Revitalizing Lower Roxbury
Housing and Neighborhood Walkability Study

Maxime Cunin   |   Jeff Geisinger   |   Cody Rose
How can planners and architects transform public housing in a way that is **environmentally responsible**, **socially equitable**, and **sensitive to the existing community and urban fabric**?
What is Public Housing?

- Housing for eligible applicants at or below 80% Area Median Income (AMI) [many families below 20%]
- Federally administered by the Department of Housing and Urban Development (HUD)
- Locally owned by Public Housing Authorities (PHA’s)
- Currently, there are approximately 1.2 million public housing units in the U.S.

The Boston Housing Authority (BHA)

- The BHA is the largest landlord in Boston and largest public housing authority in New England
- Houses approximately 10 percent of the city’s residents through its programs

In 2000, 57 percent of public housing units were in developments more than 30 years old.

“HUD should be able to reduce its energy bill by 20%--representing $1 billion in savings that could be redirected to high-priority investments in the affordable housing stock”

Source: http://www.clpha.org/facts_about_public_housing#_edn6
“Up the Chimney” Report (2010) by National Consumer Law Center
Context:
Boston’s Public Housing Transformation
The Boston Housing Authority’s efforts to redevelop three of its post-war public housing projects preceded national trends and focused on preserving and adapting existing buildings to improve living conditions for low income communities. Careful design, successful management, and well-organized community leadership played important roles in the Commonwealth Redevelopment, a successful housing transformation from this period.

Source: *Reclaiming Public Housing* by Lawrence Vale
Recent housing policies such as HOPE VI and Choice Neighborhoods seek to transform distressed public housing sites into mixed-use, mixed-income communities. Under these policies, existing sites are typically demolished and replaced with new market-driven housing, often with a percentage allotted for affordable units. The BHA addresses community displacement from demolition through a relocation and rehousing program. Whittier Street Apartments in Lower Roxbury is at the core of BHA's current Choice Neighborhood initiative, which also includes neighborhood-scale infrastructure improvements.

Source: [http://www.poah.org/WoodlawnWhittierchoice/Whittier/whittierchoice.htm](http://www.poah.org/WoodlawnWhittierchoice/Whittier/whittierchoice.htm)
A New Model of Transformation?
Middle Ground Between Rehabilitation and New Construction
- Family Development with 306 units
- Built in 1939
- Three-story walk-up buildings
- Recent energy upgrades; Antiquated heating system remains

Lenox Street Housing
How can planners and architects transform public housing in a way that is **environmentally responsible**, socially equitable, and sensitive to the existing community and urban fabric?
Four Planning Options
Lenox Housing Transformation Schemes
Retrofit
Existing Housing

20,566 m²
306
0.89

Residential Floor Area
Unit Count
FAR

# Stories
Mid-Rise
New Construction - 2x Existing Unit Count

61,557 m²
612
2.60

Residential Floor Area
Unit Count
FAR

# Stories
Low-Rise
New Construction - Existing Unit Count

30,662 m²
306
1.24

Residential Floor Area
Unit Count
FAR
# Stories
Infill
Existing Housing + New Units

- 35,960 m²
- 520 Unit Count
- 1.41 FAR
- # Stories
Quantitative Analysis - Planning Options
### Floor Area
(residential m², retail m²)

<table>
<thead>
<tr>
<th>Existing</th>
<th>Retrofit</th>
<th>Low-Rise</th>
<th>Mid-Rise</th>
<th>Infill</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>300</td>
<td>300</td>
<td>200</td>
</tr>
</tbody>
</table>

### Households to Remain In-Situ
+ Provision of New Units
(preserved units, new units)

<table>
<thead>
<tr>
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<th>Infill</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>600</td>
<td>600</td>
<td>300</td>
</tr>
</tbody>
</table>

### Life Cycle Energy
(kWh/m²/yr)
(year one, year 50)

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</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>200</td>
<td>35,000</td>
<td>100</td>
</tr>
</tbody>
</table>

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**Metrics**
Evaluating the Planning Schemes
Life Cycle Energy
Operational and Embodied Impacts
**Floor Area**  
(residential m², retail m²)

**Households to Remain In-Situ**  
+ Provision of New Units  
(preserved units, new units)

**Life Cycle Energy**  
(kWh/m²/yr)  
(year one, year 50)

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**Metrics**
Evaluating the Planning Schemes
Retrofit
Lenox Street Housing

