Recovered Heat as a Primary Resource at UBC Okanagan

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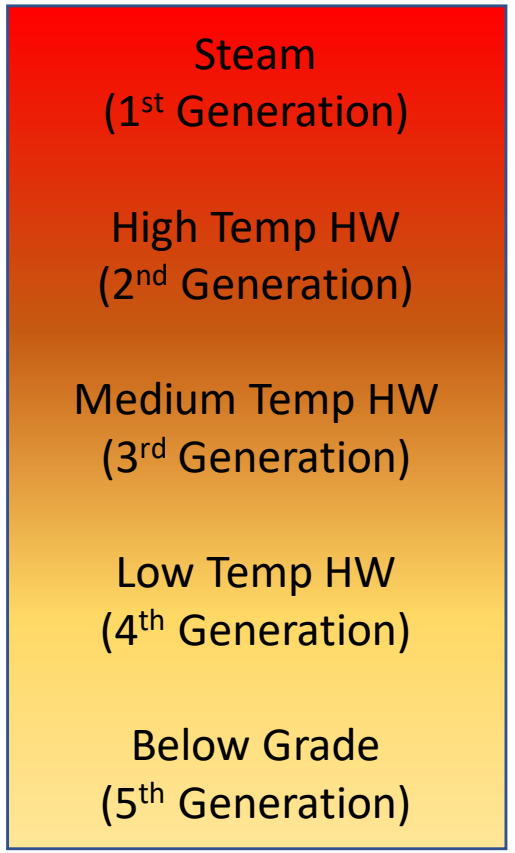
Session 6B: System Expansion

LEADING THE WAY
CampusEnergy2022
Feb.15-18 | Westin Boston Seaport District Hotel | Boston, MA

Evolution to 3rd, 4th, and 5th generation district heating enables broader integration of waste heat and renewable energy but the question is…

How Far is Far Enough?

- Selected expansion strategy
- UBC Okanagan energy landscape
- Recovered heat as a primary resource
- Assessment of alternatives to meet goals
- Benefit of emerging hybrid approach
- Decarbonization effect

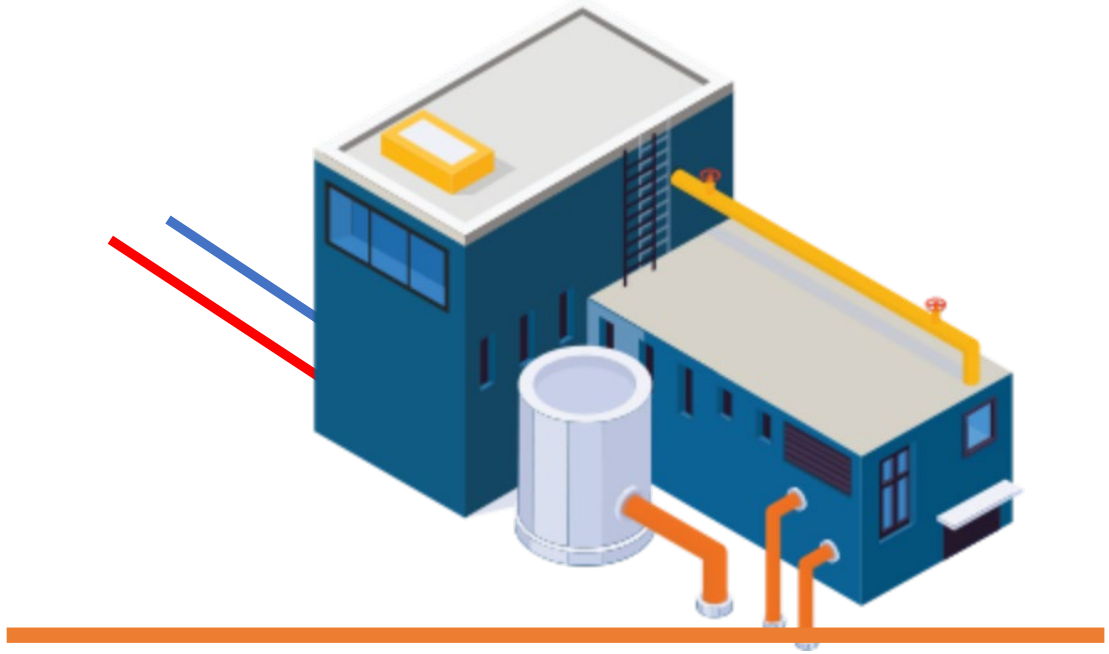


Heat Distribution Strategy
Generations 1 through 5

UBCO Selected Expansion Strategy

Hybrid System with 5th Generation Backbone

- Distributed cluster plants
- Enhanced heat recovery and energy sharing
- Unique low temperature loop advantages
- Simple 4-pipe customer connections
- District scale resilience and redundancy
- Provisions for thermal energy storage (TES)

