Energy Transfer Station (ETS) Design Principles

IDEA2018: Local Solutions, Global Impact
Wednesday June 13, 2018

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Agenda

- Energy Transfer Station (ETS) Design Principles
- Case Study
- Summary
- Q&A

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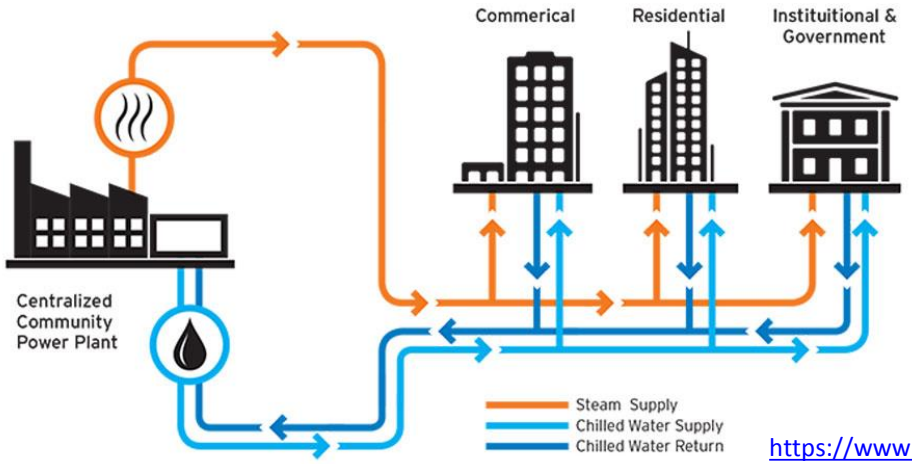
Learning Objectives

Following this presentation, you will be able to:

1. Understand importance of reviewing all building mechanical systems connected to the DES
2. Develop a language to discuss strategies for optimizing ETS performances
3. How to modify existing systems to accommodate DES connections
4. Understand how to design ETS's resulting in lower capital expenditure and increased efficiency



https://www.corix.com/cleveland-thermal/district-energy

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Mechanical System Review

Local District Energy Connection Guidelines

Local AHJ Requirements

Existing Buildings

Review: existing heating system capacity and supply temperature requirements

Advise: achieving high temperature differences between the supply and return with minor modifications.

Review: existing domestic hot water system capacity and supply temperature requirements

Advise: achieving instantaneous set-up with minor modifications

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Local District Energy Connection Guidelines

Local AHJ Requirements

New Buildings

Heating systems:

- Low supply temperature
- Achieve high temperature differences between supply & return

Domestic Hot Water systems:

- Instantaneous set-up

Consider:

