BUILDINGENERGY NYC

Net Zero Carbon Roadmap for a College Campus

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Northeast Sustainable Energy Association (NESEA)
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Learning Objectives

1.	Discuss the three-prong approach for Net-zero Carbon road mapping for historic building retrofit
2.	Define how to approach climate action plans, sustainability guidelines and mainly owners project requirements to include decarbonization
3.	Explain other factors to consider when thinking about decarbonization effects on occupant health
4.	Identify roadblocks and lessons learned when dealing at decarbonization master plan at college campus level


UNIVERSITY AT ALBANY
STATE UNIVERSITY OF NEW YORK


RAMBOLL


Klepper, Hahn & Hyatt


d2d
GREEN DESIGN
ARCHITECTURE
SUSTAINABILITY
INTERIOR DESIGN


Pathfinder
Engineers & Architects

Agenda

- Campus Overview/Goals
- Project Overview
- Electrification and Transition to LTHW
- Envelope Considerations
- Actionable Steps
- Roadblocks/Lessons Learned

Campus Overview/Goals

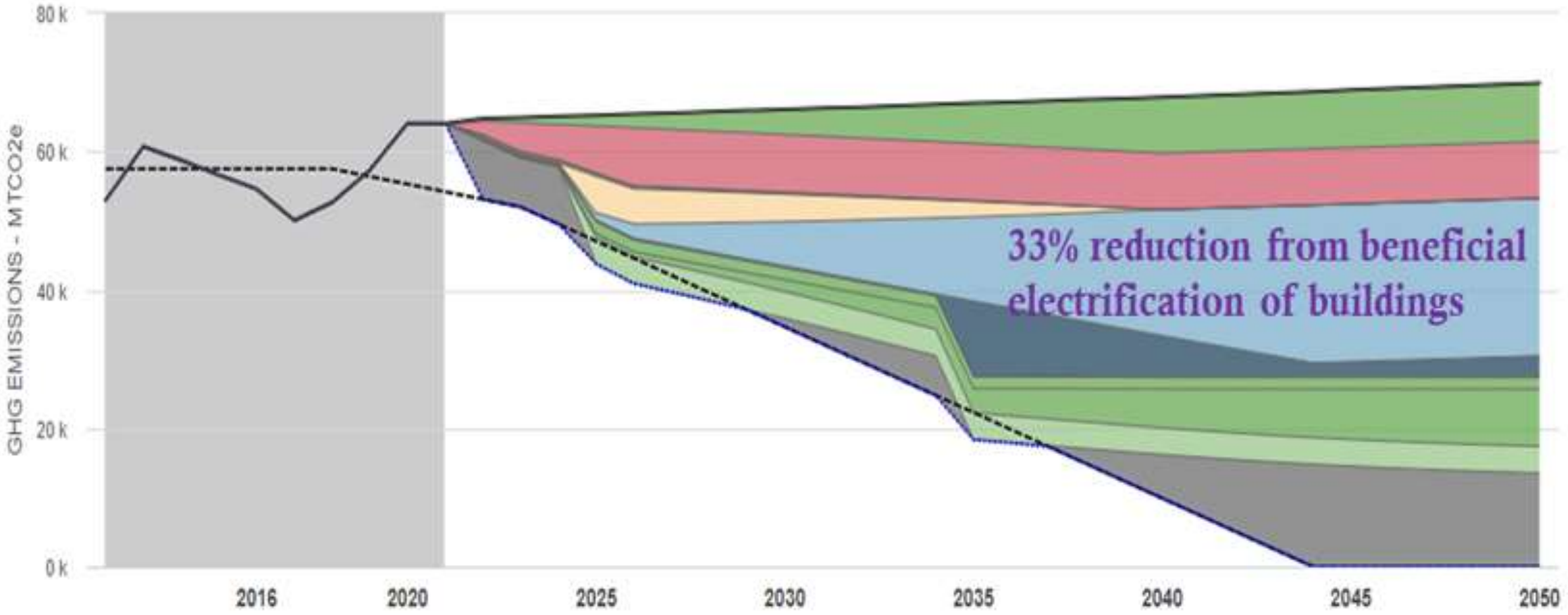
University at Albany

- Founded in 1844 as Albany Normal School
- Public, Urban, R1 research institution
- Part of the State of NY (SUNY) system
- Student demographics
  - 12,654 undergraduate
  - 4,421 graduate
  - 7,500 on-campus residents
- Demographics
  - 54% Female, 46% male
  - White 43%, Black 21%, Hispanic 18%, Asian 9%, Multiple races, non-resident alien or unknown 9%
- Endowment: ~$103 million
- Operating Budget: ~$330 million
- Total cost (tuition +):
  - in state $10,408
  - out of state $28,248
  - + room & board (~$15K)

University at Albany

- Laying out the roadmap for a public university with historic buildings and old infrastructure.
- 140+ buildings; 6.4 million square-feet
  - Uptown and Downtown campus
  - 5 residential quads, 3 apartment complexes
  - Downtown built in 1909
  - Uptown main podium/quads built in 1966
  - 1.8 million sq ft since 2005
- Created High Performance Building Guidelines and incorporated them into owner project manuals
- 12 LEED certified buildings
  - 4 silver
  - 6 gold
  - 2 platinum
- 2 Geothermal systems
- 2 MW rooftop solar

- Climate Action and Sustainability plan adopted in 2020
  - Carbon neutrality by 2044 UAlbany's 200th anniversary
  - Beneficial electrification through geothermal heat pumps is a big part of the solution
  - Electric grid sourced from renewables



2046

69,098 MTCO2e BAU

0 MTCO2e Current Portfolio

0 MTCO2e GHG Reduction Goal (2044)

-8,337 MTCO2e Greening of the Grid

-8,160 MTCO2e CAP Efficiency Investments

0 MTCO2e Solar PV - Academic Podium

0 MTCO2e Solar PV - Parking Canopies

0 MTCO2e 100% Renewable Electricity

-22,805 MTCO2e Electrification and GHX

-2,195 MTCO2e 100% Carbon Neutral Fuel

-240 MTCO2e Reduce Fleet Emissions

-1,690 MTCO2e Reduce Travel and Commuting

-7,521 MTCO2e Commuting Vehicle Electrification

-3,865 MTCO2e Air Travel Offsets

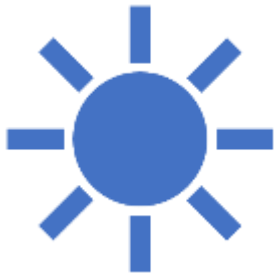
-14,285 MTCO2e Carbon Offsets

What does a net zero carbon campus look like?

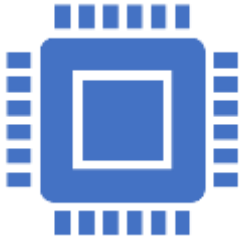
Energy efficient buildings with low EUI (SUCF Directive 1B-2 targets or lower)

Low temperature heating systems (supply water temperatures < 160F)

Beneficial electrification of heat and fleet/migrate from on-site fossil fuel combustion

