



SASAKI

# Path to Zero Energy, and Zero Carbon Feasibility Study



## Town of Brookline - The John R. Pierce School

MSBA SCHOOLS EMBRACE A SUSTAINABLE FUTURE 12/2/2021



# Goal: Zero Carbon Design

## Brookline Goals: Zero Carbon by 2050, No Fossil Fuels

### Electrification = best strategy

- Road Map to Net-Zero with renewables
- Grid is increasingly clean
- Reduced health risk from toxic fumes
- Potential to reduce costs

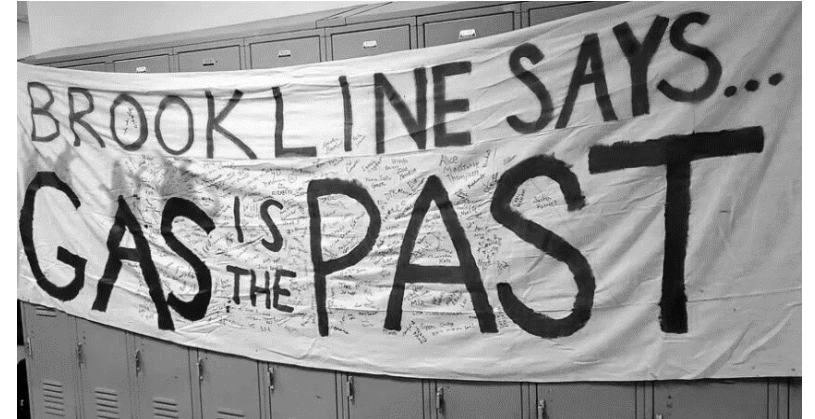
## MSBA Core Values: NE-CHPS, LEED

### Recipe for Net-Zero: integrated design process

- Consistent with Commonwealth Initiatives
- Massachusetts new Climate Legislation
- Governor's Executive Order 594- Carbon Neutrality by 2050

## Sustainability Strategy:

### Modeling integrated into design workflow



**We are here!**

Winter 2021

Spring + Summer 2021

Fall 2021

2022

### PHASE 1 PRELIMINARY DESIGN & PROGRAM

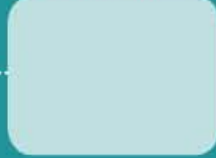
- Understand the School's past and present
- Understand community perspective and vision for the future

### PHASE 2 DEVELOPMENT OF ALTERNATIVES

Concept Options +  
Cost Estimate



Refined  
Conceptual  
Plan + Cost  
Estimate



### PHASE 3 SCHEMATIC DESIGN

Schematic  
Design Drawings



Cost  
Estimate



### DESIGN DOCUMENTATION



Public +  
Stakeholder  
Meetings



GOAL:

