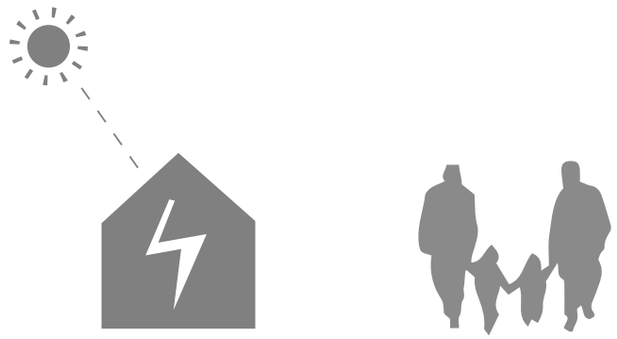
Revitalizing Lower Roxbury

Housing and Neighborhood Walkability Study



Maxime Cunin | Jeff Geisinger | Cody Rose

4.433 Modeling Urban Energy Flows - Final Presentation | May 8, 2014

TACC Opportunity Sites

Lower Roxbury
Revitalization Area

Rethinking Sustainable Public 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**?

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

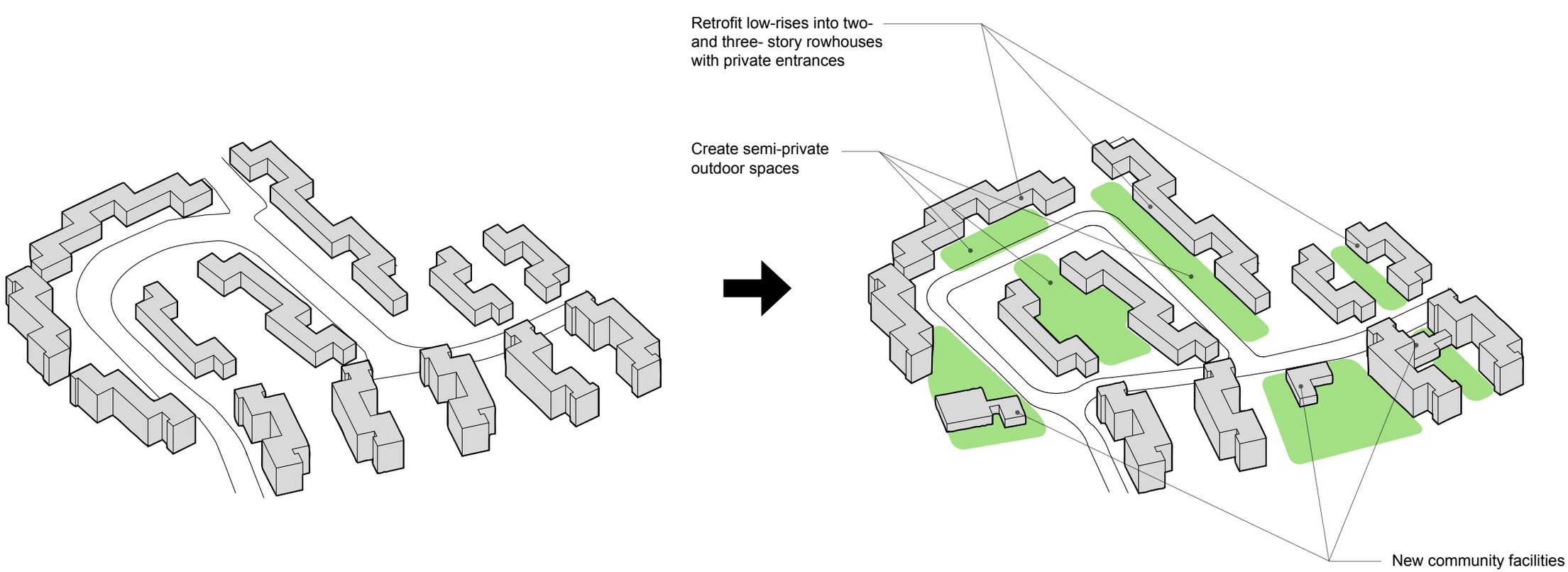
Source: http://www.nhlp.org/ http://www.bostonhousing.org/

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

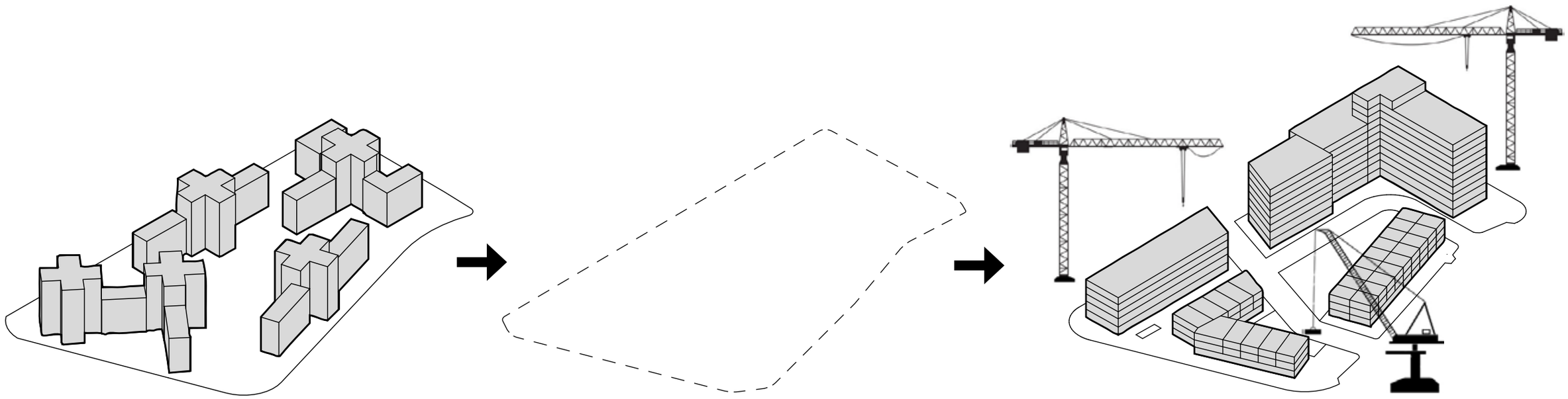


1980’s: Rehabilitating and Reclaiming

Example: Commonwealth Redevelopment

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

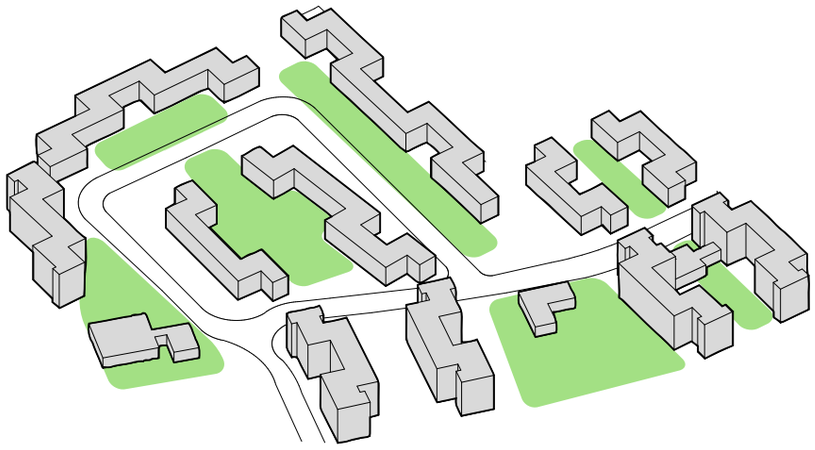


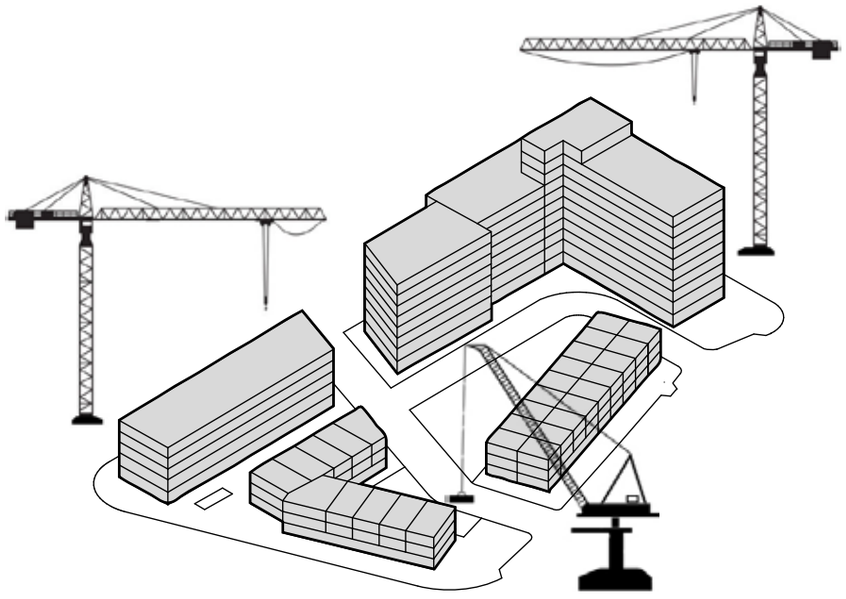
1990’s, 2000’s, Today: Clearing and Redeveloping

Example: Whittier Street Apartments

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 alloted 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 (image)*

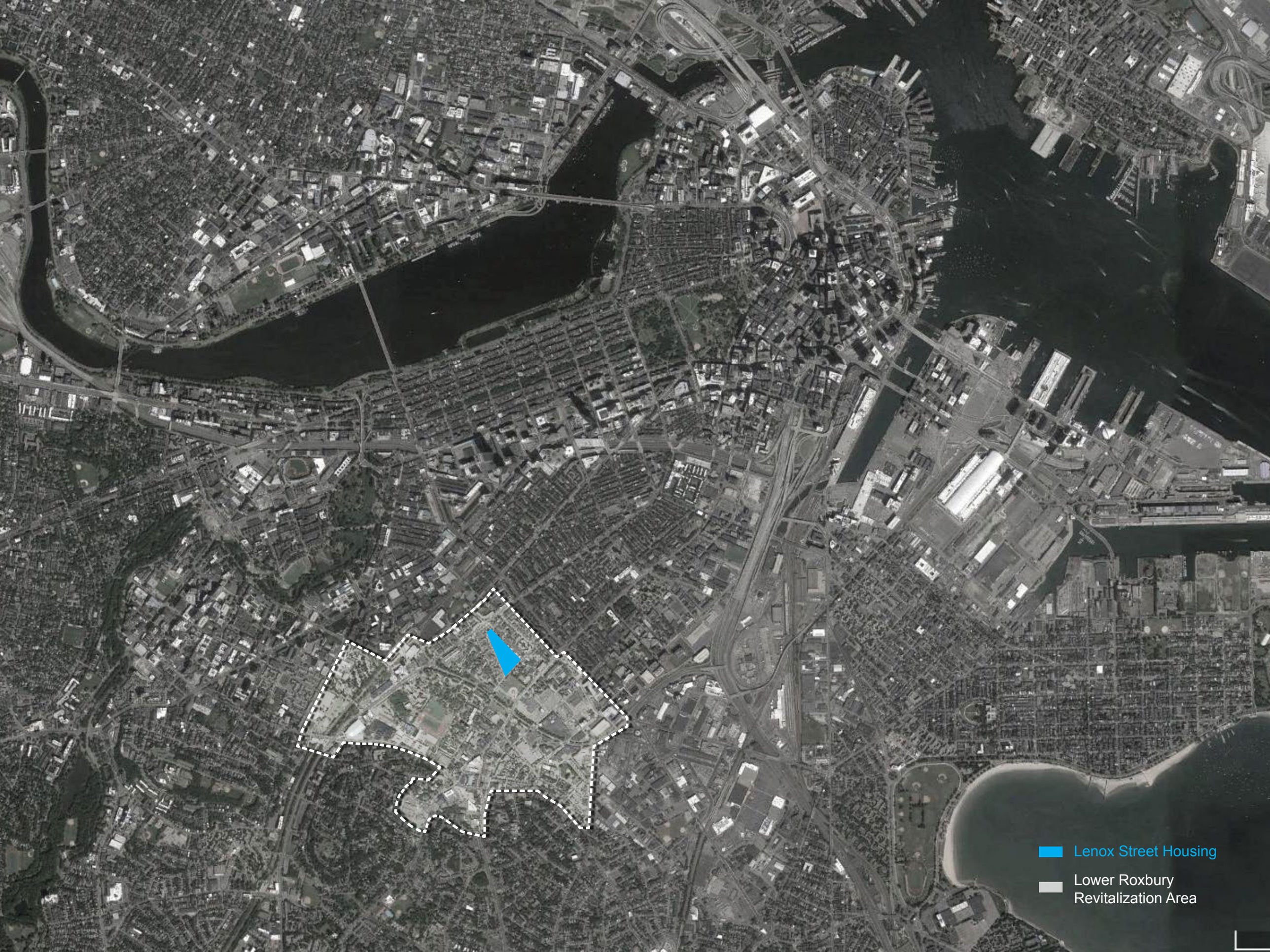




A New Model of Transformation?