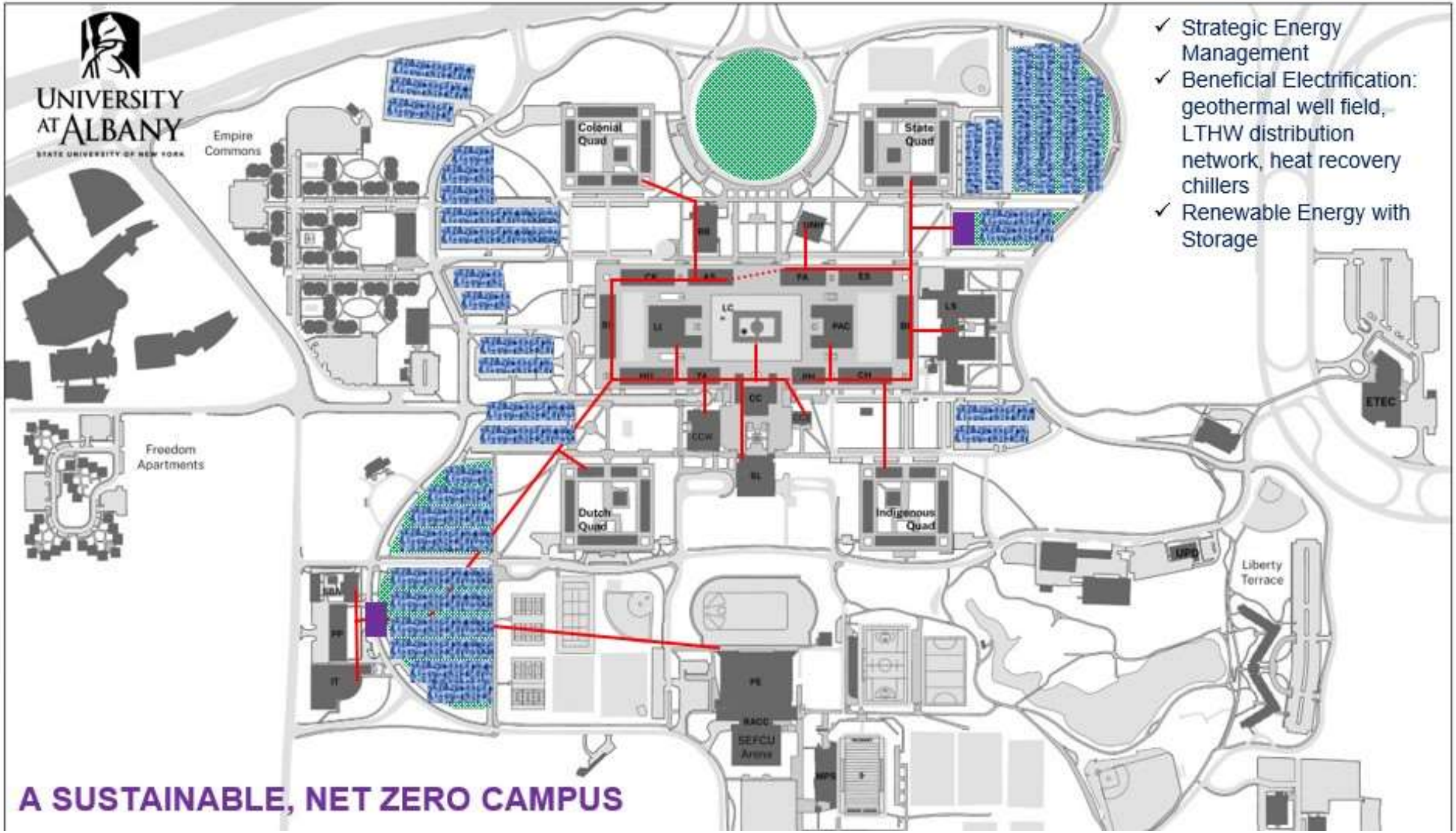


Renewable energy generation that matches campus use profile 24x7x365



Advanced data-driven operations/grid connectivity/ smart buildings

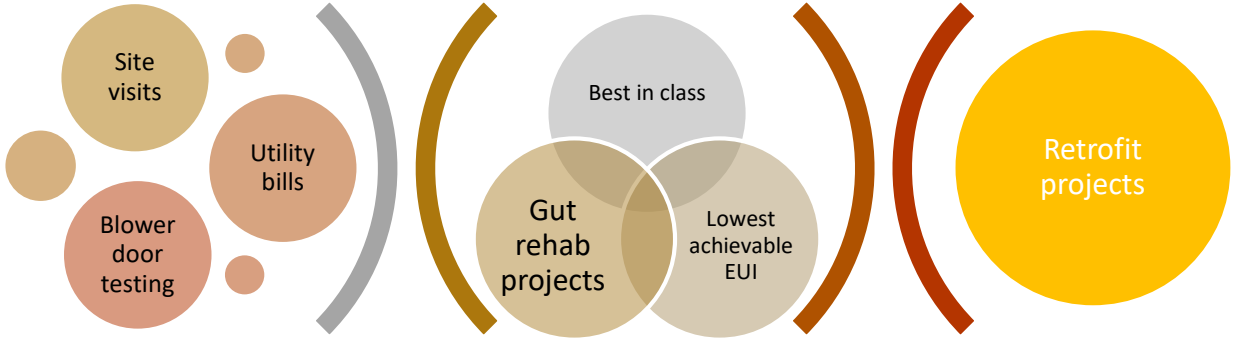
Well trained operators and educated and engaged users


UNIVERSITY AT ALBANY
STATE UNIVERSITY OF NEW YORK
Empire Commons
Colonial Quad
State Quad
Freedom Apartments
Dutch Quad
Indigenous Quad
ETEC
Liberty Terrace
SEFCU Arena
✓ Strategic Energy Management
✓ Beneficial Electrification: geothermal well field, LTHW distribution network, heat recovery chillers
✓ Renewable Energy with Storage
A SUSTAINABLE, NET ZERO CAMPUS

