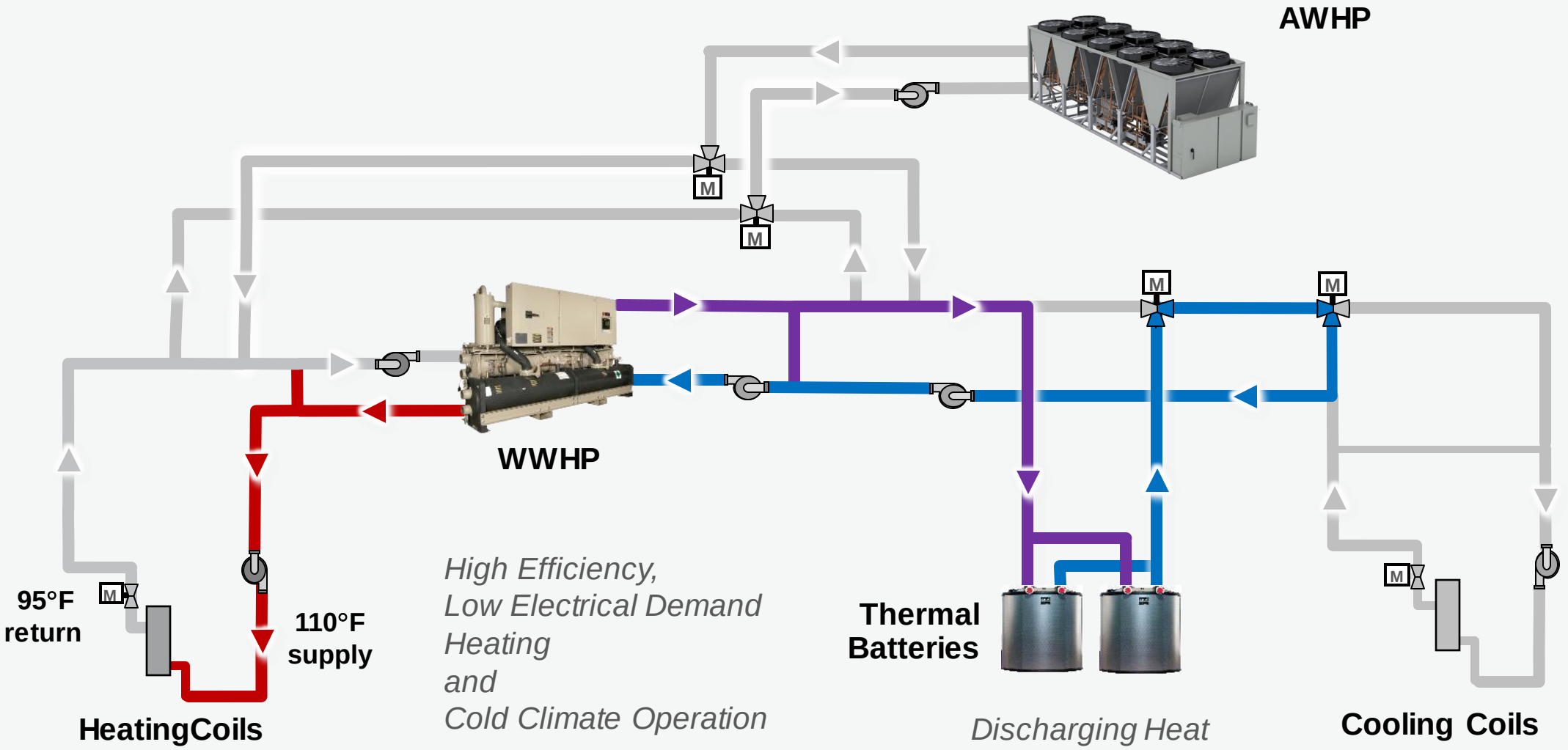
Solving Decarbonization Challenges with Thermal Batteries

