IDEA2022
Building Connections

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Decarbonized Large Scale and District Heating with Heat Pumps

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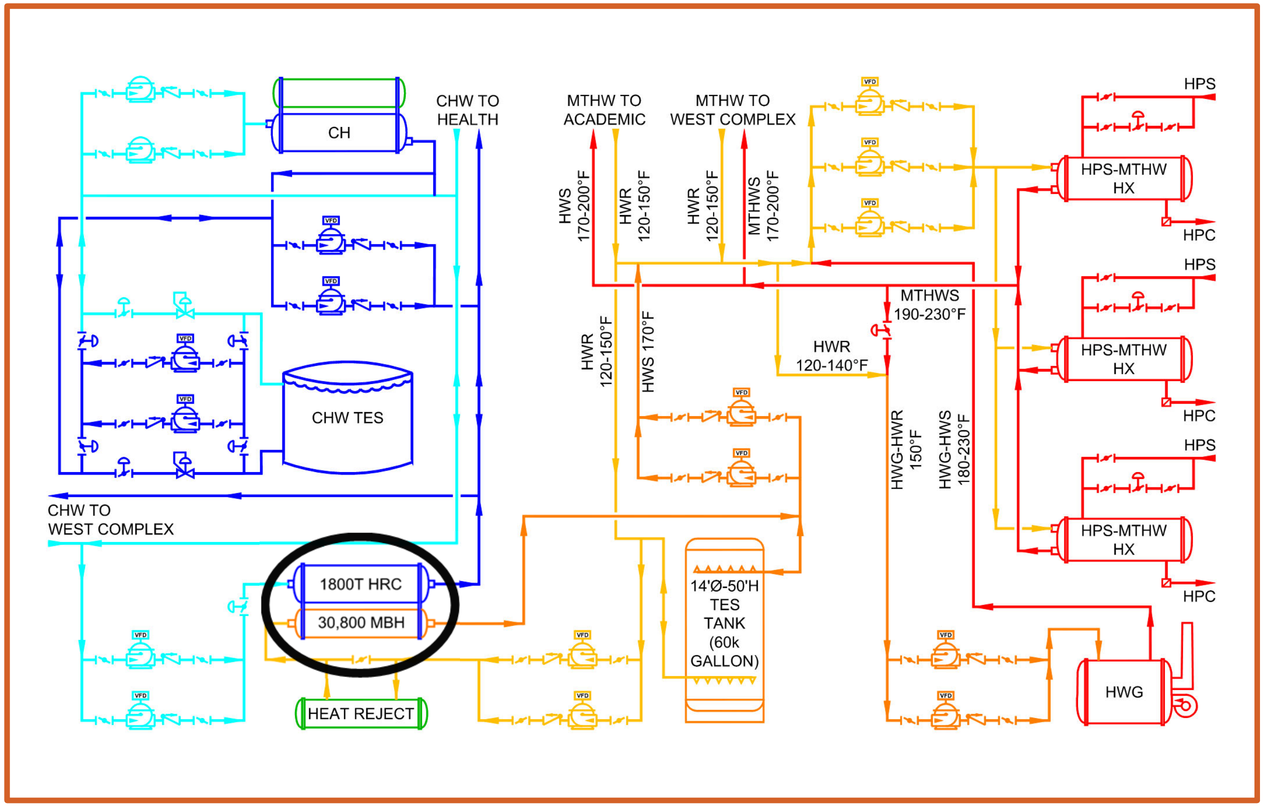
Expressing the Art of Heat Pump

- Introduction
- University Campus Simultaneous Cooling and Heating
- Sewage Waste Heat Recovery
- District Heating
- Zero GWP
- Recap – Moving Toward a Sustainable Future

University of Virginia

Simultaneous Cooling (42°F/5.5°C) and Heating Water (as High as 170°F/77°C)



Conversion from medium pressure steam and high temperature hot water to low temperature hot water

