

System Advancement and Optimization in Saint Paul

Ken Smith, President and CEO, District Energy St. Paul

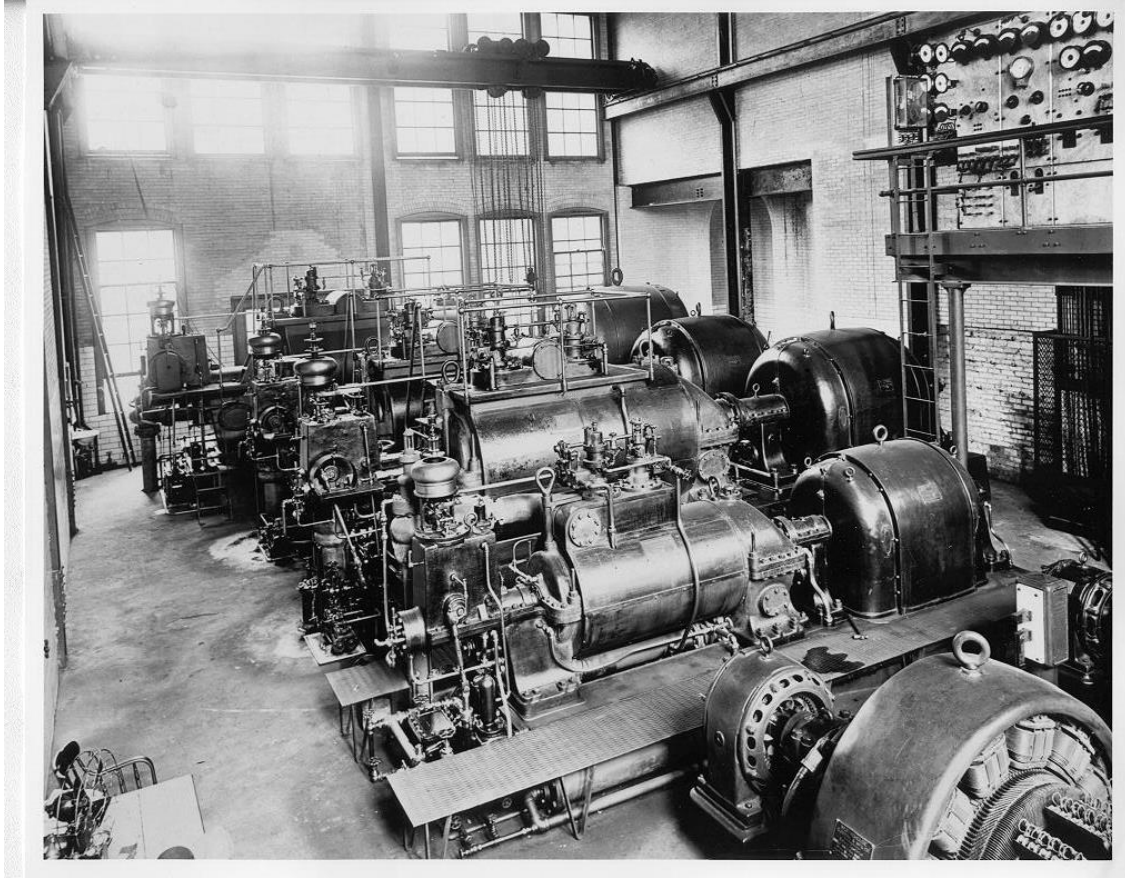
Nina Axelson, Vice President, Ever-Green Energy



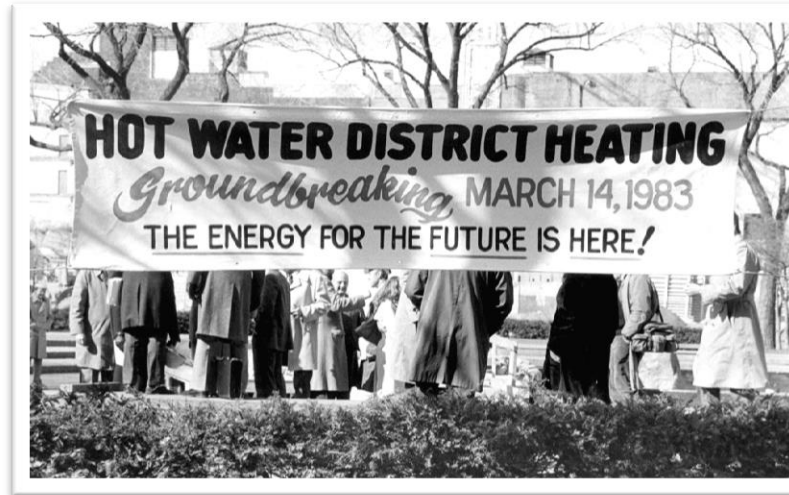
SYSTEM HISTORY



Saint Paul Power and Light



Community Utility



Community Utility

- 501(c)3 non-profit utility
 - No stockholders, cost-based rates
- Public-private partnership
 - city, county, state, federal agencies
 - BOMA, chambers of commerce, industry
- Compete for business
 - 80/60% market share for heating/cooling