Middle Ground Between Rehabilitation and New Construction

Lenox Street Housing


Lenox Street Housing
Lower Roxbury
Revitalization Area

Lenox Street Housing

- Family Development with 306 units
- Built in 1939
- Three-story walk-up buildings
- Recent energy upgrades; Antiquated heating system remains


N

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**?

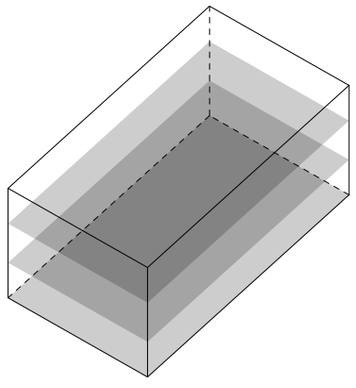
Qualifiable Factors

Residents' Control of Public Spaces

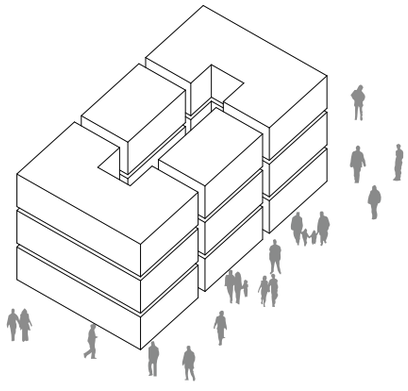
Relationship to Neighboring Urban Fabric

Aesthetics and Durability

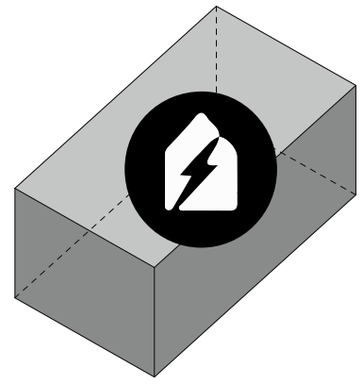
Quantifiable Factors



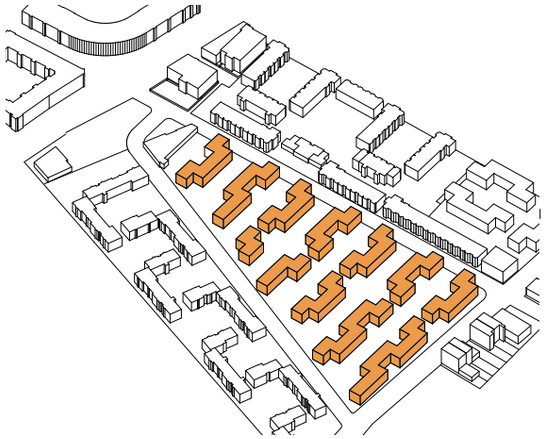
Floor Area



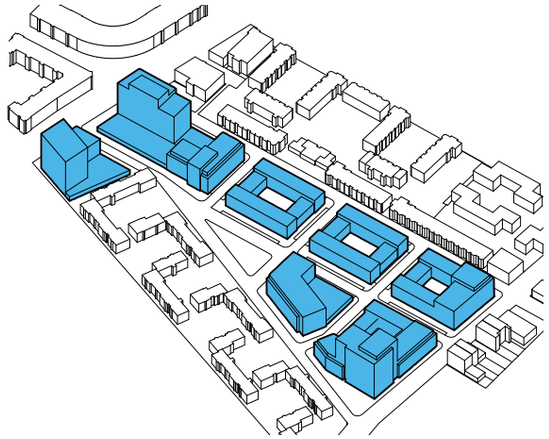
Households To Remain + Provision of New Units