Heating with Air-to-Water Heat Pump



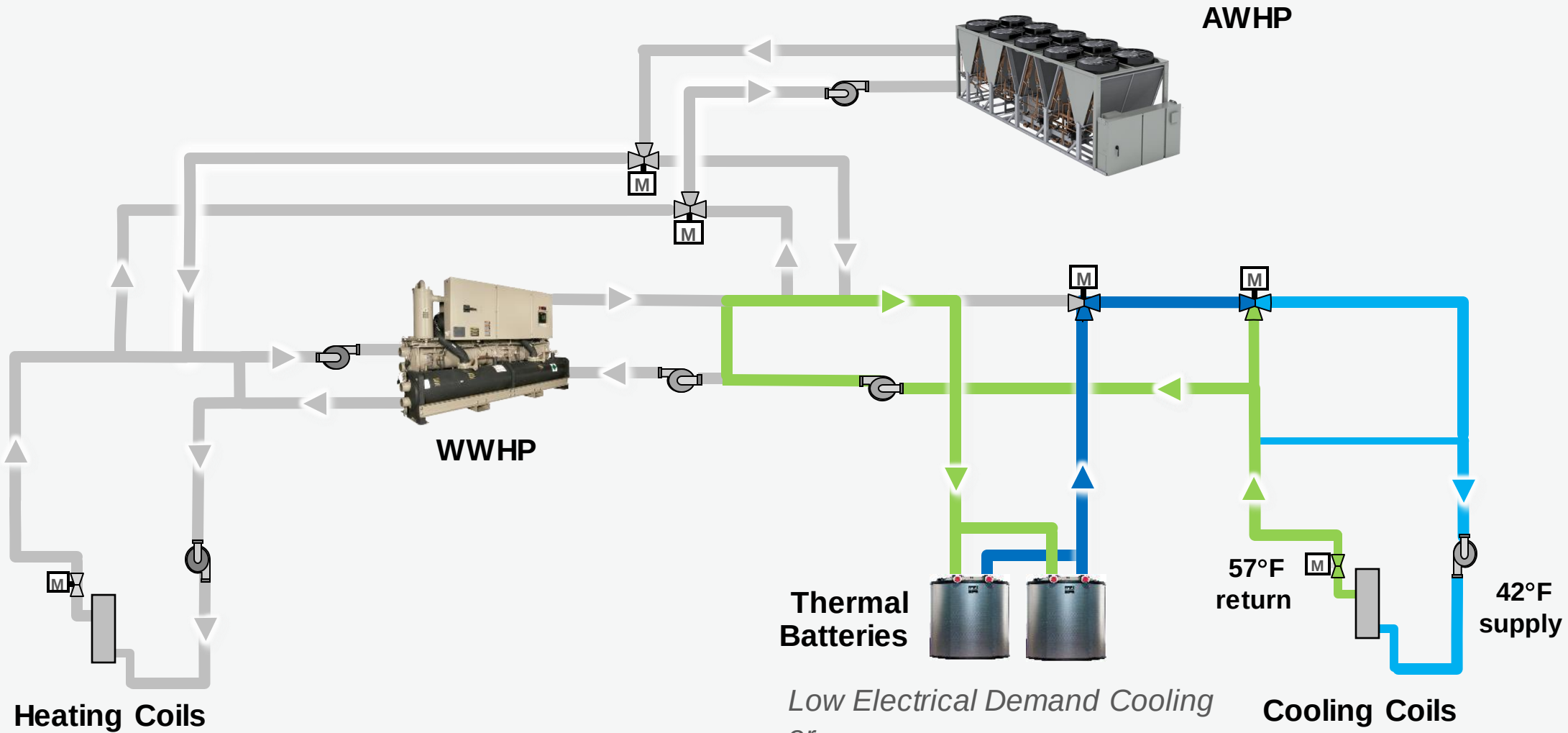
Solving Decarbonization Challenges with Thermal Batteries