- Auxiliary heating systems for high temperature process loads

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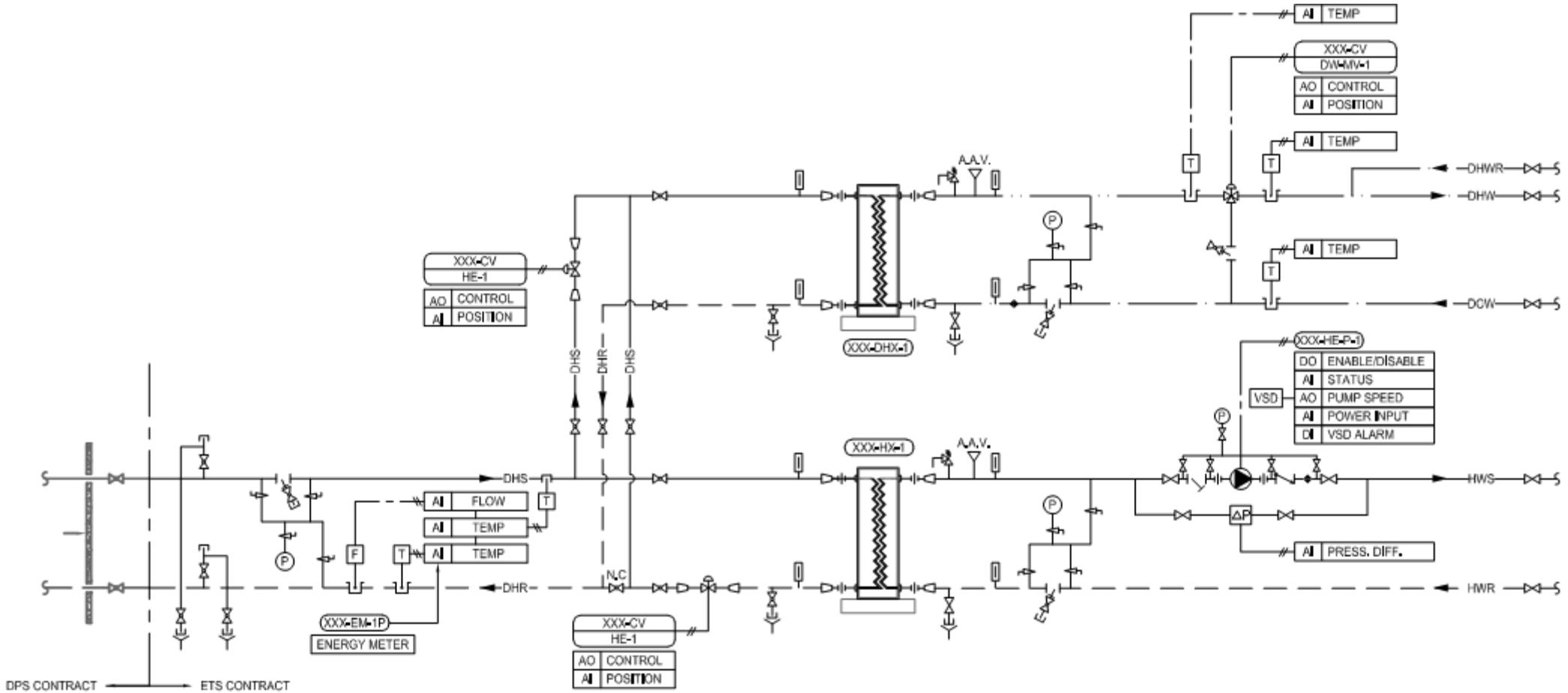
What is ETS

Energy Transfer Station (ETS)

- Transfer heat from district system to building
- Typically located in the Mechanical Room
- Consists of heat exchangers, pumps and valves
- Hydraulic Separation between primary and secondary
- Most of the DES applications

Typical ETS



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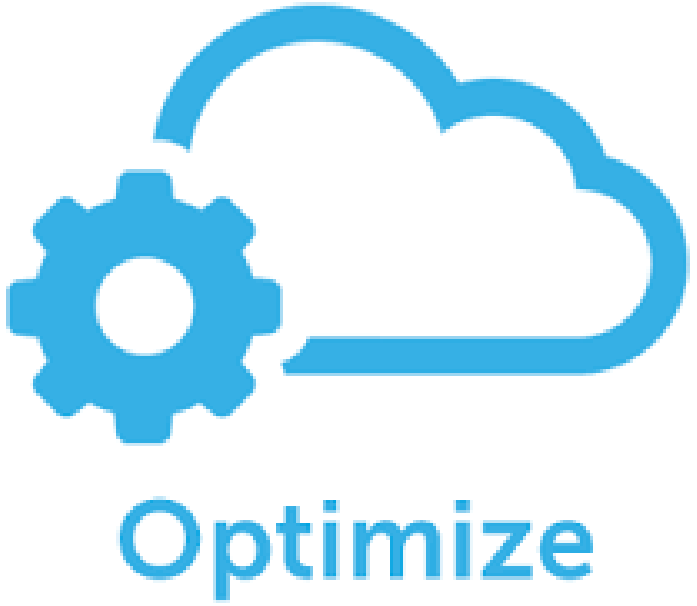
Optimizing ETS Performance

- Optimize secondary side for low temperature heat
- Increase differentially between DES supply and return
  - Cascade! If you can, cascade more than once!
- Select proper heat exchangers - type, size & arrangement
- Optimize Control sequence for ETS operation
  - Controls!



