



# University of Pittsburgh: Growing a Campus and Community While Reducing Energy, Water and Emissions



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## Essentials

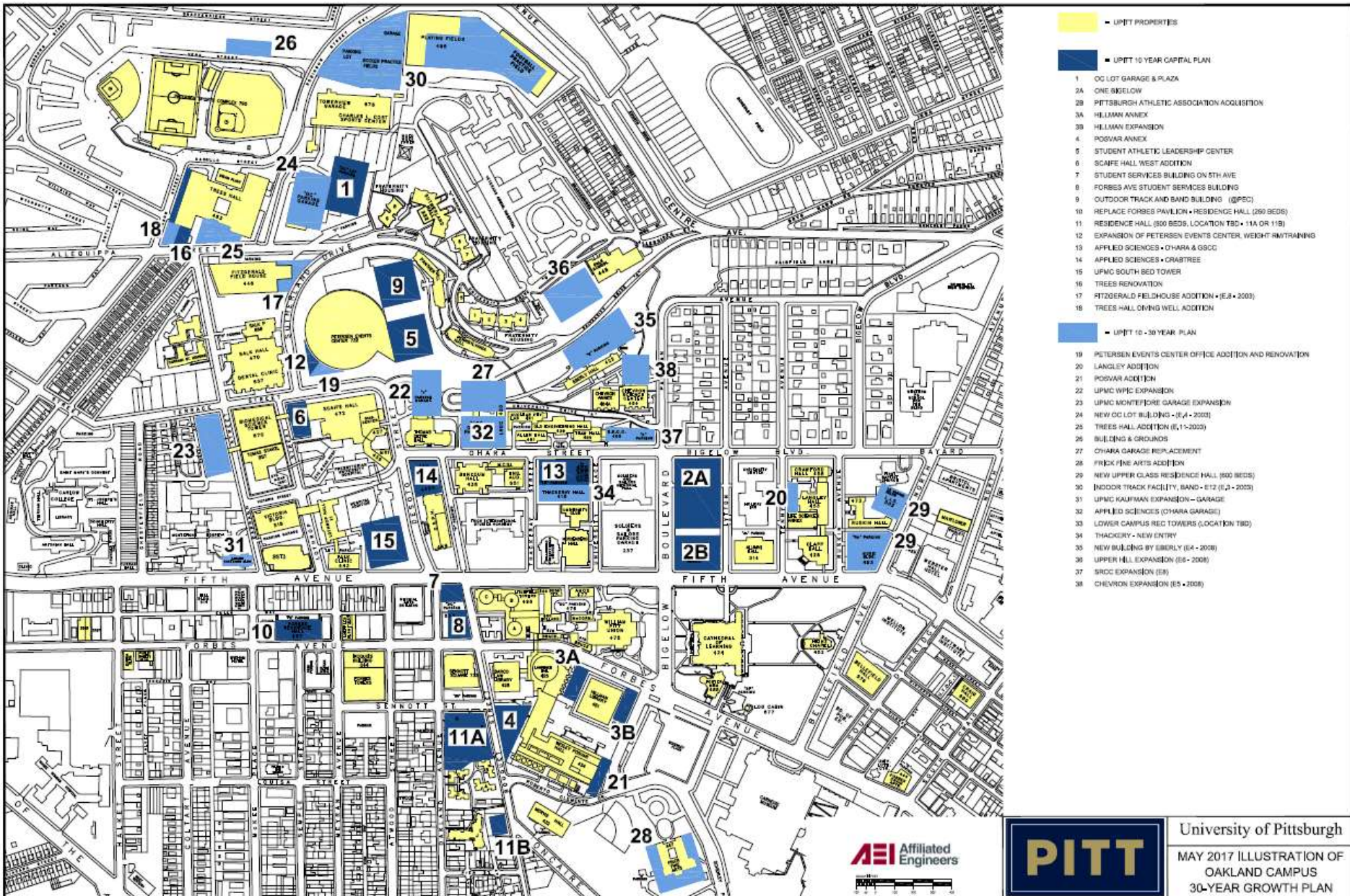


# University of Pittsburgh

- Established in 1787 as the Pittsburgh Academy
- 28,700 students
- 132-acre campus in Pittsburgh's Oakland neighborhood and four regional campuses
- 92 buildings representing 9.4 million sf on Oakland Campus
- Adjacent to the University of Pittsburgh Medical Center, Carnegie Museums of Pittsburgh and Carnegie Mellon University
- Second largest non-government employer in the Pittsburgh region
- \$2 billion operating budget, \$3.5 billion endowment
- State-related ownership structure



# 2017 Growth Projections





# The Plan and Community Collaborations

## University of Pittsburgh Medical Center

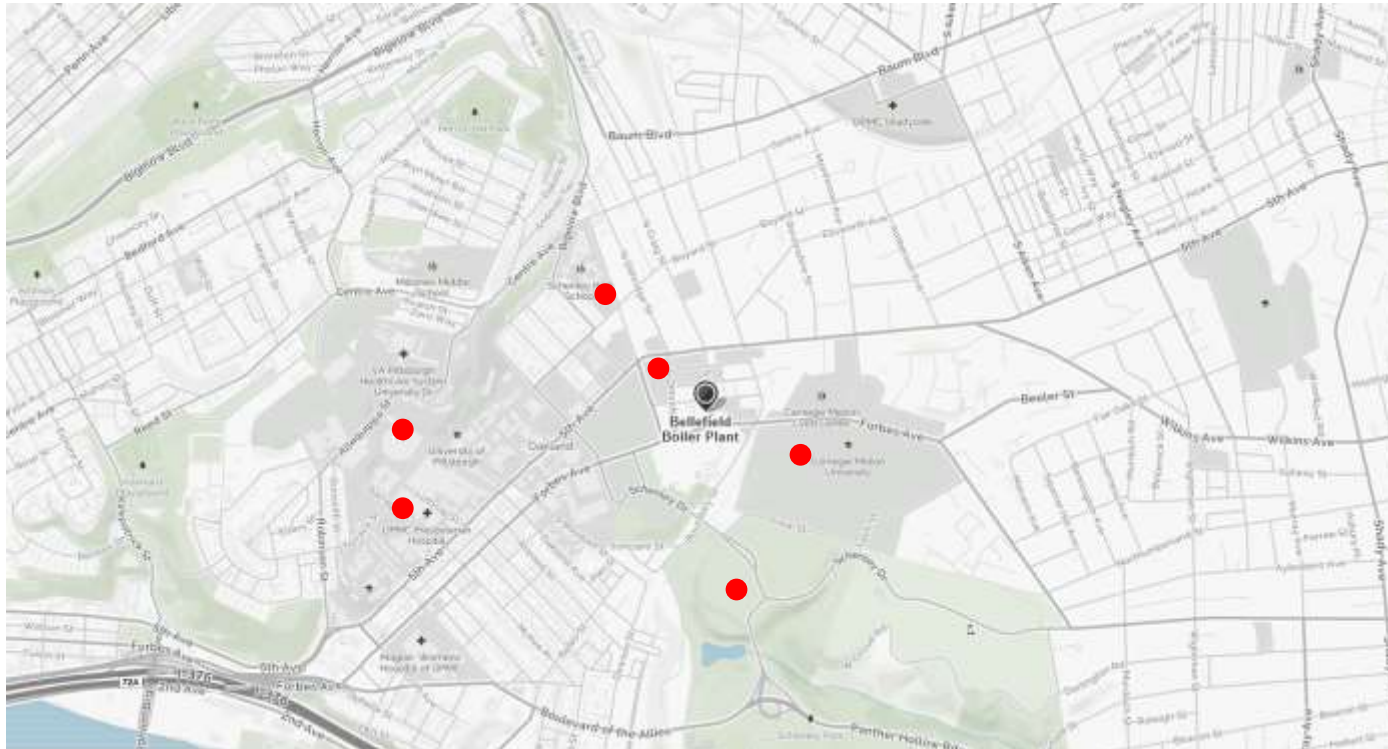
- Development and shared use of UPITT chilled water and steam systems



