



IDEA 2018

Next Generation District Energy Systems

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TRADITIONAL DISTRICT ENERGY SYSTEMS

Heating-Only Systems

- **Traditional DES = “District Heating Systems” (DHS)**
 - Central Heating only or Co-Generation Plant
 - **Combustion of Fossil or Biofuels**
 - Steam or Hot Water distribution network
- **DHS “Generations” –as defined by EU’s SETIS**
(Strategic Energy Technologies Information System)
 - 1st Generation – steam
 - 2nd Generation – high pressure & high temp. water (>100C/ 212F)
 - 3rd Generation – high temp. water (<100C/ 212F)
 - 4th Generation – low temp. water (<60C/ 140F)
- **Limitations of Traditional DES**
 - Dependence on Combustion
 - Not easily adapted to “low-grade” energy sources
 - Low-temp Waste Heat Recovery
 - Renewables



NEXT GENERATIONS DISTRICT ENERGY SYSTEMS

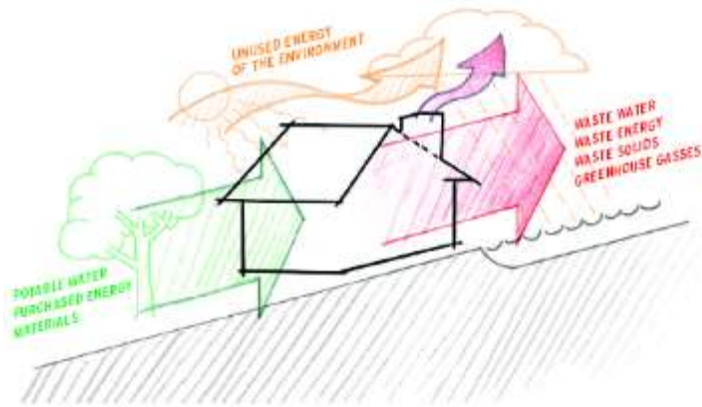
New Context

- Carbon Emissions & Climate Change
- Goal to Transition to a Low-Carbon Society
- Shift towards:
 - Energy Demand Reduction
 - Renewable Energy Sources
 - Elimination of Combustion
 - Low-Carbon Electricity Generation
 - Efficient Electric Technologies
- Increased Demand for Cooling

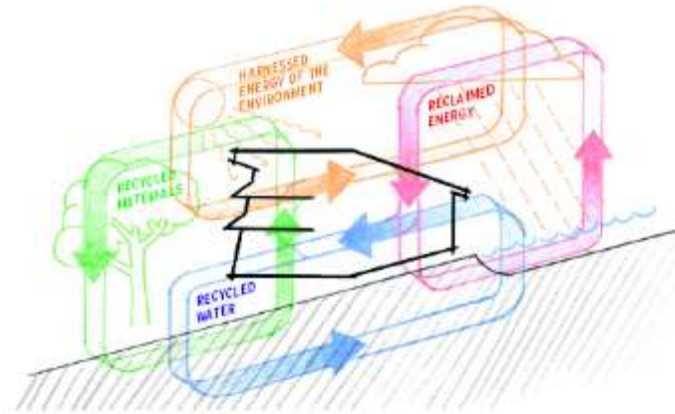
Global energy-related CO₂ emissions



BUILDINGS TODAY



BUILDINGS TOMORROW



NEXT GENERATIONS DISTRICT ENERGY SYSTEMS

Recent Trends – Zero Carbon

Policy: Zero Emissions Building Policy
Two pathways to real and reliable GHG reductions

High Performance Buildings

- “Envelope pathway”
- GHG limit achieved by minimizing heat loss through and energy use
- Enables simple heating system design

Low Carbon Energy System

- GHG limit achieved by balancing efficiency with low carbon energy supply
- Enables use of more advanced technologies with professional operators

ENERGY STEP CODE
BUILDING BEYOND THE STANDARD

2017 Metrics Research Full Report

September 2017

BC HOUSING

CLEAN ENERGY DC
A CLIMATE AND ENERGY PLAN FOR THE DISTRICT OF COLUMBIA

SUMMARY REPORT

DRAFT OCTOBER 2014

Net Zero Buildings in Canada

A Report for the Federation of Canadian Municipalities Green Municipal Fund

ZERO CARBON
CARBONE ZERO

ZERO CARBON BUILDING STANDARD
Canada Green Building Council

May 2017

CNCA
CANADIAN NEUTRAL CITIES ALLIANCE

ENERGY SYSTEM TRANSFORMATION PLAYBOOK

A Step-by-Step Guide for Municipal Governments

August 2018

GETTING TO ZERO

LONDON ENERGY TRANSFORMATION INITIATIVE: PROPOSALS FOR ENERGY POLICY

NET ZERO CAMBRIDGE

1. ENGAGE & CONSULT
2. ASSESS CURRENT ENERGY CONSUMPTION
3. SET TARGETS & PRIORITIES
4. IMPLEMENT ENERGY EFFICIENCY MEASURES
5. MONITOR & REPORT



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Recent Trends – Cleaning Electric Grid