Storage Source Heating - Thermal Batteries & Chiller-Heater



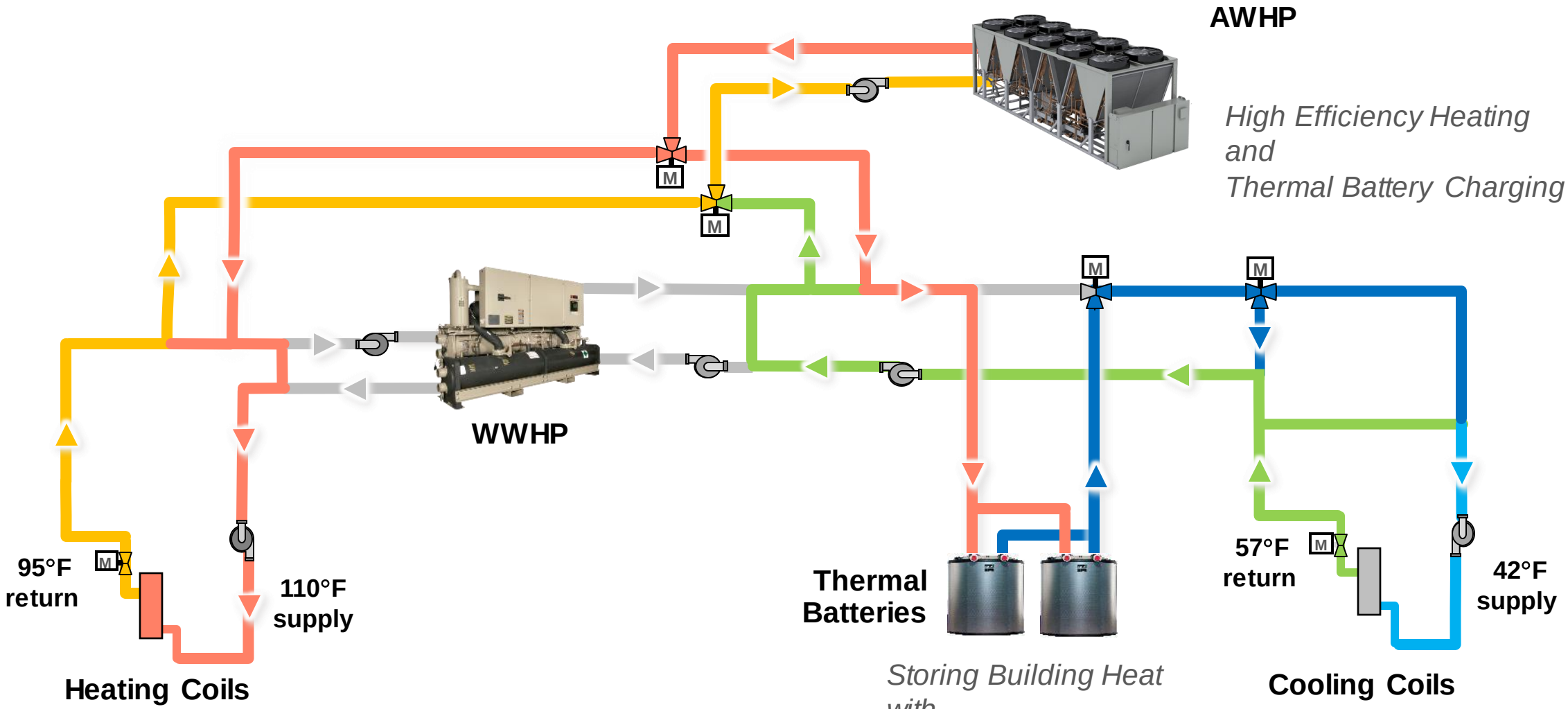
Solving Decarbonization Challenges with Thermal Batteries