**LISTEN**

**TEST CONCEPTUAL  
IDEAS**

**CONFIRM REFINED  
CONCEPT**

**MORE OPPORTUNITIES  
TO ENGAGE DURING  
DETAILED DESIGN**

# Pierce School Today



# Pierce School Today

Brookline Village,  
precinct of Town bldgs

2.5 acre site

725 students pre K-8

All parking below bldg

Playground = city park

Pickup/dropoff offsite

Steep topography

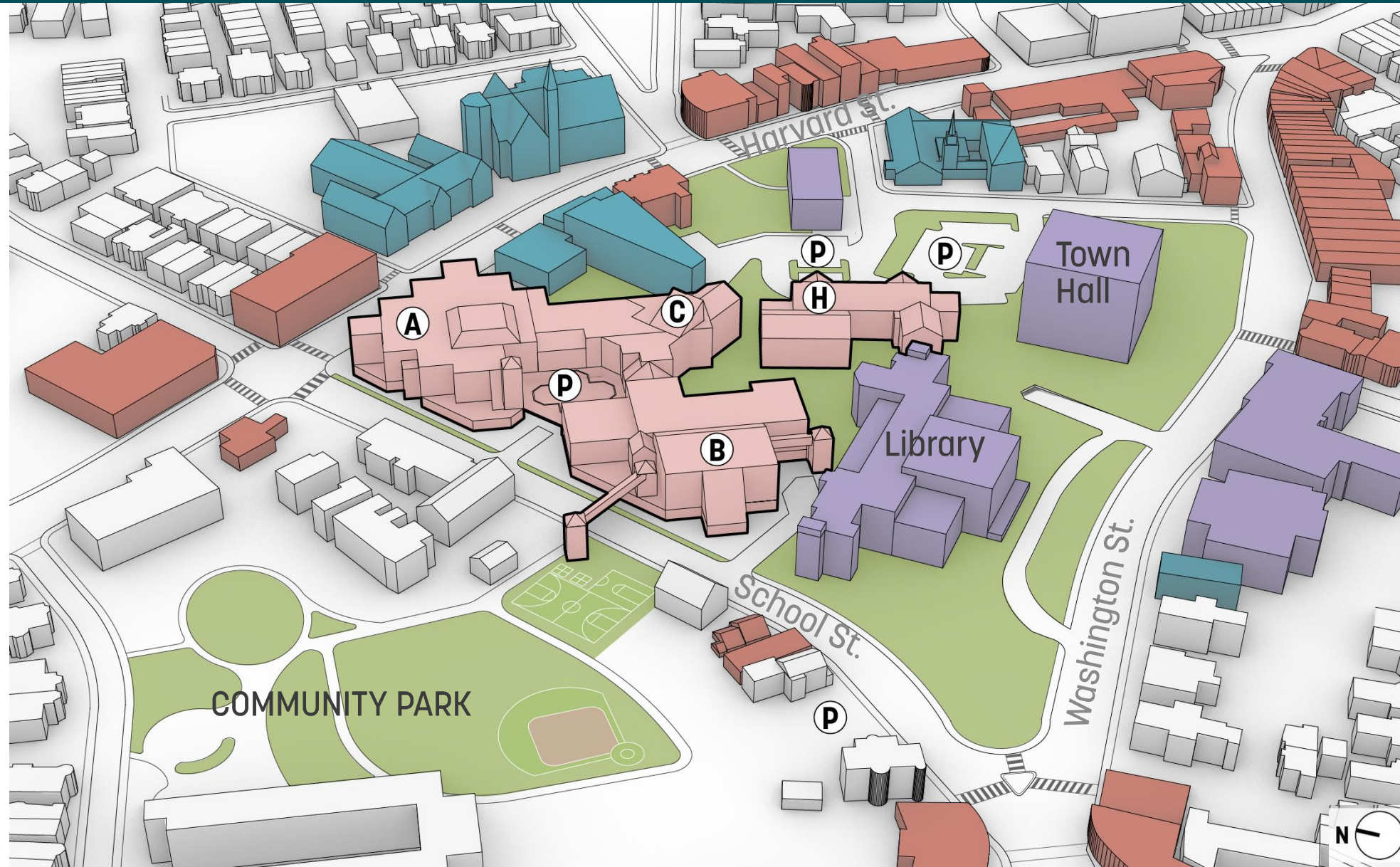
A = Existing Wing A

B = Existing Wing B

C = Existing Wing C

H = Historic Building

P = Parking



# Pierce School Today

## 1974 Open School



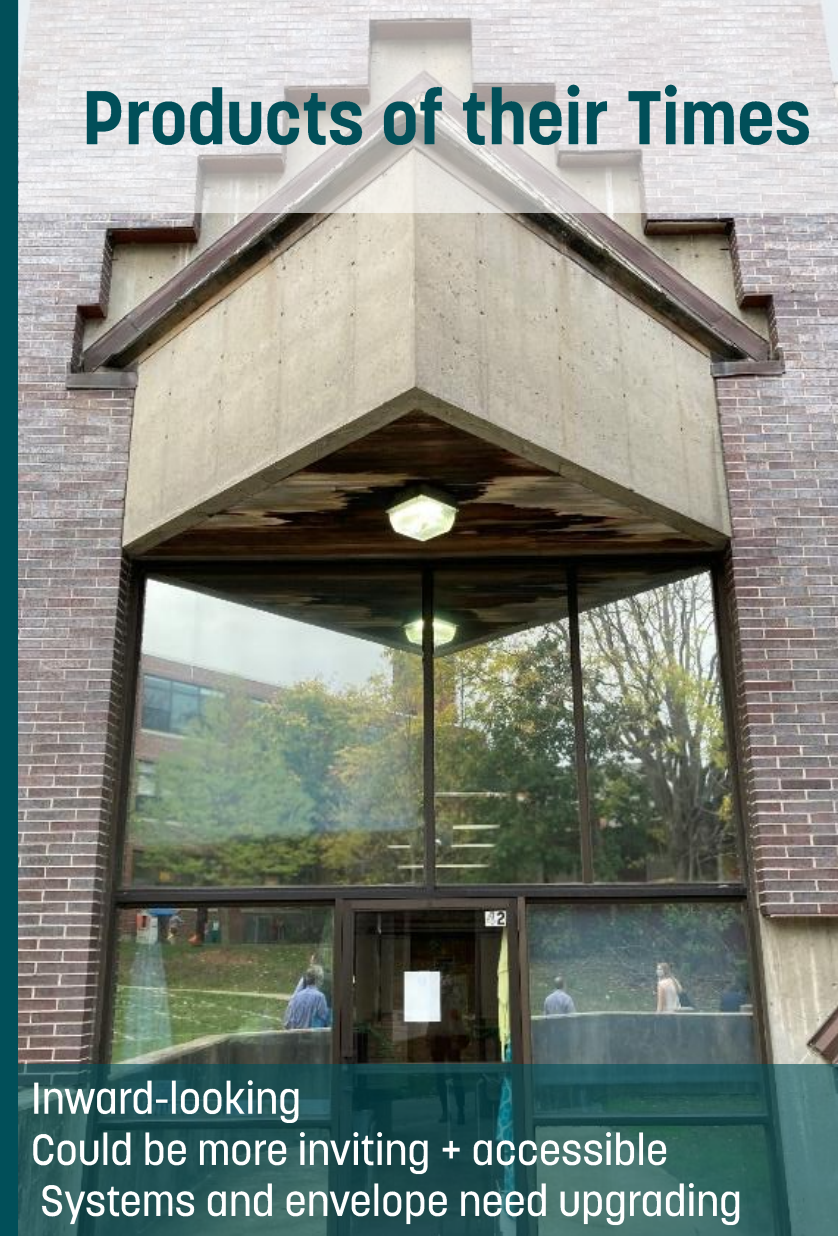
Visually + acoustically intense  
Moments of quirky delight  
Difficult to navigate

## 1854 Age of Reform



Generously proportioned  
Quiet craft + quality  
Now an island on the campus

## Products of their Times



Inward-looking  
Could be more inviting + accessible  
Systems and envelope need upgrading

# Sustainability Priorities

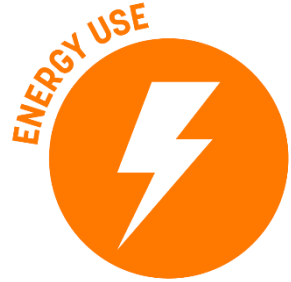


Maximizing **daylighting**

Indoor **Air Quality**,  
ventilation/filtration,  
healthy materials,  
acoustics

Sustainable  
**transportation**,  
encouraging non-car  
transportation

Great **outdoor learning**  
and play spaces



**Decarbonization:**  
electrification of  
building systems

**Minimizing loads /**  
energy efficiency, heat  
pumps and geothermal

Maximizing onsite  
renewable energy  
generation: **PV**

Purchasing any  
additional electricity  
from **renewable**  
**resources**



Potential **reuse** of  
existing building  
elements

New construction with  
**low-carbon materials**  
for structure,  
envelope and interiors