Modifications for DES Connection

- Selection of ETS Location to optimize DES pipe routing
- Existing System Optimization
- Improving Existing Control Strategies
- Accommodating antiquated high temperature equipment
- Flushing!

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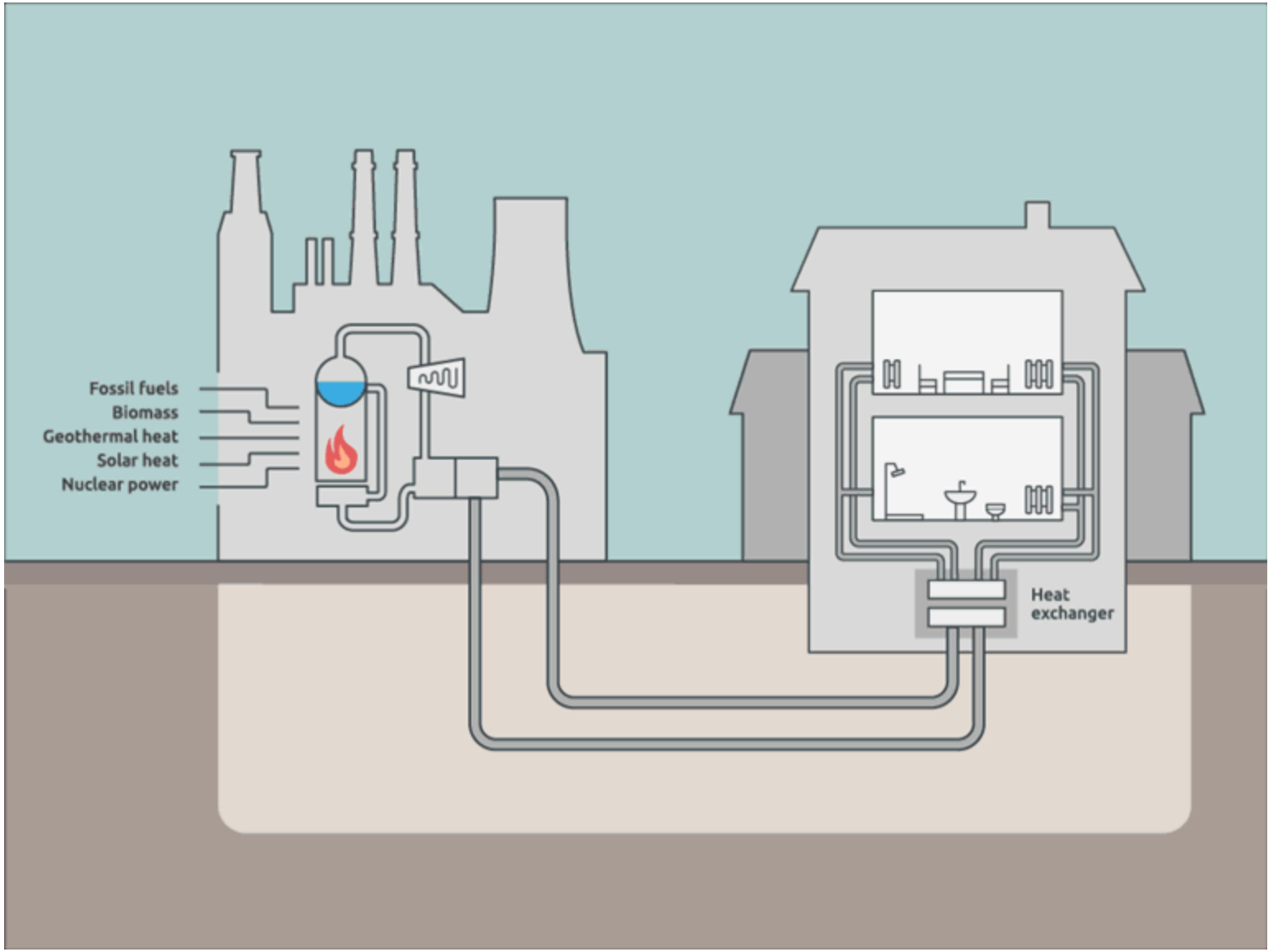

