Hudson County
Integrating Renewables with a CHP Campus

Presented by:

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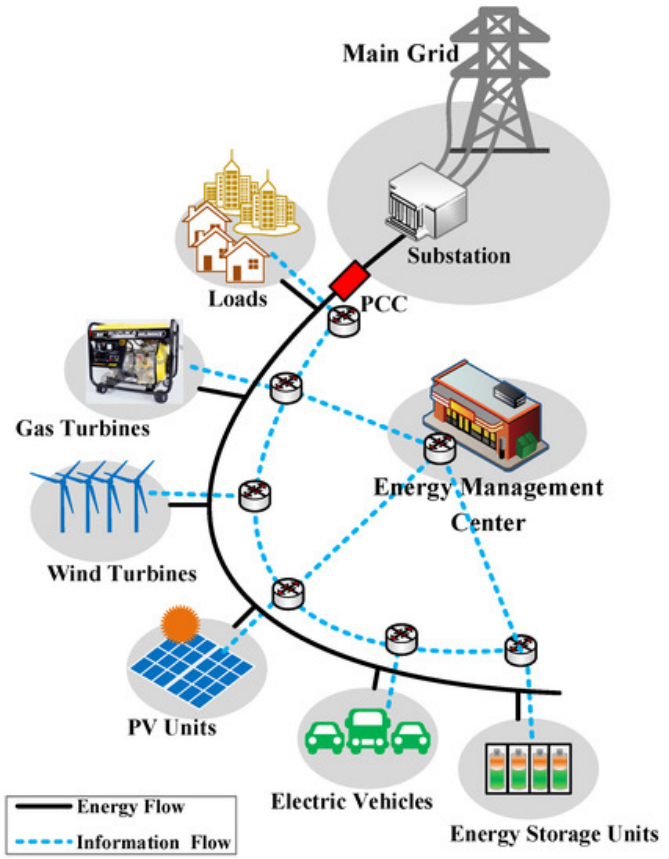
CampusEnergy2020
THE POWER TO CHANGE
FEBRUARY 10-14 ▲ SHERATON DENVER DOWNTOWN ▲ DENVER, CO

New Jersey BPU Board of Public Utilities

CHA
design/construction solutions

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

What?

- 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]

[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

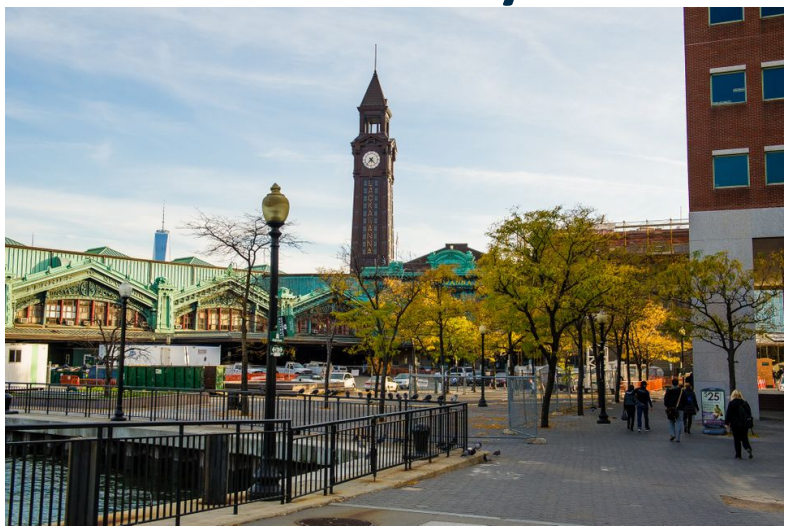
Where?

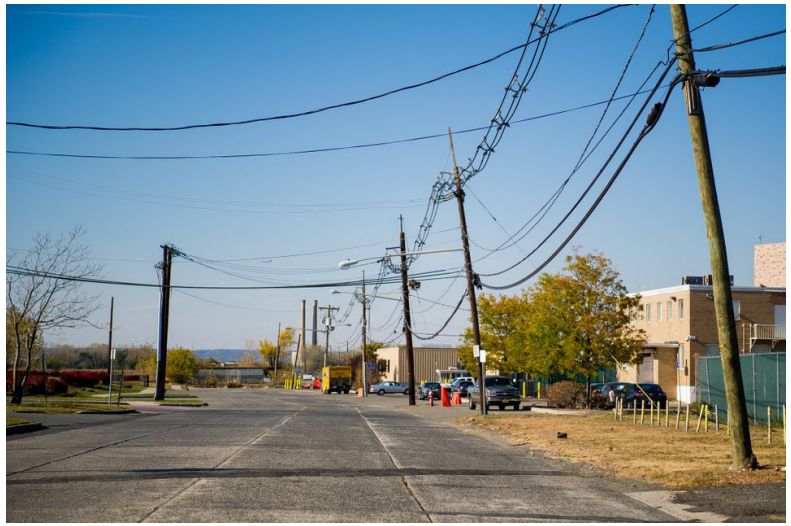
- Since Hudson County is a large area to cover, the focus of the study was in the Town of Secaucus, NJ, specifically around County Avenue where the majority of the critical risk facilities were identified.
- Proposed Critical Facilities included:
  - 4 FEMA Tier IV facilities
  - 10 FEMA Tier III facilities
  - 5 FEMA Tier II facilities

