Campus Energy Plant
Tufts University

IDEA Microgrid Conference 2017

Optimizing the Economics of a Combined Heat and Power Project

November 8, 2017

Presentation Overview:

- Campus and Project Overview
- Economic Considerations
- Summary

Campus Energy Plant

Traditional Campus Close to City

Image courtesy CBT Architects

Project Development

- Energy saving opportunities study identified Cogen possibility
- Feasibility study – no fatal flaws
- Established the business case
- Concept design – modify existing plant or new plant?
- Design
- Construction

Project Operational Highlights:

- New Plant includes:
  - On site electrical generation (4MW gas fired reciprocating engine)
  - Supplemental boilers (75 Kpph)
  - Central chilled water system (1,400 tons)
- Enhanced Sustainability
  - Greenhouse gas emissions reduced 14%
  - Significantly more efficient than the existing plant
- Enhanced Resiliency
  - Power continuity even during a long utility outage
- Utility reliability improved

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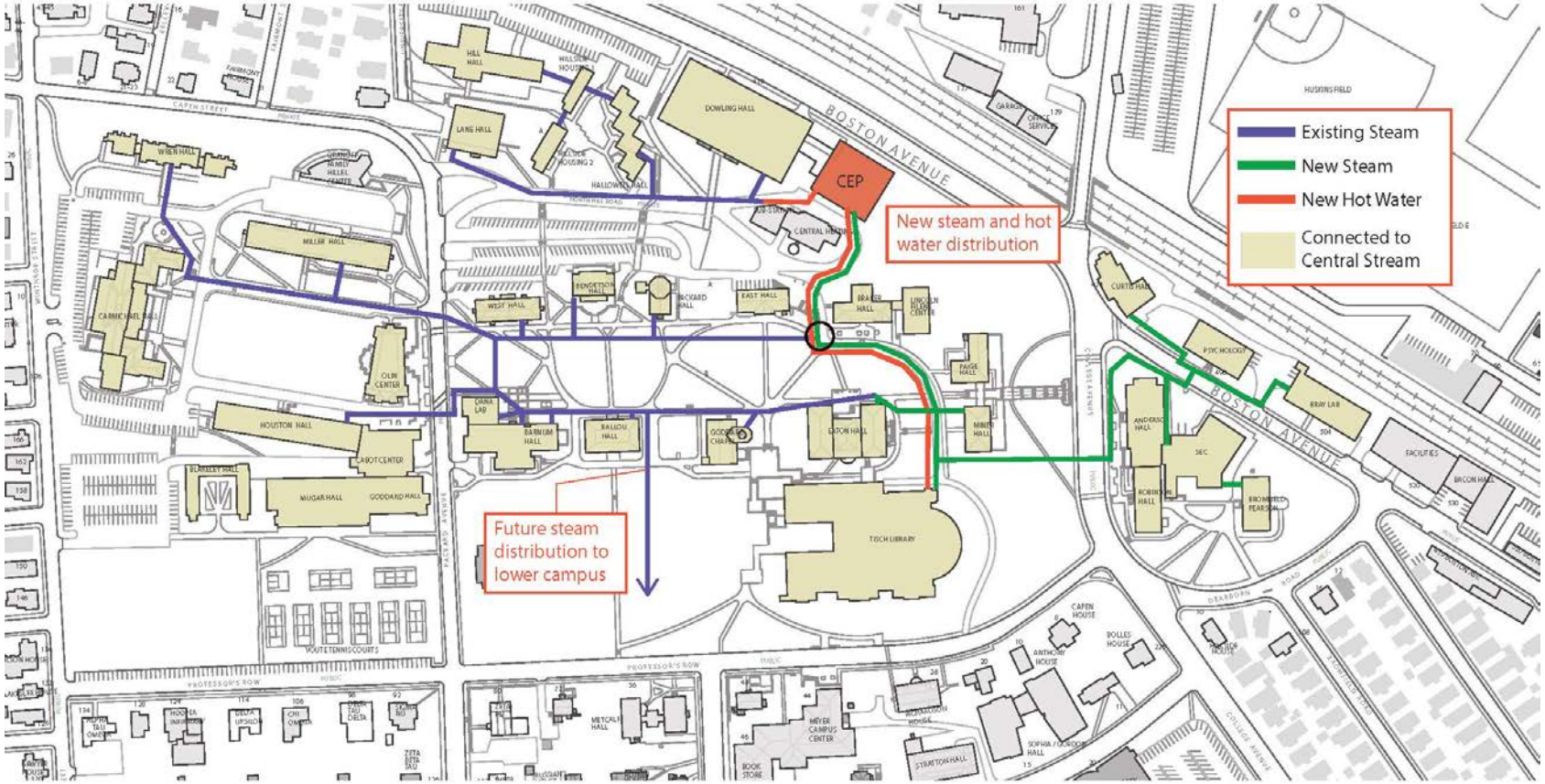
What is served on campus - Steam