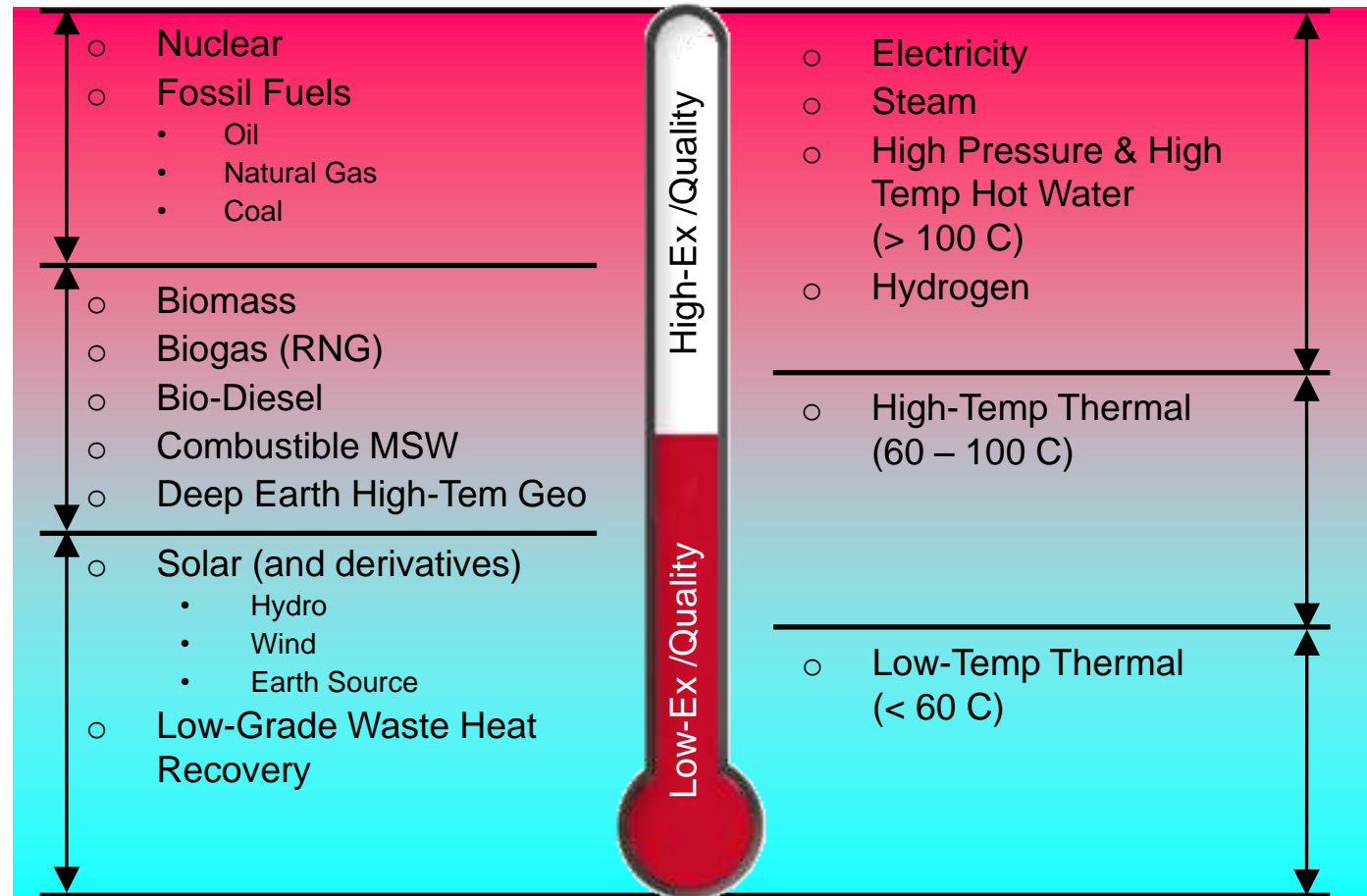
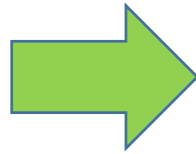
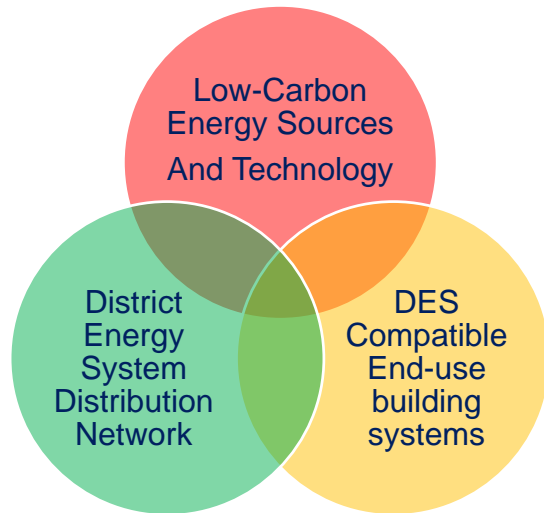
- Electric Grid Modernization,
- “Smart Grid”, “Micro Grid”
- Clean Energy & Resilience
- Cost of Electricity \$\$\$ vs. Fossil Fuels \$
- Efficient Electric Thermal Energy Conversion Technologies



ENERGY USABILITY - EXERGY

Finding an Optimal Match:

Energy Source – Conversion Technology – End Use Energy Form



Energy Source

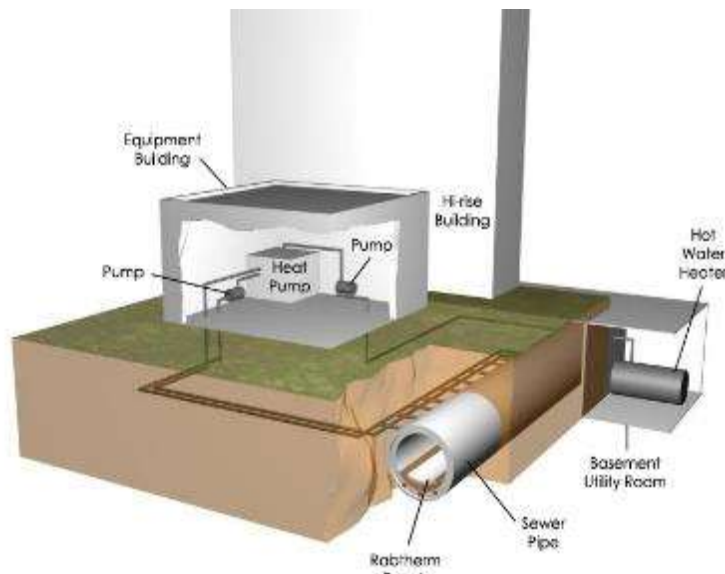
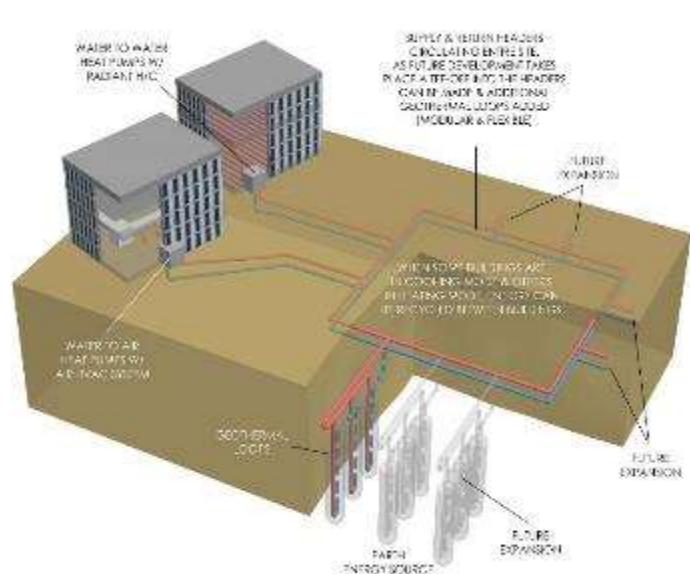
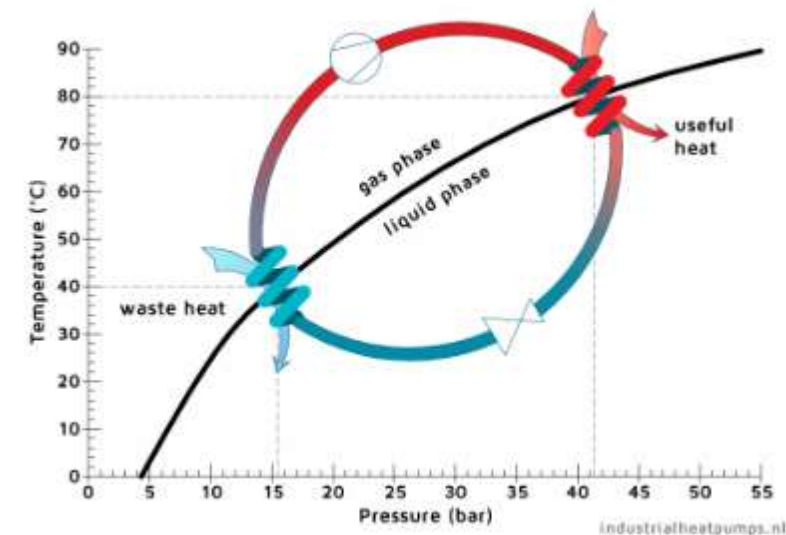
End-use Energy Form