Serving Saint Paul

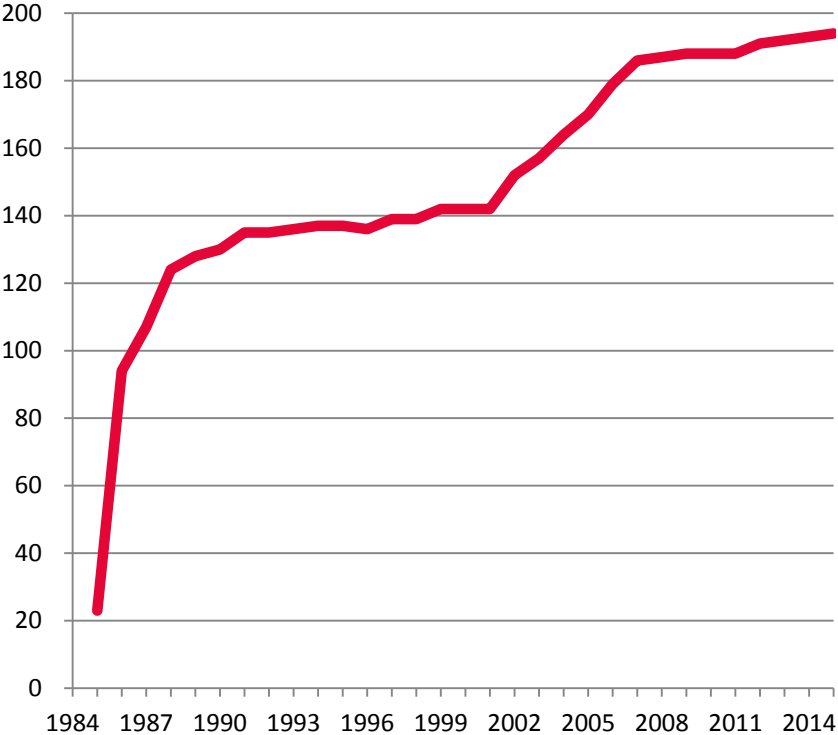


Heating and Cooling the City

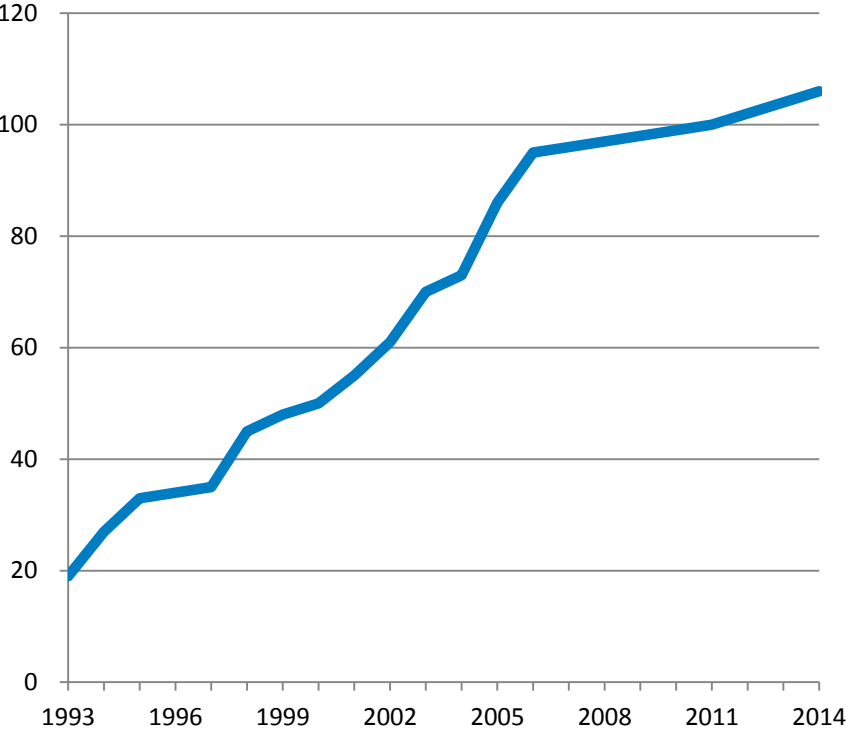


Customer Growth

Customer Growth: Heating



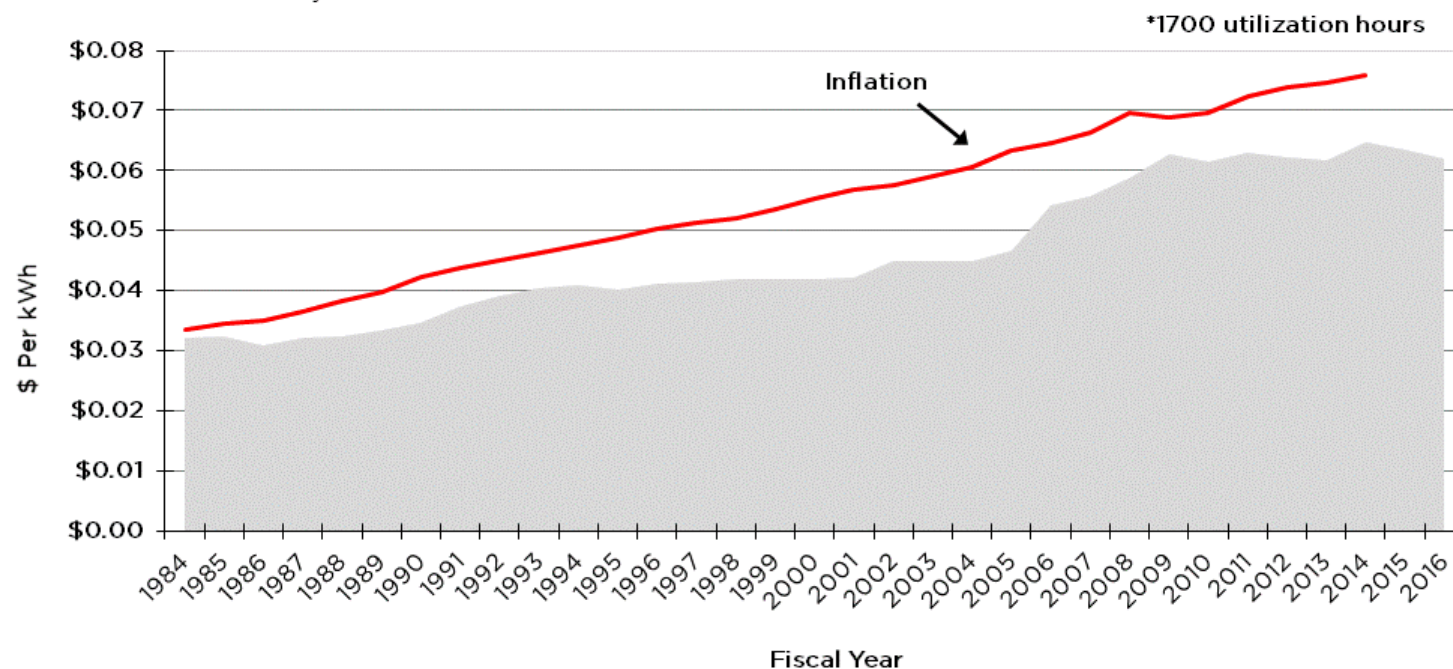
