

Not All Microgrids Are Created Equal: Northeastern University's Blueprint for Resiliency

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Green • Clean • Sustainable

Northeastern University

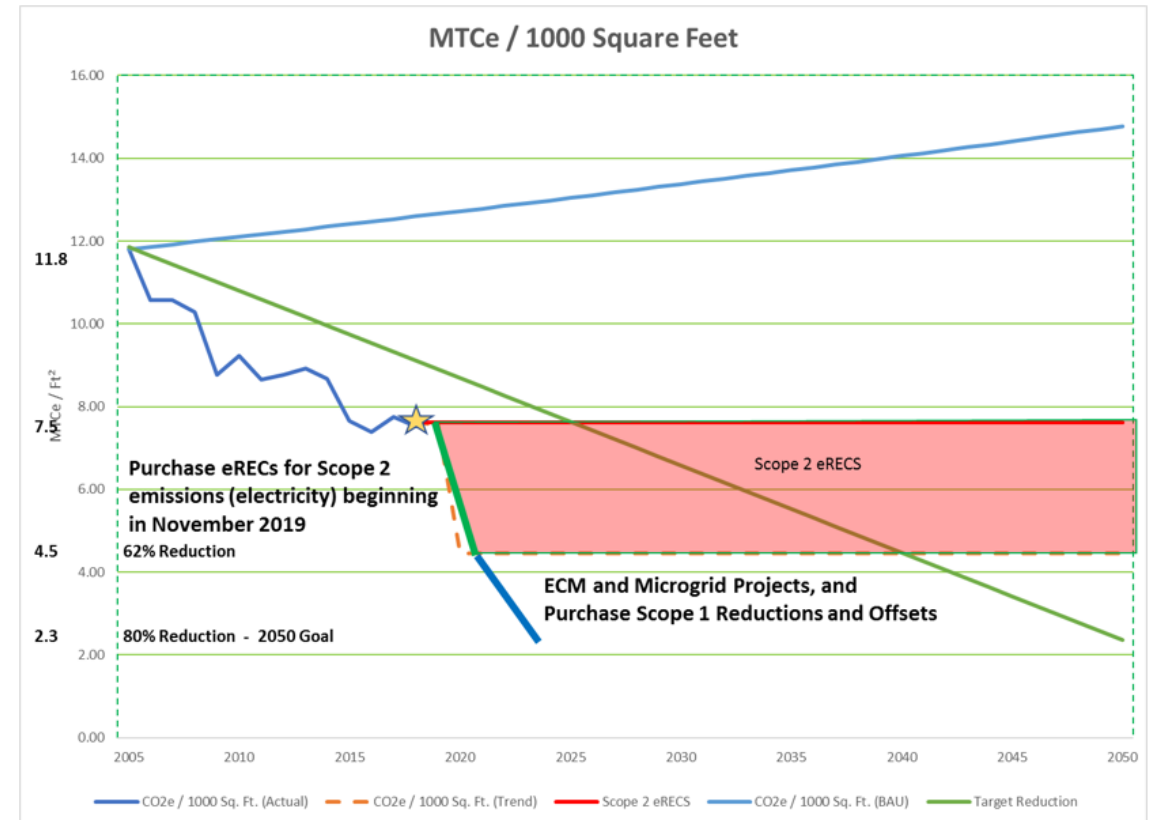
About Us:

- Urban 70+ acre campus 8M GSF and growing
- Over 36,000 students across undergrad/graduate and growing
- Learning in action: Uniquely offering Experiential Learning
- Nearly \$180M in external research funding and growing

Northeastern's Energy and Resiliency Vision for the Future:

- Reduce 2005 carbon footprint by 80% by 2050 (More Sooner)
- Improve resiliency related energy supply interruptions
- Reduce operating costs and improve cash flow
- Research partnerships and student engagement
- Maintain or improve the University's financial strength & integrity