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Heat Pump Technologies

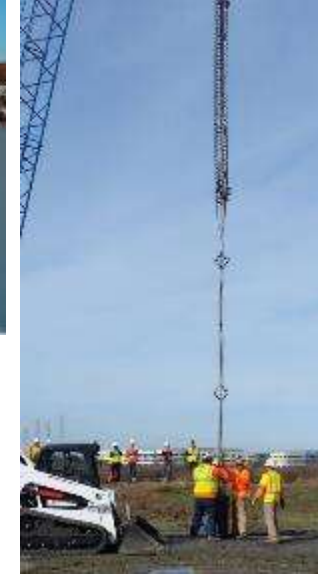
- **Electric Refrigeration Based Technology**
- **“Moves” Thermal Energy from Lower to Higher Temperature Level**
- **Air-Source, Water-Source**
- **Unitary, Modular**
- **Single-stage, Two-stage Temperature Lift**
- **More Costly \$\$\$\$ than Combustion Heating Technologies**



NEXT GENERATIONS DISTRICT ENERGY SYSTEMS

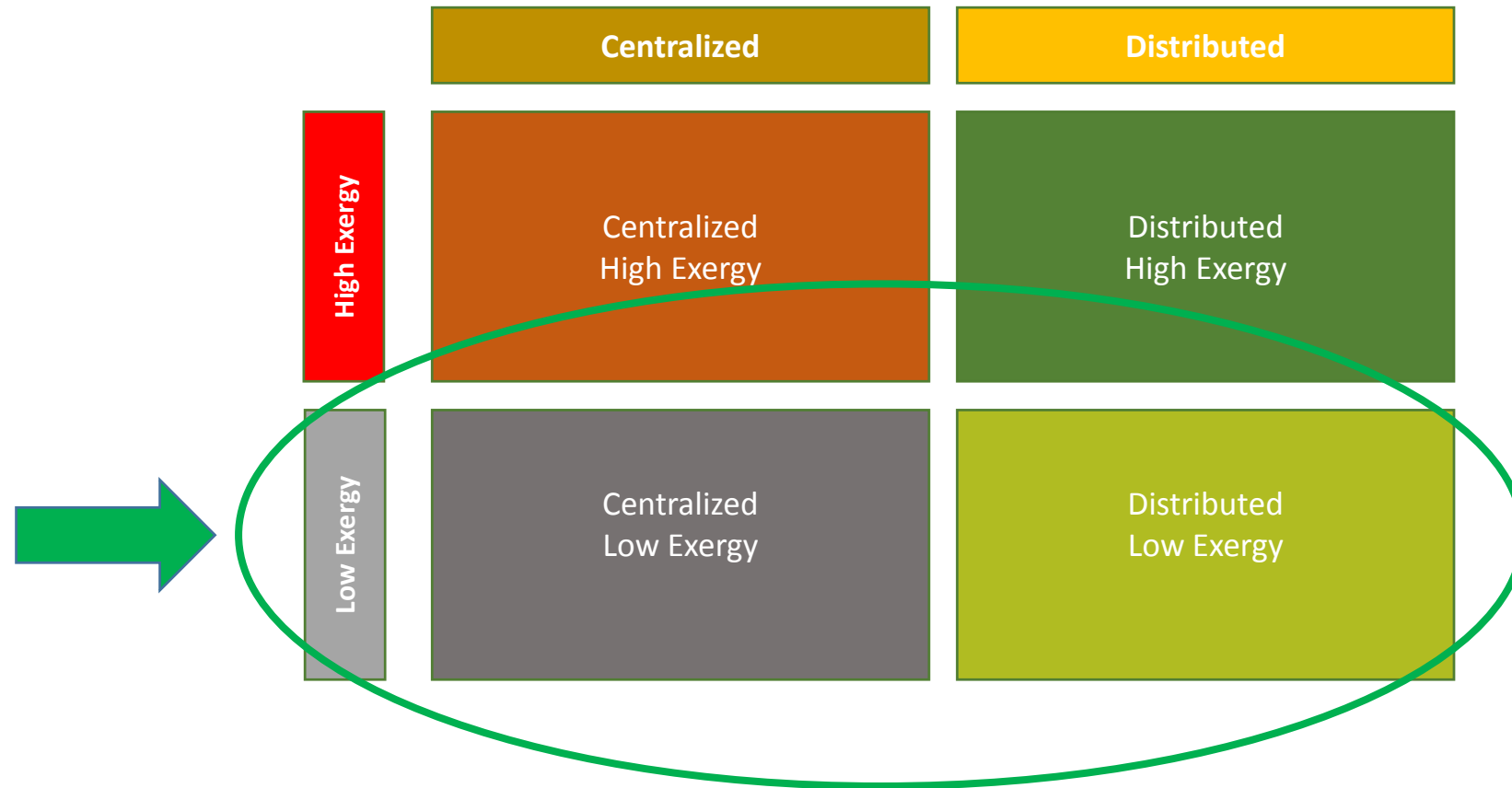
Low-Exergy Heat Sources & Sinks

- **Geo-Exchange Source/ Sink Options**
 - Open Loop (Groundwater or Surface Water)
 - Ocean or Lake Water Source
 - Closed Loop (Vertical or Horizontal)
- **Geo-Energy Piles**
 - Vertical Geo-Exchange Loops integrated into Structural Piles
- **Sewer Heat Recovery**
 - Vertical Geo-Exchange Loops integrated into Structural Piles