Retrofit existing buildings, 170°F (77°C) heating water critical

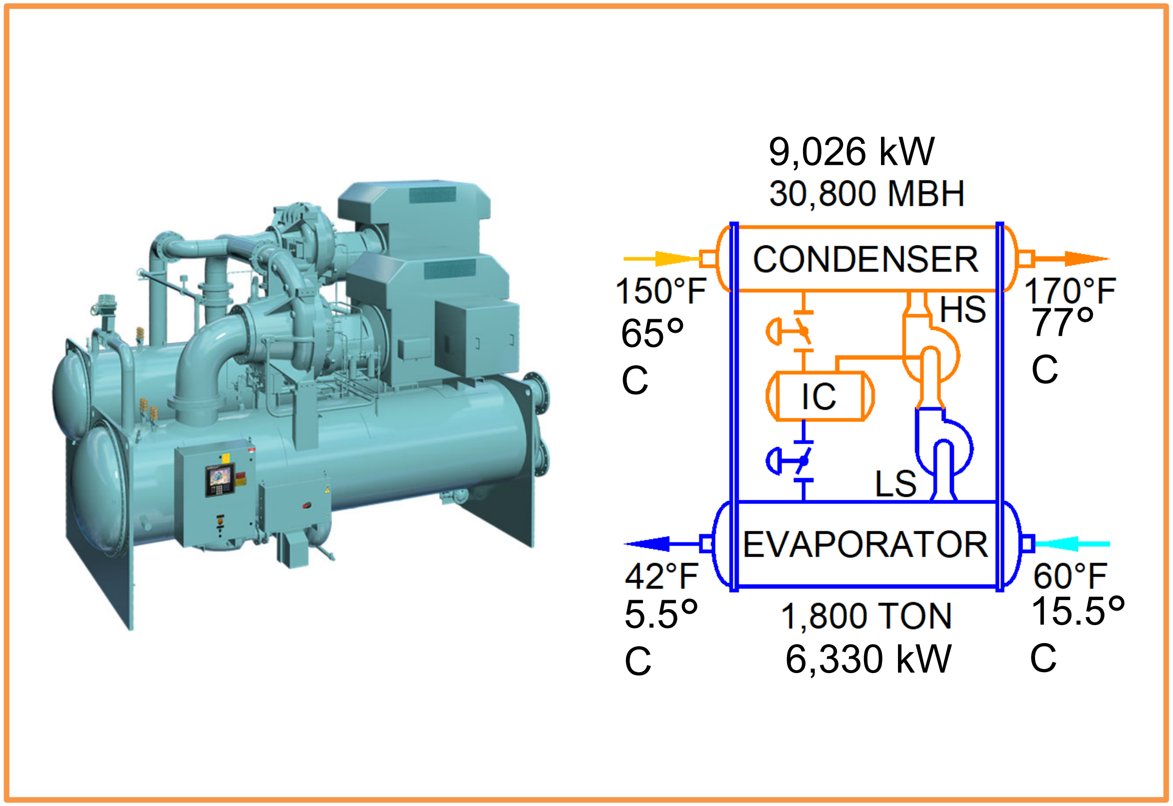
Simultaneous cooling and heating

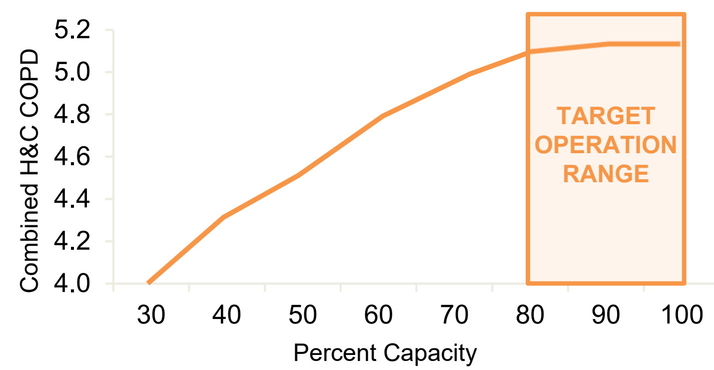
Heat recovery chiller (HRC) Base loaded

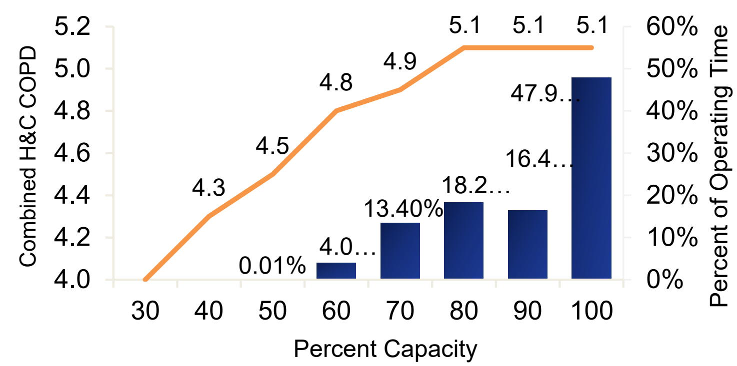
Boilers and other chillers supplement the HRC, as needed