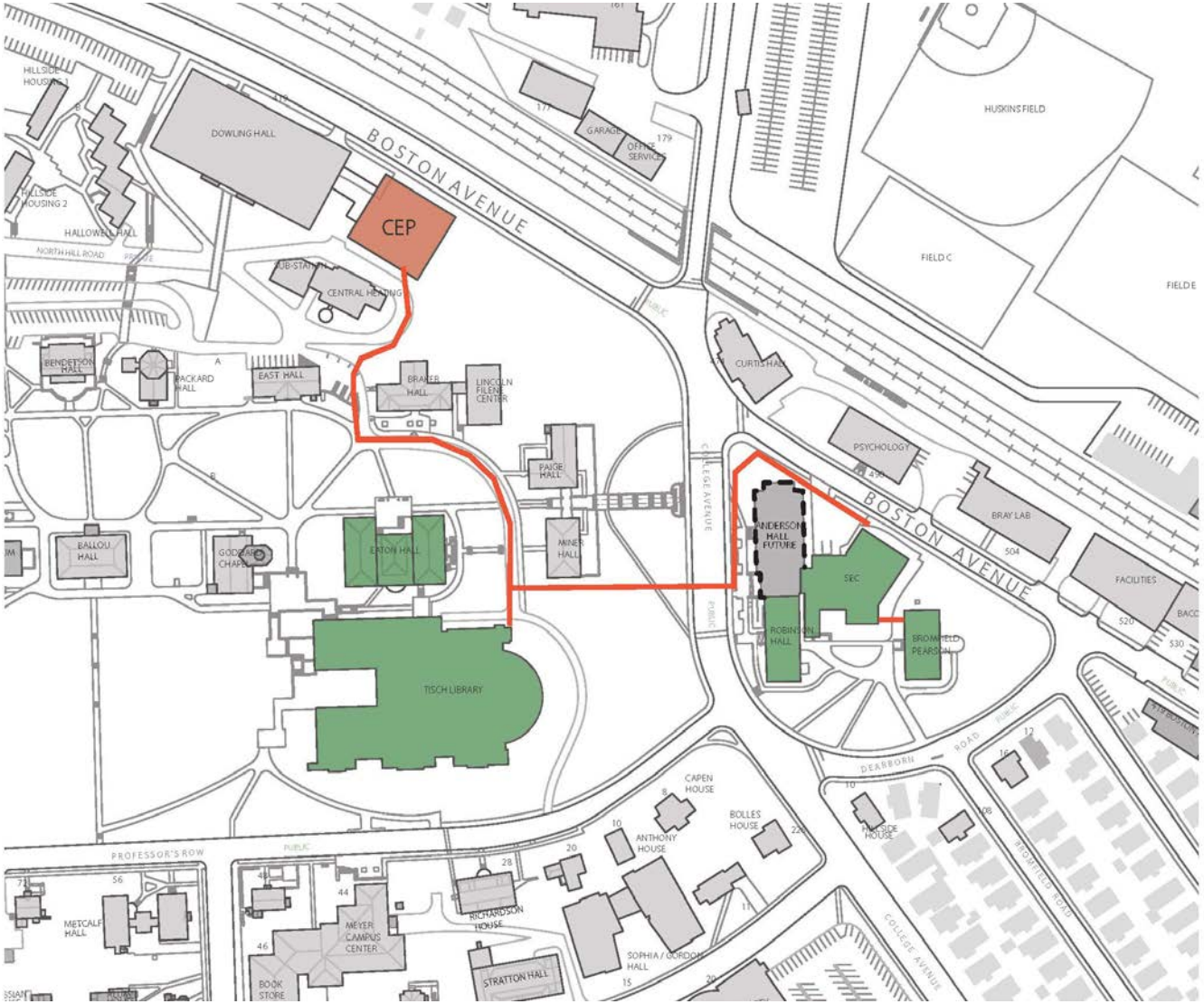


Campus Energy Plant

What is served on campus - Electricity

Campus Energy Plant

What is served on campus – Chilled Water – Day One

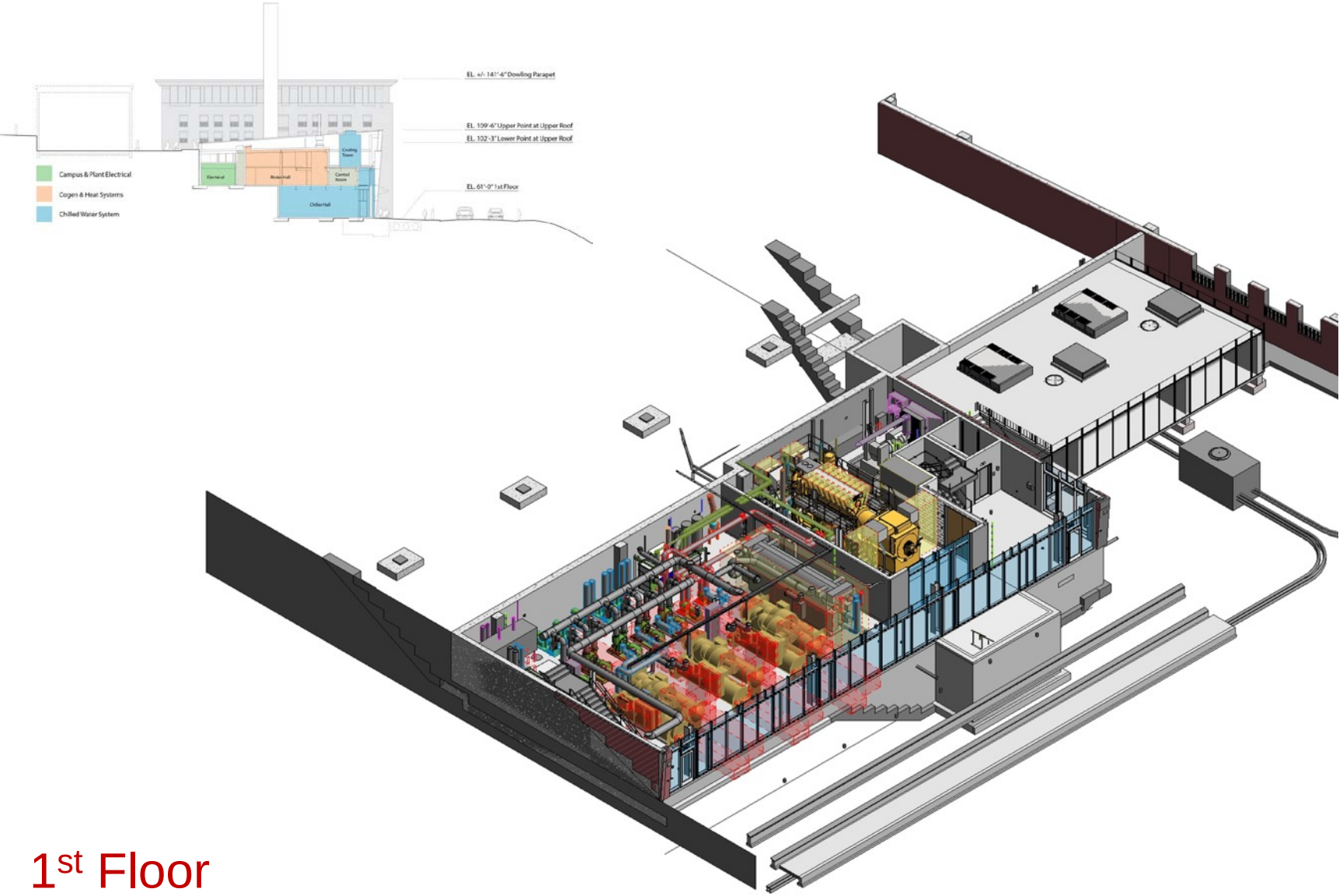


Campus Energy Plant

View from Boston Ave

Campus Energy Plant