  } 813,000 ft^2
  147,000 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



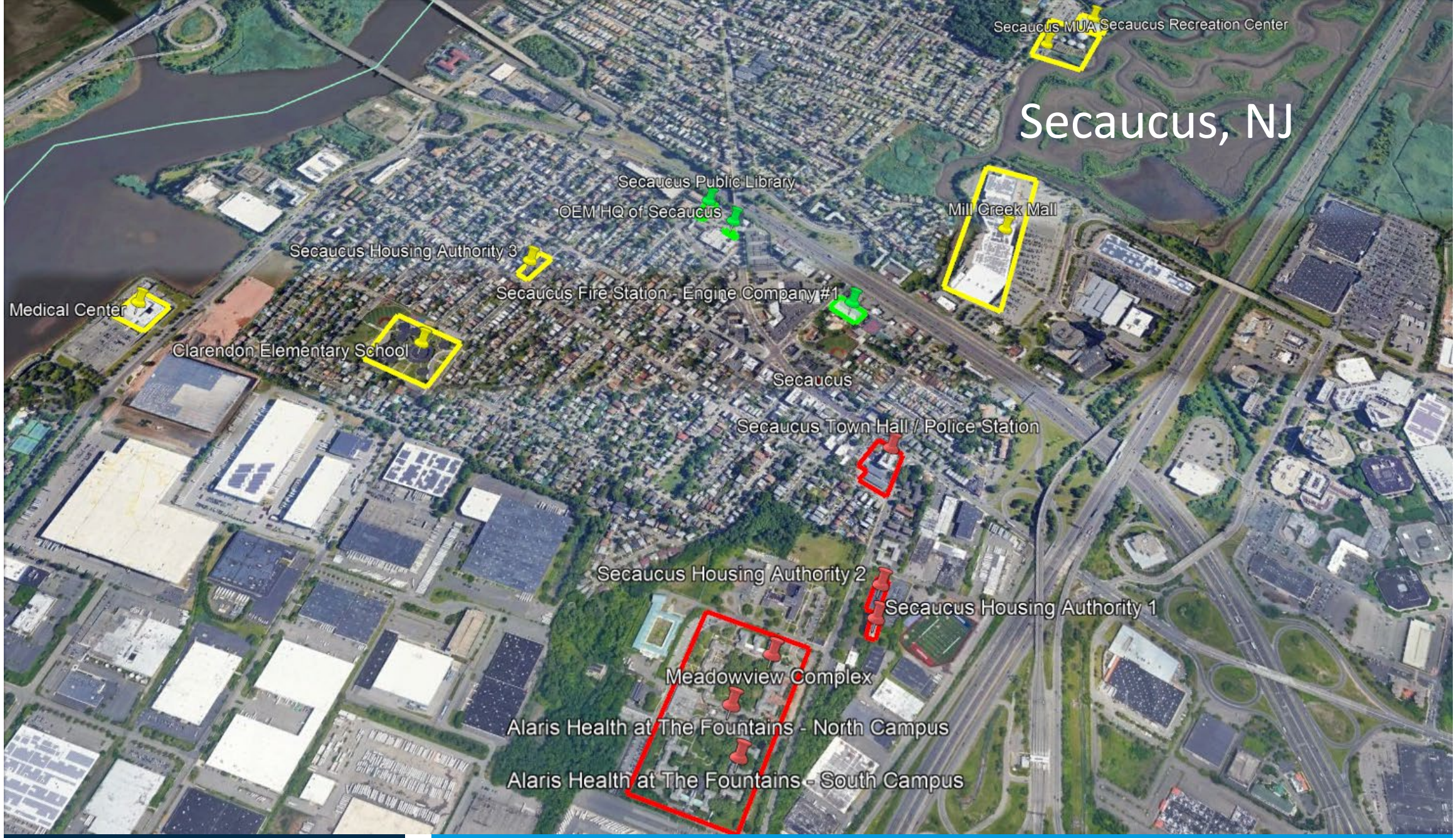


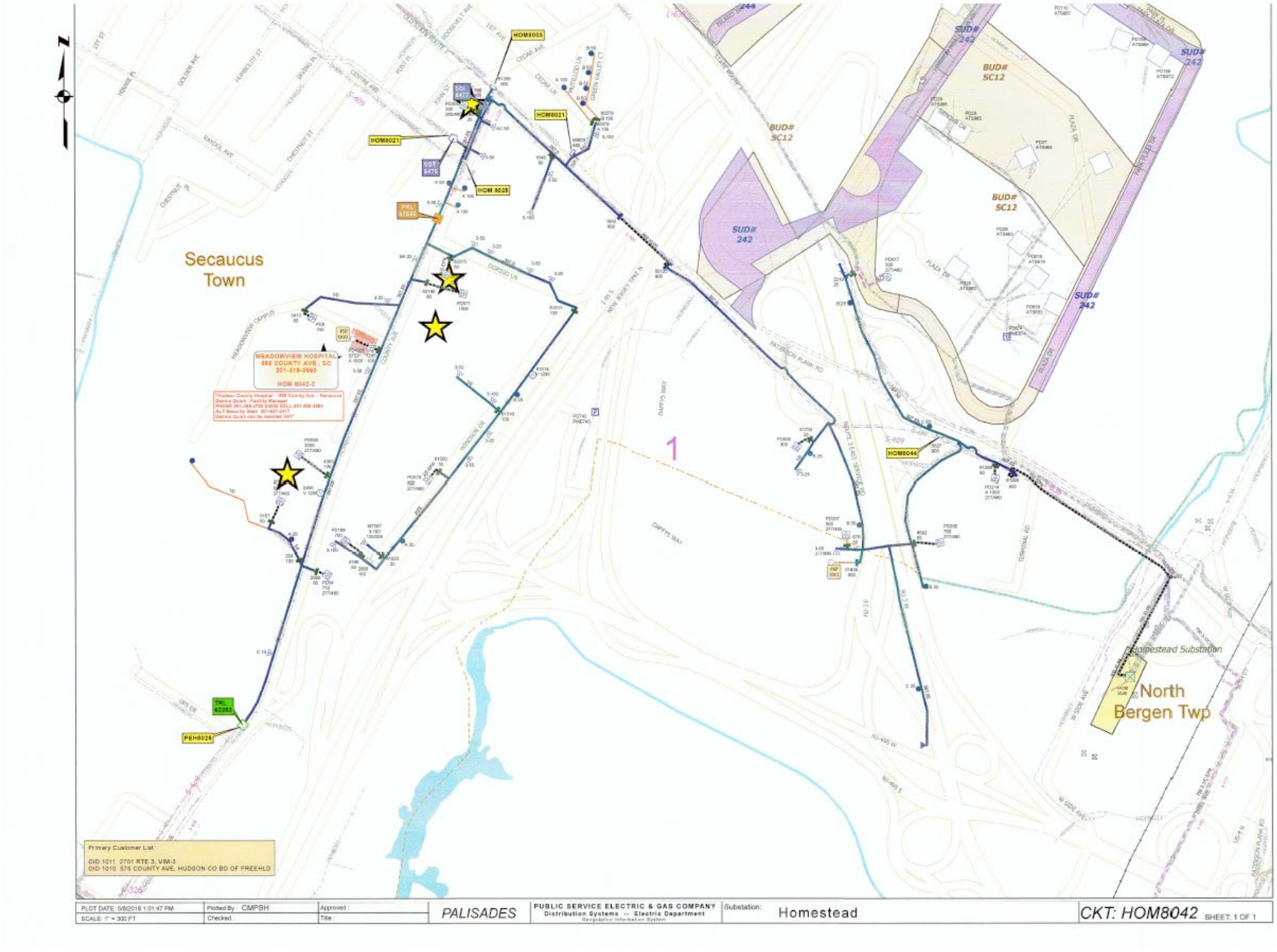
Why?

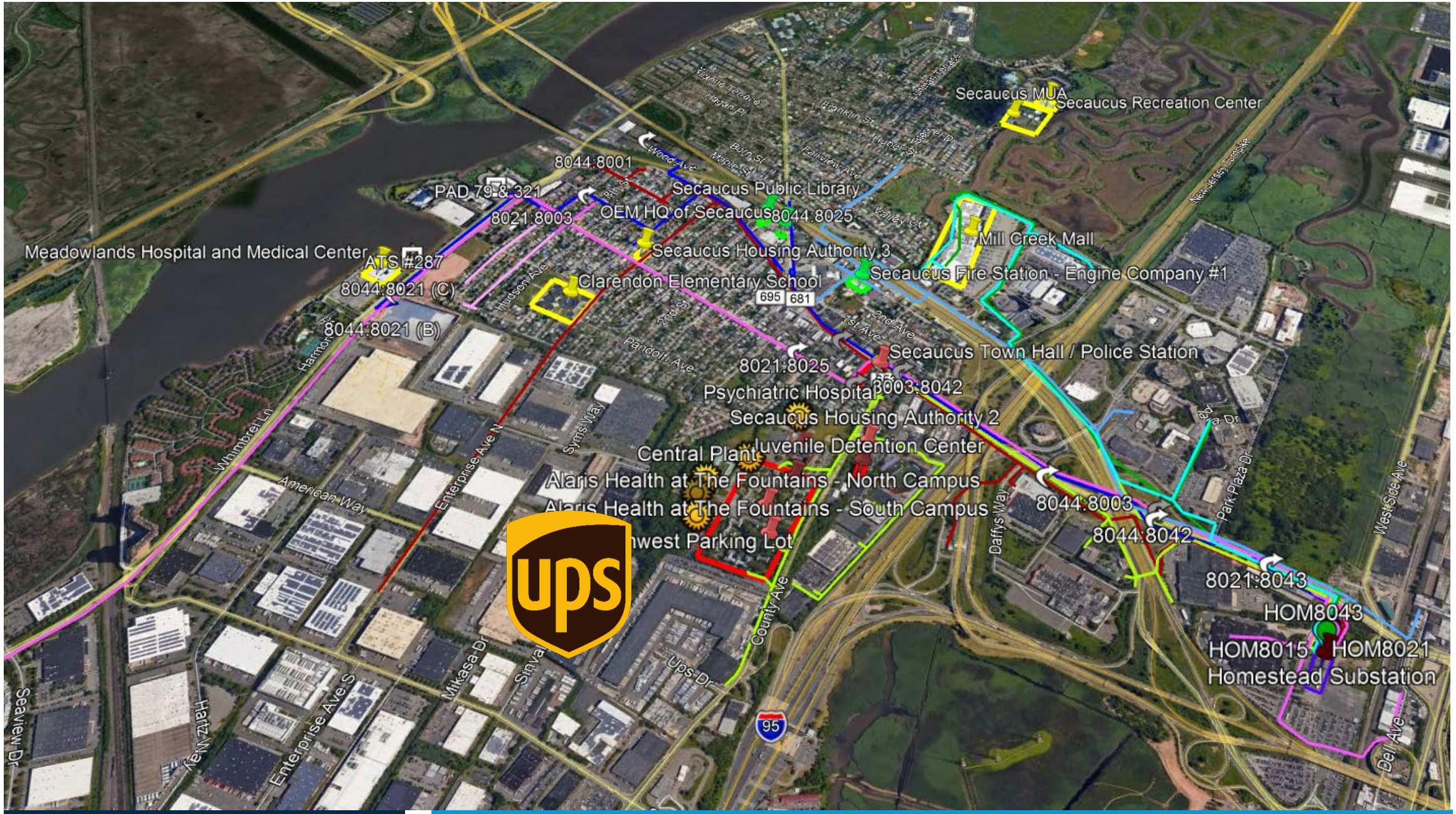
- Benefits of Microgrids include:
  - Improving local energy delivery
  - Increasing reliability
  - Saving money
  - Generating revenue
  - Aiding economic growth
  - **Making the grid more resilient**
  - Helping to counter climate change

How?