Hot water storage tank (for turndown) and dump radiator

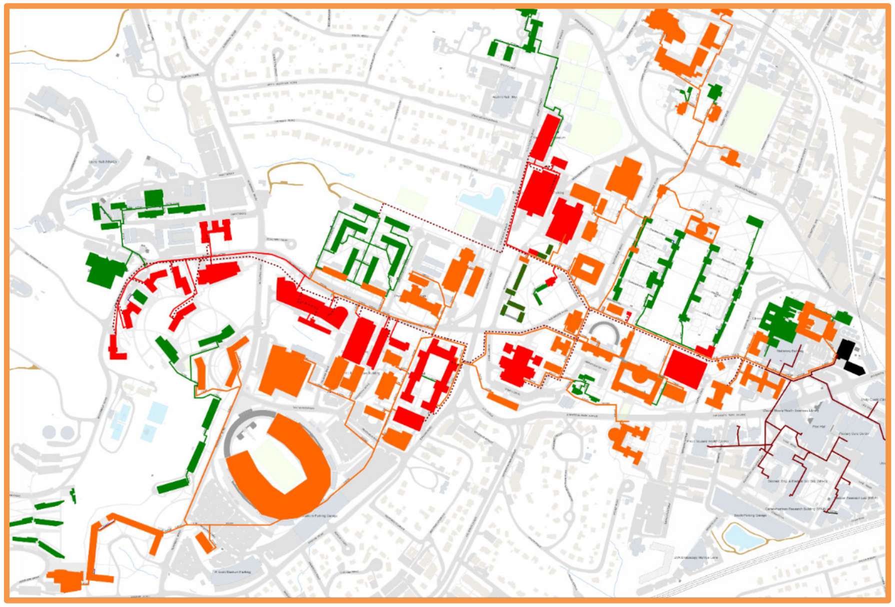
Heat Recovery Chiller COP 5.12 (7x More Efficient than Steam Plant) High Capacity High Temperature High Lift







Design Optimization by Manufacturer Enables Huge Flow Fluctuation – Summer and Winter



