

U.S. Department of Energy Solar Decathlon

Introduction

Overview

- The Sununu Youth Services Center currently houses 10 individuals on average but has plans to be relocated to another site. The redesign of this facility will minimize both embodied and operational carbon by utilizing local materials within the surrounding economy. The team presented this design in the 2024 DOE Solar Decathlon Design Challenge in Golden, Colorado.

Solar Decathlon Design Challenge

- Annual collegiate competition, sponsored by the U.S. DOE, where teams from around the world are challenged to design high-performance, sustainable, low-carbon buildings that are powered by renewables. Each team is judged based off 10 contests addressing real world issues.

Design Goals

- Net Zero Energy
- Use photovoltaics and a geothermal system to maximize energy efficiency
- Address educational, poverty, and mental health concerns
- Set precedence for future retrofits of this scale

Architecture & Building Envelope

Historic Preservation

- As a large portion of the structures date back to the 1800's, it is paramount to maintain the external façade of the renovated buildings.
- Follows guidelines of NH Division of Historical Resources

Outdoor Experience

- Introducing outdoor classrooms, picnic areas, and gardens will promote a more interactive environment. New walking paths with artistic sculptures will also inspire creativity when at times of rest.

ADA Compliant

- All elevators, doorways and entrances, and parking lots will follow the requirements of ADA.

Acoustics

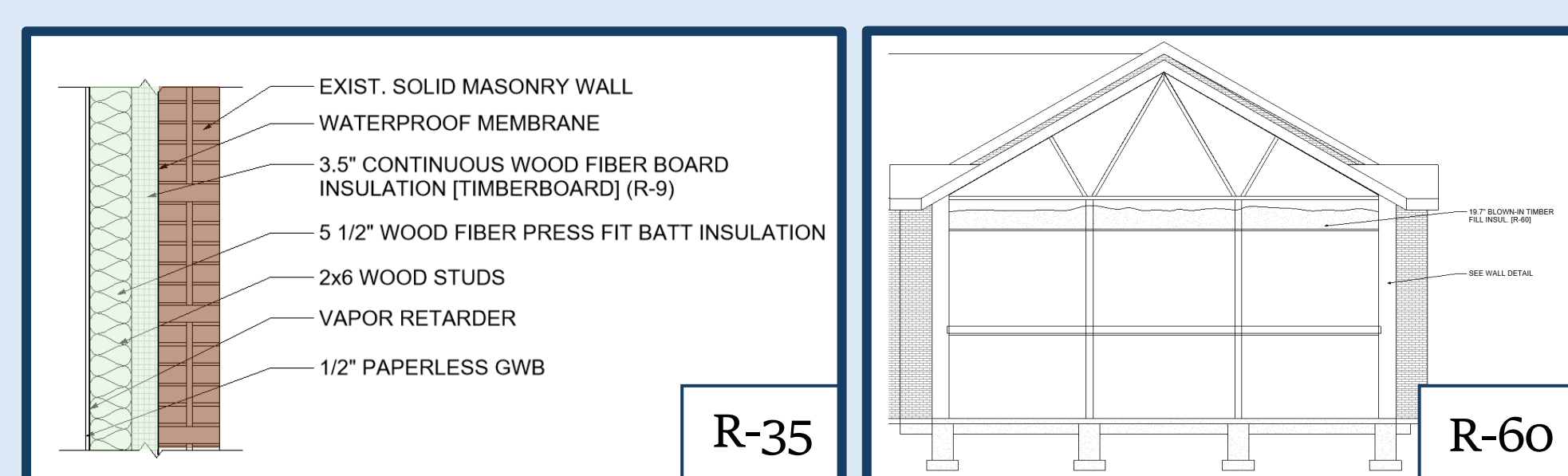
- Reverberation time for an empty classroom = 0.739 seconds
- Minimize excess noise while maximizing speech intelligibility.

