RE-ENVISIONING HEATING FOR UVA

Converting from Steam to Hot Water

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OVERVIEW

Steam vs. Hot Water for Heating

System Advantages: Generation

Steam System Components	Hot Water System Components
• Boiler	• Boiler
• Deaerator	• Primary/Secondary Pumps
• Feedwater Pumps	• Air Separator
• Blowdown Vessel	• Expansion Tank
• Flash Tanks	
• Condensate Receivers	
• Condensate Pumps	
• Water Treatment	

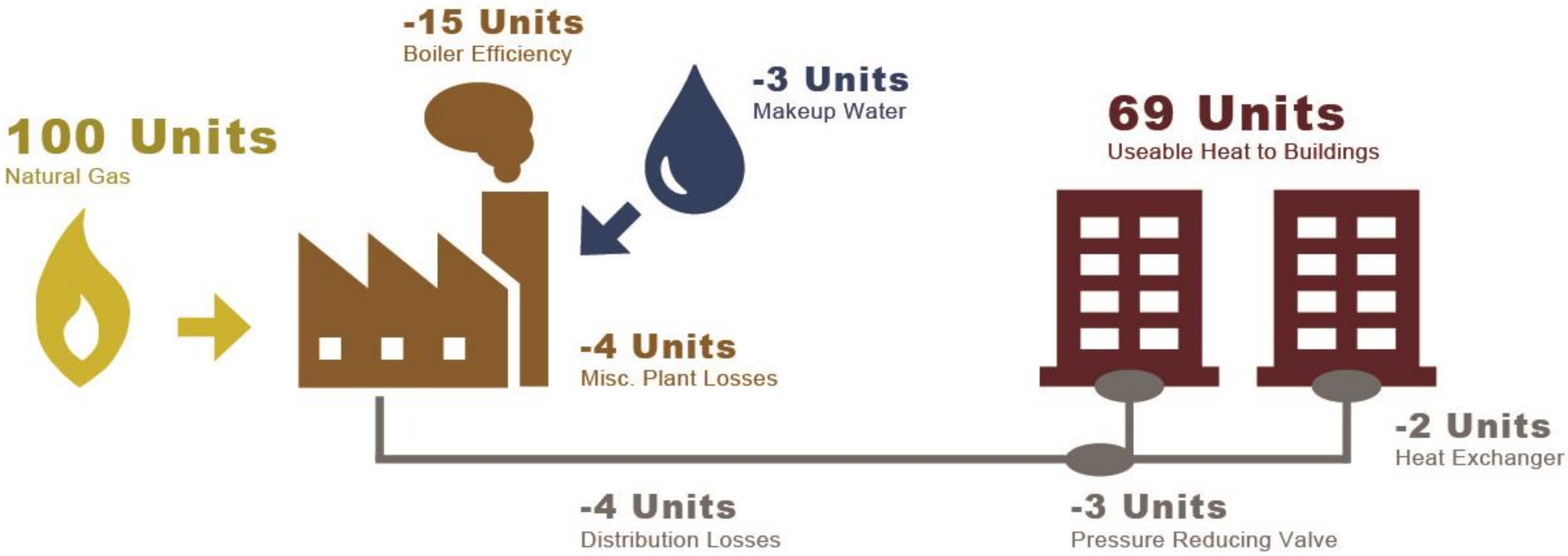
System Advantages: Generation

- Increased system efficiency and use of renewable technologies
- Supply water reset control
- Less idle/cycling losses
- Lower conductive losses to ambient
- Little/no make-up water costs
- Lower chemical treatment costs