Customer Growth: Cooling



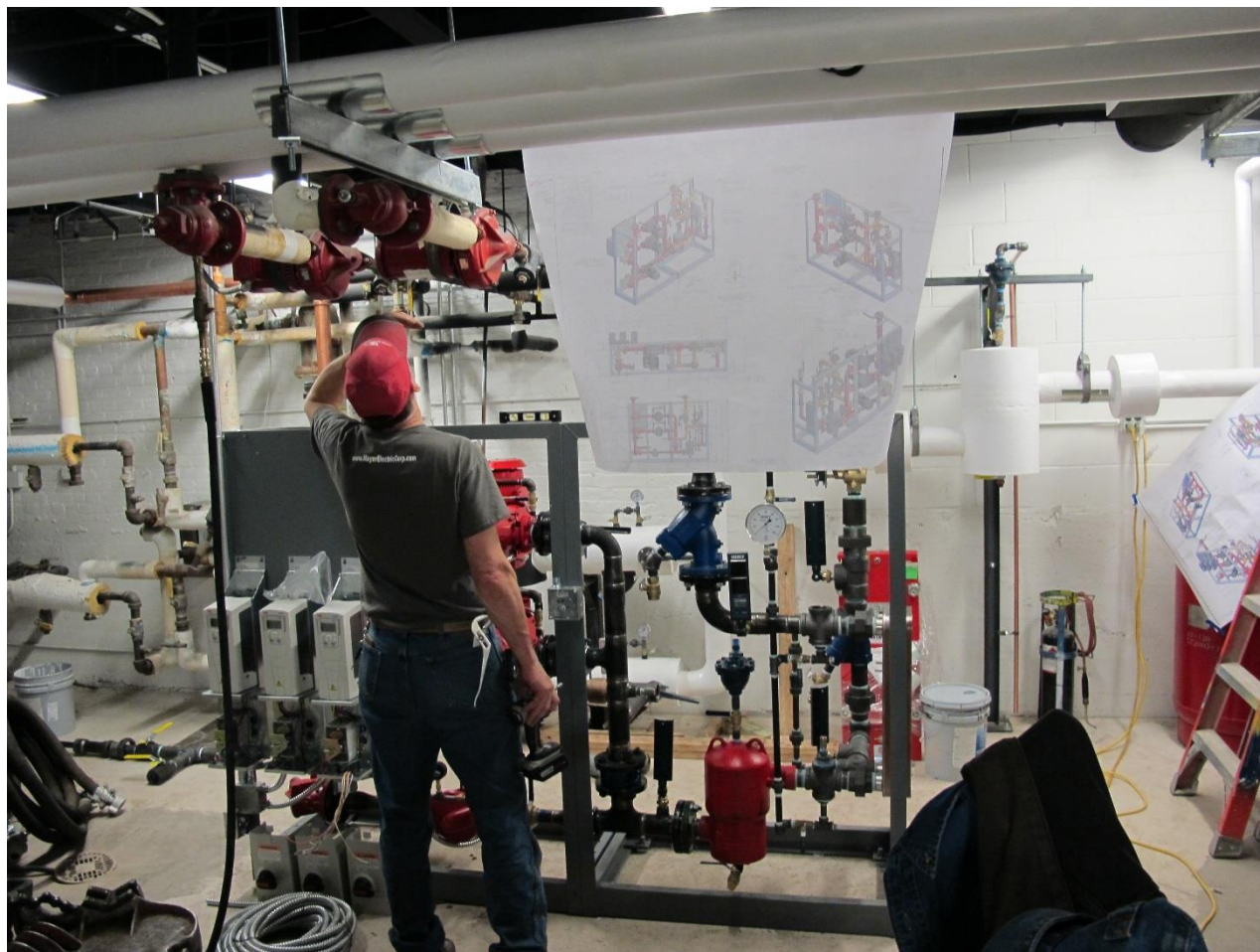
Combined Rate Summary 1984-2016

District Energy customers are paying less for our services today than 33 years ago (adjusted for inflation)