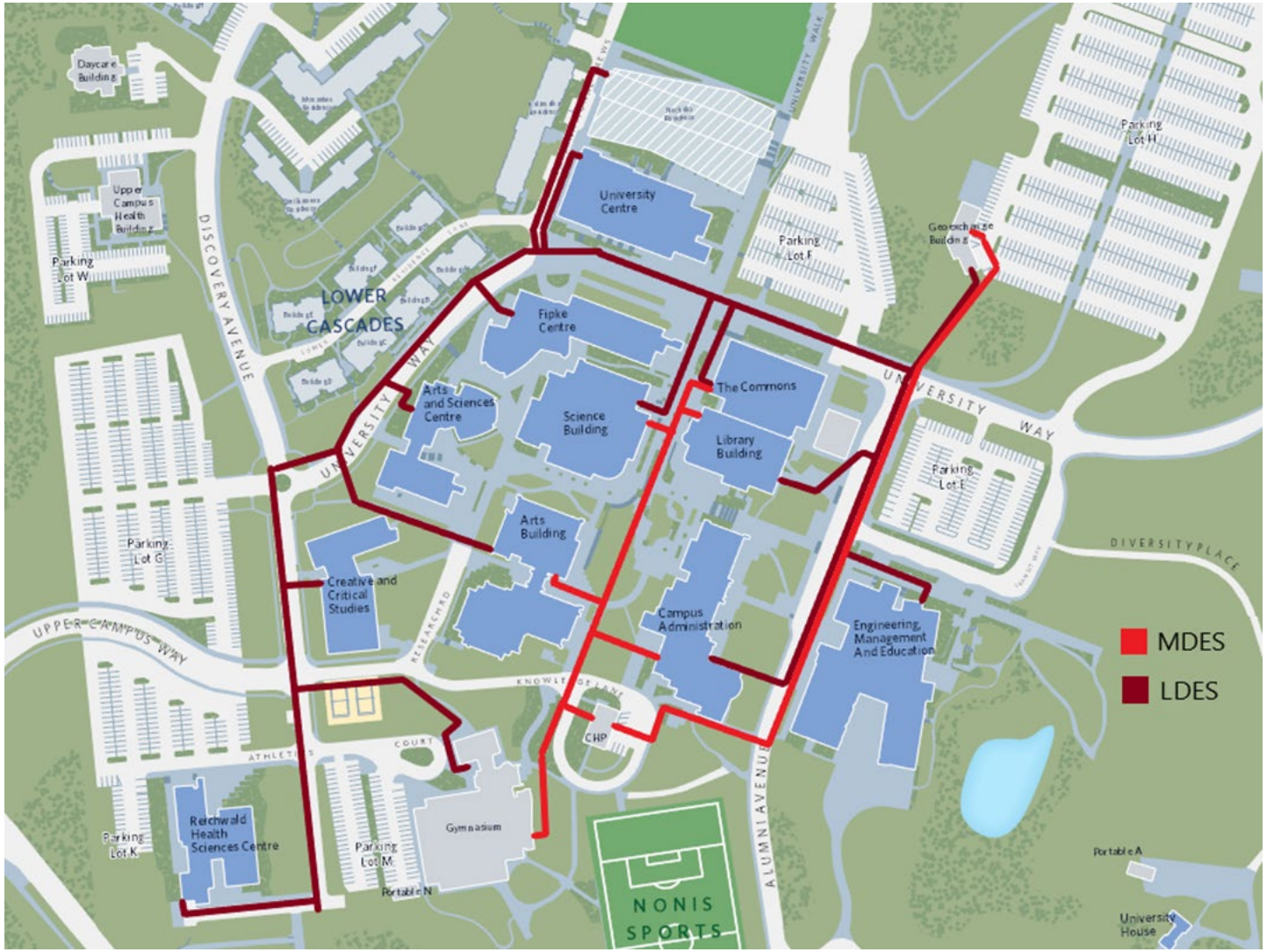


UBC Okanagan Energy Landscape

Growing Main Campus and Innovation Precinct

- Existing 3rd and 5th generation district heating with medium and low temperature loops
- Declared climate emergency
- Campus GHG reduction mandate 65% by 2030 from 2013 levels
- Expansion resilience
- Campus Growth - Number of buildings (2005-2020): 12 to 53 = 342% increase
- Currently 11,562 Students
- Low electric grid GHG emissions factor