Single Stud Walls

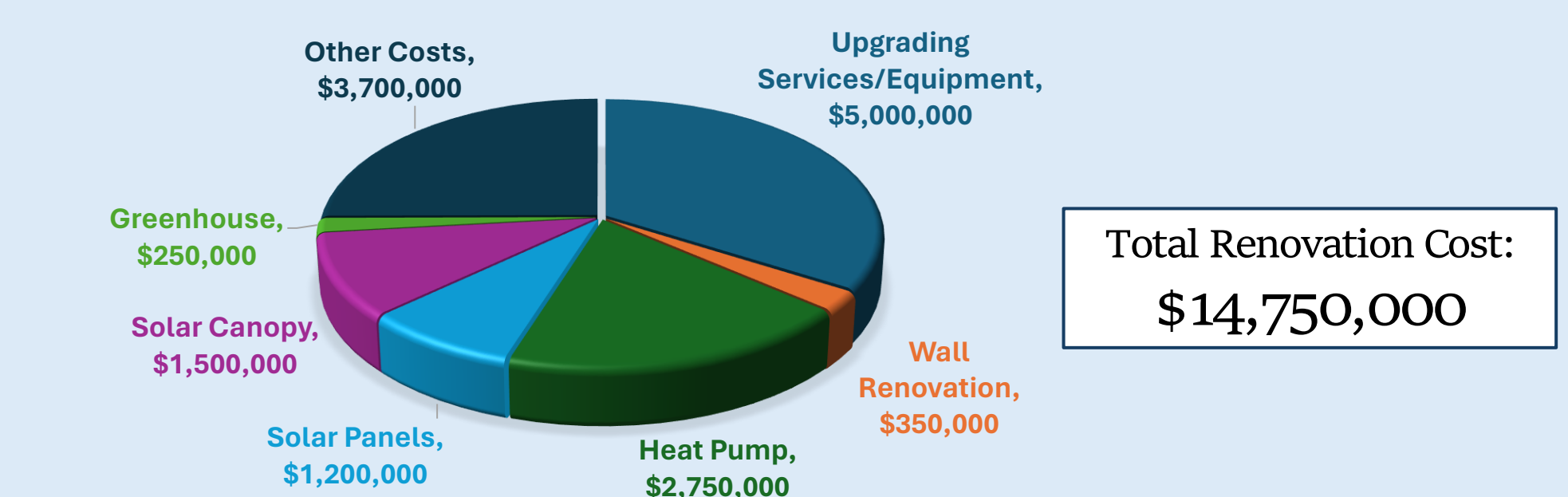
- Existing solid masonry double wythe wall
- Wood Fiber Insulation
- 8 in. thick exterior walls
- Carbon neutral lumber