# The Plan and Community Collaborations

Consortium of University of Pittsburgh, Carnegie Mellon University, the Carnegie Museums and Library, University of Pittsburgh Medical Center, Phipps Conservatory, and the School District of Pittsburgh

- Bellefield Boiler Plant and steam distribution system management



# The Plan and Community Collaborations

## City of Pittsburgh

- Water management, energy and water use reduction, civic leadership



# What the Plan Offers

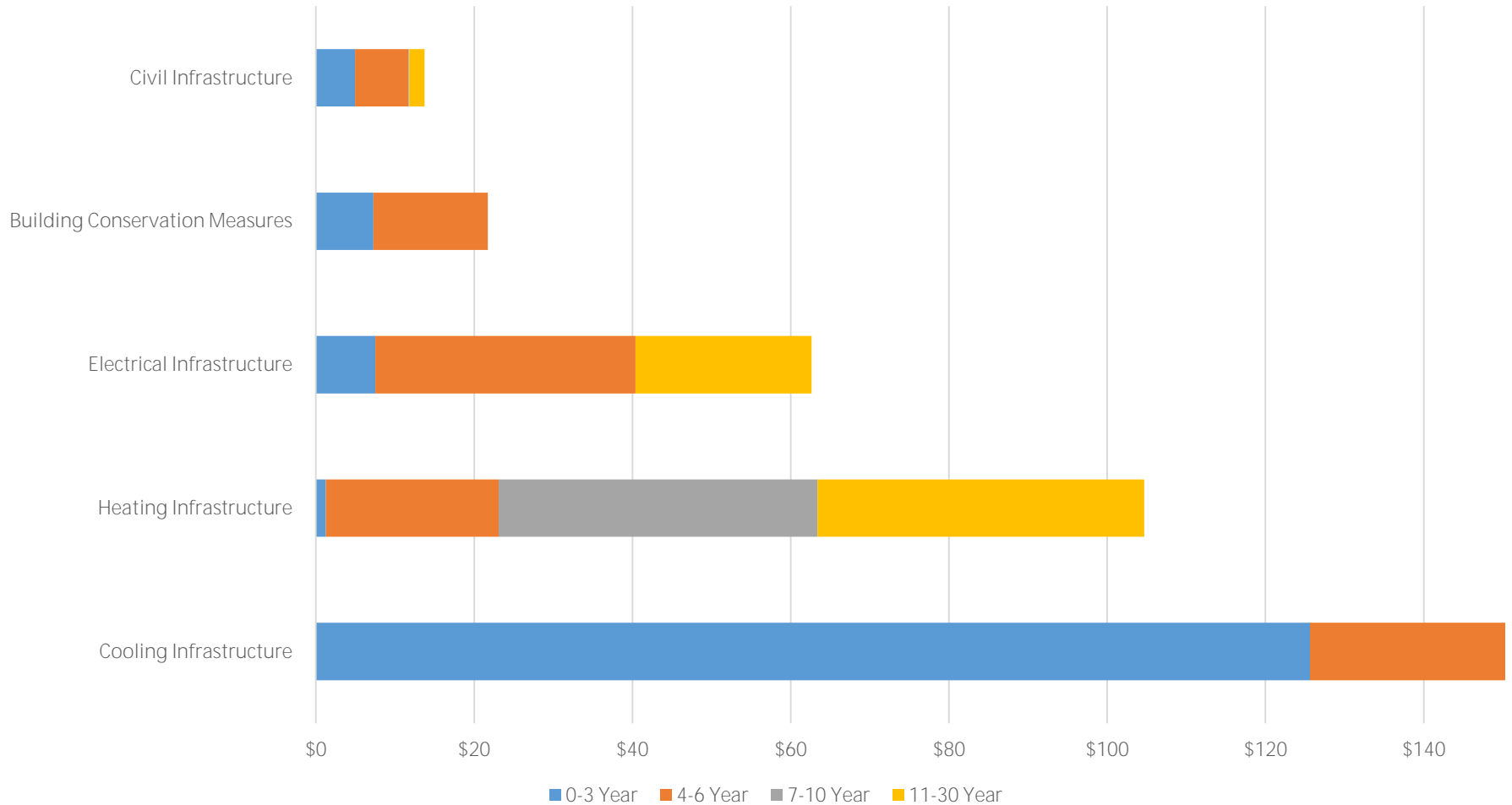
30-year energy and utility infrastructure roadmap Oakland Campus

- Existing conditions narrative
- Recommends investments
  - to support infrastructure needs for heating, cooling, electric, water supply, wastewater collection and stormwater
  - energy and water conservation
  - pilot microgrid
- Calculates cost, utility use reductions and greenhouse gas emissions reductions for the 130+ projects it recommends



# Plan Recommendations by Type

## Energy Management/Conservation Plan Investments





## Why Focus on Water Use Reduction





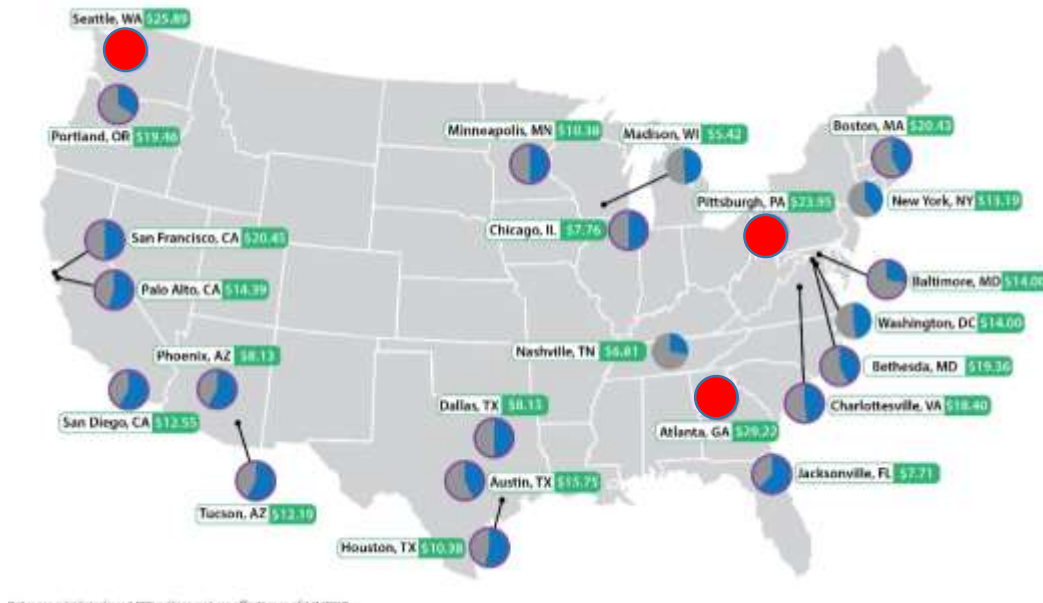
# Pittsburgh Water and Sewer Utilities

- Ample water supply and customer base
- Underinvestment, organizational instability, regulatory noncompliance
- \$840M in debt, huge capital investment needs
- 2008 Consent Decree - sewer pipe investments, eliminate overflows, separate stormwater from sewer water
- Water quality challenges
- Cross-connection problems throughout system
- Water pressure systems throughout system

# Pittsburgh Water and Sewer Utilities

“There are no easy choices... there will be costs and the costs will go through ratepayers. There are no federal or state programs to bail us out.”