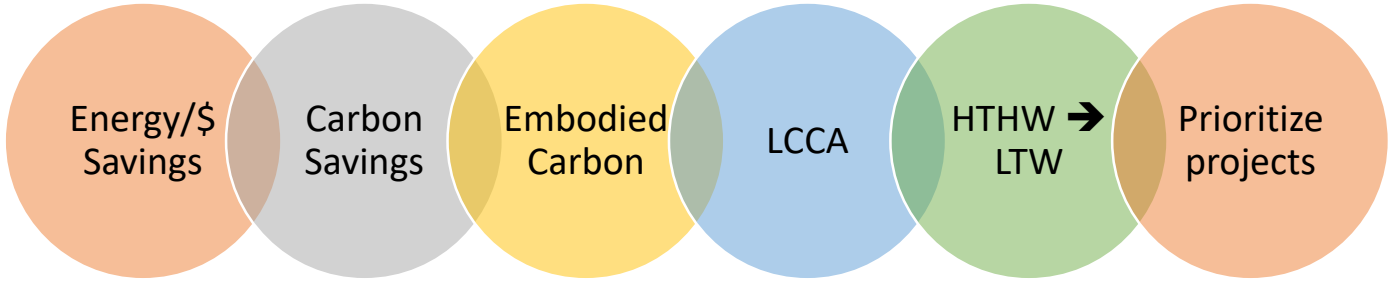
Project Overview

Approach

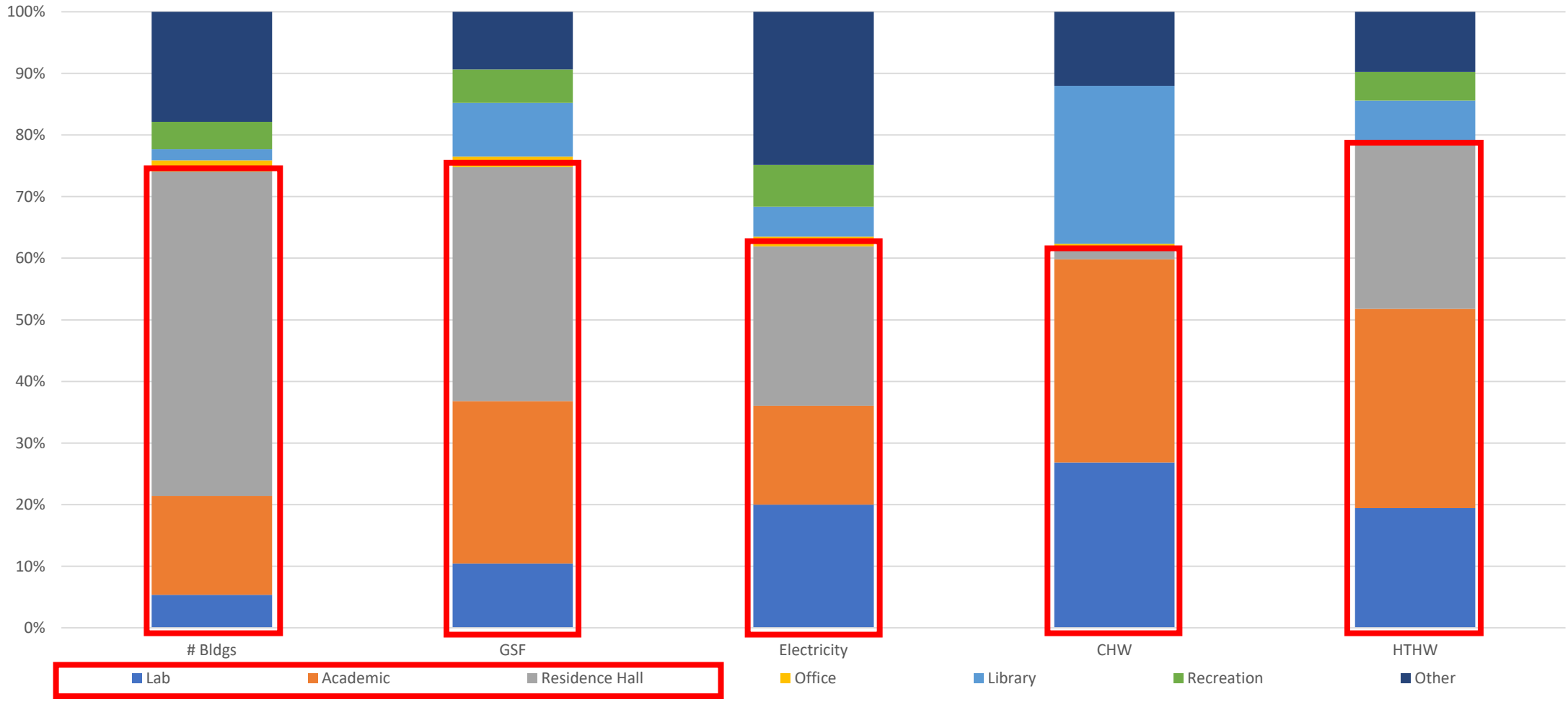
- Phase 1 focuses on building energy



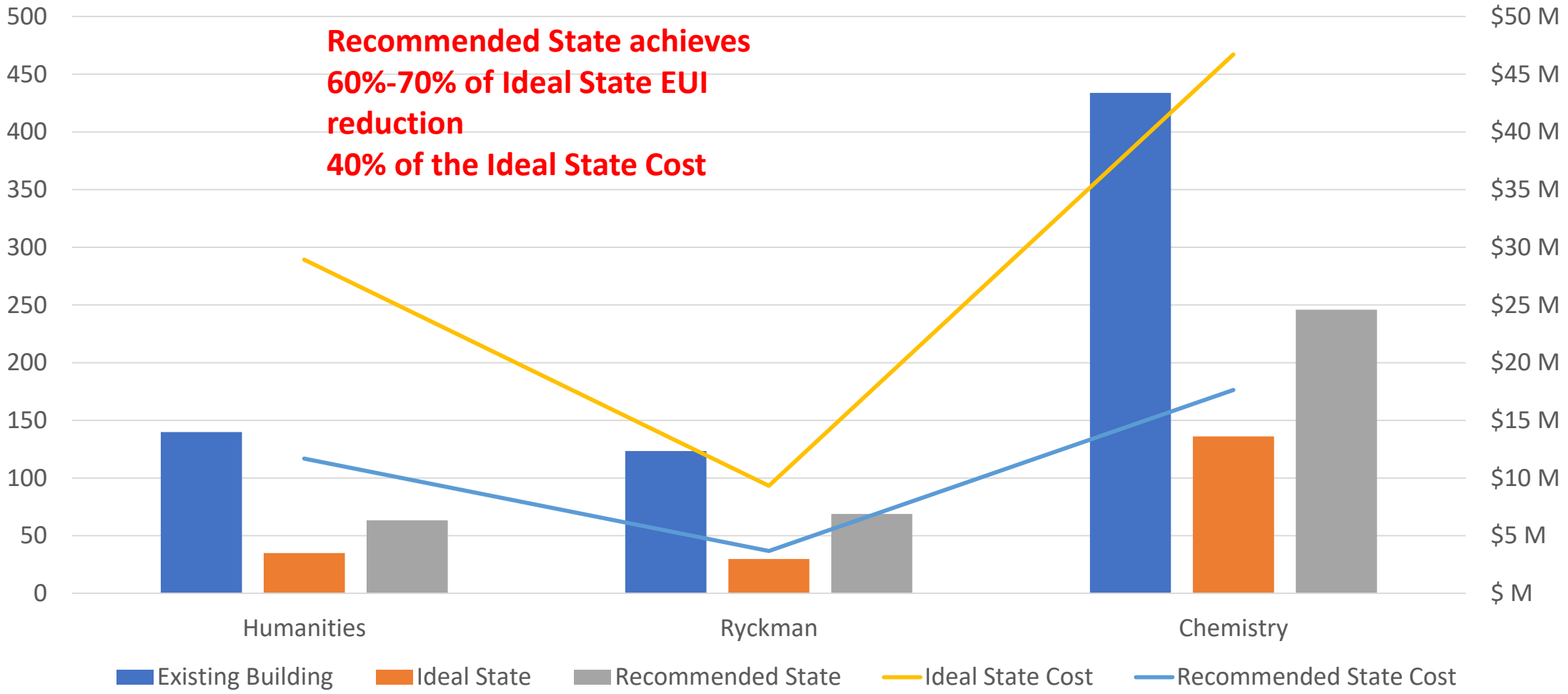
- Key Metrics



Three Building Types

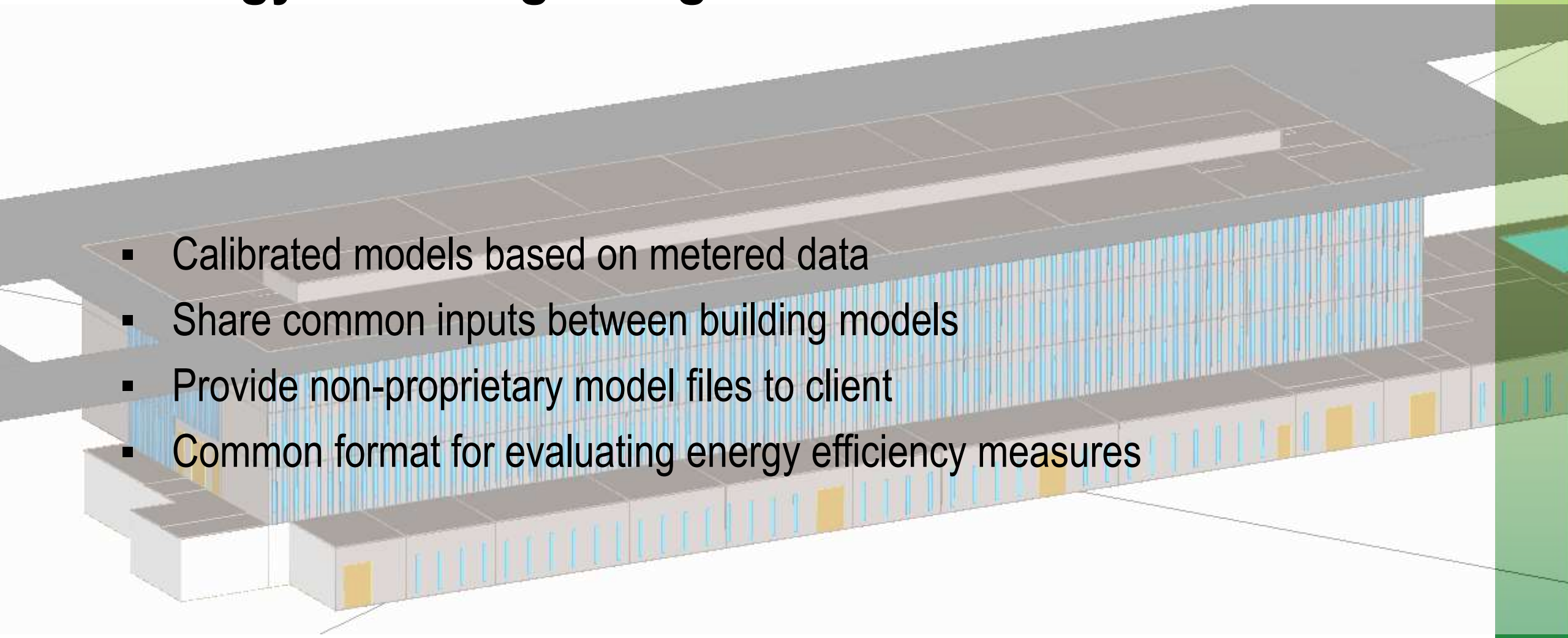


Ideal State to Recommended State



Electrification and Transition to LTHW

Energy Modeling using eQUEST



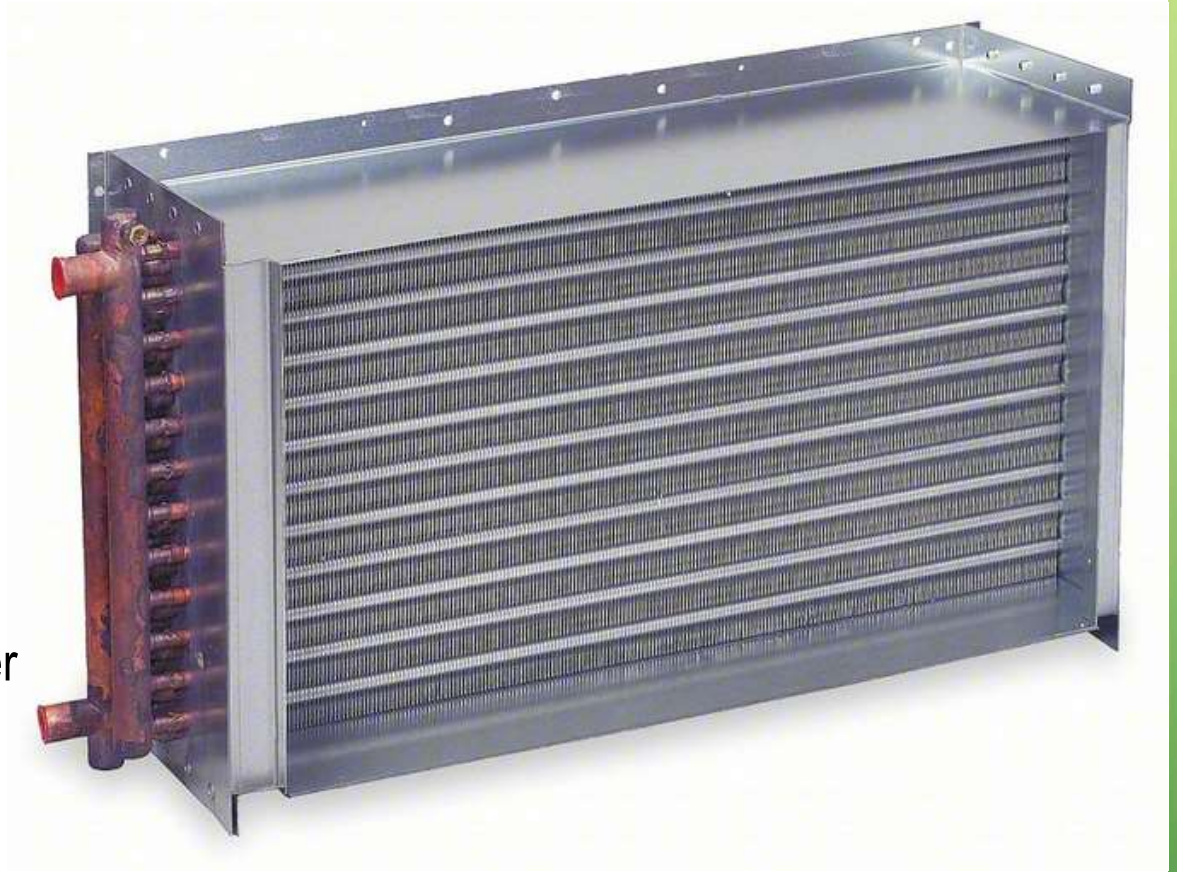
- Calibrated models based on metered data
- Share common inputs between building models
- Provide non-proprietary model files to client
- Common format for evaluating energy efficiency measures