Combined Rate Summary 1984-2016



Buildings of the Future – Demonstration and Education

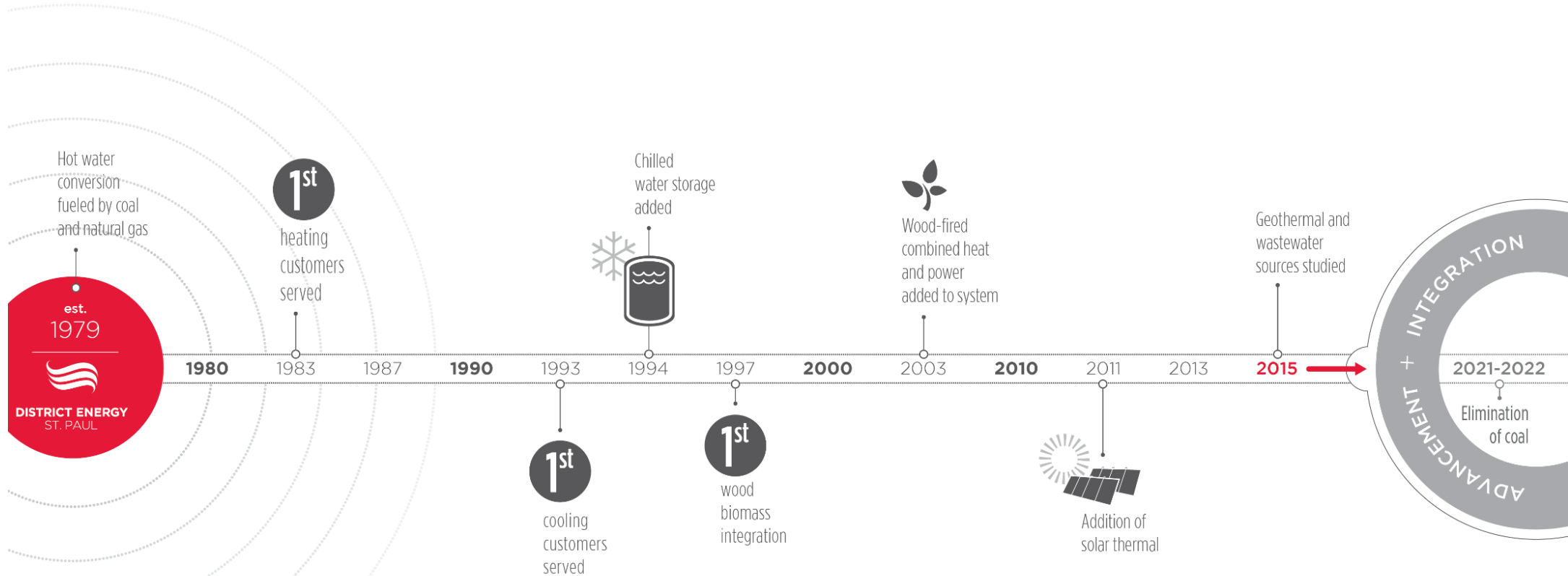


Alpha laval skid units (rendering and Jemne installation)

Advancement and Integration



Overview of 1979 - 2016



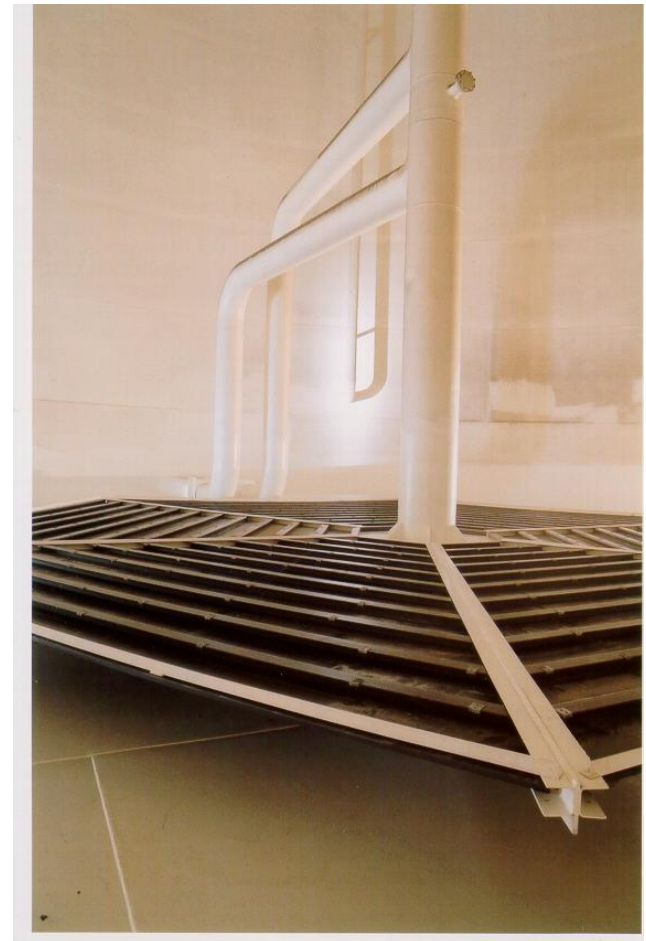
Thermal Storage

- 6.5 million gallons of storage capacity
- Chilled water storage reduces peak-electric demand
- Firm capacity for weather events