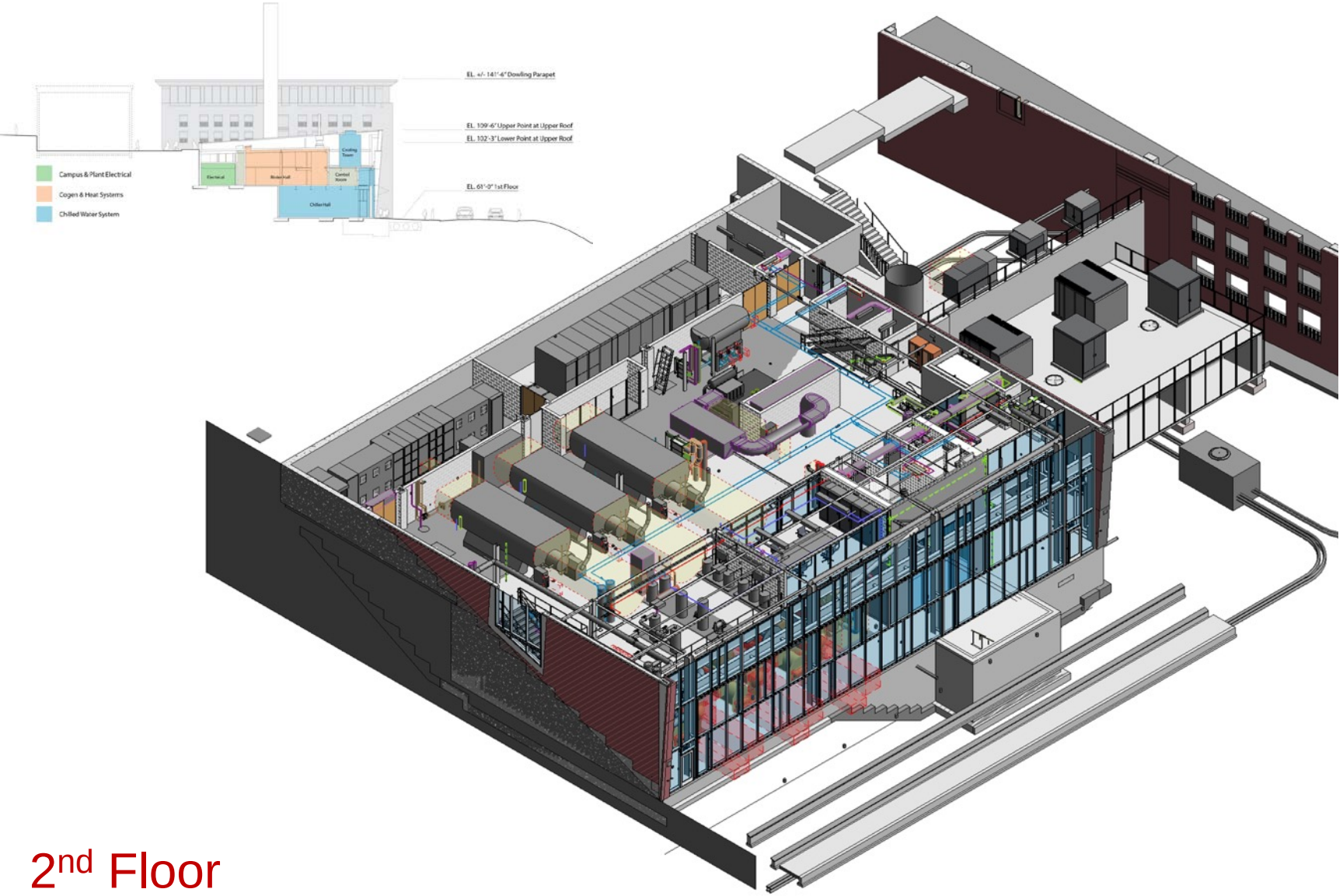
First Floor Chiller Hall and Reciprocating Engine Room
Showing Vehicle Apron and NGRID Transformer Terrace Beyond