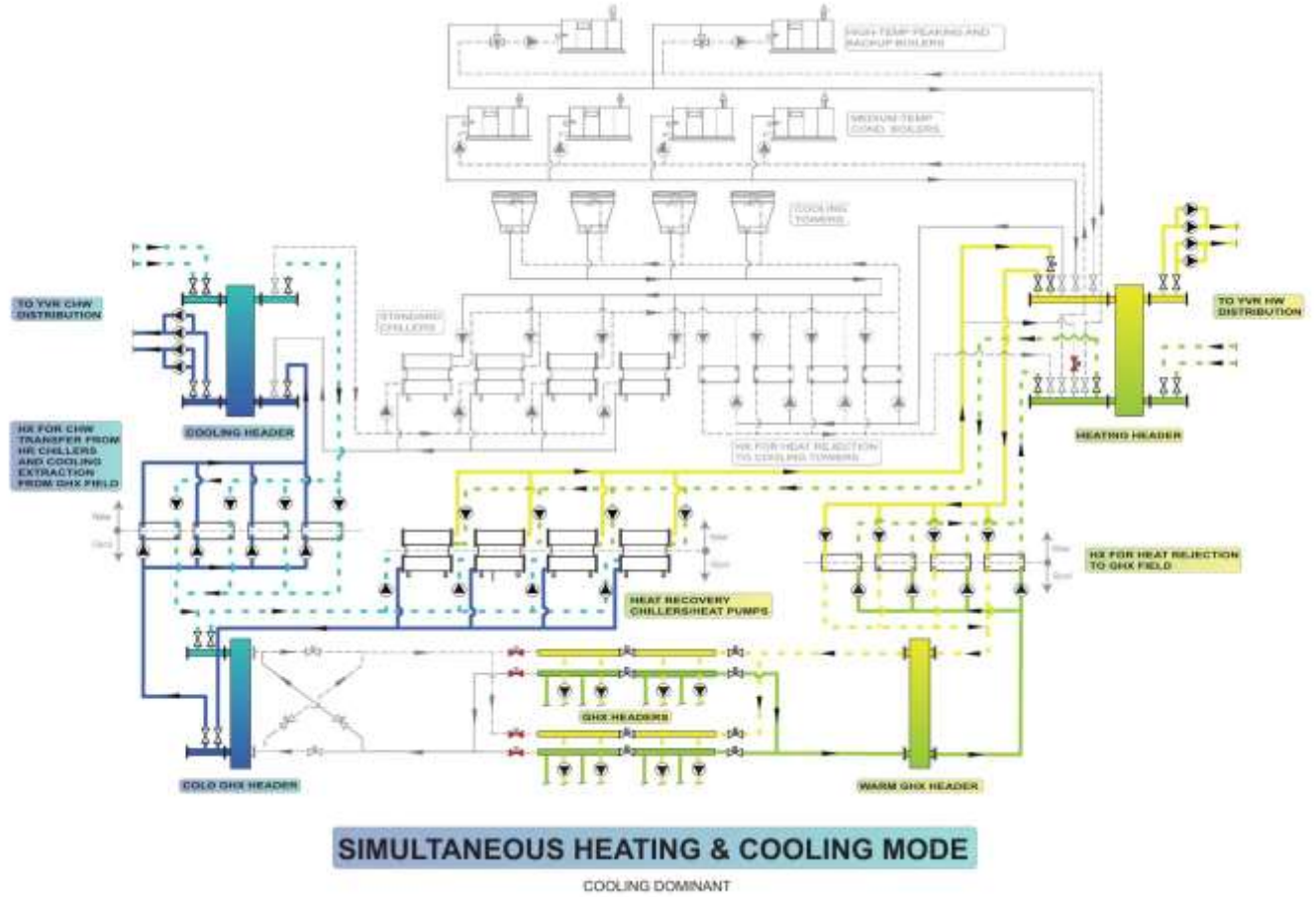
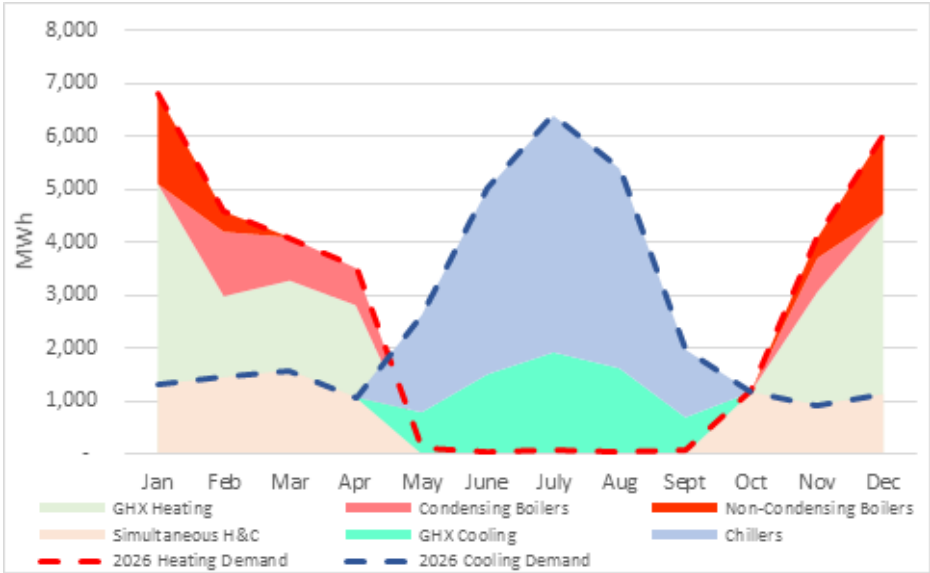
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5th Generation Low-Exergy Heating & Cooling DES (Low-Ex DES)