Mayor Bill Peduto (January 2018)



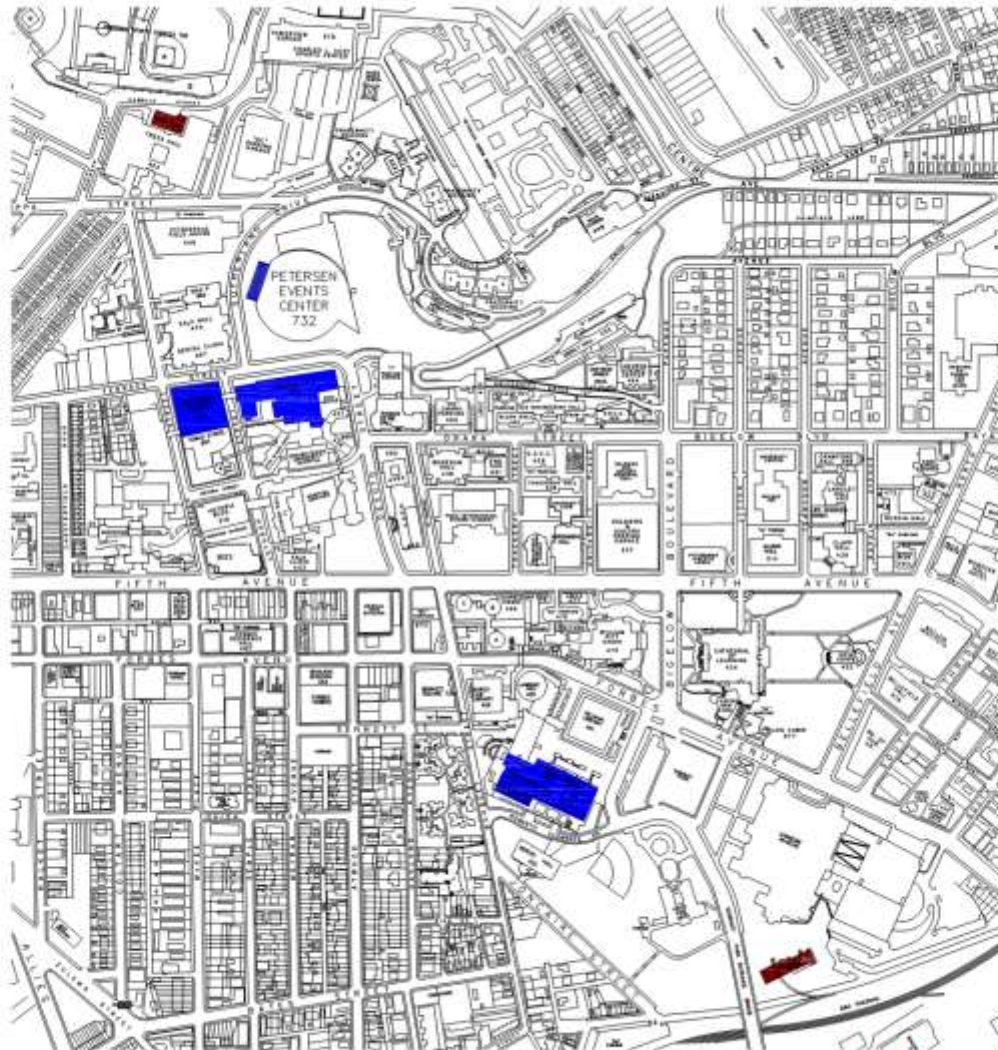




## The Plan's Big Energy Moves



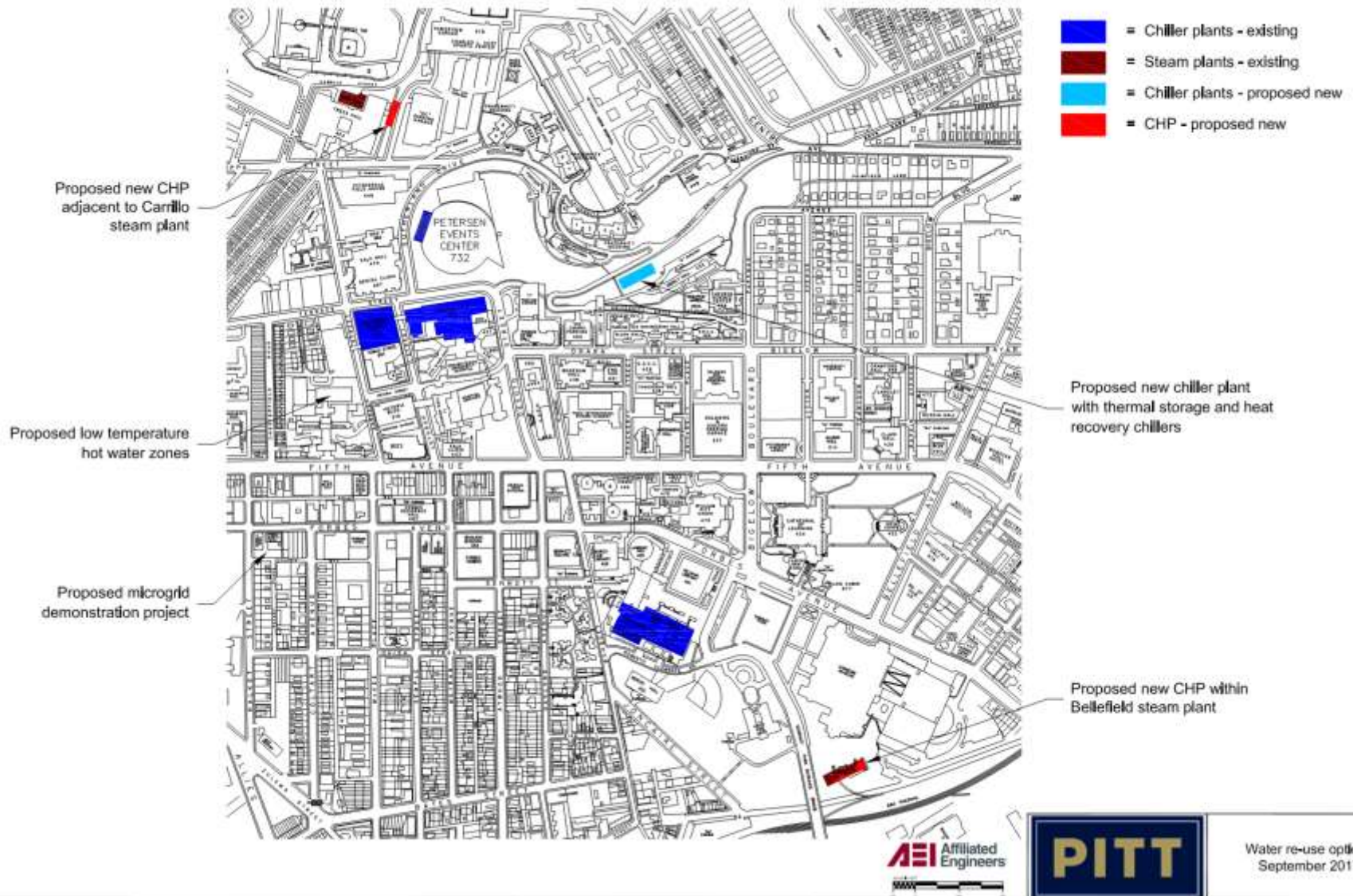
# Existing and Proposed Heating and Cooling Plants