Enhanced Thermal Storage

Tanks that can flex between chilled water and hot water storage



Combined Heat & Power



- 33 MW of electricity capacity
- Renewable, clean, urban wood residue
- Reduces over 100,000 tons of CO2 annually



Local Biomass Incorporation

- Local wood collection helps cities and counties convert a waste wood problem to renewable energy

Sources

- Wood residuals from manufacturing
- Clean wood construction waste
- Tree trimmings
- Storm and disease damaged trees
- Trees removed as part of a timber management plan/restoration



Solar Thermal Integration



Education and Engagement





COMBINED HEAT & POWER



HEAT RECOVERY



SOLAR



FOSSIL FUELS



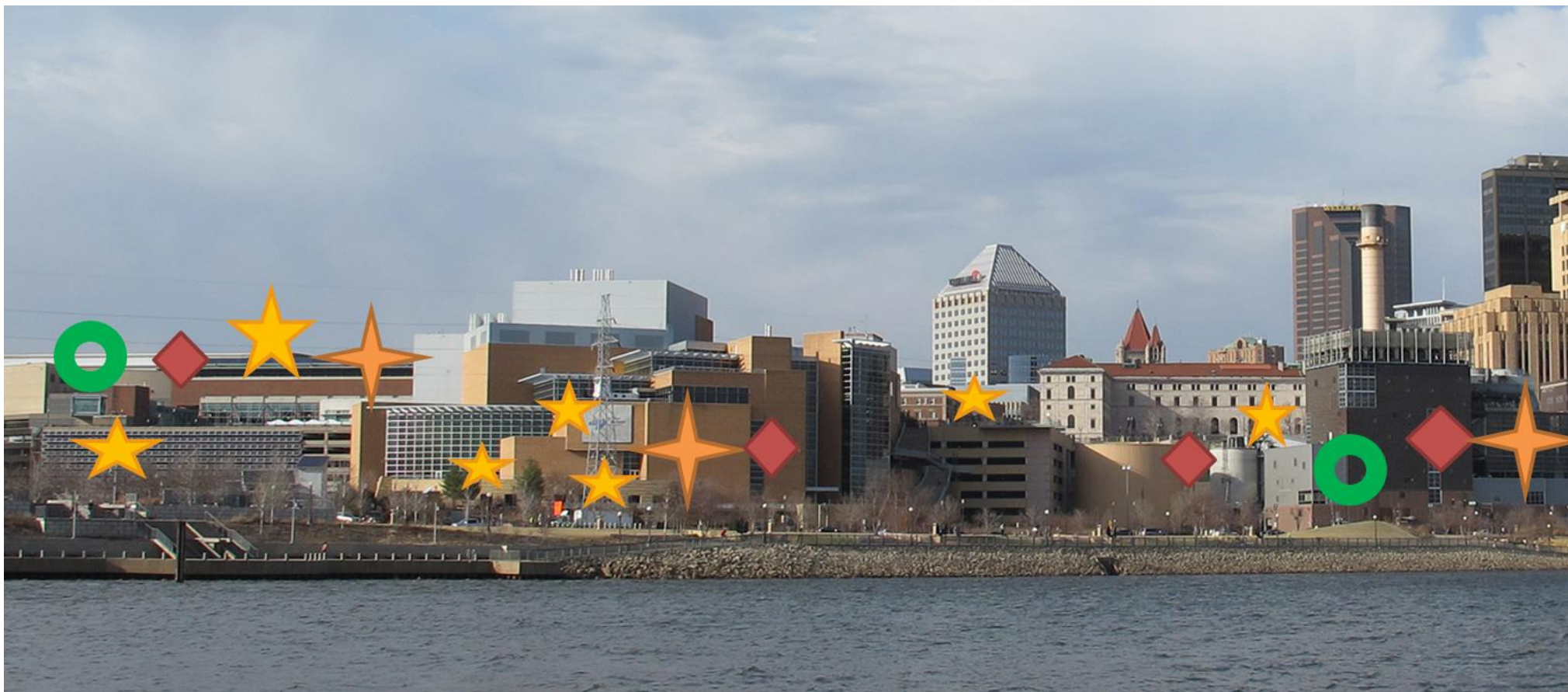
BIOMASS



THERMAL STORAGE



Saint Paul EcoDistrict



-  Renewable energy (wind/biomass)
-  Waste Reduction/Organics
-  Energy Efficiency
-  Solar