Existing District Energy Distribution



- Medium Temperature MDES 80°C (176°F) 3rd Generation
  - Gas boilers
- Low Temperature LDES 8-25°C (46-77°F) 5th Generation
  - Simultaneous Heating/Cooling
  - Building scale HP's
  - Heat Sources: Geoexchange, Gas Boilers & MDES
  - Cooling Sources: Geoexchange, Cooling Towers

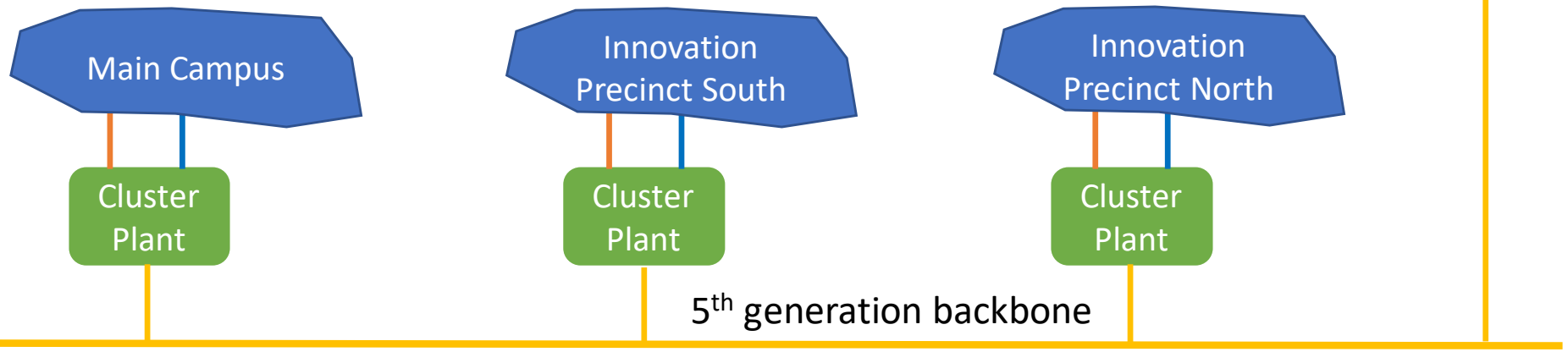
Generations of District Heat

what is the best way to support campus expansion?