**Certifications, MSBA:**  
**LEED or NE-CHPS**

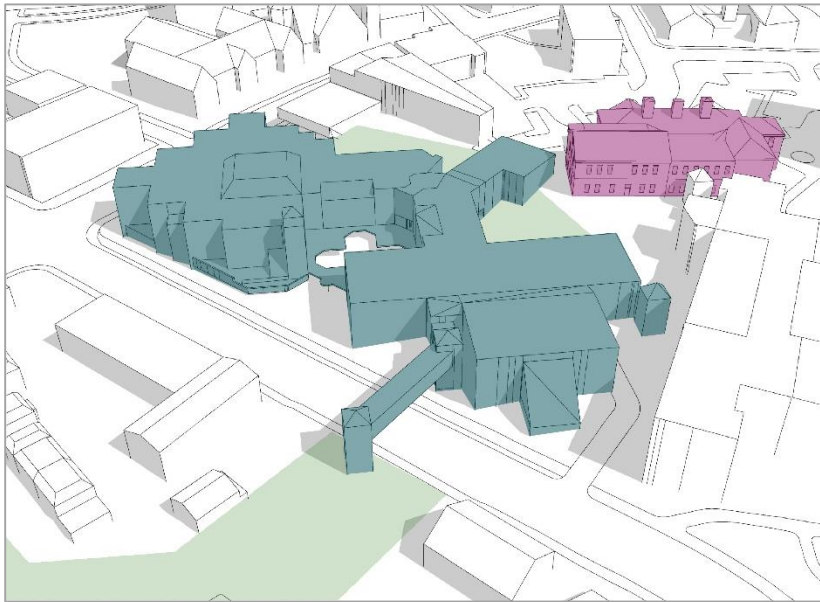
**Possible**  
**ILFI Zero Carbon:**  
aligns with  
**Town of Brookline and**  
**MSBA goals**

# Building Organization

## Existing Conditions

No through the site connection

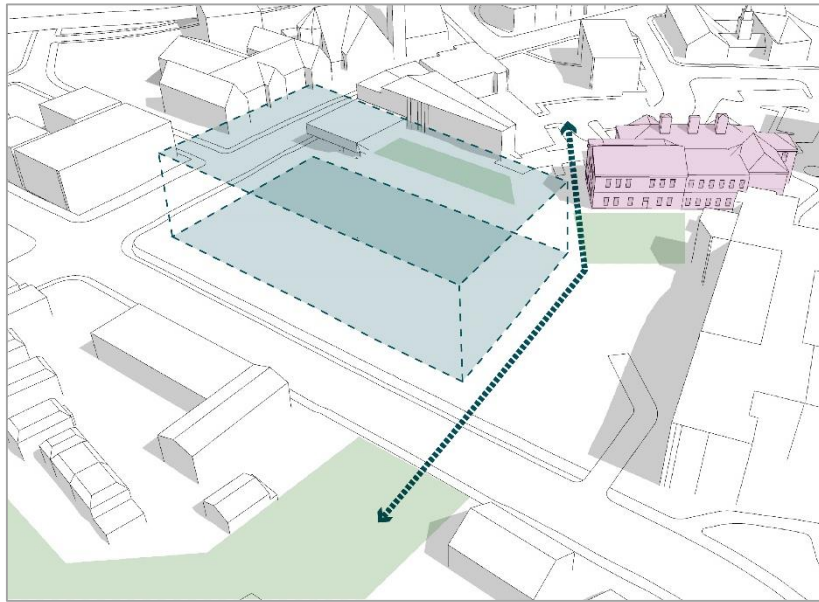
Lack of outdoor space



## Compact Footprint

Provides through the site connection

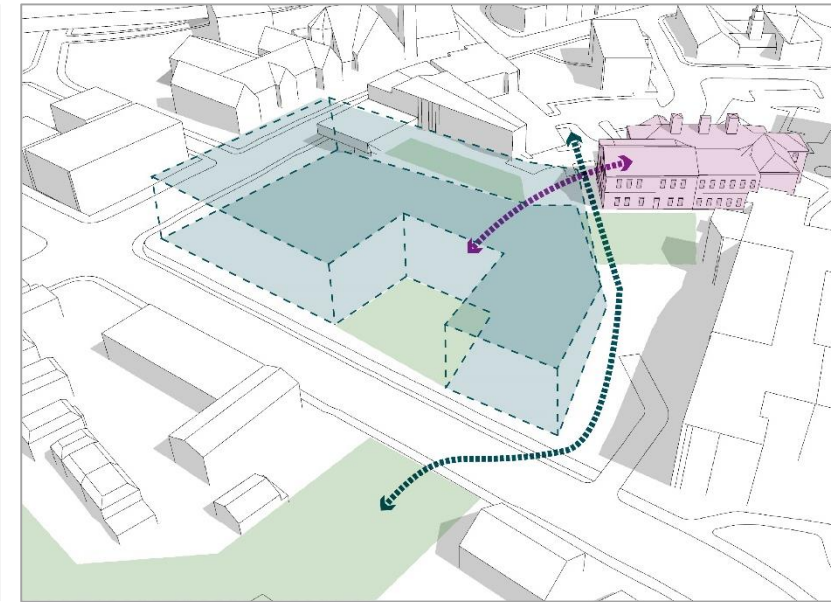
Requires **4+ stories** to fit the program



