



IDEA2021

Powering the Future: District Energy/CHP/Microgrids
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Modernizing and Decarbonizing Within the Confines of a Century-Old Plant

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BUILT: 1932



BETTER THAN EVER: 2021



Community Energy Vision

- Enhance system efficiency
- Maintain reliability
- Improve resiliency to the market and weather events
- Remain cost-competitive
- Utilize local energy sources
- Reduce carbon emissions
- Reduce water usage

Upgraded Infrastructure – Customer Buildings



- Customer building conversion from steam to hot water supply was included in the scope of the project.
- Efficiency of buildings improved due to enhanced control of HW.
 - 26% reduction in BTU on average compared to steam

Upgraded Infrastructure – Hot Water Distribution



- A robust and efficient distribution network is the foundation for the district system.
 - Expands possibilities for thermal sources
 - Reduces losses/improved system efficiency
- Opportunistically upgraded during other planned infrastructure projects to reduce cost.
 - Approx. \$30 million investment
 - 2/3 covered by grant from State of Minnesota

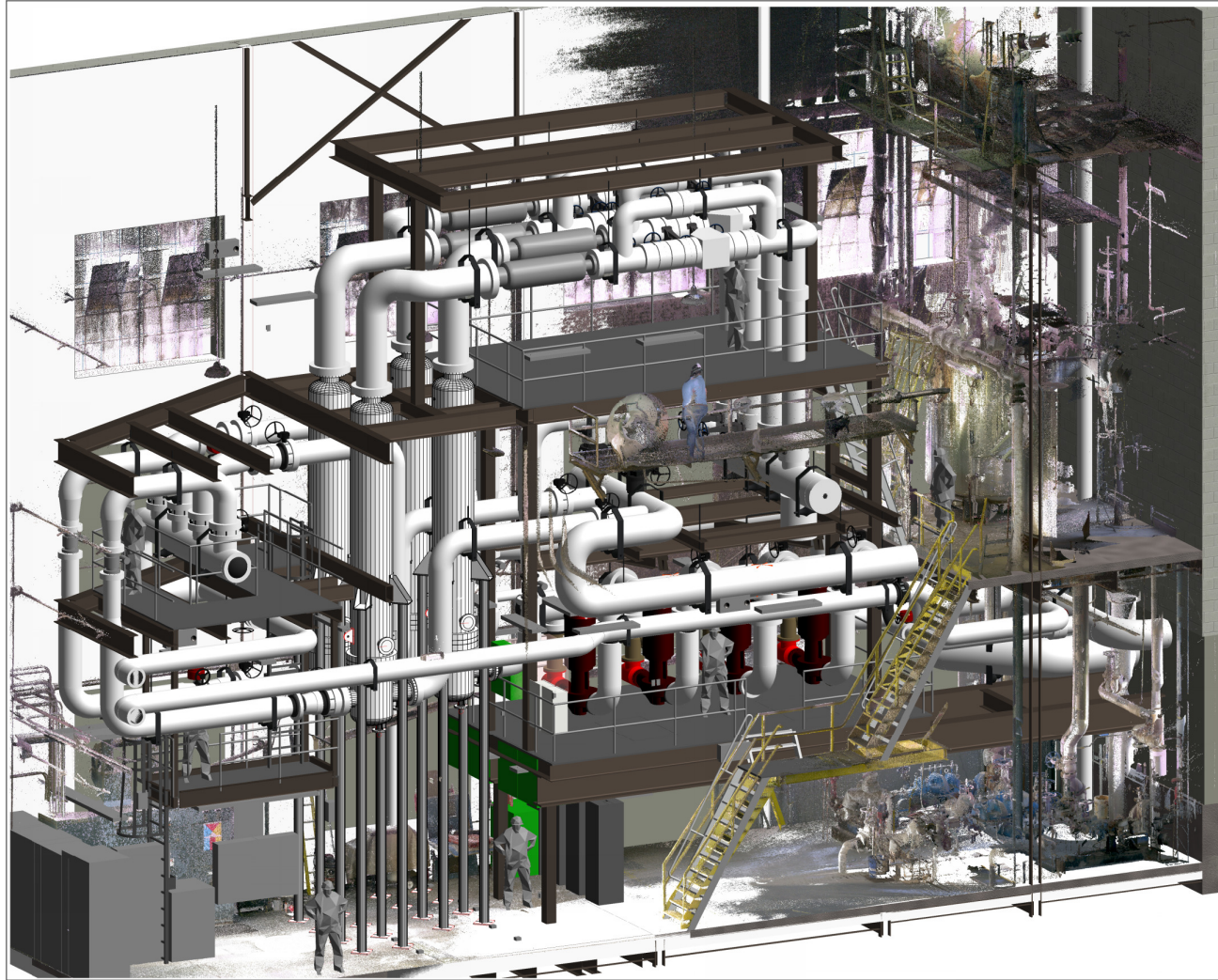
Upgraded Infrastructure – Energy Production (Hot Water)