601 Shawmut Ave.
Energy Model Calibration (J)
Total Monthly Site Fuel Use - 601 Shawmut Ave.

Calibrate simulated (solid) as close as possible to metered (hollow)

Known Information
- Building Construction + Materials
- Building Dimensions + Apartment Layout
- Metered Gas + Electric Data from BHA

Parameters Considered
- Infiltration Rate: 0.9 ach (leaky building)
- Heating/Cooling Setpoints: 23 / 24 deg C
- Boiler Efficiency: 50%
- Internal Loads + Schedules: varies

Metered Data (J)
- Electricity
- Steam
- Cooling

Energy Simulation (J)
- Electricity
- Steam
- Cooling
Retrofitting Measures

Energy Use Intensity - 601 Shawmut Ave.

- **Base**: Roof Insulation, Infiltration, Wall Insulation, Boiler Efficiency, Glazing, Lighting, PV
- **Measured EUI**: EUI (kWh/m²)
- **Retrofitting Measures**:
  - Roof Insulation
  - Infiltration
  - Wall Insulation
  - Boiler Efficiency
  - Glazing
  - Lighting
  - PV
  - [10cm Polyiso already in place]
  - [Weather-seal around windows and doors]
  - [Add 5cm Spray Foam Insulation]
  - [Upgrade to 90% AFUE]
  - [Thermally improved windows]
  - [Replace fluorescents with LED’s]
  - [Rooftop Photovoltaic Array]
Retrofitting Measures
Energy Use Intensity and Cost - 601 Shawmut Ave.
Wall Section at Existing Masonry Facade

Interior Insulation Retrofit Concept

Additional Recommendations:

• Improved air-tightness means fewer fresh air exchanges; provide additional exhaust (primarily through kitchen fans) to accommodate ventilation.

• Use high-permeability interior finishes wherever possible to prevent condensation.

Source: Recommendation from “Interior Insulation Retrofits of Load-Bearing Masonry Walls in Cold Climates,” Straube et. al., in Building Science Digest v114; http://www.buildingscience.com/
Life Cycle Energy Intensity (kWh/m²)
Existing Conditions vs. Retrofit
Floor Area
(residential m2, retail m2)
(preserved units, new units) (year one, year 50)
(kWh/m2/yr)

Life Cycle Energy
(kWh/m2/yr)
(year one, year 50)

Metrics
Evaluating the Planning Schemes
Life Cycle Energy Intensity (kWh/m²)
Existing Conditions vs. Retrofit
Floor Area
(residential m², retail m²)

Households to Remain In-Situ
+ Provision of New Units
(preserved units, new units)

Life Cycle Energy
(kWh/m²/yr)
(year one, year 50)

Metrics
Evaluating the Planning Schemes
Qualitative Site Strategies - Infill
Reinforce the street edge
Activate sidewalk frontage with “eyes on the street”
Permeate the Superblock
Create + improve pedestrian and vehicular thoroughfares
Create multiple points of entry

Foster a sense of individual ownership of the streetscape
Create new + protected green spaces
Engender a mix of public, semi-public, and private outdoor areas
Introduce new retail spaces
Engender a mix of public, semi-public, and private outdoor areas
Existing
Representative Housing Block
Expand

New annex to bring existing apartments to today’s space recommendations
Floor Plans - Expansion
Weatherize
Create a well insulated envelope for both the existing and new areas
Infill

Reinforce the street edge with new market rate and workforce housing
Floor Plans - Infill

First Floor

Second Floor

New Infill Apartments

0 5 10 m
Individual Housing Layouts
New market-rate and workforce housing
Daylight + Energy Performance Strategies
Effect of Infill on Existing Housing

Daylight + Energy Potential of Infill
Two-Story Infill
Direct Solar Hours Comparison

Winter (Dec. 21st)  Summer (June 21st)

Direct Solar Hours Comparison

0h  6h+

Two-Story Infill
Direct Solar Hours Comparison
Winter (Dec. 21st)  Summer (June 21st)
Direct Solar Hours Comparison

Three-Story Infill
Direct Solar Hours Comparison
Winter (Dec. 21st)  
Summer (June 21st)

Direct Solar Hours Comparison

Four-Story Infill
Direct Solar Hours Comparison
Existing

New annex to make the existing apartments larger

Create a well insulated envelope in both the existing and new areas.