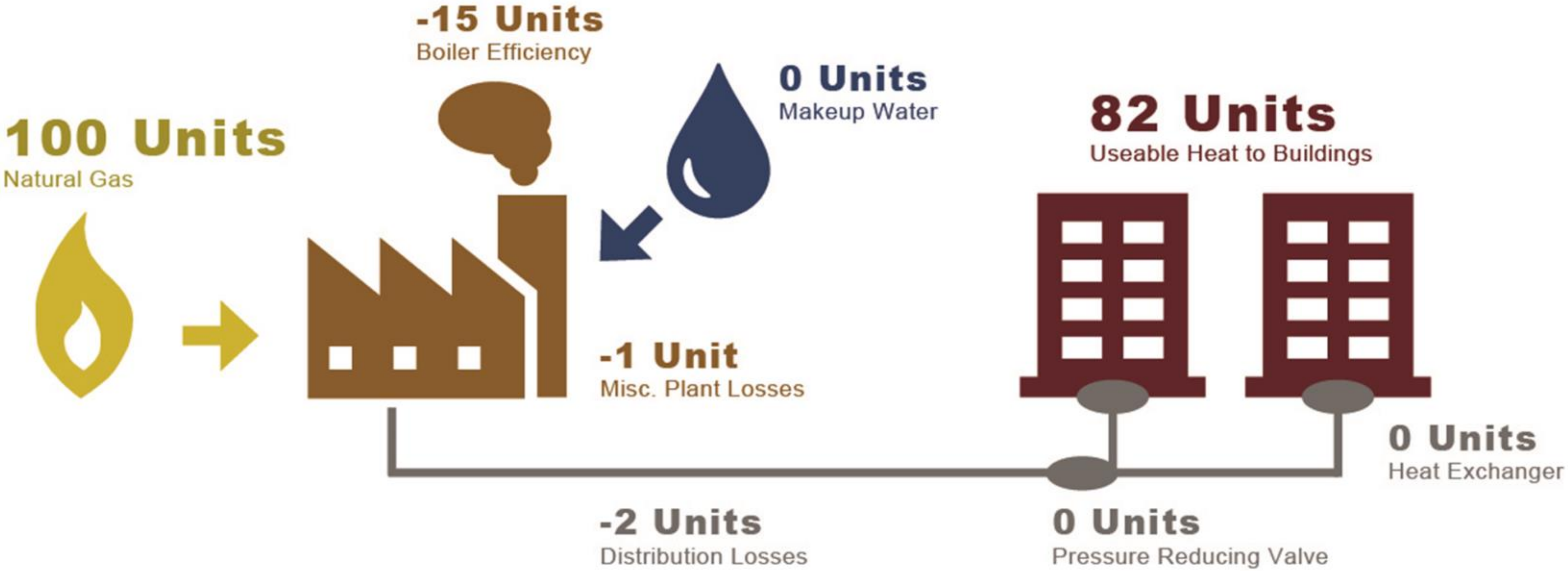
System Advantages: Distribution

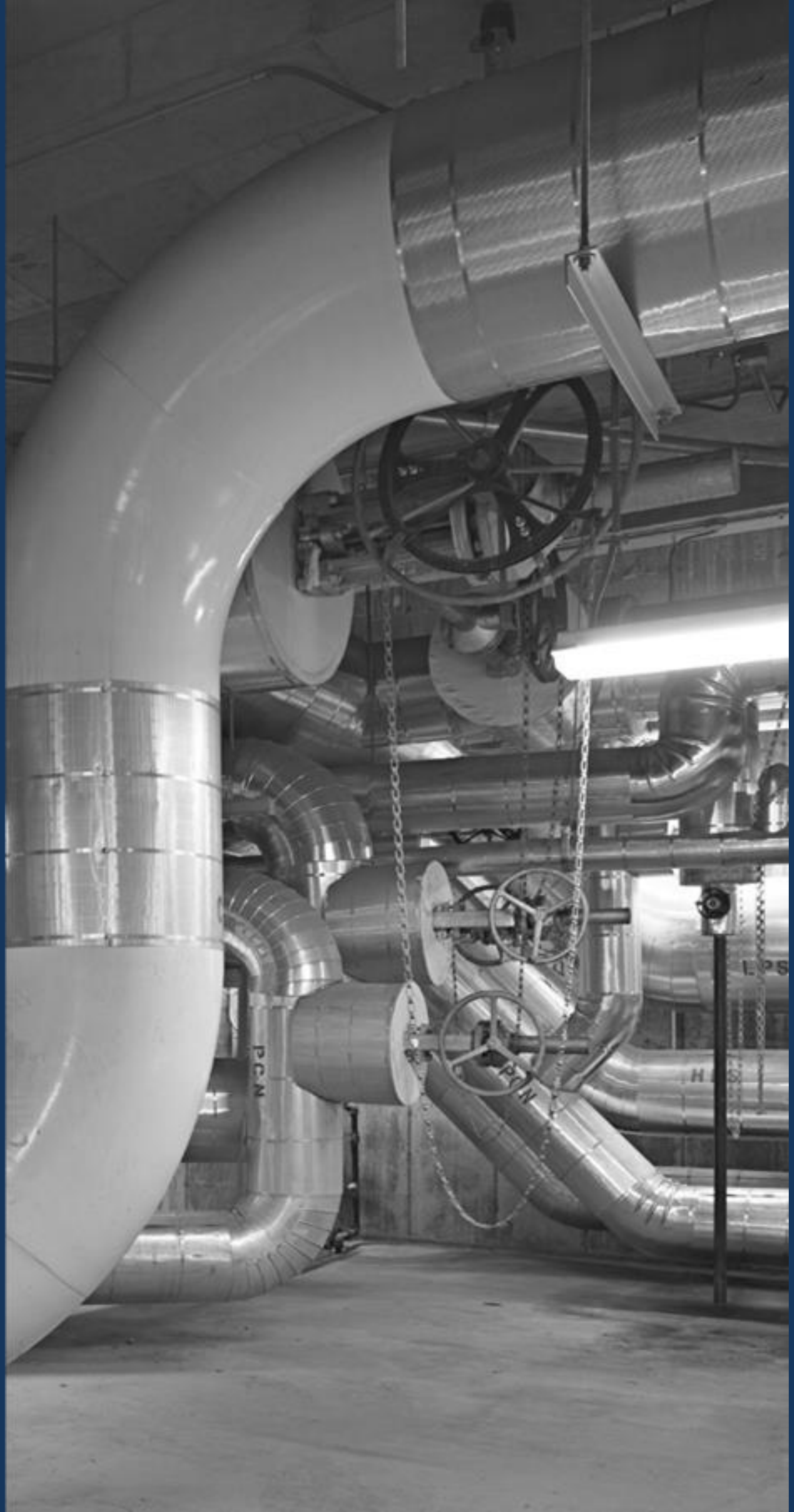
- Safety – System leaks are less dangerous
- Lower temperatures = less heat loss
- Utilize lower cost insulating materials
- Corrosion potential in condensate return system
- Reduced number of expansion loops
- No condensate recovery vaults
- Tunnels?

Typical System Energy Losses: Steam



Typical System Energy Losses: Hot Water





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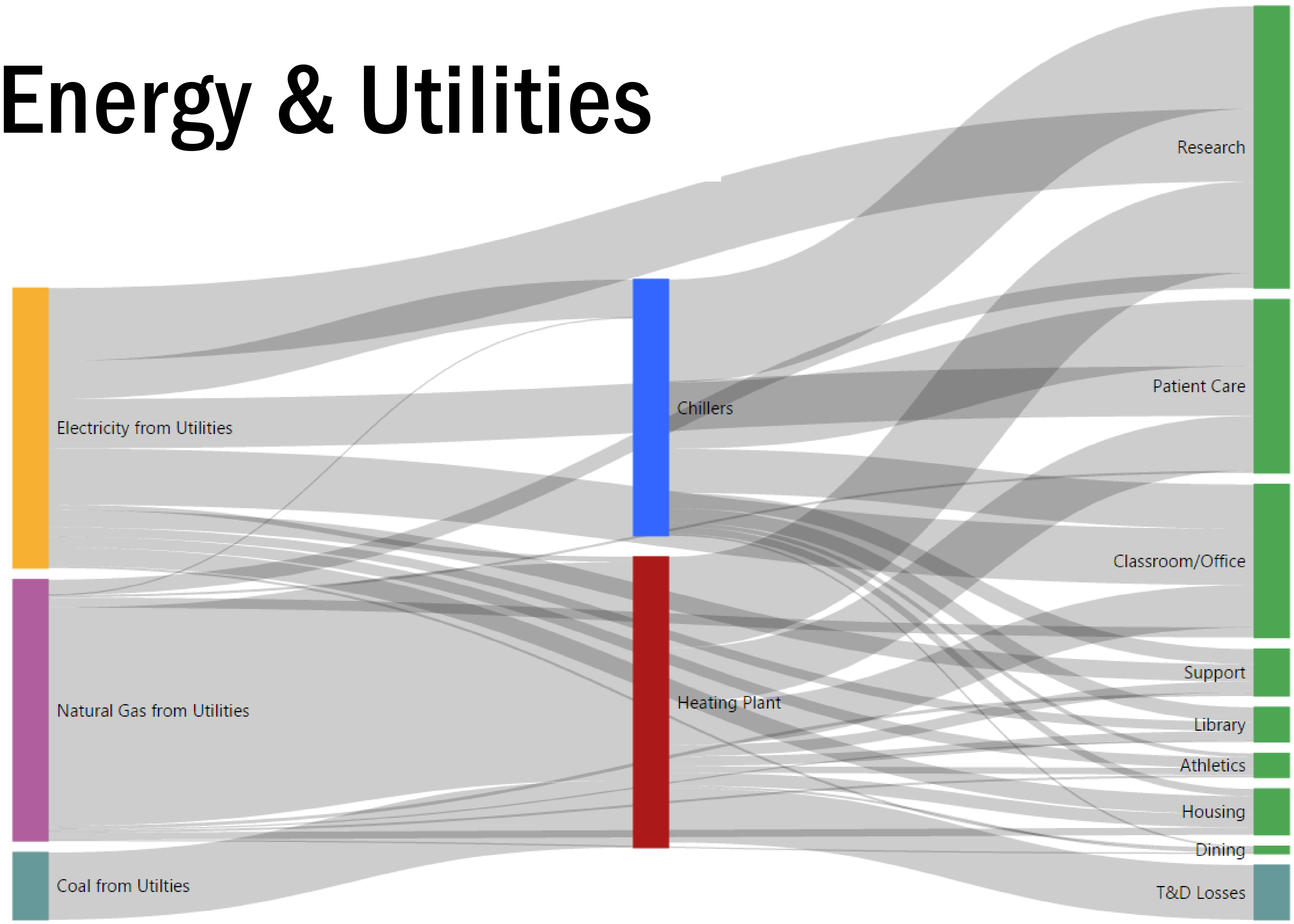
Background and Perspective

Energy and Utilities

Procurement, generation, and distribution

- **Steam** – main heat plant
- **Hot water** – two small mechanical plants
- **Chilled water** – eleven chiller plants
- **Steam, MTHW, CHW distribution**
- **13kV power** – three substations (outdoor lighting)
- **Domestic water** – three million gallons storage
- **Sanitary sewer**
- **Storm water**

UVA Energy & Utilities



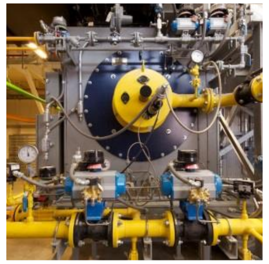
Drivers

- Stewardship
- Sustainability
- Strategic investment
- Minimizing fossil fuel
- Integration of new and alternative energy generation

Issues

- Firm fuel
  - Coal is only legitimate firm fuel
- Firm capacity of MHP
  - Title V emission constraints eroding coal boiler capacity
- Steam/MTHW systems do not support waste heat recovery

One Solution, Many Questions



Production

- We have a steam plant… why spend money?
- Generate steam, distribute steam, design to steam - jump in or gradual?
- Generate MTHW or LTWH? How to transition?