Cooling with Thermal Batteries



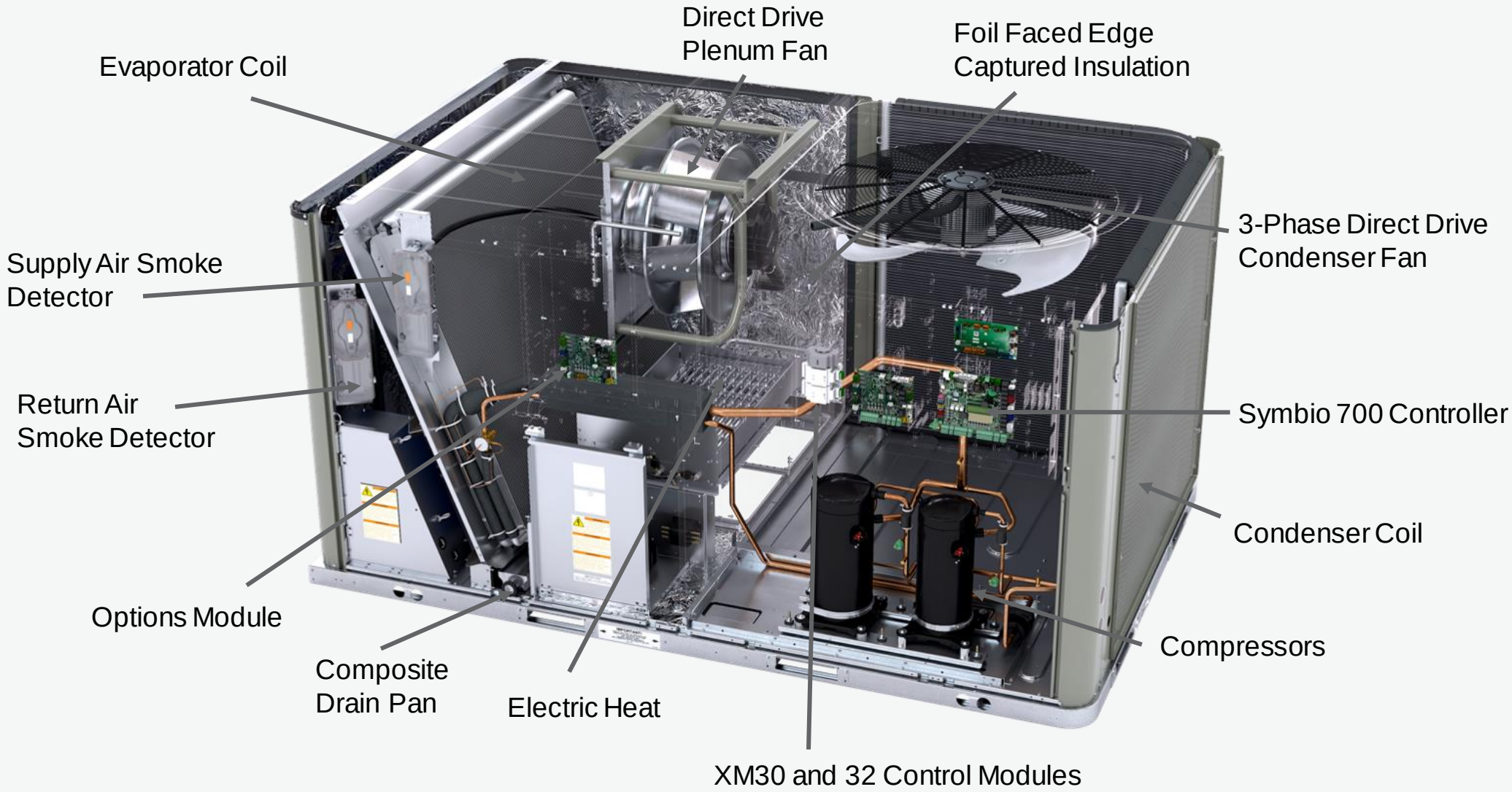
Solving Decarbonization Challenges with Thermal Batteries

Heating and Cooling with Supplemental Energy – when Ample Green Power!



Heat Pump RTUs

Reducing complexity.
Precedent makes the most of your time.



ASCEND® Air-to-Water Heat Pump

Model: ACX

Capacity Range: 140 to 230 tons cooling, 1500 to 2500 MBh heating

Refrigerant: R-454A

Compressor Design: Scroll

Controls: Symbio® 800 with Adaptive Controls™

Factory-installed Optional Features: Integrated pump packages & sound-reduction packages, Drain pan

Operating Limitations		
Chilled Water	40 to 65F	0 to 125F Ambient
Hot Water	68 to 140F	0 to 95F Ambient
Max leaving at min ambient – 100F at 0F		
Catalog (AC-PRC002*-EN) IOM (AC-SVX002*-EN)		