- Added steam to hot water converter station to 1932-vintage plant.
 - Little floor space but plenty of empty volume overhead
- Vertical converter station configuration that had to be fit into and integrated into the facility.







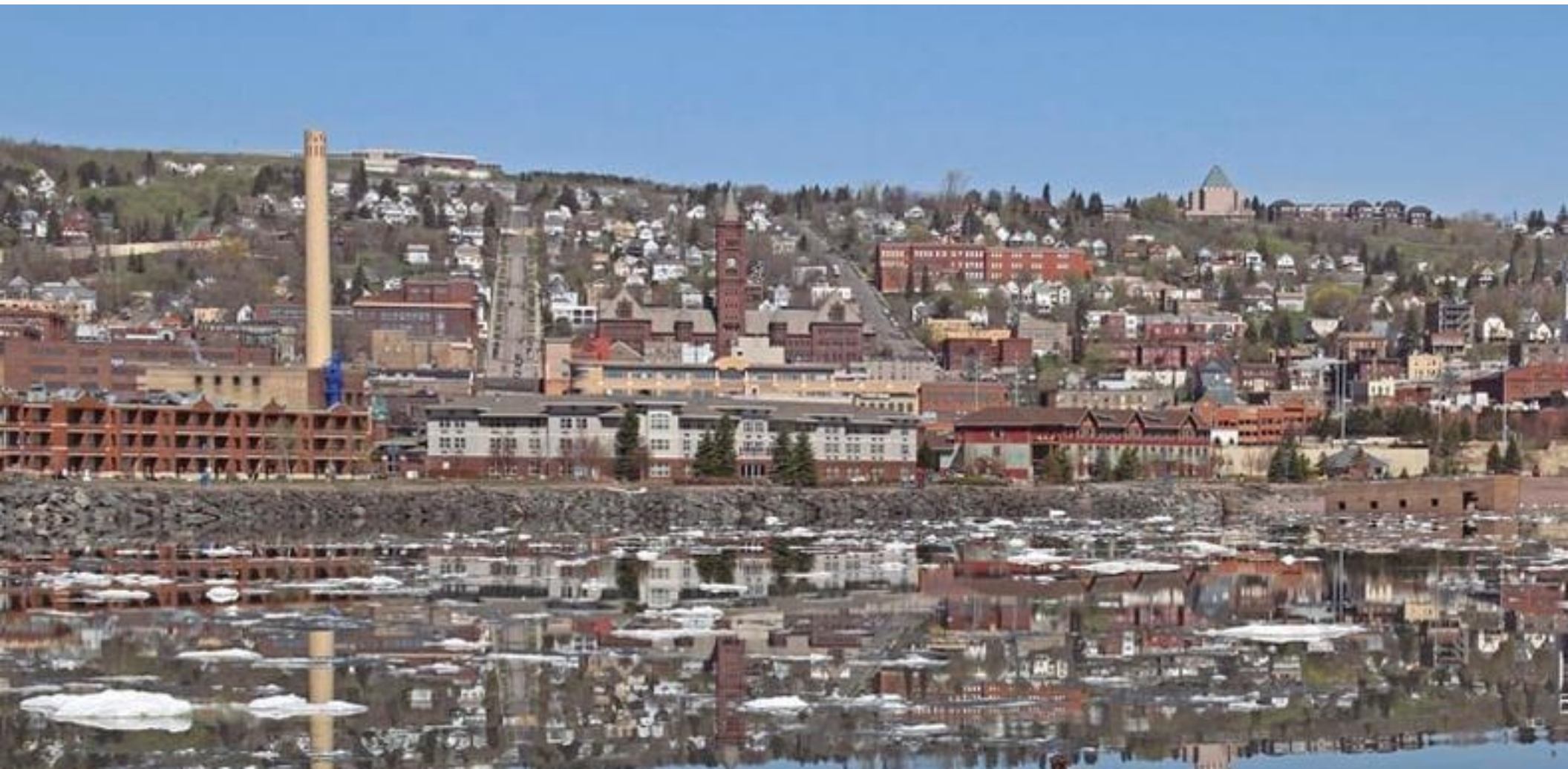
Building Limitations

- Age of Building – Built in 1932
- Limited Structural Drawings
- Limited Structural Capacity
- Coal-fired plant undergoing conversion to natural gas
- Steam Distribution System
- Canal Park Hotel Loop and DECC



Challenges

- Structure must be independent of Building
 - “Table Top” Design
 - Differential Settlement
- Tight Area
 - Vertical Expansion
 - Limited or No Pipe Flexibility
- Pump Stress Limitations
- Generator Limitations
 - Active Demand Controls
- Freeze Potential
 - Start up at -25°F
 - Initial load small relative to ultimate buildout



Design Parameters Production

- Hot Water Temperatures: 215°F – 160°F (220°F maximum)
- Pressures:
 - 165 FT elevation difference
 - 230 FT Pump Head, 275 FT Shut-off head
 - Buildings isolated
- Hydraulic Model
- Expansion Volume
 - 176,000 gallon system volume
 - (4) 4,000 gallon expansion tanks