https://commons.wikimedia.org/wiki/File:District_heating.gif

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ETS Design Parameters

Primary Side Temperature & Pressure

- Steam
- High Temperature and High Pressure Water (>212 F / 100 C)
- High Temperature Water (<212 F / 100 C)
- Low Temperature Water (<140 F / 60 C)

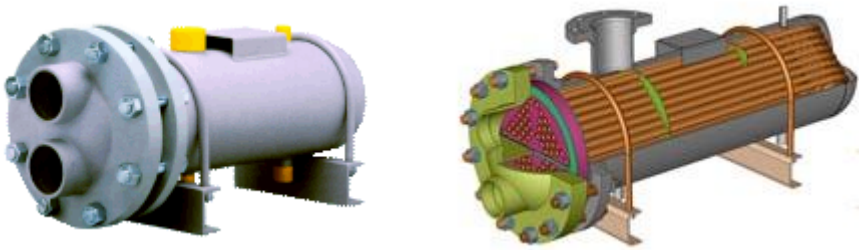
Secondary Side Temperature Requirement

- High Temperature Water (<212 F / 100 C) for existing buildings
- Low Temperature Water (<140 F / 60 C) for new buildings

ETS – Heat Exchanger Selection

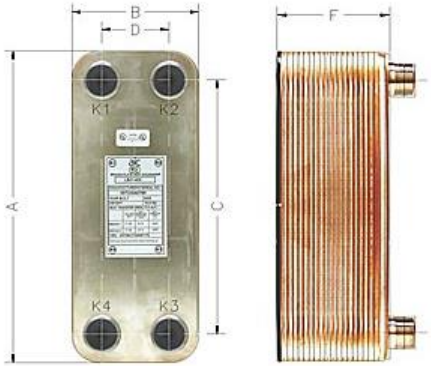
Heat Exchangers Selection

- Sizing – surface area vs. pressure drop
- Arrangement – series vs. parallel
  - Series cascaded parallel connections
- Type – shell vs. plate



Shell & Tube

Plate and Frame



Brazed Plate

Energy Transfer Station - ETS

Controls Strategies and Metering

- Reducing Initial Investment
    - Primary side control valves and multiple functions
    - Secondary side control valves
- Where will the energy meter be installed?

Lower Capital & Increased Efficiency

- Minimize system components as much as you can, especially on primary side!
- Use the components for more one than one purpose!
- 3D Scanning, minimize the site work
- Cascade, Cascade and Cascade!
- Commission and control properly