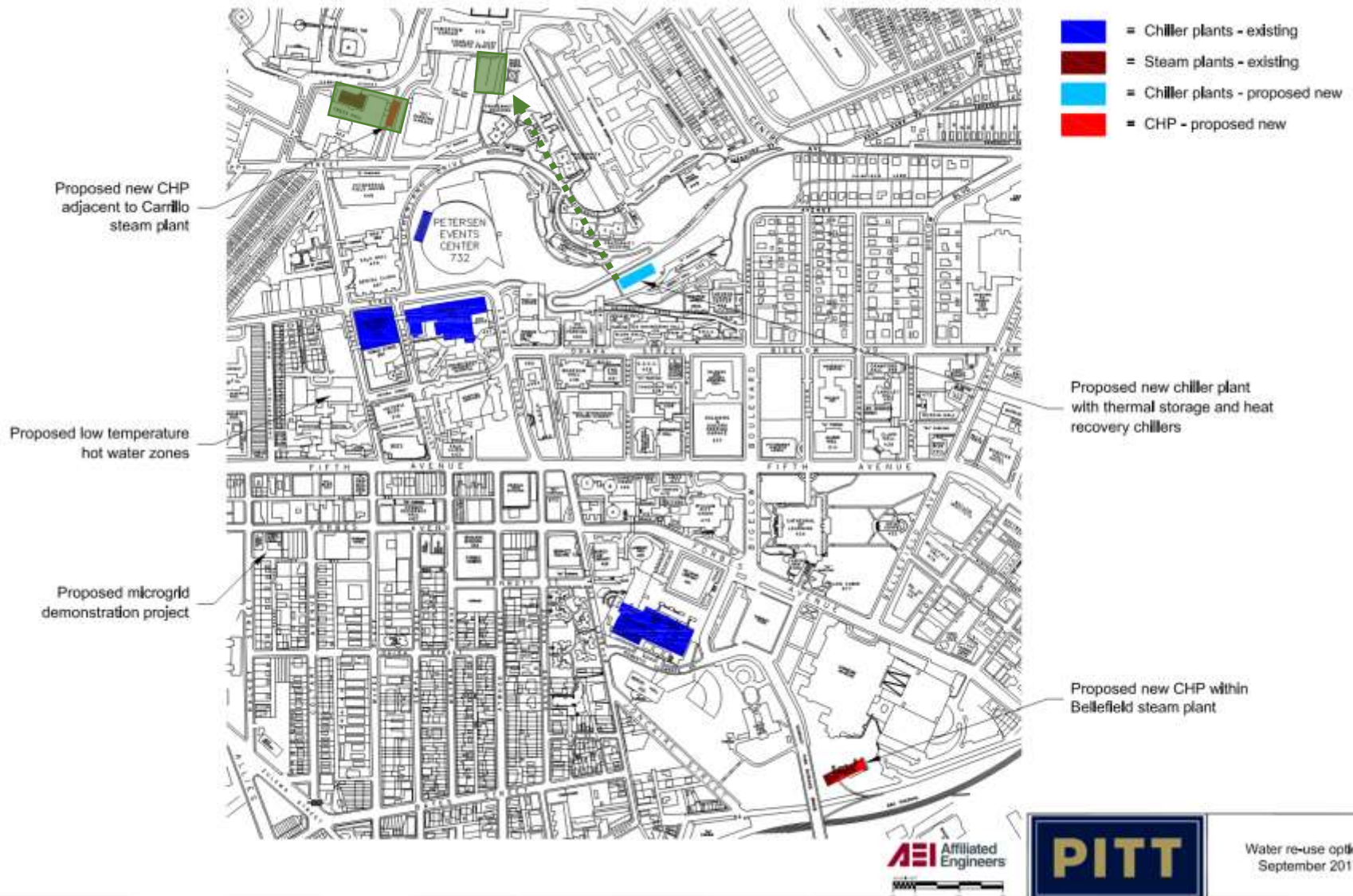
- = Chiller plants - existing
- = Steam plants - existing