Features and Benefits

Support of electrification of heat

Ease of installation

Simplified service

Next Gen Future ASHP

Thermafit™ Heater/Heat Recovery – Retrofit

Model: MWC and MWT

Capacity Range: 15 to 80 tons cooling, 216 to 1140 MBh

Max of 10 modules per bank

Refrigerant:R-410A, 134a for Heat Recovery above 140F

Compressor Design: Scroll

Factory-installed Options: VSD, Free Cooling, Low sound, Pump/Tank package

Features and Benefits

Easy expandability

Extreme flexibility

Simplified service

Small footprint/Easy Access

Operating Limitations	
Chilled Water	38 to 65F
Hot Water	60 to 165F
R410A, 42 F minimum LWT and 140 F maximum LWT	
R134a, ~ 70 F minimum LWT to get 175 F maximum LWT; at 42 F LWT, maximum 160 F LWT	
Available literature Catalog (ARCTC-PRC002*-EN) IOM (ARTC-SVX002*-EN & ARTC-SVX004*-EN)	

Thermafit™ Multipipe Unit – Geothermal

Model: MWS

Capacity Range: 30 to 60 tons cooling, 1275 to 2690 MBh

Min of 3, Max of 8 modules per bank

Refrigerant: R-410A

Compressor Design: Fixed scroll

Factory-installed Optional Features: Single Point Power, Low Sound Panel Package

Operating Limitations		
Cooling only	Chilled water 54-44F	Source 85-95F
Heating only	Hot water 100-120F	Source 54-44F
Simultaneous	Chilled water 54-44F	Hot water 100-120F

Available literature
Catalog (ARCTC-PRC003*-EN)
IOM (ARTC-SVX005*-EN)

Features and Benefits

Simultaneous Heating and Cooling

Single System to meet Varying Heating and Cooling Demands

Electric Heating

Fluids from Different Loops do not mix

RTWD – Heater/Heat Recovery

Capacity Range: 80 to 250 tons

Refrigerant: R-134a or R-513A or 515B

Compressor Design: Helical-Rotary

Controls: CH530 with Adaptive Controls™

Factory-installed Optional Features: sound-reduction package

Operating Limitations	
Chilled Water	10F (-12C) to 65F
Hot Water	60 to 167F (75C)
Max lift 100F	
Brochure (RLC-SLB018-EN) Catalog (RLC-PRC29*-EN) IOM (RLC-SVX09*-EN)	

Features and Benefits

Reliability

High Lift Versatility

Precision Temperature Control

Cascade Chiller Heater

Capacity Range: 20,000 to 35,000 heating MBh

Refrigerant: R-514A or R-1233zd(E)

Compressor Design: Centrifugal

Controls: Tracer® SC+ for module and Symbio 800 for unit

Factory-installed Optional Features: 6 pipe heat recovery, Belzona coating, sacrificial anodes, CuNi tubes