## Creating Outdoor Spaces and Connection

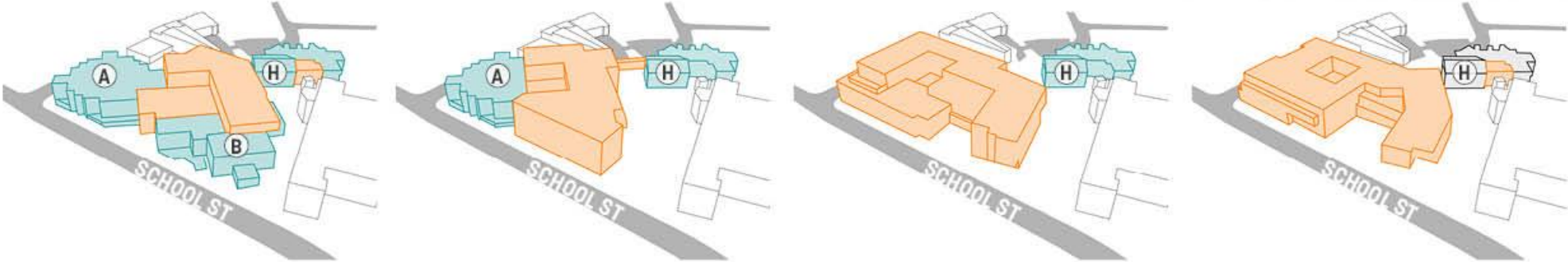
Provides through the site connection

**3 Stories** to fit all the program





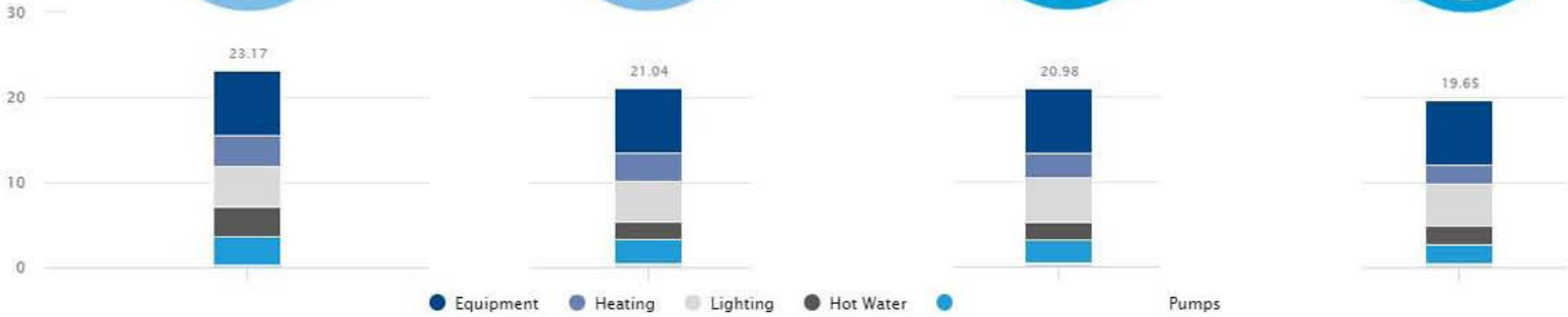
# Energy Use



## Energy Use Intensity (EUI)



## Energy Use Intensity by different loads



Note: Preliminary analysis meant for comparison. Final values will vary as the design progresses.

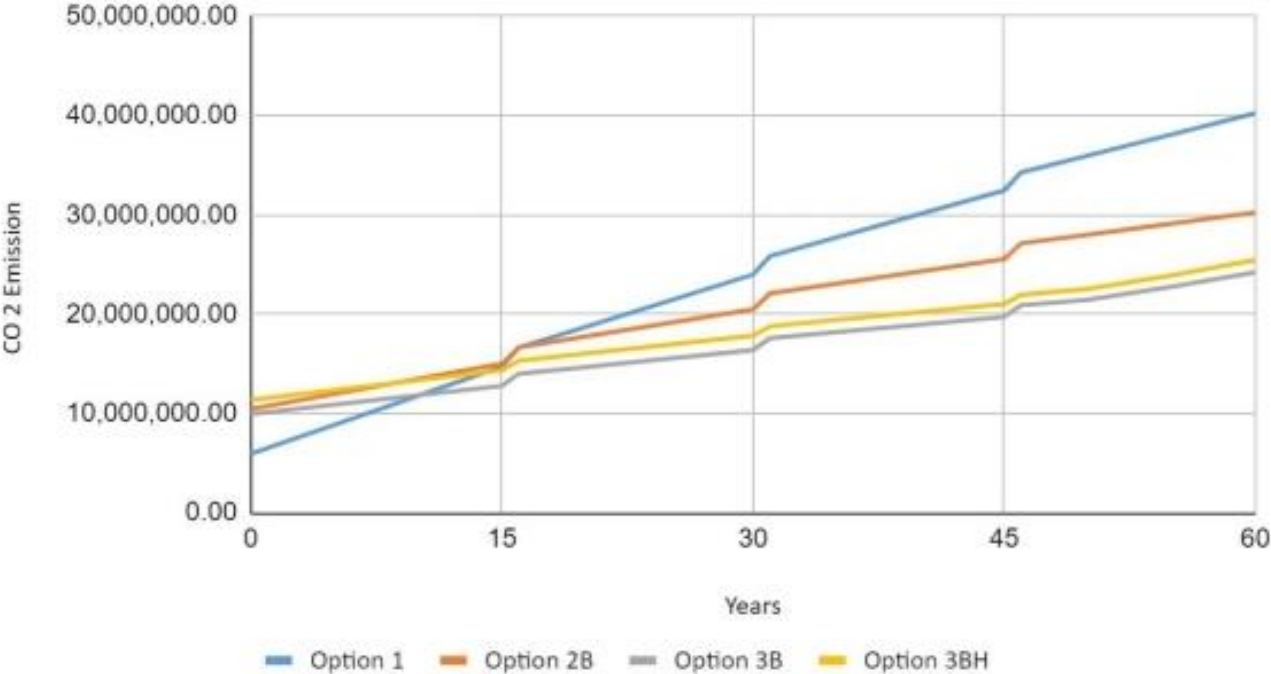
# Embodied and Operational Carbon Emissions