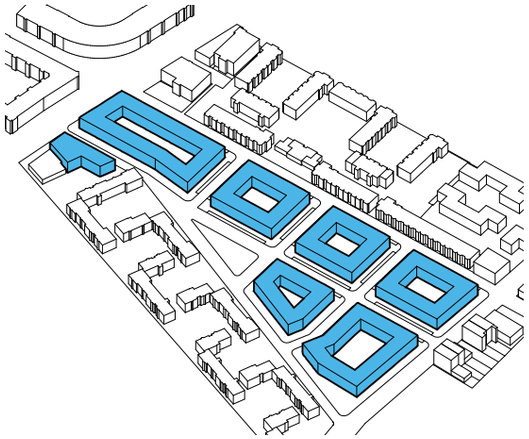
Life Cycle Energy



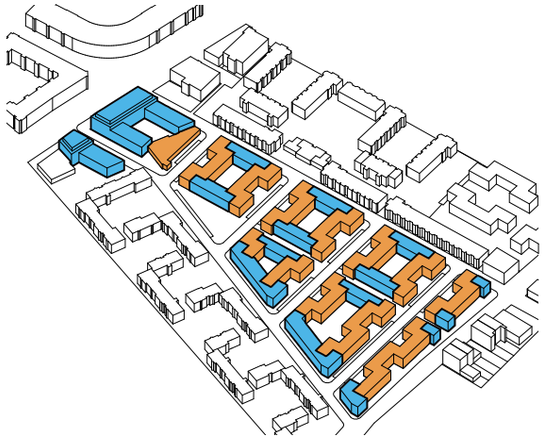
Retrofit



Mid-Rise



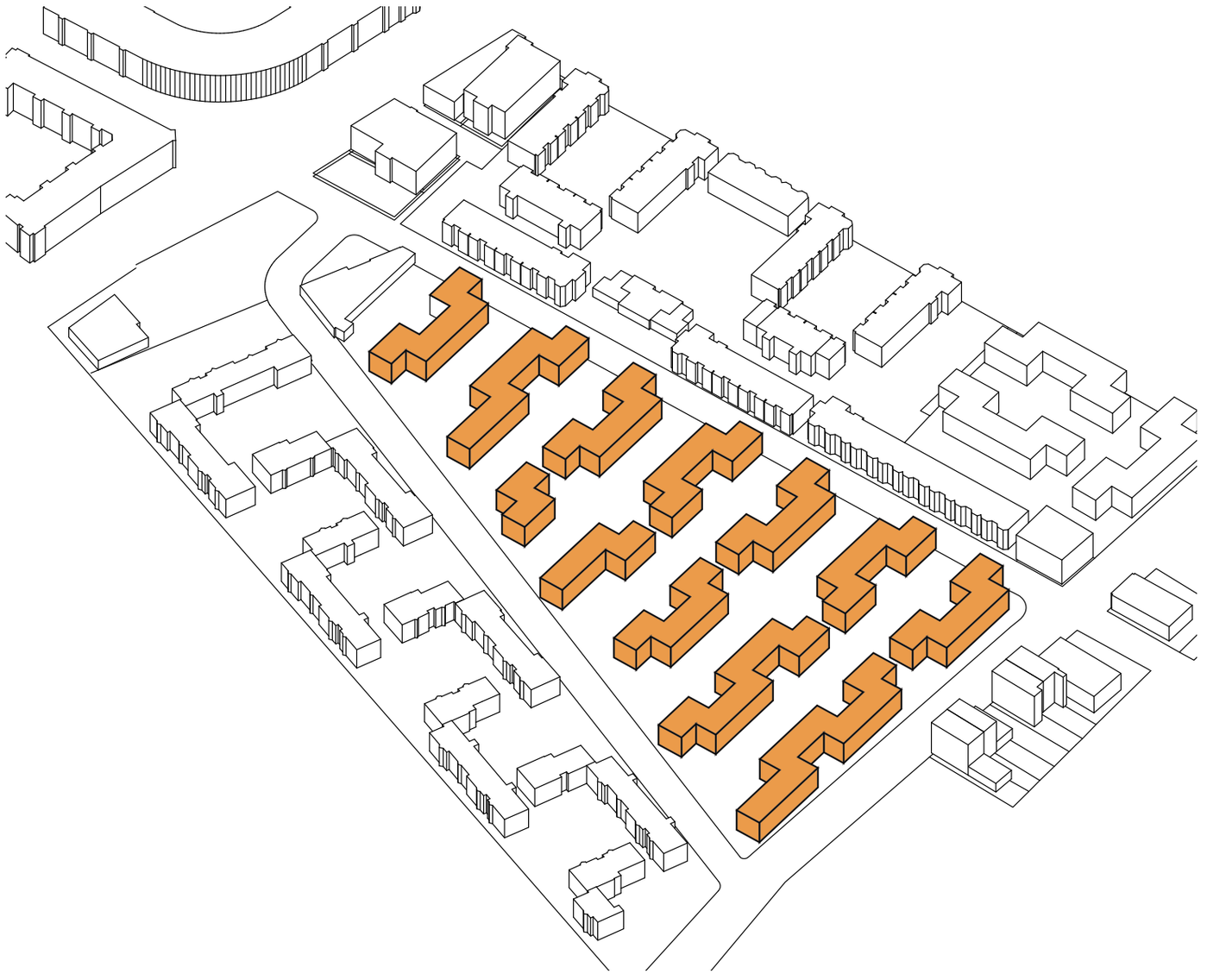
Low-Rise



Urban Infill

Four Planning Options

Lenox Housing Transformation Schemes

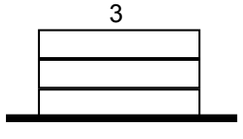


Retrofit
Existing Housing

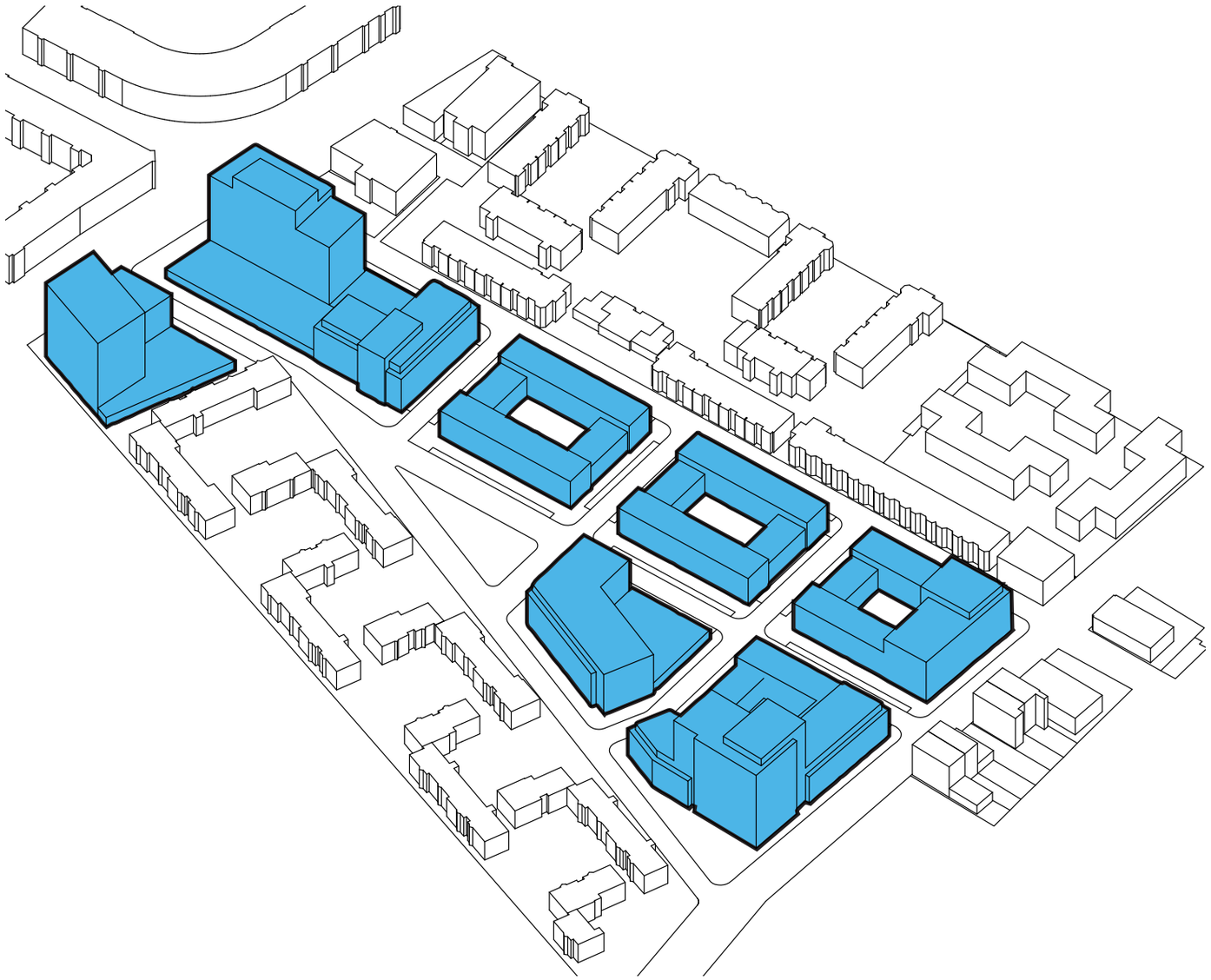
20,566 m2
Residential Floor Area

306
Unit Count

0.89
FAR



Stories



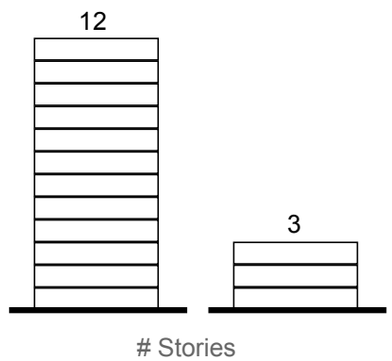
Mid-Rise

New Construction - 2x Existing Unit Count

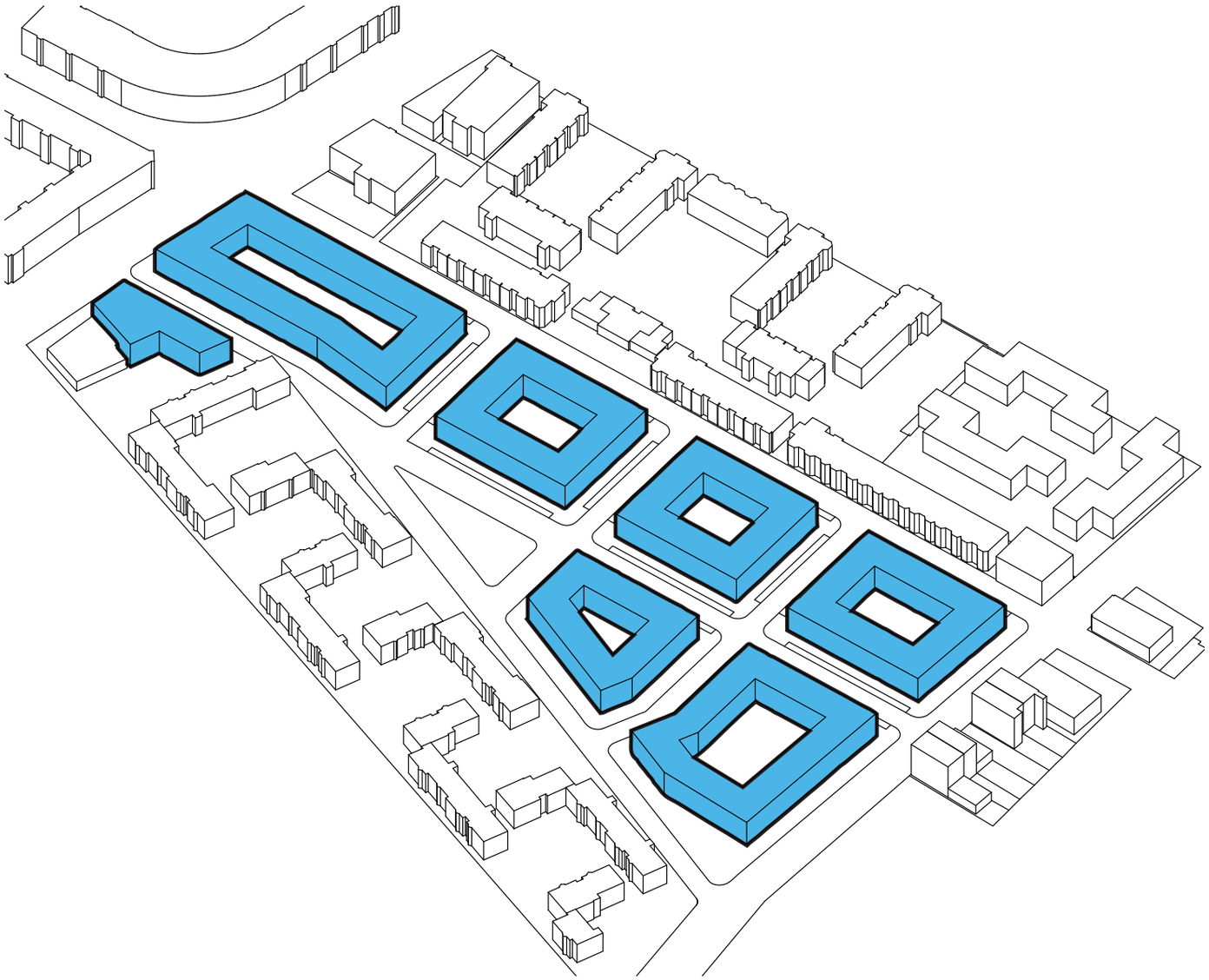
61,557 m2
Residential Floor Area

612
Unit Count

2.60
FAR



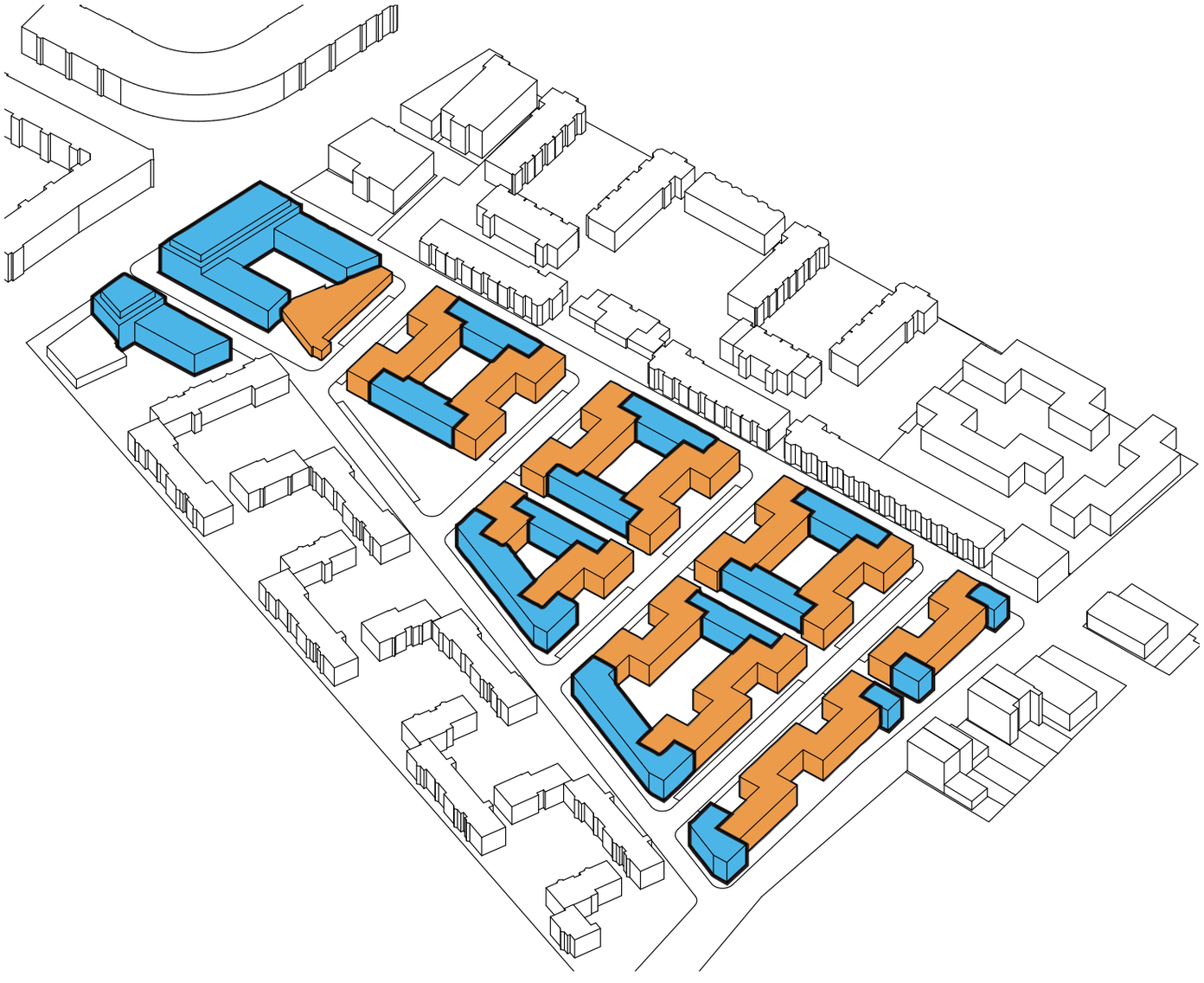
Stories



Low-Rise

New Construction - Existing Unit Count

30,662 m2	306	1.24	3
Residential Floor Area	Unit Count	FAR	# Stories



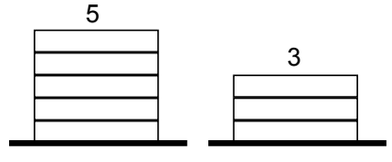
Infill

Existing Housing + New Units

35,960 m2
Residential Floor Area

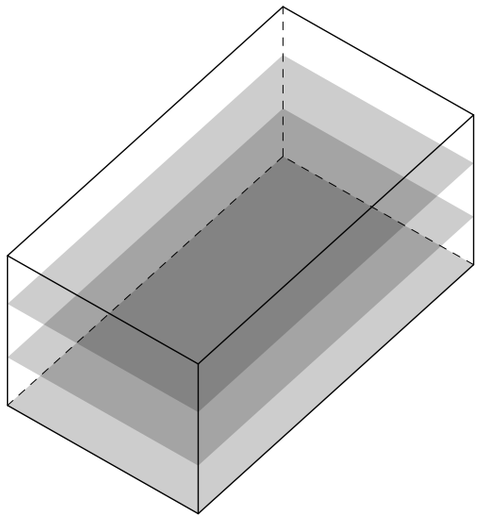
520
Unit Count

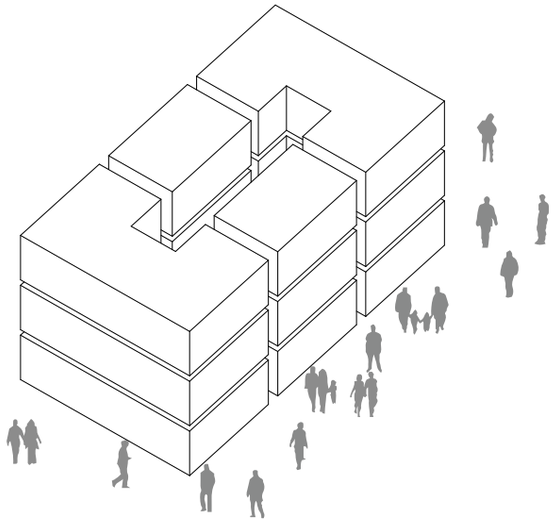
1.41
FAR

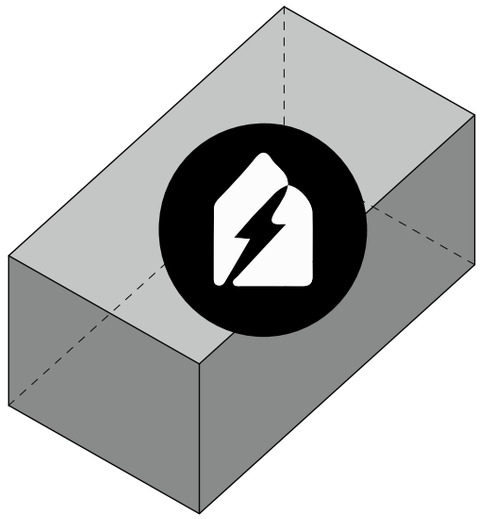


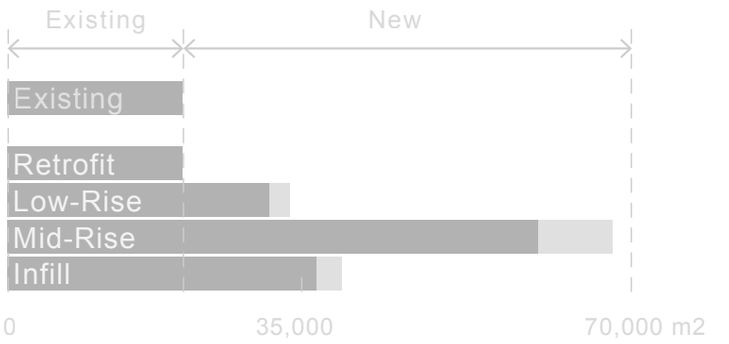
Stories

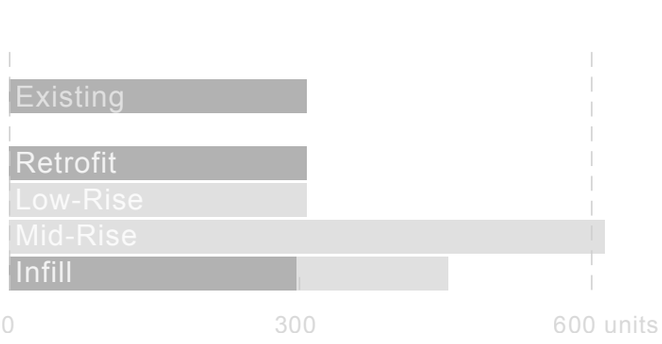
Quantitative Analysis - Planning Options