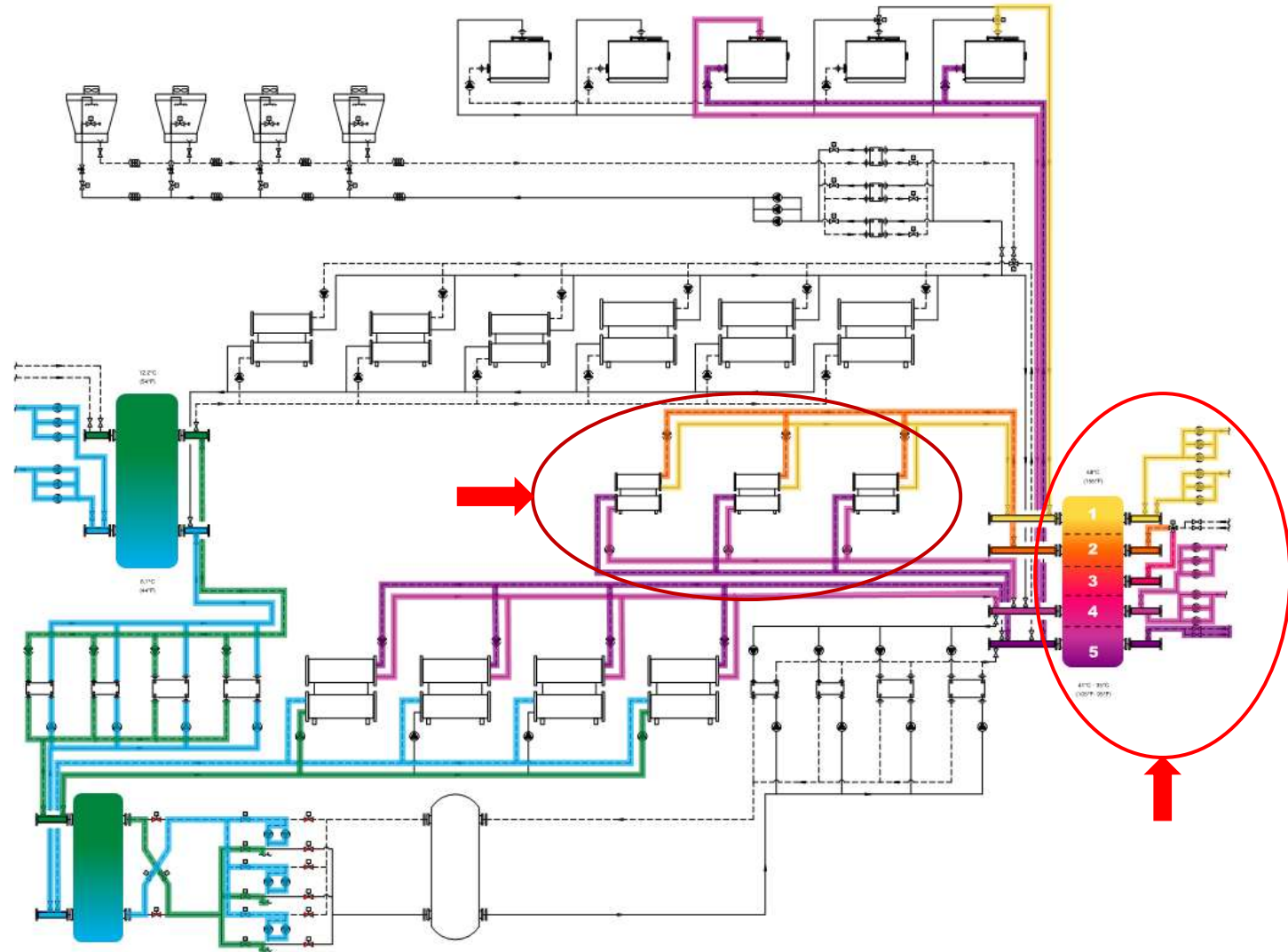
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Example of Centralized Low-Ex DES – YVR CORE



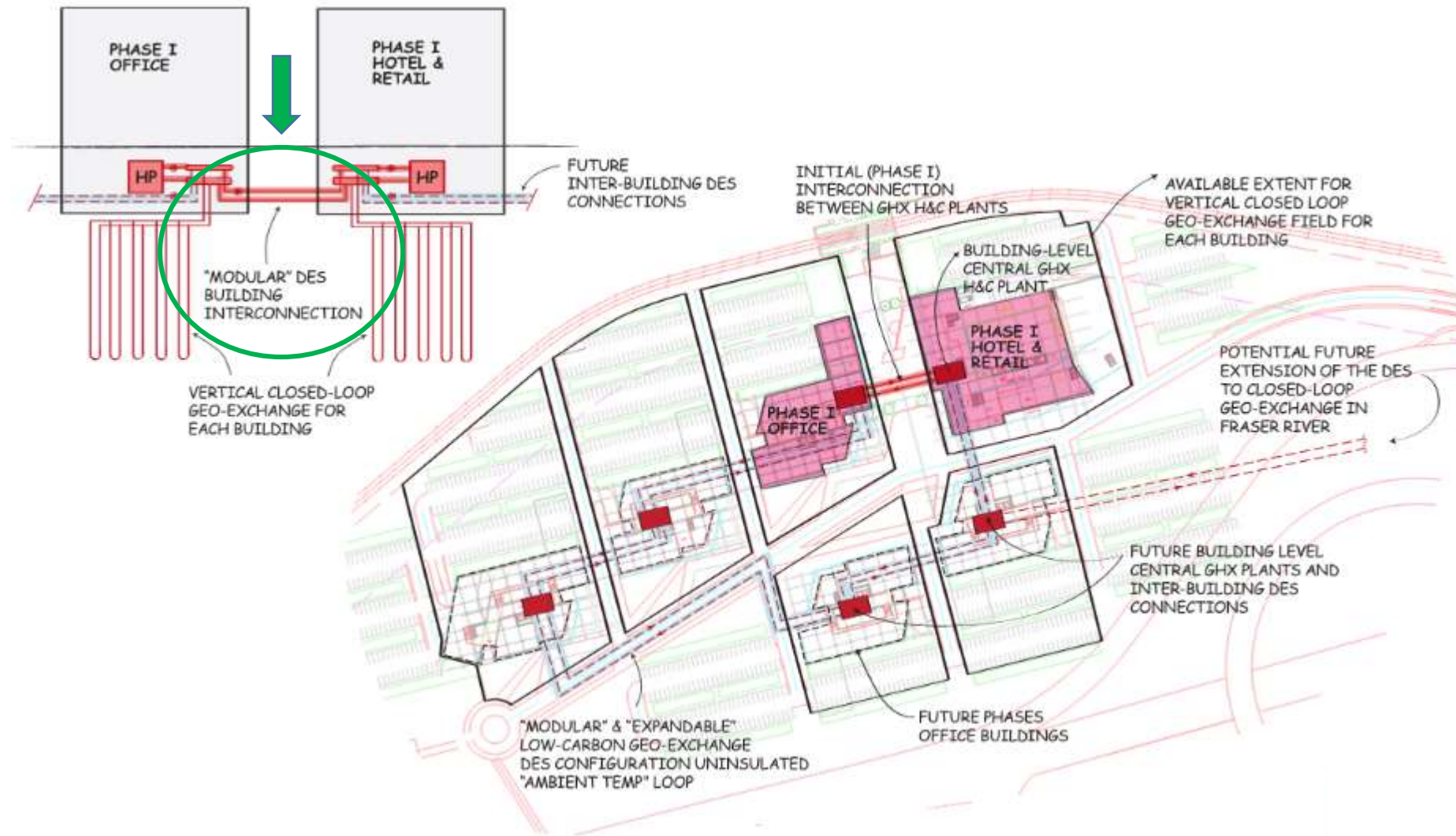
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Example of Centralized Low-Ex DES - Oakridge