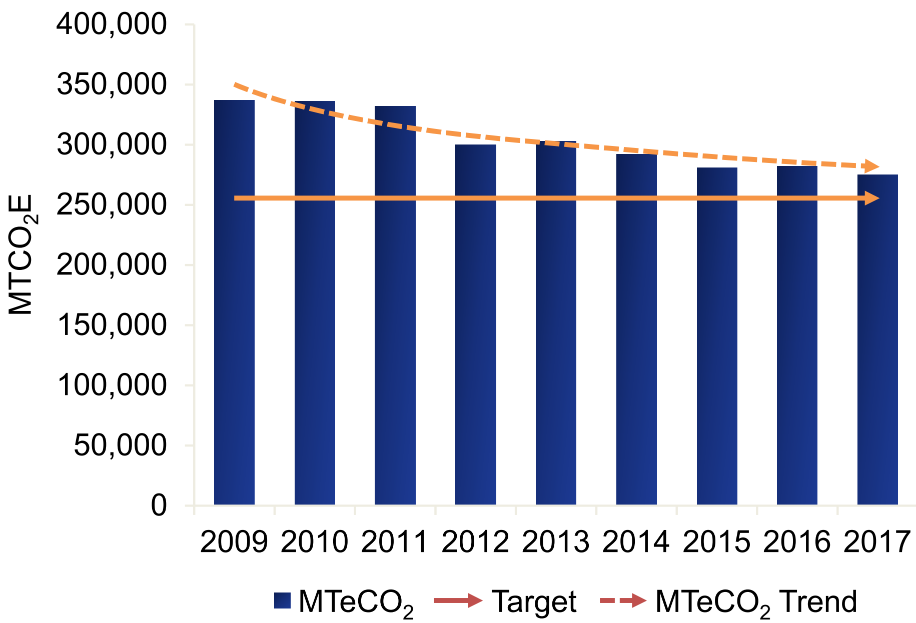
Legend

- MPS Building Conversion
- MTHW Building Conversion
- LTHW Building Conversion
- De-activated MPS
- Existing MPS
- New LTHW
- Convert MTHW to LTHW
- Existing LTHW
- New MTHW
- Existing MTHW

Parameter	Summer	Winter
Efficiency (kW/ton)	1.764	1.786
Capacity	1500 Tons (5,275 kW)	1800 Tons (6,330 kW)
Evaporator	1,562 gpm ($359\ m^3/h$) (65/42°F) (18/5.5°C)	**6,617 gpm** (**$1,522\ m^3/h$**) (48.5/42°F) (9.1/5.5°C)
Condenser	1,753 gpm ($403\ m^3/h$) (140/170°F) (60/76.6°C)	**4,030 gpm** (**$927\ m^3/h$**) (154/170°F) (67.7/76.6°C)

Heat Recovery Chiller Supports UVA's Climate Action Goal Carbon Neutrality by 2030, Fossil Fuel Free by 2050

UVA's goal is to reduce GHG emissions 25% below 2009 levels by 2025



12,000 metric tonnes of CO_2 emissions to be avoided annually due to the heat recovery chiller

City of Vancouver False Creek Neighborhood Energy Utility

Johnson Controls

False Creek Energy Center
Innovative Neighborhood Energy Utility

1st Renewable district heating system in Vancouver Canada

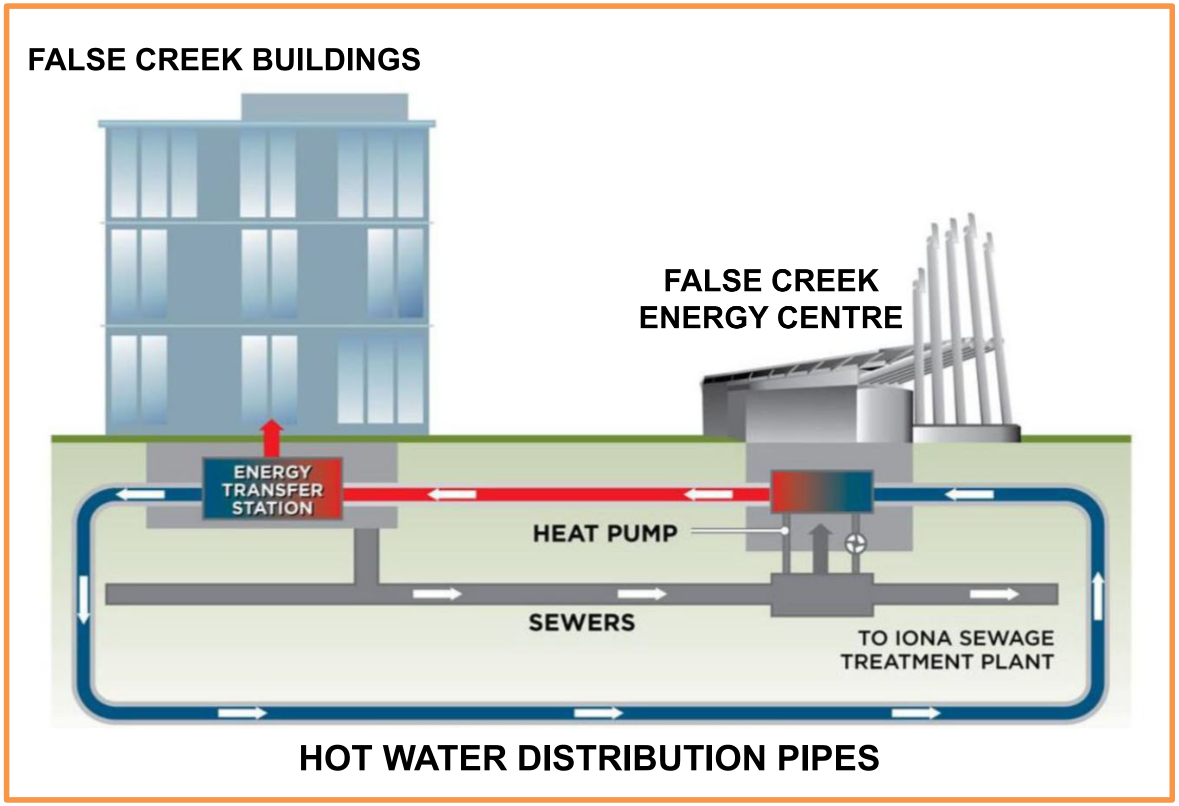
Started in 2010; currently serving **6 million ft²** (0.5 million m²); expanding to **23 million ft²** (2 million m²)