Reducing energy with Energy Efficiency Measures (EEMs)

- Lighting
- HVAC
  - Simultaneous heating and cooling
  - Airside energy recovery
  - Controls for laboratory general and fume hood exhaust
- DHW
- Plug loads (including laundry)
- Envelope
  - Walls; Roofs; Windows
  - Infiltration

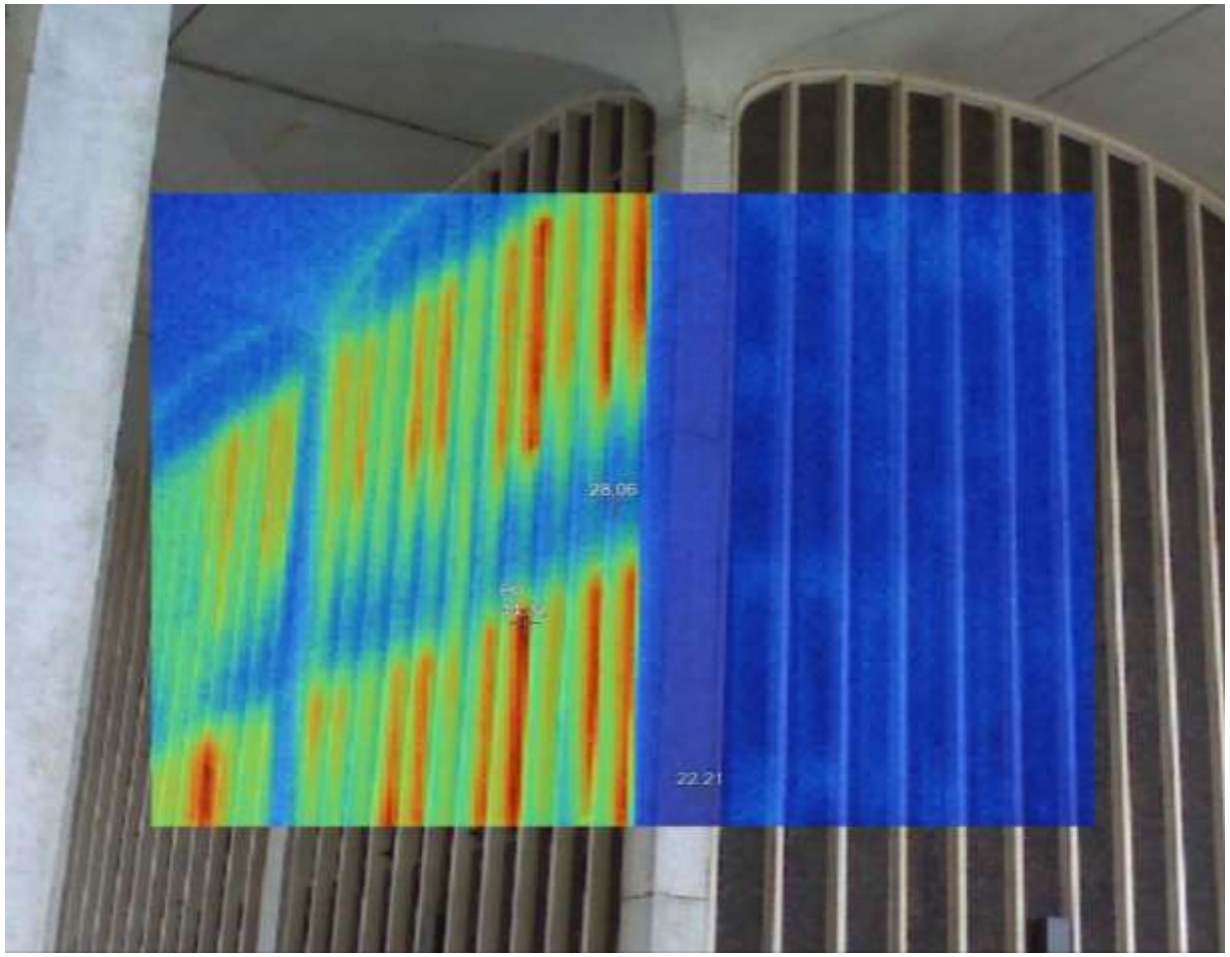
Electrification

- For UAlbany – Phase 2 will focus on campus central HTHW plant
  - Industrial water-to-water heat pumps
  - Planning for 160F heating hot water temperature
- Building heating will still be hydronic
  - Existing systems use 380F high temperature hot water
  - Convert existing **HW coils** to low temperature **LTHW (less than 160F)**



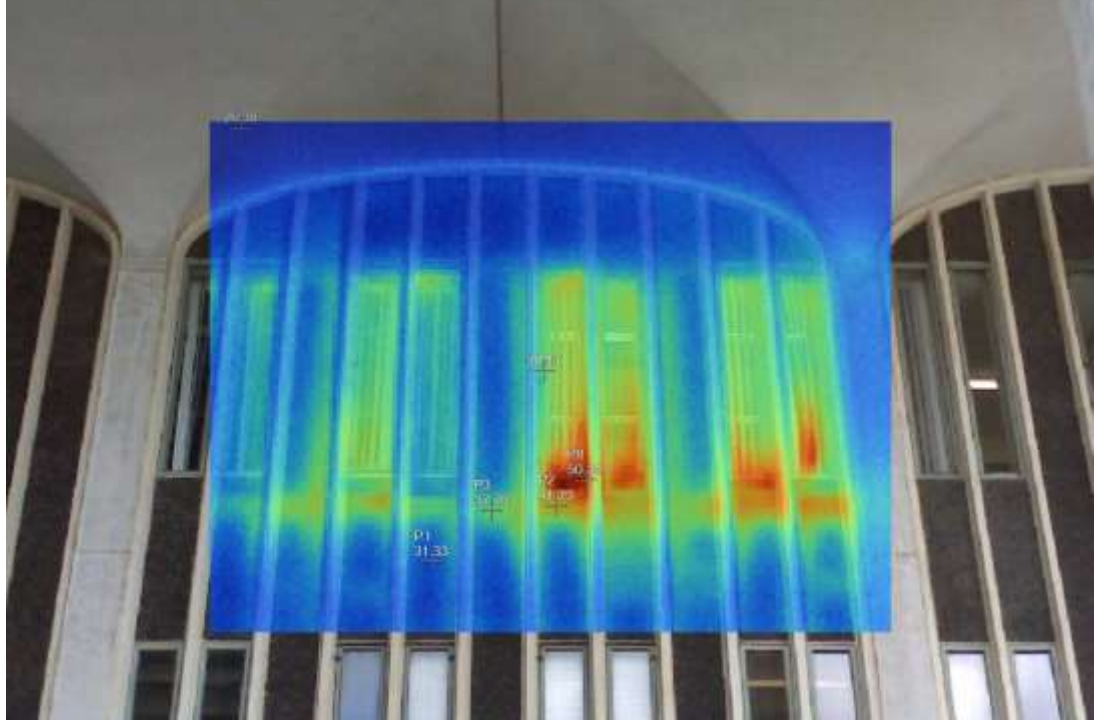
- HW temperatures dependent on heat pump technology
- Trade-offs
  - Energy - Heat pump efficiency vs. fan/pump energy (air-side; water-side penalties)
  - Cost $$$ – First costs of larger coils vs. life cycle costs including energy