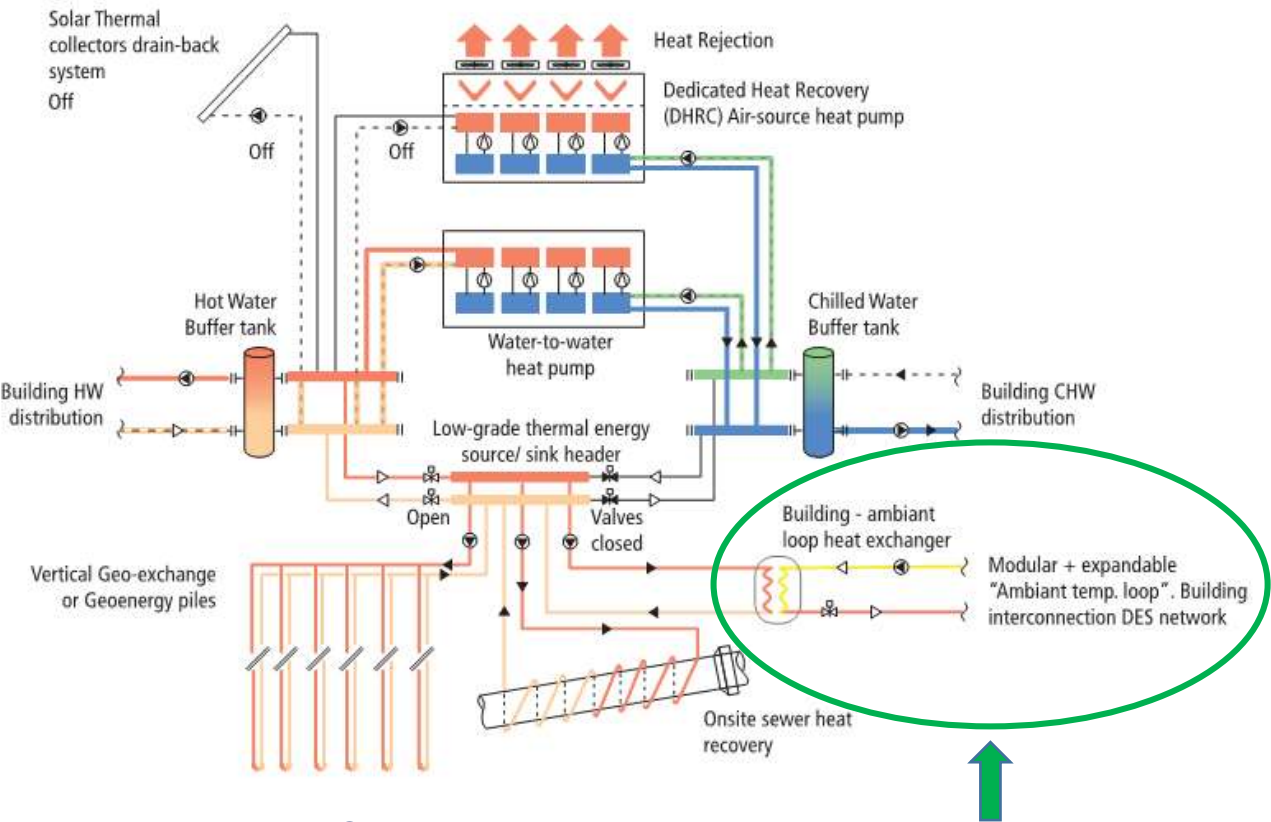
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Example of Distributed Modular Low-Ex DES