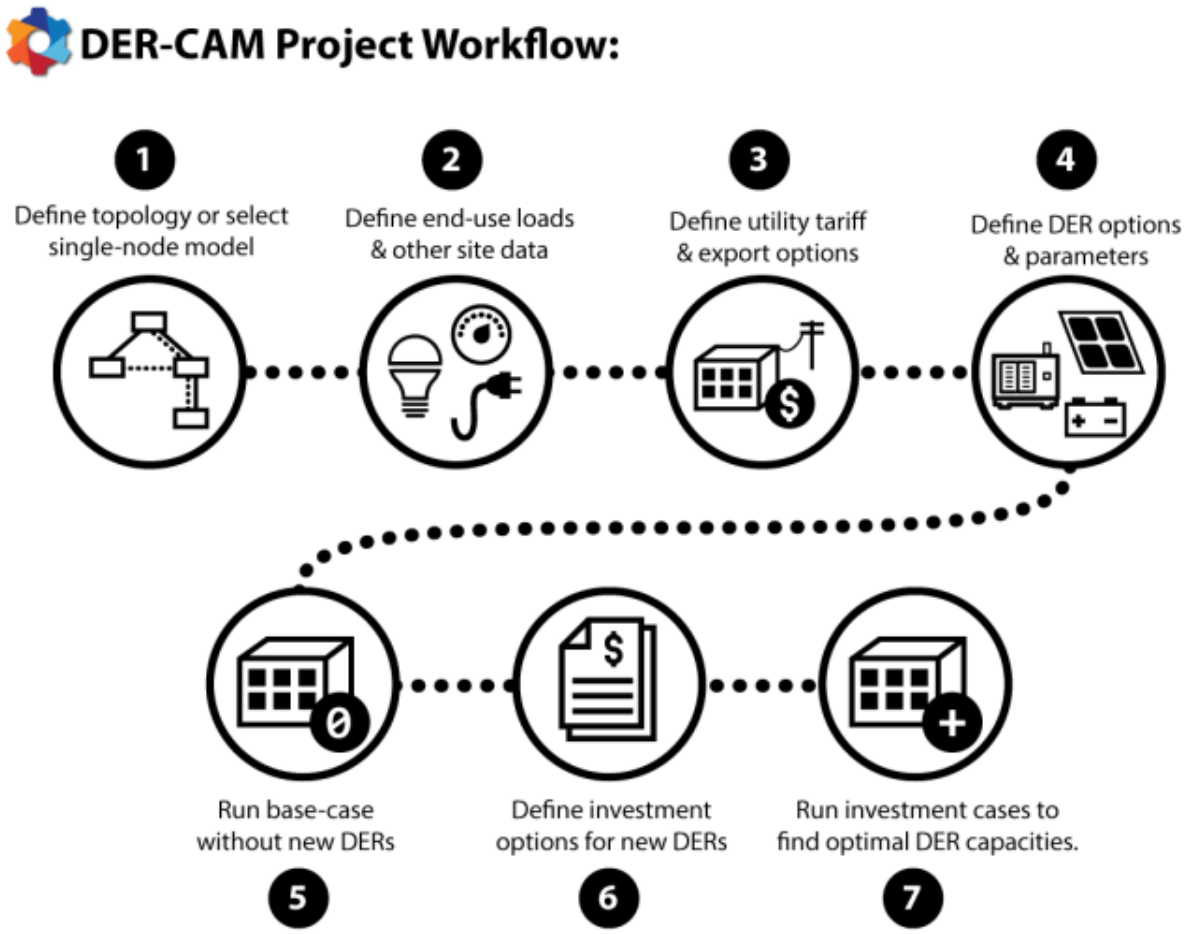
- **Step 1** – Determine utility load profiles
  - Electrical and thermal
- **Step 2** – Define design/evaluation criteria of project
  - Financial, resiliency, environmental, spatial, availability, redundancy, simplicity/operability
- **Step 3** – Analyze utility outputs for DER technologies to satisfy dynamic load profile
  - Is dynamic load profile satisfied?
  - Consider constraints of respective connection to macrogrid (feeder) & host facility
  - Consider limitations of selected DER technologies


Secaucus, NJ
Secaucus MUA Secaucus Recreation Center
Secaucus Public Library
OEM HQ of Secaucus
Mill Creek Mall
Secaucus Housing Authority 3
Secaucus Fire Station - Engine Company #1
Medical Center
Clarendon Elementary School
Secaucus
Secaucus Town Hall / Police Station
Secaucus Housing Authority 2
Secaucus Housing Authority 1
Meadowview Complex
Alaris Health at The Fountains - North Campus
Alaris Health at The Fountains - South Campus


Secaucus Town
North Bergen Twp
Homestead Substation
MEADOWVIEW HOSPITAL
595 COUNTY AVE., SC
201-319-3669
HOM 8042-2
HOM8033
HOM8021
HOM8026
HOM8044
PBH8026
SUD# 242
BUD# SC12
1
Primary Customer List:
OID:1011 2701 RTE 3, VIM-3
OID:1010 575 COUNTY AVE, HUDSON CO BD OF FREEHLD
PLOT DATE: 5/8/2018 1:01:47 PM
SCALE: 1" = 300 FT
Plotted By : CMPBH
Checked :
Approved :
Title :
PALISADES
PUBLIC SERVICE ELECTRIC & GAS COMPANY
Distribution Systems -- Electric Department
Geographic Information System
Substation: Homestead
CKT: HOM8042
SHEET: 1 OF 1


Secaucus MUA
Secaucus Recreation Center
8044:8001
PAD 79 & 321
Secaucus Public Library
8021:8003
OEM HQ of Secaucus
8044:8025
Meadowlands Hospital and Medical Center
ATS #287
Secaucus Housing Authority 3
Mill Creek Mall
Secaucus Fire Station - Engine Company #1
8044:8021 (C)
Clarendon Elementary School
695
681
8044:8021 (B)
Secaucus Town Hall / Police Station
8021:8025
Psychiatric Hospital
8003:8042
Secaucus Housing Authority 2
Juvenile Detention Center
Central Plant
Alaris Health at The Fountains - North Campus
Alaris Health at The Fountains - South Campus
8044:8003
8044:8042
8021:8043
HOM8043
HOM8015
HOM8021
Homestead Substation
95