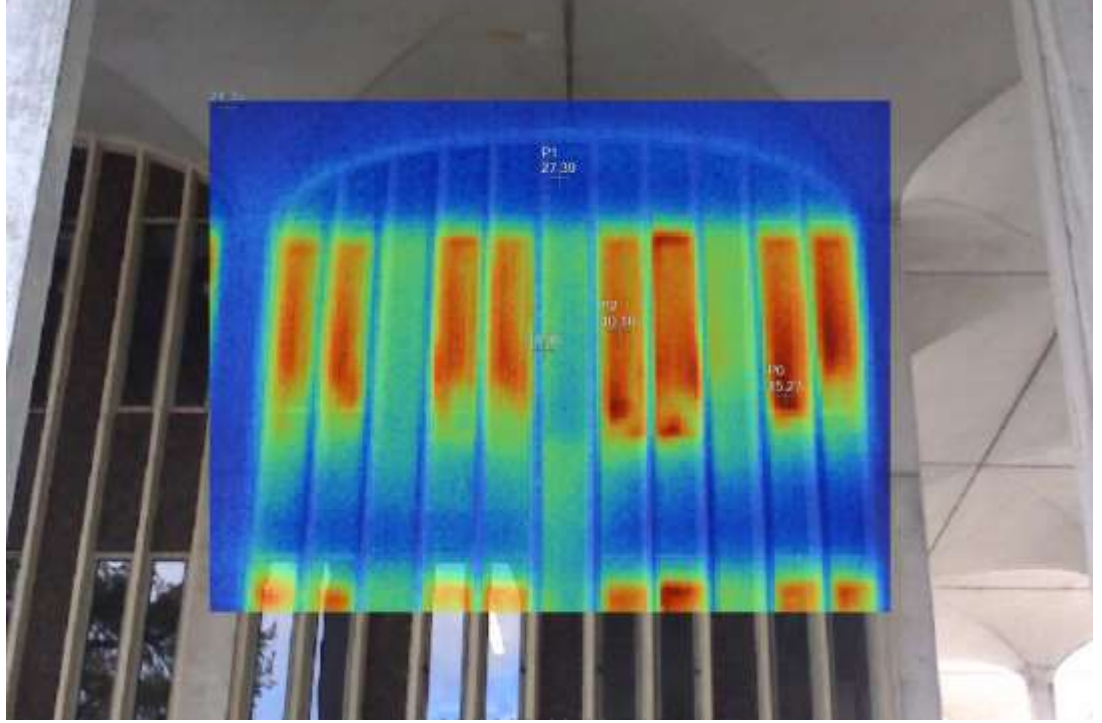
Envelope Considerations

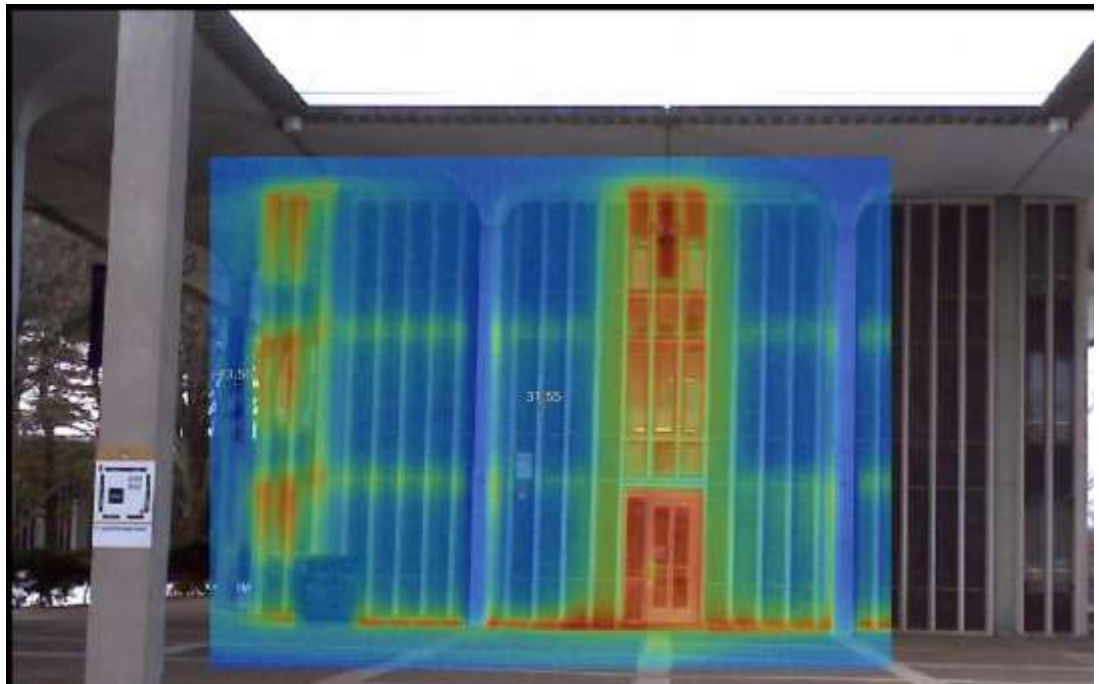


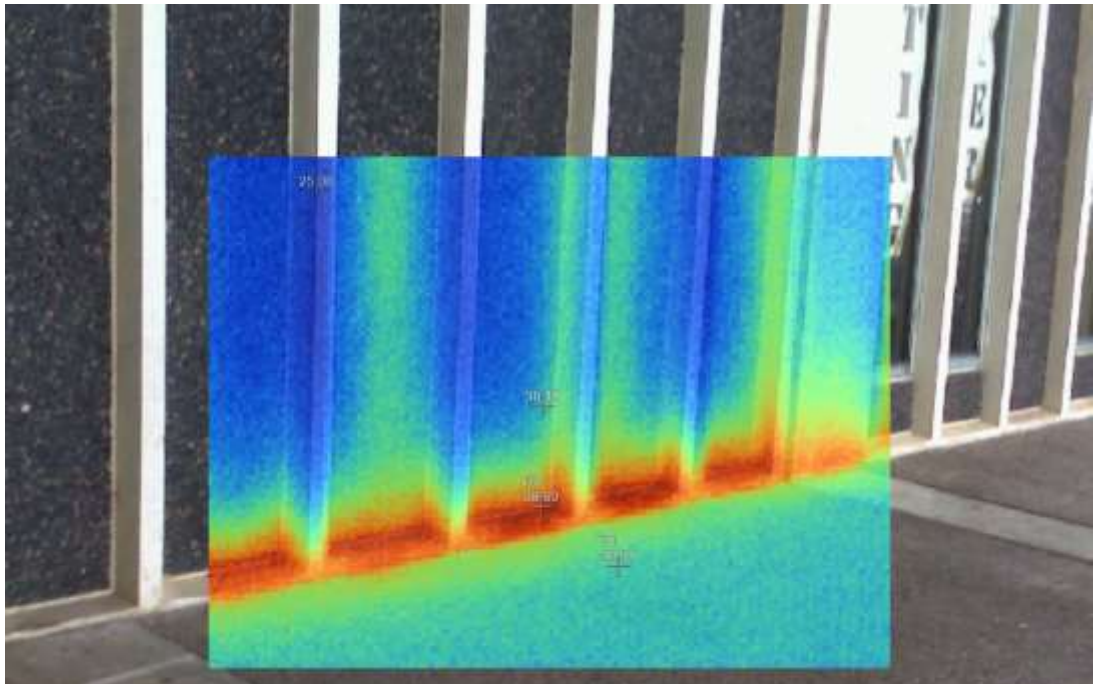
The Building Envelopes

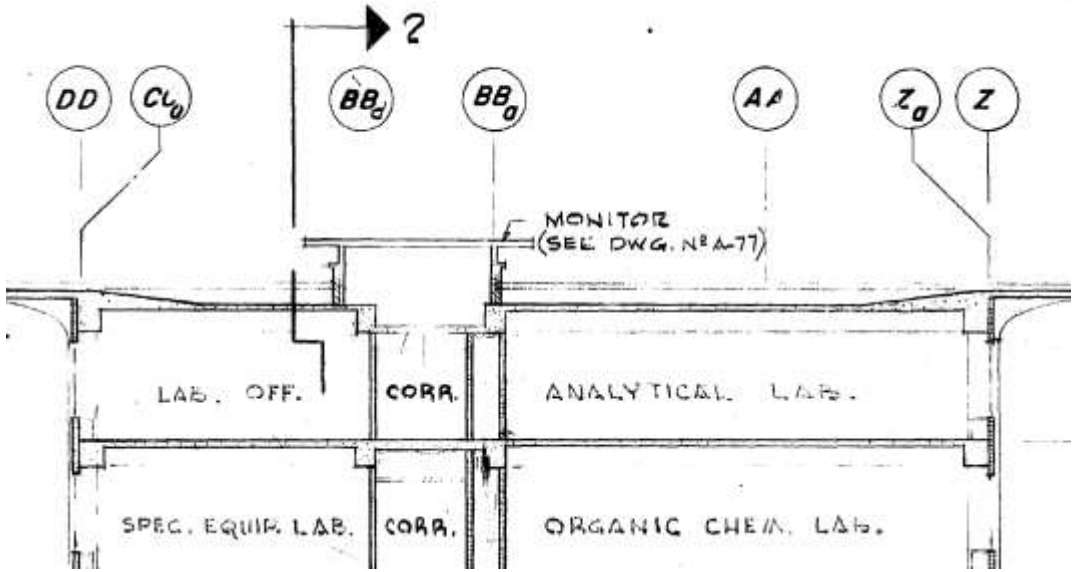
- Thermal Mass
- Thermal Bridging
- Windows
- Rooftop Monitors
- Blower Door Testing
- THERM Analyses