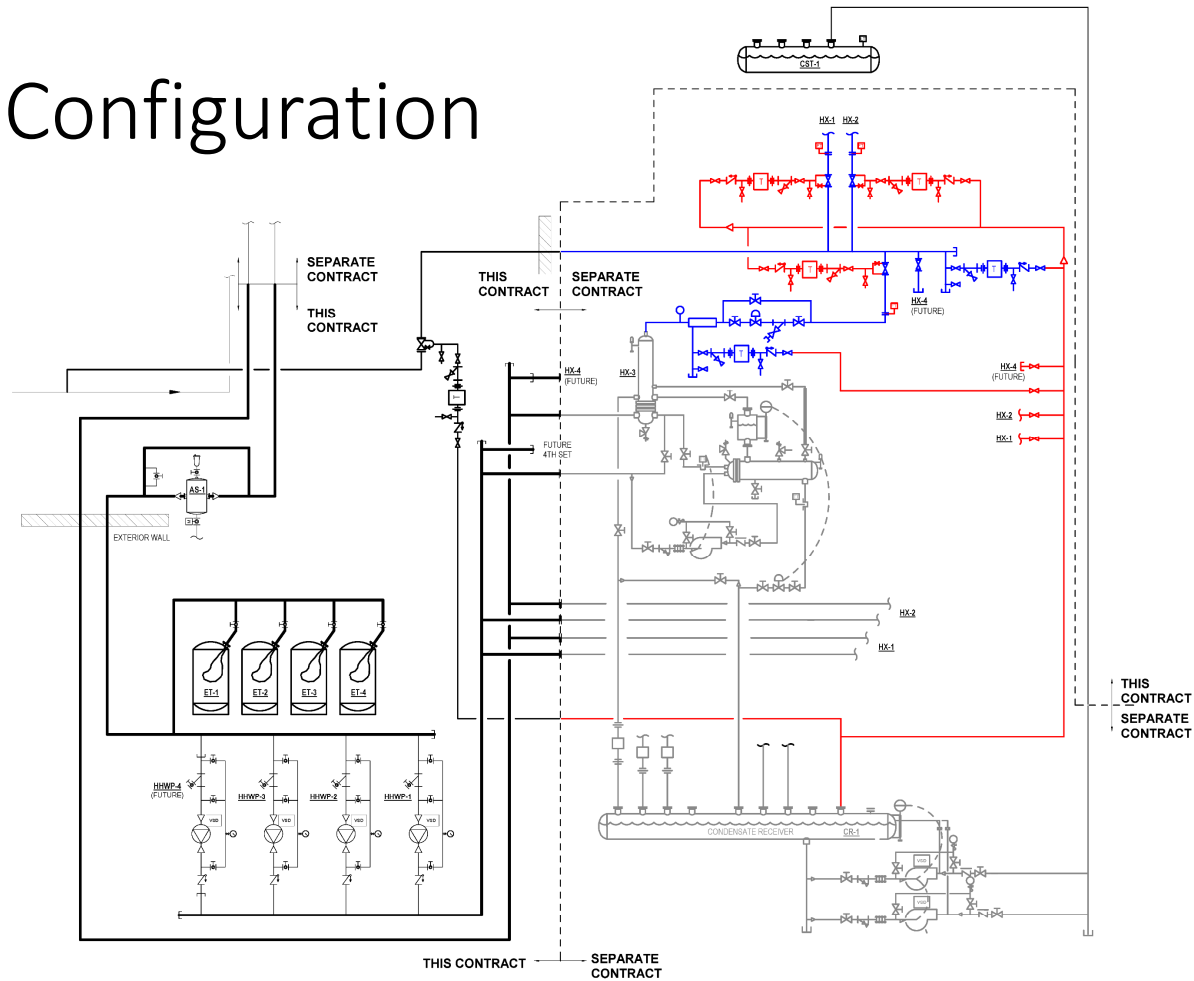


Ultimate Buildout

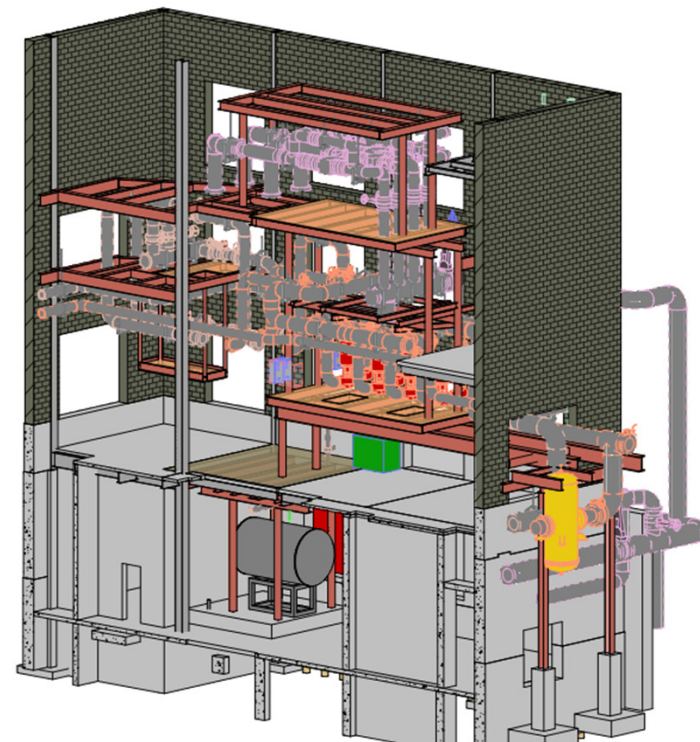