Operating Limitations	
Hot Water	Up to 180F
Chilled Water	34 to 65F

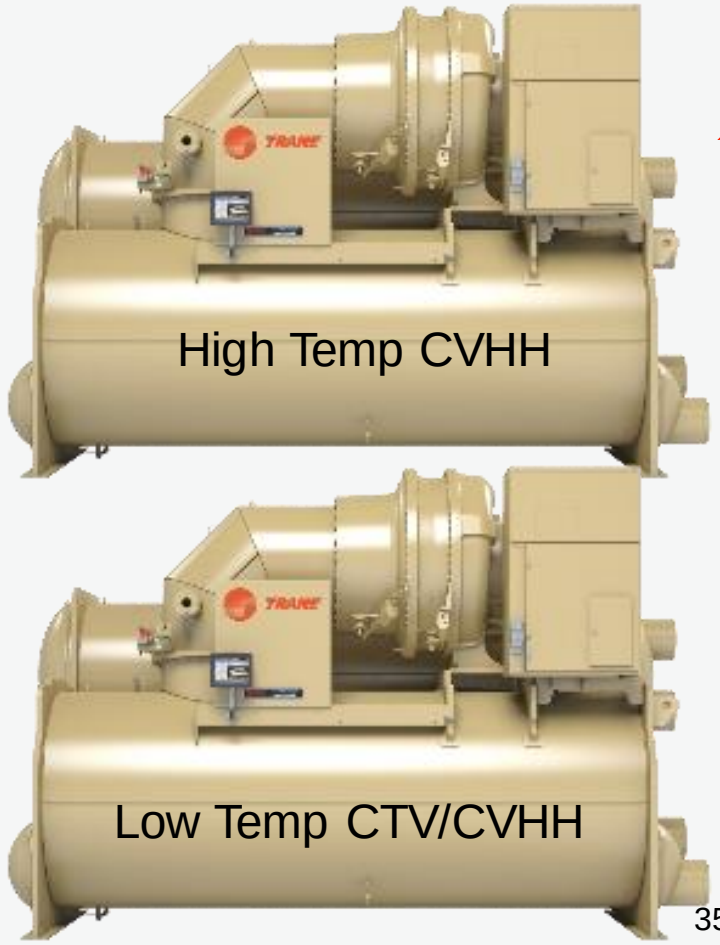
Features and Benefits

Lift capability: 145F

Turndown: 25%

High Temp CVHH can provide additional cooling in summer

High Temp CVHH can be sold individually as boost



High Temperature Hot water Booster

- Refrigerants near zero GWP
- Maximum condenser temperature of **+120°C (248°F)**
- Minimum Heat Source temperature of **-20°C (-4°F)**

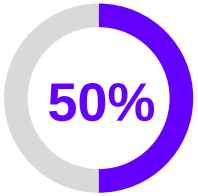
- Exergy heat pumps provide significant results for a wide variety of applications:

- Heating in residential or commercial buildings
- District heating
- Heating industrial processes
- Domestic hot water delivery

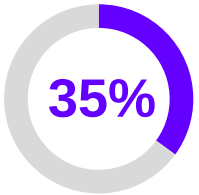
Trane Technologies is positioned to **meet global challenges by addressing**

Carbon Emissions, Food Loss, and Achieving Diversity

In doing so, we have achieved significant **2020 Commitments**



reduction in GHG refrigerant footprint of our product portfolio

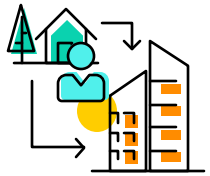


reduction in GHG footprint of our operations

However, we continue to see **opportunities in the world's challenges…**

Sustainability

Climate Change



Urbanization

Technological Disruptions

Demographics

…Leading to our **2030 Commitments**

Gigaton Challenge

Reduce customer carbon footprint by **1 gigaton***

- ✓ Accelerate clean technologies that heat and cool buildings in sustainable ways
- ✓ Increase energy efficiency in buildings, homes and transport
- ✓ Reduce food loss in the global cold chain
- ✓ Transition out of high-Global Warming Potential Refrigerants

Design systems for circularity

Increase access to heating, cooling and fresh food

Leading by Example

Achieve carbon neutral operations

Deliver zero waste to landfills

Become net positive with water use

Reduce absolute energy consumption by 10%†

Opportunity for All

Achieve workforce diversity reflective of our communities

Achieve gender parity in leadership roles

Maintain world-class safety metrics

Provide market-competitive wages, benefits and leading wellness offerings for workforce

Invest $100 million in building sustainable futures for under-represented students

