Overview of Cogeneration Facility

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Pittsburgh, PA

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PUC Presentation
• Founded in 1878
• 50 acre campus
• Approx. 4 million total building square footage
Energy Center History

- Duquesne signed an agreement with NORESCO, after facing several challenges:
  - Aging equipment
  - Environmental issues
  - Energy costs
- The partnership with NORESCO addressed these by developing the Energy Center and using the most advanced technology.
Duquesne University and NORESCO entered into a 15 year contract Feb. 1996

Start of construction was Feb. 1997

Facility in Operation November 1st, 1997

Project cost was approximately $9.6 million with NORESCO financing $4.5 million over the life of the contract

Off balance sheet financing
Relationship With Local Utilities

- At the time, Duquesne Light Co. had no independent customer energy generation. This concept was fairly new to them.
- Much effort went into the process from start to finish.
- The University had to adhere to interconnection regulations.
- Led to creation of Rider 16 which is back up power supply to non-utility generators.
- Relationship over time has improved and led to adjustment of Rider 16.
Energy Center Equipment

- 5MW Solar Tarus 60 natural gas fired turbine
- 25,000 lb./hr. waste heat boiler (125 psi)
- Natural gas compressor 15 to 235 psi
- Condensate receiver and boiler feed water system for new and existing boilers
- Utility electric interconnect breaker/relay system
- Existing electric system upgrade
- Electronic control package for co-gen and existing boilers
Two (2) 750 ton 2 stage absorption chiller
One (1) 1000 ton 2 stage absorption chiller
Approx. 4,000 feet of 18 inch to 6 inch chilled water campus supply and return distribution piping and controls
Two (2) 150 HP chilled water pumps
Two (2) 250 HP condenser water pumps
Four (4) cooling tower cells to handle 2,500 tons
Internal plant chilled water and condenser water piping and controls
Complete electric and control system
Generator to run in parallel with Duquesne Light.
Not intended to furnish all electric.
Design to utilize all waste heat all the time.
Waste heat to drive absorption chillers in summer and heat campus in winter.
Can run isolated if load is reduced.
Automatic load shedding.
Duquesne Light
Steam Distribution System
Average Annual Performance

- Generator produced - 32,382,044 Kwh (86%)
- Imported from DLCO – 5,149,038 Kwh (14%)
- Turbine availability – 8,533 hours (97.5%)
- Waste heat boiler produced – 157,344 MLB (74%)
- Gas boilers produced – 56,617 MLB (26%)
- Gas turbine used – 406,766 MCF of natural gas
- Boilers used – 68,481 MCF of natural gas
- Energy center used – 14,430,034 Gal. of water
2009 ENERGY STAR® AWARD
COMBINED HEAT AND POWER

Presented to

Duquesne University

By the United States Environmental Protection Agency and the United States Department of Energy in recognition of the significant pollution reduction and energy efficiency qualities of the Duquesne University Energy Center.

Awarded on June 29, 2009

Kathleen Hogan
Director, Climate Protection Partnerships Division
U.S. Environmental Protection Agency
## How do Others Compare?

### Comparison To Atlantic 10 Schools

<table>
<thead>
<tr>
<th>School</th>
<th>Year Completed</th>
<th>Total Carbon Footprint</th>
<th>Carbon Footprint/Student</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duquesne University</td>
<td>2010</td>
<td>42,044.4</td>
<td>4.05</td>
<td>Pittsburgh, PA</td>
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<tr>
<td>Temple University</td>
<td>2009</td>
<td>233,138</td>
<td>8.33</td>
<td>Philadelphia, PA</td>
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<td>Xavier University</td>
<td>2007</td>
<td>37,000</td>
<td>5.6</td>
<td>Cincinnati, OH</td>
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<tr>
<td>University of Massachusetts-Amherst</td>
<td>2007</td>
<td>142,237</td>
<td>5.4</td>
<td>Amherst, MA</td>
</tr>
<tr>
<td>George Washington University</td>
<td>2008</td>
<td>128,301</td>
<td>6.3</td>
<td>Washington D.C.</td>
</tr>
</tbody>
</table>

Source: Center for Environmental Research & Education - 2010
How we’ve grown

- Added additional 1,250 ton centrifugal chiller 2000
- Added 6,000 ton ice storage in 2007
- Added capacity and relocated cooling towers in 2014
- Added capacity is in accordance with the University’s 10 year master plan on file with the City of Pittsburgh
Why we selected Ice Storage

- Added 6000 ton/hr. capacity without adding cooling towers
- Utilizes off peak electric rates
- No change in condenser loop piping
- More efficient utilization of existing equipment
28 Storage Tanks – 6000 ton hrs
Questions?