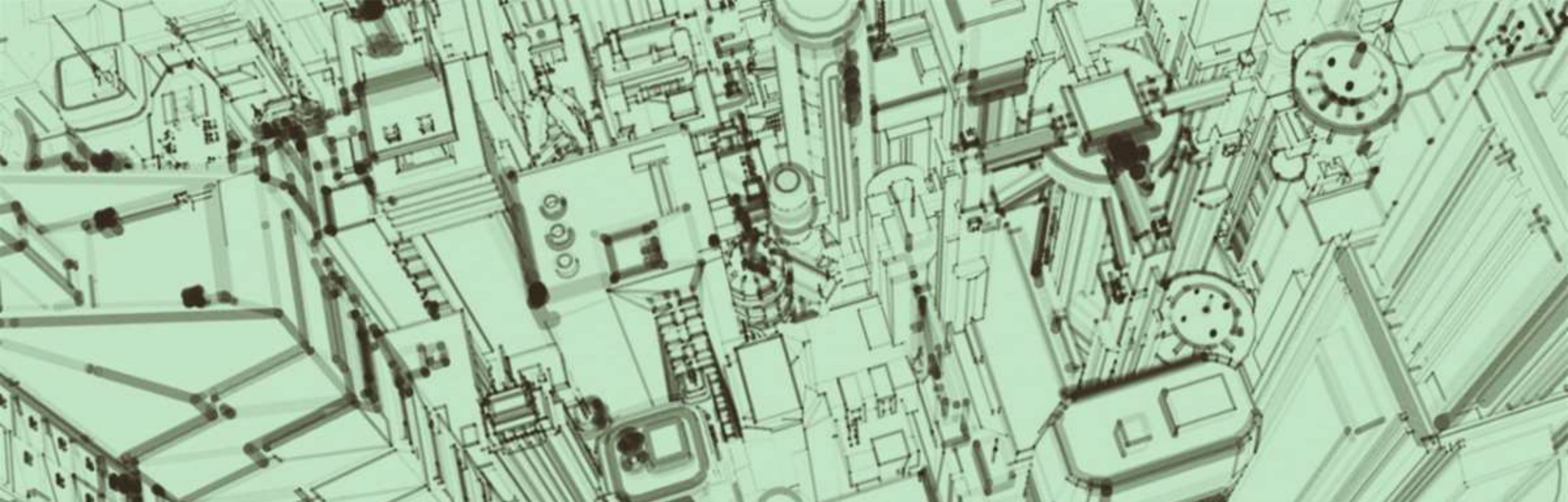




Best Practices in District Energy/CHP

Project Life Cycles Series: Part 1



Best Practices in District Energy/CHP: Project Life Cycles
is generously supported by the
US Department of Energy Office of Energy Efficiency and Renewable Energy:
Industrial Efficiency & Decarbonization Office



For more information on the project:
<https://www.districtenergy.org/doebestpractices/home>

Housekeeping

Webinar and Q&A Format

This webinar is scheduled for one hour, including the presentation and approximately 15 minutes for Q&A, which will take place which will take place following the panel discussion. Please submit any questions in the Q&A box. If needed, the webinar will extend past the hour to answer as many audience questions as we can.

This webinar will be recorded and streamed on the IDEA website within 24 hours of the conclusion of this webinar. Registrants will also be sent a follow-up email with links to the recording and presentation slides.

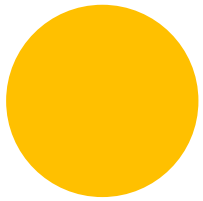
How to Submit Questions

Please submit questions via the “Q&A” box during the presentation portion of the webinar. The Q&A icon can be found in the menu bar at the bottom of your screen. Questions will be reviewed by IDEA and posed to the presenters by the host at the conclusion of their presentation.

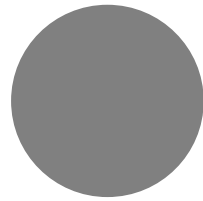


If you are having audio or video issues, please send a note via the Chat Box to our host, Jason Beal.

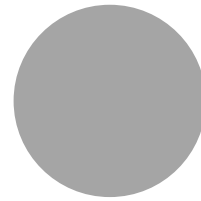
• *Project Life Cycles: A 4 Part Series*



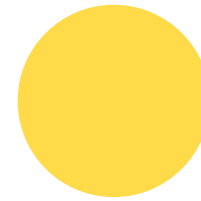
- Project Development
- November 8, 2023



- Engineering
- December 2023



- Implementation
- January 2023



- Maintenance & Lessons Learned
- February 2023

• Panelists



- Ted Borer
- Energy Plant Director
- Princeton University



- Meghan Riesterer
- Chief Sustainability Officer & SVP ESG & Decarbonization
- CenTrio



- Dave Woodson
- Executive Director, Campus Energy, Utilities, and Operations
- University of Washington



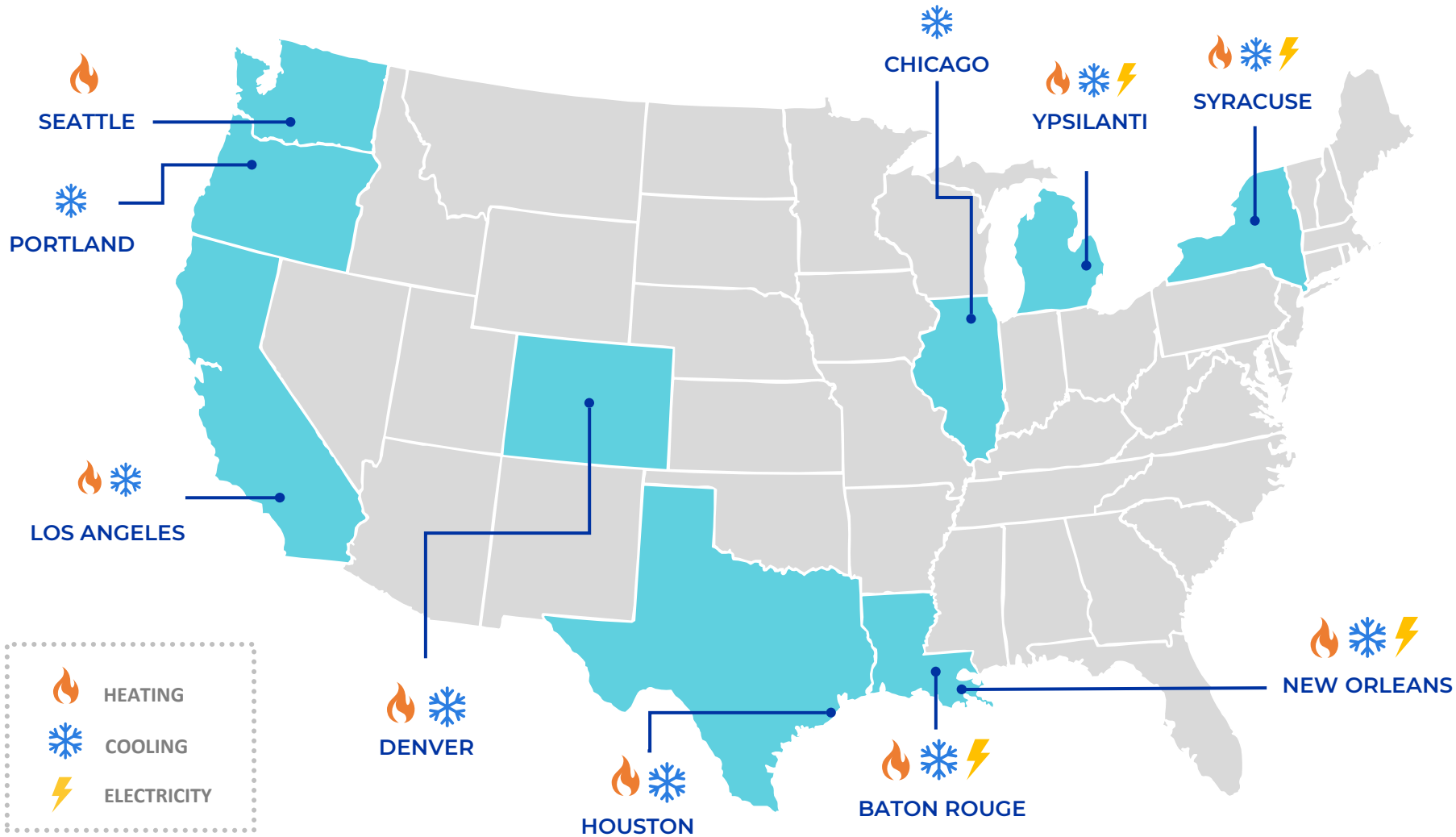
- Paul Zmick
- Director of Energy and Utilities
- University of Virginia