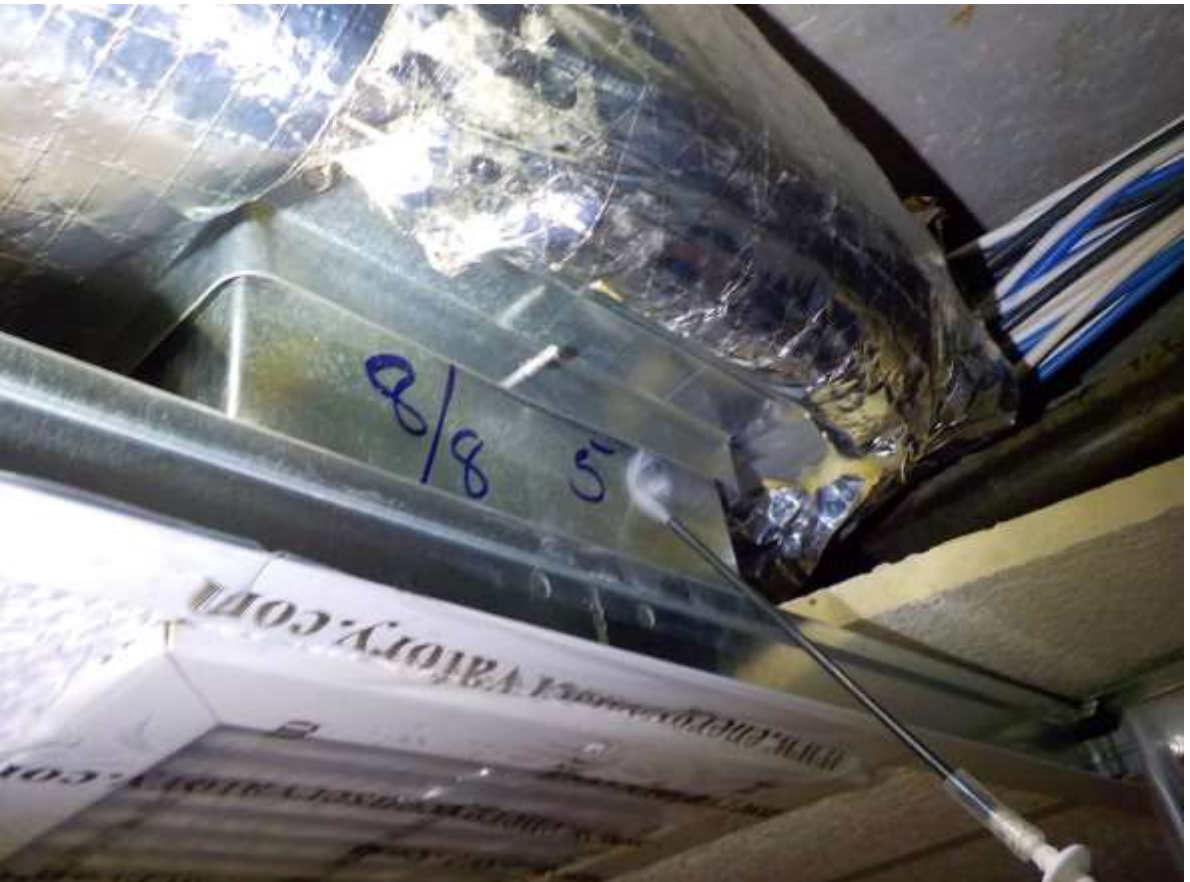







DD
CL0
BB1
BB0
AA
Z0
Z
MONITOR
(SEE DWG. NO A-77)
LAB. OFF.
CORR.
ANALYTICAL LAB.
SPEC. EQUIP. LAB.
CORR.
ORGANIC CHEM. LAB.

Air Gaps in Monitor Floor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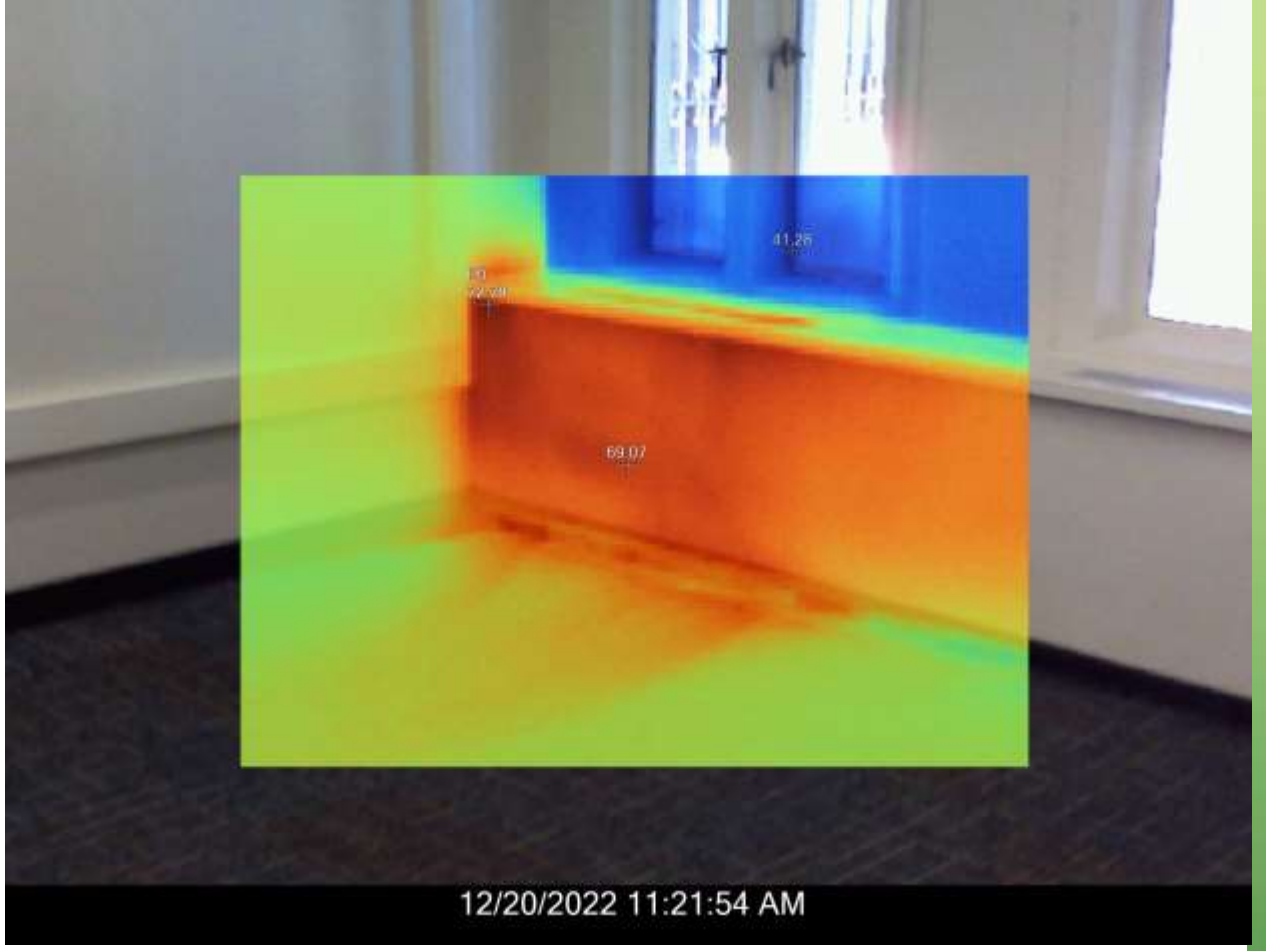