Education



Demonstration
Projects



Public
Engagement



Best
Practices



INDUSTRY TRENDS

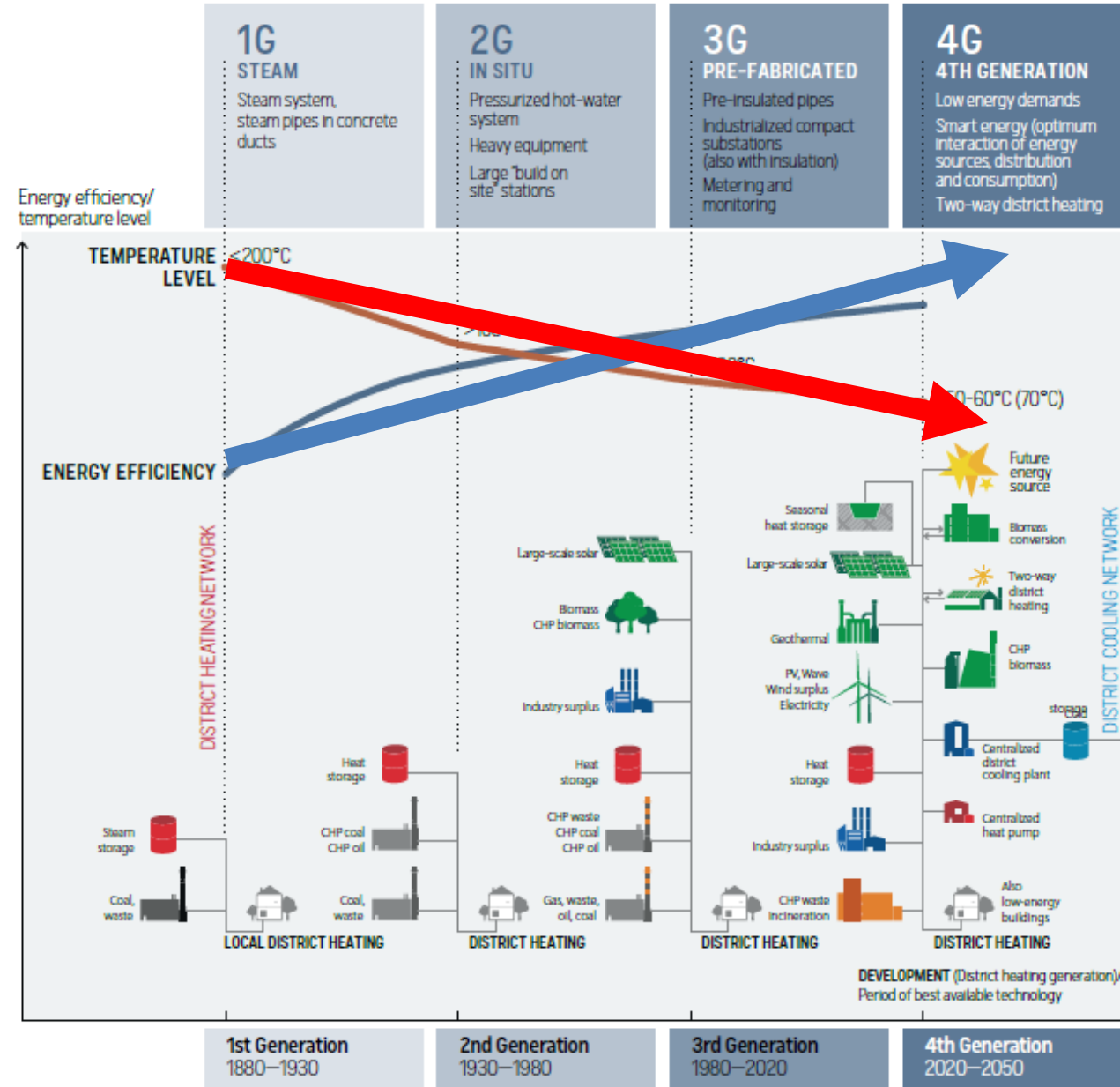


Societal Changes Driving Energy Sector Change

Broad changes are sweeping through society that will have a lasting impact on utilities

- Technology: Advancements are rapidly making new technologies available and cost-effective to implement
- Democracy: Consumers are increasingly taking control of their own destiny
- Climate: Reducing carbon in the U.S. economy is driving the need for energy system efficiency gains and development of low-carbon sources