PART 1: PROJECT DEVELOPMENT

Best Practices in
District Energy/CHP:
Project Life Cycles

► November 8, 2023
1:00 PM – 2:30 PM CST

CENTRIO SYSTEMS



BY THE NUMBERS



200+
Employees



370+
Customers



140+ msqft
Served



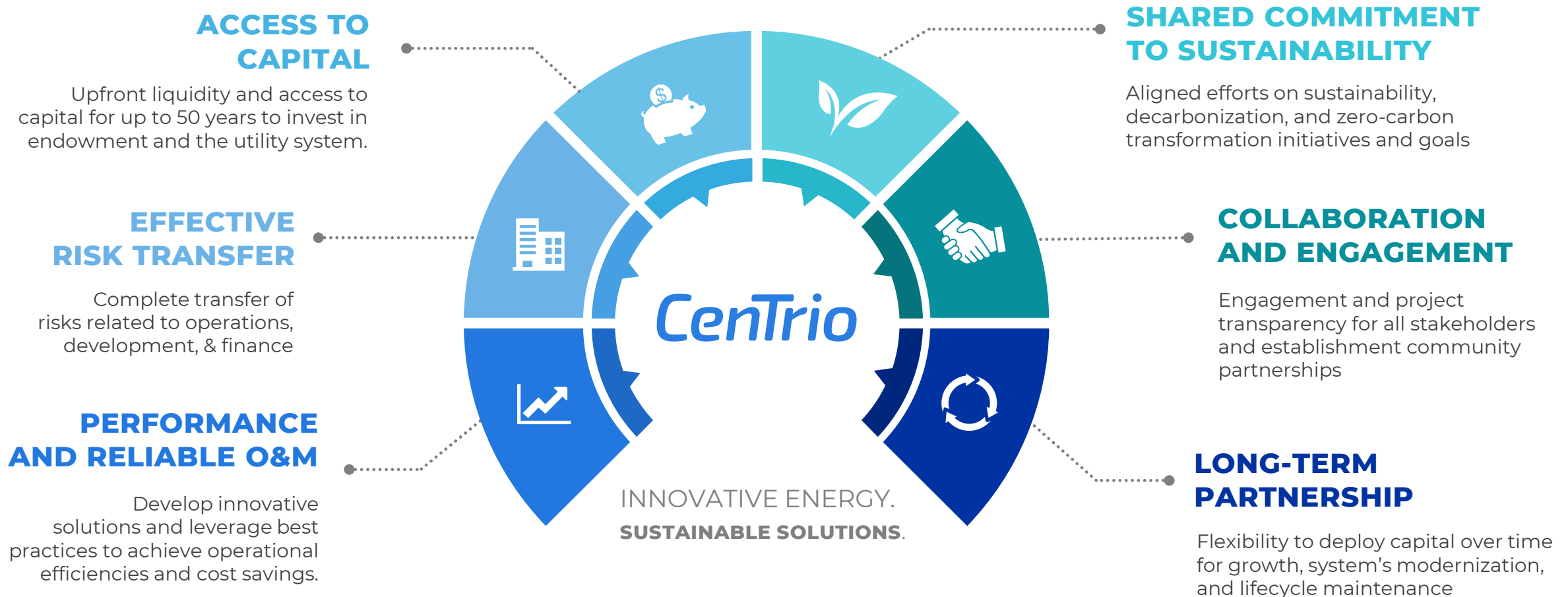
660 kton
Cooling



1,300 kpph
heating

DELIVERING THE ULTIMATE VALUE

CenTrio brings the best combination of development expertise, financial strength, operational excellence, advanced technology, and commitment to a long-term partnership - aligning with clients' goals:



PROVEN PERFORMANCE



- Upfront Utility System modernization of \$125 million
- \$90 million energy savings for LSU
- ~\$375 million capital improvements over 30 years
- Academic Collaboration



- Upfront Utility System modernization of \$118 million
- Upfront Payment of \$100 million to invest in endowment
- ~\$200 million capital improvements over 30 years
- Academic collaboration; 3rd Party Customers; Affordable housing expansion



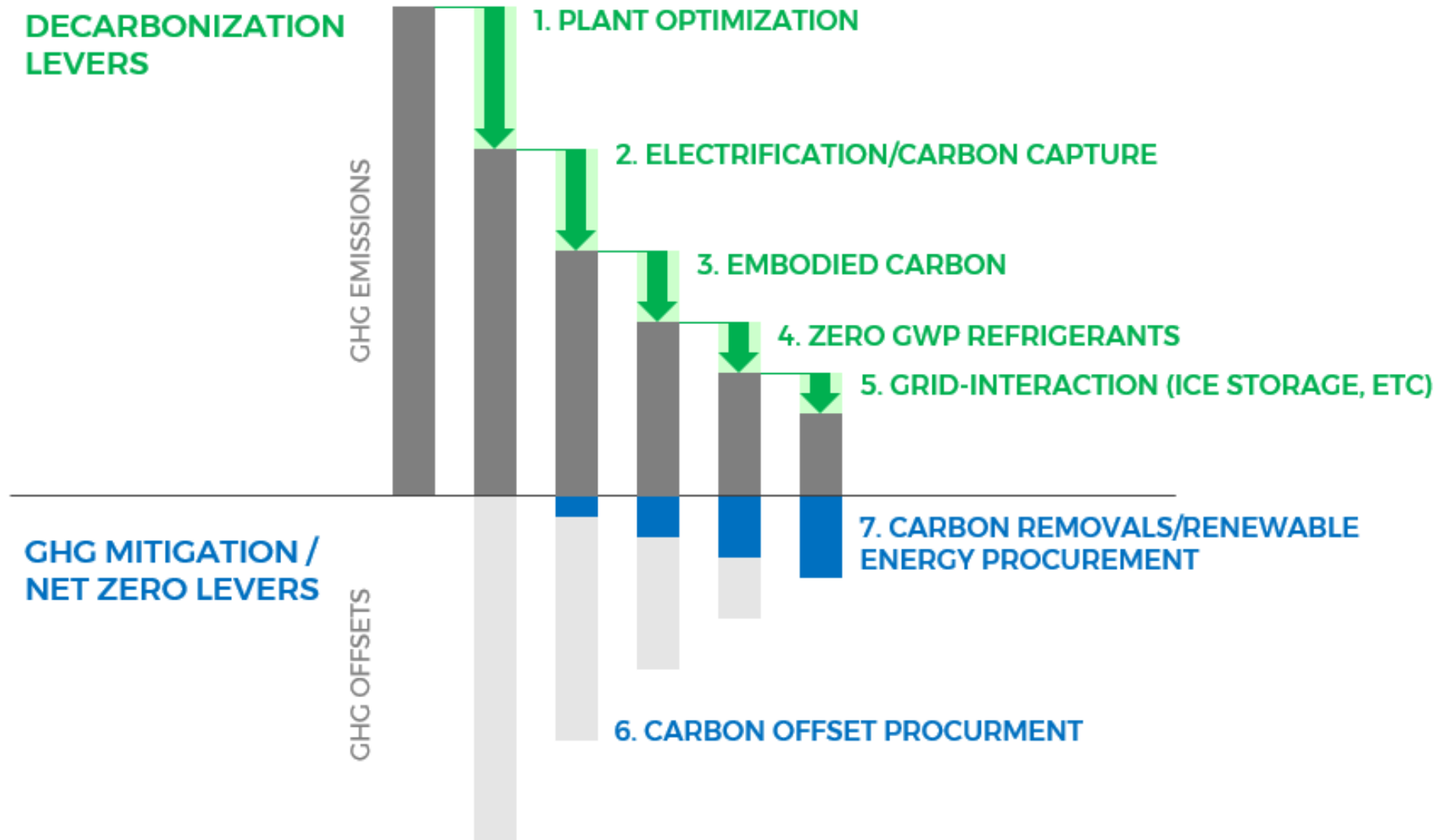
COLORADO STATE
UNIVERSITY

- North America's Largest Sewer Waste Heat Recovery System
- Carbon reduction 70%; 4 million gallons (80%) reduced water consumption
- Academic collaboration with CSU; Community benefit engagement programs



- Modernize, manage, and operate the downtown NOLA district energy system
- 2015 35-year concession agreement

LOW/NO CARBON SYSTEM LEVERS





CenTrio

INNOVATIVE ENERGY.
SUSTAINABLE SOLUTIONS.

CenTrio - Headquarters

1301 McKinney St, Ste 2060
Houston, TX 77010
713.315.5200

centrioenergy.com

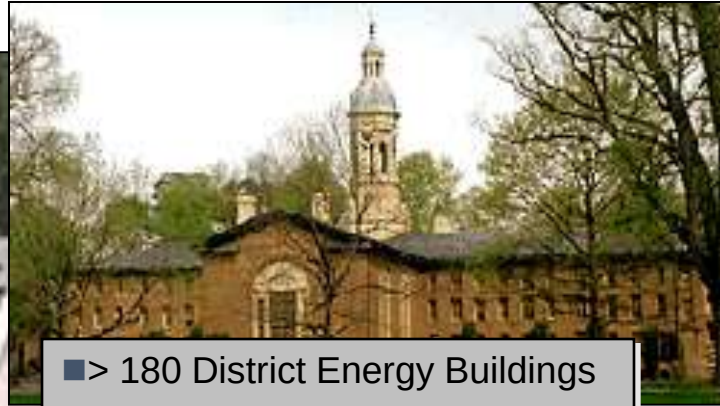


Princeton University

- Private liberal arts
- Established 1746
- 5,590 undergrad
- 3,212 graduate
- 7800 faculty & staff
- ~ 10 million square feet of conditioned space
- District Steam: 1860's
- Cogeneration: 1890's
- District Chilled Water: 1960's
- District Hot Water: 2023!