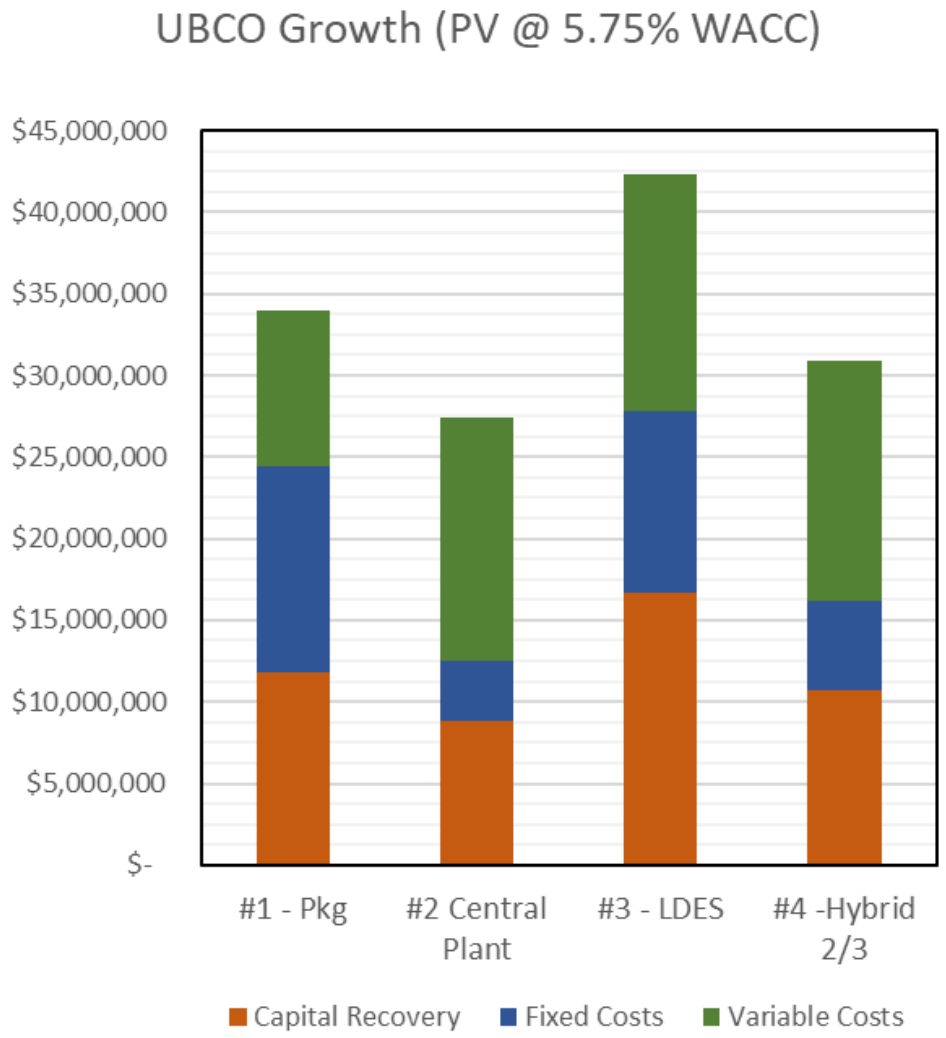
Heat Injection and Rejection

Generation	Heat Grade	Production	Notes
1st	Steam	Central	Not Used at UBCO
2nd	Hot Water > 100C (212F)	Central	Not Used at UBCO
3rd	70C (158F) < Hot Water < 100C (212F)	Central	Existing MDES System
4th	50C (122F) < Hot Water < 70C (158F)	Central	To Expansion Clusters
5th	10C (50F) < Warm Water < 50C (122F)	Distributed	To All Cluster Plants