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

BERKELEY LAB

BPU

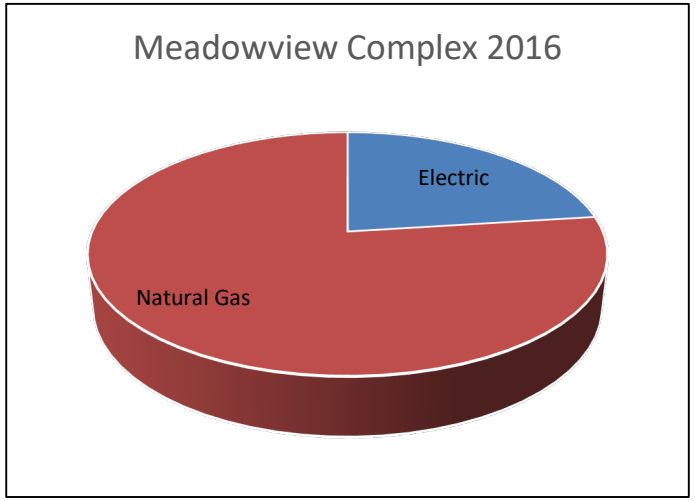
CHA

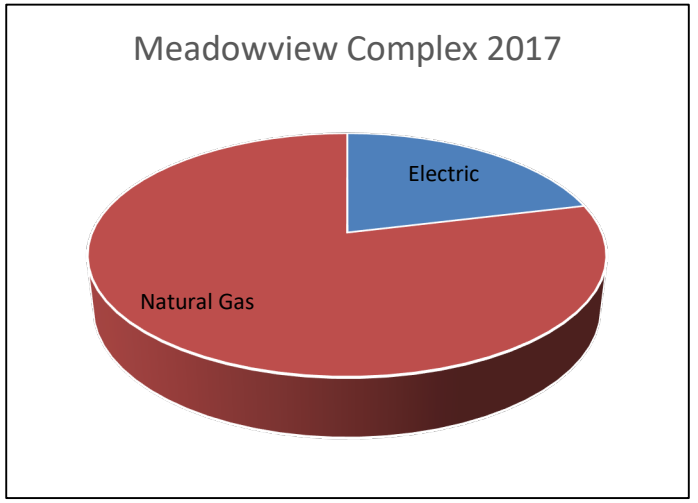
Monthly Load Profile

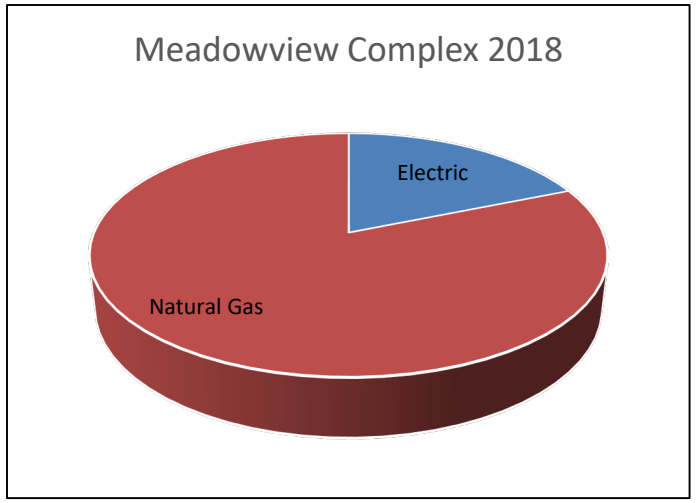
2017 Energy Usage					
Facility	Meadowview Complex 2017				
	Monthly kWh	kW	Gas (Therms)	MMBtu	Daily MMBtu
January-17	485,159	652	101,599	10,160	327.74
February-17	439,829	655	87,819	8,782	313.64
March-17	426,765	574	93,842	9,384	302.72
April-17	482,016	669	58,702	5,870	195.67
May-17	457,632	615	48,271	4,827	155.71
June-17	537,337	746	37,555	3,755	125.18
July-17	688,819	926	34,714	3,471	111.98
August-17	610,315	820	36,259	3,626	116.96
September-17	563,918	783	38,160	3,816	127.20
October-17	561,454	755	47,531	4,753	153.33
November-17	443,822	616	84,465	8,446	281.55
December-17	441,123	593	109,592	10,959	353.52
Total	6,138,189.00	8,404.41	778,509.03	77,850.90	2,565.21
Min	426,765.00	573.61	34,714.24	3,471.42	111.98
Max	688,819.00	925.83	109,592.20	10,959.22	353.52
Average	511,515.75	700.37	64,875.75	6,487.58	213.77
Facility Type	Government				
Sq Ft	412,047				
	0.020	kWh/SF	0.0062	MMBtu/SF	

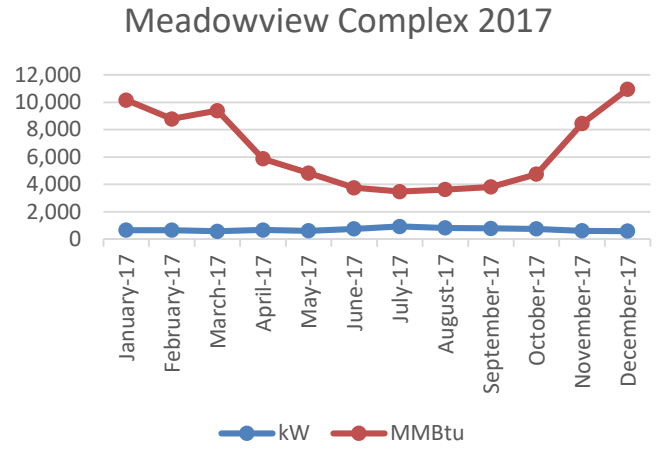
	Meadowview Complex	
Utility	kBtu	%
Electric	20,944,370	21%
Natural Gas	77,832,319	79%
Total:	98,776,689	100%

	Electrical	Thermal
Energy Use Intensity (EUI) kBtu/SF/Yr	50.8	188.9
	Electrical	Thermal
Energy Use Intensity (EUI) kBtu/SF/Month	4.2	15.7



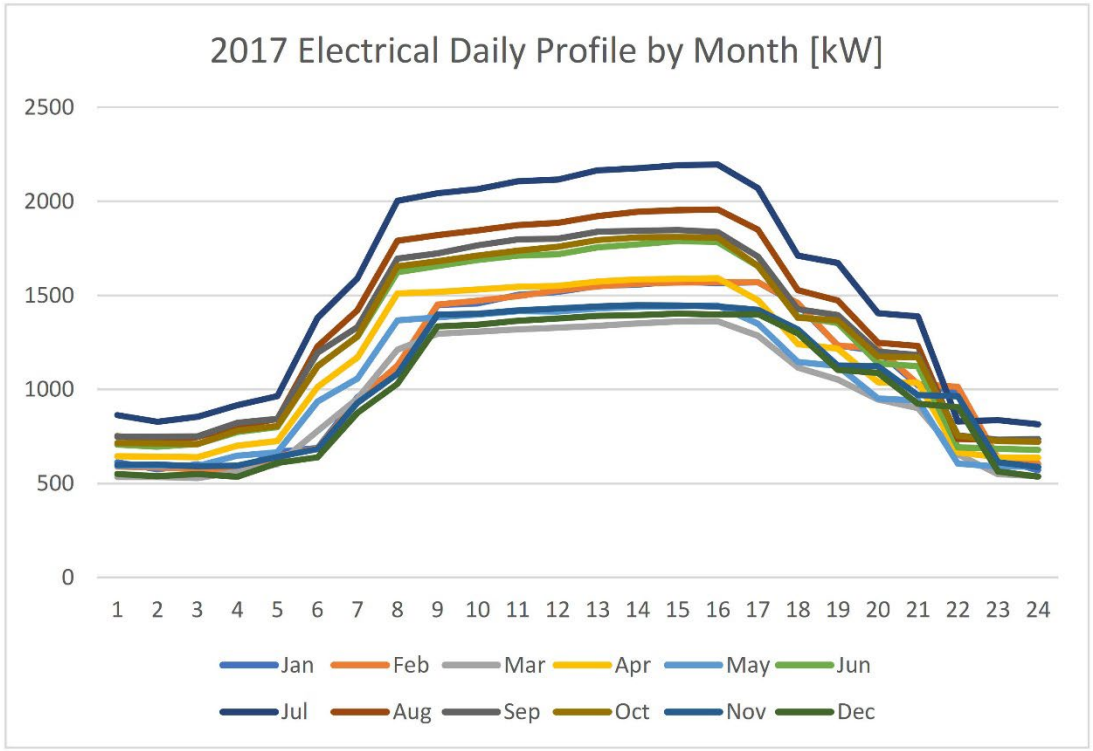


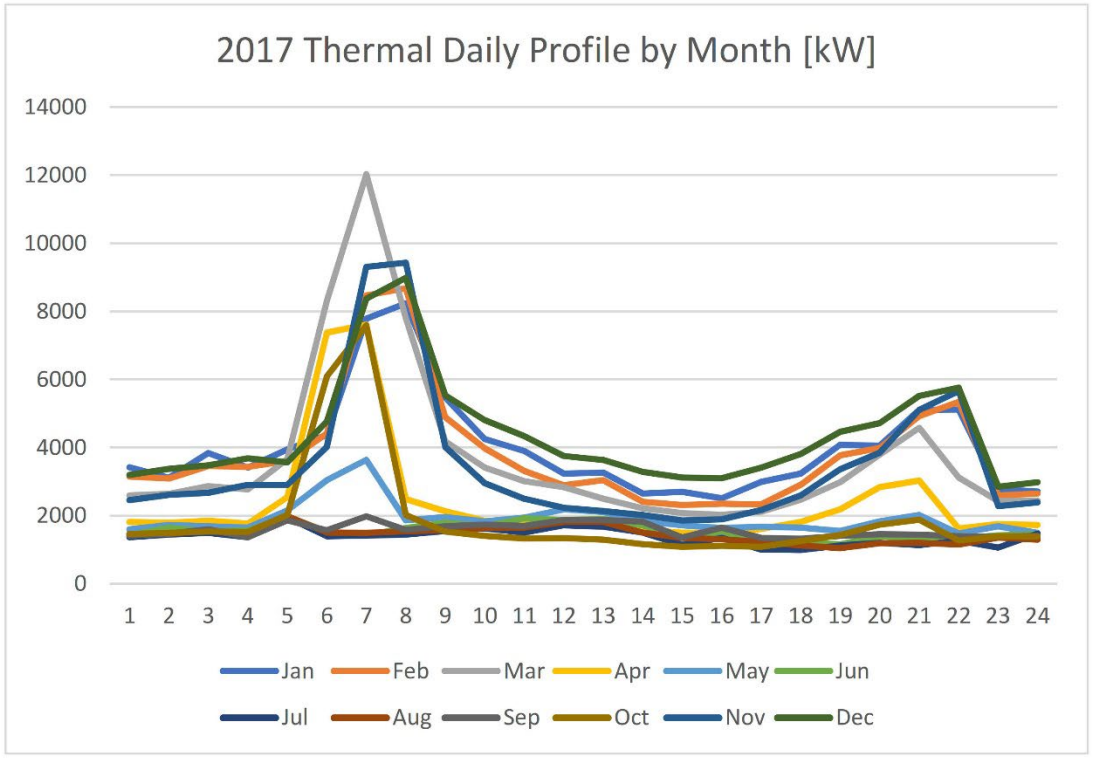




Daily Load Profile (by Month)