Energy Demands at Princeton



■ > 180 District Energy Buildings

- Academic
- Research
- Administrative
- Residential
- Athletic



Today's Energy Equipment and Peak Demands

- **Electricity**

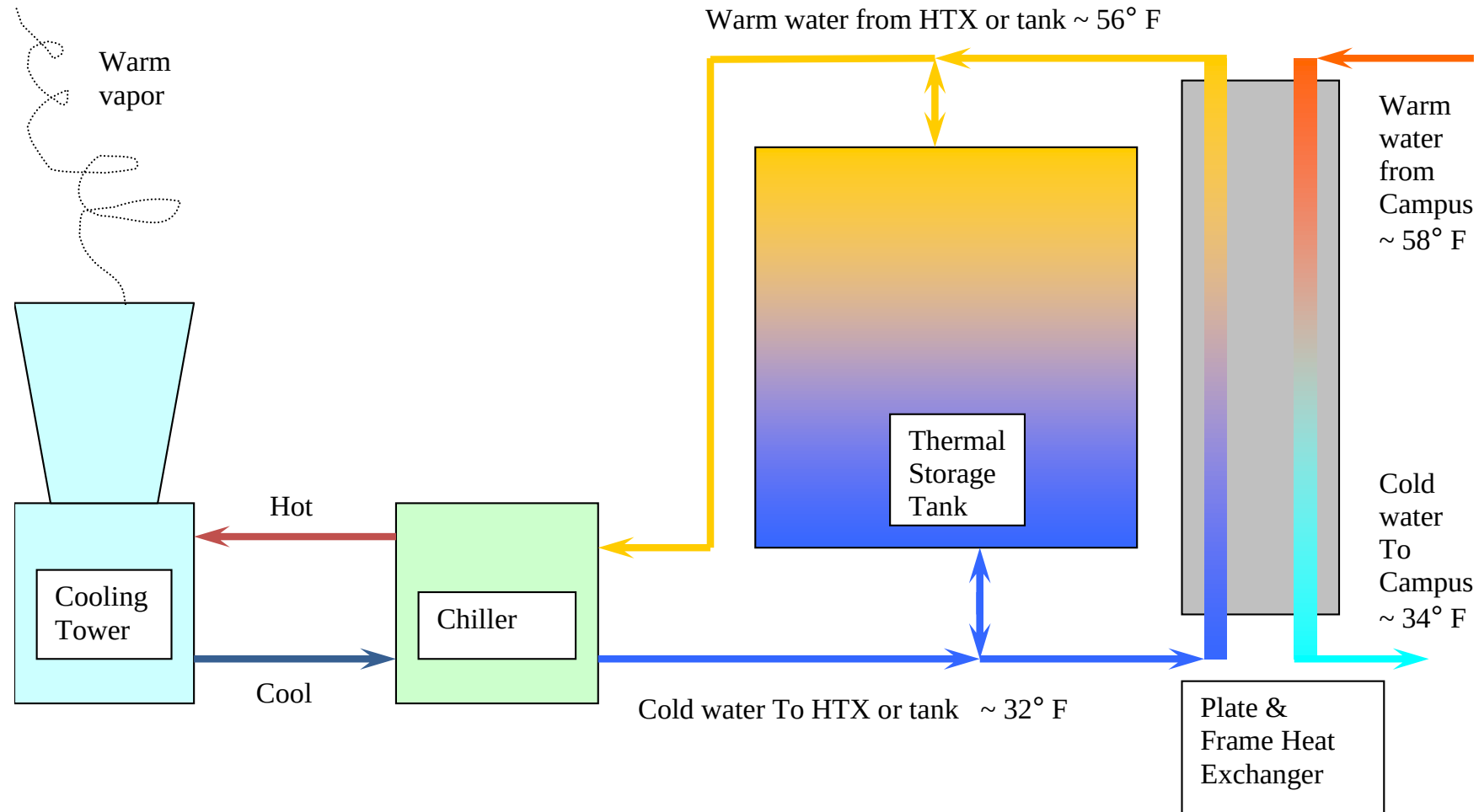
- (1) Gas Turbine Generator
- Solar Photovoltaic System

	<u>Capacity</u>	<u>Peak Demand</u>
(1) Gas Turbine Generator	15.0 MW	27 MW
Solar Photovoltaic System	16.5 MW	
(1) Heat Recovery Boiler	180,000 #/hr	
(2) Auxiliary Boilers @ 150 ea.	300,000 #/hr	240,000 #/hr (70.3 MW heating)
(3) Steam-Driven Chillers	10,100 Tons	
(5) Electric Chillers	10,700 Tons	15,000 Tons (52.7 MW cooling)
(1) Thermal Storage Tank	40,000 Ton-hours	
• *peak discharge	10,000 tons (peak)	

- **Steam Generation**

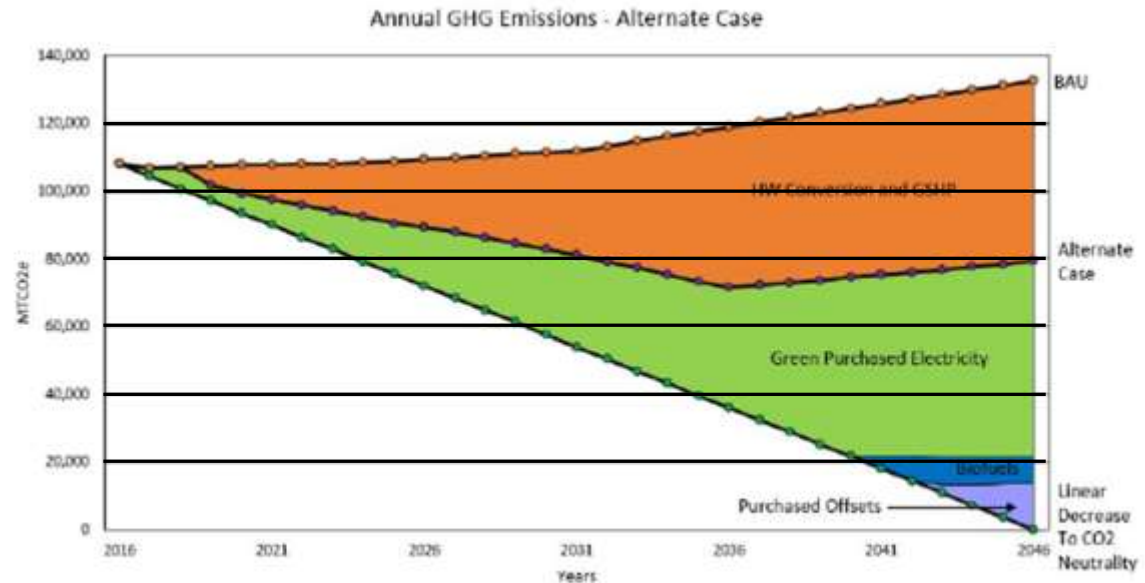
- **Chilled Water Production**

Chilled Water & Thermal Storage



Goal: Carbon Neutrality

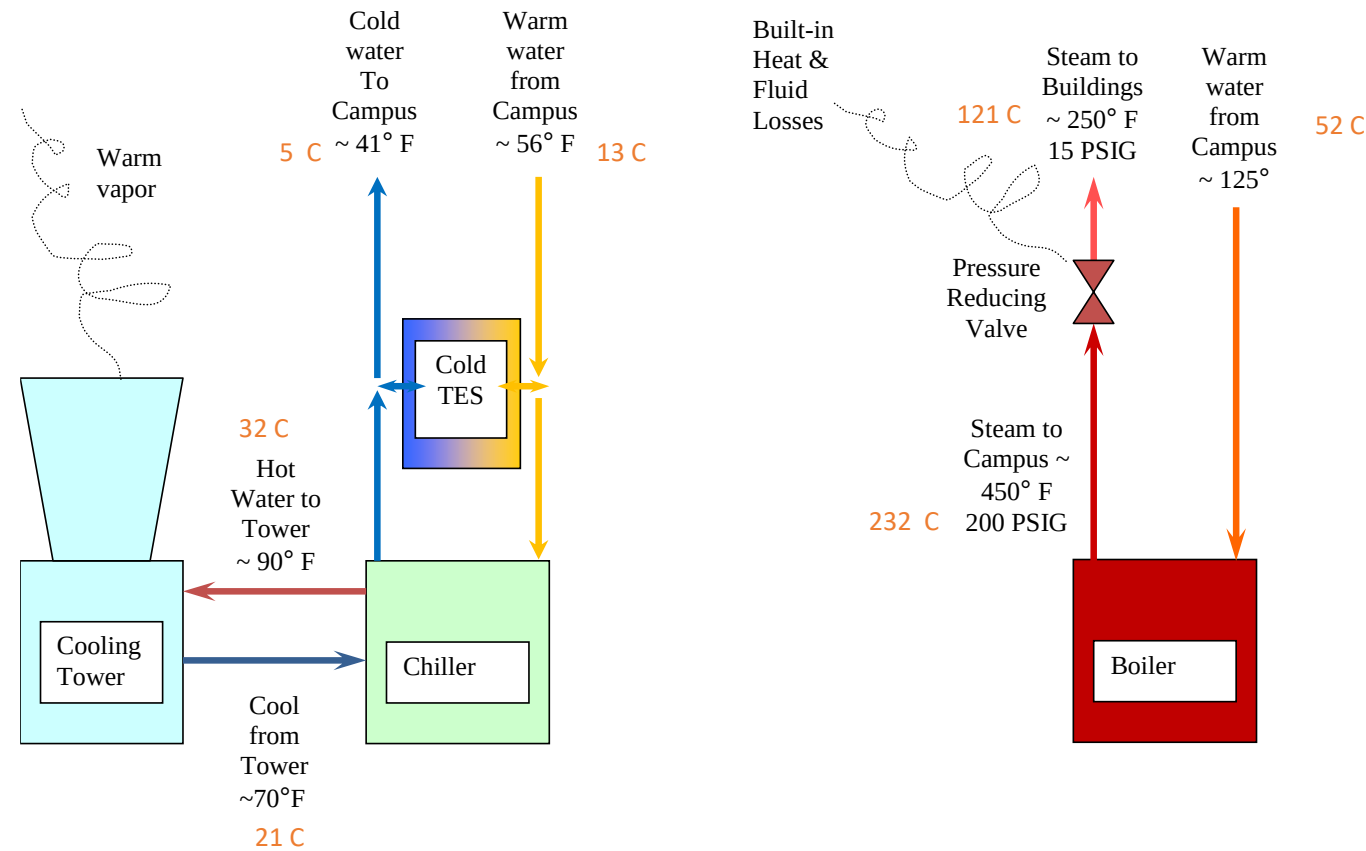
- Carbon Neutrality by 2046
- Continuous downward slope from present