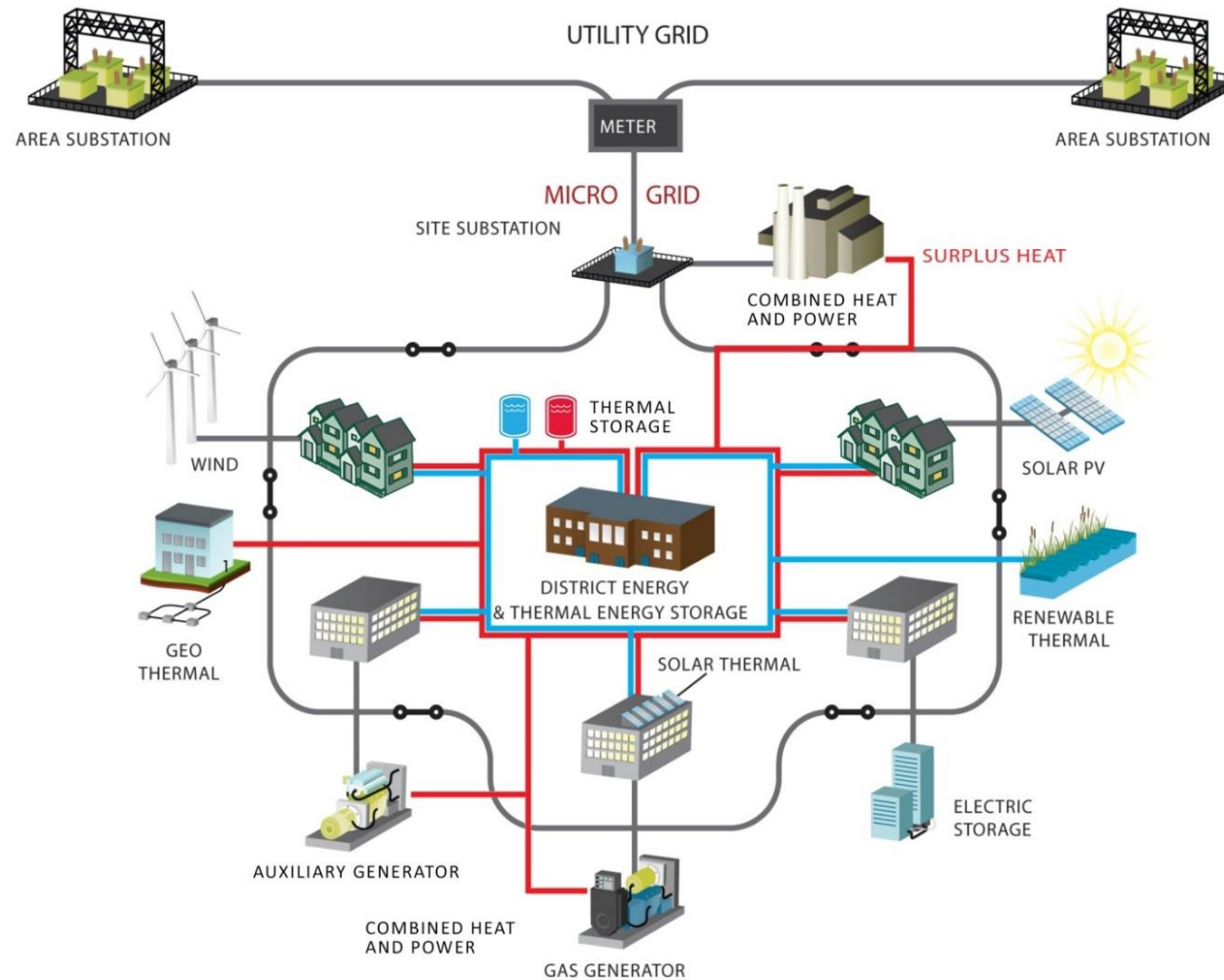


**Integration and
Renewables
Carbon/GHG**

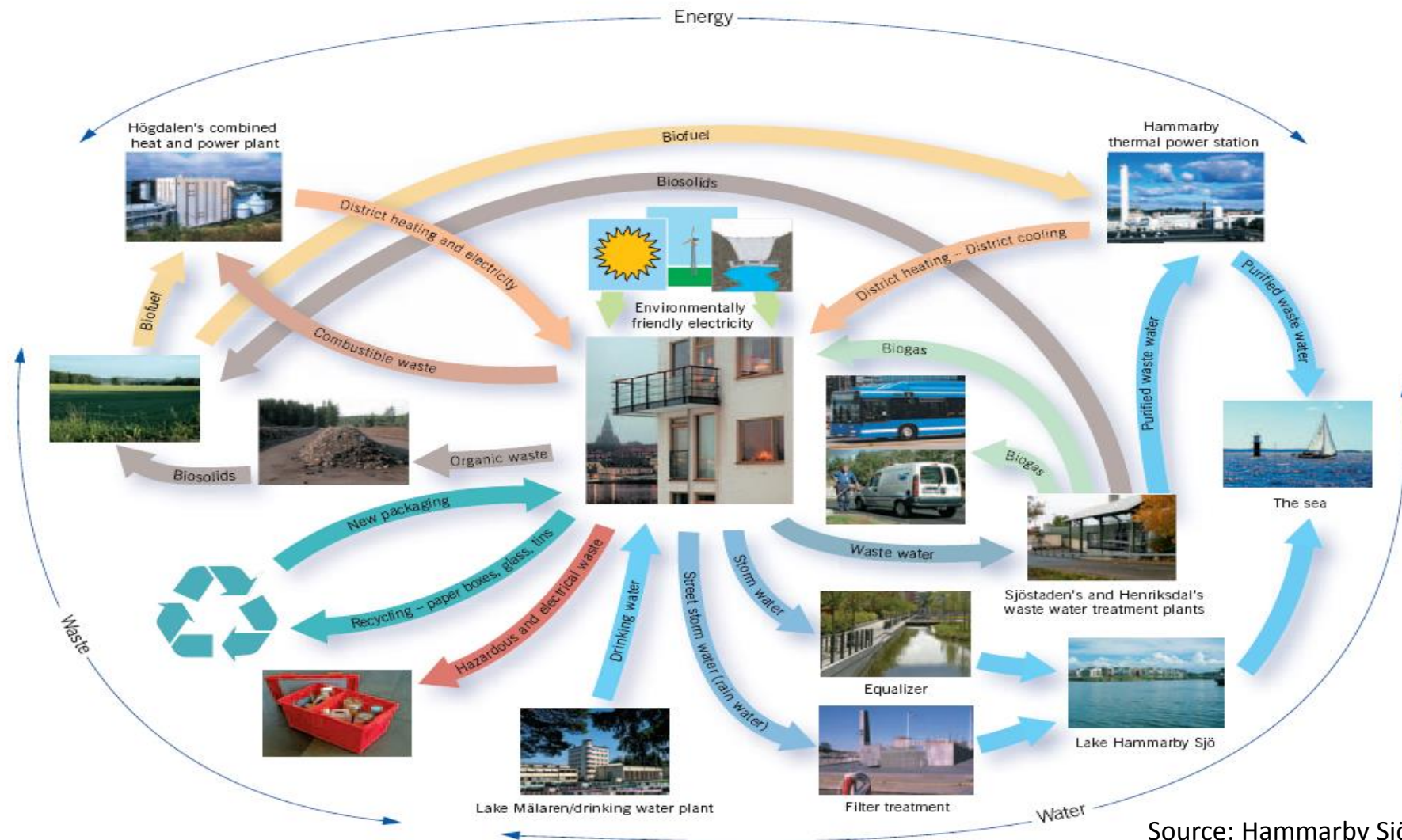
Source: Aalborg University and Danfoss District Energy, 2014