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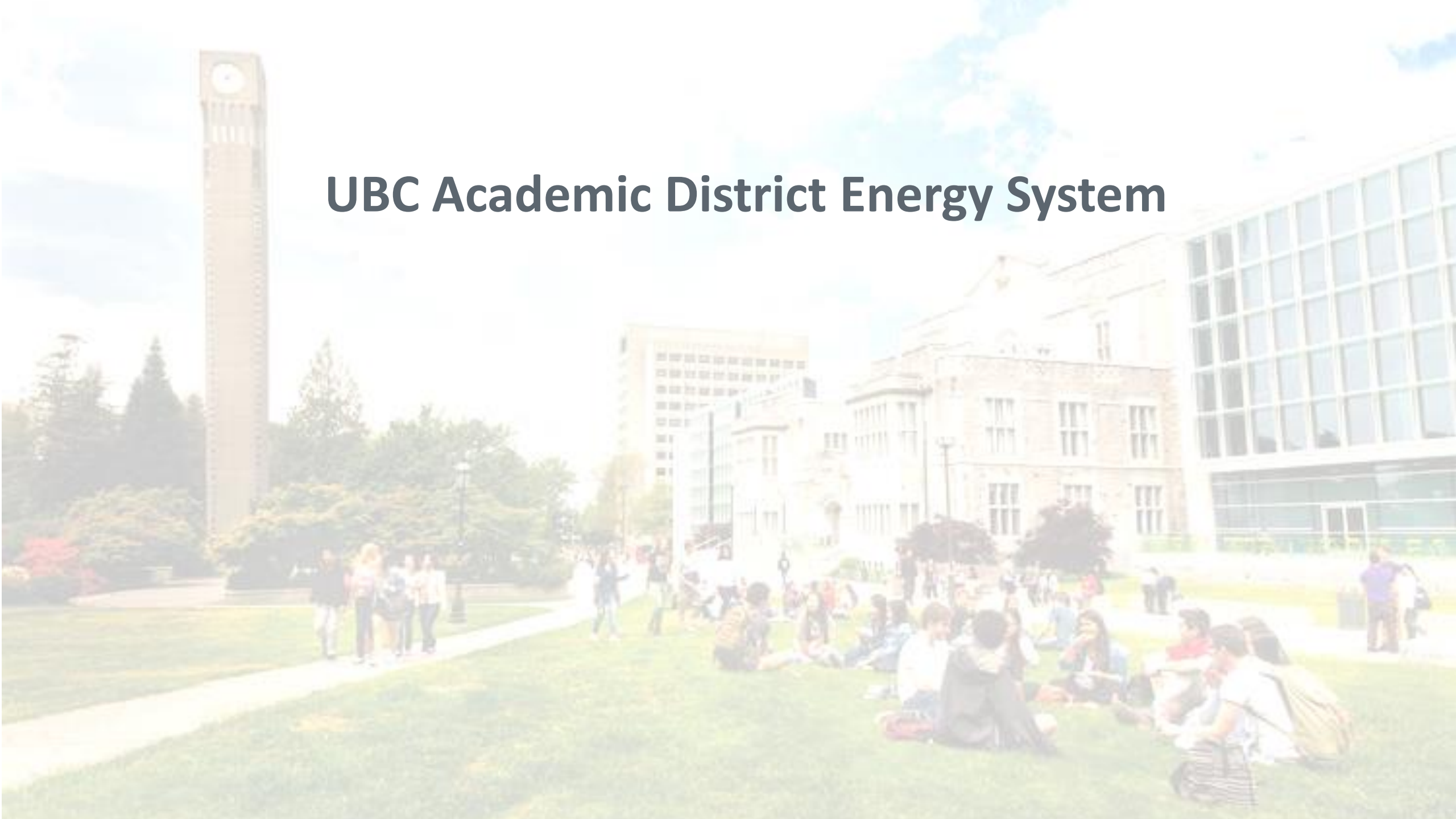
UBC Academic District Energy System



Big Picture

Academic District Energy System (ADES)

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Big Picture

Academic District Energy System (ADES)

- $88M Project – 5 Year/ 10 Phase
- Converting from steam to high temperature hot water system
- Essential to the Universities Climate Action Plan
- Aid in long-term targets of eliminating the use of fossil fuels on campus by 2050
- Heats over 130 UBC buildings over 800,00 m^2 (8,600,000 sq.ft.)
- Over 100 Energy Transfer Stations
- The ADES Reduces the University's:
  - Thermal energy by 24%,
  - GHG emissions over 22%
  - Operational and energy costs by $5.5 million per annum