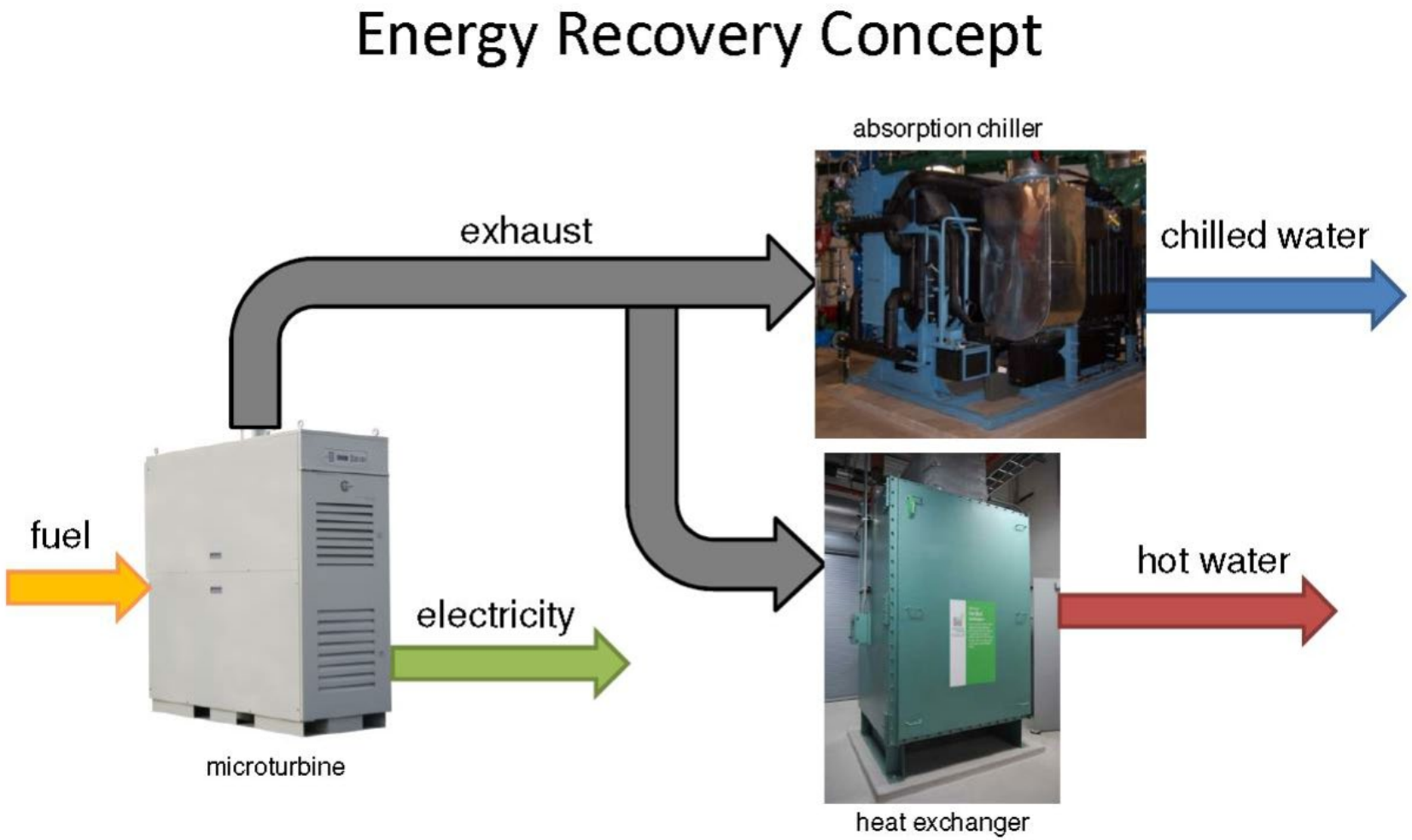
Meadowview Complex and Alaris Health





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

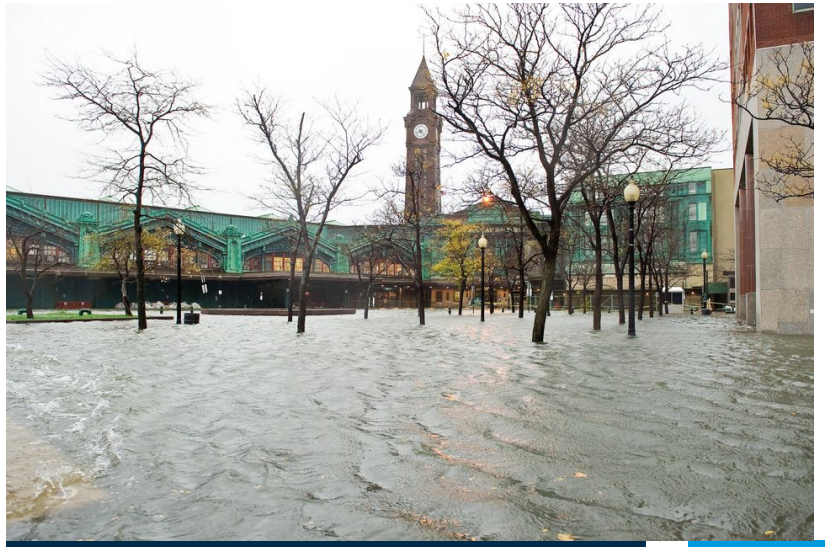
Existing Assets to Leverage (PV)

- 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



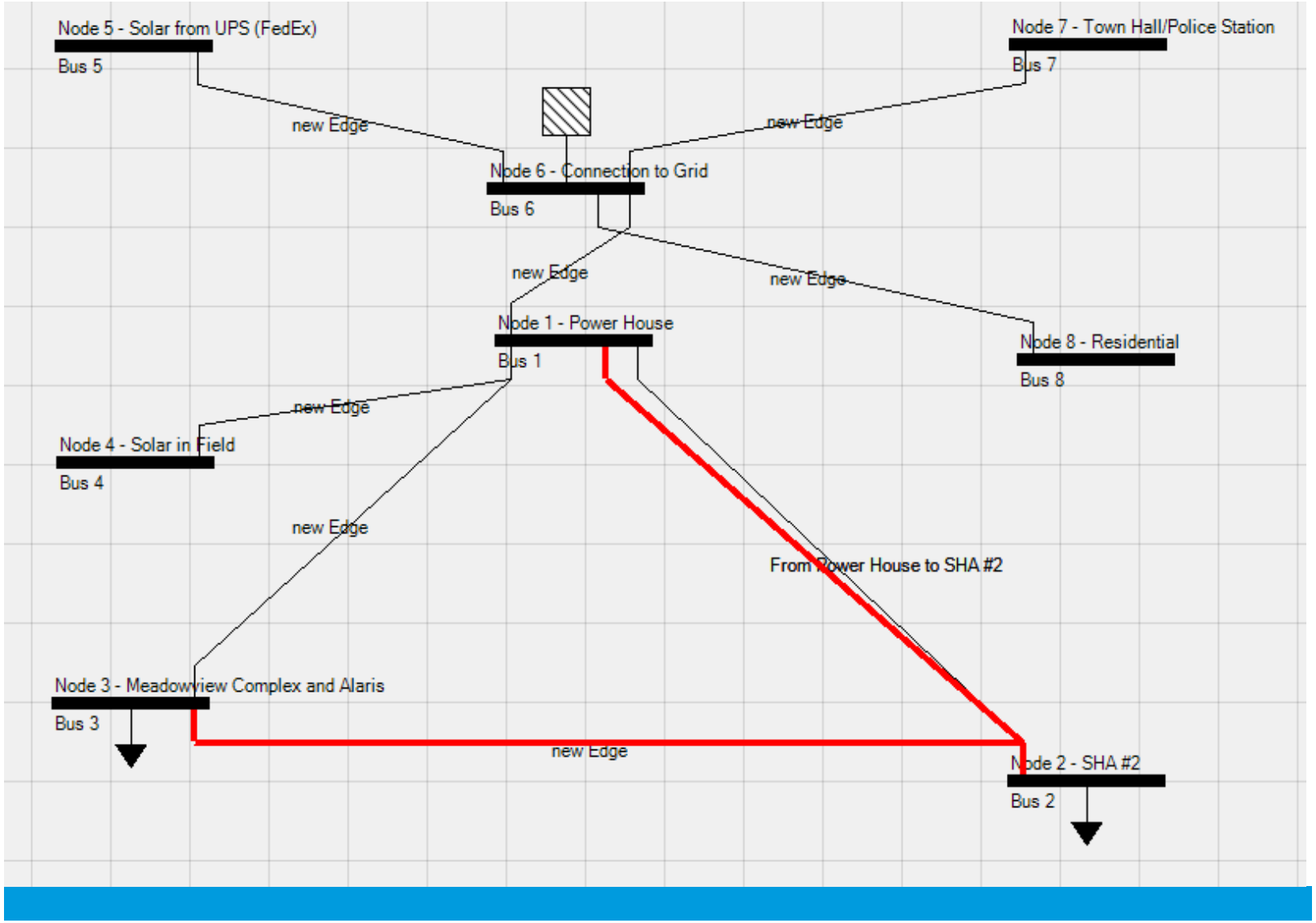
- Financial
- Environmental
- Spatial
- Availability
- Redundancy
- Simplicity/operability