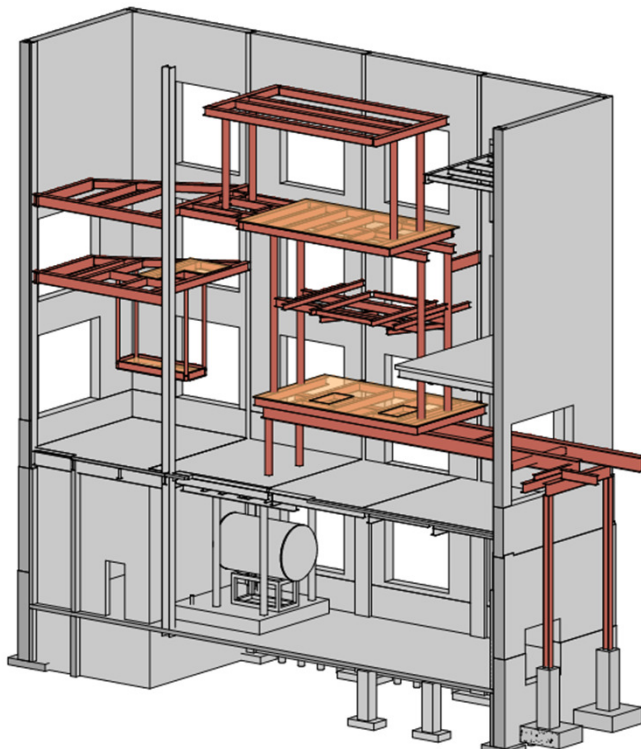
- (4) 60,000 kBtu/h steam to hot water HX
- 240,000 kBtu/h (N+1)