Double Pane Windows

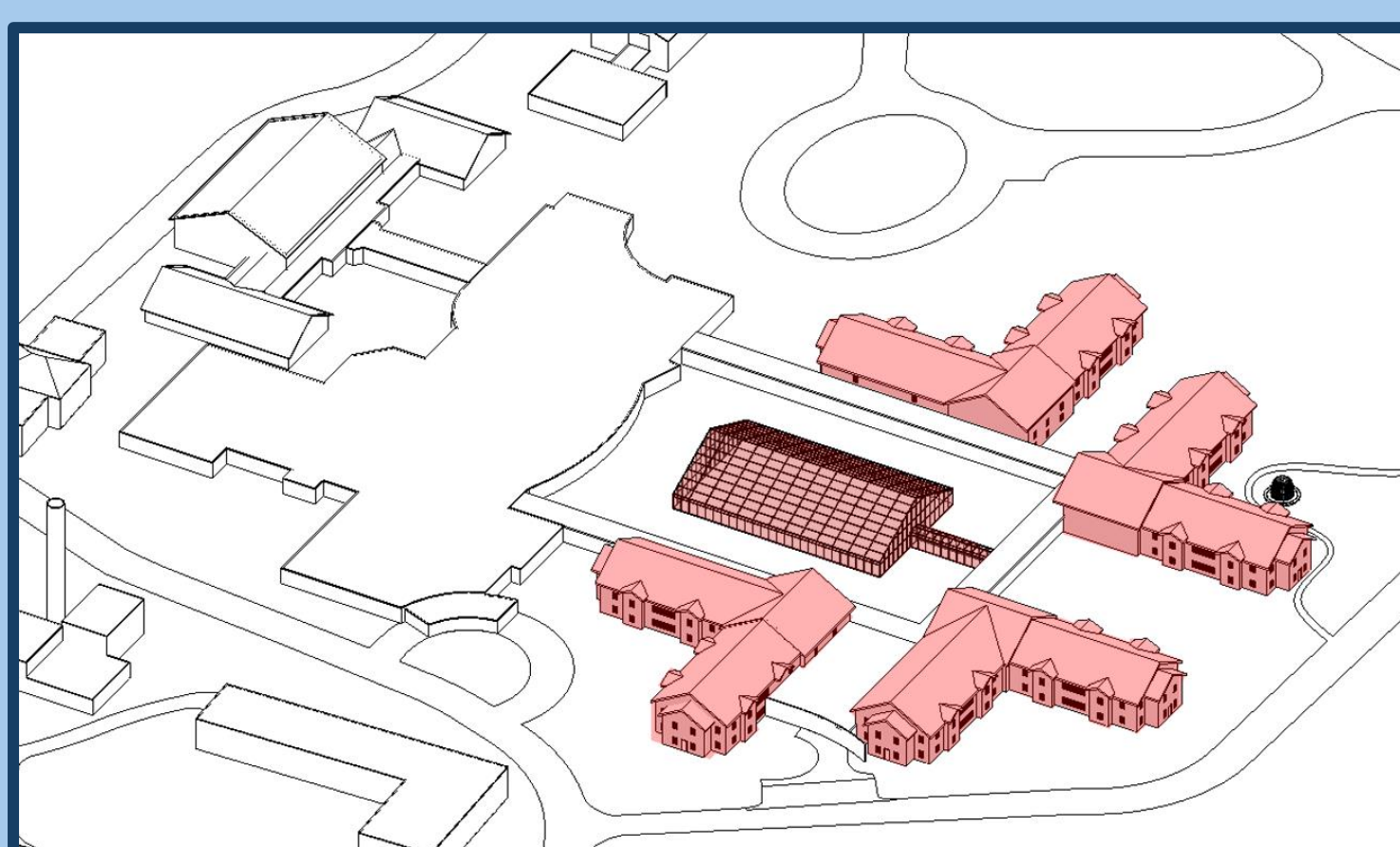
- With VIP
- Passive solar use
- Limits heat loss
- 100x more efficient than single paned