## Operational Carbon Emissions



## Total Carbon Emissions



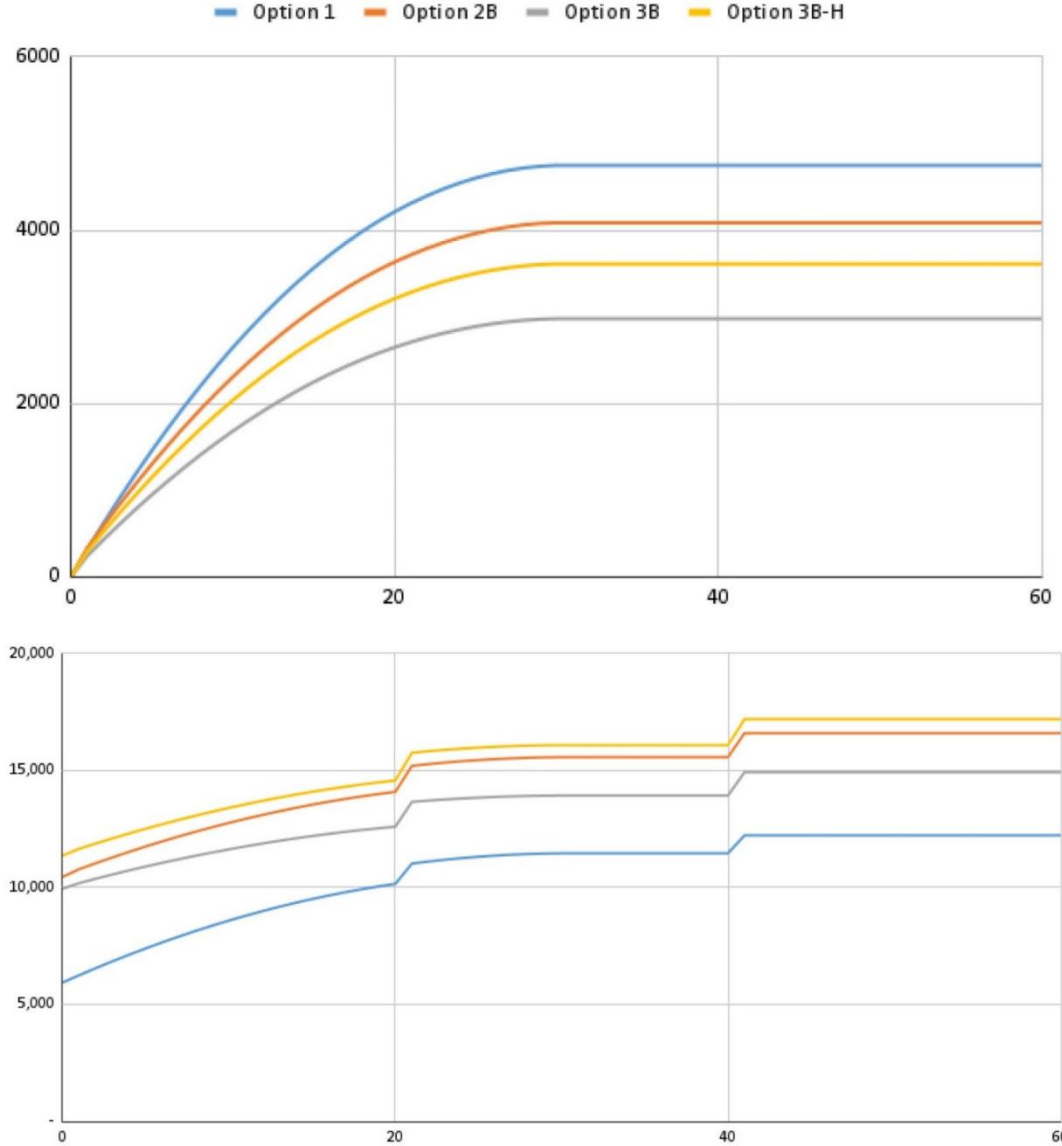
# Embodied and Operational Carbon Emissions



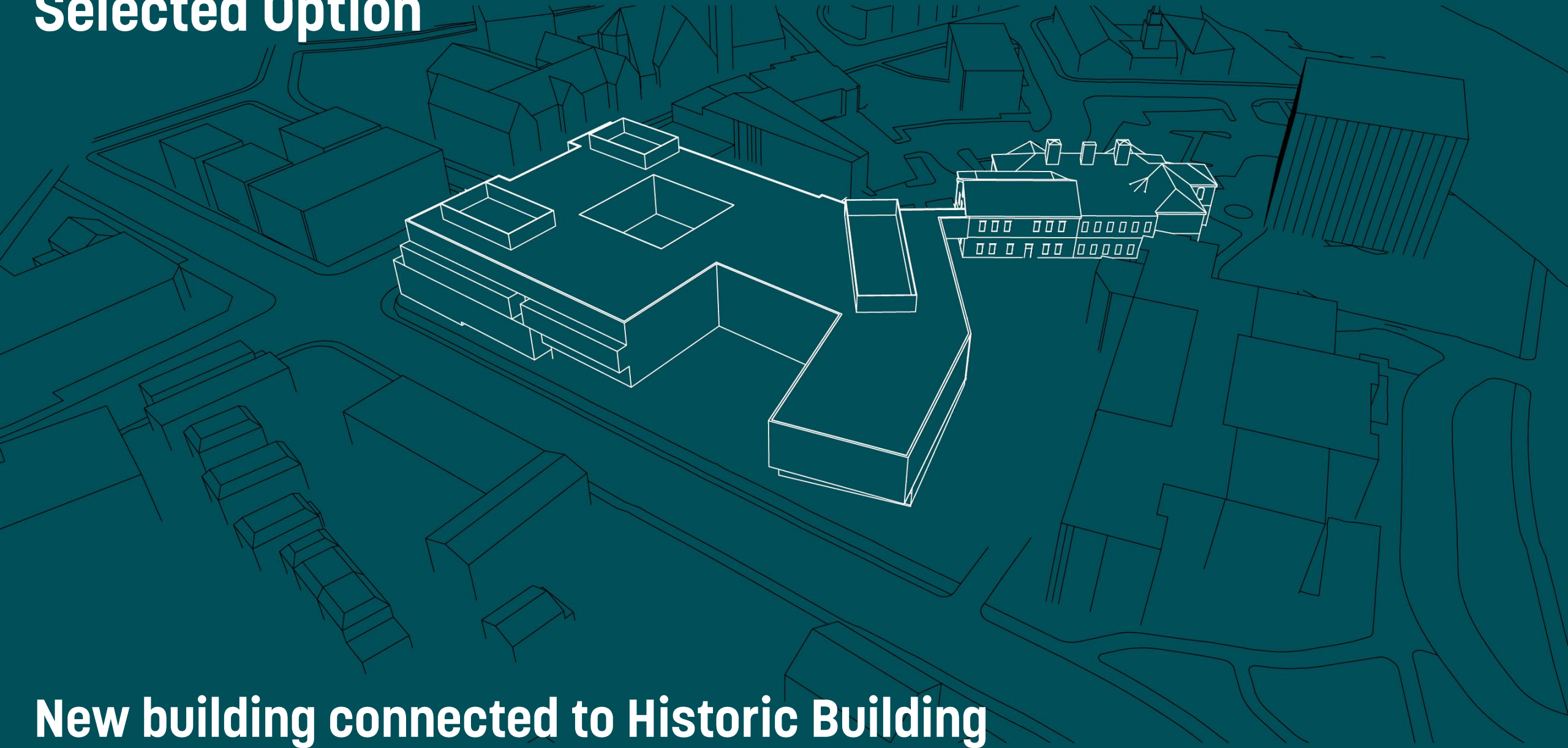
**Operational Carbon Emissions**  
commitment to purchase 100%  
renewable energy by 2050