Hybrid system with 4-pipe heating and cooling to connected buildings



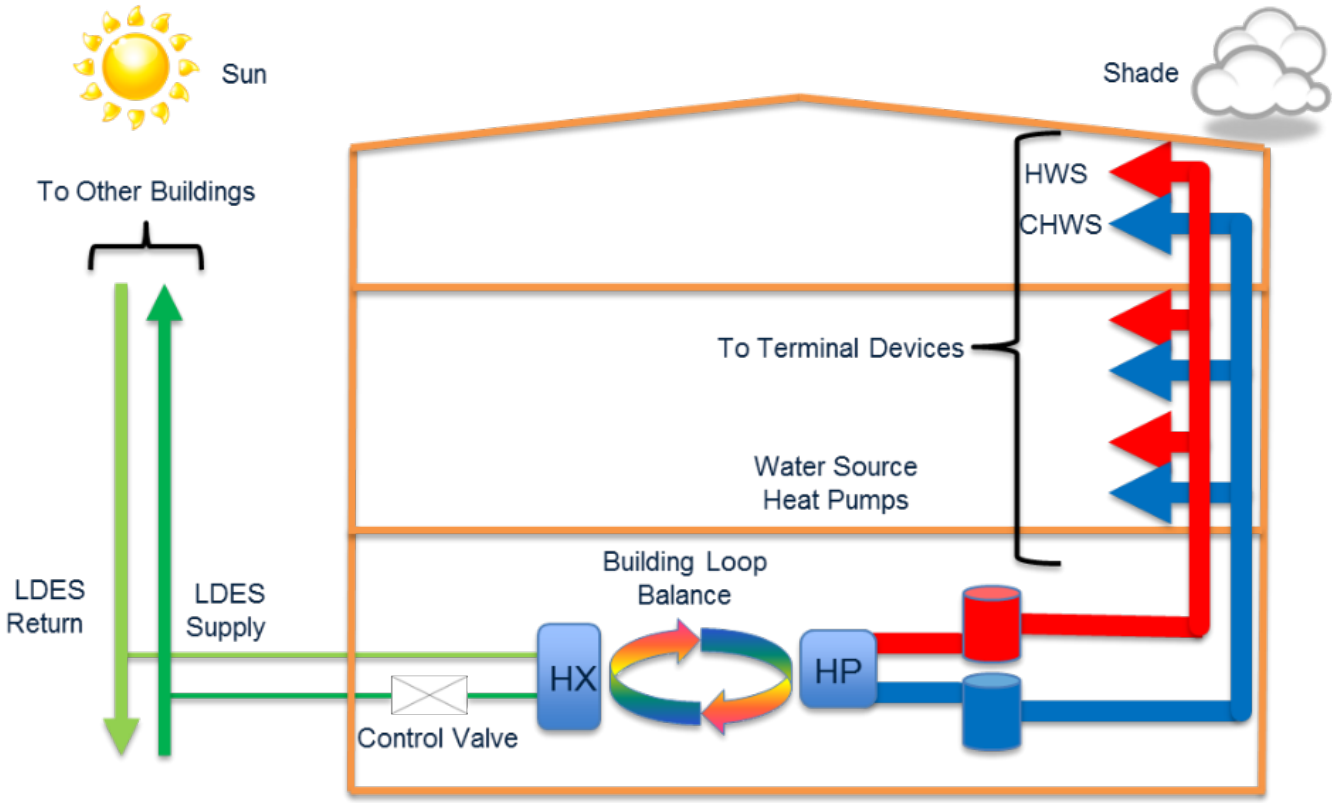
Expansion Alternatives Assessment



1. Packaged standalone building systems
2. Central heating and cooling plant
3. Low temperature system expansion with heat pumps in each building
4. **Hybrid cluster plants approach (2+3)**

Low Temperature District Energy Expansion

High Cost and Complexity of Expansion with Current 5th Generation (Low Temperature) System Creates Challenges

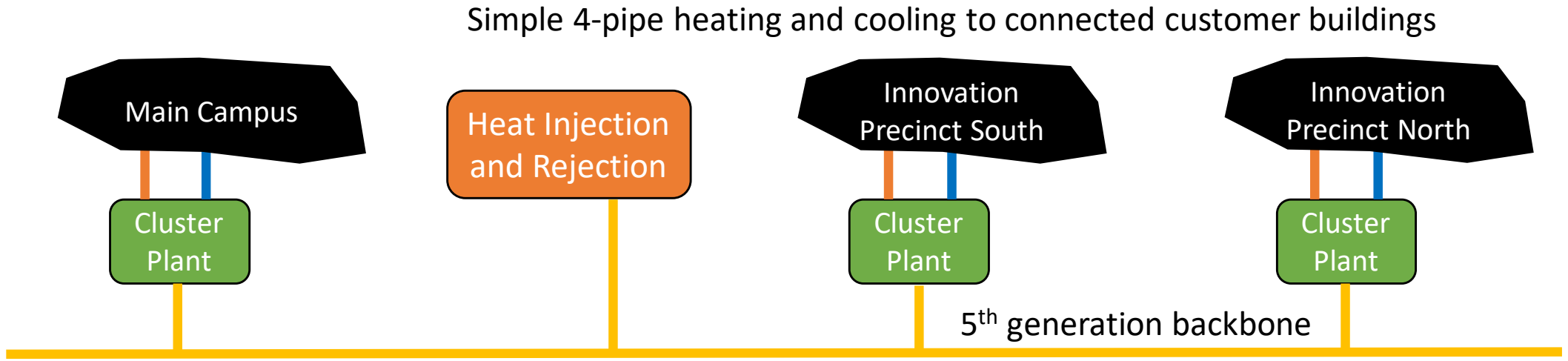


- Heat pump economy of scale and capital cost
- System redundancy, resilience, and emergency power
- Mechanical space and provisions in each building
- System operating and maintenance costs
- Marginal business case