# Existing and Proposed Heating and Cooling Plants

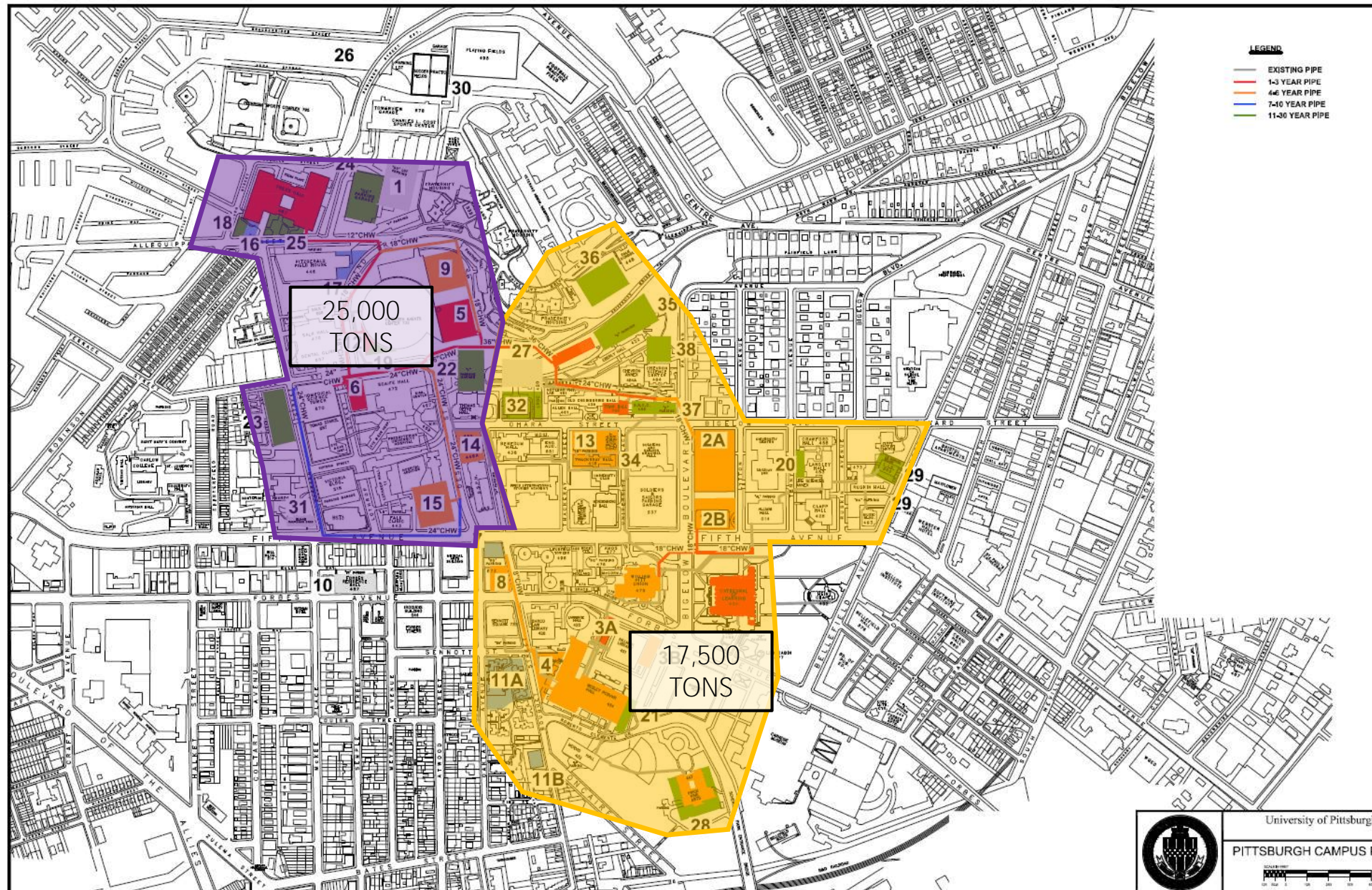


# Existing and Proposed Heating and Cooling Plants



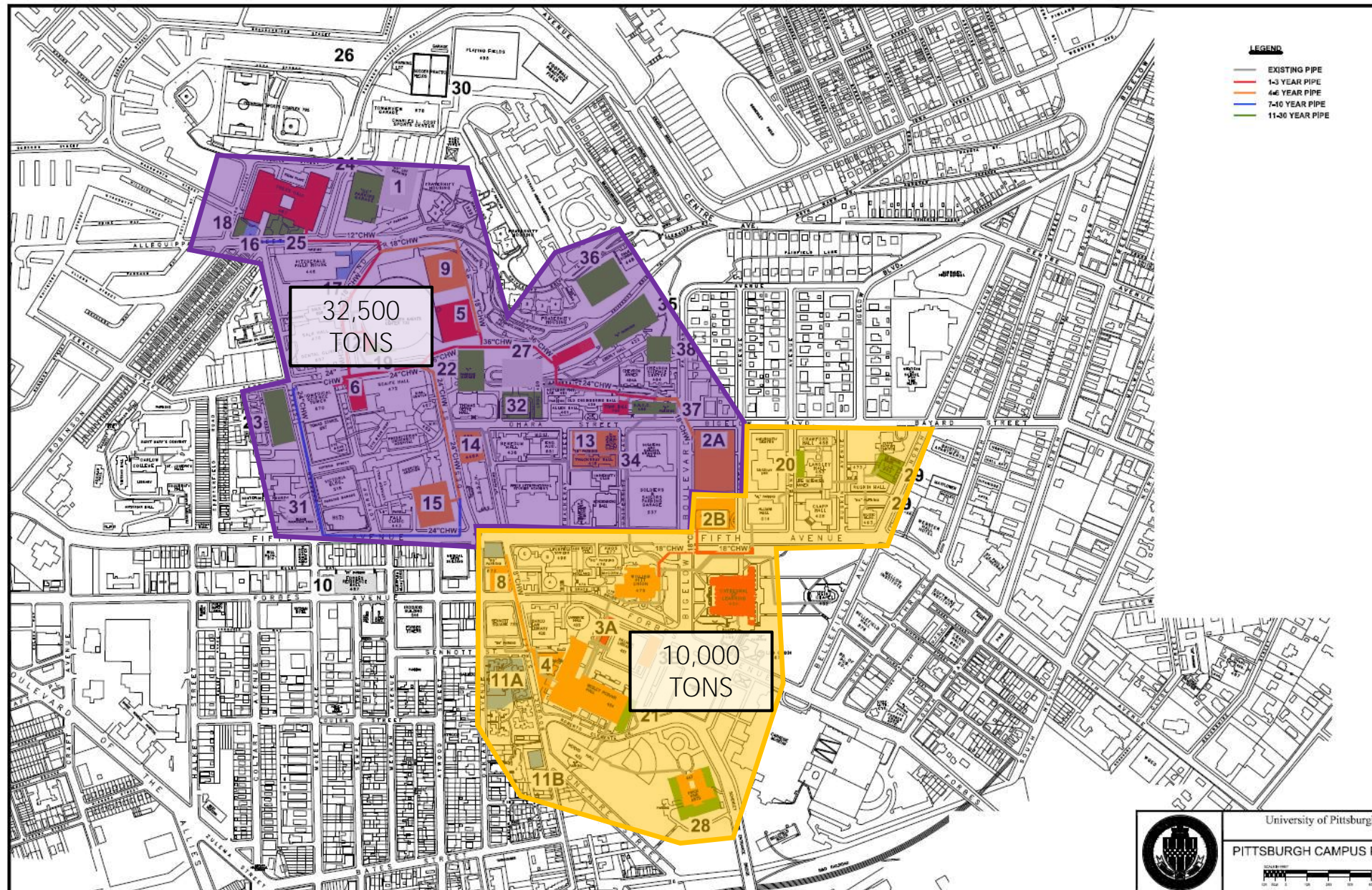


# Chilled Water Load Shift as Growth Strategy

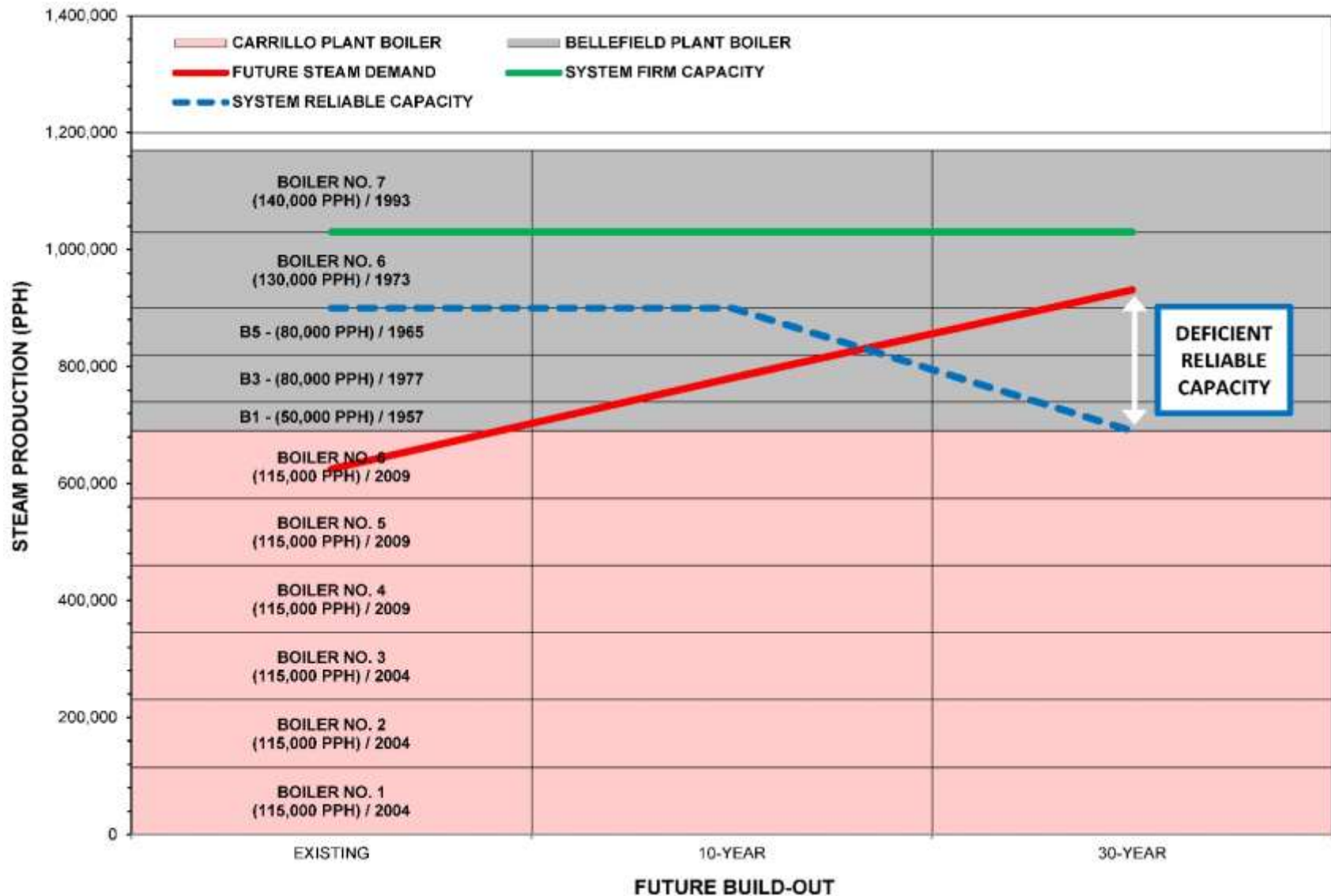




# Chilled Water Load Shift as Growth Strategy

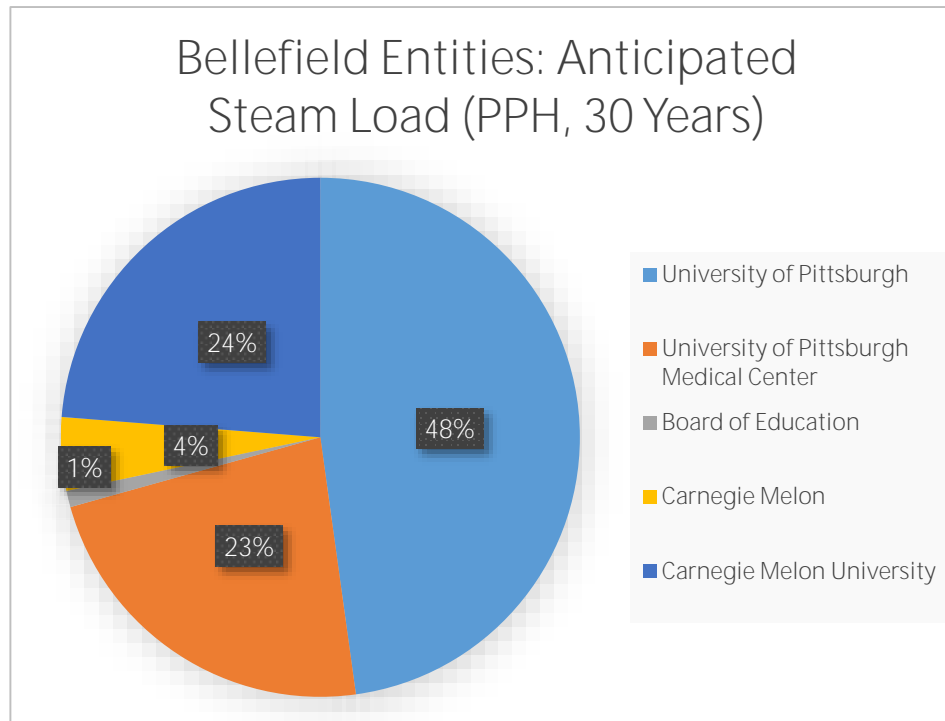


# Future Steam Load Compared to Existing Boiler Capacity





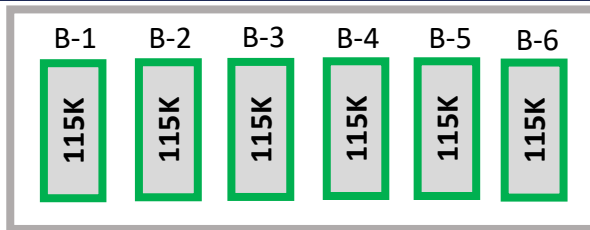
# Anticipated Steam Loads



Bellefield Entities	Steam Load Increases (PPH)	
	10 Years	30 Years
University of Pittsburgh	54,200	100,800
University of Pittsburgh Medical Center	53,800	20,300
Board of Education	0	0