Distribution ✓

- Piping materials?
- Why hubs?
- Energy transfer stations
- Building influences on plant

Buildings/Loads

- AHU coil configuration
- Control valves (ch. ball or PICV)
- Freeze protection
- Coil design temps
- Delta T
- Domestic water (legionella)
- Design guidelines (steam vs. LTHW)

An Elegant Solution

flexible hubs

- MTHW supply and HX
- MTHW return and HX
- MTHW return and bypass HX
- MTHW supply and bypass HX

LOW TEMP HOT WATER

Evaluation and Case Study

Importance of Conversion

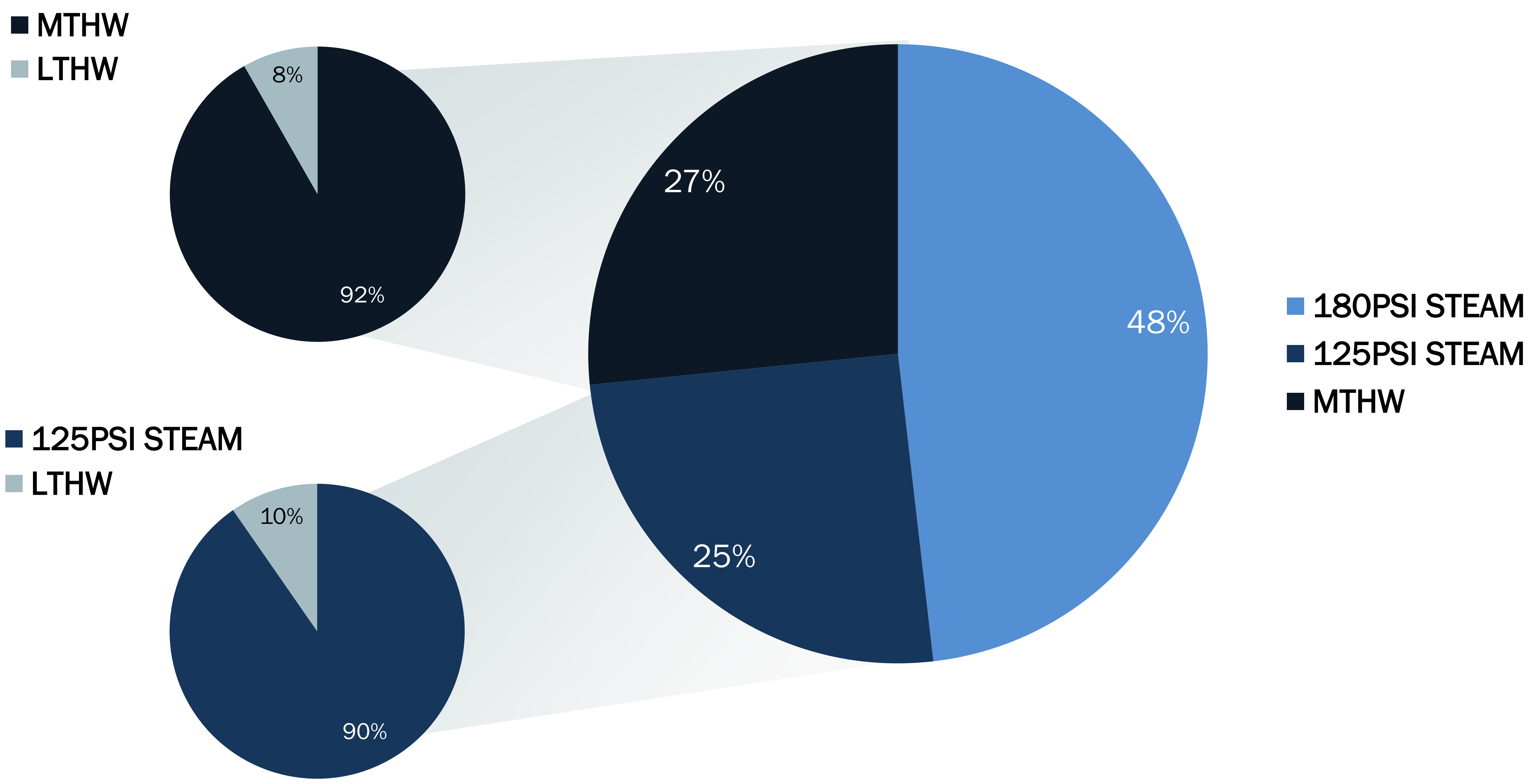
IMPROVE SYSTEM EFFICIENCY

- Lower return temperature to maximize efficiency
- Maximize temperature differential to increase distribution infrastructure capacity