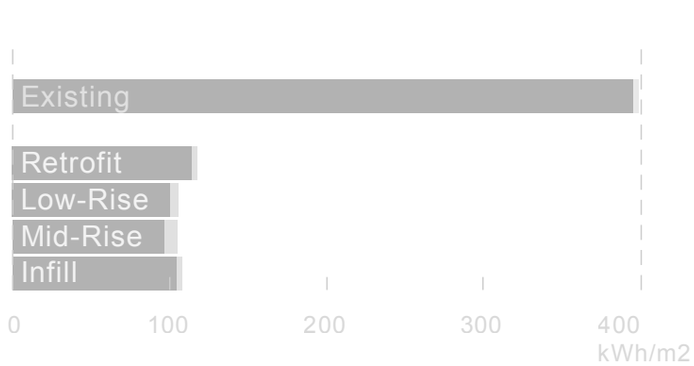










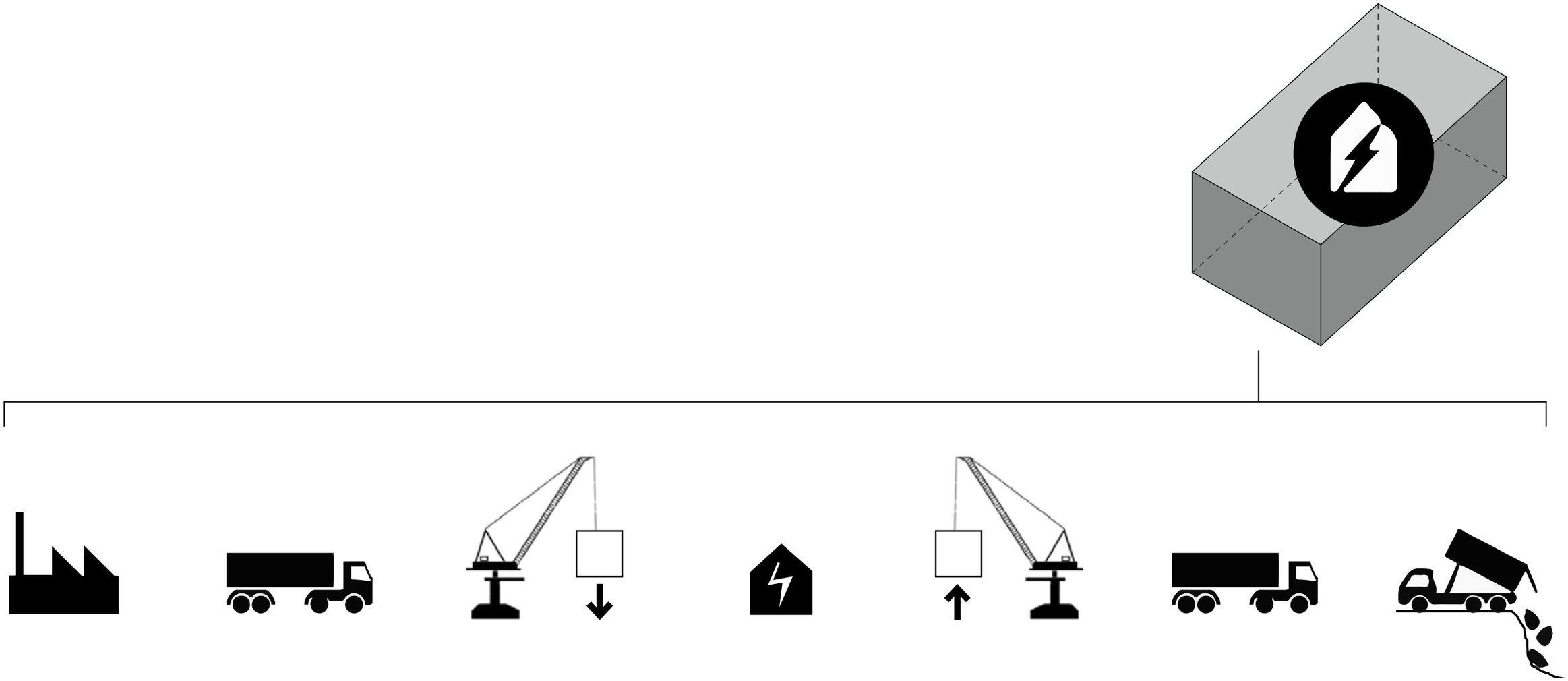


Floor Area
(residential m2, retail m2)

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

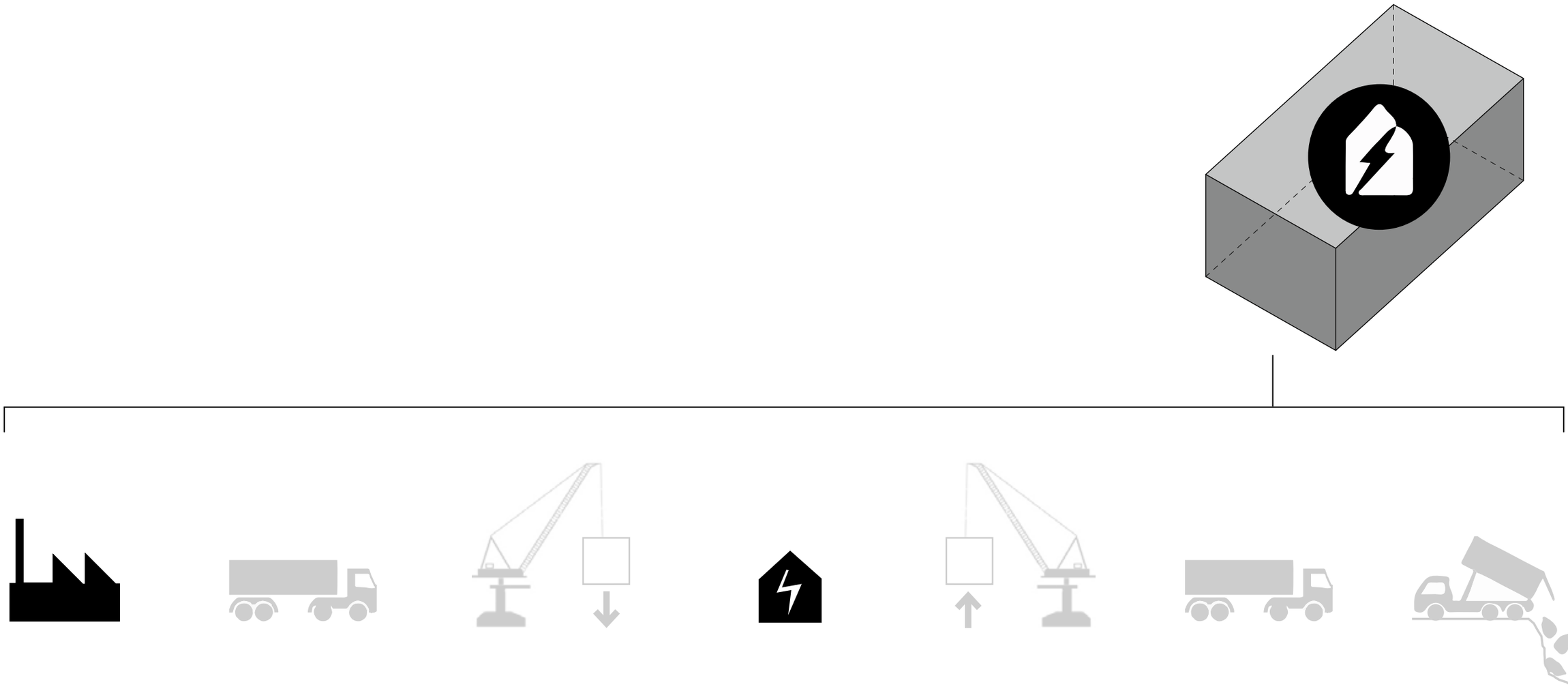
Life Cycle Energy
(kWh/m2/yr)
(year one, year 50)