Infill with new townhouses

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**EUI**

93.5 kWh/m²

**Monthly Energy Use Intensity breakdown**

(heating, cooling, lighting, equipment)

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**Average cDA**

0.43

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**Window-to-Wall Ratio** 20%

Energy and Daylight Analysis

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Percentage of floor area that exceeds 300 lux for at least 50% of occupied time
Existing
New annex to make the existing apartments larger
Create a well insulated envelope in both the existing and new areas.

Energy and Daylight Analysis

Window-to-Wall Ratio 30%

Percentage of floor area that exceeds 300 lux for at least 50% of occupied time
Existing annex to make the existing apartments larger

Create a well insulated envelope in both the existing and new areas.

Infill with new townhouses.

**EUI**

103.3 kWh/m²

**Window-to-Wall Ratio** 40%

**Energy and Daylight Analysis**

- Percentage of floor area that exceeds 300 lux for at least 50% of occupied time

**Average cDA**

0.64

**Monthly Energy Use Intensity breakdown**

(heating, cooling, lighting, equipment)
Urban + Architectural Character
Relating Performance, Design, and Existing Neighborhood Fabric
New + Existing
View across Lenox Street
Retrofitting
Consider the feasibility of adapting existing assets to today’s performance and space standards. Measures could include:

Adding insulation to roof and, where applicable, walls. Seal all wall openings such as doors and windows to prevent infiltration losses.

Where feasible, upgrading the conditioning systems such as increasing the thermal efficiency of boilers can greatly reduce energy consumption and cost.

Reduction to lighting energy through LED’s, while not making a huge change to EUI, can represent a considerable cost savings.

Similarly, implementing solar PV on the rooftops can further reduce electrical costs.

Daylight
In order to provide equitable daylight for existing and new construction, the height, depth, and orientation of new structures should be studied, as well as the effects of overshadowing.

Window-to-Wall Ratio
The bigger the opening, the more daylight enters the space, but the more losses through the envelope will occur. An optimal balance of window size, daylight, and energy consumption should be carefully considered.

Recommendations
Neighborhood Guidelines for Infill Planning
Walkability of Lower Roxbury
Present and future
Lower Roxbury Revitalization Area
Destinations within Lower Roxbury only
Walkability metric

Walk Score (2011)

Shortest-path routing

Distance-based scoring

Score aggregation within amenity types

Score aggregation across amenity types

Source: Walk Score, Walk Score, 2011
Walkability metric

Walk Score (2011)

- Distance-based scoring
- Score aggregation within amenity types
- Score aggregation across amenity types

Our metric

Source: Walk Score, Walk Score, 2011
Metric demonstration: grocery stores
Grocery store access - existing
Grocery store access - under construction
Metric exploration: restaurants
(and other restaurant-like destinations)
Current restaurant availability
Destinations within Lower Roxbury only
Current restaurant availability
Trips out of Lower Roxbury allowed
New restaurants
Investigation Method

Comparison of different artificial amenity arrangements

Amenity concentration changes, but total number of amenities remains constant
New restaurants - condensed placement
At currently-under-construction redevelopment sites
New restaurants - distributed placement
Along nearby plausible future commercial corridors
In order for residents of new market-rate housing in northern Lower Roxbury to take full advantage of assets within the neighborhood, new commercial destinations should be developed and existing amenities strengthened.

Lower Roxbury is small enough that one or two centrally-located commercial cores make walking trips convenient for most of the neighborhood. However, simply building up these cores will not help homes along the perimeter, which will need their own services if they are to be as convenient as central areas.

Bunched-up commercial development and spread-out commercial corridors yield approximately equal trip length scores for surrounding residences (although corridors can have other, beneficial effects, such as improved safety).

Above all, neighborhood walkability is a complex product of multiple factors. Many types and instances of amenities are required for a truly walkable area, and a single dangerous park, street with no sidewalk, or unlit parking lot can change the entire local walking landscape. A community’s involvement in planning its own development is crucial.
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Infill Housing
Recommendations for Environmental Performance

Walkability
Recommendations for Neighborhood Amenities

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