Path to Zero Energy, and Zero Carbon
Feasibility Study

Town of Brookline - The John R. Pierce School
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!

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

Timeline:
- Winter 2021
- Spring + Summer 2021
- Fall 2021
- 2022

Design Documentation

Goals:
- 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**

**HEALTH + WELLNESS**
- Maximizing daylighting
- Indoor Air Quality, ventilation/filtration, healthy materials, acoustics
- Sustainable transportation, encouraging non-car transportation
- Great outdoor learning and play spaces

**ENERGY USE**
- 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

**EMBODIED CARBON**
- Potential reuse of existing building elements
- New construction with low-carbon materials for structure, envelope and interiors

**CERTIFICATIONS**
- Certifications, MSBA: LEED or NE-CHPS
- Possible ILFI Zero Carbon: aligns with Town of Brookline and MSBA goals
**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 Intensity (EUI)

23.17

21.05

20.98

19.66

Energy Use Intensity by different loads

Equipment  Heating  Lighting  Hot Water  Pumps

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

- Zero Tool Baseline: 138
- Energy Code Baseline: 44
- Stretch Code: 40
- Improved Envelope: 36
- Improved Systems with Geothermal: 19

- 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

Remaining needs to be met with:
- Onsite PV
- Offsite green power

MassSave incentives: EUI below 25

55% of the energy use can be generated with solar PV on 60% of the roof area.
Daylight and Glare Control

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

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

**Occupancy schedule:** refine summer programming

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