1st Floor

Campus Energy Plant

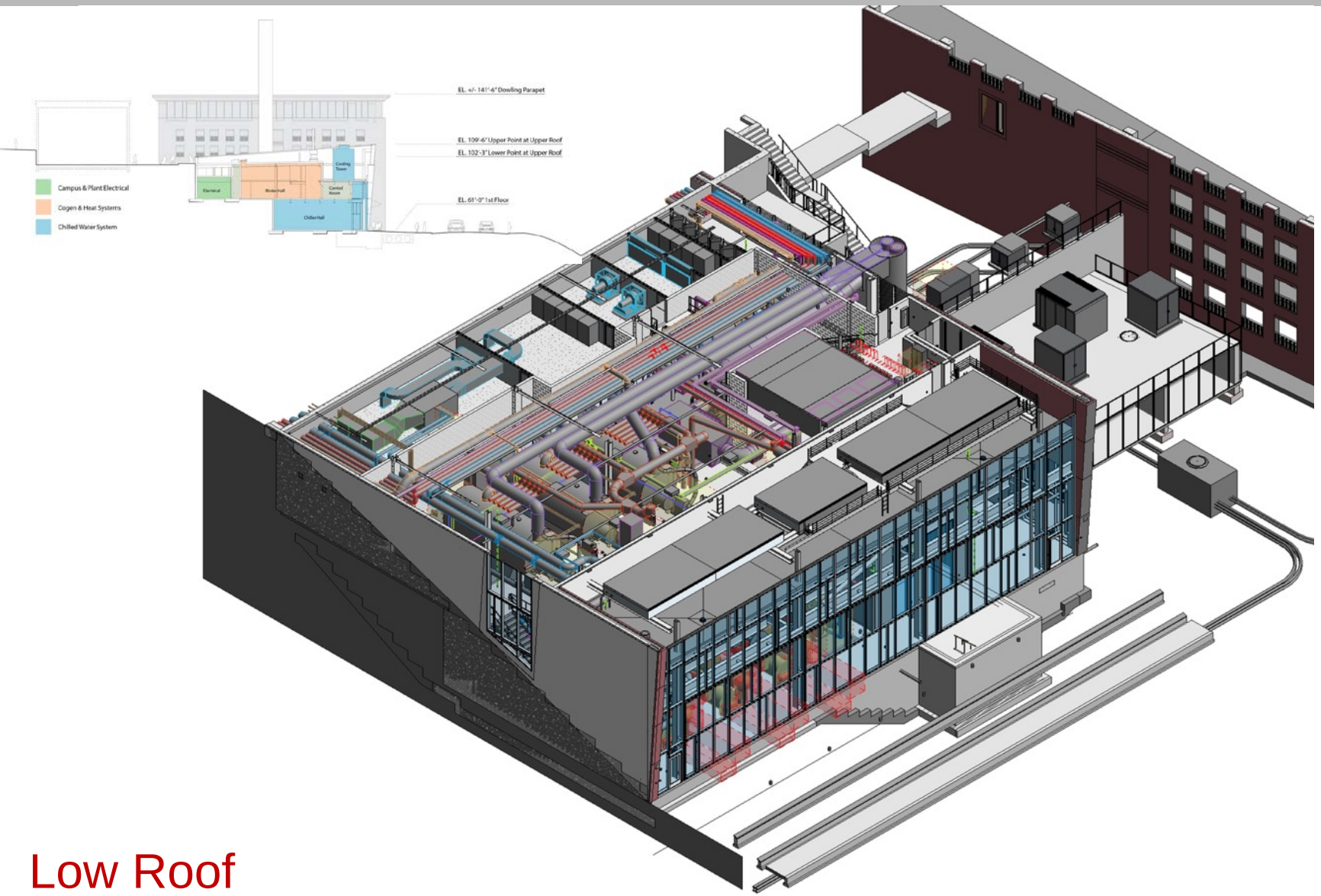
Second Floor with Boilers, HRSG, Plant and Campus Electric Rooms
Control Room, Lockers and Restrooms, Meeting Room and NGRID transformers and Meter Cabinets Beyond