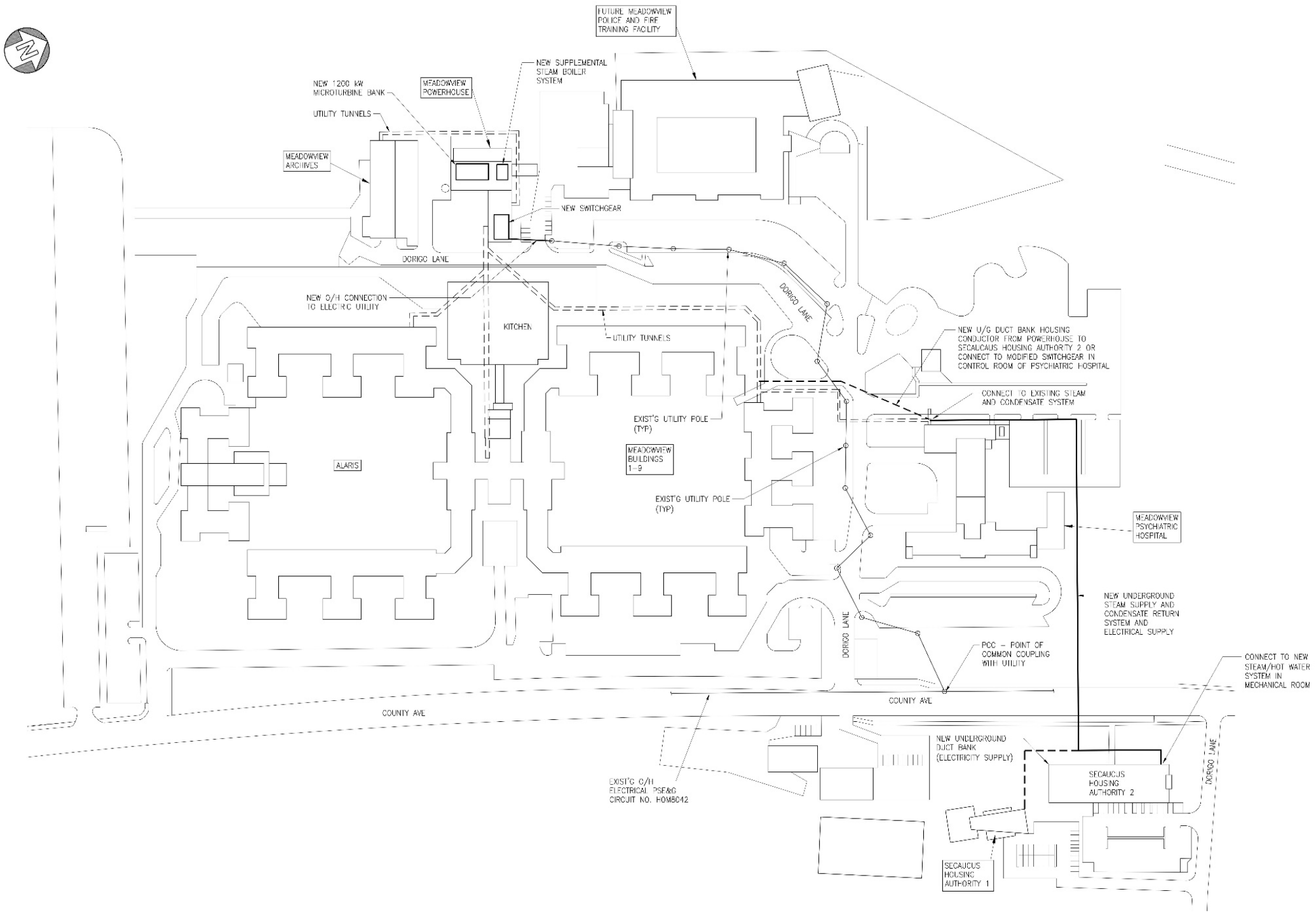
HCAM Facility Summary

Facility Name	Risk Category	Highlights
Secaucus Town Hall / Police Station	4	- existing solar - electrical backup during blacksky event
Meadowview Complex (including Alaris Health)	2, 3, 4	- significant electric load - significant thermal load - planned 600 kW solar - room for additional solar and CHP/boilers - existing steam tunnel
Secaucus Housing Authority #2	3	- electric and thermal loads - rooftop area for solar
United Parcel Service (UPS)	2	- existing 1.2 MW solar potentially available for blacksky event

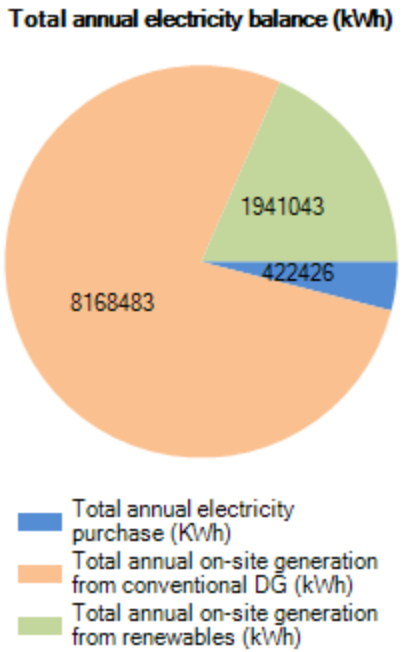
Topology Development in DER-CAM

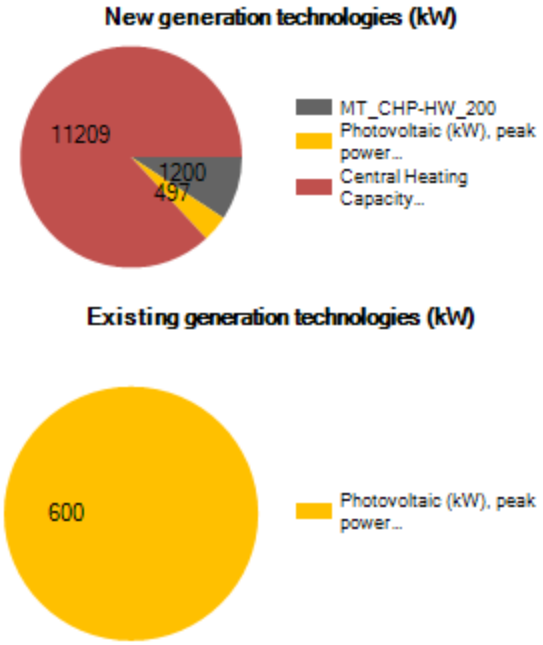
- Each facility is connected together so that combined loads can be considered in concert
- Red lines indicate the thermal loop (steam from power house)