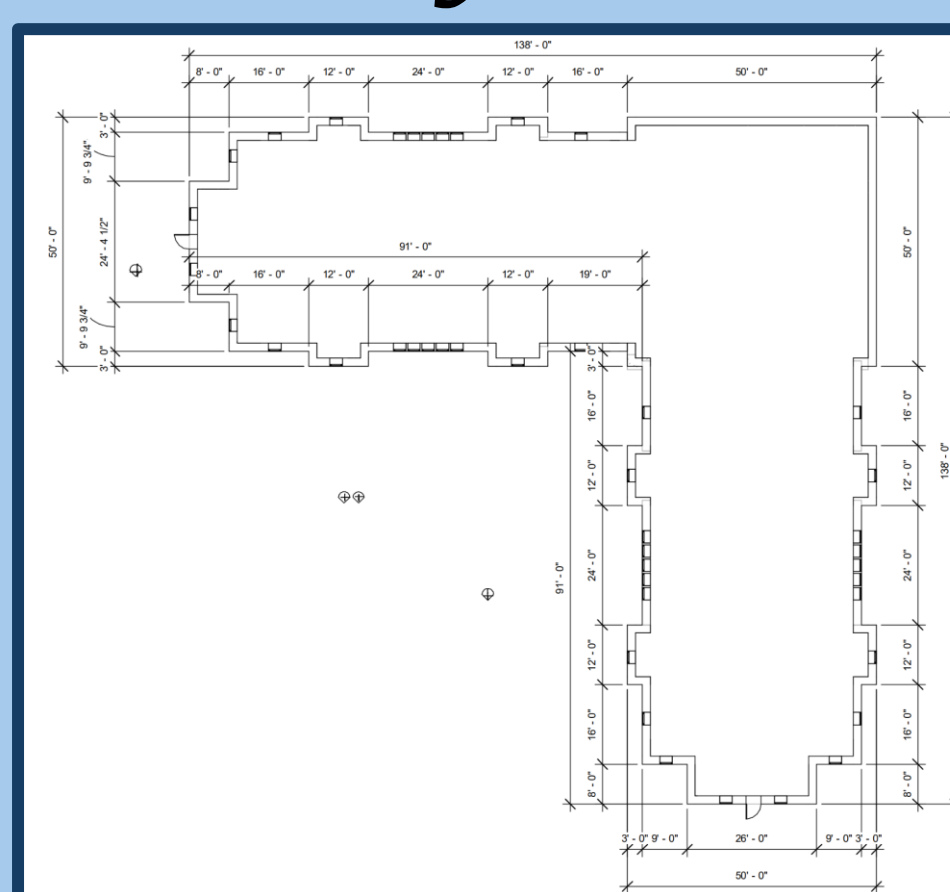
Cost Analysis



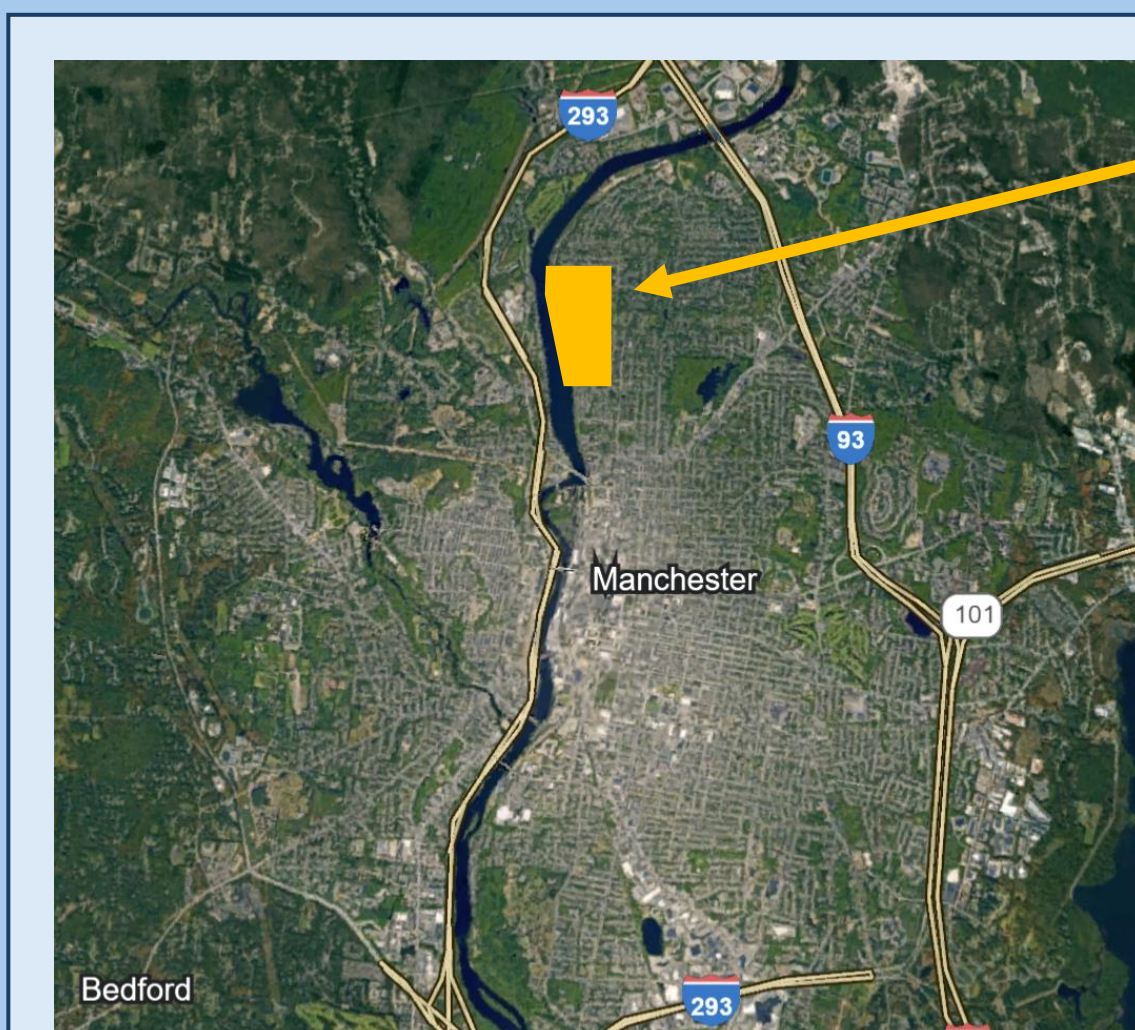