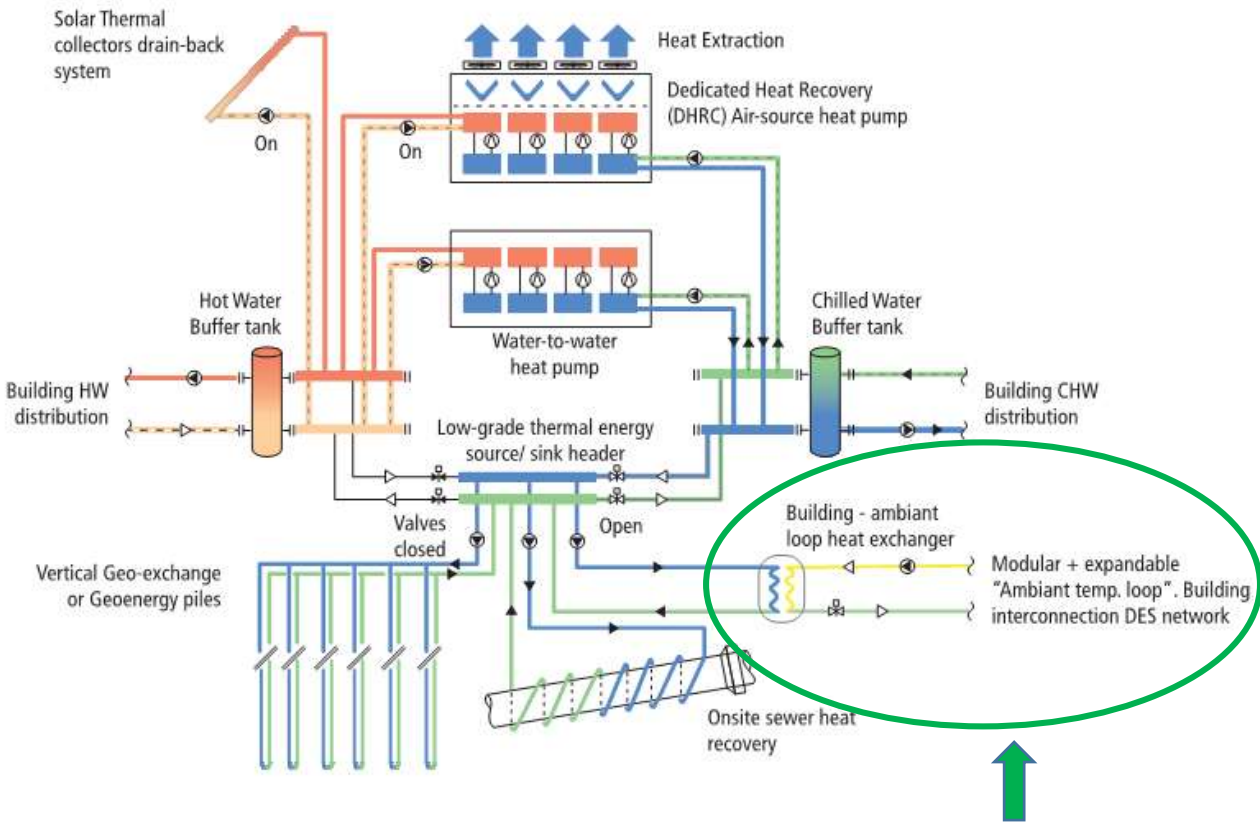


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Example of Distributed Modular Low-Ex DES



Cooling Dominant Mode

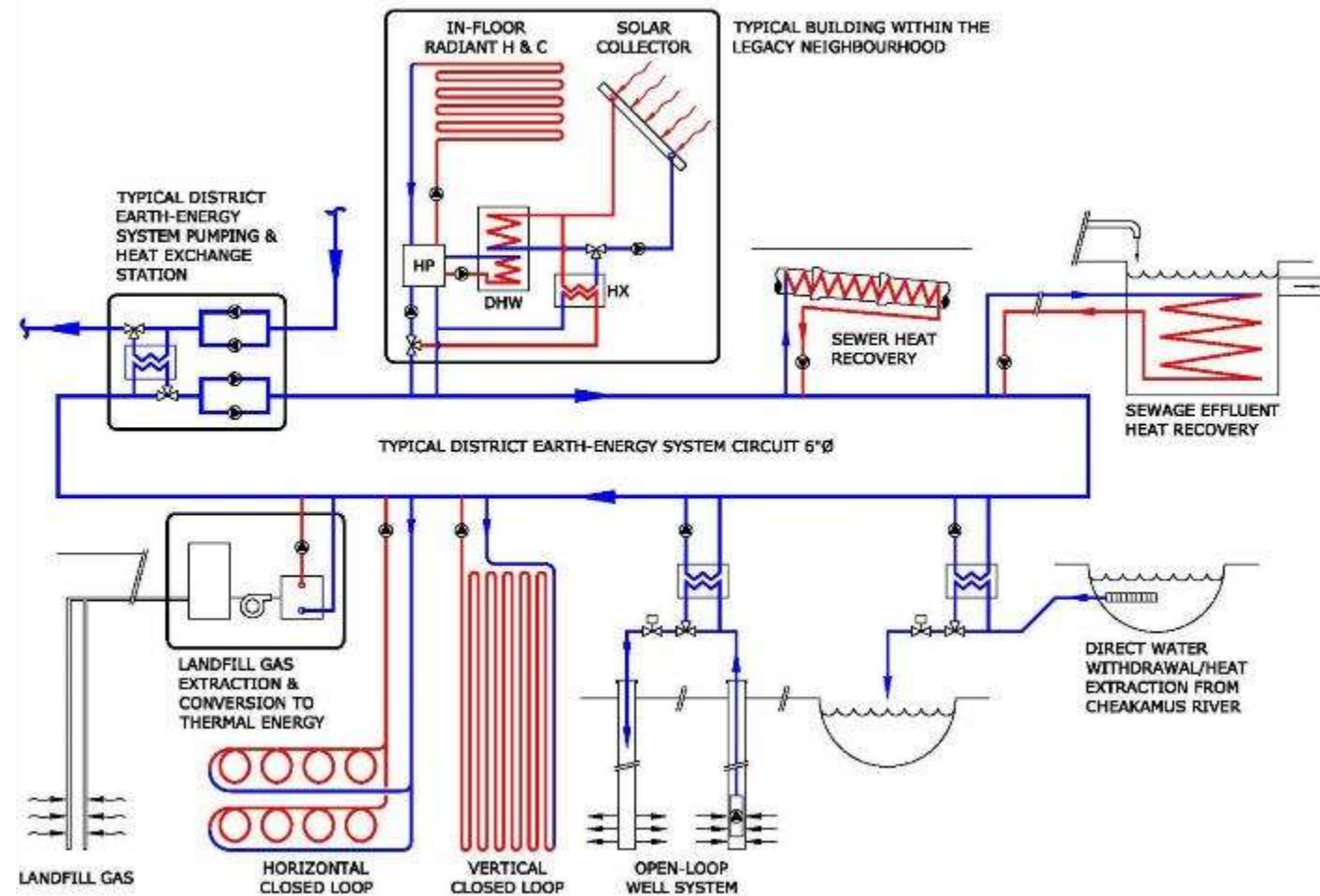
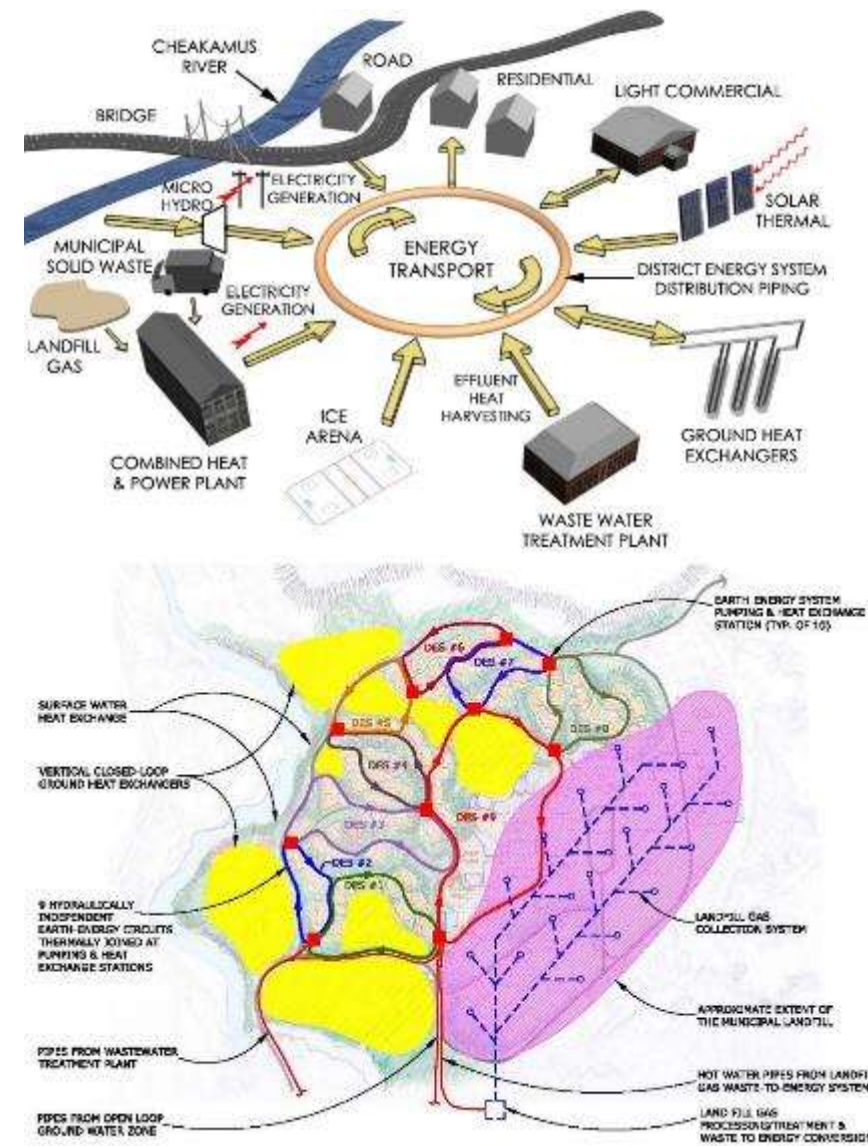


