Deep Energy Retrofit of Brown University’s Heating System
ON PATH TO CARBON NEUTRALITY
Agenda

Background

Current project

2017-2020

Carbon neutrality

2020-2040
Background
Current District Heating System
Current District Heating System
Current District Heating System
Current District Heating System
Decarbonization Plan
BROWN UNIVERSITY

2025
75% REDUCTION

2040
CARBON NEUTRAL
Thermal Efficiency Project (TEP)
TEP: Unified HW System
TEP ... on path to carbon neutrality

- Reduction of energy waste
- Conversion to lower temp hot water – necessary to electrification of heating

- 2025: 75% REDUCTION
- 2040: CARBON NEUTRAL
1. Reduce
   ...energy waste
   ...temperatures
   ...pressures
2. Rethink the systems
3. Repurpose existing assets
TEP – Delivery Model

1. Proposal
2. Integrated design and construction process
3. 1-yr performance tracking
TEP – Outcomes

OPERATIONAL
- Simplified maintenance
- Improved reliability

ENVIRONMENTAL
- 4,700 MTCDE/yr reduction
- 7.5M gallons/yr water savings

FINANCIAL
- $1M/yr guaranteed energy savings
- $1M incentives
- $16.8M avoided costs
- $25M investment
Buildings
Typical Steam Building
Repurpose Steam Radiators for HW use

Demolition:
1. Remove inside part of existing steam trap to make it hollow to let water flow.
2. Unscrew or cut supply, existing valve to be demolished.

Cleaning:
1. New air vent watts model has provided and installed by the following contractor. (Air vent installed during cleaning phase; same air vent as in adjacent construction view)

Construction:
1. New air vent watts model has provided and installed by the following contractor.
2. New flow cartridge provided by ecosystem but installed by the following contractor. Install 5 pipe diameters downstream of new control valve and 2 diameters upstream of fitting.
3. New control valve, see plan view and schedule.

Little field steam to hot water radiator conversion
Scale: None
Repurpose Steam Risers for HW use
Dual heat recovery / hot water coils
DISTRIBUTION
Secondary Loop (Steam Hubs)
Steam Hub
STATUS QUO

2 steam networks
  ‣ Heating (8”)
  ‣ Process (4”)
Steam Hub

PLANNED WORK

- New HW piping
- High cost
- High impact
- Budget: $4.3M
Steam Hub

TEP: New Piping
Steam Hub
KEY INNOVATION FOR CONVERSION

- Repurposed majority of steam piping
- Cut costs by 50%
Steam Hub Conversion
KEY INNOVATION: Inverted supply-return arrangement

AS THE FLOW DECREASES, HOT WATER SUPPLY IS SENT IN THE SMALLER PIPE
DISTRIBUTION
Primary Loop
Primary District Loop Re-engineering

- BioMed
  - Last bldg
  - Biggest EUI
  - In series
Central Heating Plant
Central Heating Plant Conversion
Converting the Boilers

- 3 x 80,000 lbs/hr
- Keystone O-type
- 150 psig steam
Converting the Boiler
Converting Boiler from Steam to HW
NEXT STEP
Carbon Neutrality
Campus Decarbonization Plan
BROWN UNIVERSITY

2020
- 40 MW Solar PV
- 8 MW Wind
- THERMAL EFFICIENCY PROJECT
  Remove steam and lower hot water temperature 50% total carbon reduction

2023
- LIQUID BIOFUEL CONVERSION OF CENTRAL PLANT
  80-85% scope 1 carbon reduction

2024-2035
- BUILDING RENOVATIONS
  LOWER HOT WATER LOOP TEMPERATURE TO 185°F
  *Continue to evaluate low carbon technologies

2035-2040
- ELECTRICAL UPGRADES
  CONVERT CEP TO AIR SOURCE HEAT PUMPS (ASHP)
Ecosystem

- Founded in Quebec, 1993
- Market driven by the lowest electricity costs in North America
- Drove innovation and 26-yr expertise in:
  1. Electrification of heating
  2. Heat pump applications
  3. Steam to hot water conversion

To date, Ecosystem has successfully designed, implemented, guaranteed, and optimized more than

250 Projects

Worth

$780M

In

1,525+ Buildings