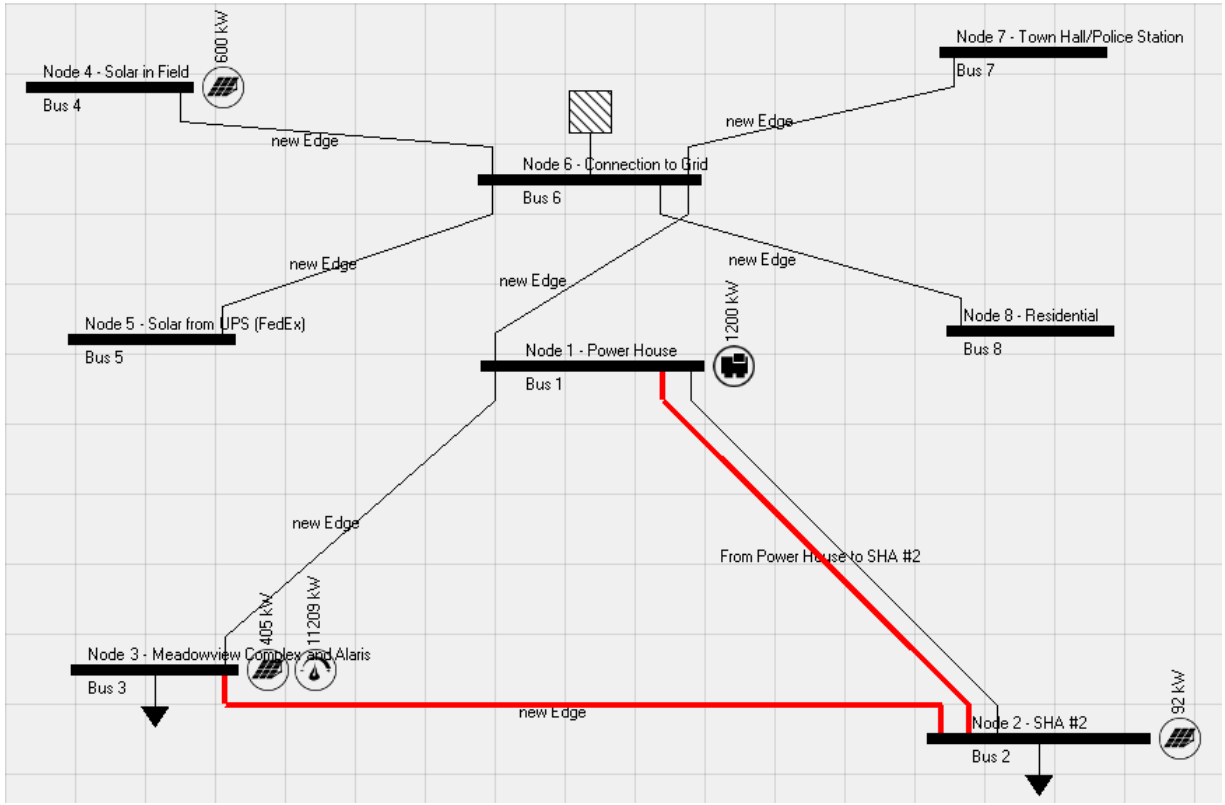



FUTURE MEADOWVIEW POLICE AND FIRE TRAINING FACILITY
NEW SUPPLEMENTAL STEAM BOILER SYSTEM
NEW 1200 kW MICROTURBINE BANK
MEADOWVIEW POWERHOUSE
UTILITY TUNNELS
MEADOWVIEW ARCHIVES
NEW SWITCHGEAR
DORIGO LANE
NEW O/H CONNECTION TO ELECTRIC UTILITY
KITCHEN
UTILITY TUNNELS
DORIGO LANE
NEW U/G DUCT BANK HOUSING CONDUCTOR FROM POWERHOUSE TO SECAUCUS HOUSING AUTHORITY 2 OR CONNECT TO MODIFIED SWITCHGEAR IN CONTROL ROOM OF PSYCHIATRIC HOSPITAL
CONNECT TO EXISTING STEAM AND CONDENSATE SYSTEM
EXIST'G UTILITY POLE (TYP)
MEADOWVIEW BUILDINGS 1-9
ALARIS
EXIST'G UTILITY POLE (TYP)
MEADOWVIEW PSYCHIATRIC HOSPITAL
NEW UNDERGROUND STEAM SUPPLY AND CONDENSATE RETURN SYSTEM AND ELECTRICAL SUPPLY
DORIGO LANE
PCC – POINT OF COMMON COUPLING WITH UTILITY
CONNECT TO NEW STEAM/HOT WATER SYSTEM IN MECHANICAL ROOM
COUNTY AVE
COUNTY AVE
NEW UNDERGROUND DUCT BANK (ELECTRICITY SUPPLY)
SECAUCUS HOUSING AUTHORITY 2
DORIGO LANE
EXIST'G O/H ELECTRICAL PSE&G CIRCUIT NO. HOMB042
SECAUCUS HOUSING AUTHORITY 1

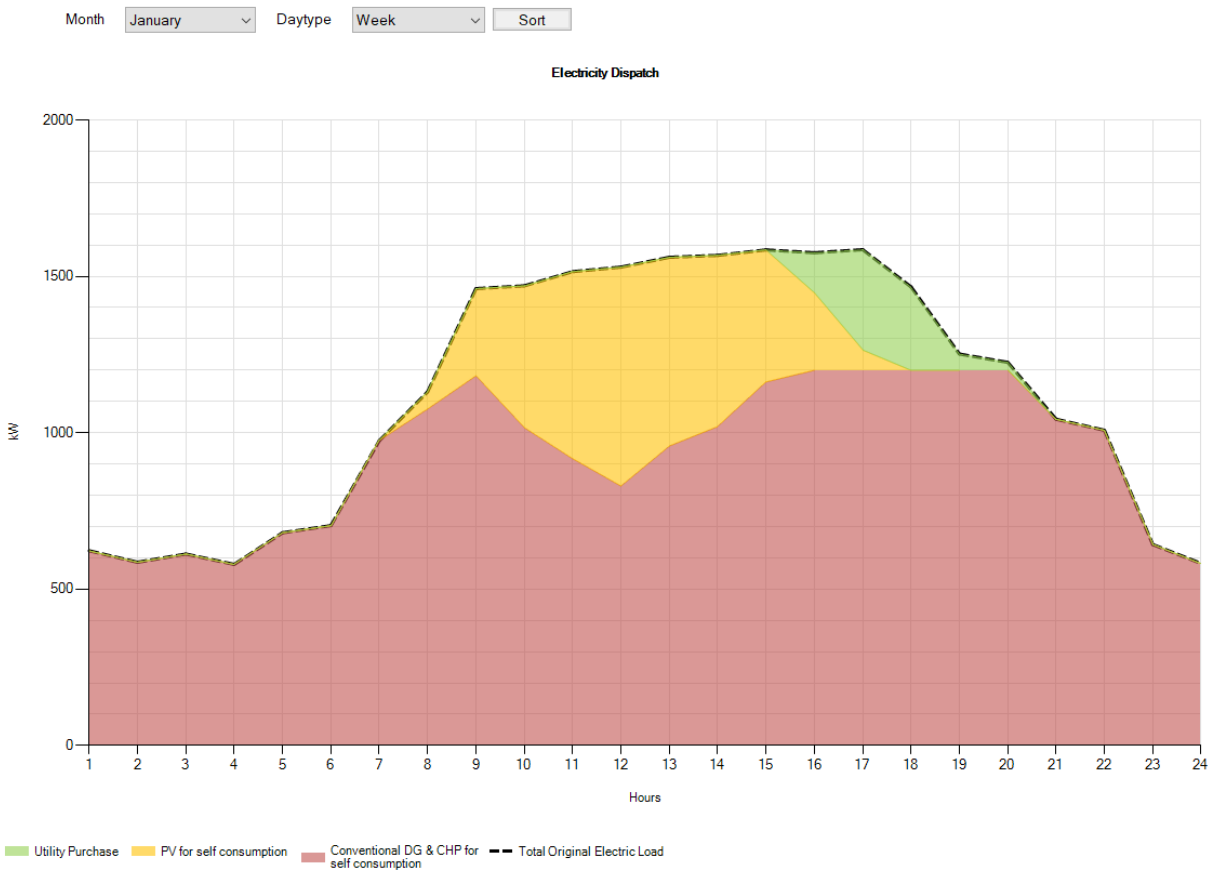
Analysis Results (1)