Heating Dominant Mode



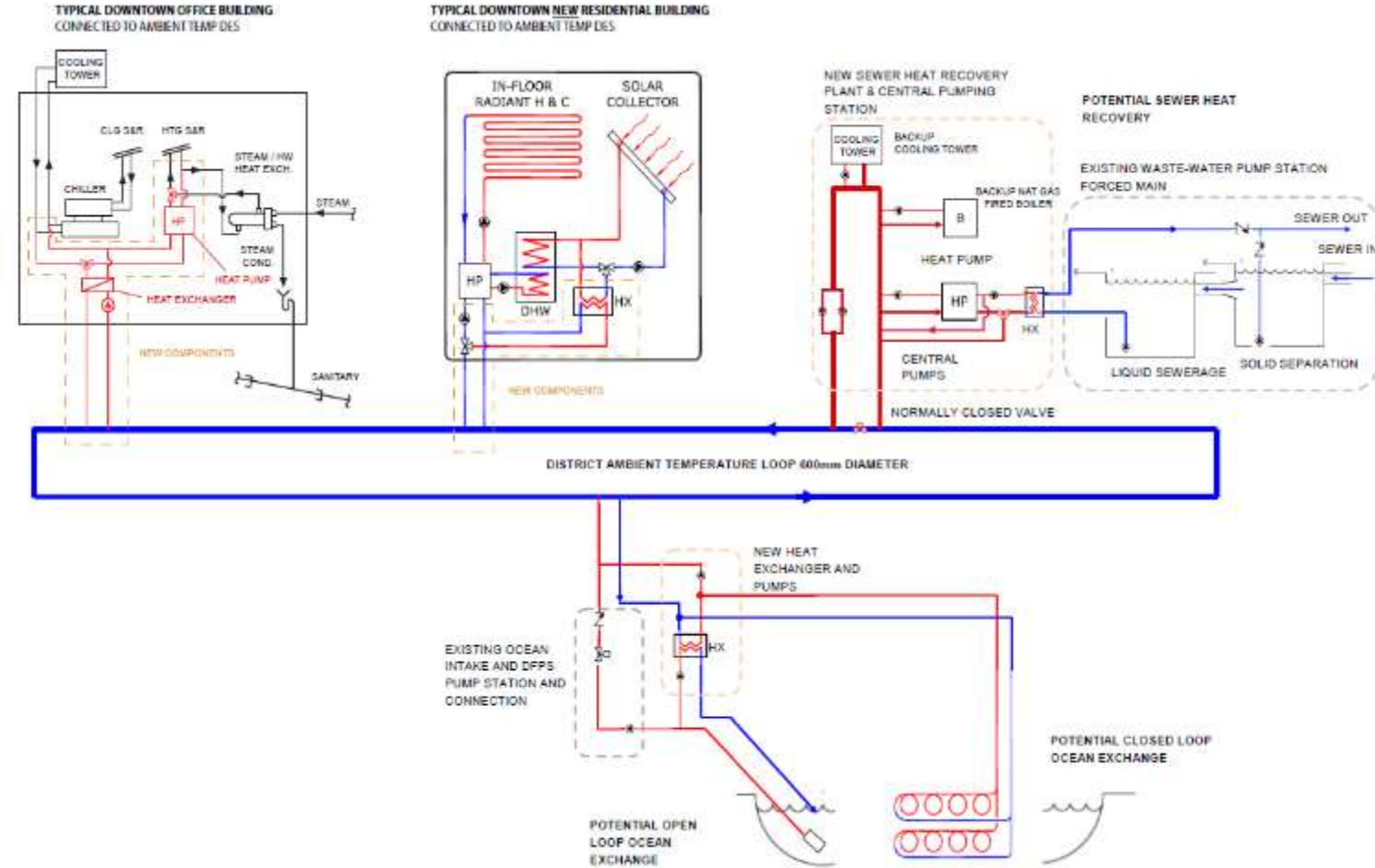
NEXT GENERATIONS DISTRICT ENERGY SYSTEMS

Whistler Olympic Village – The Original “Ambient Loop” Concept



NEXT GENERATIONS DISTRICT ENERGY SYSTEMS

Vancouver, BC Downtown – DFPS Conversion into “Ambient Loop” Concept



NEXT GENERATIONS DISTRICT ENERGY SYSTEMS

Selecting Centralized vs. Distributed 5th Generation Low-Ex DES

Centralized Low-Ex DES

- Single Central Energy Plant
- Plant capacity downsized based on demand diversity
- 4-pipe DES (CHW and HW S&R)
- Insulated Piping
- Best Suited for:
 - **Compact developments with short piping distribution network**
 - **Developments completed in the same timeframe**



Distributed Low-Ex DES

- Multiple Building-level Energy Plants
- Building-level plant capacities sized for each building demand
- Modular & Expandable via interconnected 2-pipe “Ambient Temp Loop” DES
- Non- Insulated HDPE Piping
- Best Suited for:
 - **Large or dispersed development areas requiring extensive piping distribution network**
 - **Developments completed over extended timeframe**



Future 6th Generation Multi-Energy DES



Questions ?

Thank You