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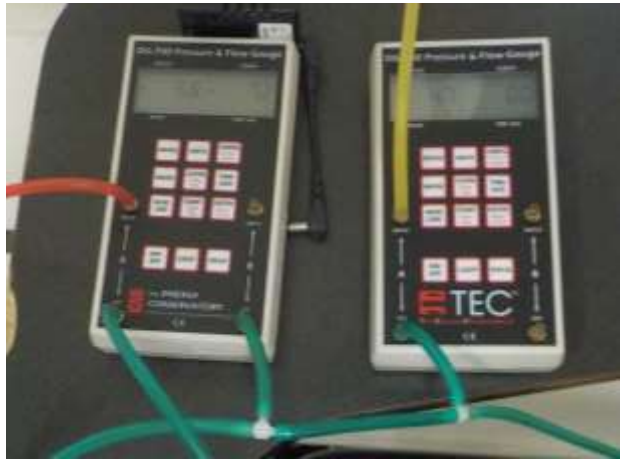
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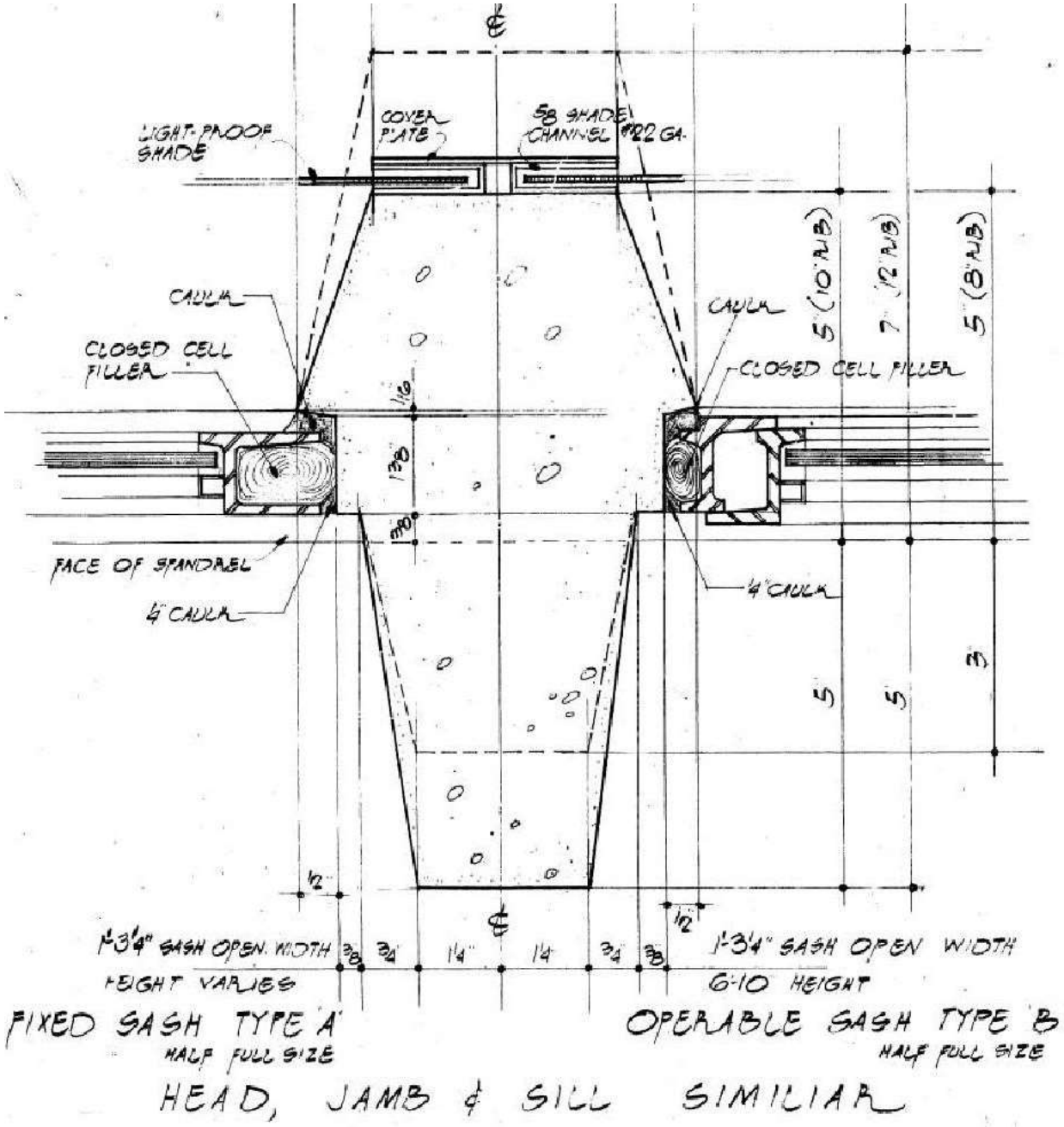
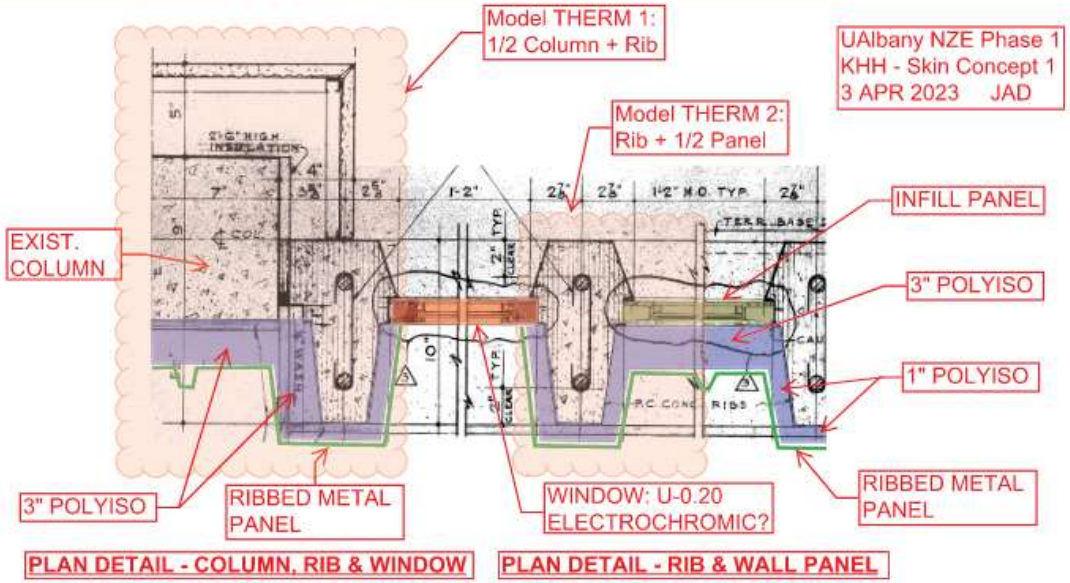
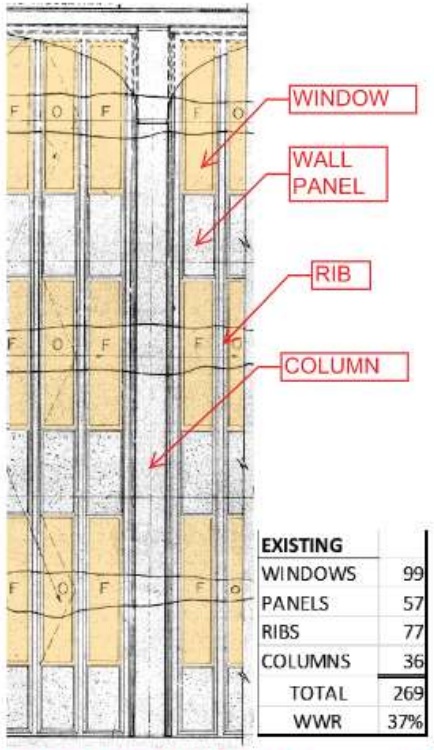
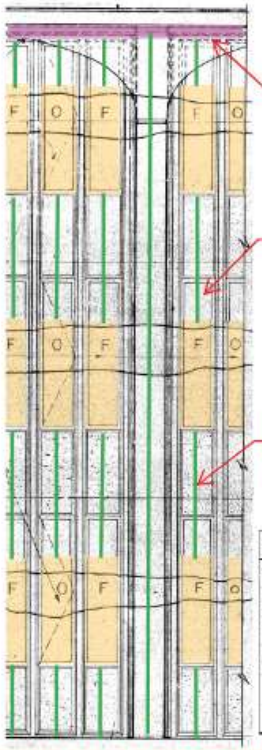