Hybrid System Expansion Selected

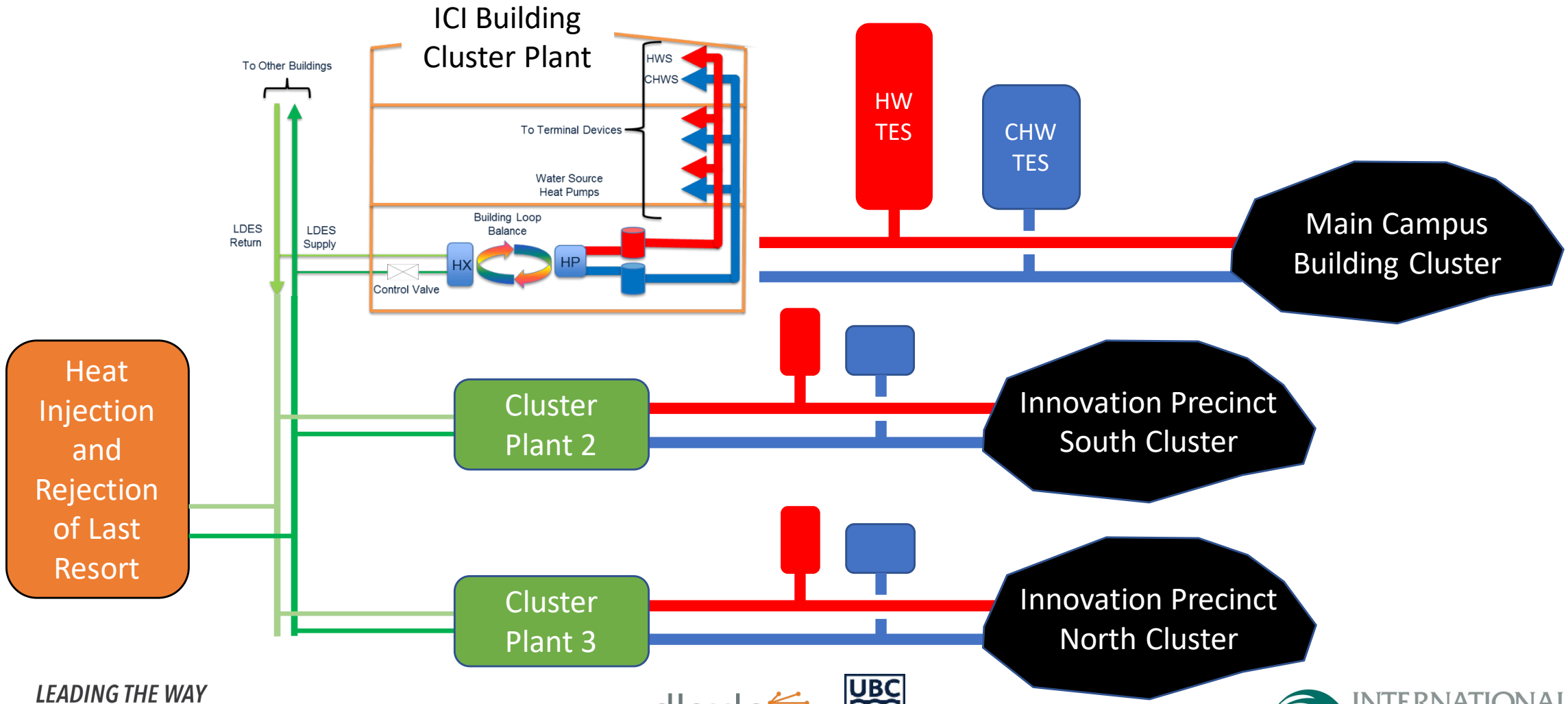
5th Generation Backbone with Distributed Cluster Plant

- The lowest cost options are centralized and hybrid cluster DES.
- The sensitivity analysis did not make any difference to the ordering based on financial costs.
- Meeting UBC GHG goals will rely on both supply side and demand side reduction measures.
- The evaluative criteria found DES was best placed to achieve carbon goals and resiliency due to flexibility in low carbon energy supply options.
- **The lowest cost options are also the best placed to achieve GHG targets and strategic goals**