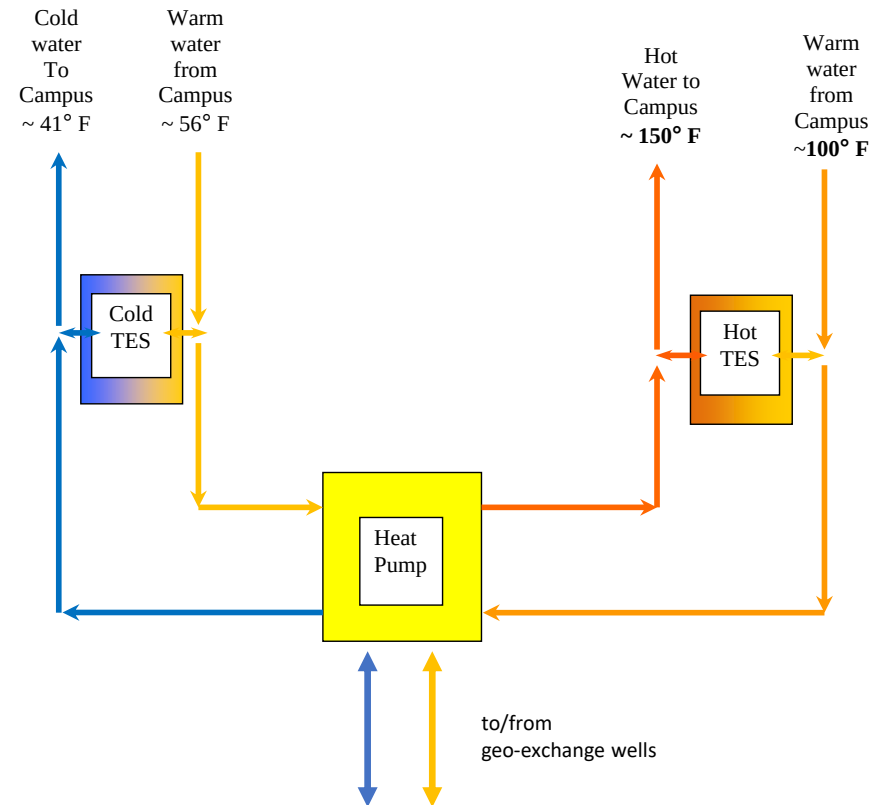
Major Areas of Work to Minimize Carbon Footprint:

- High performance envelope, passive design, use of hot water for heating
- Replace district steam system with district hot water system
- Create electric-powered Heat Pump facility
- Create daily thermal storage – tanks
- Create seasonal thermal storage – geoexchange
- Install on-site renewable energy production – solar PV
- Supplement with off-site renewable energy

Separate Heat Removal (CHW) & Addition (Steam)