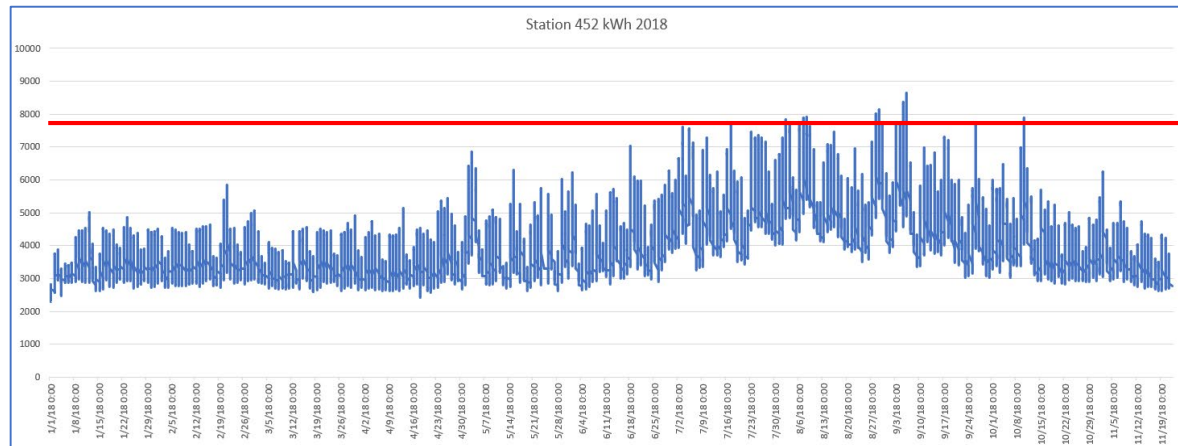
Carbon Reduction Roadmap:



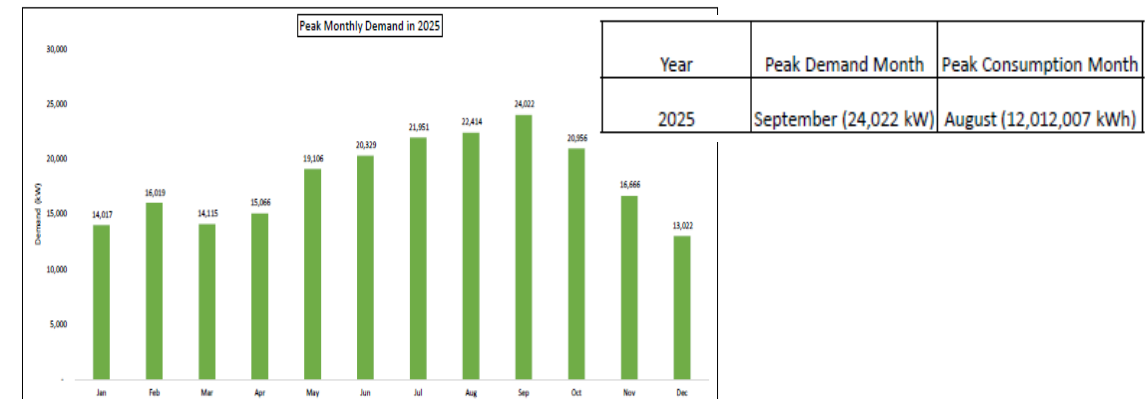
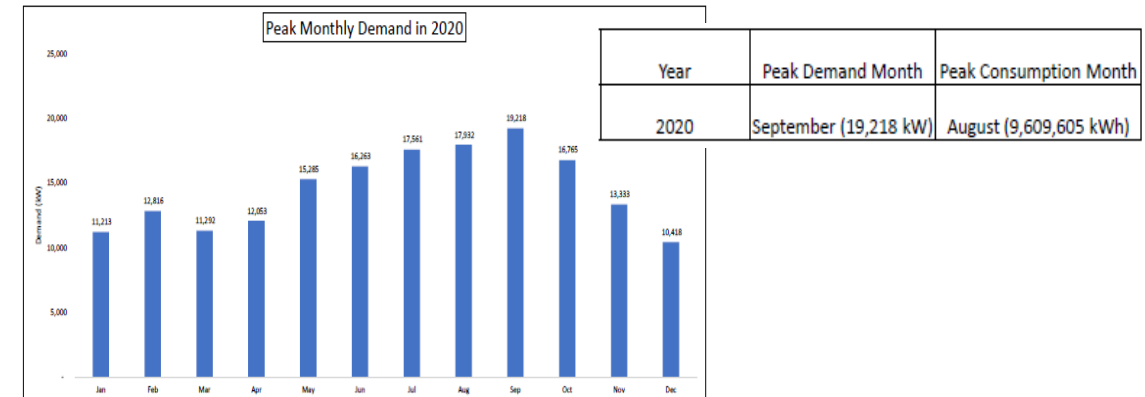
Energy Challenges

Electric Substation Capacity Issue

Substation Load Analysis: Eversource firm capacity limitation is being exceeded on one main campus feed – Forsythe

[illegible]

Electric Peak Projections – 2020 and 2025



Advanced Energy Solutions Developed for Resiliency

Energy Efficiency

- Comprehensive energy conservation measures
- Reduces energy demand/use on campus