Metrics
Evaluating the Planning Schemes



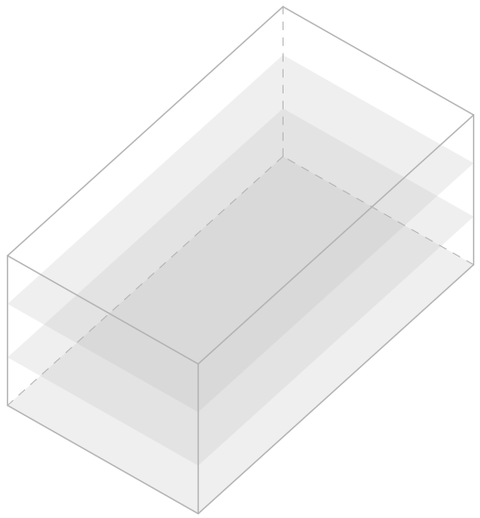
Life Cycle Energy

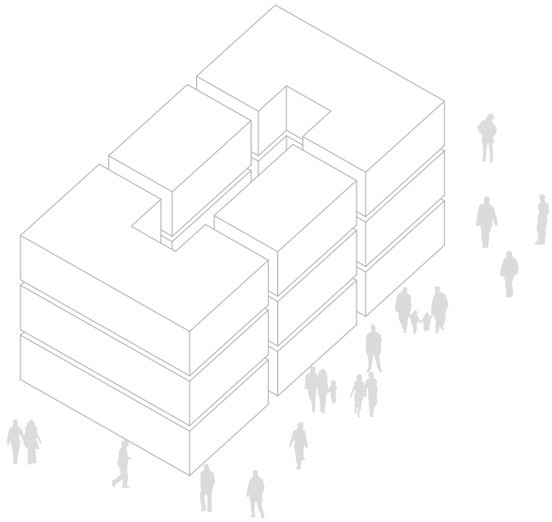
Operational and Embodied Impacts

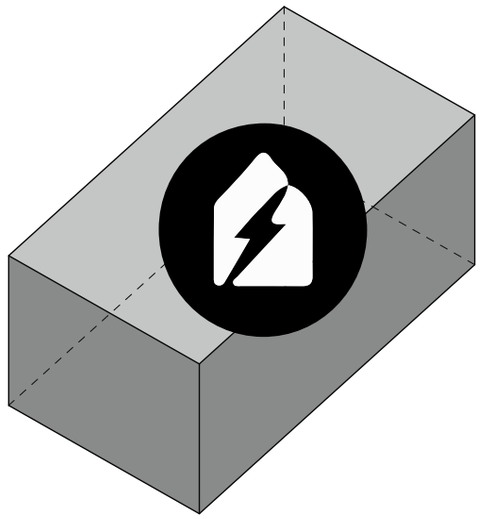


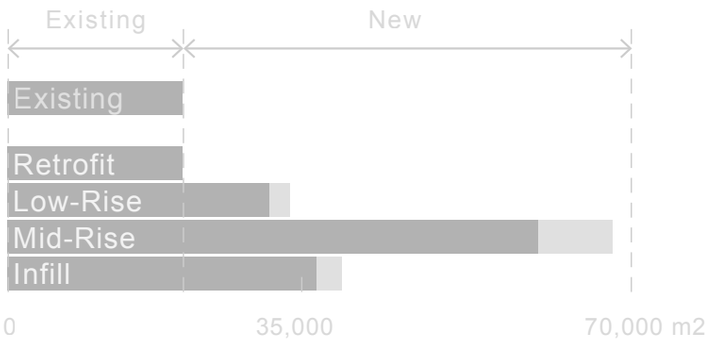
Life Cycle Energy

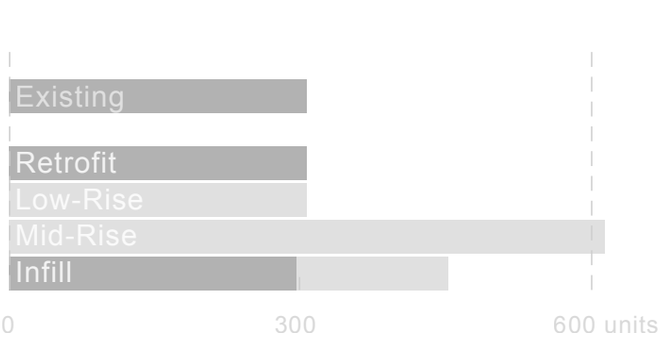
Operational and Embodied Impacts

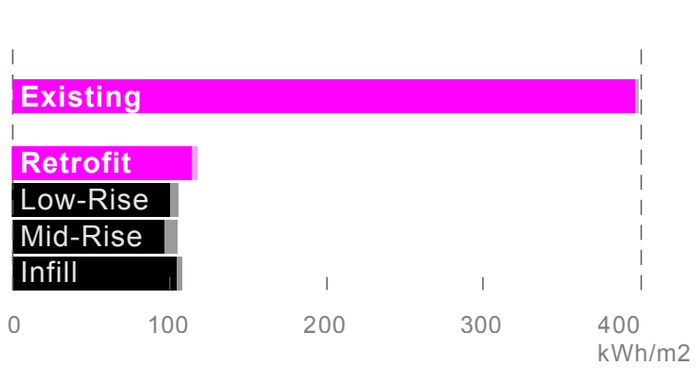










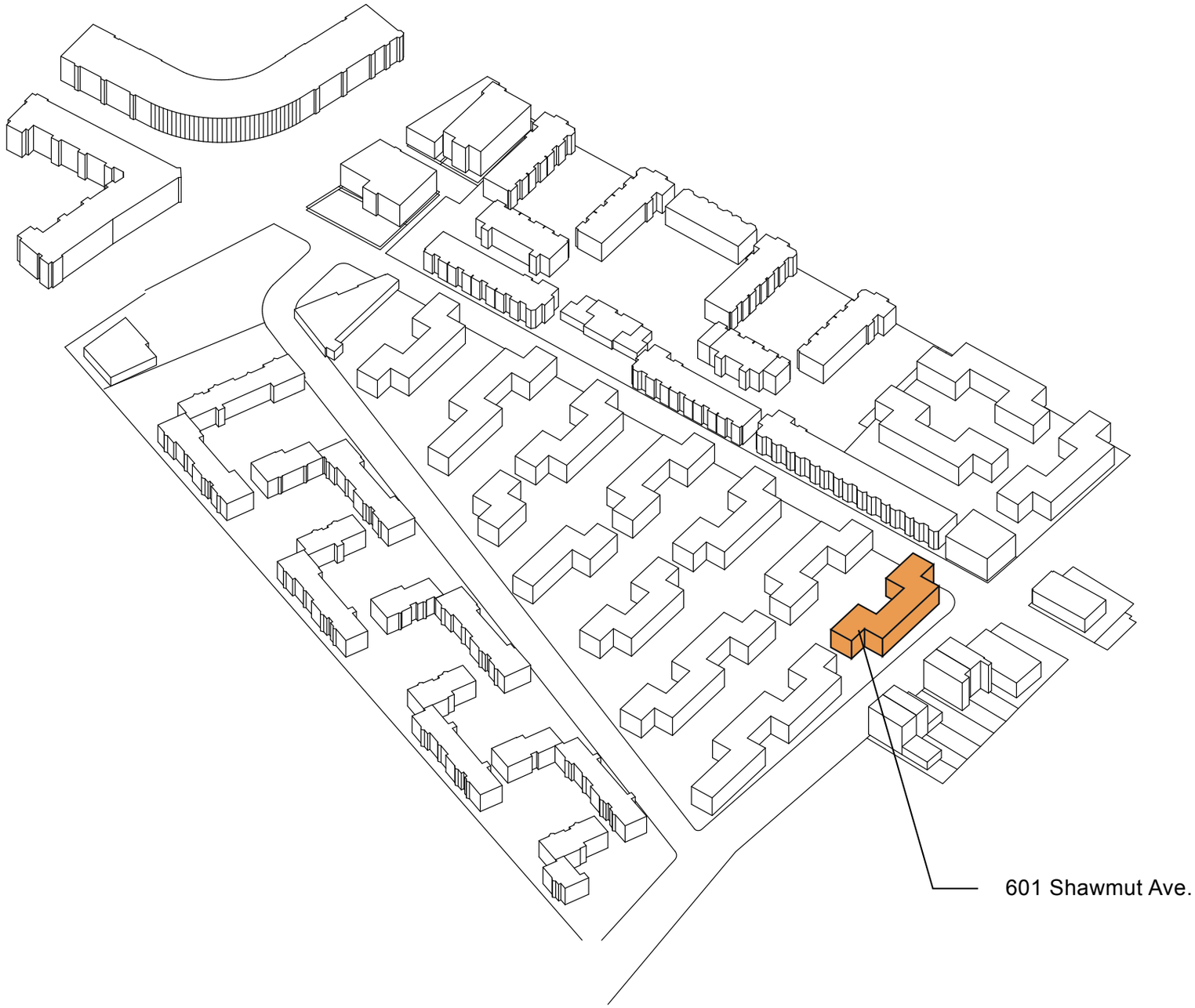


Floor Area
(residential m2, retail m2)

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

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

Metrics
Evaluating the Planning Schemes

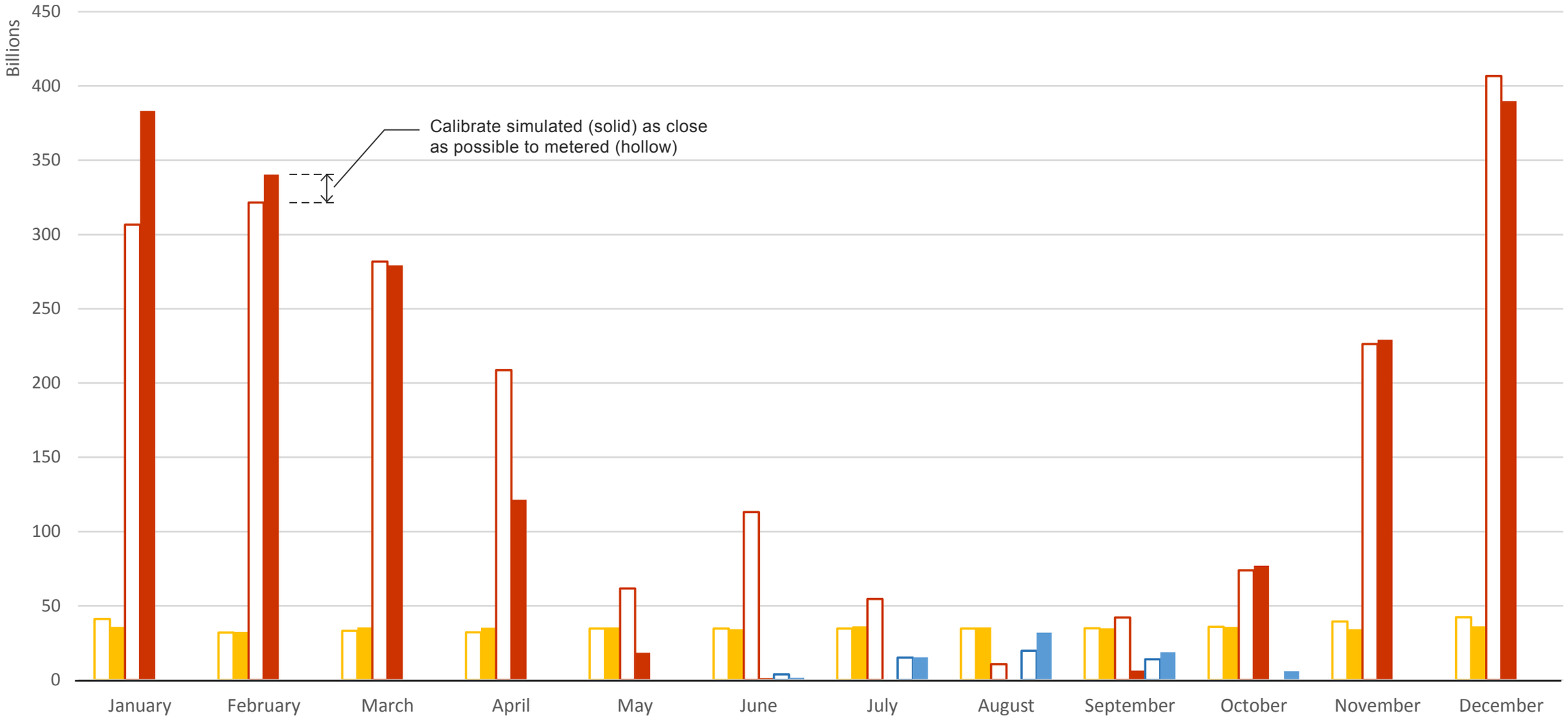


Retrofit

Lenox Street Housing

Energy Model Calibration (J)

Total Monthly Site Fuel Use - 601 Shawmut Ave.



Known Information

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

Parameters Considered

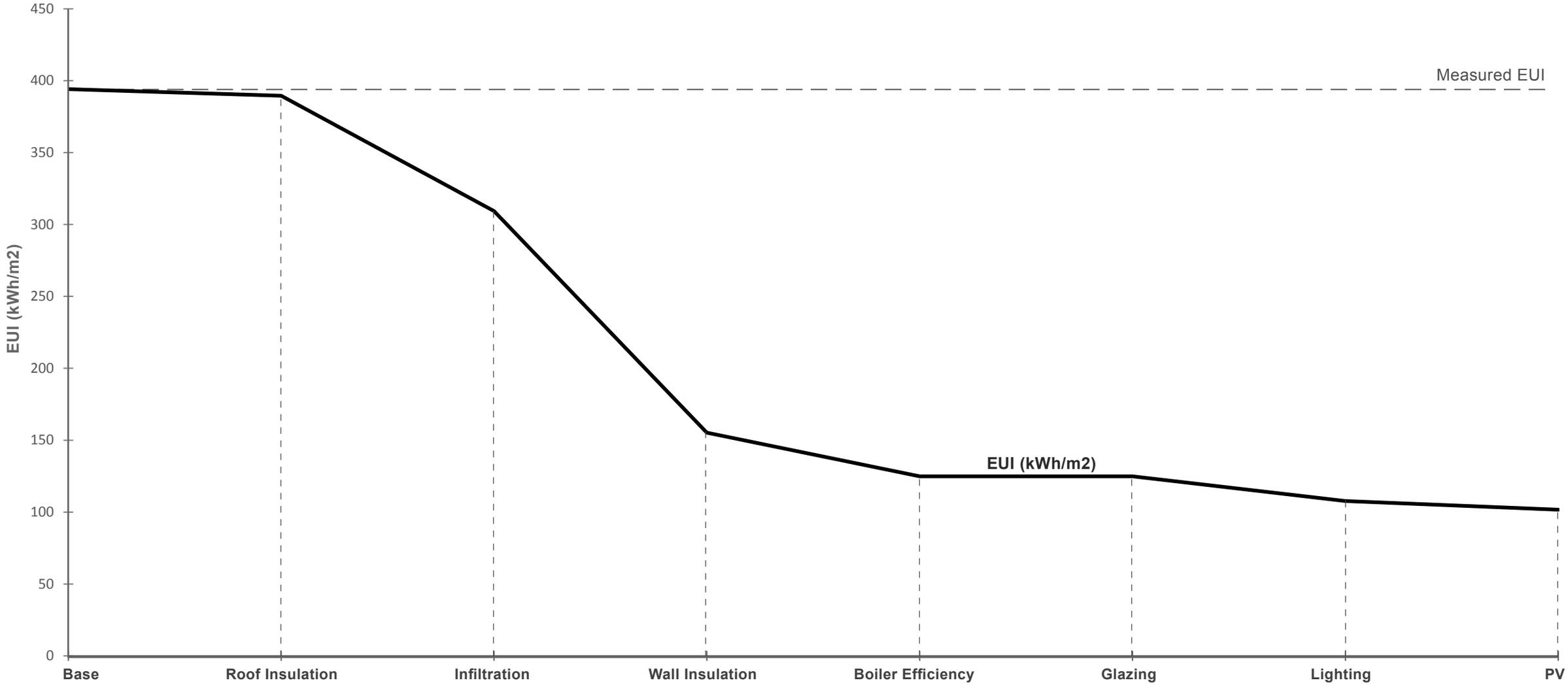
- 0.9 ach (leaky building) — Infiltration Rate
- 23 / 24 deg C — Heating/Cooling Setpoints
- 50% — Boiler Efficiency
- varies — Internal Loads + Schedules