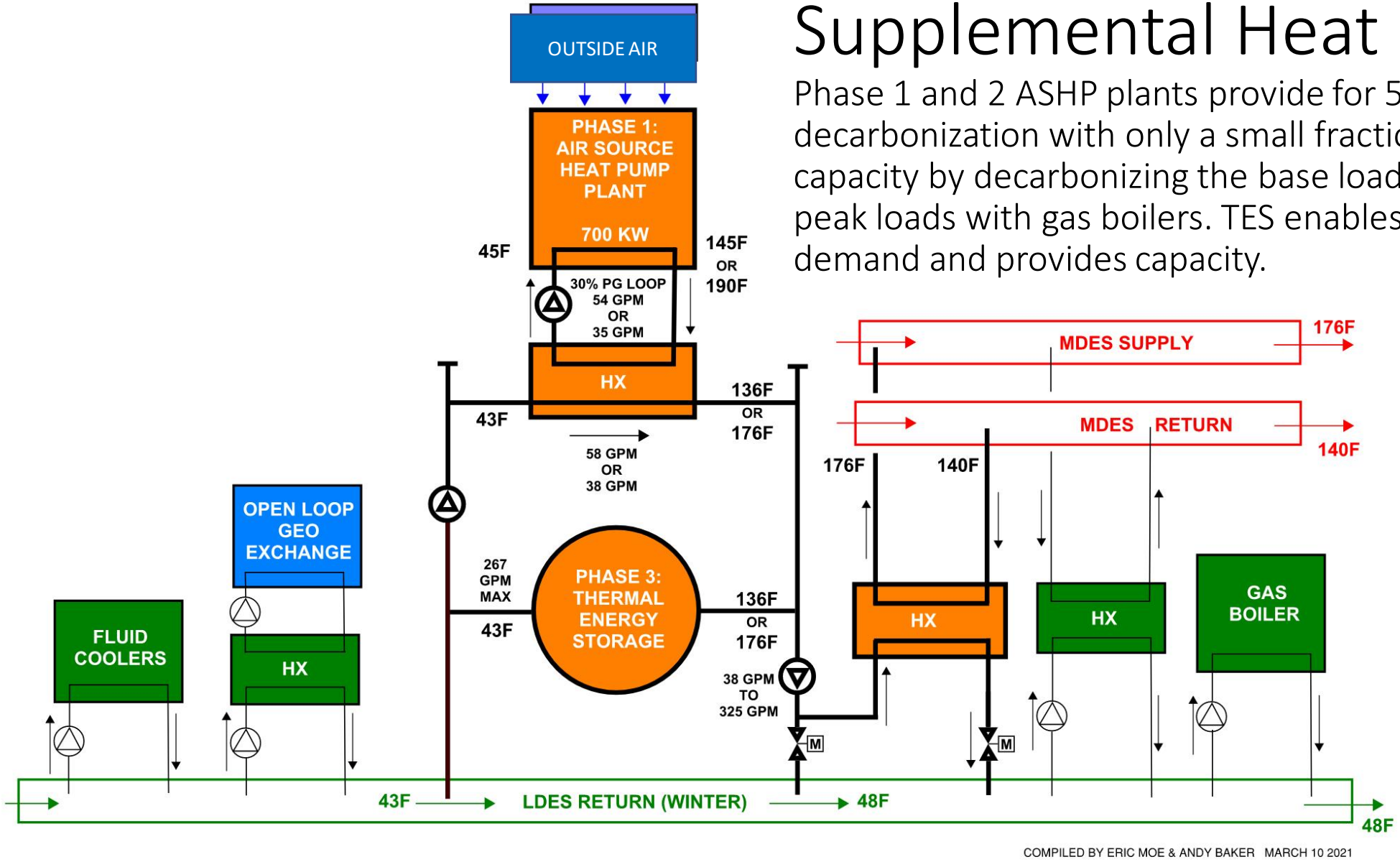
Hybrid District Energy Expansion Strategy

Advantage of Combined Temperature Approach



Supplemental Heat Injection

Phase 1 and 2 ASHP plants provide for 50% and 75% DES decarbonization with only a small fraction of installed capacity by decarbonizing the base load and meeting peak loads with gas boilers. TES enables off-peak electric demand and provides capacity.



COMPILED BY ERIC MOE & ANDY BAKER MARCH 10 2021

Summary

Campus Growth Requires a Resource Efficient Net Zero Carbon Strategy

- 5th generation district heating was a step too far.
- 4-pipe cluster plant strategy employs a 5th generation backbone but defies conventional label
- Capital and operational advantages without massive disruption

Many Challenges Addressed with Hybrid Cluster Plants

- Less disruptive and more adaptable with simpler building connections.
- Regulatory benefits with smaller plants (electrical capacity, equipment size)
- Makes use of existing distribution assets
- Smaller cluster plants can be integrated within new buildings
- Thermal storage can be more gainfully employed in this hybrid system and increases recovered heat as a primary resource

Thank you. Questions?

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