EXISTING	
WINDOWS	99
PANELS	57
RIBS	77
COLUMNS	36
TOTAL	269
WWR	37%

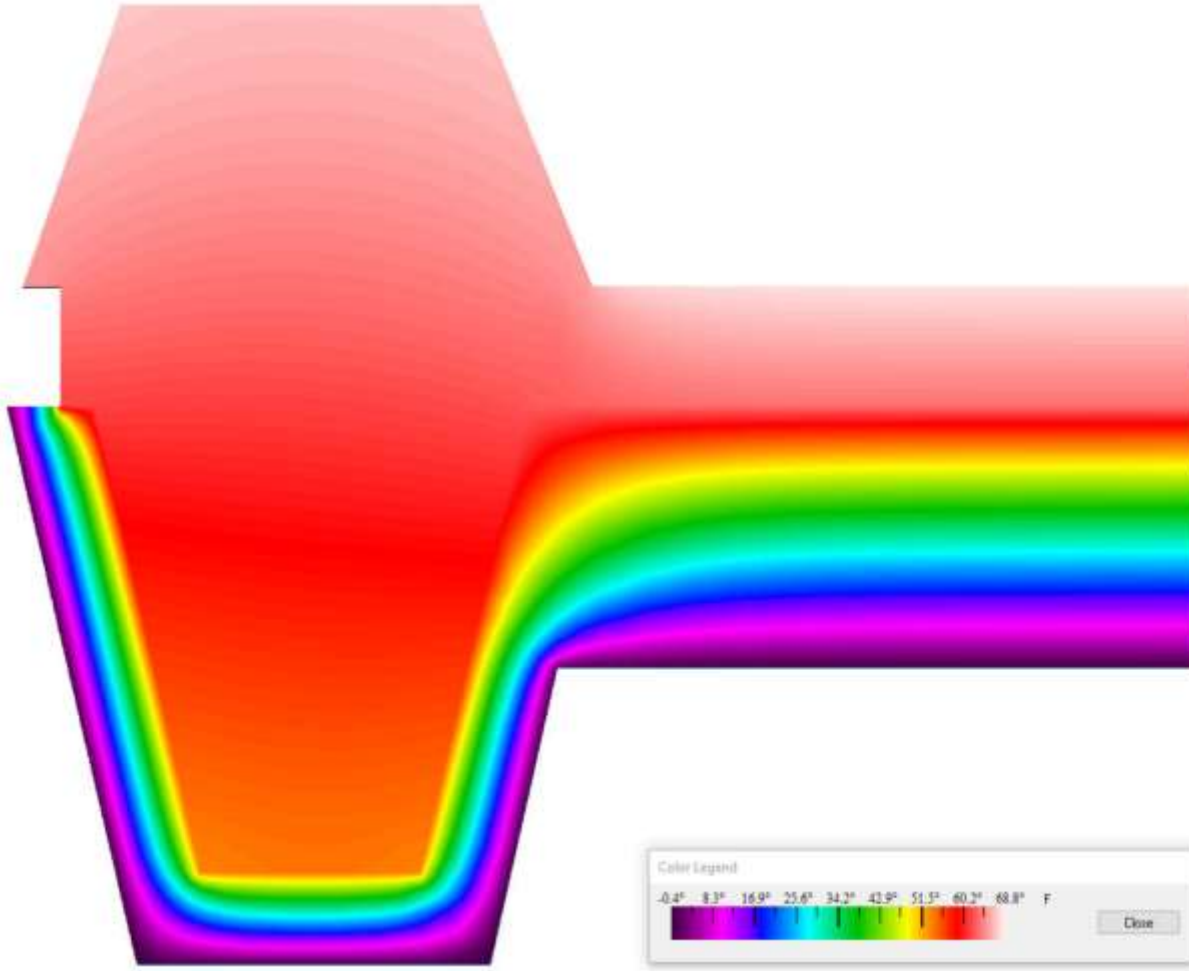
EXISTING RYCKMAN FACADE

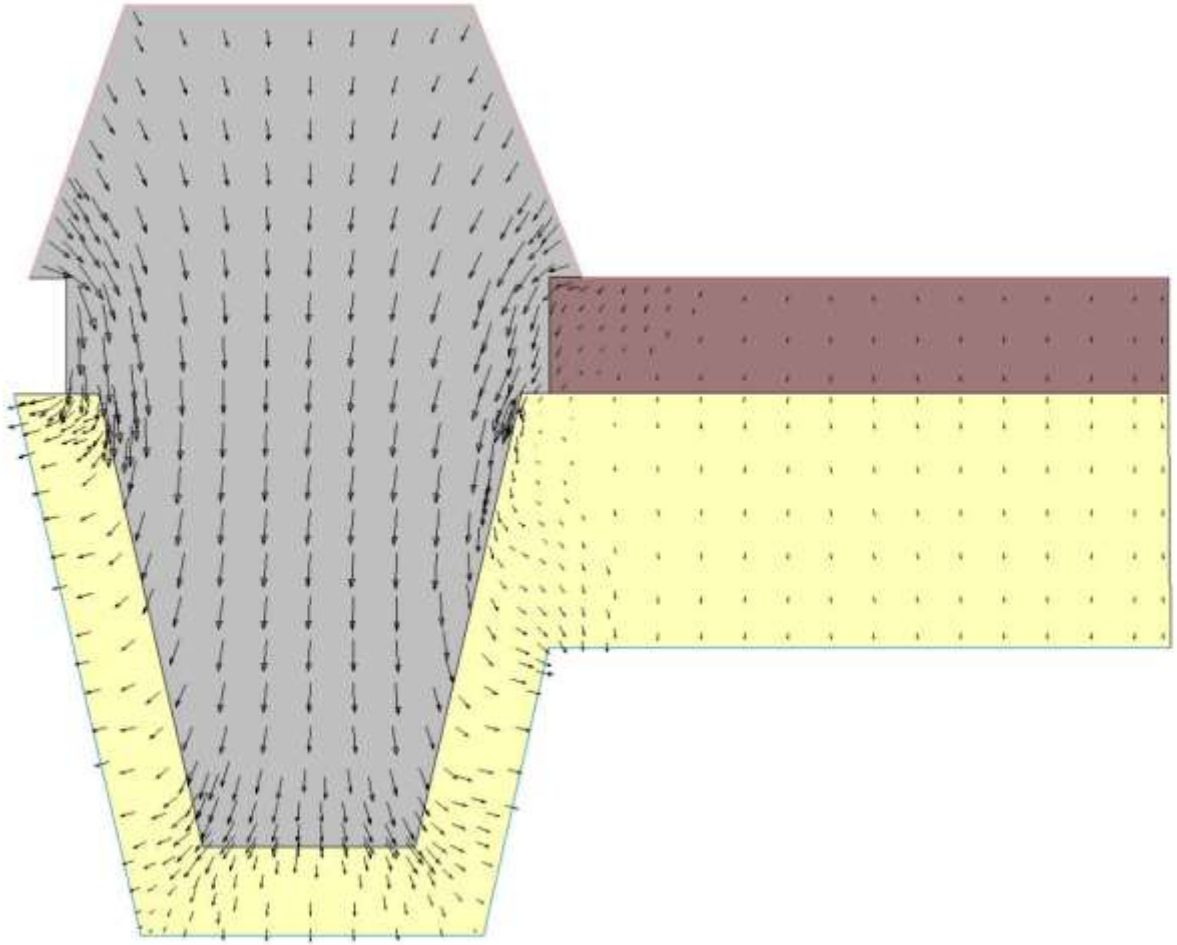


MOLTO BENE	
WINDOWS	66
PANELS	90
RIBS	77
COLUMNS	36
TOTAL	269
WWR	25%

PROPOSED MOLTO BENE RYCKMAN FACADE

THERM Output from Exterior Improvement Scheme





Actionable Steps

Campus Sustainability Guidelines

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SOURCE: UN SUSTAINABLE DEVELOPMENT GOALS

Campus Sustainability Guidelines

- OPR: Providing Clear direction for design team
  - Target EUI for different types of buildings
  - Building Systems
    - Envelope
    - HVAC
    - Lighting
    - Plumbing
    - District Systems and connections
  - Materials
  - Possible rating systems for each type of building
  - Plug Loads and Occupant Behavior

EO22

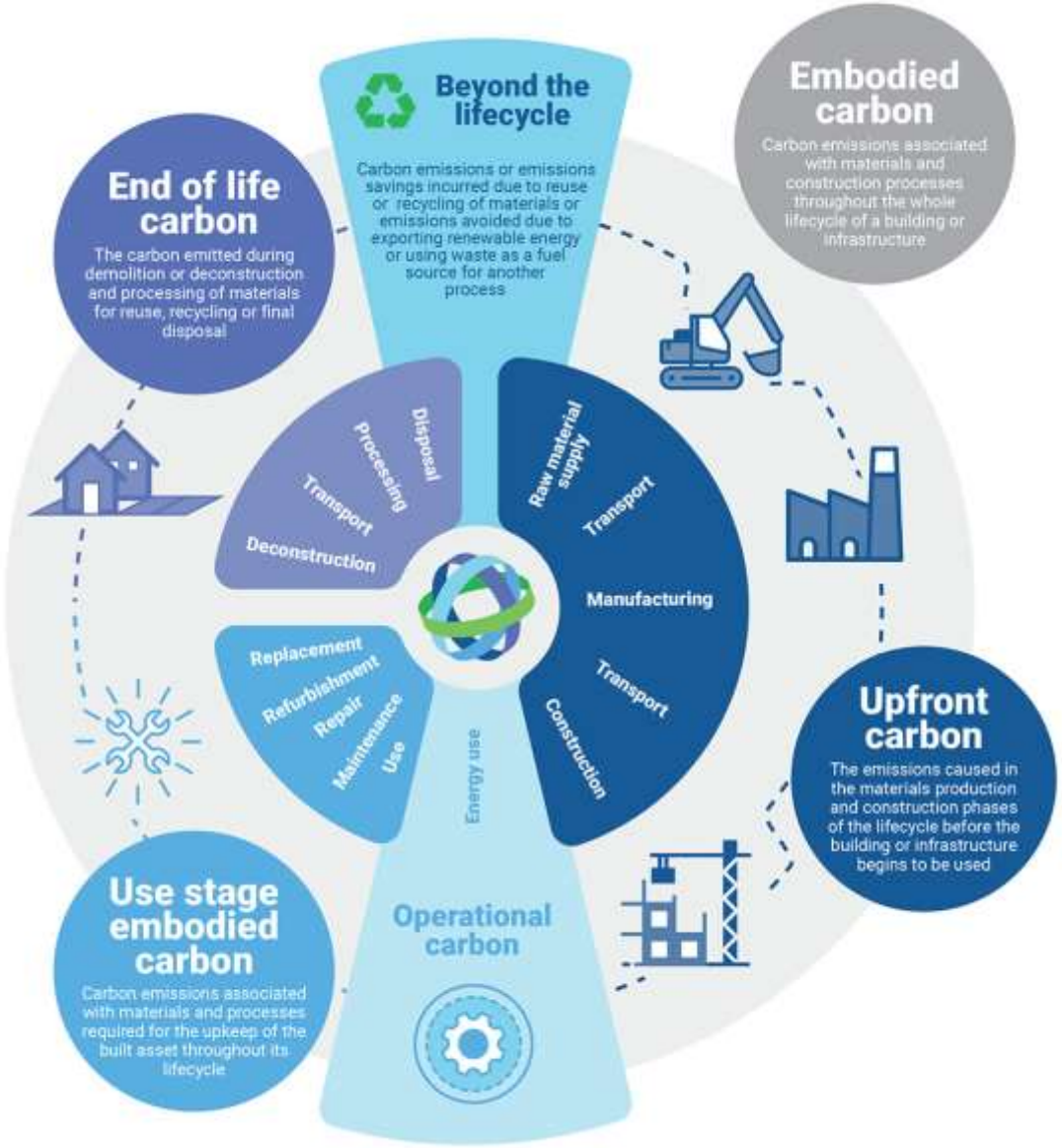
- Climate Leadership & Community Protection Act
- 2030 Renewable Energy goal: 100% of the electricity used in NYS operations will come from renewable energy
- No Fossil Fuels: for NYS projects starting in 2024
- BTU Savings: Energy savings of 11 trillion BTUs by 2025 (BuildSmart Program)
- Climate resiliency: increased at NYS facilities including but not limited to-
  - Healthy Materials
  - Protecting natural resources
  - Waste management
- Social Justice

SOURCE:NYS EO22

Materials: Embodied Carbon

Steps for Reducing Embodied Carbon:

- Integrated Low Carbon Design
  - Materials and equipment life cycle
- Design for Longevity
- Bottom line use existing buildings instead building new ones where applicable



SOURCE:
RMI- RESEARCH; **Reducing Embodied Carbon in Buildings; Low-Cost, High-Value Opportunities** By Rebecca Esau, Matt Jungclaus, Victor Olgyay, Audrey Rempher

University of Kentucky, Embodied Carbon

Materials: Embodied Carbon

SOURCE: RMI- RESEARCH; **Reducing Embodied Carbon in Buildings; Low-Cost, High-Value Opportunities**
By Rebecca Esau, Matt Jungclaus, Victor Olgyay, Audrey Rempher

Materials IAQ for NetZero Energy/Carbon Buildings

SOURCE: SIX CLASSES.ORG

Materials IAQ for NetZero Energy/Carbon Buildings

SOURCE: SIX CLASSES.ORG

Roadblocks/Lessons Learned

LESSONS LEARNED- PANEL DISCUSSION

- What is our message? All
- How can your Campus model for Net zero carbon roadmap be used for other campuses? Especially Historic Buildings – UA
- What were your obstacles, and lessons learned/takeaways? All