Dedicate 500,000 employee volunteer hours in our communities

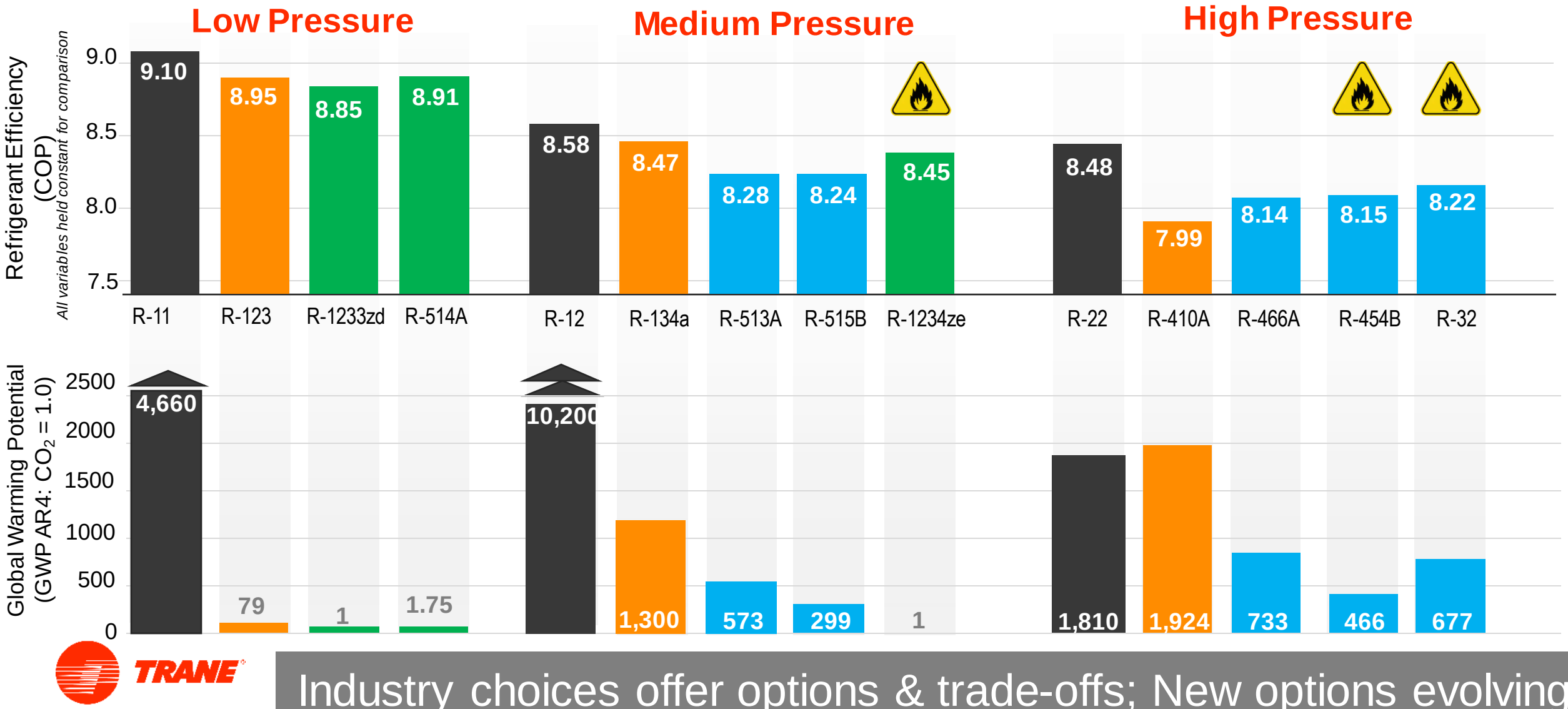
*1B metric tons of CO_2e

†Compared to 2019 baseline

Contact: Trane Canada
Lukas Glaspell
525 Cochrane Dr. Markham ON L3R 8E3
647.991.9570
Lukas.Glaspell@trane.com

Efficiency and GWP Comparison

Past | Transitional | Lower GWP | Ultra-Low GWP



TRANE

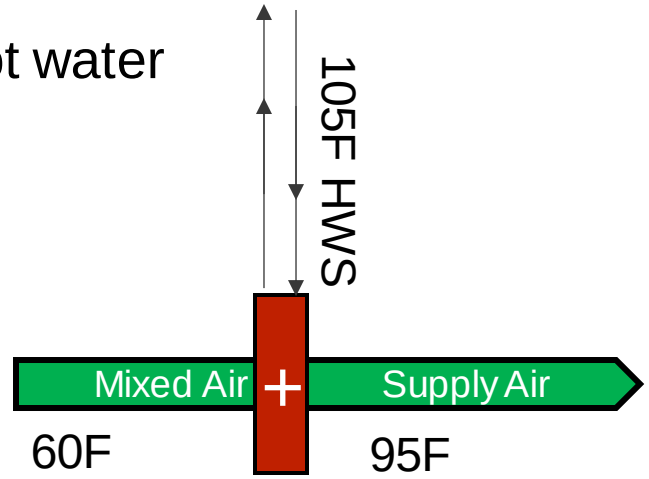
Industry choices offer options & trade-offs; New options evolving

Hot Water Supply Temperature

What is needed by the zone equipment?

Most equipment can be selected for space heating with 100-110°F Hot water

Equipment	Minimum Hot Water Supply Temperature
DOAS Air Handler	>80°F
Central Air Handler/VAV	95-105°F
Single Zone VAV AHU	100-105°F
VAV boxes (4 row)	95-105°F
Fan Coil Units w/ Changeover coil	100-115°F



Hydronic Changeover Coil

Q&A

Partners in Project Green

A Program of Toronto and Region Conservation Authority

Thank You!