Onsite Energy Generation

- Solar PV system
- Turbine-based combined heat and power (CHP)

Battery Energy Storage

- Consumption of onsite generation
- Backup power/microgrid support

Microgrid

- Ties all elements together
- Enables stored power supply when the local grid goes down

Microgrid Project – Needs and Benefits

- Implements part of the Carbon Reduction Roadmap
- Increases the electrical capacity and reliability of the campus infrastructure
- Reduces annual utility operating costs
- Addresses electric and steam deferred maintenance needs
- Improves the resiliency of the University's utility infrastructure
- Frees valuable campus real estate



Microgrid Project – Description

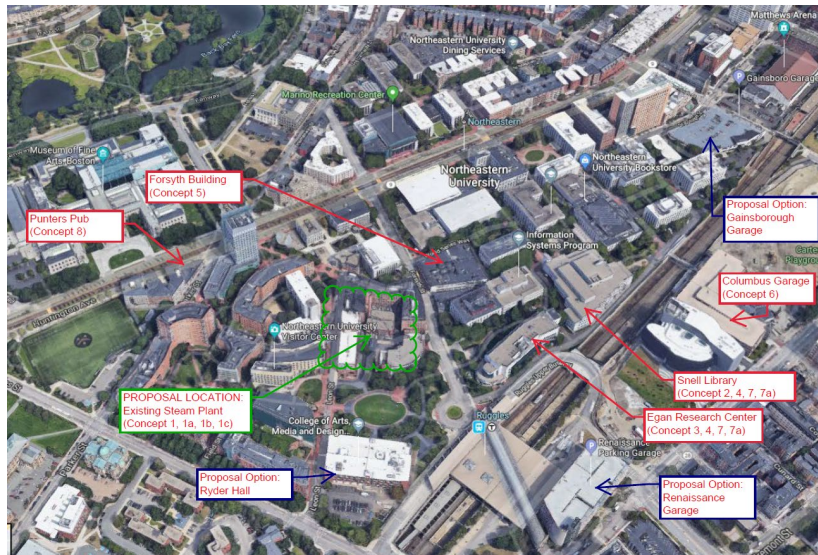
- Two (2) 4.6 MW Cogeneration Gas Turbines
 - ISO Dispatch/Ancillary Services
 - Island Mode Capable
- 32,000 Lb/Hr Heat Recovery Steam Generator
- Electrical Substation Upgrades Throughout Campus
- New Boilers and Steam Improvements
- 2MW/3MWh Battery System and Resiliency Improvements
- ~2MWdc solar PV
- Living Learning Lab



Location Analysis

Multiple Tasks, Many Skill Sets

- Matrix of Locations (12+ Sites over 12+ months)
- Structural Analysis
- Proximity to Fuel
- Campus Steam Infrastructure
- Campus Electric Infrastructure



Criteria & Constraints

- Economics
- Campus and Academic Disruption
- Operations and Maintenance
- Campus Resiliency

Northeastern University - CHP Plant Location Decision Matrix													
Factors	Importance (0-10)	Concept 1 Revolt of Old Steam Plant (New)	Concept 1a Steam Plant Expansion with 2nd Level	Concept 1b Connect to Varsity Steam Plant Allow In with Replacement of Steam Plant	Concept 1c New Plant in North A corner of Steam Plant	Concept 2 New Plant on East of Library	Concept 3 New Plant on East of Research Center	Concept 4 New Plant on East of South & East	Concept 5 New Plant on Forsyth Building	Concept 6 New Plant on Columbus Parking Garage	Concept 7 Decentralized Steam Plant with Replaced CHP Plant	Concept 7a Decentralized Steam Plant with New CHP Plant	Concept 8 Puniers Pub
Inconspicuous	10	3	3	2	2	3	3	3	3	3	2	2	2
Educational Programs and Opportunities	10	2	3	2	3	1	1	1	3	2	1	1	1
Carbon Impact	10	2	2	2	2	2	2	2	2	2	2	2	2
Site access for plant O&M (loading dock, freight elevator, etc.)	10	3	3	2	1	2	2	2	3	2	2	2	1
Access to underground oil storage area	10	3	3	3	3	1	1	1	2	1	1	1	1
Sufficient space for central plant equipment and future expansion	10	1	3	2	2	2	2	2	2	3	1	1	1
Structural feasibility of concept	10	2	2	2	3	2	2	2	1	2	2	2	2
Site access to existing steam condensate distribution system	10	3	3	2	3	1	1	1	2	1	2	2	1
Site access to existing central plant natural gas service	10	3	3	3	3	1	1	1	2	1	2	2	1
Site access to existing electrical distribution system	10	3	3	3	3	1	1	1	2	1	2	2	1
Potential building academic disruption during project construction	10	3	3	1	2	1	1	1	1	3	2	2	3
Disruption to existing central plant operations during construction	10	2	3	2	2	3	3	3	3	3	2	2	3
Improved Resiliency to Campus Steam System	10	3	3	2	2	2	2	2	3	3	3	3	2
Improved Resiliency to Campus Electrical System	10	3	3	3	3	3	3	3	3	3	3	3	3
Energy and Cost Savings	10	3	3	2	2	2	2	2	2	2	2	2	2
Cost of Implementation	10	3	2	2	1	1	1	1	0	0	0	0	0
TOTAL		420	480	380	370	280	280	280	340	320	290	290	260
		420	480	380	370	280	280	280	340	320	290	290	260