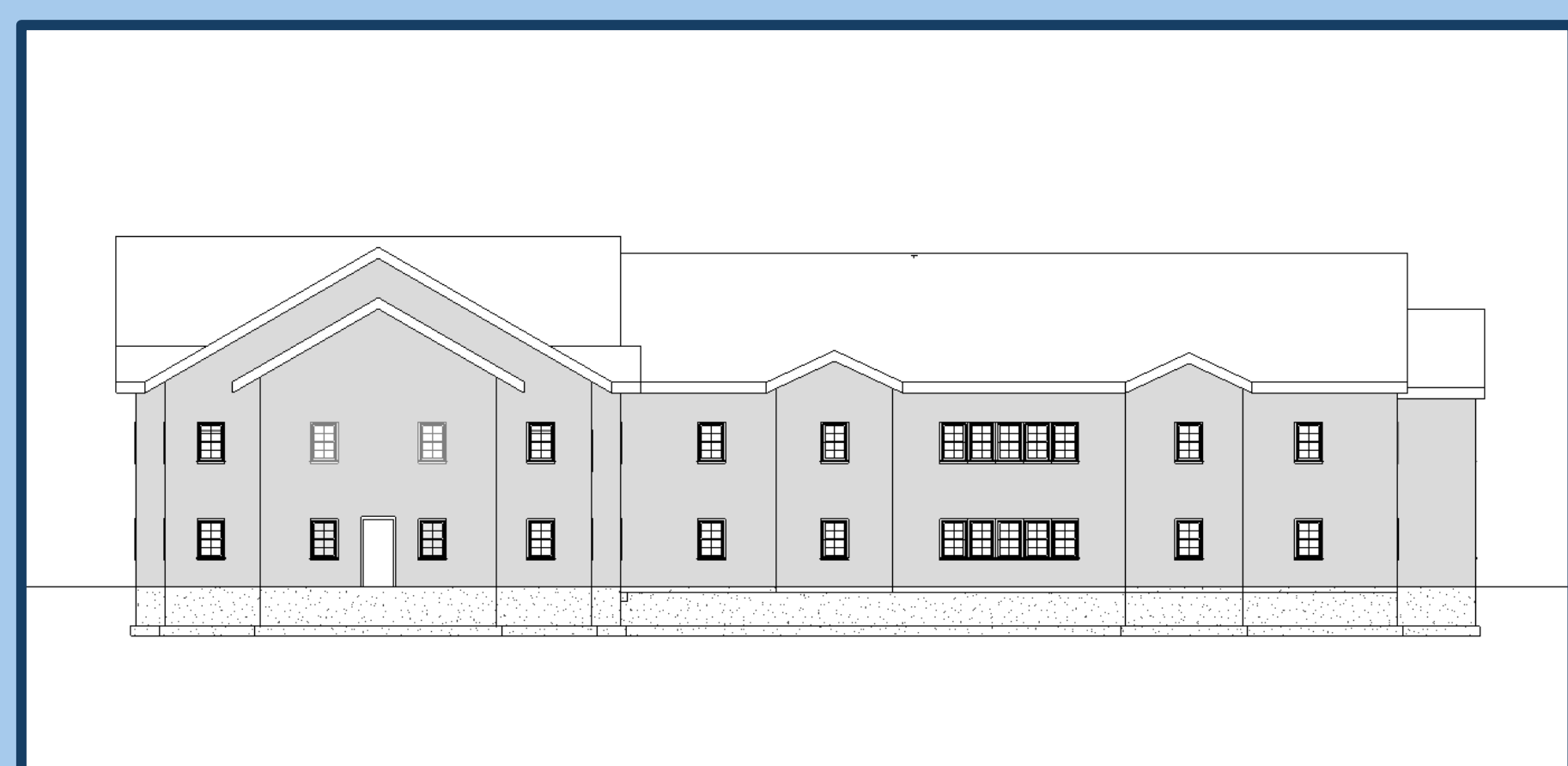
Renovation Focus