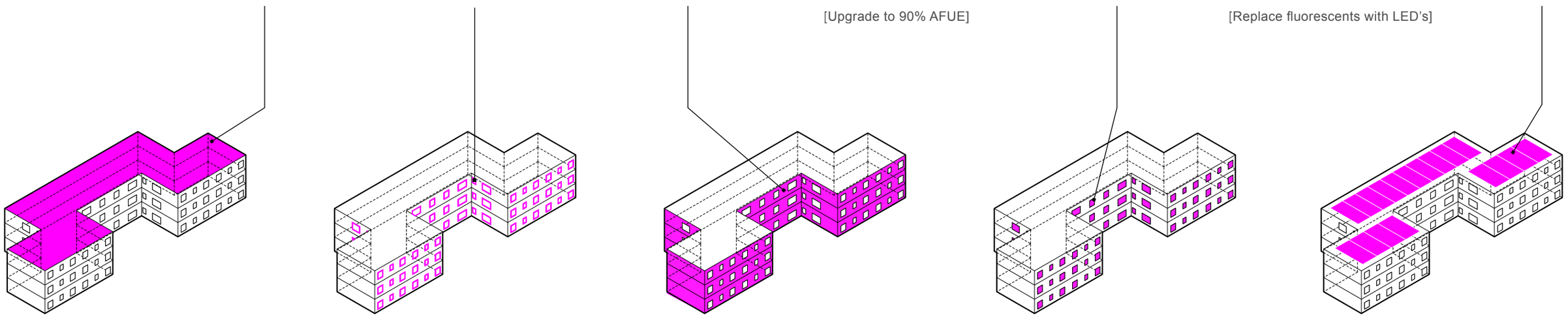
Metered Data (J)

- Electricity
- Steam
- Cooling

Energy Simulation (J)

- Electricity
- Steam
- Cooling





[10cm Polyiso already in place]

[Weather-seal around windows and doors]

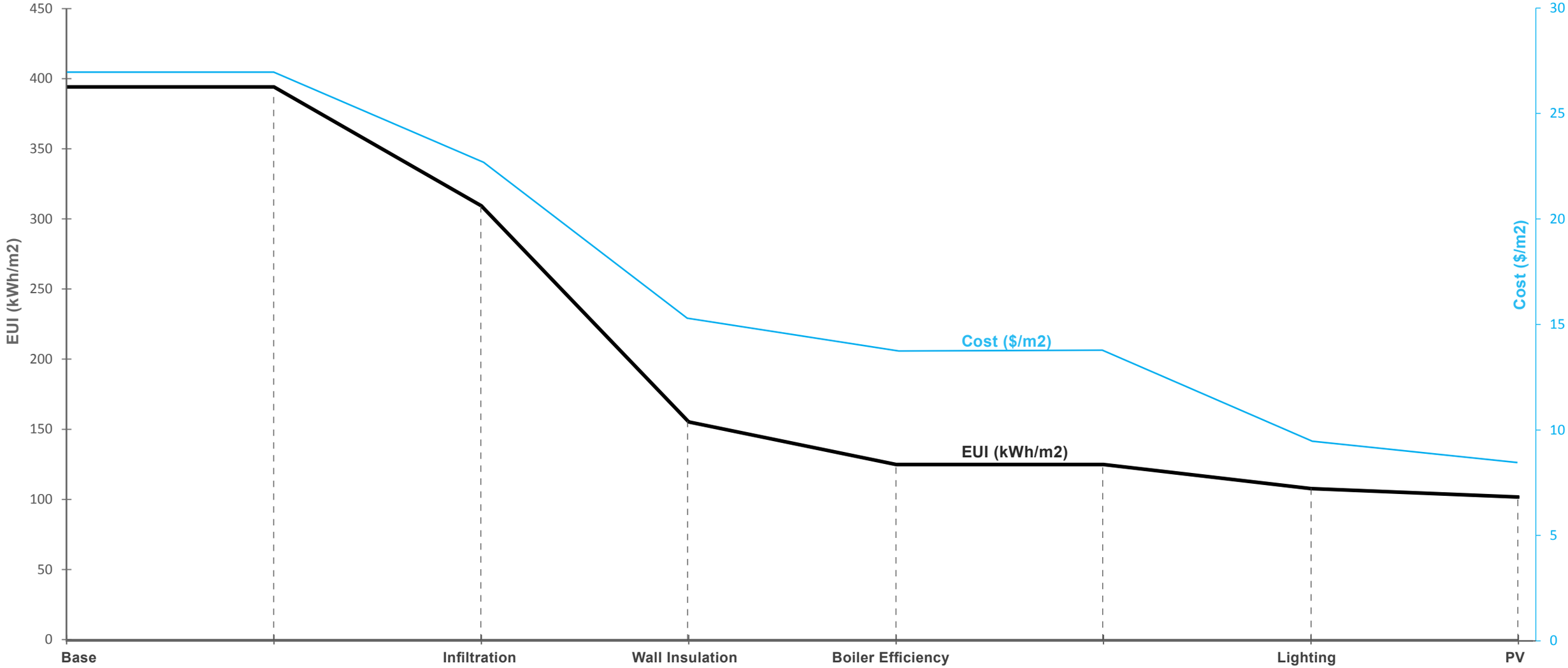
[Add 5cm Spray Foam Insulation]

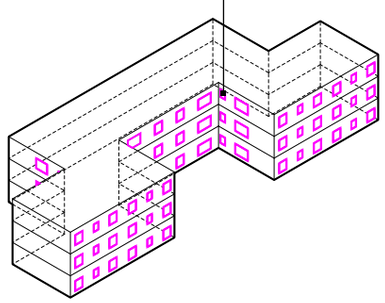
[Thermally improved windows]

[Rooftop Photovoltaic Array]

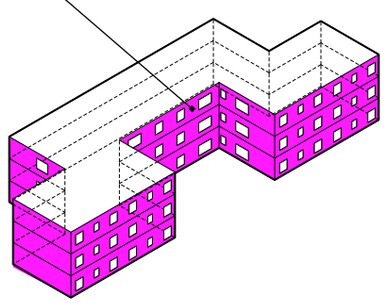
Retrofitting Measures

Energy Use Intensity - 601 Shawmut Ave.

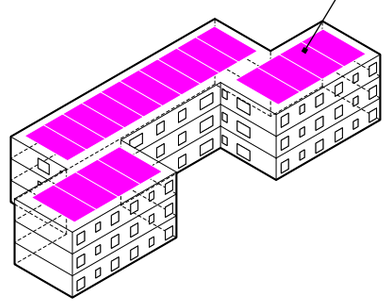




[Weather-seal around windows and doors]



[Add 5cm Spray Foam Insulation]



[Rooftop Photovoltaic Array]

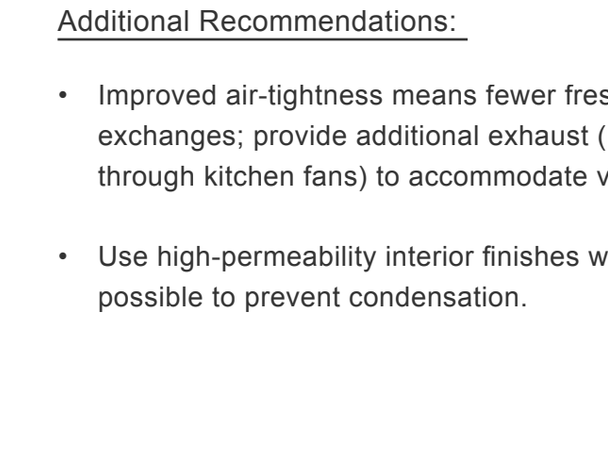
Retrofitting Measures

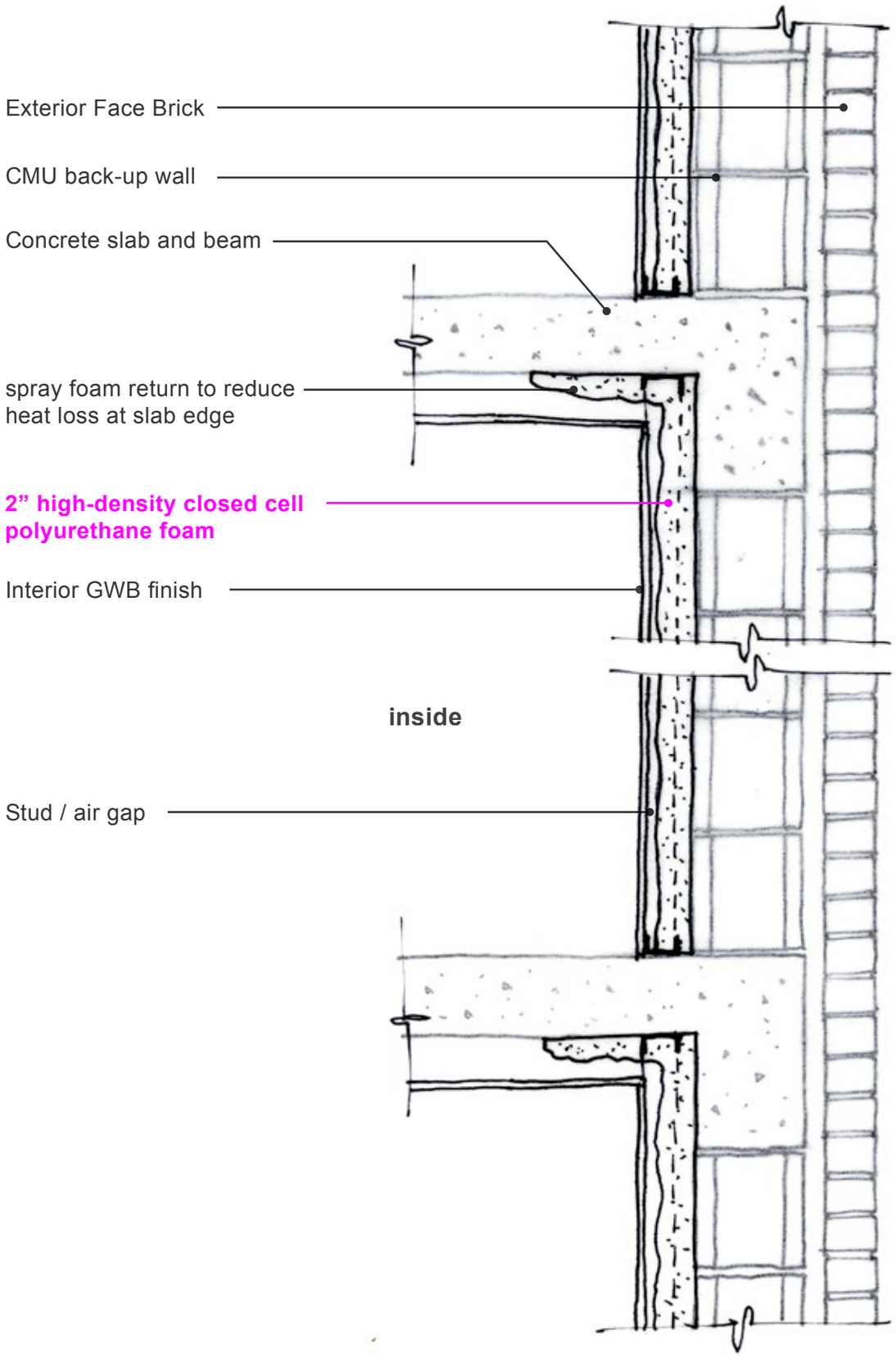
Energy Use Intensity and Cost - 601 Shawmut Ave.

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.