Phase	Load (kBtu/h)	Loop Description
1	22,000	3rd Ave W past 6th Ave W, ends at Lennox
2	46,000	Lake Ave through 4th Ave W
3	27,000	3rd Ave through Lake Ave
4	30,000	St. Luke's piping run
5	9,000	County Buildings
6	40,000	Hotel and DECC Loop
Total	174,000	

System Configuration



Building Layout

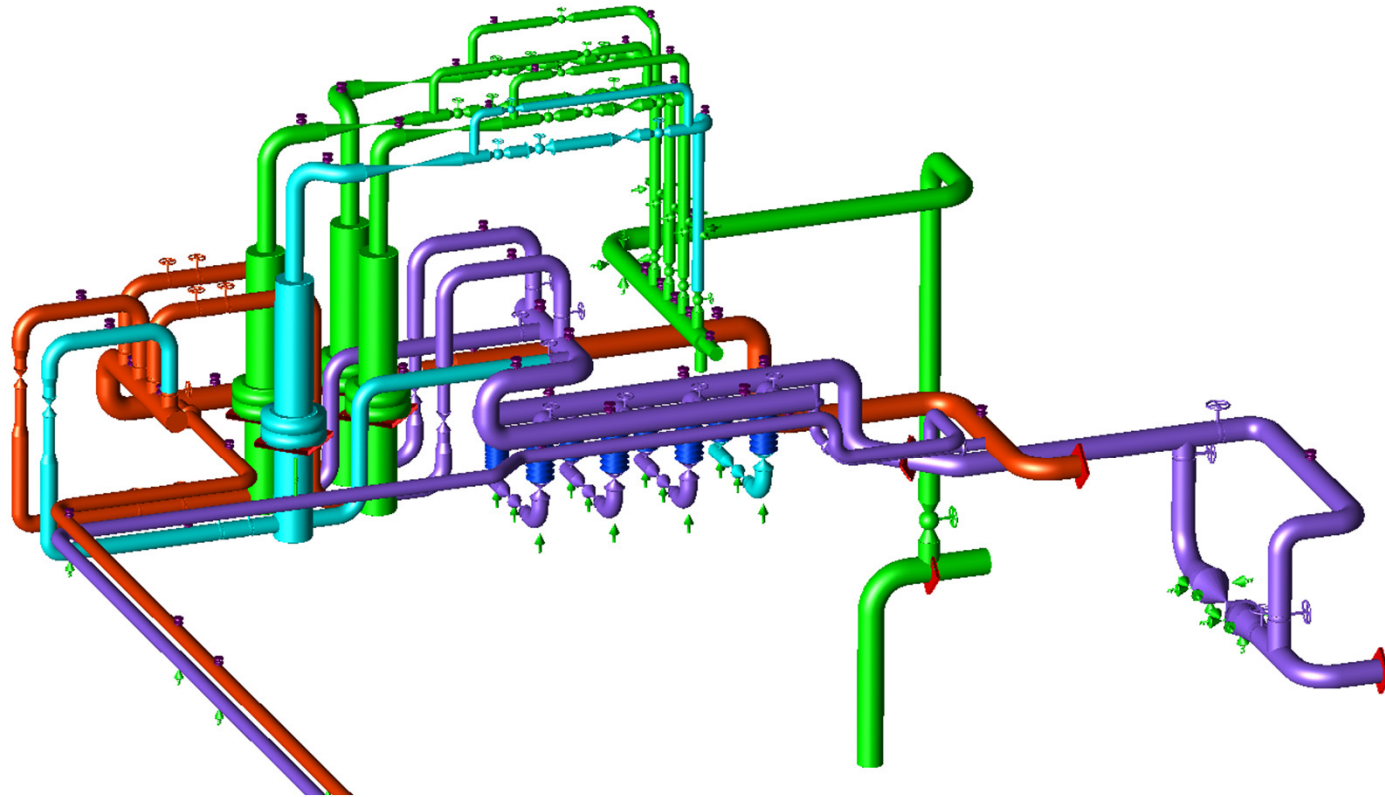


Differential Settlement





Non-linearized Stress Analysis



Generator Limitations

- 1500 kW Generator
- Current Limited each HHWP VSD :
- $I_{HHWP|MAX} =$
 $(389 * (1 - SFEDG) - 0.634 * VEDG * IEDG) / (VEDG)$