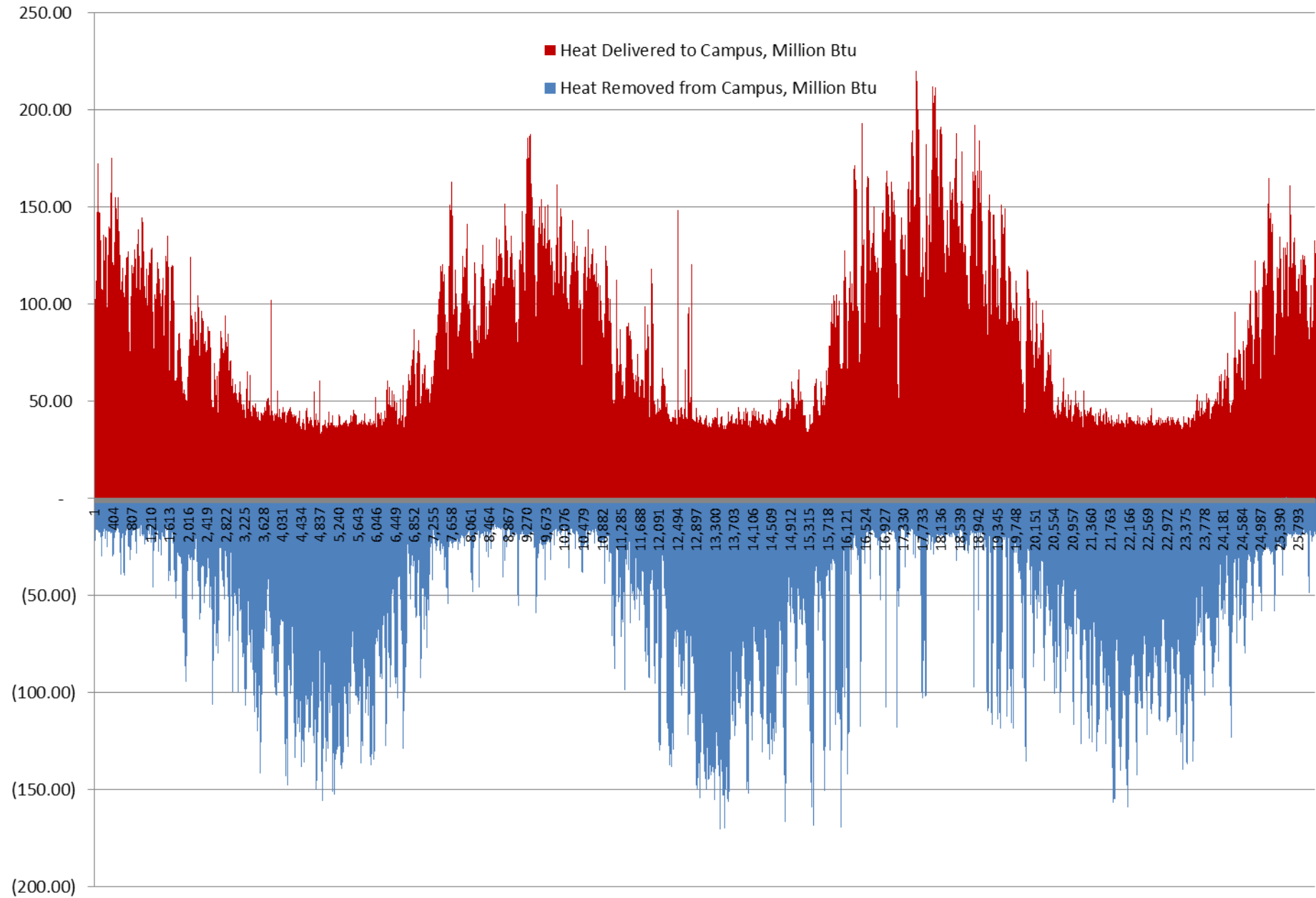


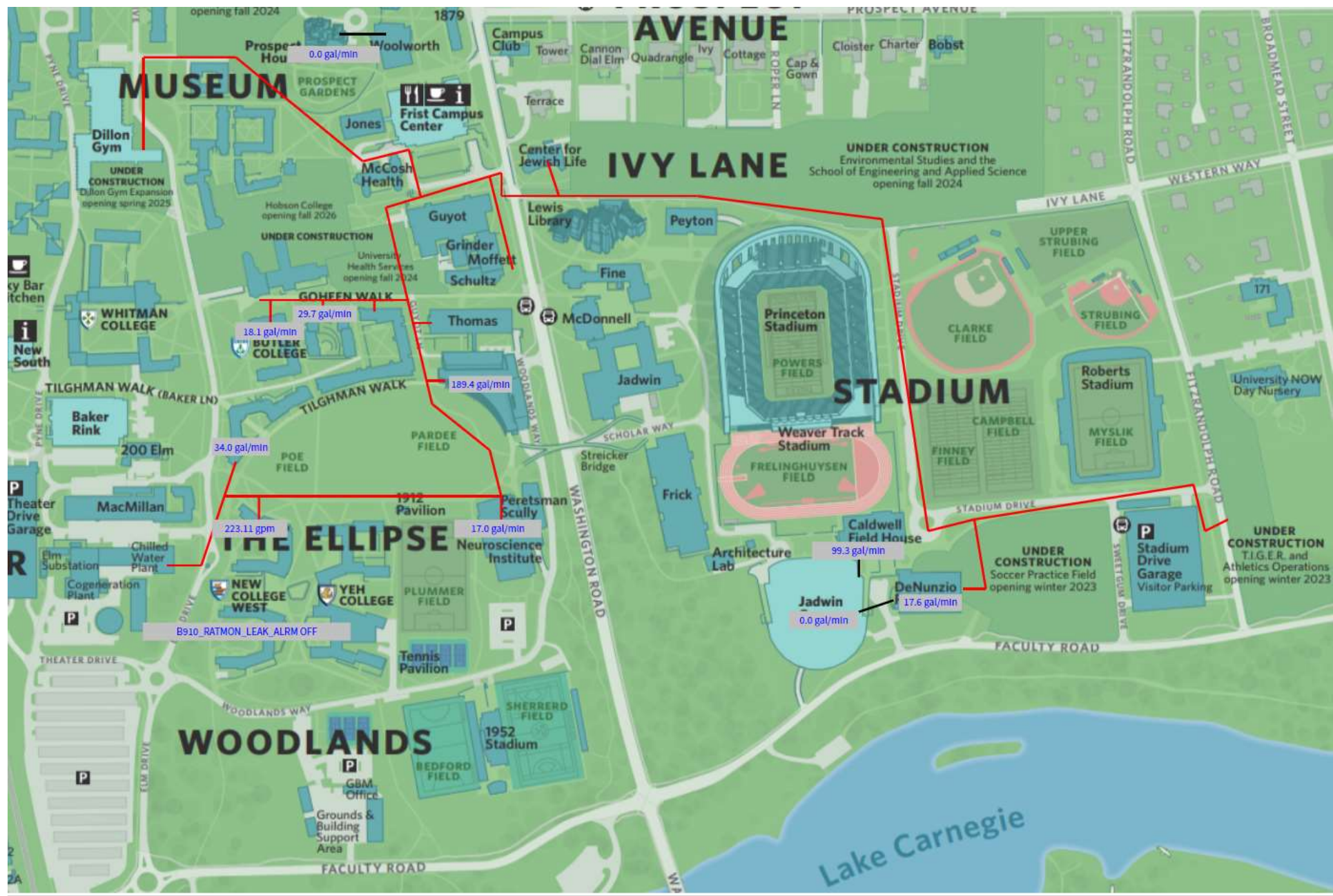
Combined Heat Removal (CHW) & Addition (HTW)



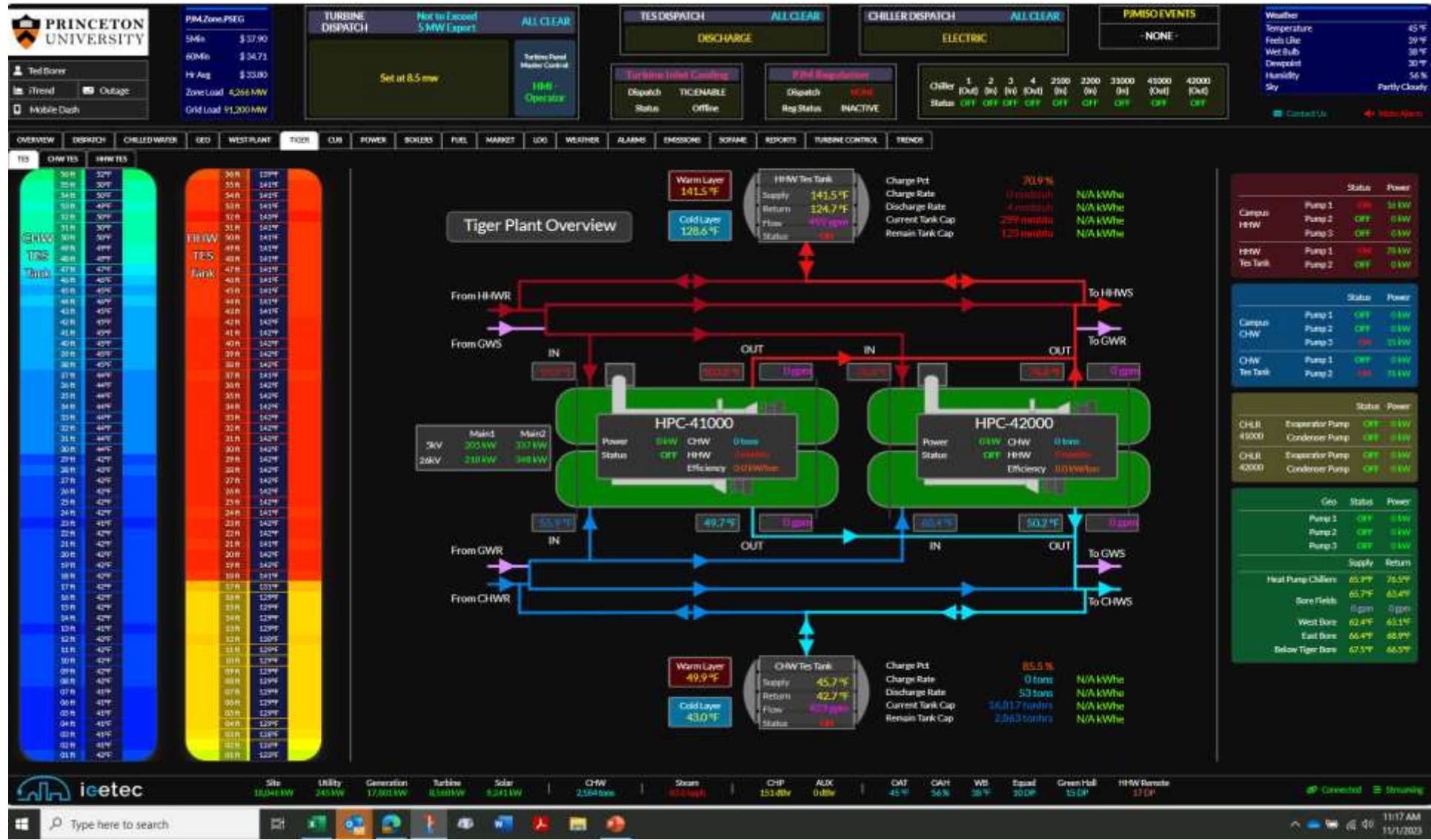
Hourly Heat Addition to campus and heat removal from campus