Smarter, Locally Integrated Energy Grids



Symbiotic Integrated Systems



Source: Hammarby Sjöstad



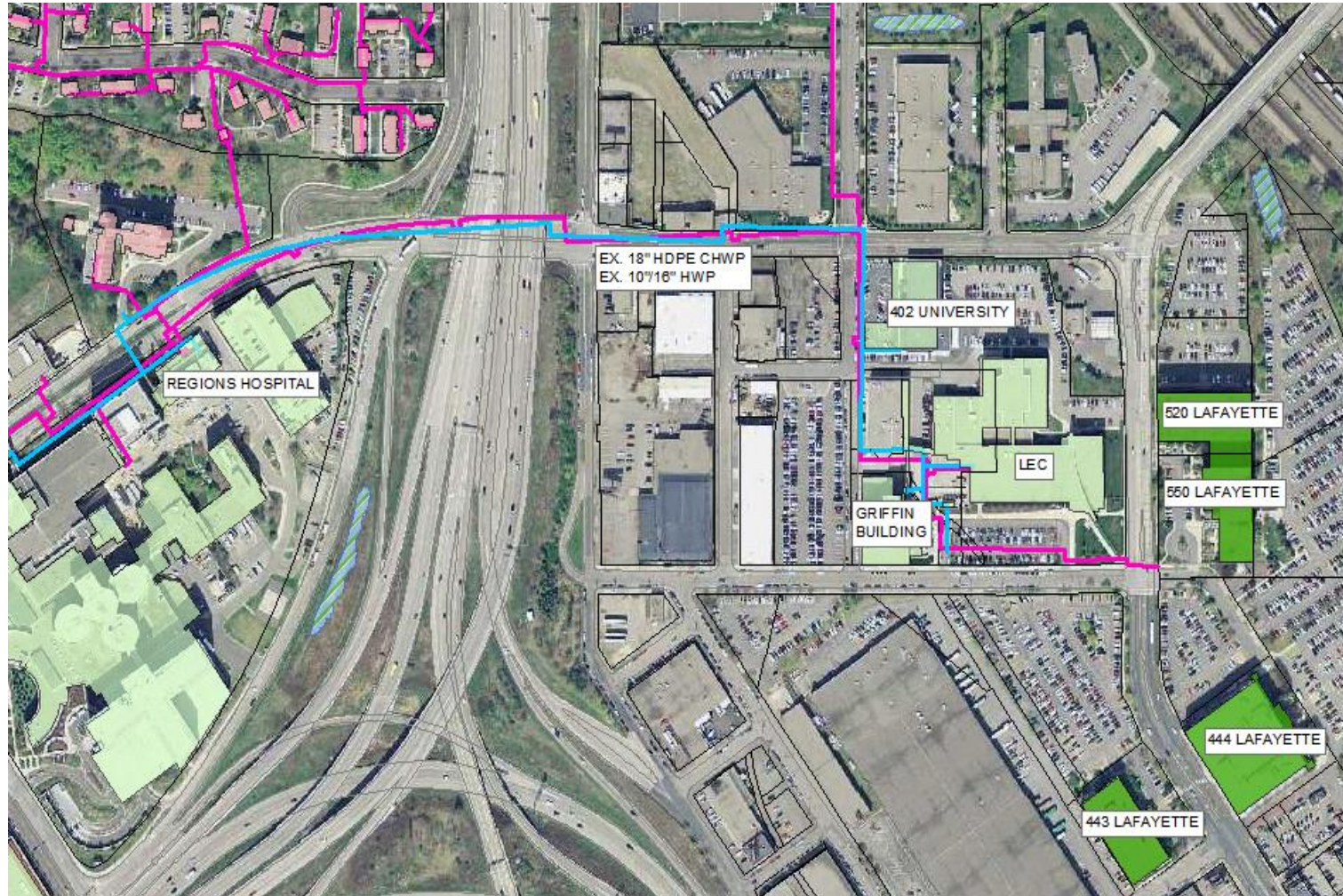
THE END OF COAL BY 2020 – 2021



Distributed Gas Generation



Secondary Core Water Loop Wastewater Energy Recovery



Waste Heat Recovery

- Local recycler
- Potential customer
- Waste heat
- Backup heating supply assets



Questions?