Carnegie Mellon	0	0
Carnegie Mellon University	48,000	29,000

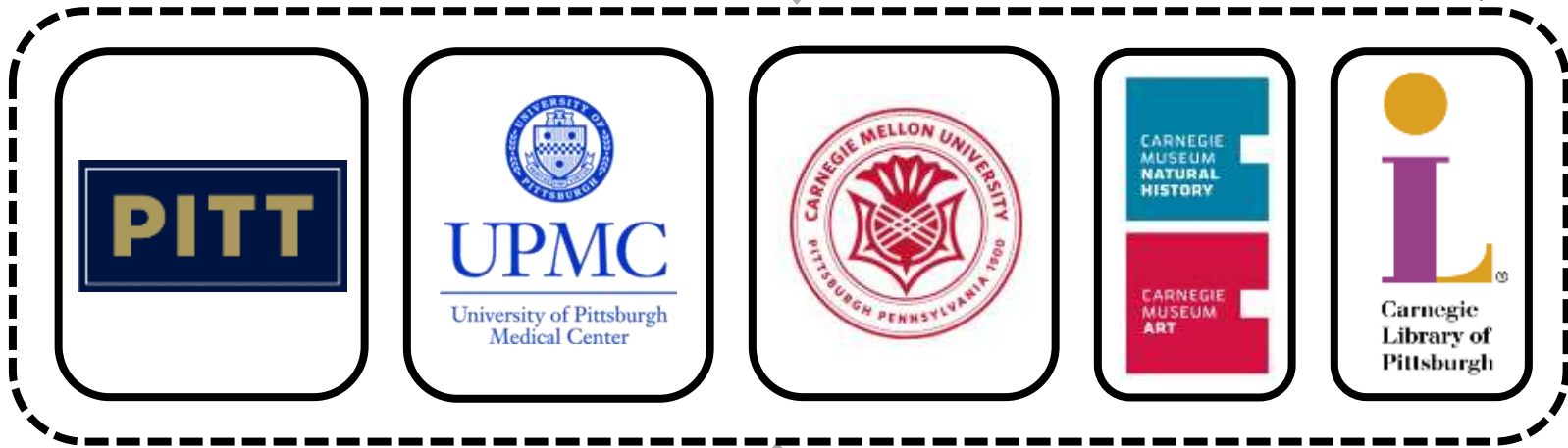


# Existing Steam System Configuration



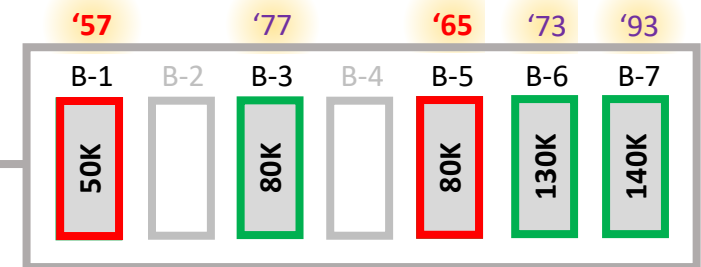
**CARRILLO CAPACITY:** 690,000 PPH  
**FIRM CAPACITY:** 575,000 PPH  
**RELIABLE CAPACITY:** 575,000 PPH

**TOTAL SYSTEM CAPACITY:** 1,170,000 PPH  
**FIRM CAPACITY:** 1,030,000 PPH  
**RELIABLE CAPACITY:** 900,000 PPH



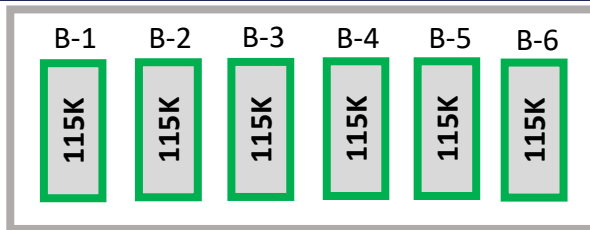
## LEGEND

- X** EX BOILER CAPACITY (PPH)
- X** UNRELIABLE CAPACITY BOILER (PPH)



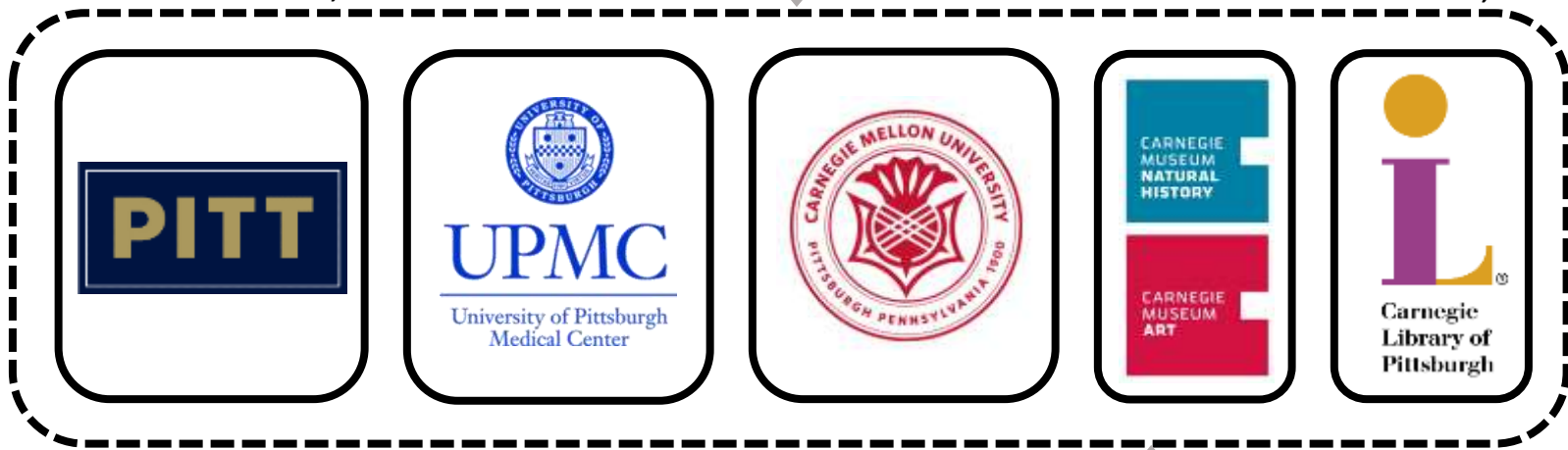
**BELLEFIELD CAPACITY:** 480,000 PPH  
**FIRM CAPACITY:** 340,000 PPH  
**RELIABLE CAPACITY:** 210,000 PPH