3-year period, Jan 2012 - Dec 2014





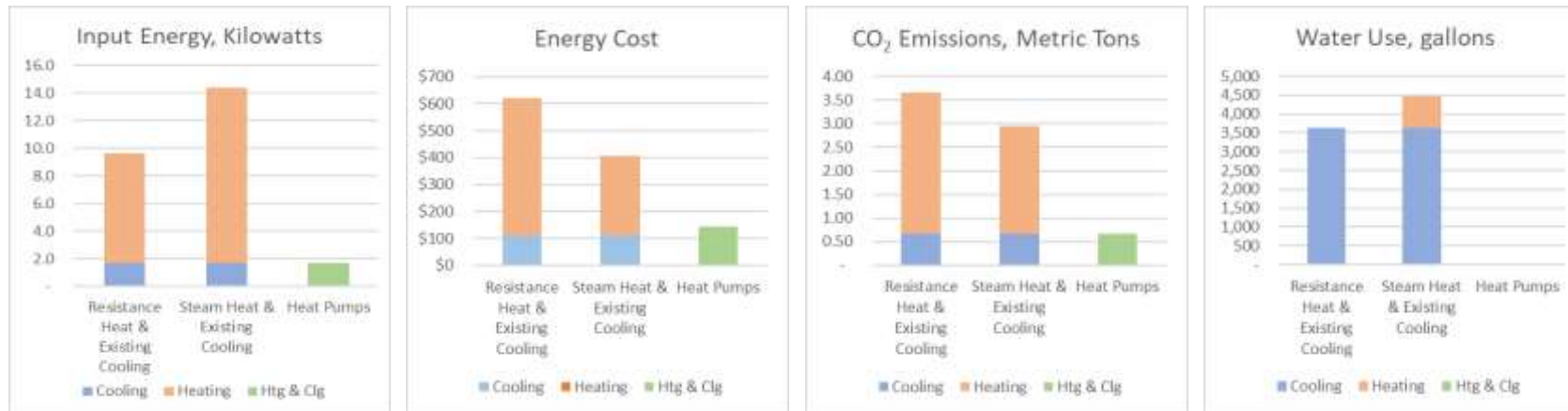
TIGER Economic Dispatch Screen



Geoexchange Monitoring



Summary of Change to Heat Pumps

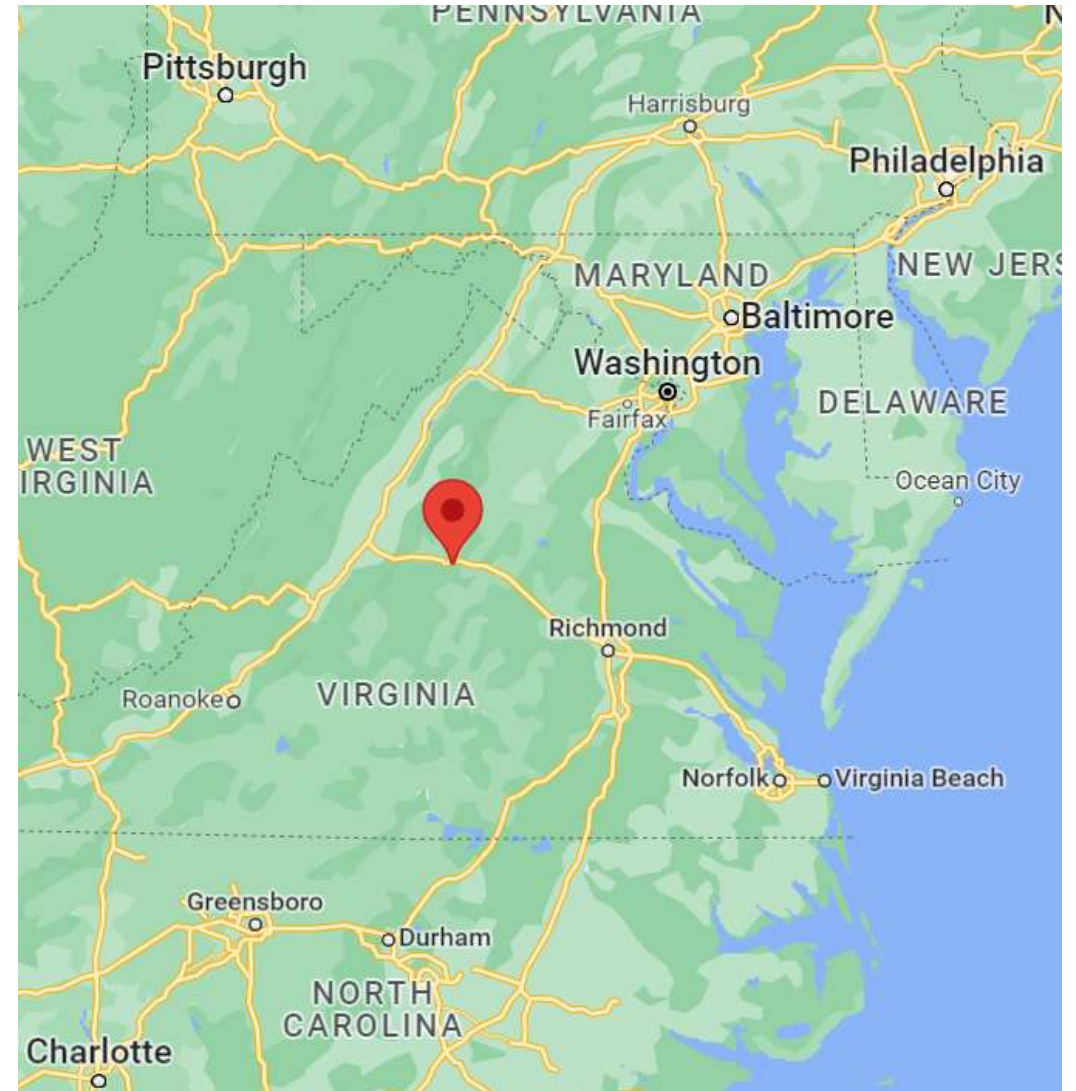


Natural Gas fuel input for steam production is shown as energy-equivalent Kilowatts.

UVA Today

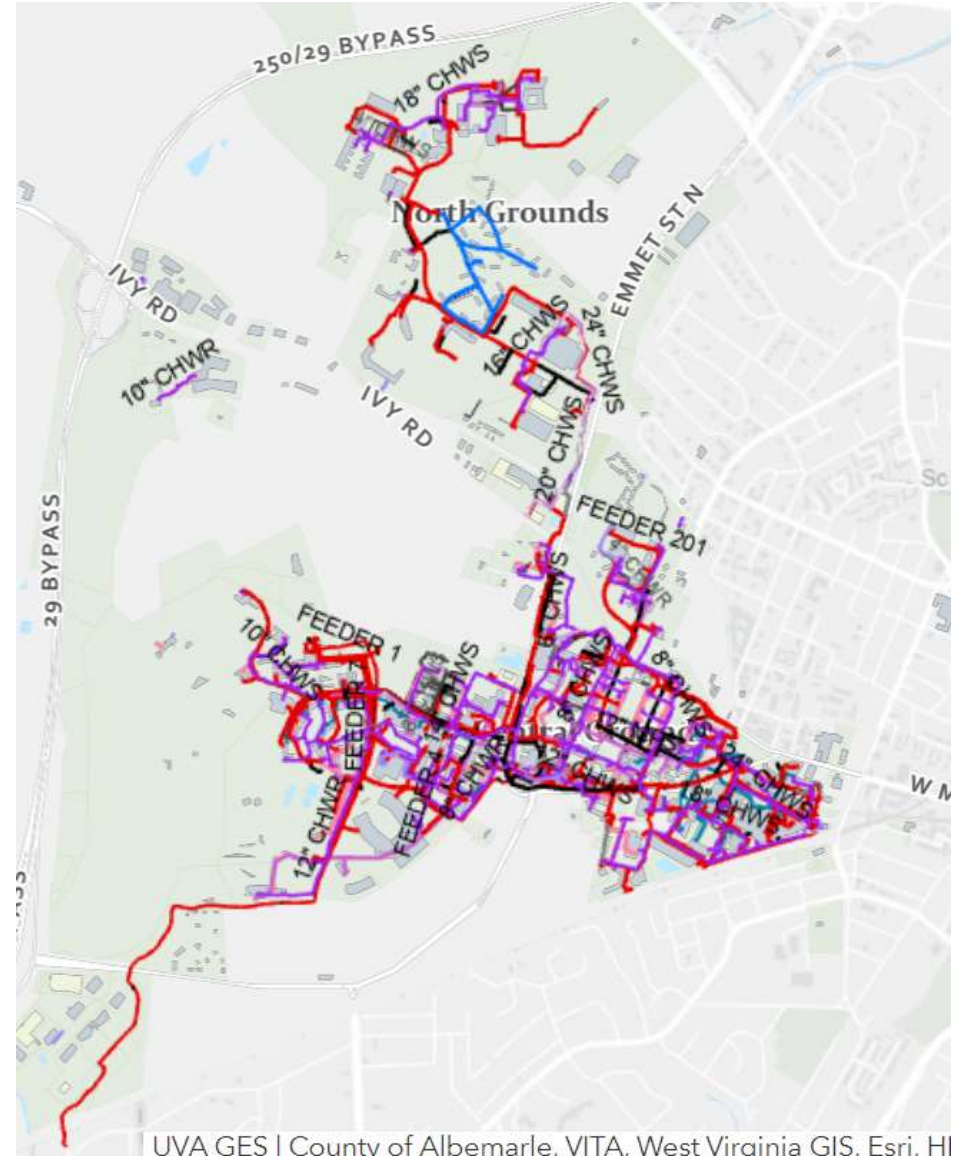


- Founded in 1819 ... 204 years old
- Public University
- 19.1M SQFT
- 569 Buildings
- 1240 Acres on Grounds
- 25.3K Enrollment
- 22.8K Employees



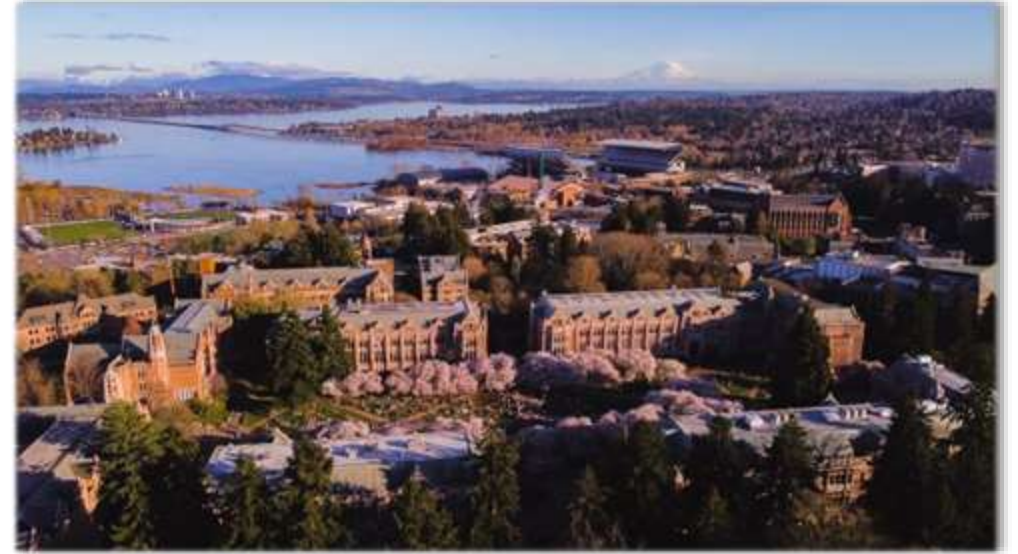
UVA Energy & Utilities

- 58 miles of steam, hot water, and chilled water
 - 43 miles of 13kV power
 - 6.3 miles of walkable tunnels
-
- 5 thermal utility plants
 - 9 chilled water plants
 - 6 heating loops
 - 7 chilled water loops
 - 1 2M gallon CHW TES
 - 3 13kV substations