**Total Carbon Emissions**  
(Operational and Embodied)  
commitment to purchase 100%  
renewable energy by 2050



# Selected Option



**New building connected to Historic Building**

# Site Plan

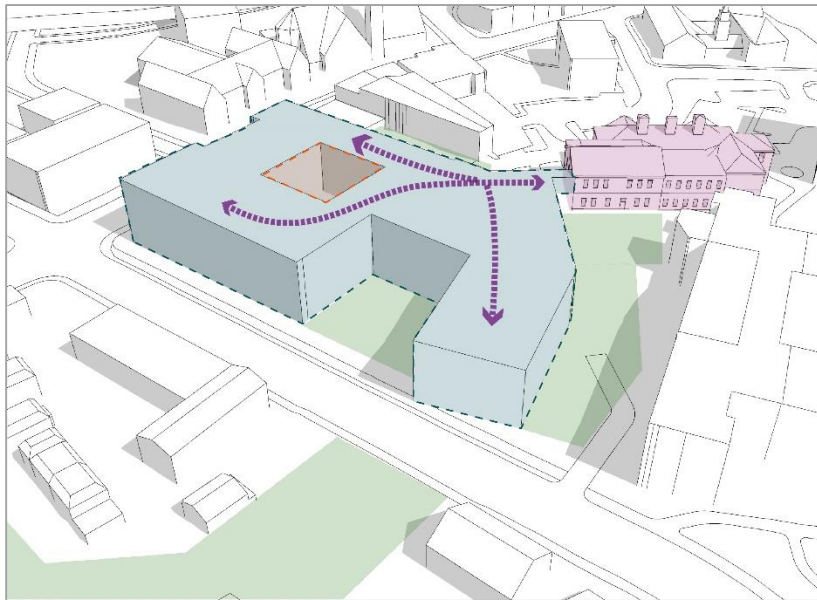
## Connection with Park Raised Crosswalk