Wing Floor



Elevation View



Site Location

- 1056 River Road, Manchester, New Hampshire
- Northwest side of the city
- Lot Size: 150.7 Acres
- Climate Zone 5A
- Risk Category III
- Next to the Merrimack River



Energy Performance

Photovoltaics

- Target EUI will be less than 54 kBtu/ft²yr
- 610-watt, 23.6% efficiency solar panels.
- Fixed and dual axis tracking will cover about 2.75 acres of land.
- To achieve net zero, the facility needs to generate 863,000 kWh/yr. To combat low solar gain periods, the system is designed to generate 1.06 million kWh/yr.
- Net metering will allow any excess energy to be sold back to the grid.

Solar Canopy

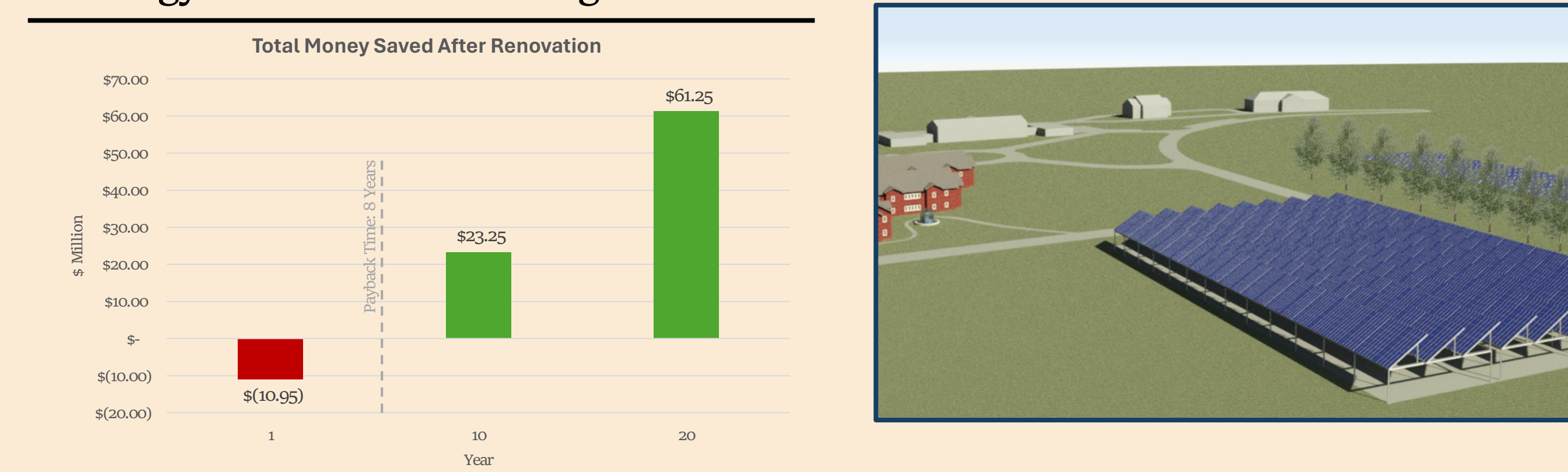
- Parking lot capacity: 204 Spaces
- Total Square Footage: 60,480 sqft of PV collectors
- Fixed axis panels positioned at 30°
- Optimized for greatest electricity generation on an annual basis
- Reduces the heat island effect of the site
- Supplement additional on-site energy generation

Passive Design

- Double pane windows will be paired with vacuum insulating panels allowing for an increase in energy savings when rooms are unoccupied.