# Steam System Enhancement: Step 5



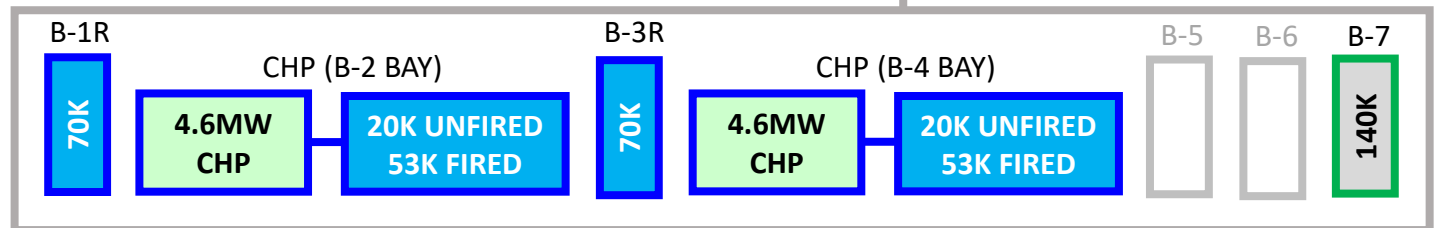
**CARRILLO CAPACITY:** 690,000 PPH  
**FIRM CAPACITY:** 575,000 PPH  
**RELIABLE CAPACITY:** 575,000 PPH

**TOTAL SYSTEM CAPACITY:** 1,076,000 PPH  
**FIRM CAPACITY:** 936,000 PPH  
**RELIABLE CAPACITY:** 936,000 PPH



## LEGEND

- EX BOILER CAPACITY (PPH)
- NEW BOILER CAPACITY (PPH)
- NEW ELECTRIC GENERATION



**BELLEFIELD CAPACITY:** 386,000 PPH  
**FIRM CAPACITY:** 246,000 PPH  
**RELIABLE CAPACITY:** 246,000 PPH

# Campus Microgrid: Strategy

1. Capitalize on knowledge and experience of Center for Energy (Swanson School of Engineering)
2. Demonstrate technical feasibility at a small scale



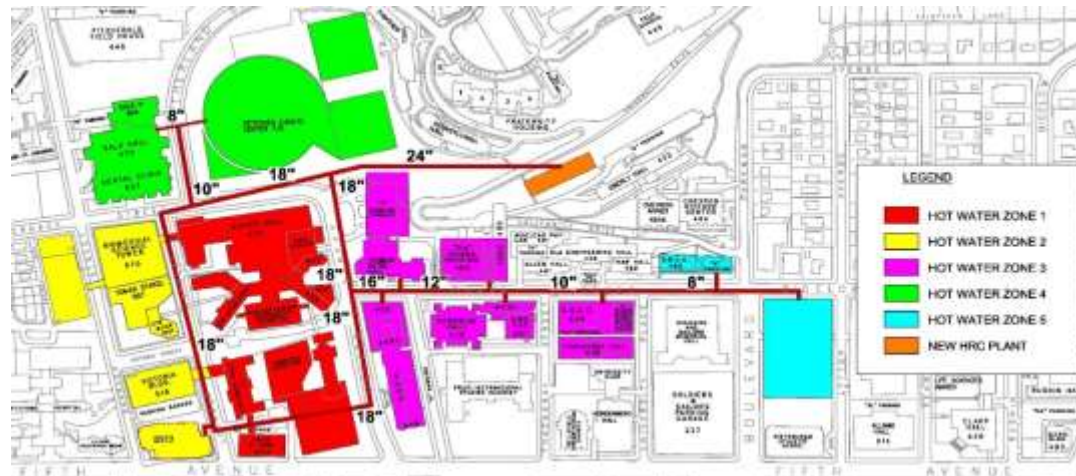
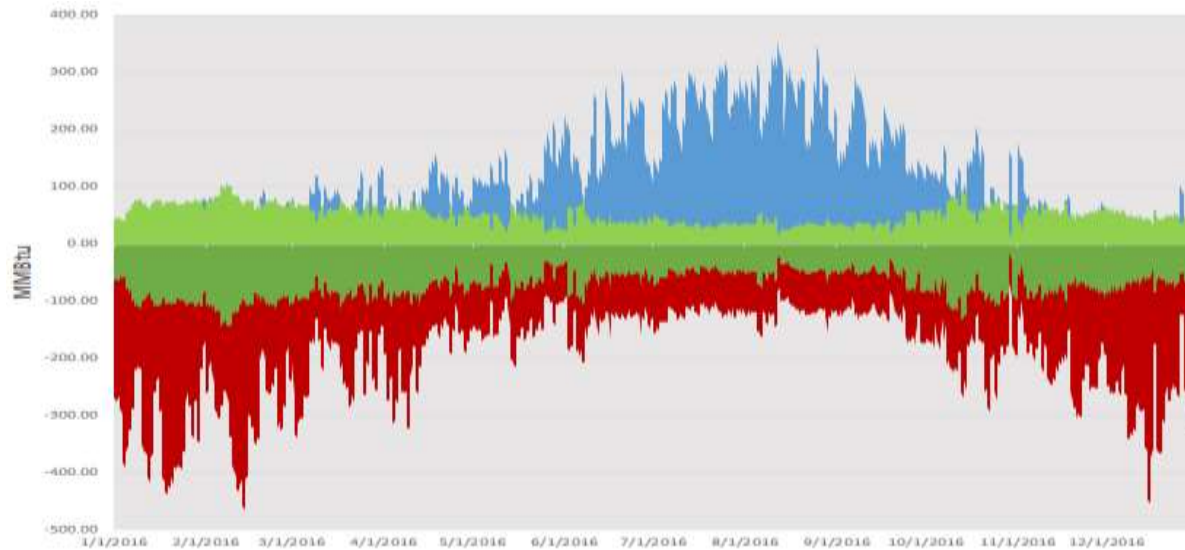