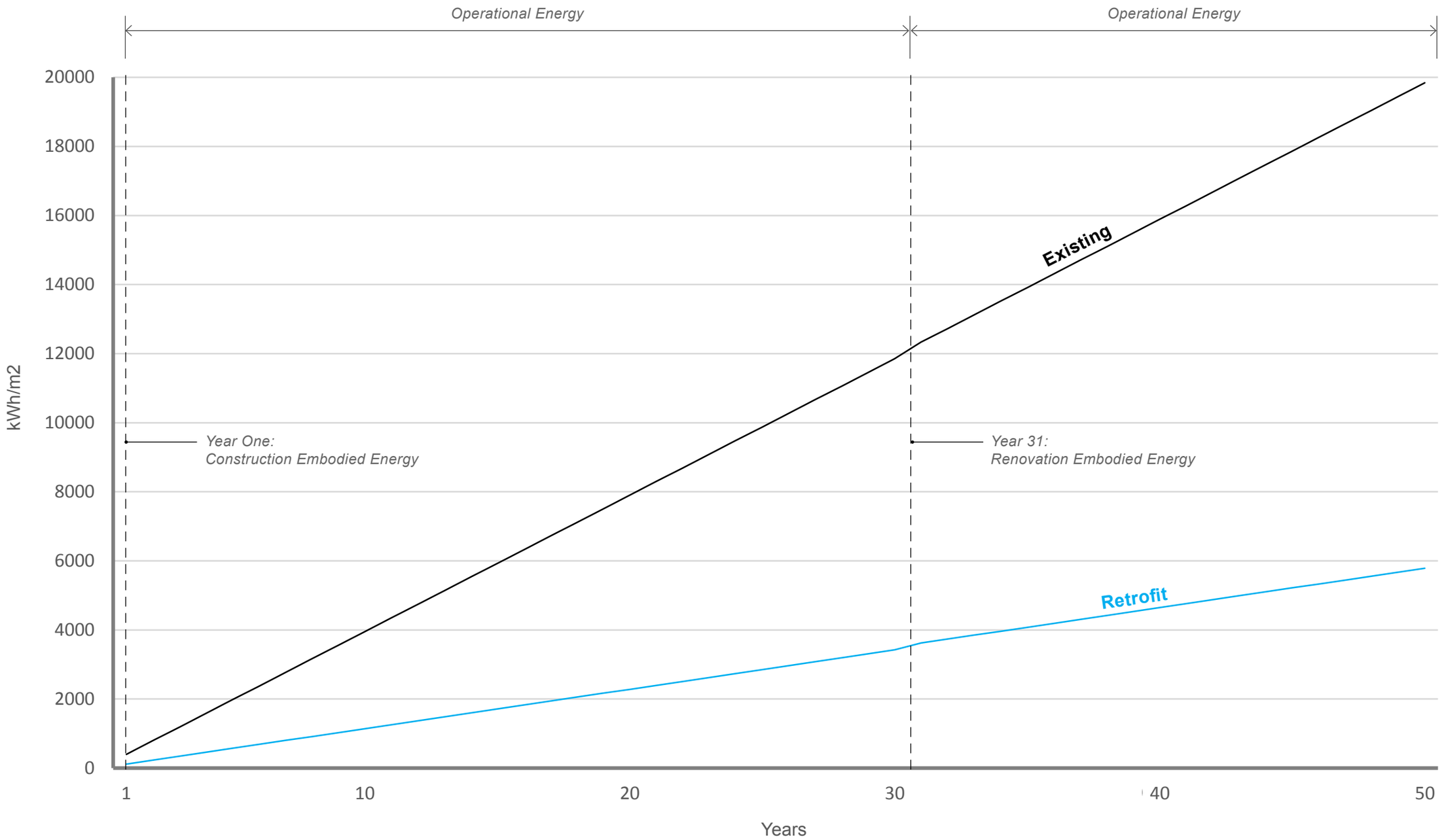




Wall Section at Existing Masonry Facade

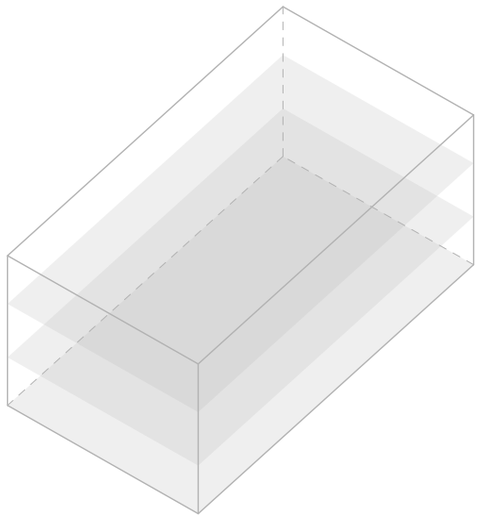
Interior Insulation Retrofit Concept

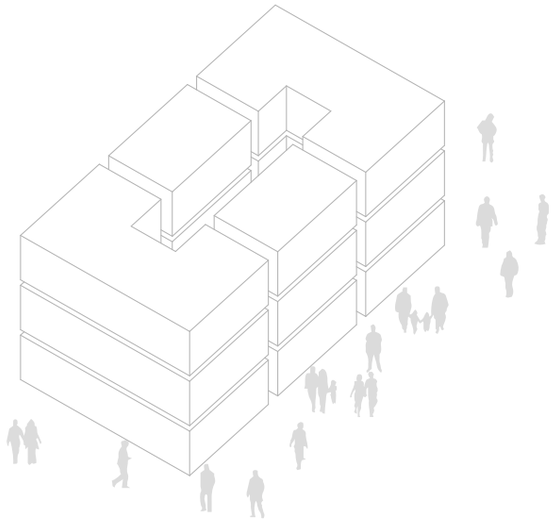
Source: Recommendation from “Interior Insulation Retrofits of Load-Bearing Masonry Walls in Cold Climates,” Straube et. al., in *Building Science Digest* v114; http://www.buildingscience.com/

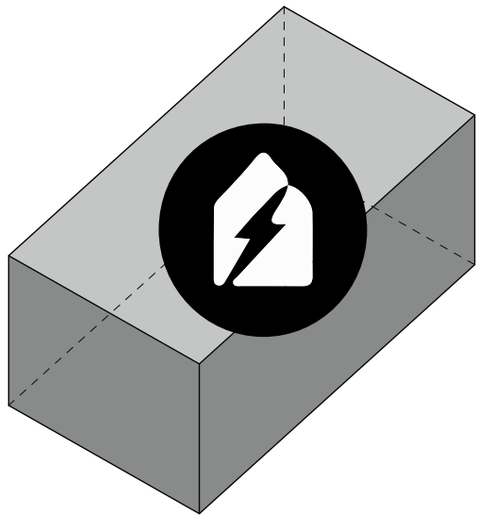


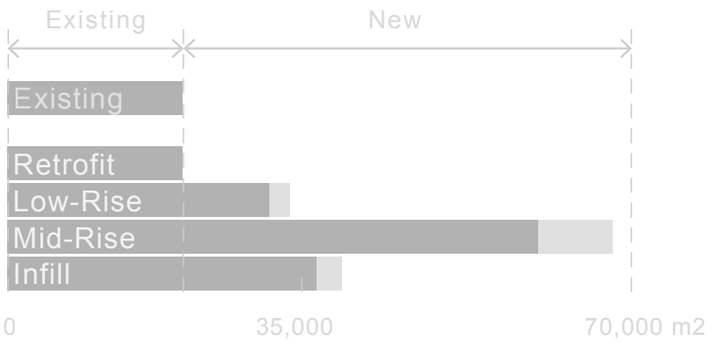
Life Cycle Energy Intensity (kWh/m2)

Existing Conditions vs. Retrofit



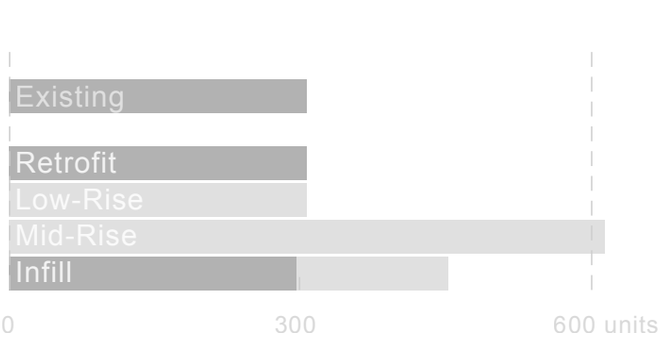






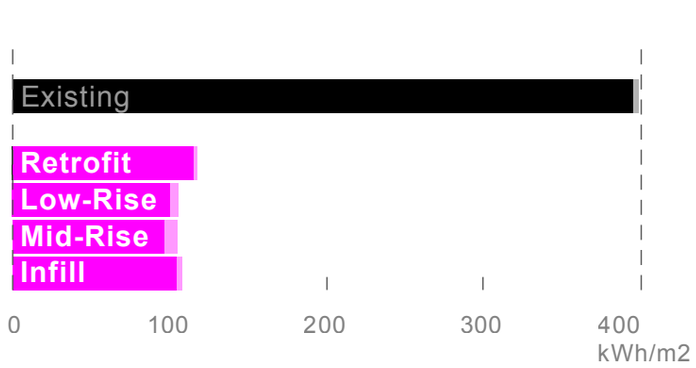
Floor Area

(residential m2, retail m2)



Households to Remain In-Situ
+ Provision of New Units

(preserved units, new units)



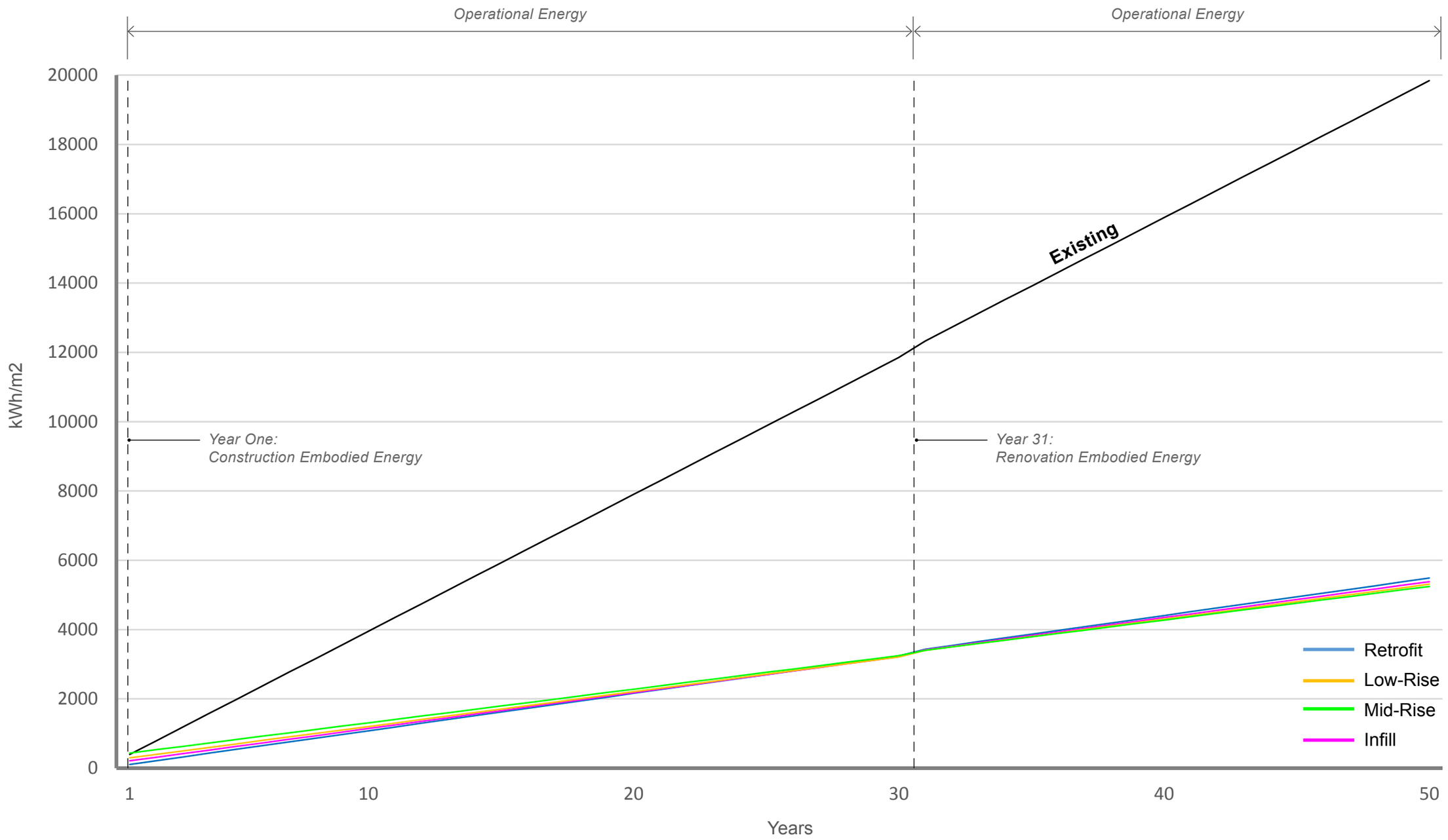
Life Cycle Energy

(kWh/m2/yr)

