Hudson County
Integrating Renewables with a CHP Campus

Presented by:
Heather Thomas, EIT | CHA, Thermal Mechanical Engineer
Agenda

- Introduction to Hudson County Advanced Microgrid (HCAM)
- Driving Force
- Facilities Selected
- Connecting to the Macrogrid
- Electric and Thermal Loads
- Technology Selection
- Existing Assets to Leverage
- Energy and Financial Results
- Questions
Who?

- **Client:**
  - New Jersey Board of Public Utilities (NJBPU)

- **Partners:**
  - CHA Consulting, Inc.
  - Greener by Design, LLC
The U.S. Department of Energy Microgrid Exchange Group provides this definition:

“A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. A microgrid can connect and disconnect from the grid to enable it to operate in both grid-connected or island-mode.”

1 https://building-microgrid.lbl.gov/about-microgrids
What?

• NJBPU Town Center Distributed Energy Resources Microgrid Feasibility Study Incentive Program
  – Exclusively intended for a project that includes multiple critical facility customers in a single municipality developed as an advanced microgrid
  – Requires a nucleus of critical buildings and customers that can provide essential services and emergency energy services under “black sky” conditions in a cost effective manner
  – Must also operate in a cost effective manner 24-7 under “blue sky” conditions
Where?

- Since Hudson County is a large area to cover, the focus of the study was in the Town of Secaucus, NJ, specifically around County Avenue where the majority of the critical risk facilities were identified.

- Proposed Critical Facilities included:
  - 4 FEMA Tier IV facilities
  - 10 FEMA Tier III facilities
  - 5 FEMA Tier II facilities

\[
813,000 \text{ ft}^2 \quad 147,000 \text{ MMBTU annual energy use}
\]
Why?

- Major driving force was the effect of Hurricane Sandy on the Hudson County Township
- The storm was ranked #5 on The Hudson Reporter's 2013 list of the 50 most influential people and entities in Hudson County
Why?

• Benefits of Microgrids include:
  – Improving local energy delivery
  – Increasing reliability
  – Saving money
  – Generating revenue
  – Aiding economic growth
  – **Making the grid more resilient**
  – Helping to counter climate change
How?

• **Step 1** – Determine utility load profiles
  • Electrical and thermal

• **Step 2** – Define design/evaluation criteria of project
  • Financial, resiliency, environmental, spatial, availability, redundancy, simplicity/operability

• **Step 3** – Analyze utility outputs for DER technologies to satisfy dynamic load profile
  • Is dynamic load profile satisfied?
  • Consider constraints of respective connection to macrogrid (feeder) & host facility
  • Consider limitations of selected DER technologies
Using DER-CAM to Analyze Microgrids

- NJBPU requested that we use DER-CAM to analyze the recommended microgrid
- DER-CAM: Distributed Energy Resources Customer Adoption Model (DER-CAM)
  - Free analysis tool for optimal DER investment selection
  - Continually developed by Berkeley Lab since 2000
Daily Load Profile (by Month)

Meadowview Complex and Alaris Health
Technology Selection - Microturbine

- Produces electricity and “waste heat” in the form of hot exhaust gas
- Energy from exhaust gas can be transferred to usable thermal energy in the form of hot water, steam, or chilled water with an absorption chiller
Technology Selection - Microturbine

- A suitable microturbine array which we used in our analysis is Capstone’s C1000S microturbine combined with Cain’s heat recovery unit (exhaust steam generator)
Technology Selection – Solar

• Photovoltaic (PV) devices convert light energy to electricity
• Renewable energy source, but not always available
• Requires space either on ground level, on rooftops, or as canopies
Existing Assets to Leverage (CHP)

- Meadowview Complex has a utility corridor (underground tunnel network) for steam and condensate circuit emanating from the Powerhouse.
- This existing distribution infrastructure is a key attribute of the microgrid project’s feasibility allowing a CHP-based solution to serve as the main DER for this project.
- Agglomerate loads to serve.
Existing Assets to Leverage (PV)

• Secaucus Town Hall / Police Station site contains solar photovoltaic (PV) canopies of approximately 130 kW and two electric vehicle (EV) Class II charging stations (top)
• 600 kW rooftop solar array is already planned for Meadowview Complex
• Meadowview Complex has a large field with good exposure to the sun which could potentially house future solar panels (bottom)
• The UPS facility south of Meadowview Complex has 1.2 MW of rooftop solar which “could” be added to the microgrid during a blacksky event
Design/Evaluation Criteria of Project

- As mandated by NJBPU, the main criteria for designing and evaluating this microgrid project was:

  **RESILIENCY**

- Financial
- Environmental
- Spatial
- Availability
- Redundancy
- Simplicity/operability
<table>
<thead>
<tr>
<th>Facility Name</th>
<th>Risk Category</th>
<th>Highlights</th>
</tr>
</thead>
<tbody>
<tr>
<td>Secaucus Town Hall / Police Station</td>
<td>4</td>
<td>- existing solar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- electrical backup during blacksky event</td>
</tr>
<tr>
<td>Meadowview Complex (including Alaris Health)</td>
<td>2, 3, 4</td>
<td>- significant electric load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- significant thermal load</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- planned 600 kW solar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- room for additional solar and CHP/boilers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- existing steam tunnel</td>
</tr>
<tr>
<td>Secaucus Housing Authority #2</td>
<td>3</td>
<td>- electric and thermal loads</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- rooftop area for solar</td>
</tr>
<tr>
<td>United Parcel Service (UPS)</td>
<td>2</td>
<td>- existing 1.2 MW solar potentially available for blacksky event</td>
</tr>
</tbody>
</table>
Topology Development in DER-CAM

- Each facility is connected together so that combined loads can be considered in concert
- Red lines indicate the thermal loop (steam from power house)
Analysis Results (1)
Analysis Results (2)

January Electricity and Heating Dispatch
Analysis Results (3)

July Electricity and Heating Dispatch
## Description of Overall Costs and Revenues

<table>
<thead>
<tr>
<th>Microgrid Component</th>
<th>Assumption</th>
<th>Year 1 Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV across all facilities</td>
<td>$7.50 / kW</td>
<td>$3,728</td>
</tr>
<tr>
<td>CHP Natural Gas Cost</td>
<td>$0.64 / therm</td>
<td>$662,788</td>
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<tr>
<td>CHP Maintenance</td>
<td>$0.035 / kWh</td>
<td>$301,173</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Microgrid Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground-mount/Rooftop Solar PV</td>
<td>$110,500</td>
</tr>
<tr>
<td>Carport Solar PV</td>
<td>$1,138,621</td>
</tr>
<tr>
<td>CHP generator sets at the Meadowview Power House</td>
<td>$2,675,200</td>
</tr>
<tr>
<td>Steam and electric distribution to Secaucus Housing #2</td>
<td>$1,512,000</td>
</tr>
<tr>
<td>SCADA and Switchgear (Transfer-Trip Switch, ATS, Switchgear, Transformer at Town Hall)</td>
<td>$850,000</td>
</tr>
<tr>
<td>Soft Costs (Contractor Fees, Development Fees, Project Management, Engineering Support, Permitting, Interconnection Applications)</td>
<td>$1,645,041</td>
</tr>
<tr>
<td>Boiler at the Meadowview Power House</td>
<td>$1,103,360</td>
</tr>
<tr>
<td><strong>Total Project Cost Estimate</strong></td>
<td><strong>$9,034,722</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy</th>
<th>Annual Production</th>
<th>Unit Price</th>
<th>Year 1 Energy Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar PV Electricity to Alaris Health / Meadowview Complex</td>
<td>555,261 kWh</td>
<td>$0.112 / kWh</td>
<td>$62,189</td>
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<tr>
<td>Solar PV Electricity to Secaucus Housing Authority #2</td>
<td>126,080 kWh</td>
<td>$0.150 / kWh</td>
<td>$18,912</td>
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<tr>
<td>CHP Electricity to Alaris Health / Meadowview Complex</td>
<td>7,959,250 kWh</td>
<td>$0.112 / kWh</td>
<td>$891,436</td>
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<tr>
<td>CHP Electricity to Secaucus Housing Authority #2</td>
<td>69,244 kWh</td>
<td>$0.150 / kWh</td>
<td>$10,387</td>
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<tr>
<td>CHP Steam to Alaris Health / Meadowview Complex</td>
<td>277,796 therms</td>
<td>$0.7529 / therm</td>
<td>$209,153</td>
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<tr>
<td>CHP Steam to Secaucus Housing Authority #2</td>
<td>34,700 therms</td>
<td>$1.0118 / therm</td>
<td>$35,108</td>
</tr>
<tr>
<td><strong>Total Revenue from Energy Sales</strong></td>
<td><strong>$1,227,185</strong></td>
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- Analysis assumes that a non-utility, third party will develop the microgrid through a DBOOM model (design, build, own, operate and maintain)
Final Recommendations to Client

• Proposed DER assets to be integrated are:
  – 1,200 kW Microturbine with Heat Recovery Steam Generator at Meadowview Complex Boiler House
  – 600 kW solar already planned + 405 kW solar in field at Meadowview Complex
  – 92 kW solar on roof of SHA #2
  – 153 kW existing solar canopies at Town Hall/Police Station

• These DERs are estimated to be able to generate:
  – > 10,000,000 kWh of electricity annually
  – ~ 328,000 therms of usable heat
Questions?
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Integrating Renewables with a CHP Campus

Thank you!