2nd Floor

Campus Energy Plant

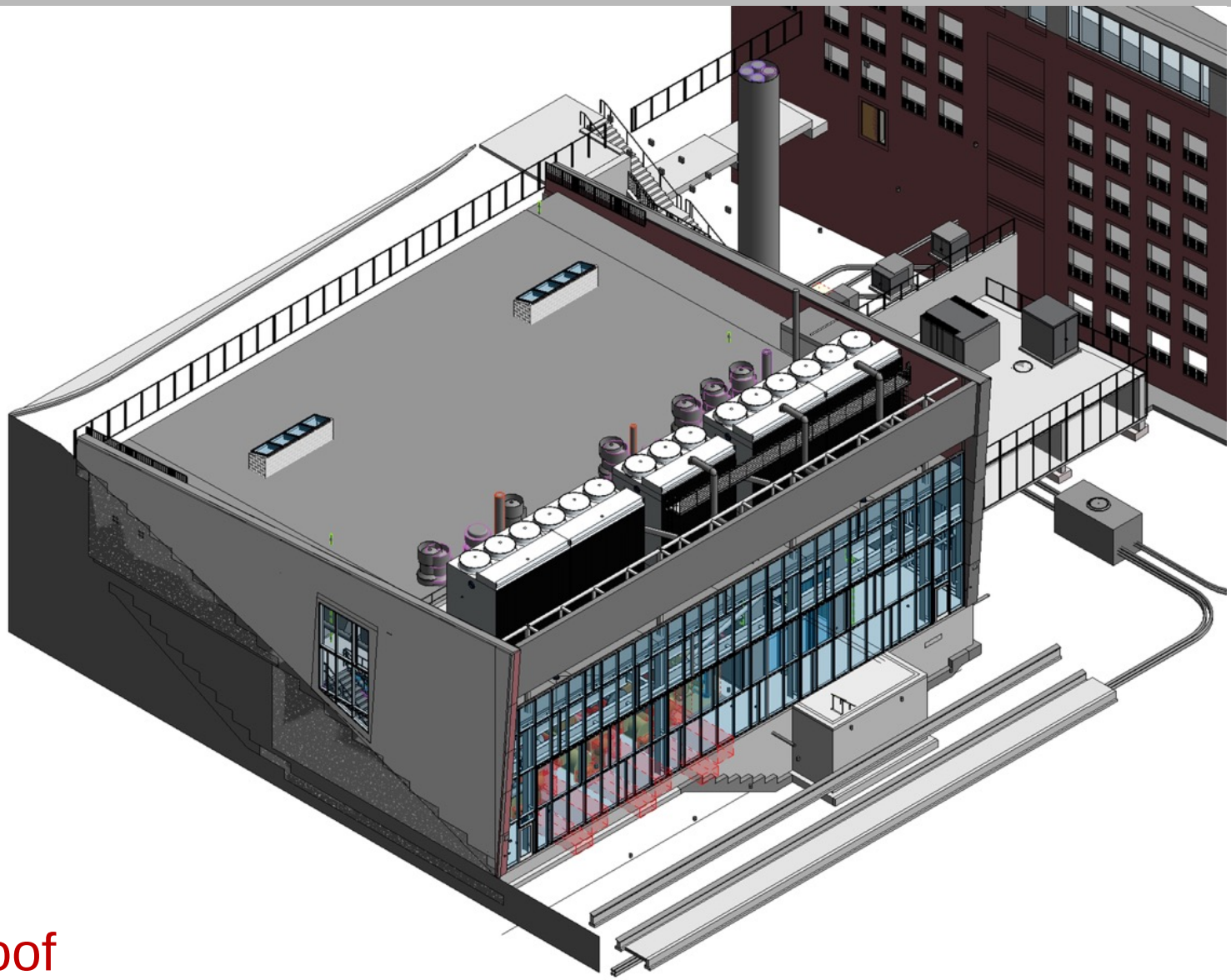
Lower Roof Level with Cooling Tower Basins, Upper Boiler Hall Piping, Air Plenum and Site Utilities Exits