1st Large scale waste-water heat pump system in North America

70% of heat generated using renewable energy; 100% by 2030

Sewage Heat Recovery Heat Pump – Low Carbon Technology

- Recovered waste heat from screened municipal sewage
- Heat water from heat pumps and boilers to service buildings in the neighborhood
- Distribution pipes buried under the streets
- Each building with its own energy transfer station



Important Considerations

Original (2008) design considered 3.0 MW in the 1st phase and an additional 3.0 MW in the 2nd phase

Maximizing performance with space constraints

Limit motor size to 1000 KW (avoiding 24x7 operator)

Evaporator tube material CuNi 90:10 (sewage water)

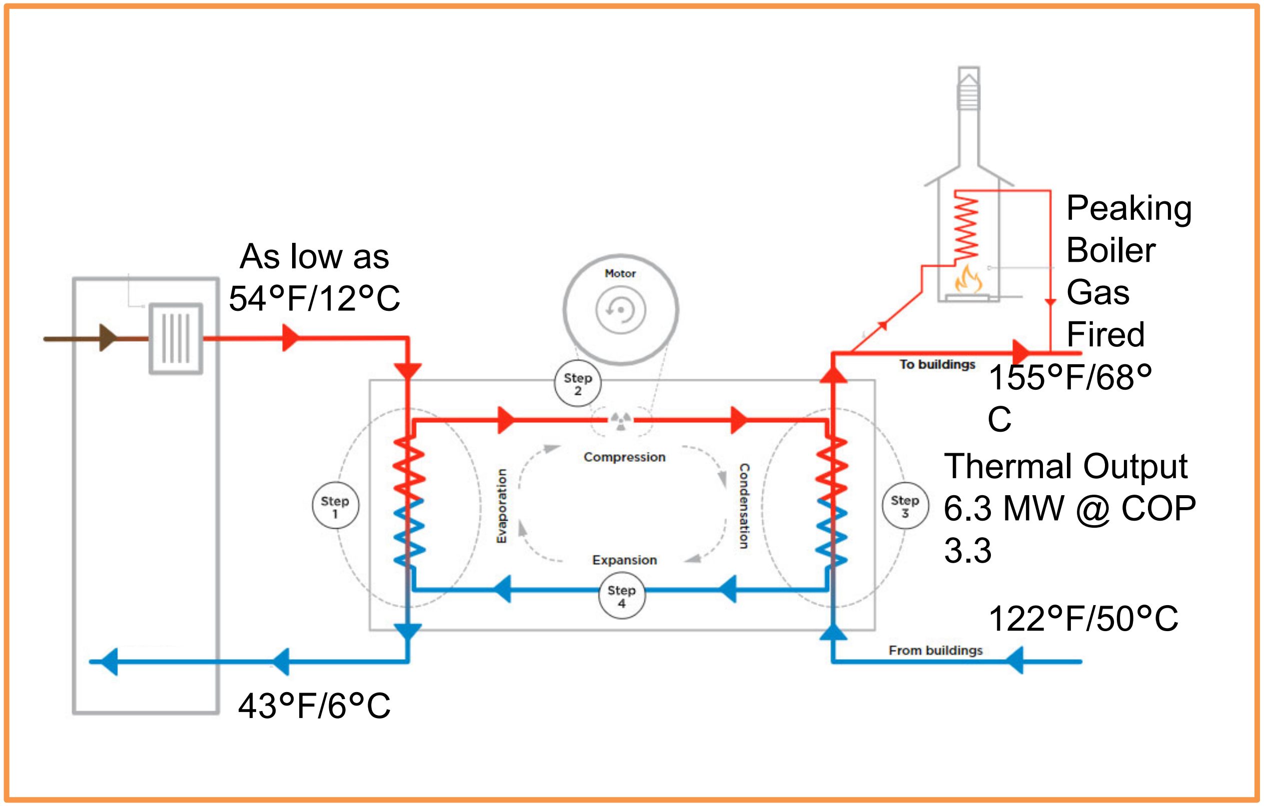
Close collaboration with the heat pump manufacturer resulted in optimizing the design to get up to 6.3 MW (21,500 MBH) instead of the 3.0 MW (10,236 MBH) expansion originally intended