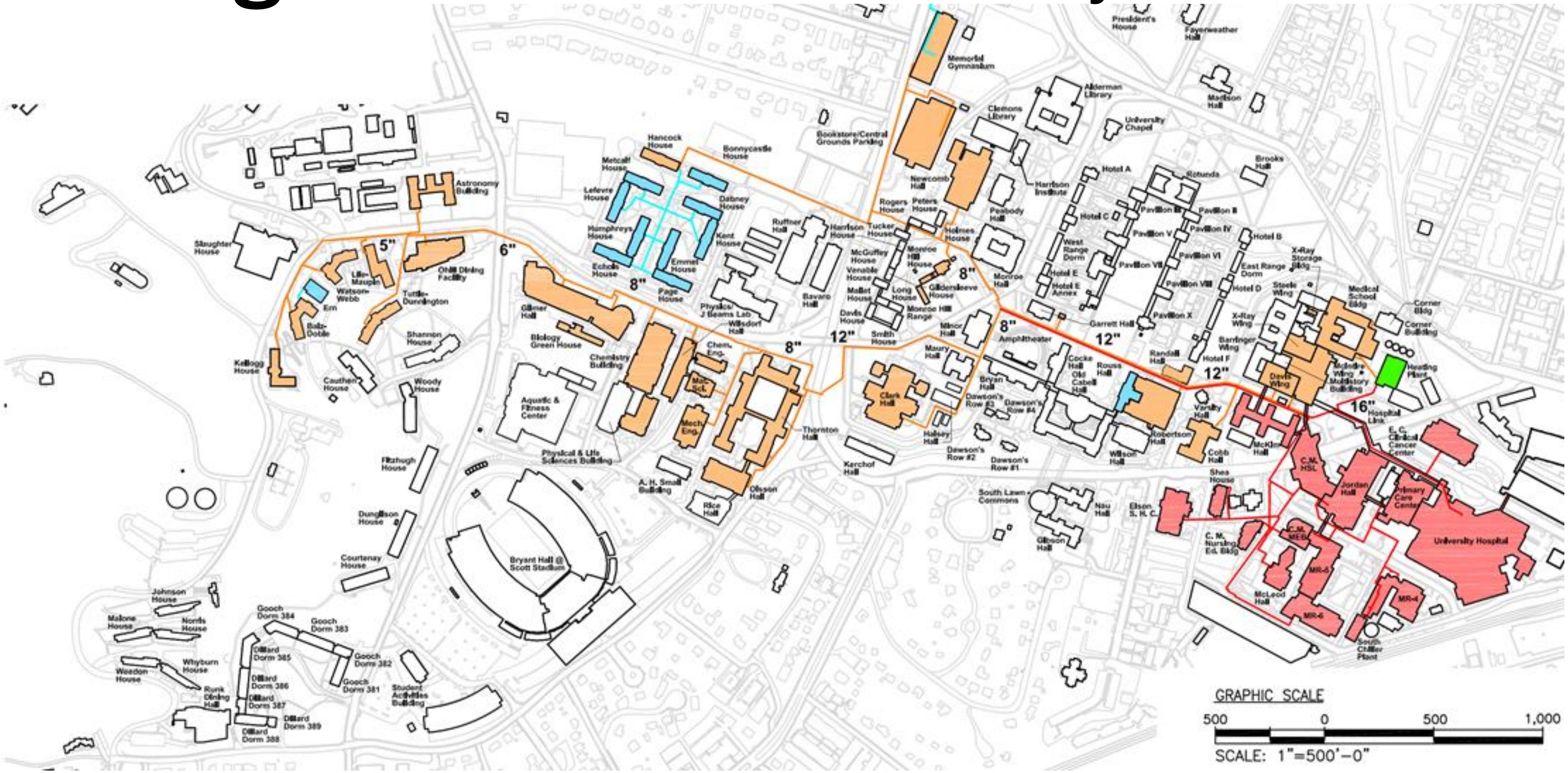
SHIFT GENERATION, IMPROVE EFFICIENCY

- Energy efficient sources
- Renewable energy sources
- Recover and utilize low grade waste heat

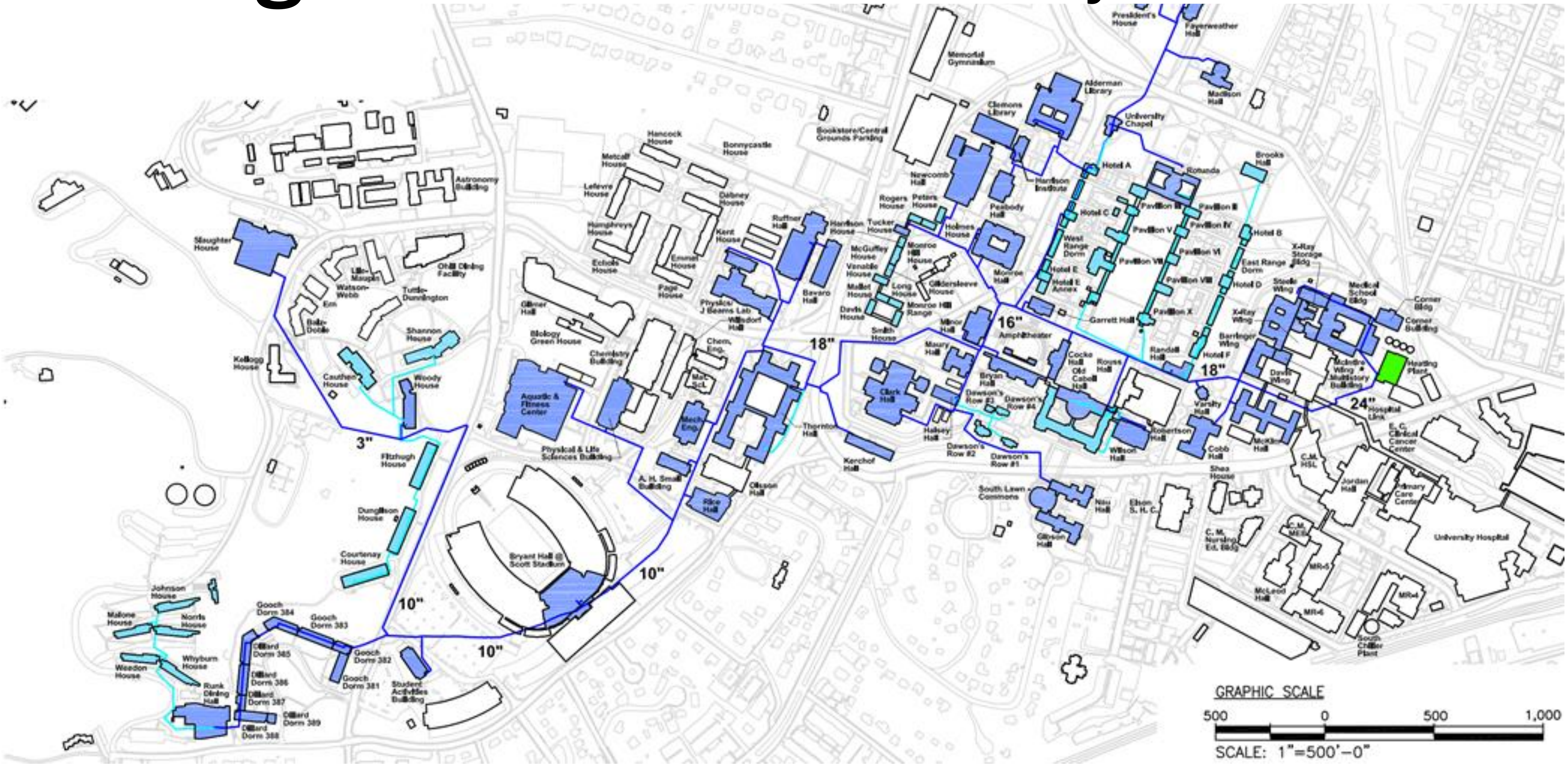
Existing Conditions: Heating Distribution