# Massing

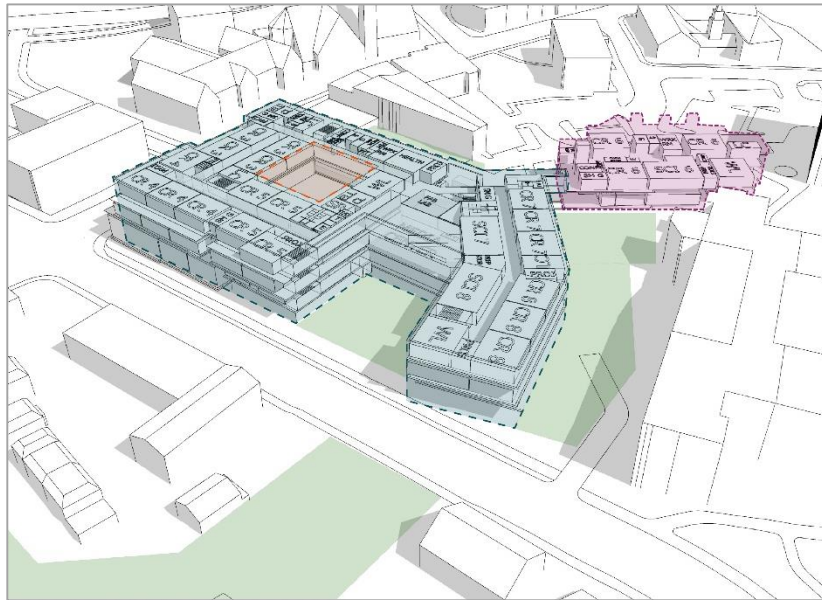
## Daylight & Connection

Providing connection to historic Building  
Adding Courtyards



## Program Test-Fit

Organizing grade bands around heart of school: library, cafeteria



## Façade Development

To continue in Schematic Design



# Strategies

## ROOF GARDEN

Maker Space  
Art

## EVENT SPACES

Gym  
Multipurpose  
Music

## HEART OF THE SCHOOL

Library  
Cafeteria  
Entrance

## Solar PV

60% of roof area

## NEW LINK

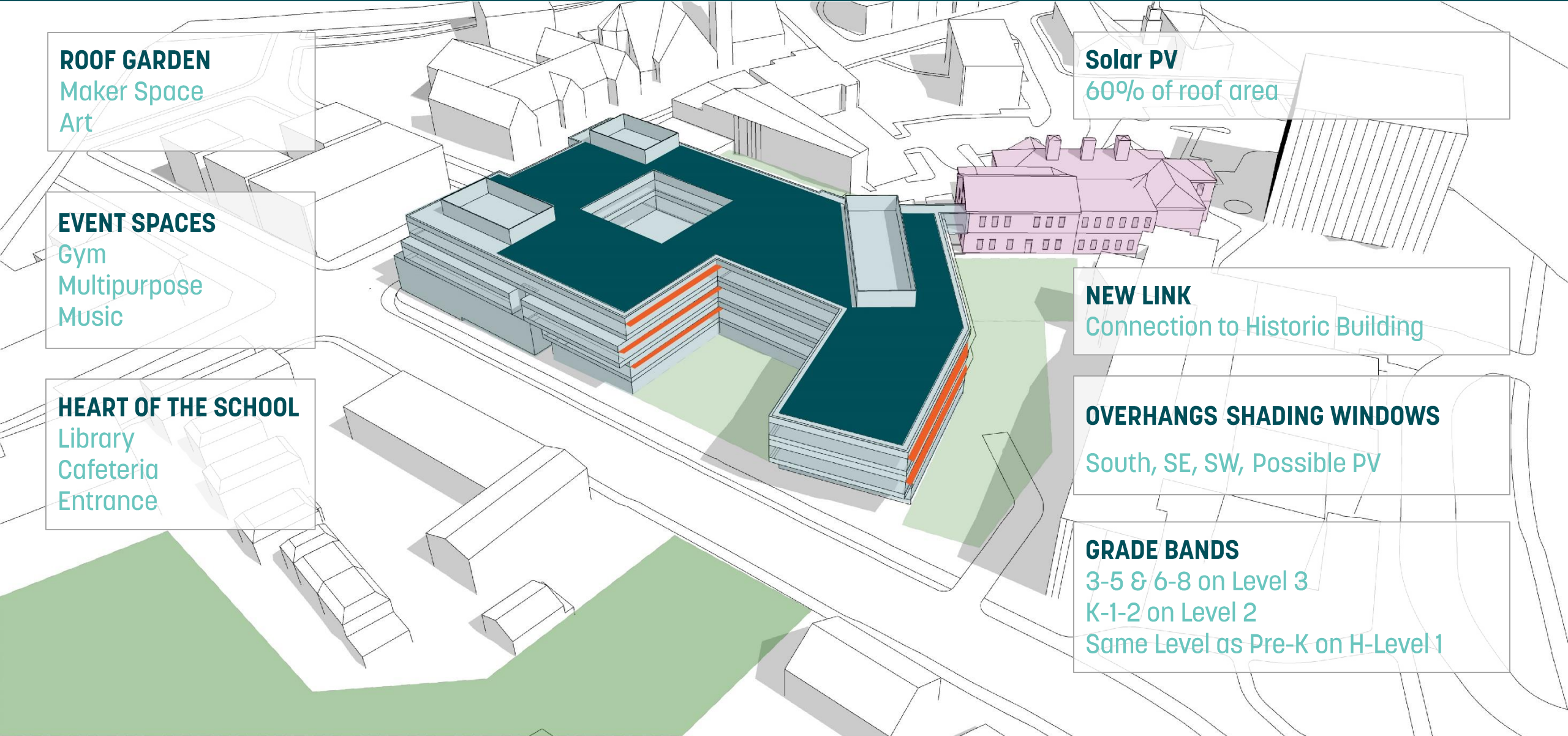
Connection to Historic Building

## OVERHANGS SHADING WINDOWS

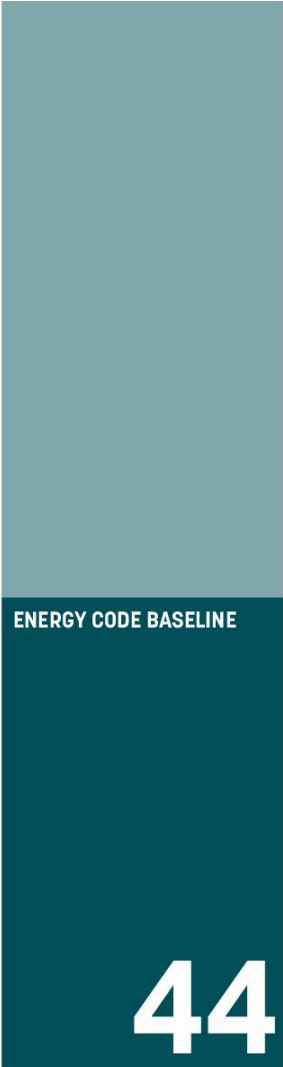
South, SE, SW, Possible PV

## GRADE BANDS

3-5 & 6-8 on Level 3  
K-1-2 on Level 2  
Same Level as Pre-K on H-Level 1



# EUI = Energy Use Intensity



High efficiency boilers  
Energy recovery  
Building Management Systems

Additional insulation exceeding code  
Reduced window/wall ratio

All electric systems  
Ground source heat pumps,  
Geothermal bore fields  
Reduced Lighting Power Density  
Advanced Building Management Systems

MassSave incentives:  
EUI below 25

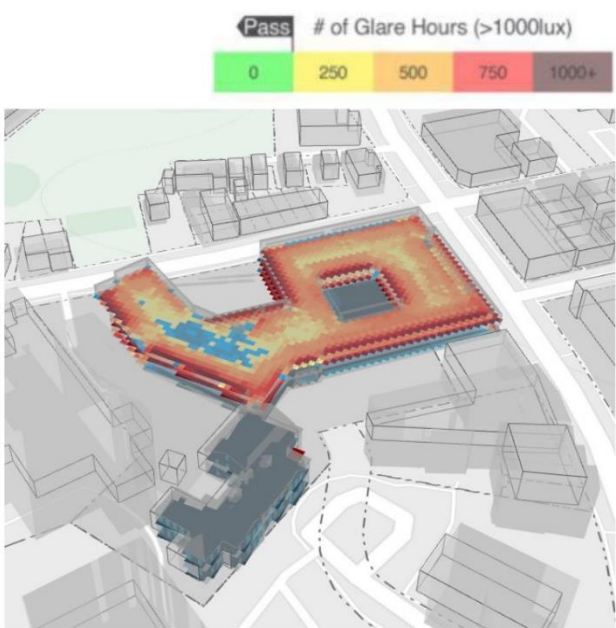
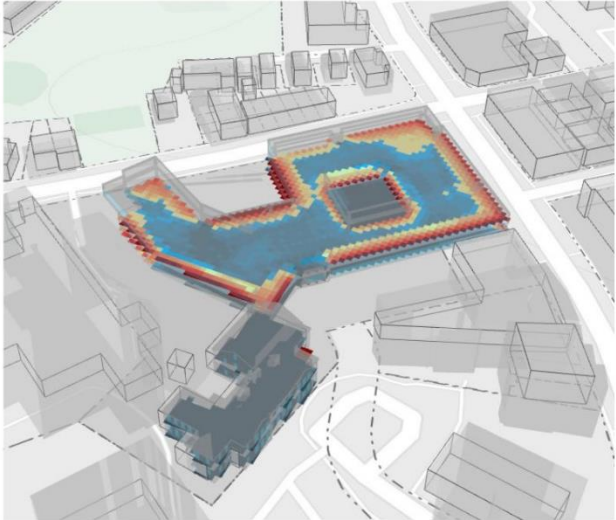
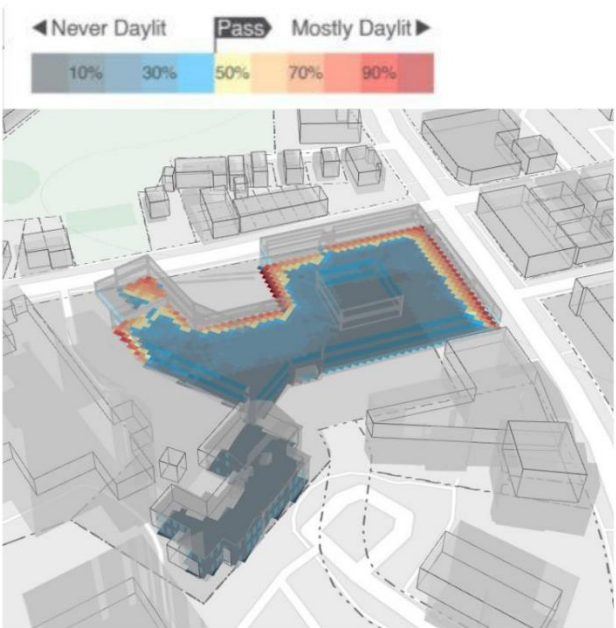
Remaining needs to be met with:  
onsite PV  
offsite green power