Variable sewage conditions

Low GWP refrigerant (R-513A) required by the city

Factory Test – For performance validation

New 6.3 MW Centrifugal Heat Pumps to Supplement Existing 3.0 MW Screw Heat Pumps



Fully packaged high temperature high lift centrifugal heat pumps will provide **155°F/68°C heating water** (21,500 MBH/6.3 MW) for connected buildings

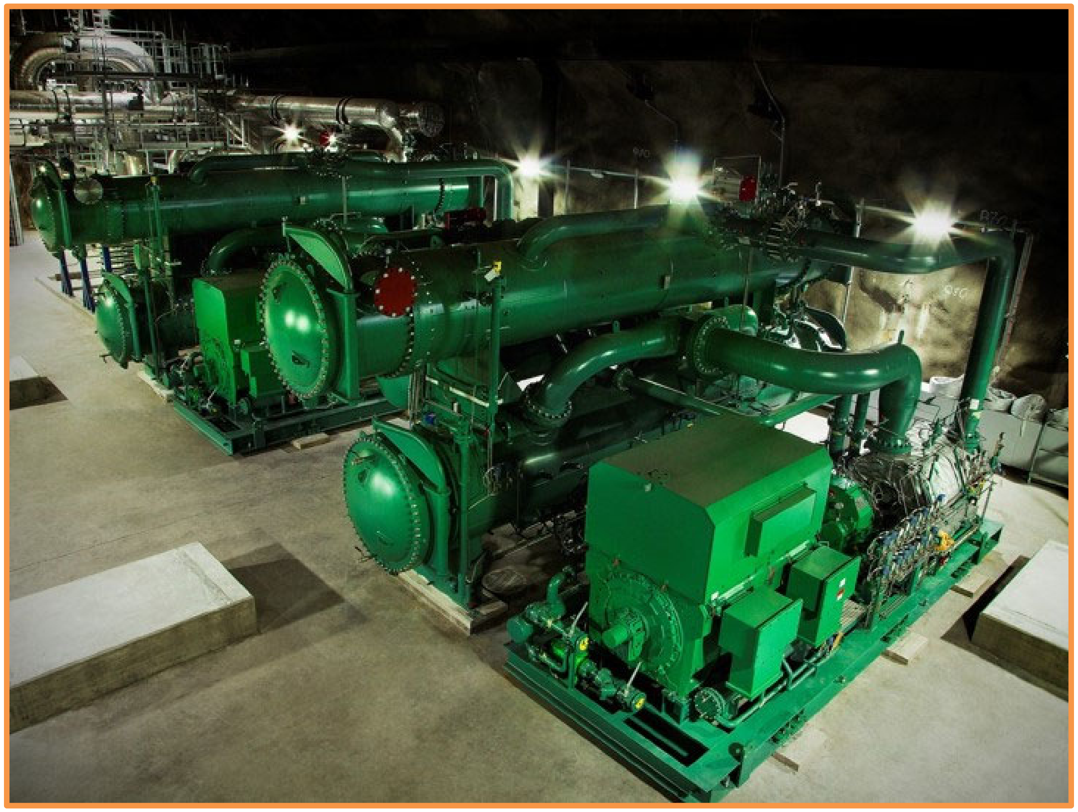
Gas boilers (82,000 MBH/24 MW) are for supplemental heating during coldest days of the year