Existing Conditions: Steam System



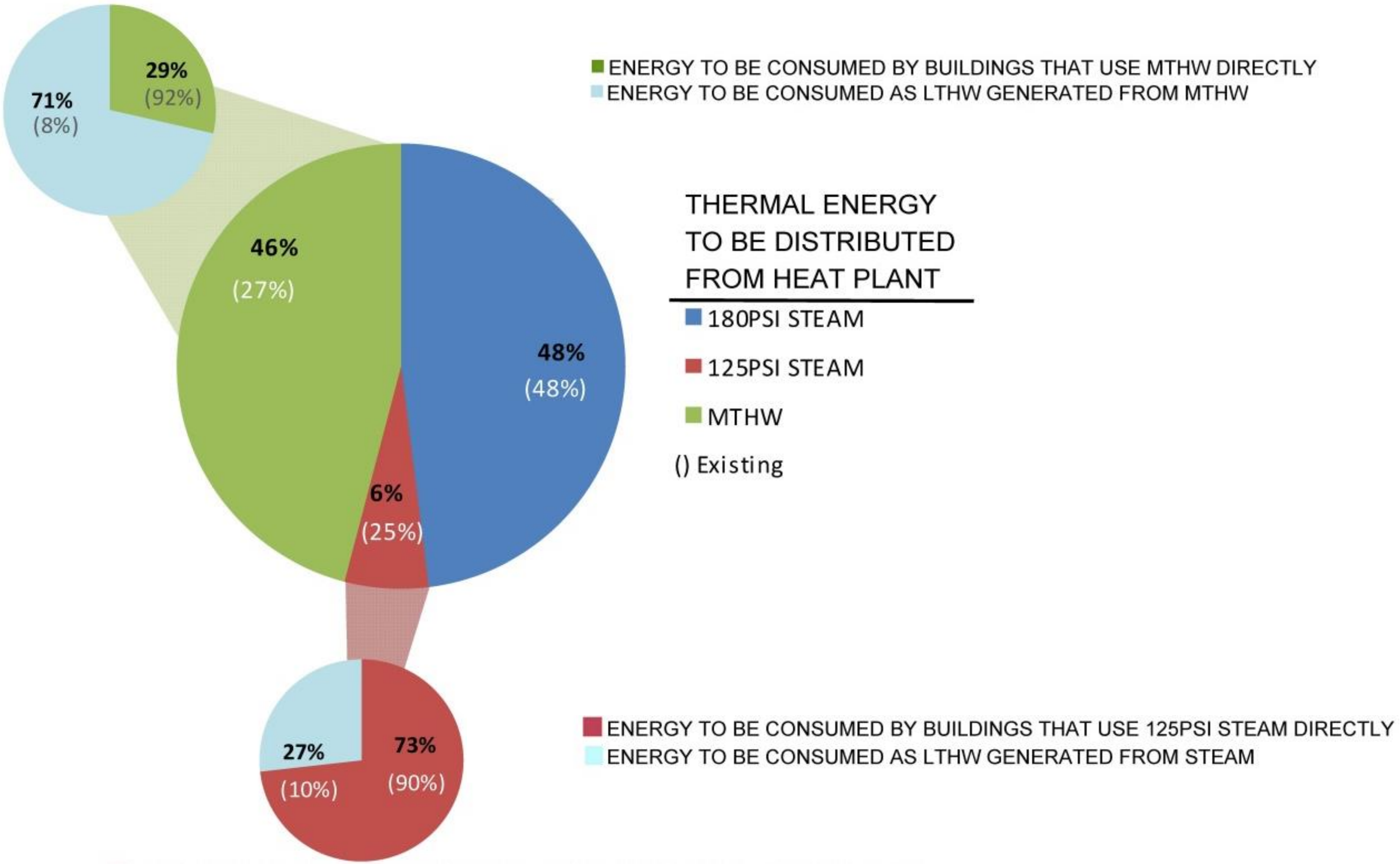
Existing Conditions: MTHW System



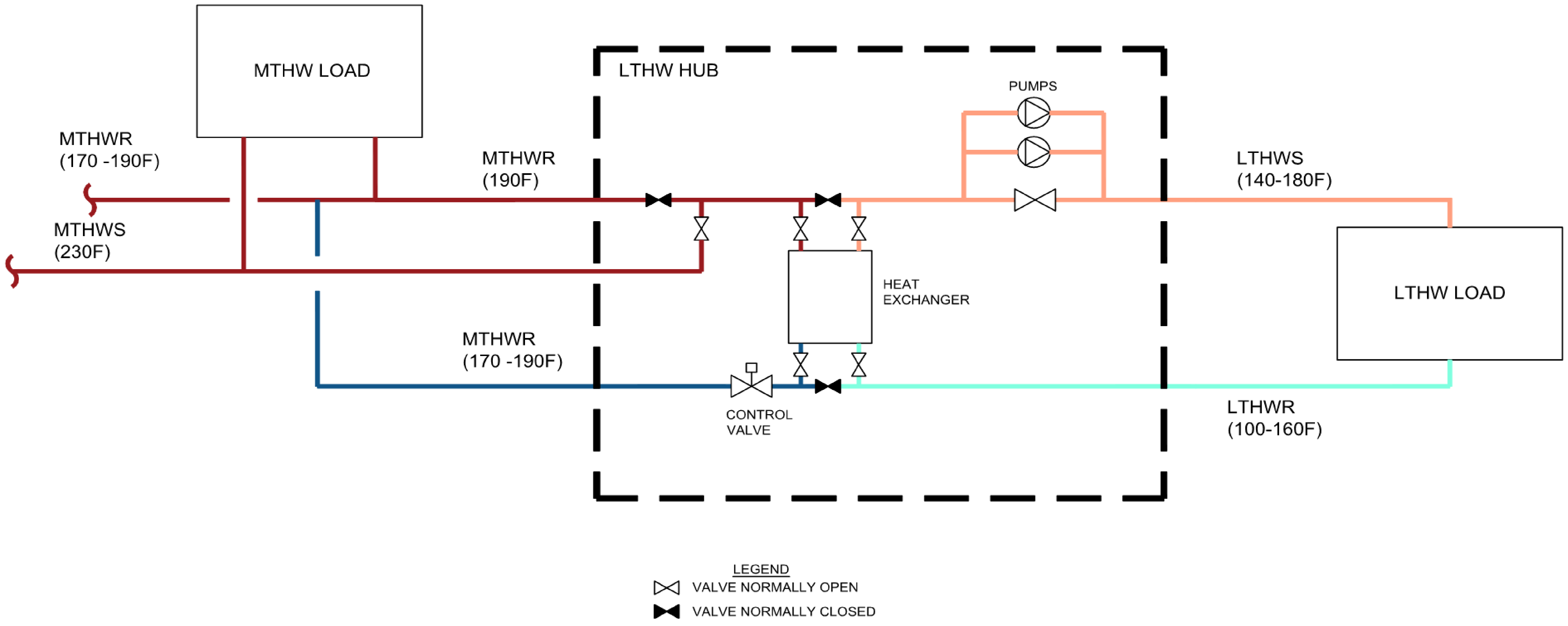
LTHW Hubs


LEGEND
RUNK HUB
OHILL HUB
WEST GROUNDS HUB
NEWCOMB HUB
HUB LOCATION

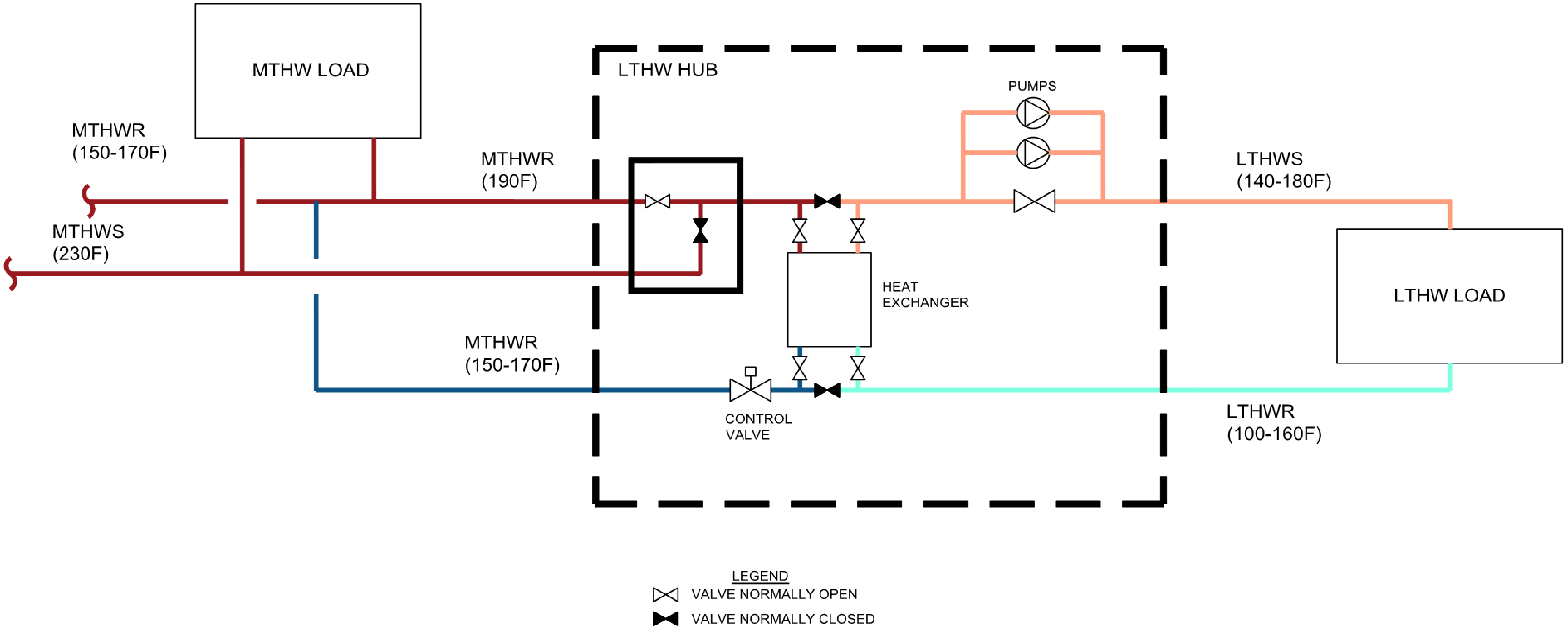
Proposed Conditions: Heating Consumption