VIP Windows

- Retractable insulated panels for after-hour energy savings
- Upgraded double pane windows with vacuumed insulated panels save over 250% of heating energy
- CO₂ sensors to detect room use

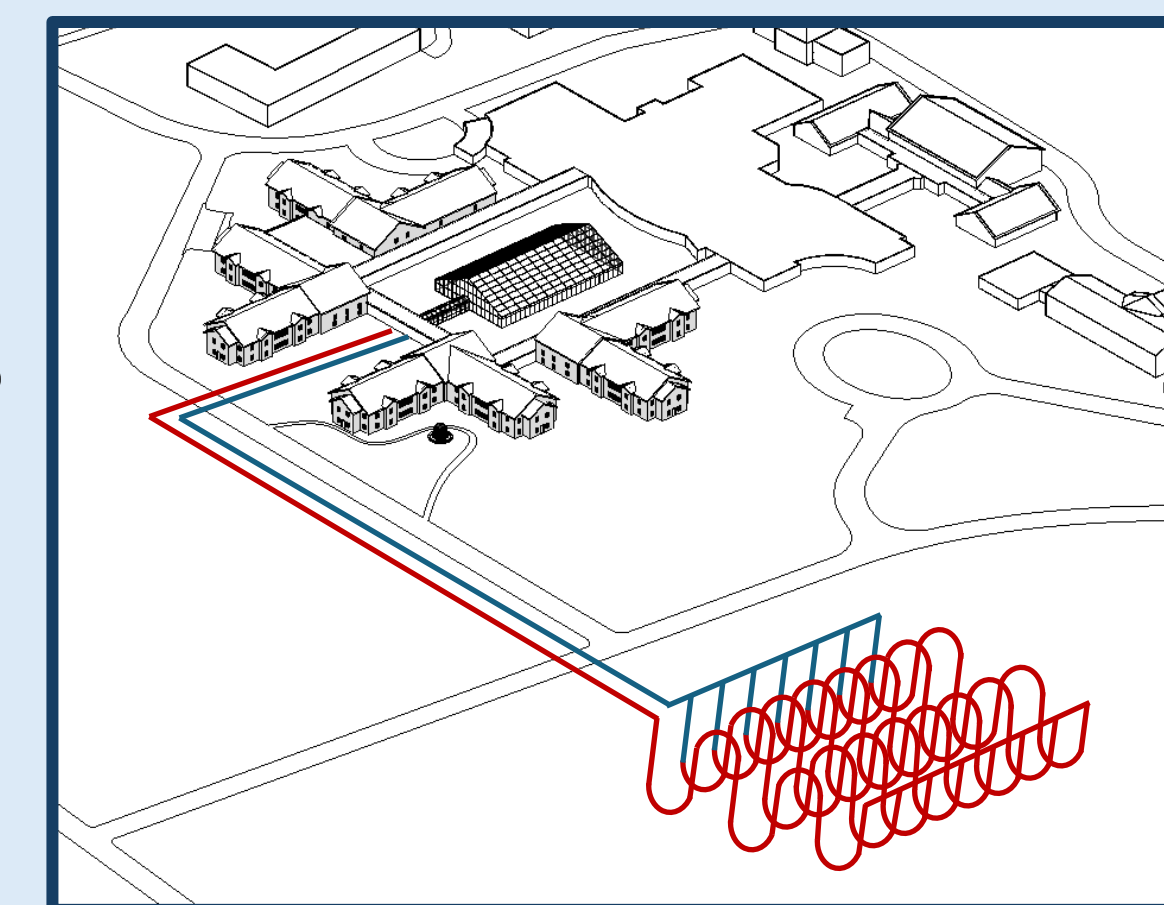


	Single	Double	Triple	VIP
Yearly Loss (\$)	\$1,580,000	\$13,000	\$6,500	\$160
Yearly Energy Loss (KBTU)	48,500	400	200	5

Mechanical Systems

Ground Source Heat Pump

- System Size: 460 tons
- Will consist of 168, 500ft deep boreholes with high density polyethylene PE40 piping to cool R-410A refrigerant to a constant temperature of 55° F
- Provides heating/cooling with a reversible valve



Building HVAC

- Multizone rooftop air conditioning system
- Seasonal Energy Efficiency Ratio (SEER) = 14
- Enthalpy heat recovery package that removes heat and humidity from the airflow.