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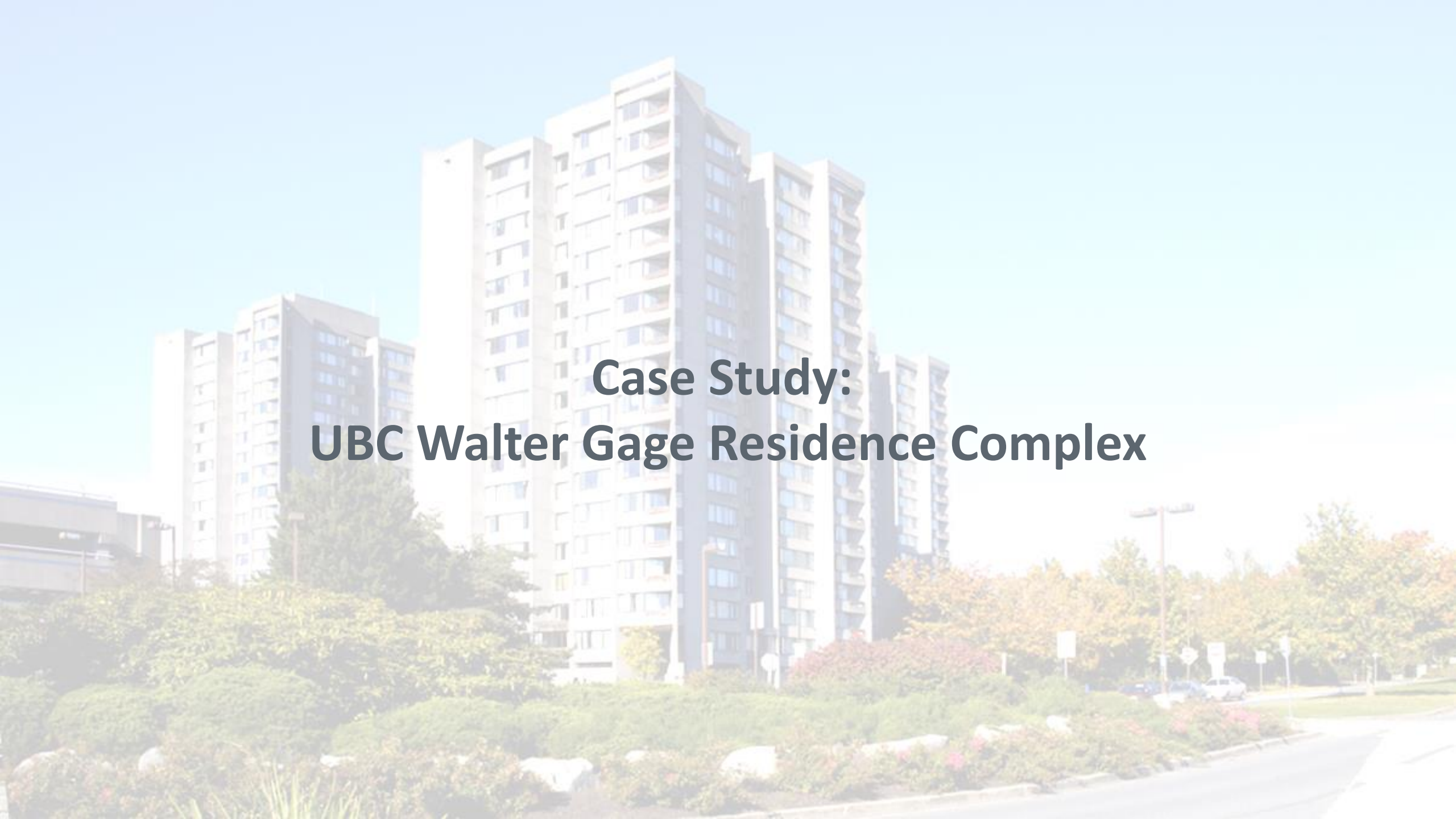
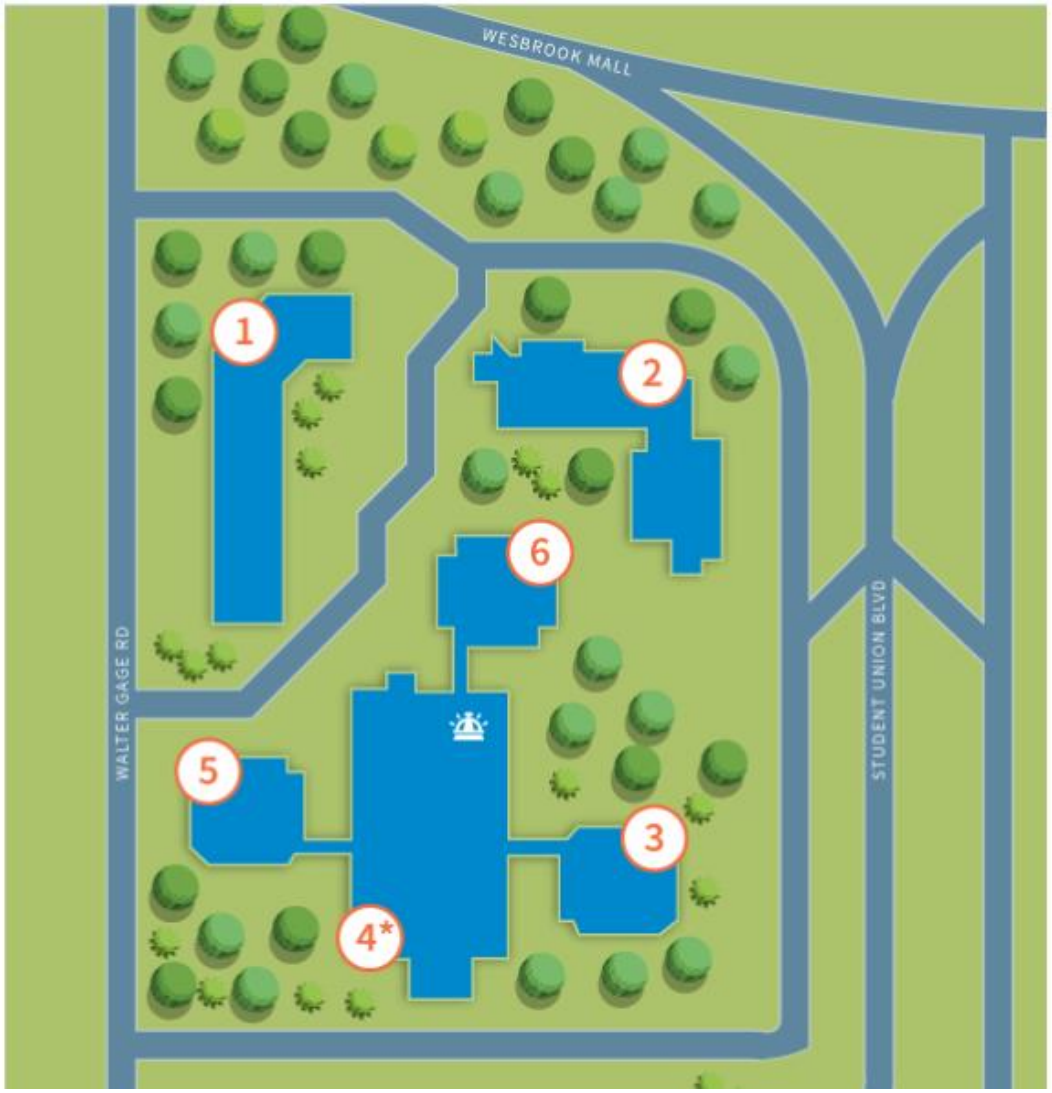