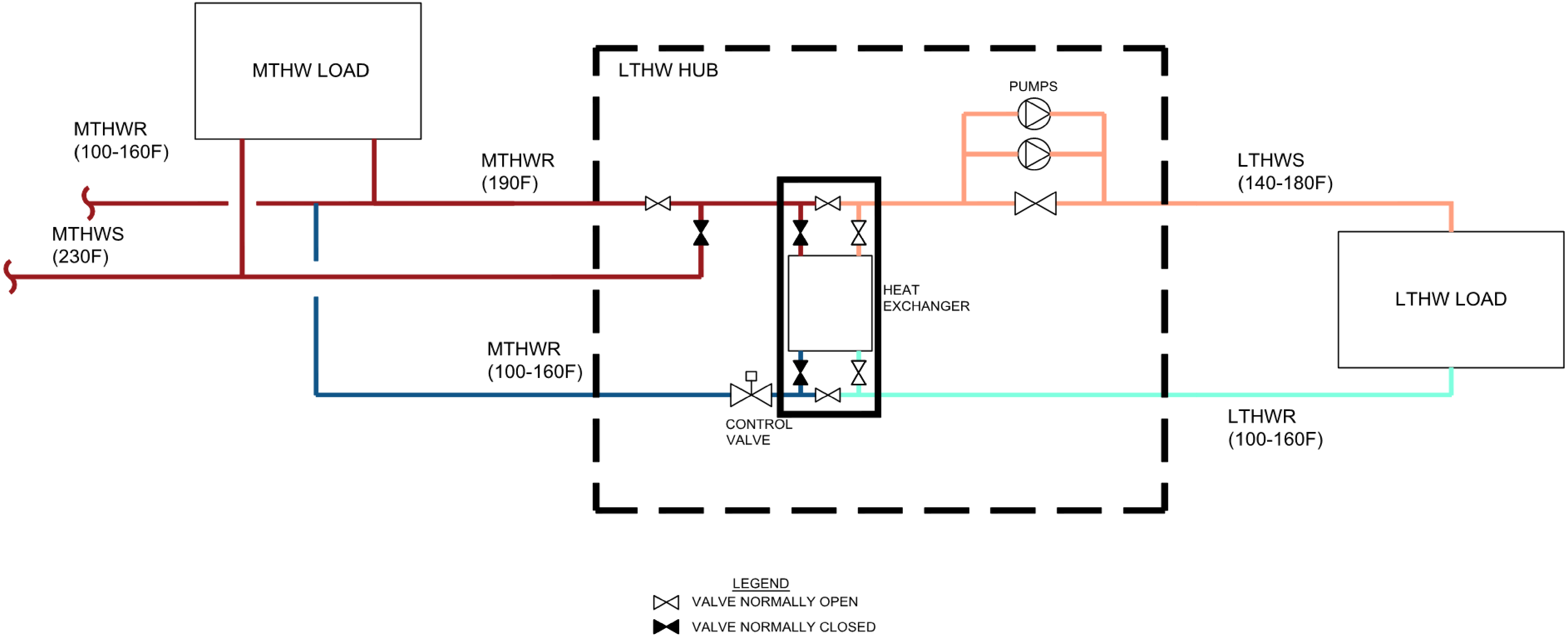
LTHW Hubs: Piping Schematic #1



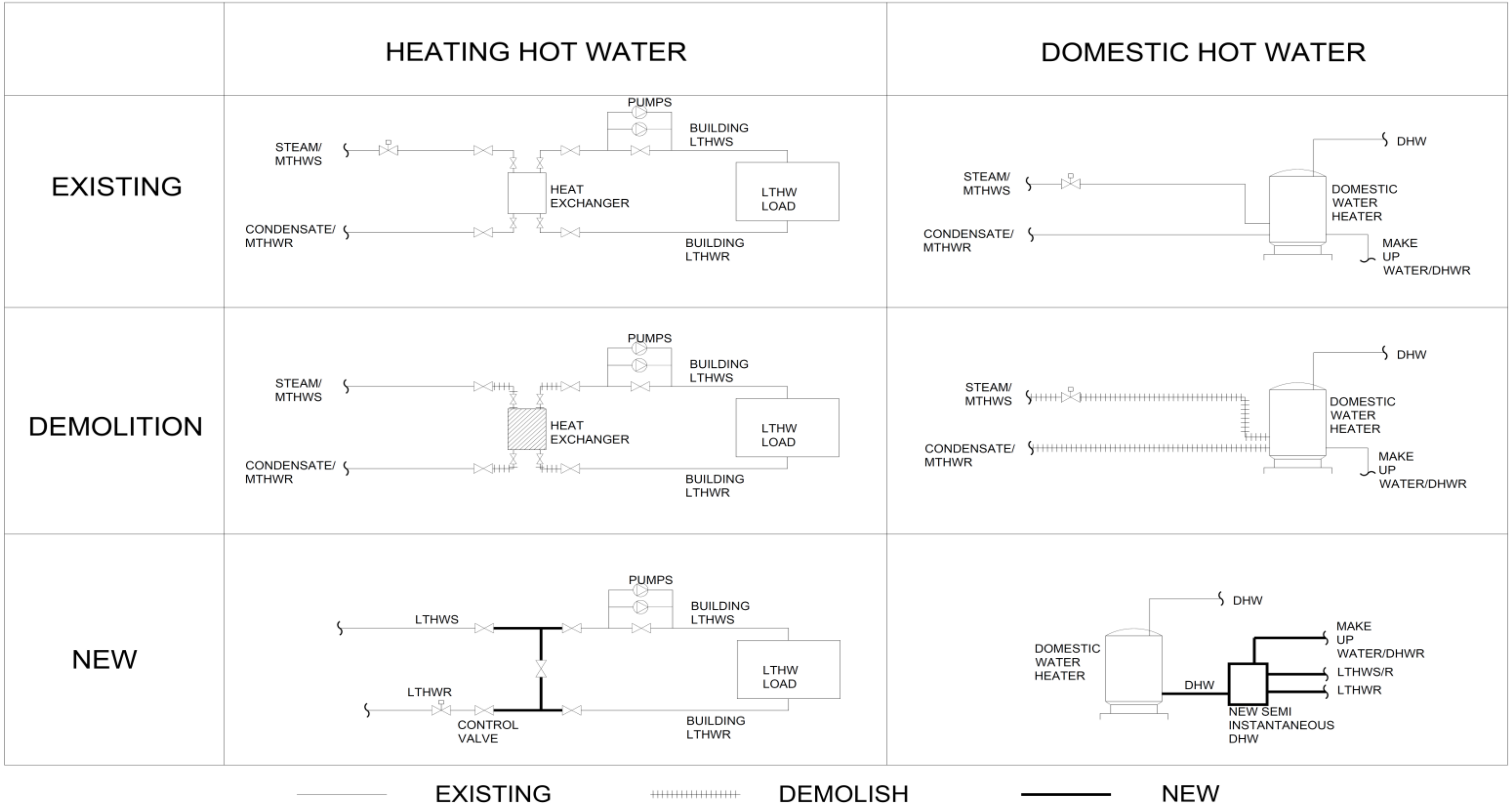
LTHW Hubs: Piping Schematic #2



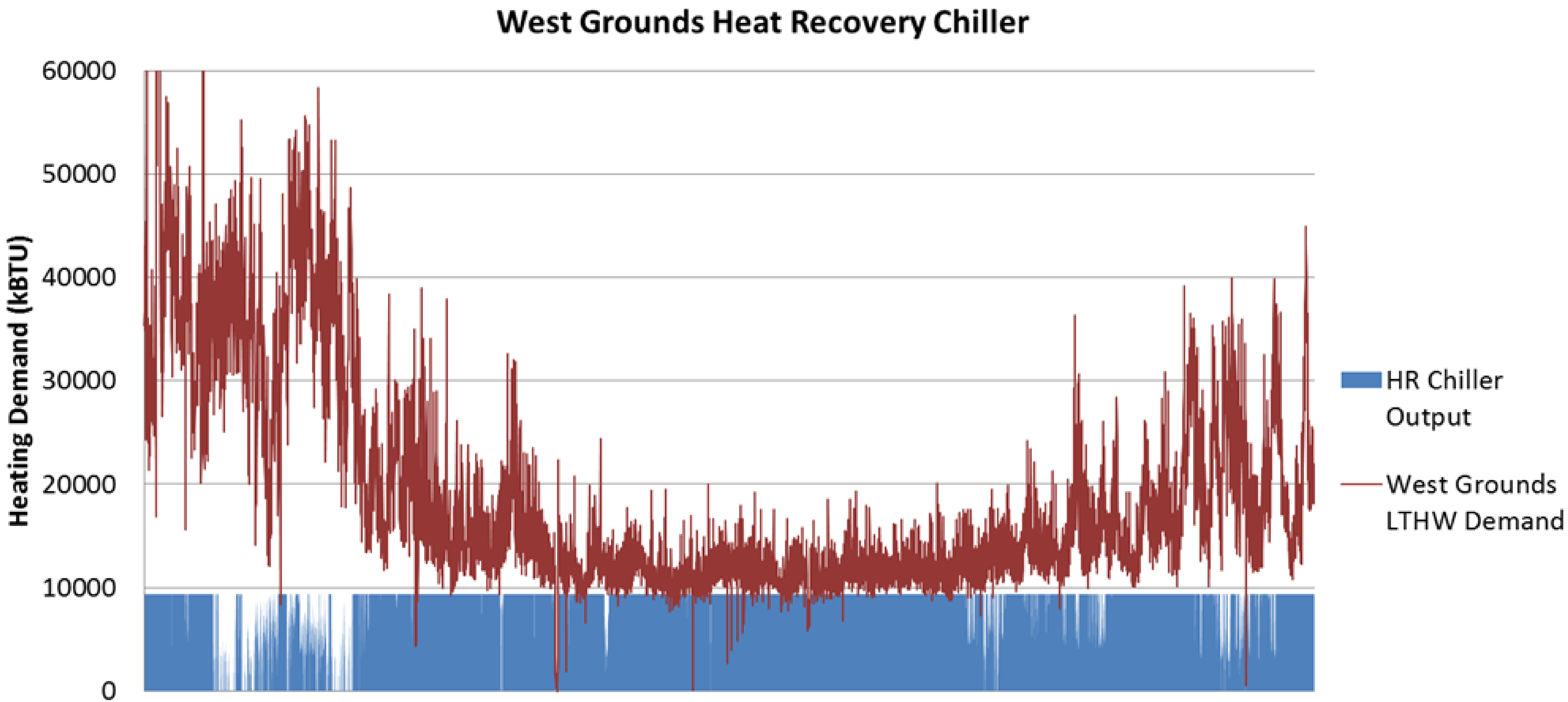
LTHW Hubs: Piping Schematic #3

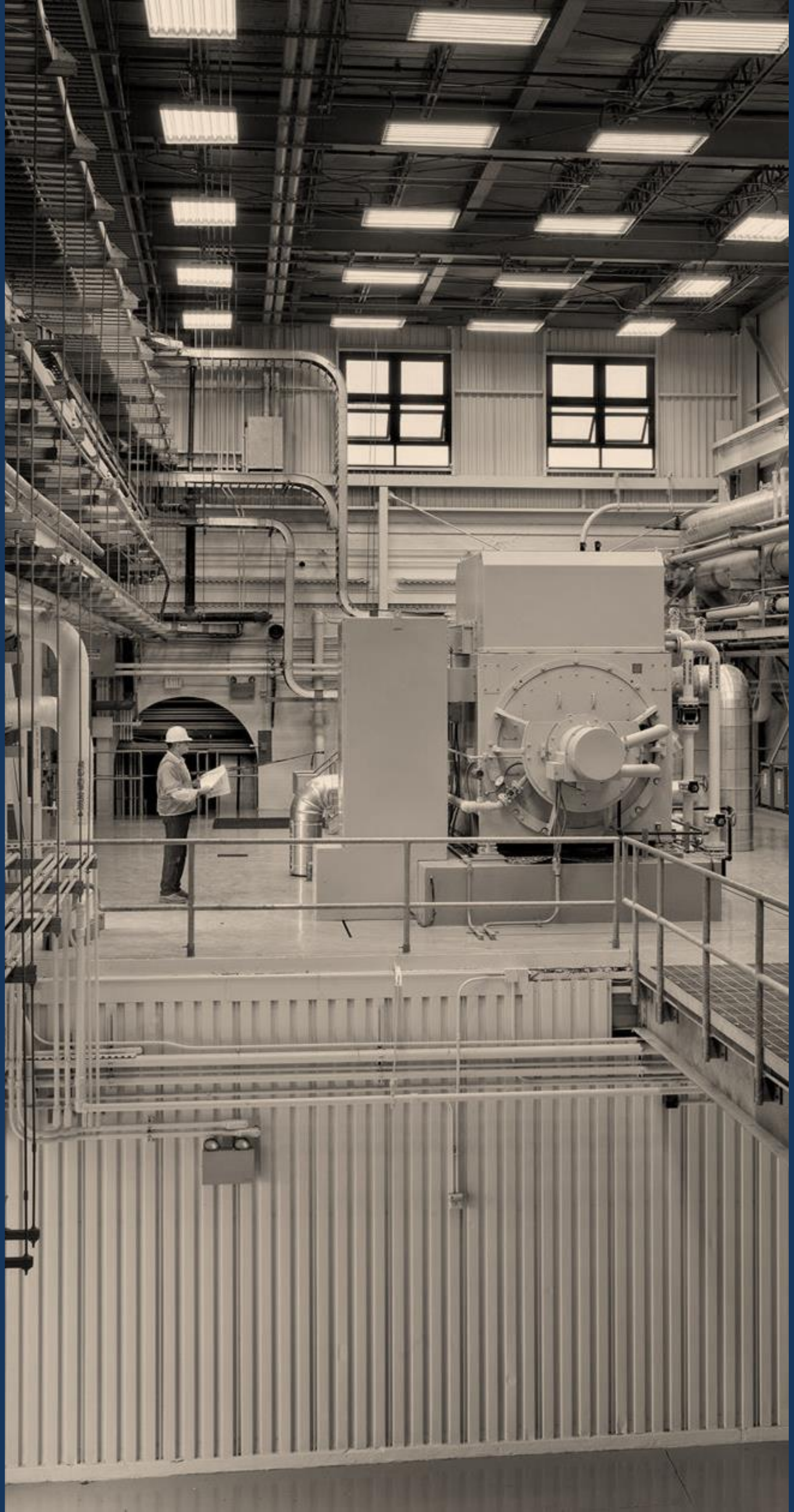


Building Conversion Diagram



Interaction of CHP And HR Chiller





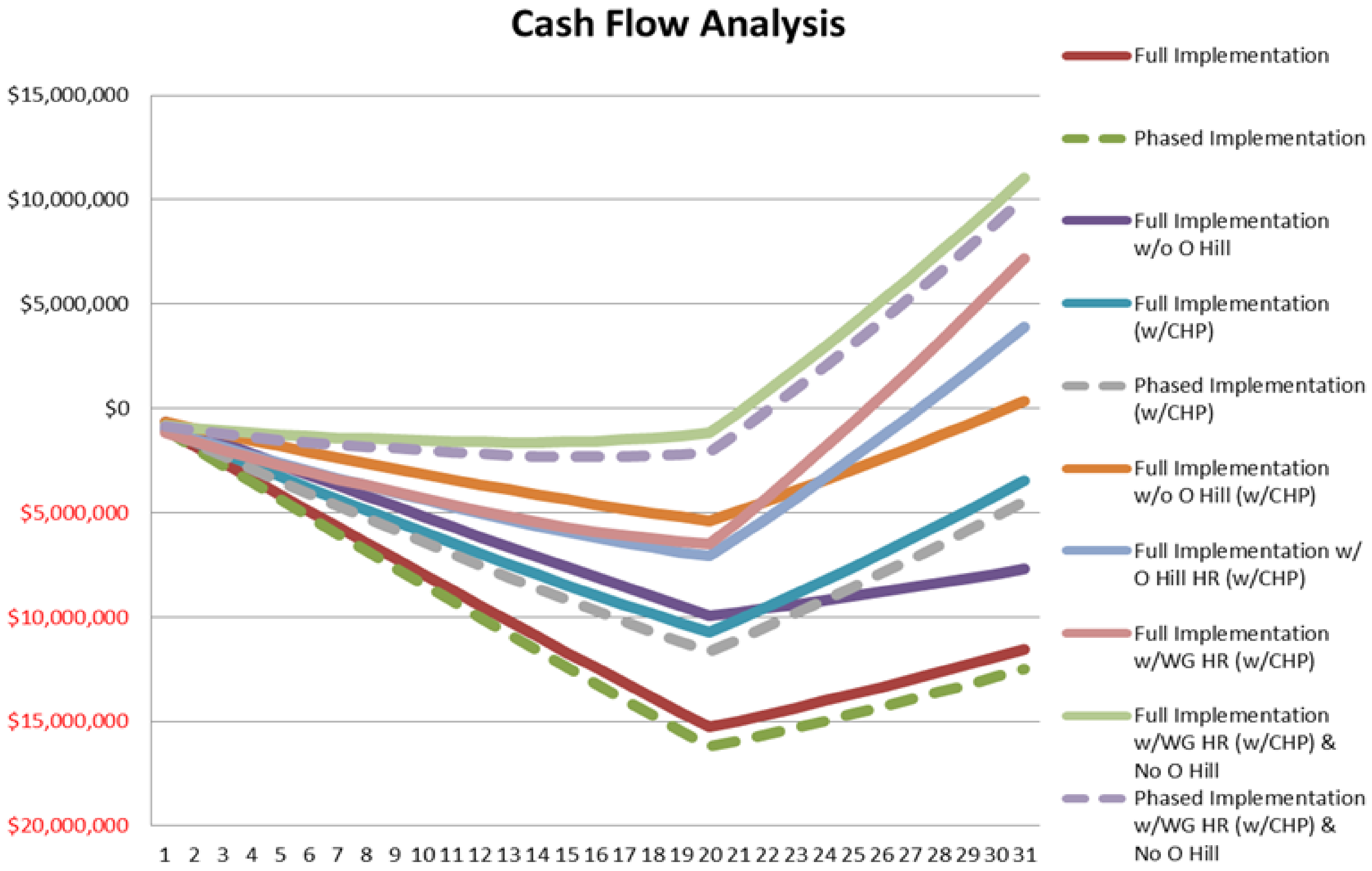
SUMMARY AND NEXT STEPS

Action Plan

Life Cycle Savings Comparison

Scenario	Annual Savings ($)	Capital Cost ($)	Net Present Value ($)	LCC Savings ($)
Scenario 1 - Full Implementation	$379,398	$13,739,173	-$5,093,923	-$3,490,508
Scenario 2 - Phased Implementation	$377,298	$14,388,295	-$5,779,495	-$4,440,127
Scenario 3 - Full Implementation w/o O Hill	$301,505	$8,750,239	-$1,789,595	$364,554
Scenario 4 - Full Implementation w/ O Hill HR	$571,806	$14,480,528	-$1,098,396	$3,904,029
Scenario 5 - Full Implementation w/WG HR	$667,880	$16,087,597	$291,244	$7,183,170
Scenario 6 - Full Implementation w/WG HR & No O Hill	$589,988	$11,098,663	$3,595,572	$11,038,233
Scenario 7 - Phased Implementation w/WG HR & No O Hill	$587,988	$11,747,785	$2,912,608	$10,093,371
Scenario 1A - Full Implementation (No CHP)	$185,456	$13,739,173	-$9,660,527	-$11,552,900
Scenario 2A - Phased Implementation (No CHP)	$183,356	$14,388,295	-$10,346,099	-$12,502,519
Scenario 3A - Full Implementation w/o O Hill (No CHP)	$107,563	$8,750,239	-$6,356,199	-$7,697,837

Life Cycle Savings Comparison



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