UW Overview

- ❖ Founded in 1861 as the Territorial University of Washington
 - Seattle Campus moved to its current location in 1895
 - Composed of three campuses: Seattle, Tacoma and Bothell
 - 2022 Enrollment – 60,106
 - Square footage – 29.3 million
 - 7.5 miles of utility tunnels



UNIVERSITY *of* WASHINGTON

University of Washington

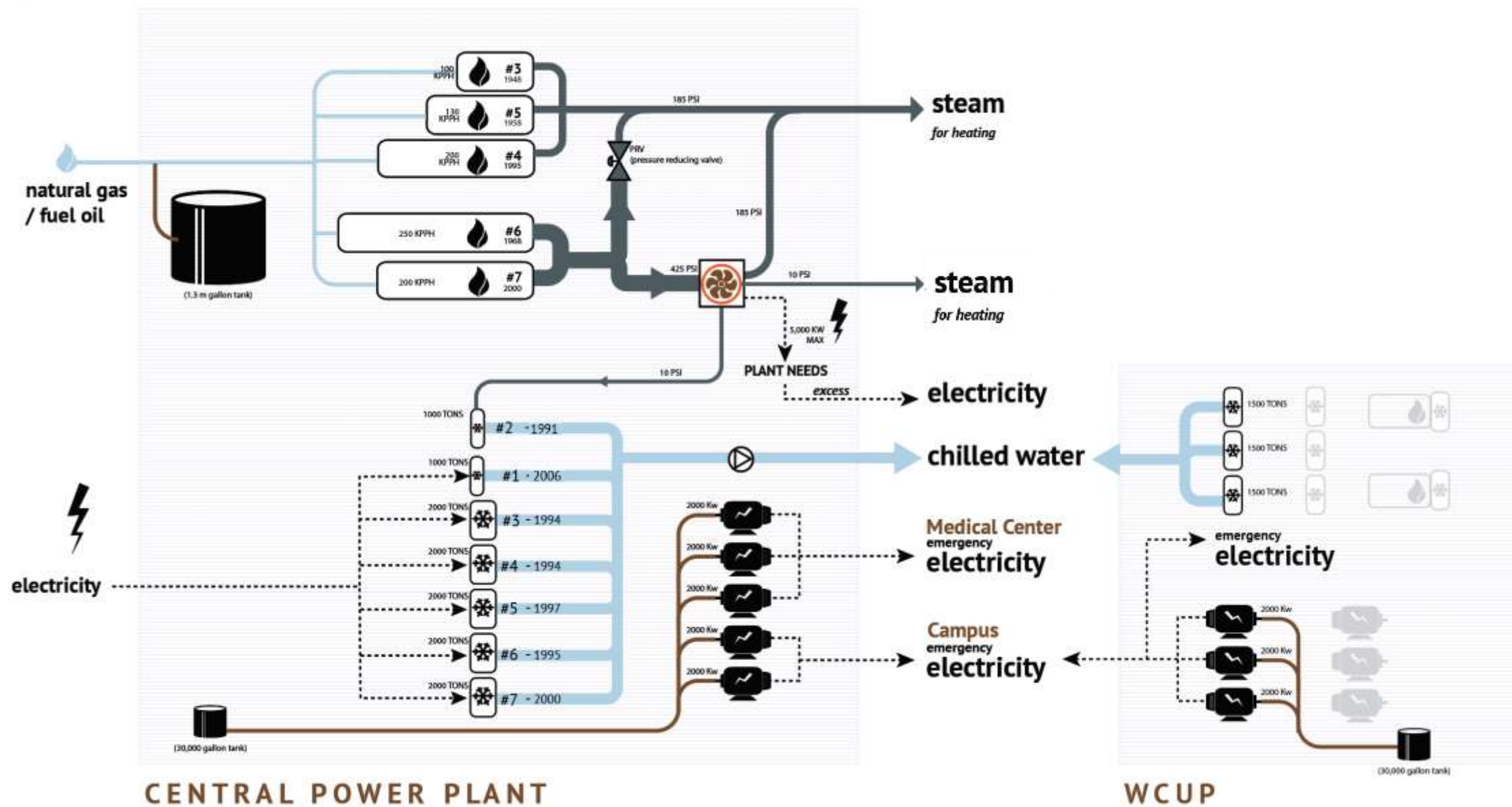
- Seattle Campus
- 14.7M SQFT (E&G)
- 200 Buildings
- 700 Acres
- 50K Enrollment
- 22K Employees

The Current Facility is the Third Steam Plant Built by the UW

- The first plant built in 1895 was replaced in 1901, which was then replaced by the 1908 plant, the site of the current plant.
- Primary fuel - Natural Gas
- Power purchased from Seattle City Light (100% carbon neutral)



Current plant



Today's Energy Equipment and Peak Demands

• Electricity

(1) Gas Turbine Generator

Capacity

3.0 MW

Peak Demand

54 MW

• Steam Generation

- (3) Boilers @ ~200 ea.
- (2) Boilers @ ~100 ea

~850,000 #/hr

350,000 #/hr

(102 MW heating)

• Chilled Water Production

- (1) Steam-Driven Chiller
- (9) Electric Chillers

1,000 Tons

15,000 Tons

16,000 Tons

(56 MW cooling)



Energy Renewal Plan - Drivers



#1 Source of Direct Emissions, UW's power plant represents 93% of the UW Seattle Campus GHG emissions.

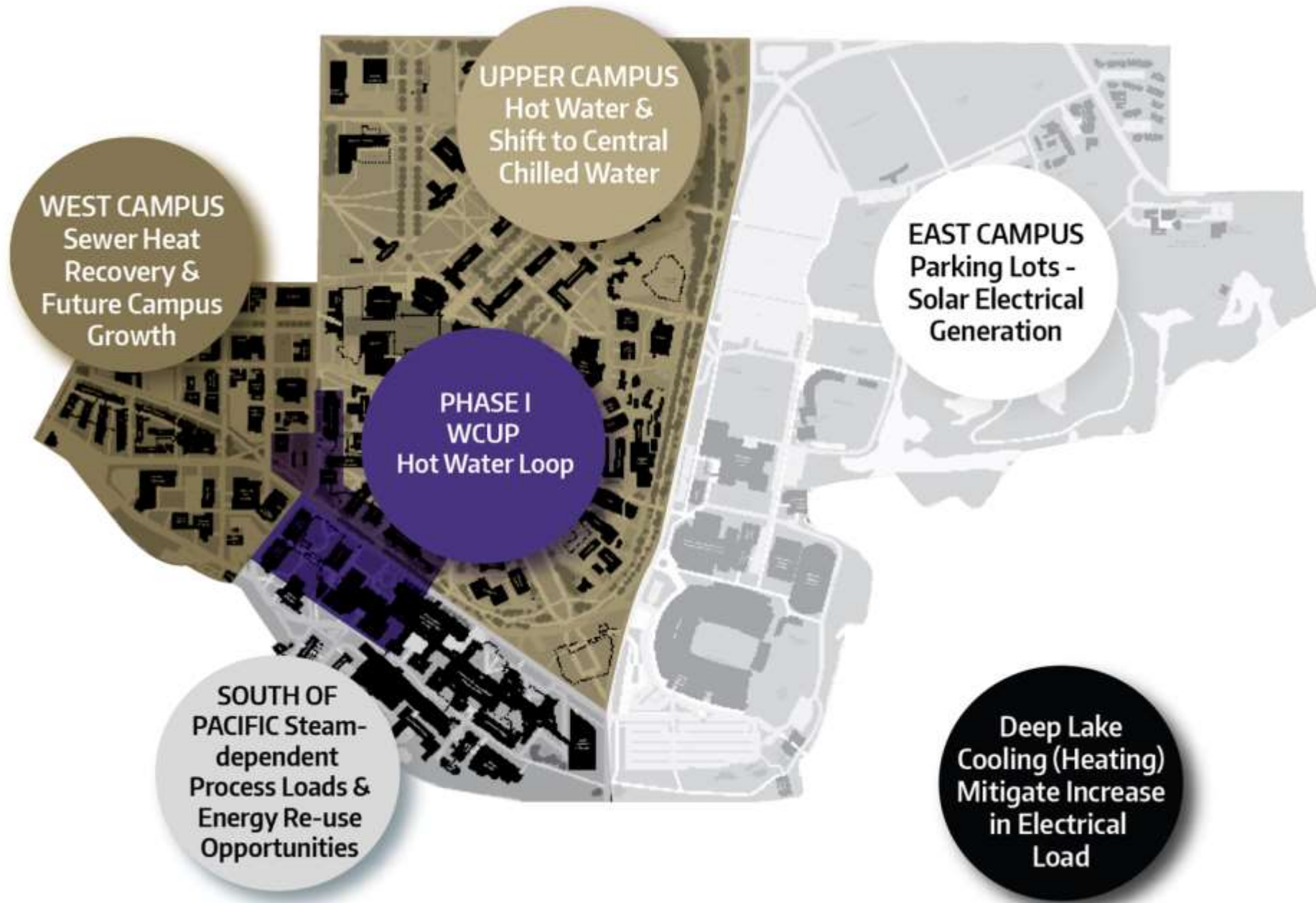
Required by Legislation, the Washington State Clean Building Performance Standard Act requires that state-owned district energy systems have a decarbonization plan in place by June 2025.