# Daylight and Glare Control

> All options will benefit from exposure-specific design of windows and shading

Daylight Analysis



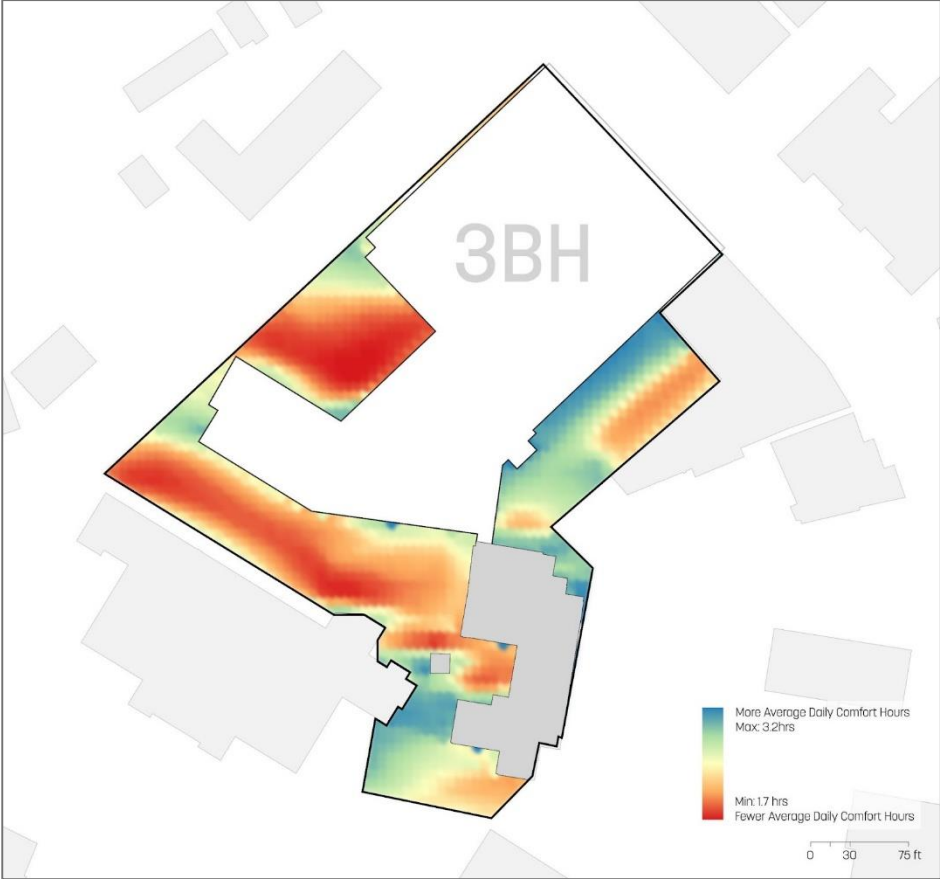
Glare Analysis



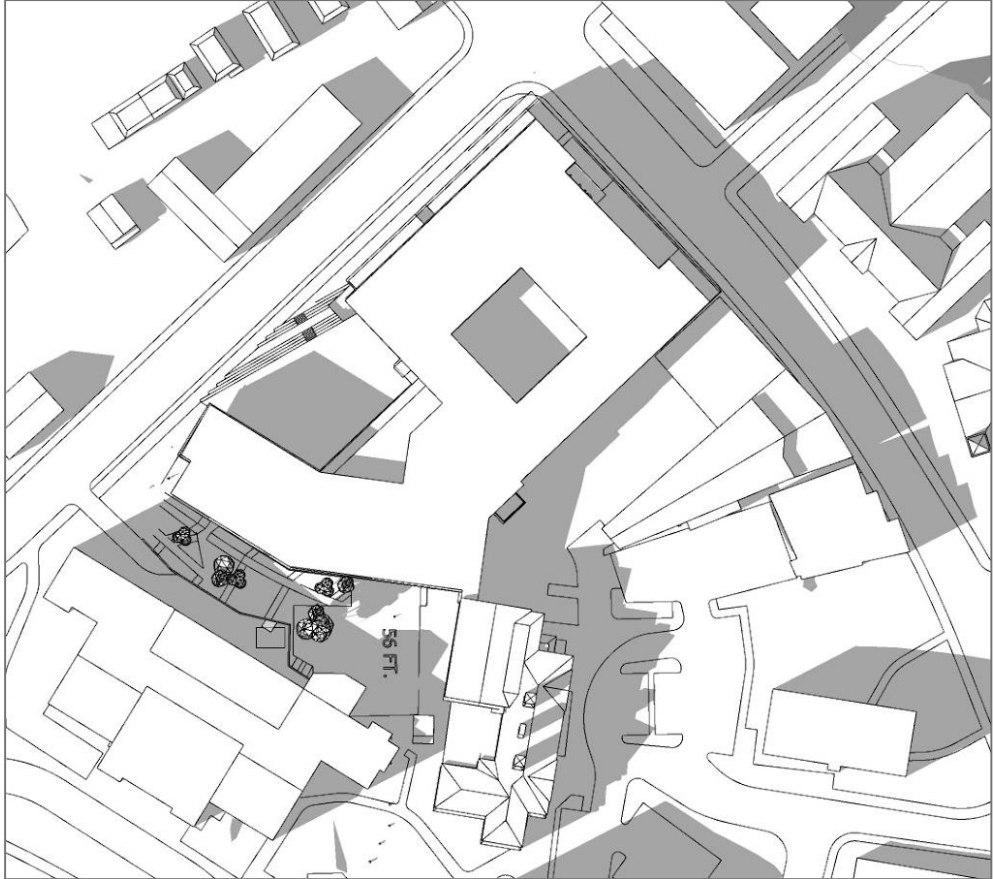
# Outdoor Comfort & Shadow Studies

> As we develop plans for selected design, there is an opportunity to tune outdoor activities to best exposure

Annual Average Outdoor Thermal Comfort



Shadow Studies  
Example: September 2 at 3pm



# Path to Zero Carbon: Issues to address at start of SD

**Façade development:** Building-Integrated Solar PV on overhangs on south facades

**Refine roof plan:** to maximize solar PV

**All-electric kitchen:** induction cooktops

**Geexchange bore fields:** below building or in the park across the street

**Occupancy schedule:** refine summer programming

**IAQ:** interior and exterior building material HPDs



**Thank you!**