Environmental Impact

Greenhouse

- Aluminum structure with glass panels, allowing for maximum light transmission
- Provides hands-on learning
- Algae production to make biodiesel fuel
- Plant and vegetable growth

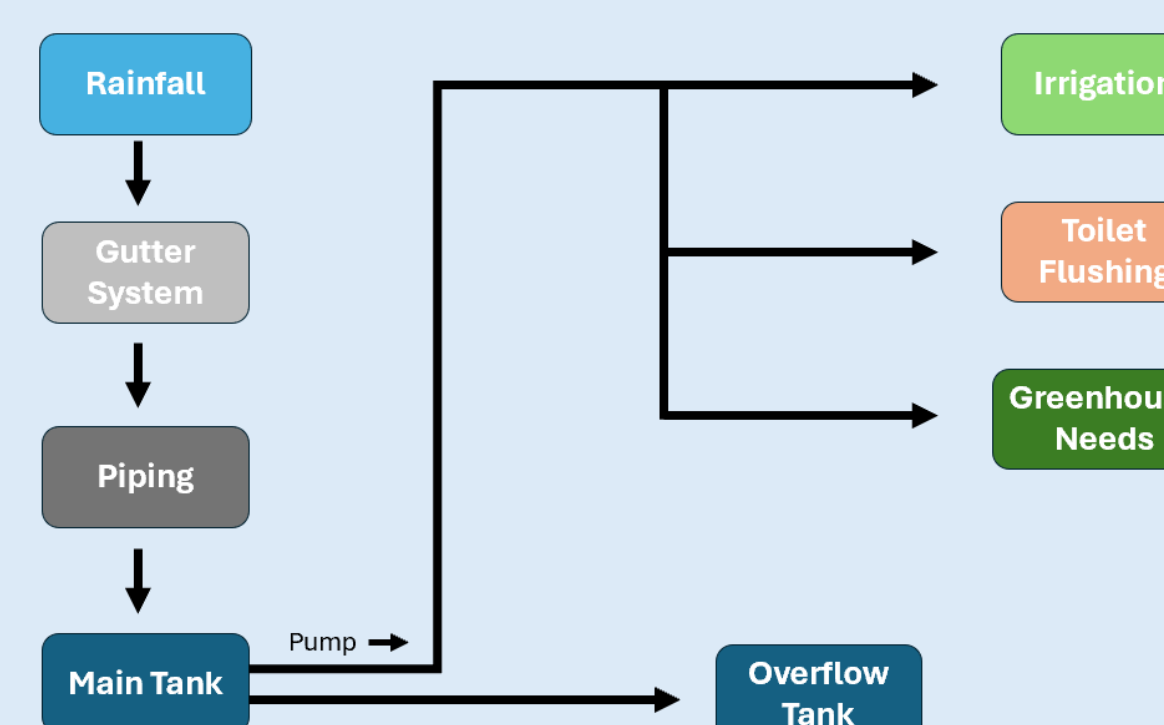


Reduction of Carbon Emissions

- Retrofit vs. Construction - Significantly reduces carbon footprint
- Locally sourced materials from companies in the community
 - Utilizing TimberHP products, all insulation for this project will arrive on site with a negative carbon impact.
- All components and systems were designed to be low-carbon emitting, with extended service periods.

Rainwater Harvesting

- Significantly reduce the utilization of municipal water needs.
- Repurpose the collected water for irrigation, flushing, and watering plants in the greenhouse.



LEED

- LEED Gold for O&M of existing buildings
- CO₂ sensors and VIP shutters to limit energy consumption
- Optimized water efficiency and energy performance
- Acoustic calculations to enhance indoor comfort and air quality



Acknowledgements

Project Advisor: Felix DeVito
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 U.S. Department of Energy Solar Decathlon

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