System commissioning in 2022

Helen Helsinki Finland

Johnson Controls

Renewable Urban Energy by Helen in Helsinki Keskuskatu District Energy Station



Helen's investment in two massive centrifugal heat pumps in 2018, resulting in less usage of fossil fuel (coal) and cutting CO_2 emissions by 20,000 tons per year

Underground cooling center (excavated cave) at a depth of 164 ft (50 m)

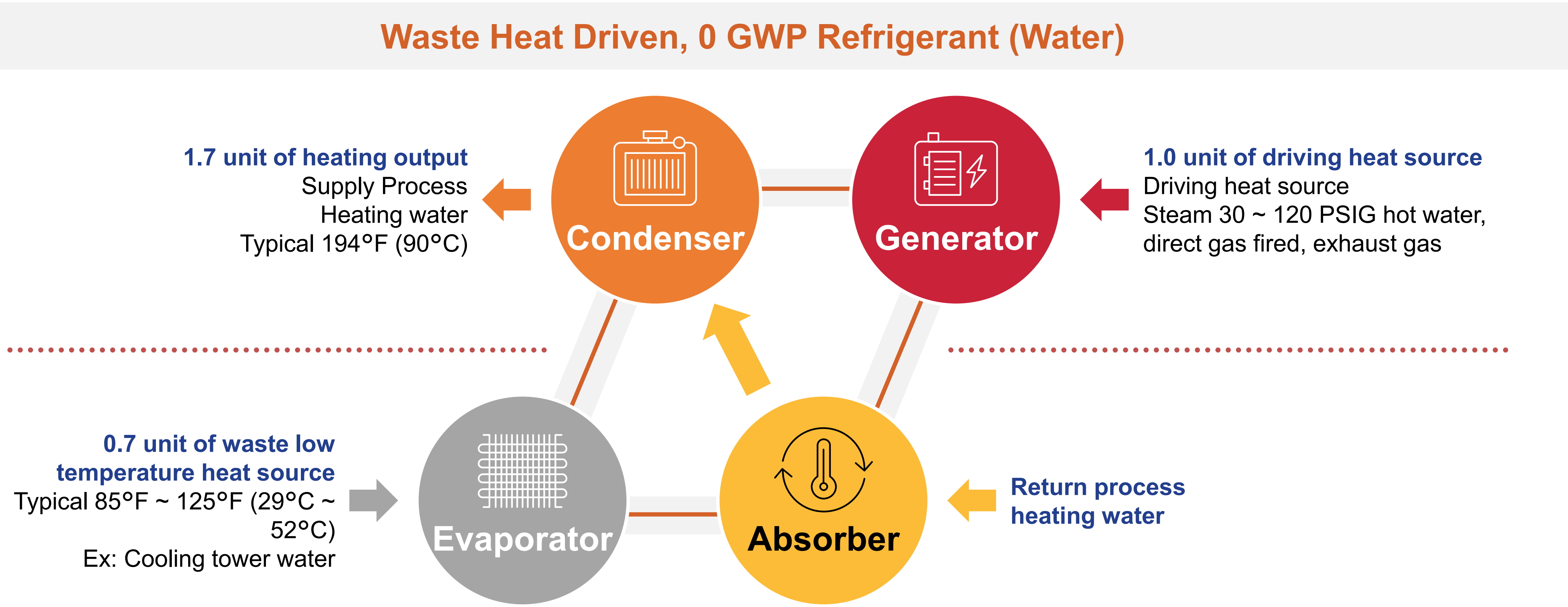
Extending the district cooling capacity in Keskuskatu from 9,971 (35 MW) Tons to 14,245 Tons (50 MW)

Delivering district heating capacity 75,067 MBH (22 MW), equivalent to 10,000 apartment buildings

Combined COP 5.63, Chilled Water 37.4°F (3°C), Heating Water 176°F (80°C)