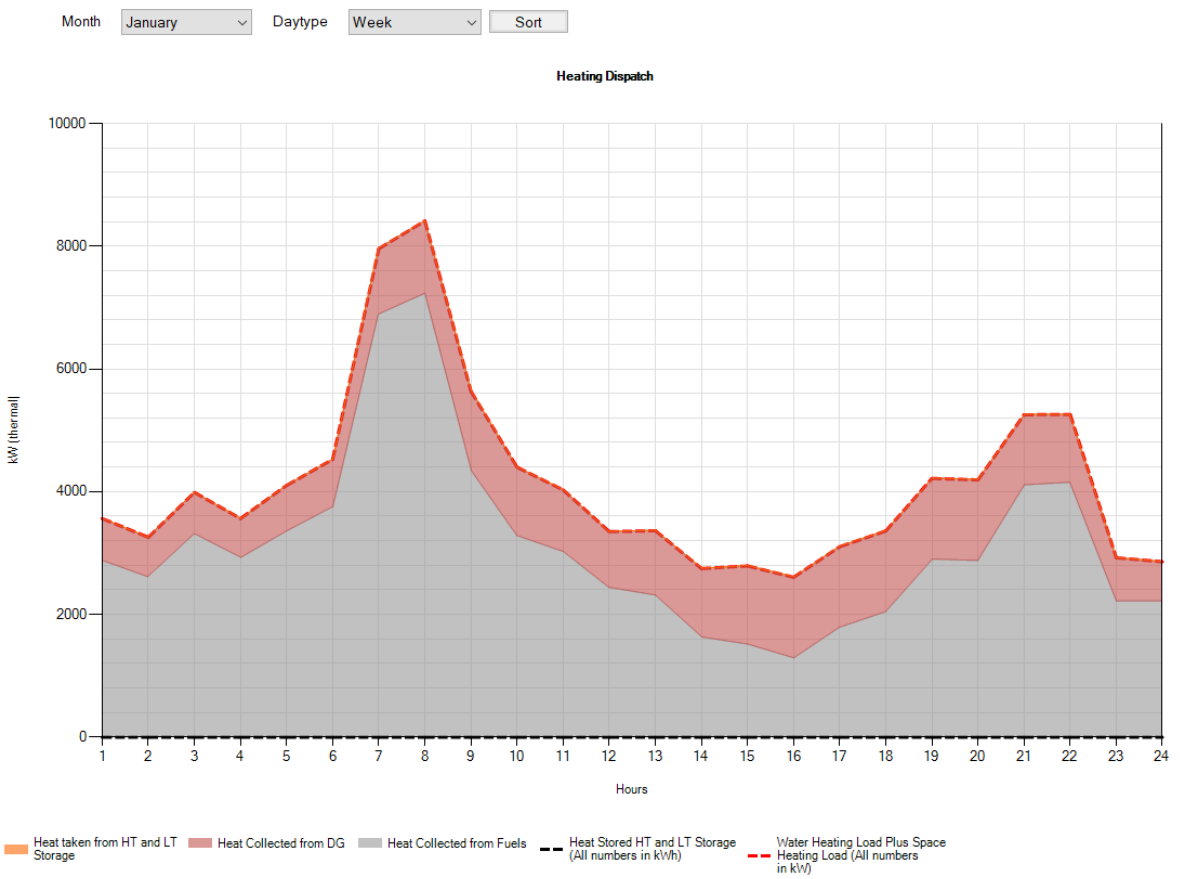






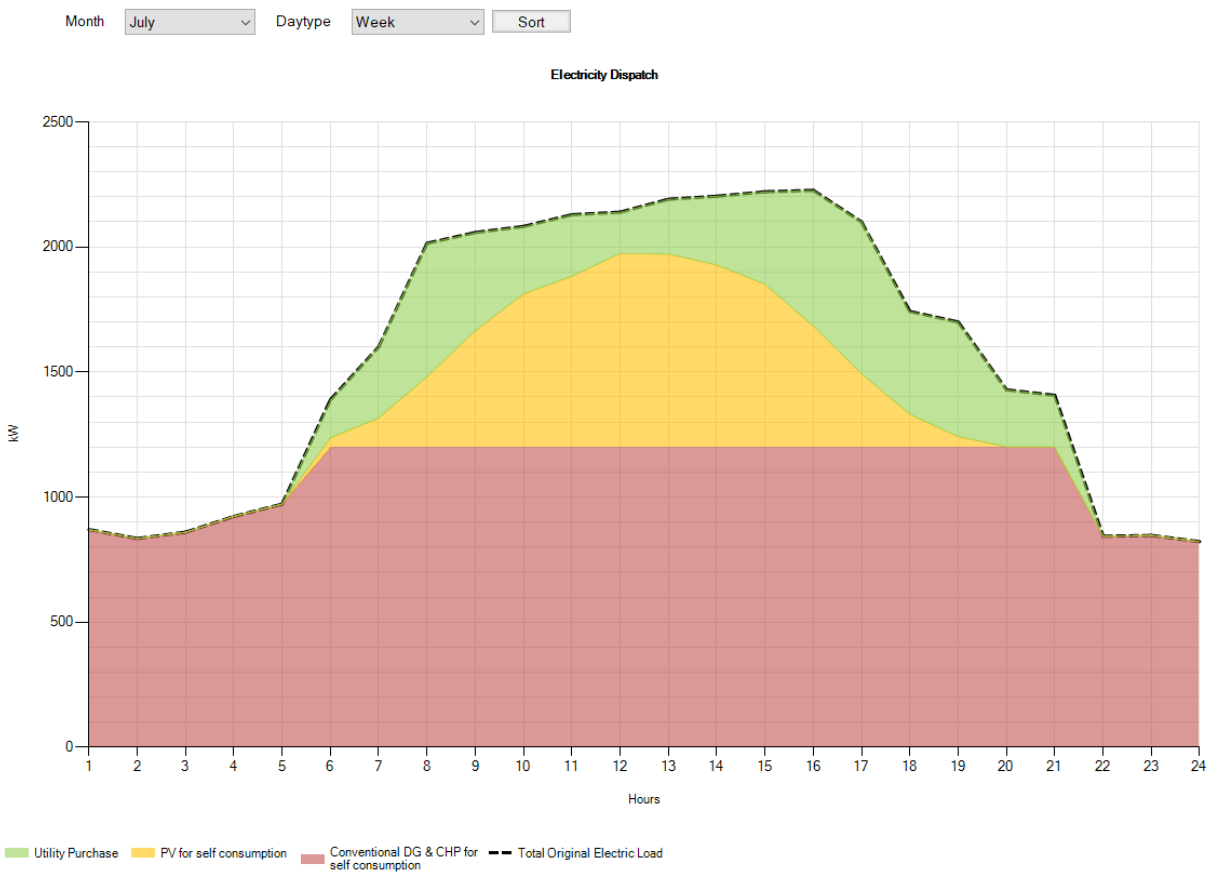
Analysis Results (2)

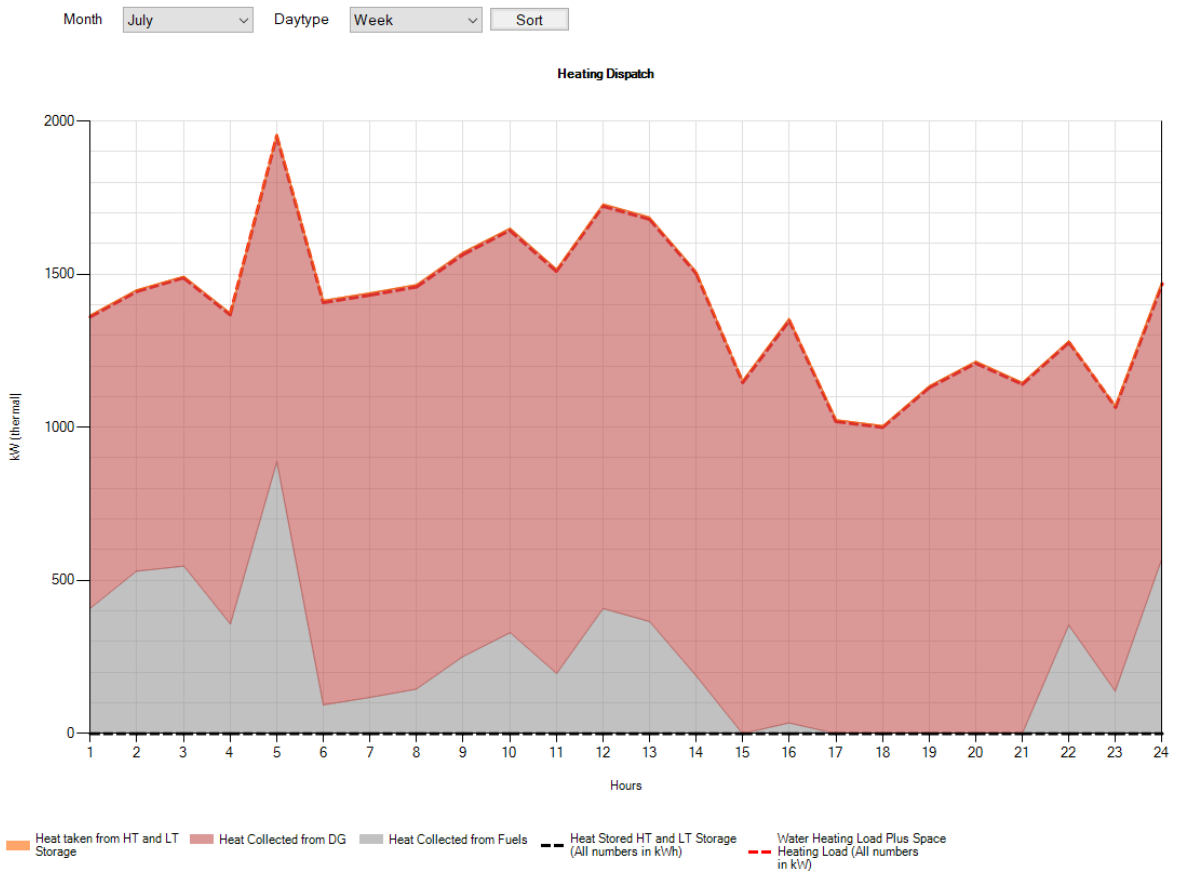




January Electricity and Heating Dispatch

Analysis Results (3)





July Electricity and Heating Dispatch

Description of Overall Costs and Revenues

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

Energy	Annual Production	Unit Price	Year 1 Energy Sales
Solar PV Electricity to Alaris Health / Meadowview Complex	555,261 kWh	$0.112 / kWh	$62,189
Solar PV Electricity to Secaucus Housing Authority #2	126,080 kWh	$0.150 / kWh	$18,912
CHP Electricity to Alaris Health / Meadowview Complex	7,959,250 kWh	$0.112 / kWh	$891,436
CHP Electricity to Secaucus Housing Authority #2	69,244 kWh	$0.150 / kWh	$10,387
CHP Steam to Alaris Health / Meadowview Complex	277,796 therms	$0.7529 / therm	$209,153
CHP Steam to Secaucus Housing Authority #2	34,700 therms	$1.0118 / therm	$35,108
Total Revenue from Energy Sales			**$1,227,185**

Microgrid Component	Assumption	Year 1 Cost
Solar PV across all facilities	$7.50 / kW	$3,728
CHP Natural Gas Cost	$0.64 / therm	$662,788
CHP Maintenance	$0.035 / kWh	$301,173

- 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?

Hudson County
Integrating Renewables with a CHP Campus

Thank you!

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