Case Study:
UBC Walter Gage Residence Complex

Walter Gage Residence



1. Gage Apartments
2. West Coast Suites
3. South Tower
4. Commonsblock, Front Desk, Mini Mart
5. North Tower
6. East Tower

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Walter Gage Residence

Steps Taken for Building Analysis

- Building Load Analysis
- Building System Analysis
- Optimization opportunities
- ETS Location
- Existing system components to reused
- Opportunity for preheating for domestic loads

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Walter Gage Residence

Energy Transfer Station (ETS)

Review

- Existing System
- Main heating Plant Location
- 2 major Hydronic Loops
- Independent Domestic Water Systems

ETS Design

- Loads
- Flow Rates
- Existing HEXs
- Existing Building Design & One Heat Source
- Hydronic system was combined into one single heat source
- Additional Preheat HEXs
- Total ETS differential temperature of up to 60C
- Single central Mechanical Room

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Walter Gage Residence

Key Elements to Optimizing ETS Design Implementation

- Reduce flow rates
  - Cascaded temperatures
  - Increase ETS differential temperature

- Combining multiple systems
  - Increase redundancy
  - Reduce overall length of DES piping
  - Old mechanical spaces = additional usable space

Questions?

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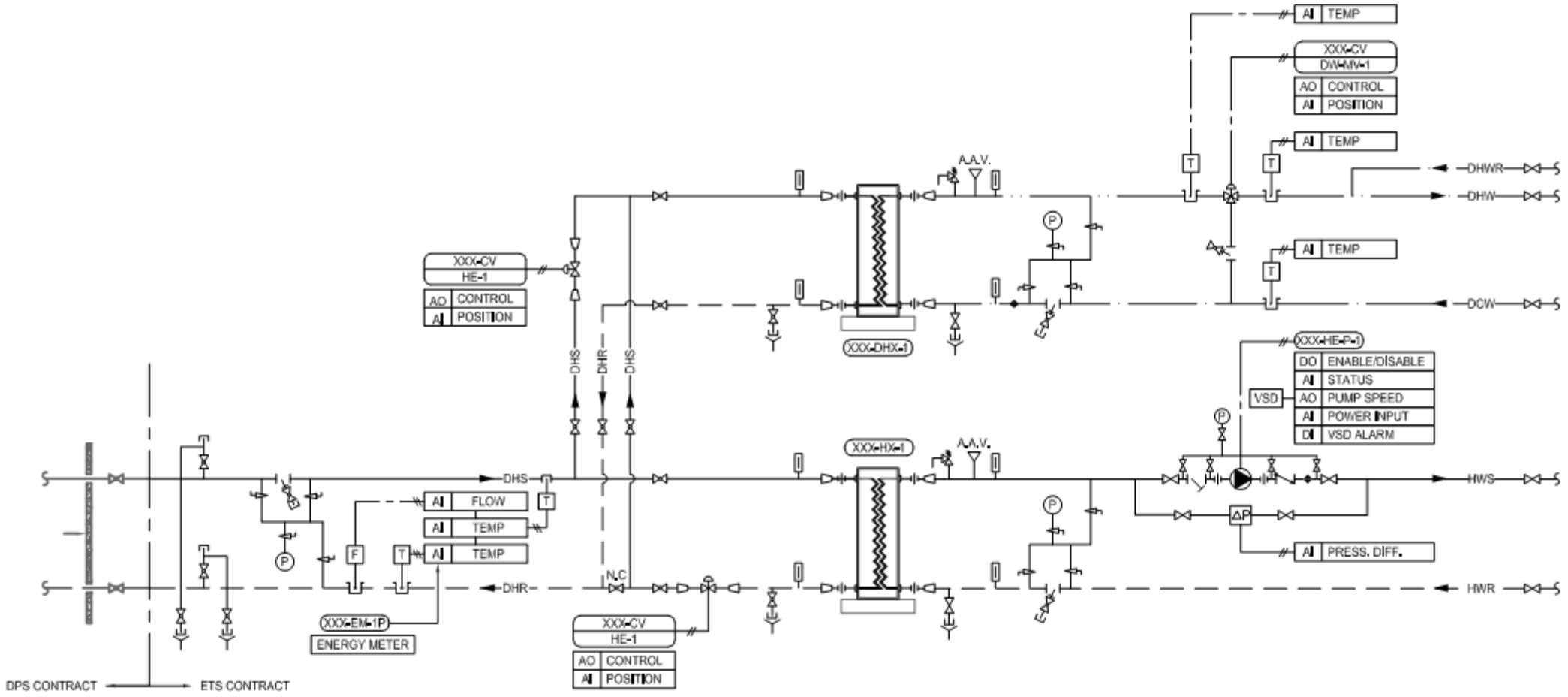
Typical ETS



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Thank You!

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