Zero GWP Heat Pump

Waste Heat Driven Absorption Heat Pump, 0 GWP
A Truly Sustainable Technology

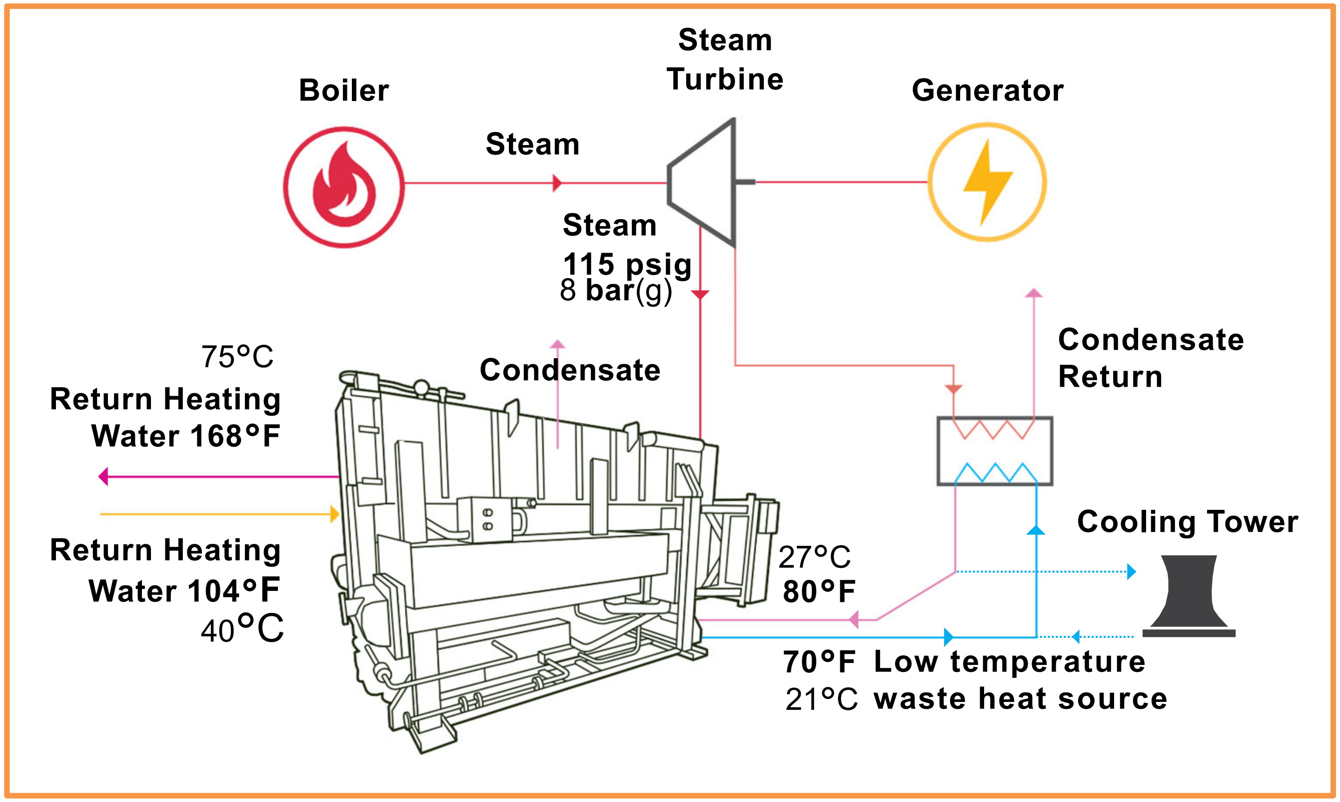


Steam Driven, Zero GWP, Absorption Heat Pump Application

Extracted Steam
Driving Heat Source

Evaporator Waste Heat
Cooling Tower Water

Heating Water 168°F for
Boiler Feed Water Heating



Towards A Sustainable Future
Every Chiller is a Heat Pump

Moving the BTUs efficiently

Proven renewable technology

Tailor-made for your application

A key technology to achieve your sustainability goals

Diversity of Usage

Industrial Waste Heat Reovery, University Campus Cooling and Heating, District Heating

Diversity of Refrigerants

Low GWP to Ultra-low GWP to Zero GWP

Diversity of Technology

Electric and Thermal

Q&A

Thank You!

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