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

Presented by Stephen Svoboda, University of Pittsburgh, and Willa Kuh, Affiliated Engineers, Inc.
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
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
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

- Civil Infrastructure
- Building Conservation Measures
- Electrical Infrastructure
- Heating Infrastructure
- Cooling Infrastructure

0-3 Year | 4-6 Year | 7-10 Year | 11-30 Year

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$0 | $20 | $40 | $60

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$100

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$120 | $140

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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
“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
Existing and Proposed Heating and Cooling Plants
Existing and Proposed Heating and Cooling Plants
Chilled Water Load Shift as Growth Strategy

25,000 TONS

17,500 TONS
Chilled Water Load Shift as Growth Strategy

- 32,500 TONS
- 10,000 TONS
Future Steam Load Compared to Existing Boiler Capacity

- **Boiler No. 7**  
  Capacity: 140,000 PPH  
  Year: 1993

- **Boiler No. 6**  
  Capacity: 130,000 PPH  
  Year: 1973

- B5 - (80,000 PPH) / 1965
- B3 - (80,000 PPH) / 1977
- B1 - (50,000 PPH) / 1957

**Future Build-Out**

- **Existing**
- **10-Year**
- **30-Year**

**Deficient Reliable Capacity**
Anticipated Steam Loads

<table>
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<tr>
<th>Bellefield Entities</th>
<th>Steam Load Increases (PPH)</th>
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<tbody>
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<td>University of Pittsburgh</td>
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Bellefield Entities: Anticipated Steam Load (PPH, 30 Years)
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

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

LEGEND

X EX BOILER
CAPACITY (PPH)

X UNRELIABLE CAPACITY
BOILER (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

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

LEGEND
X EX BOILER CAPACITY (PPH)
X NEW BOILER CAPACITY (PPH)
X NEW ELECTRIC GENERATION
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

The image shows a comparison of 30-year costs for different systems, with various costs listed per MTCO2e ($2,460, $2,480, $2,630, $2,430, $2,430). The systems are categorized by initial cost, 30-year natural gas PV, 30-year water PV, 30-year electric PV, and annual GHG emissions. The diagram includes columns for base systems and zones with specific cooling capacities.
### Estimated campus energy impact of implementing aggregated bundles

<table>
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<tr>
<th>Bundle</th>
<th>Energy Savings (kbtu/yr)</th>
<th>Energy Cost Savings ($/yr)</th>
<th>Plant Water Savings (gpy)</th>
<th>Plant Water Cost Savings ($/yr)</th>
<th>Total Cost Savings ($/yr)</th>
<th>Project Cost ($/yr)</th>
<th>Simple Payback (yrs)</th>
<th>Building GHG Savings (MTCO₂e/yr)</th>
<th>Central Plant GHG Savings (MTCO₂e/yr)</th>
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The Plan’s Water Use Reduction Elements
Water: Resolve Site-Specific Problems
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