Energy Efficiency, collectively UW's buildings consume twice as much energy as they should.

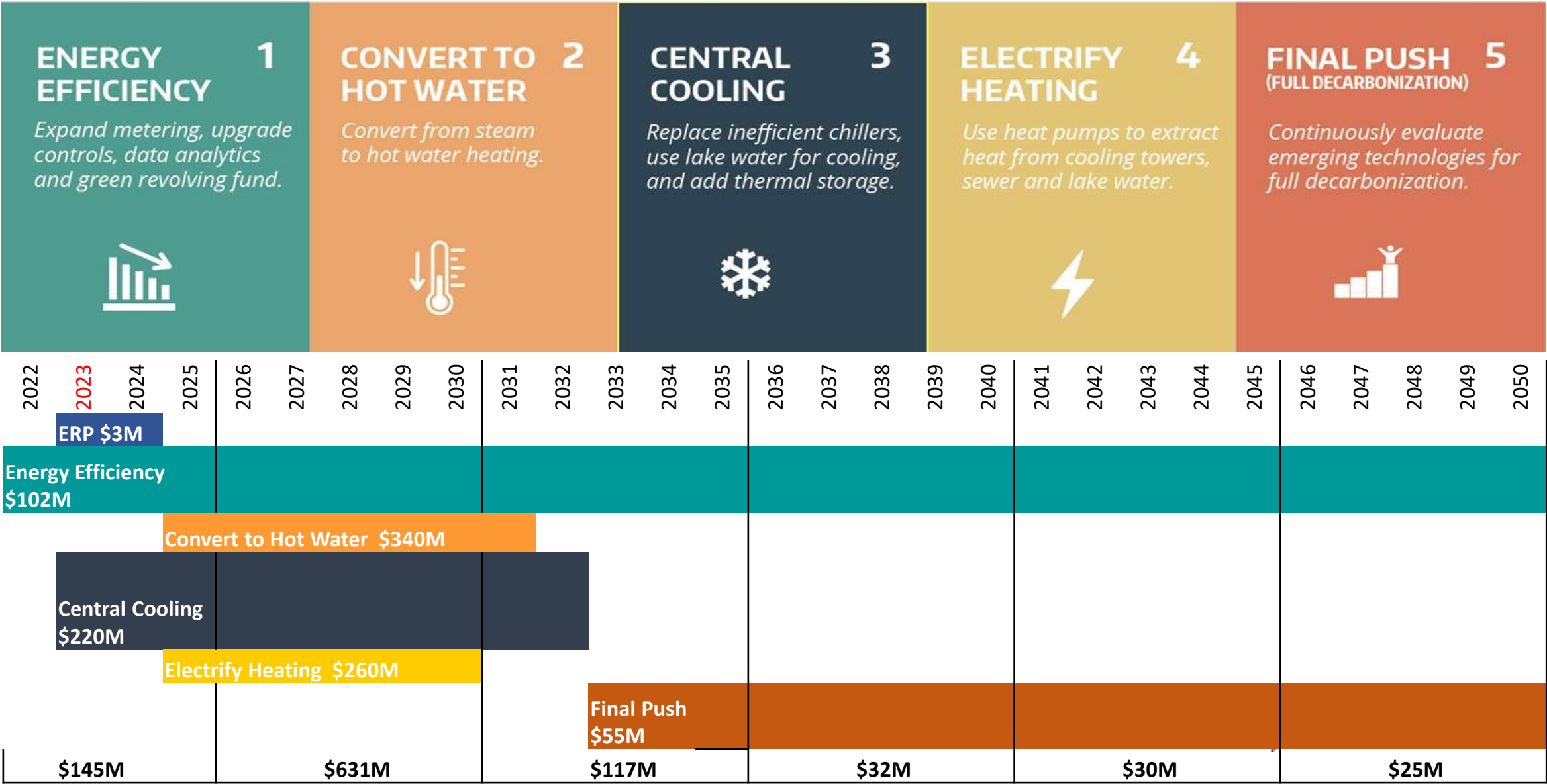
Aging Steam Plant, investments will be required anyway. Better to invest in new infrastructure that addresses energy needs

Reliable & resilient energy systems essential to support world class research and healthcare.

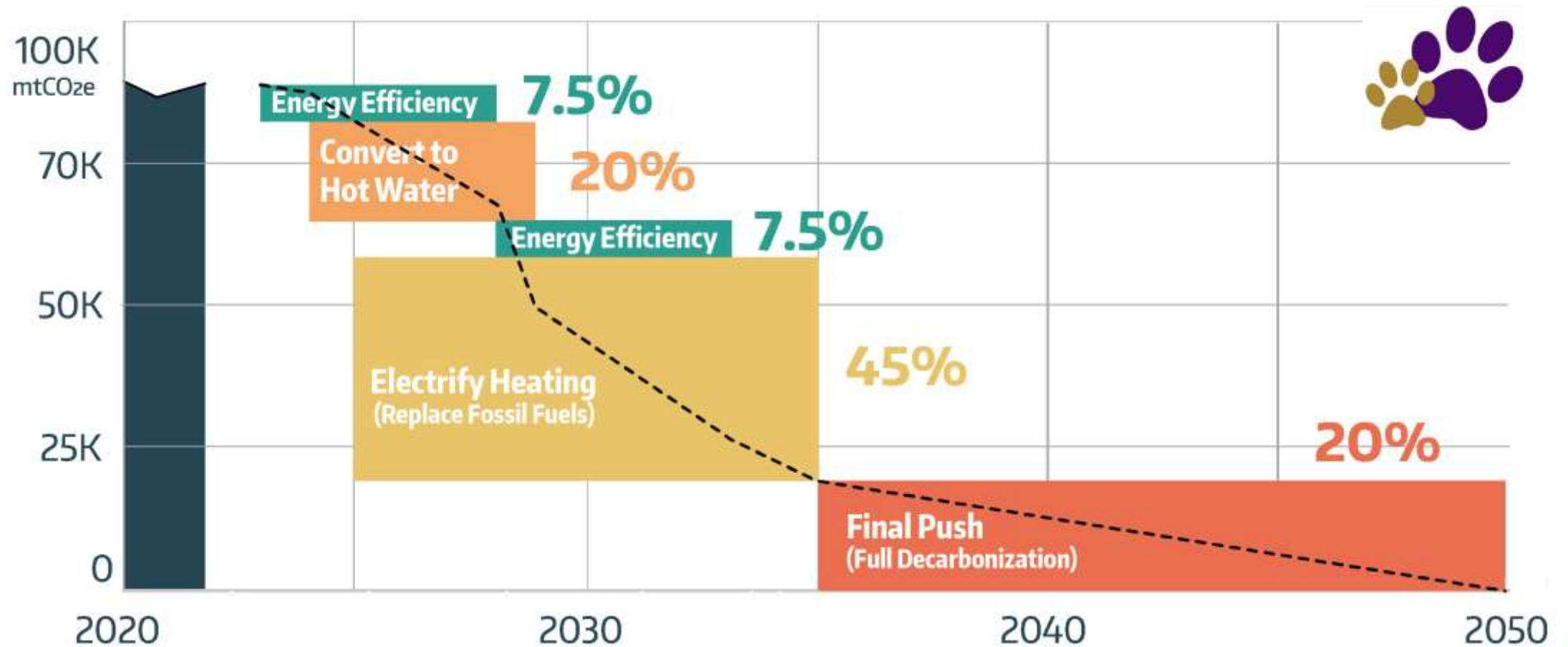
New funding available, the federal Inflation Reduction Act and the State's Climate Commitment Act will be the primary sources of the energy renewal funding strategy.



5-PART TRANSFORMATION STRATEGY



Path to a carbon-free Seattle campus



Power Plant Project Update - Turbine Generator Installation

Generator startup and testing is scheduled for 8/17/2023!



New Switchgear, piping and supports 8/7/2023



Lube Oil Skid installed 7/3/2023

What's Next at IDEEA?



CampusEnergy2024 registration

<https://bit.ly/CampusEnergy24Reg>

Preliminary Technical Program now online

<https://bit.ly/IDEACampus24Ed>

Looking to exhibit or sponsor? Contact Tanya Kozel at tanya.idea@districtenergy.org to reserve space.



Call for Presentations for IDEA2024, taking place in Orlando, **June 17-20, 2024 is now open!**
Deadline to submit is December 1, 2023.

Submit Abstract: <https://bit.ly/CFP-IDEA2024>



Upcoming Online Webinars

Thursday, November 9 – District Energy Women's Initiative Virtual Meetup - <https://bit.ly/DEWINov9>

Wed, November 29 – “IDEA Geothermal Symposium” at 1:00pm EST (online)
<https://bit.ly/IDEA-GeoSymposium>

As always, registration is free to all.

If you can't make it, register anyway and the recordings will be sent to you the next day.