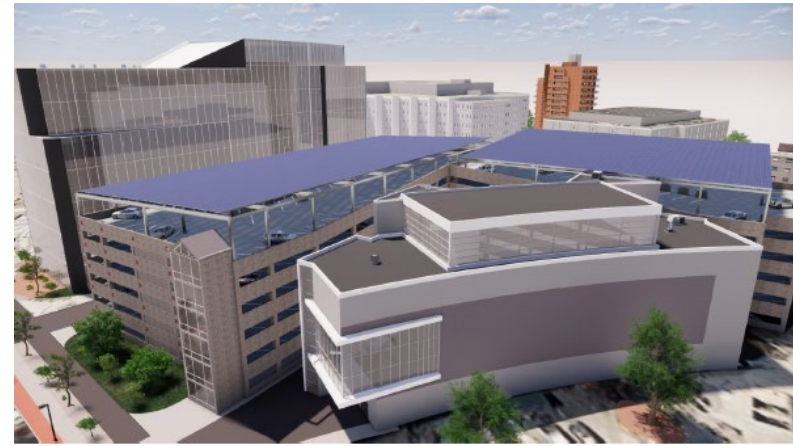
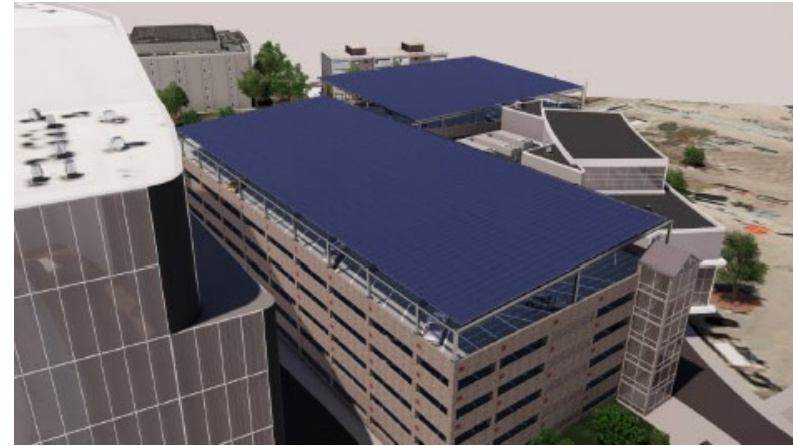
Solar PV Opportunities

Review of on-site PV potential ongoing

- Primary opportunities: Columbus Garage and Curry Student Center
- Additional considerations: Cabot Center & Barletta Natatorium, Snell Library, and Marino Center

Site	DC Capacity (kW)	kWh/Year	System Type
Curry Student Center	136.1	171,951	Rooftop
Cabot/Barletta	750.0	881,111	Rooftop
Snell Library	189.2	229,784	Rooftop
Marino Center	243.4	295,695	Rooftop
Columbus Garage	625.0	735,625	Carport Canopy
All Sites	1,943.7	2,314,166	

Solar PV Opportunities – Columbus Renderings



Research and Education Partnerships

- Leverage partnerships to implement a research and development program that leverages EMS with the integrated distributed energy systems
- Vision to build a simulation platform to allow students and faculty to simulate, analyze and research a wide variety of use cases in the distributed energy management domain

Three Pillars of Research Partnerships

1

Microgrid Energy Solution – Grid Operation Research Platform
A Research Platform for Integrated
Smart Distribution Grid Operation

2

University as a Living Learning Lab – Smart City Research Platform
Smart Campus Energy Management with
Clean Technology & Electric Economy

3

Engineering & Training Program Enhancements
Certification Program Development –
Work Force Training on GE Technologies

Questions?

Thank You!



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