## The Plan's Big Moves: Energy Water Nexus

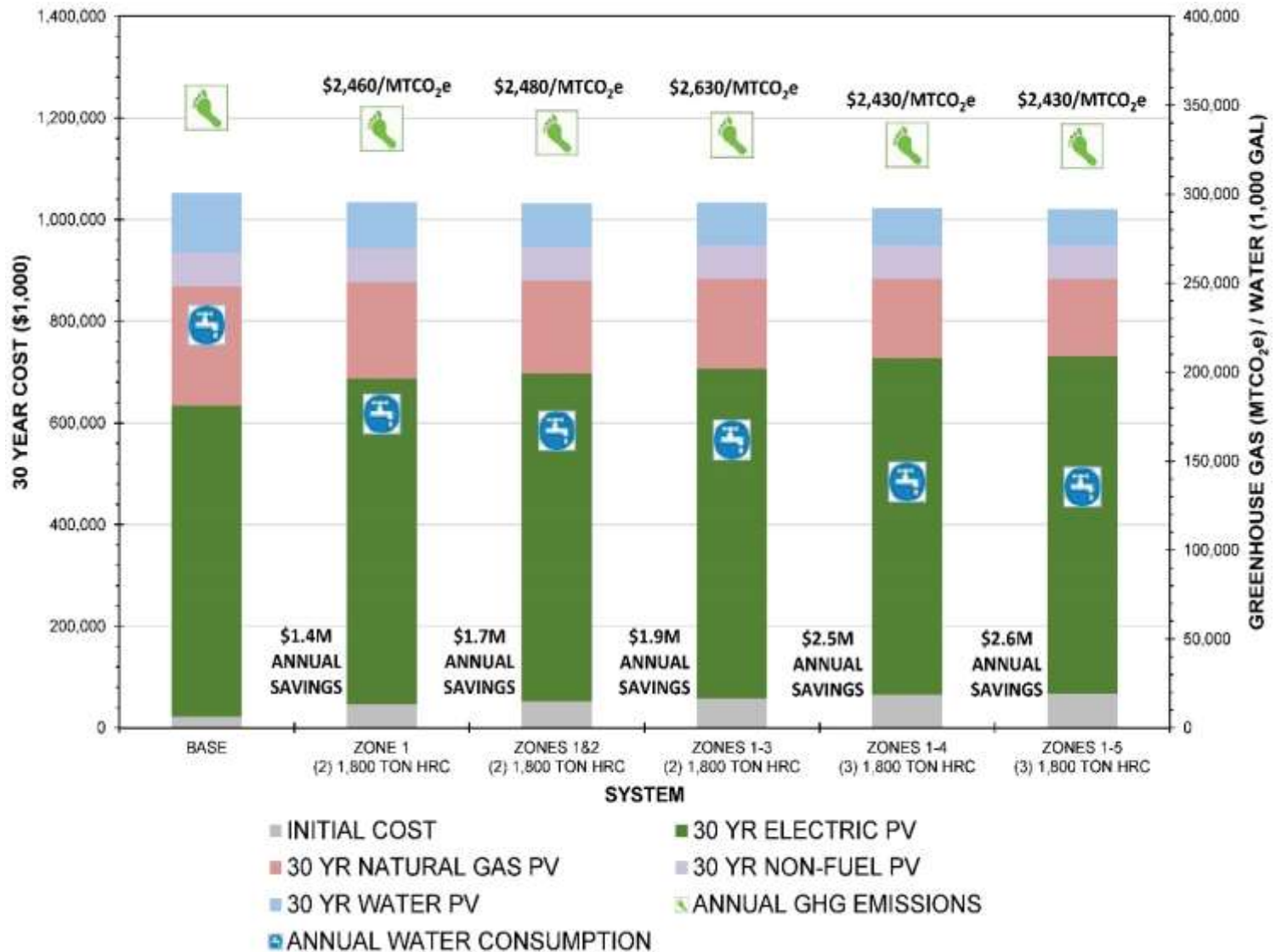


# Heat Recovery Chillers and Hot Water Distribution System





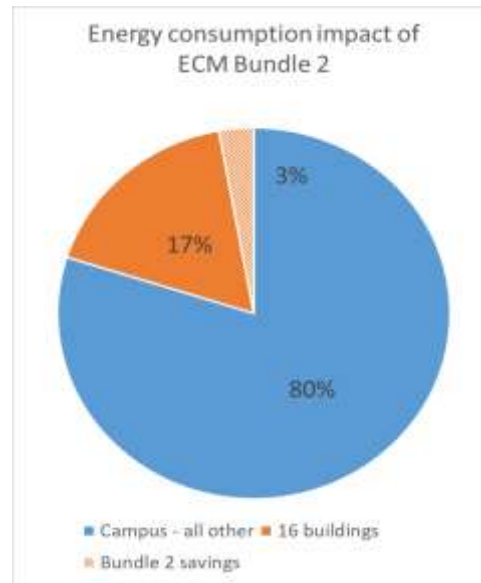
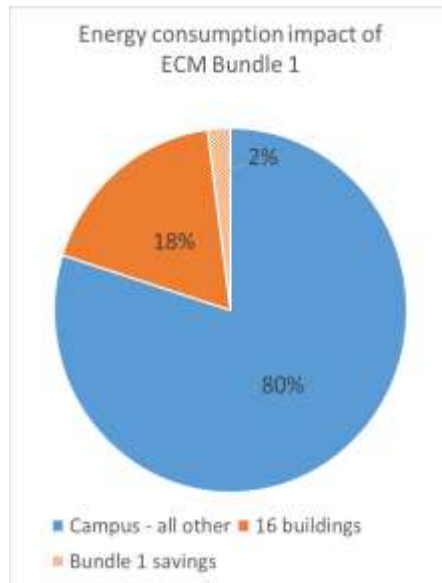
# Heat Recovery Chillers and Hot Water Distribution System





# Building Energy and Water: Sample and Campus Potential

Estimated campus energy impact of implementing aggregated bundles



Bundle	Energy Savings (kbtu/yr)	Energy Cost Savings (\$/yr)	Plant Water Savings (gpy)	Plant Water Cost Savings (\$/yr)	Total Cost Savings (\$/yr)	Project Cost (\$)	Simple Payback (yrs)	Building GHG Savings (MTCO <sub>2</sub> e/yr)	Central Plant GHG Savings (MTCO <sub>2</sub> e/yr)
1	80,390,000	\$839,000	4,139,000	\$71,000	\$910,000	\$4,052,000	4.5	2,100	4,680
2	130,707,000	\$1,422,000	9,577,000	\$163,000	\$1,585,000	\$18,259,000	11.5	2,600	7,020



## The Plan's Water Use Reduction Elements





# Water: Resolve Site-Specific Problems



- Secondary water laterals
- Backflow preventers, grinders, etc.
- Sewer Separation
- Stormwater Management

# Water: Reduce Water Consumption

## Tower blowdown recovery

- Petersen and Posvar
- 11 million gpy savings

## Black and Stormwater reuse at plants

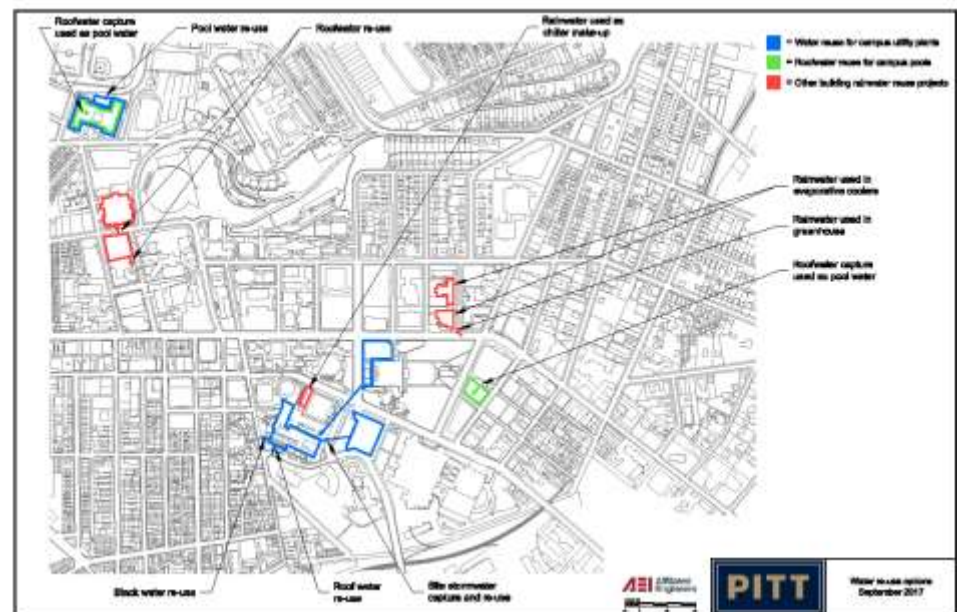
- Posvar and new chiller plant
- 72 million gpy savings

## Rainwater reuse at plants

- 4+ buildings
- 3 million gpy savings

## Rainwater reuse for pools

- 2.4 million gpy savings





**THANK YOU**