Low Roof

Campus Energy Plant

Upper Roof Level with Cooling Tower Full Buildout, Fans and Acoustic Baffle



High Roof

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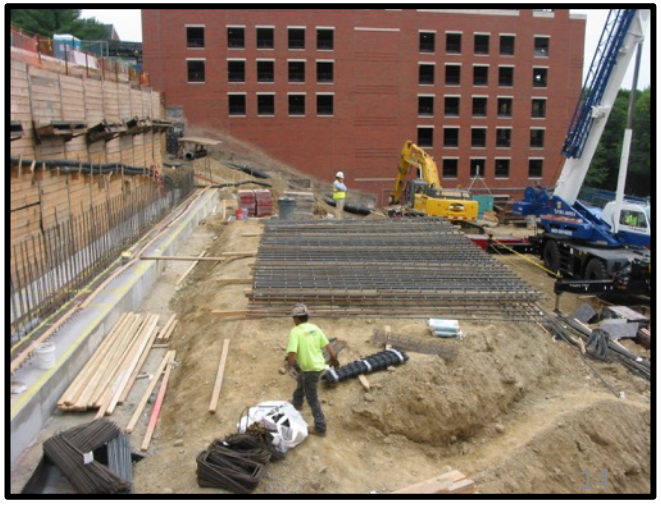
Construction is underway



Campus Energy Plant

Construction is underway

Financial Objectives:

- Maximize the University's return on investment
- Pay back the debt in as short as time as possible
- Decrease operating expenses

Tools to Maximize the ROI:

- Icetec “smart” plant dispatch
- Mass Save up front Capacity Payment
- ISO NE Capacity Payments
- APS payments under MA Clean Energy Act
- New utility purchase strategy

Problem: Some of these strategies are in conflict

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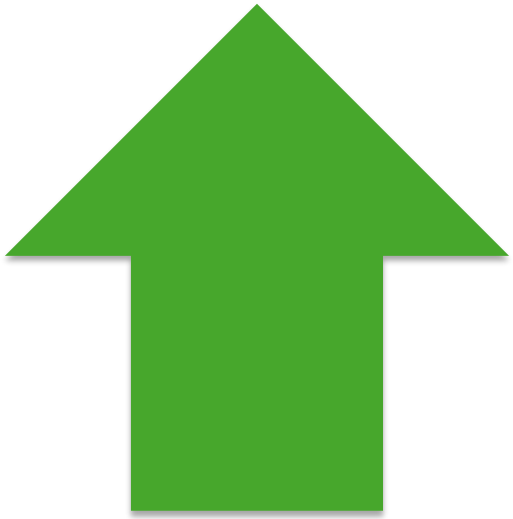
Finding the sweet spot



Flexible / Dispatch-capable;

Utility savings / optimization

ISO Revenue in Full Integration

Leveraged risk management

Function of:

Projected loads

Economic Tradeoff

Site Business Rules

Manufacturer Specs

Base-load;

AECs

Efficiency driven

ISO Revenue (Passive)

Mass Save Eligible

Two Paths for DR in ISO

Passive

- Non-dispatch, always on
- Similar to EE or lighting
- Capacity credits but
- Not able to participate in energy (LMP) or Ancillary Service (AS)