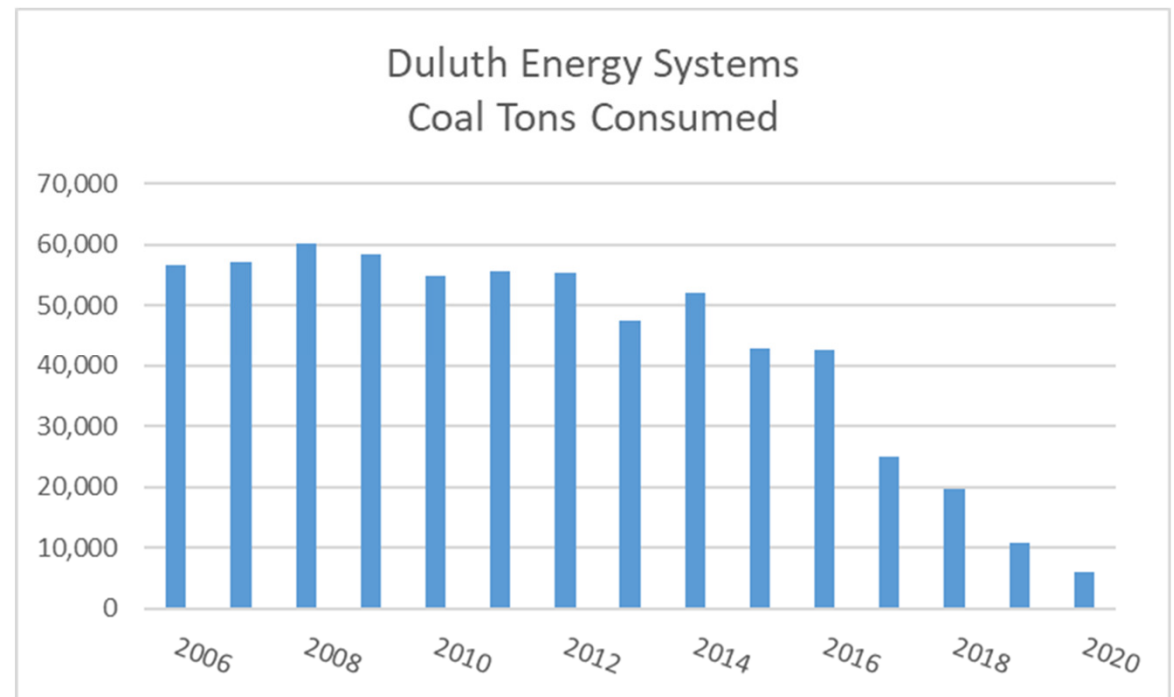


Freeze Protection



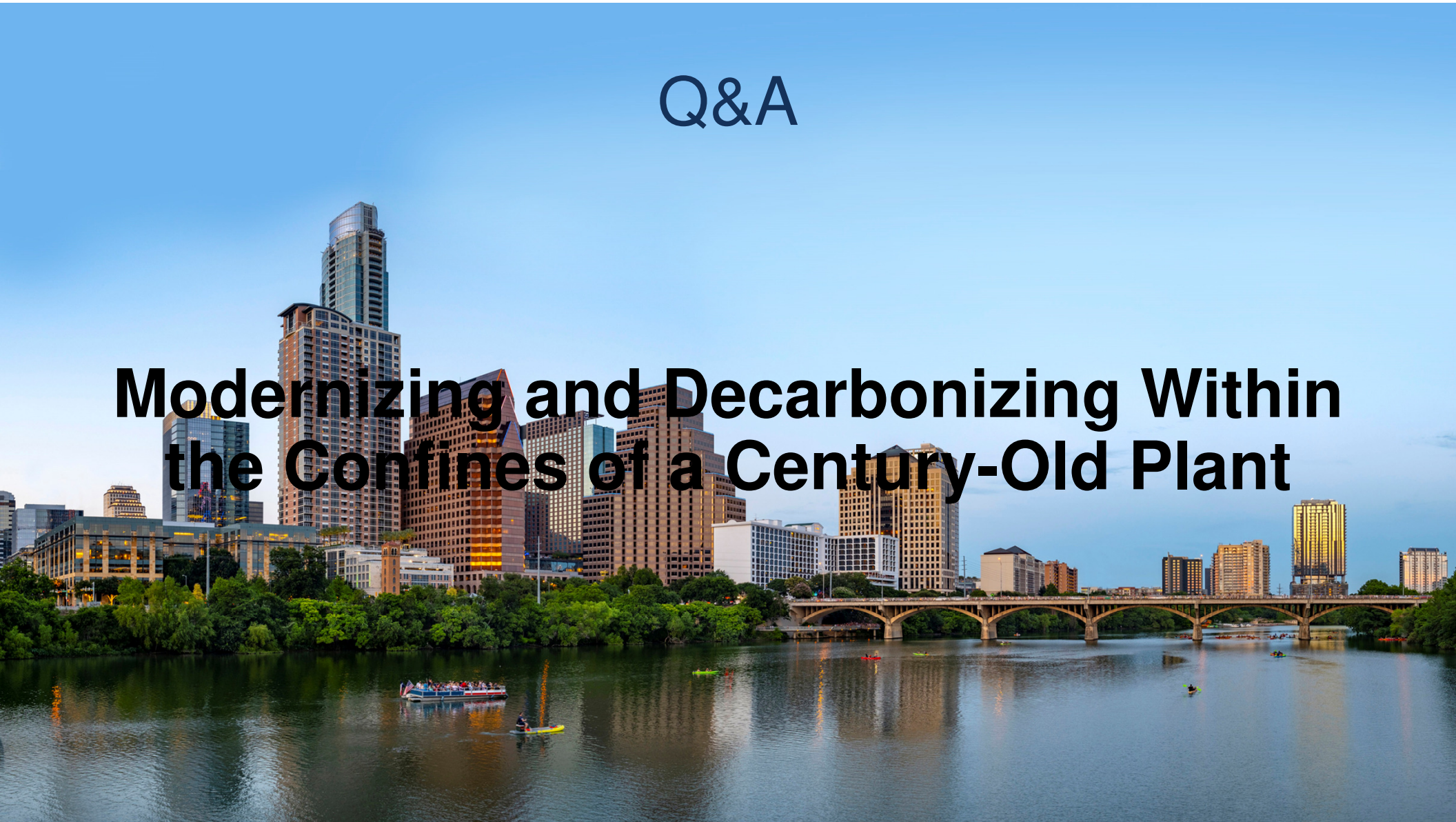
Results

- Fossil Fuel Reduction
- Less energy use per building
 - Reduced system losses
- Reduced water consumption
- 26% average reduction relative to steam



Q&A

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Thank You!

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HGA