Active

- Dispatch capable, load baseline
- Real-Time Telemetry required
- Capacity credits *and* Energy and Ancillary Service (AS)
- Must be ramping or changing operations according to dispatch

CHP usually has attributes of both:
Can we operate seamlessly and respect both business rules
Can we work with ISO / Utility to bridge these concepts

Optimizing the Economics – Considerations

- Mass Save Incentive up to $750/KW*
  - Effectively an up front *Passive* Capacity Payment
  - Utility registers this capacity with ISO NE and the rights to Passive capacity payments remain with the utility
- Lack of registered *Active* capacity precludes participation in "Active" markets such as:
  - Active capacity payments
  - Energy payments
  - Ancillary services
- Problem: Tufts wanted both the up front Mass Save incentive *and* the benefits of Active market participation
- What to do??

*See a National Grid rep for your site specific incentive

Mapping a Way Forward

- If we had two machines this wouldn't a problem ….
- One could be registered as a Passive asset by the Utility and
- One could be registered as an Active asset by Tufts
- Unfortunately, we only had one machine, but …
- Could we consider this machine ***two*** virtual machines and split the capacity?
- Even if ISO approved, would the Utility agree to this approach?
- Enter Bruce Edwards, NE Commercial Sales Manager for National Grid

National Grid's – Considerations

- Creative idea that was made possible by a collaborative partnership between National Grid and Tufts
- Socialization internally within National Grid
- Enabled Tufts to meet its campus energy needs while fulfilling National Grid's mission to "Bring Energy to Life"

Optimal Path:

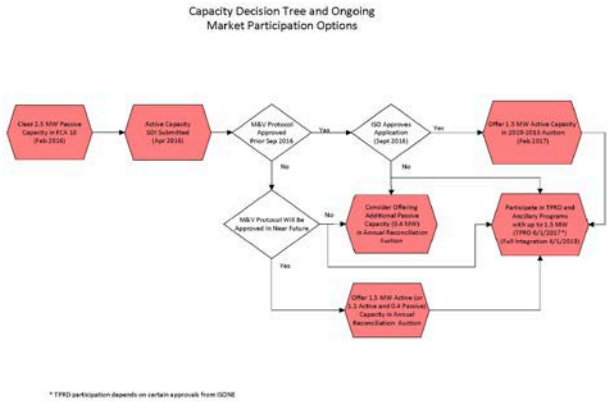
- Designate some portion as base load (Approx. 2.5 MW)
  - Passive DR
  - Work with National Grid to monetize through MASS SAVE Program
  - Work with DOER to qualify Alternative Energy Credits (AECs)
  - Approximately 2.5 MW
- Designate some portion as dispatchable (Approx. 1.5 MW)
  - Actively manage as Active DR (ISO Revenue)
  - Utility cost savings from dynamic operations
  - Transparent retail structure on power
  - Incorporate flexibility into gas purchasing strategy
- Building these two cases would result in:
  - Best economic scenario
  - Most operating flexibility
  - Observance of site business rules
  - Most impact on avg. utility cost

ISO Capacity Registration

- Capacity registration with ISO NE
  - A passive and an active registration for the same asset?
  - Not so fast!
    - Market rules do not explicitly provide for it
    - Complications of M&V in two settlement world
    - No precedent for 2 Lead Market Participants
- Initial position was for 2.5MW Passive

Path to Active Registration

- *Additional discussion with ISO NE*
- *Coalition building within ISO NE*
- *A game plan*
- *Perseverance*



Results

- *Ultimately the project was registered for 4.0 MW of active and passive capacity*
- *Mass Save payments approved*
- *National Grid maintains its rights to the passive capacity payments*
- *With full integration, Tufts will be in a position to be a full market participant*

Conclusion

- *An Organized approach to maximize return on investment paid off*
- *Need similar centralized intelligence to make optimal dispatch decisions w/o hurting passive*
- *Novel concept and a willingness to partner with key stake holders ultimately bore fruit*
- *National Grid and ISO NE flexibility and willingness to think outside of the box were key factors*