(year one, year 50)

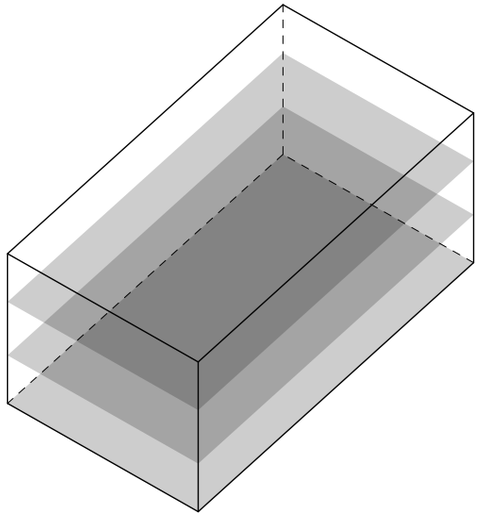
Metrics

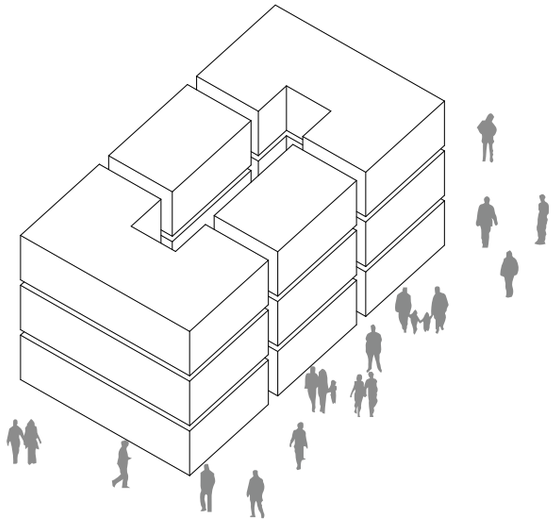
Evaluating the Planning Schemes

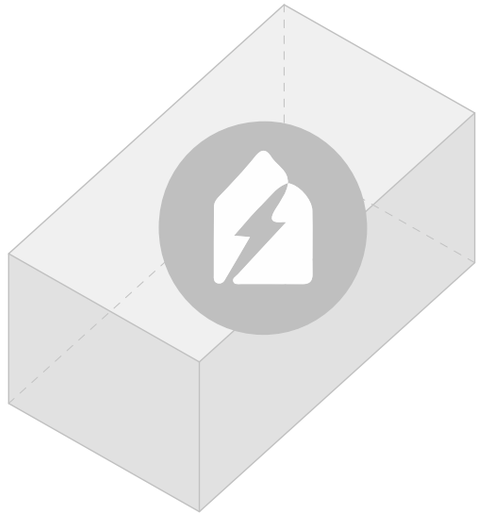


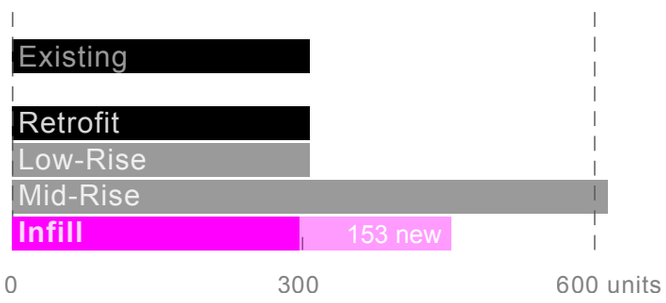
Life Cycle Energy Intensity (kWh/m2)

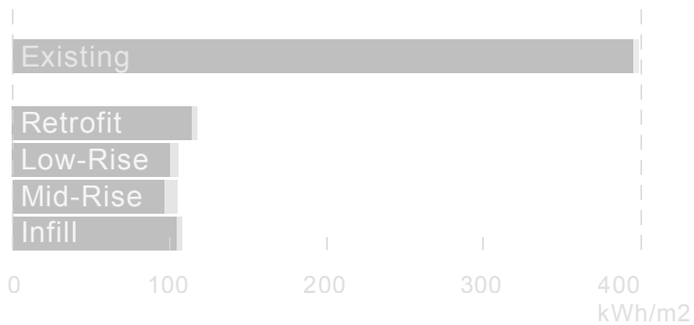
Existing Conditions vs. Retrofit









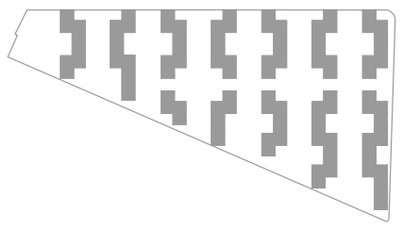


Floor Area
(residential m2, retail m2)

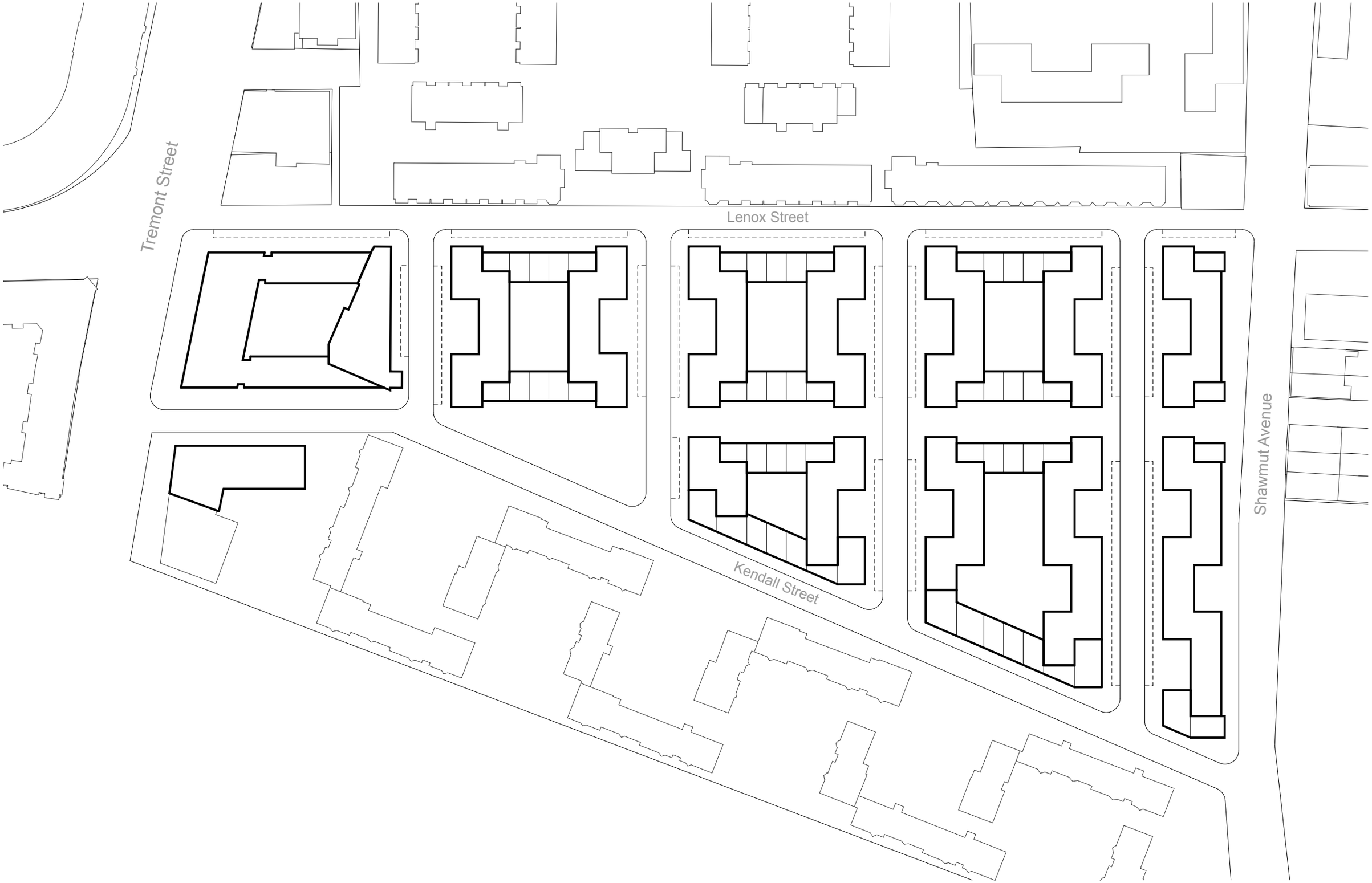
Households to Remain In-Situ + Provision of New Units
(preserved units, new units)

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

Metrics
Evaluating the Planning Schemes



Qualitative Site Strategies - Infill

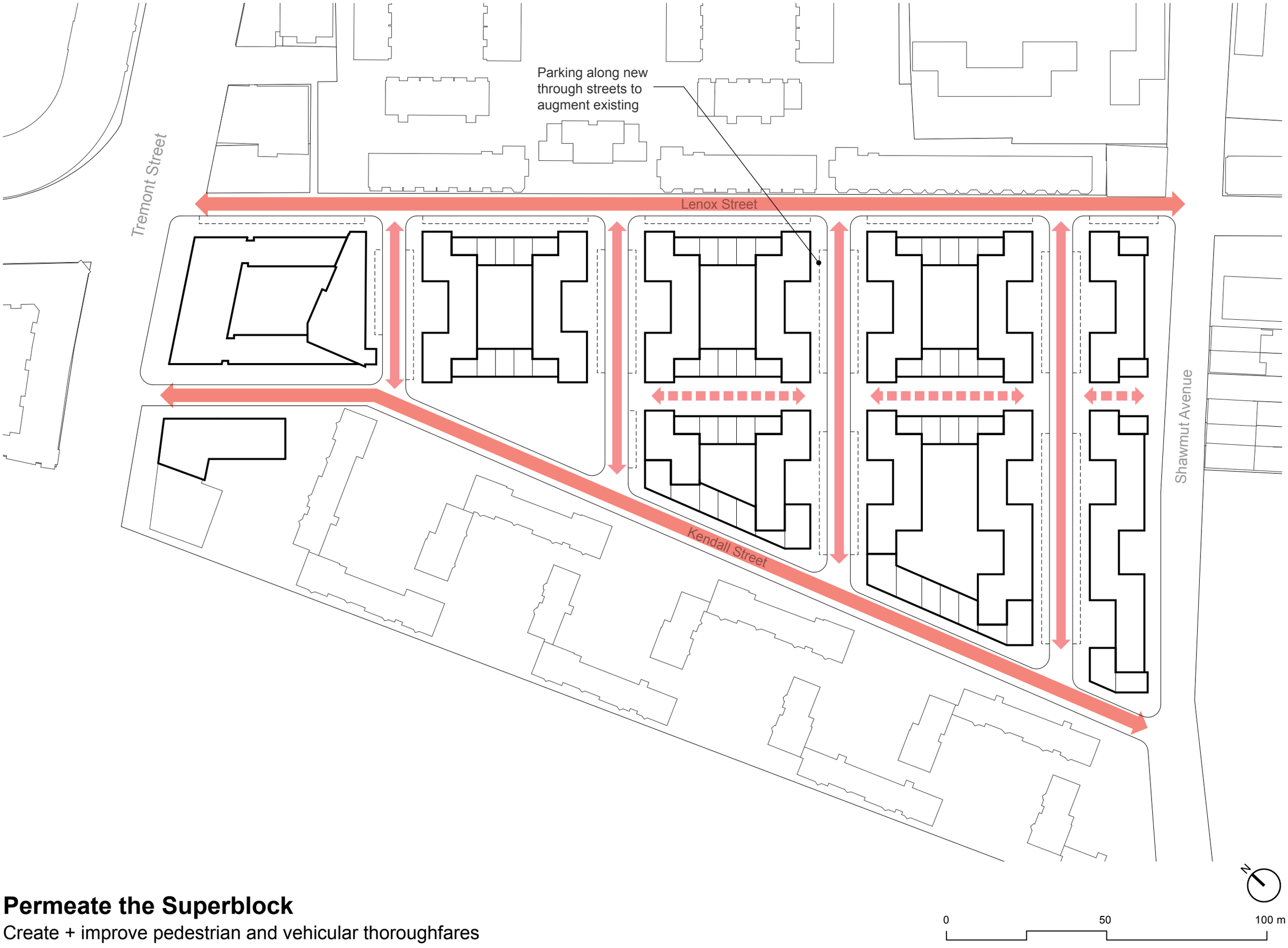


Proposed site plan

Lenox Housing Urban Infill

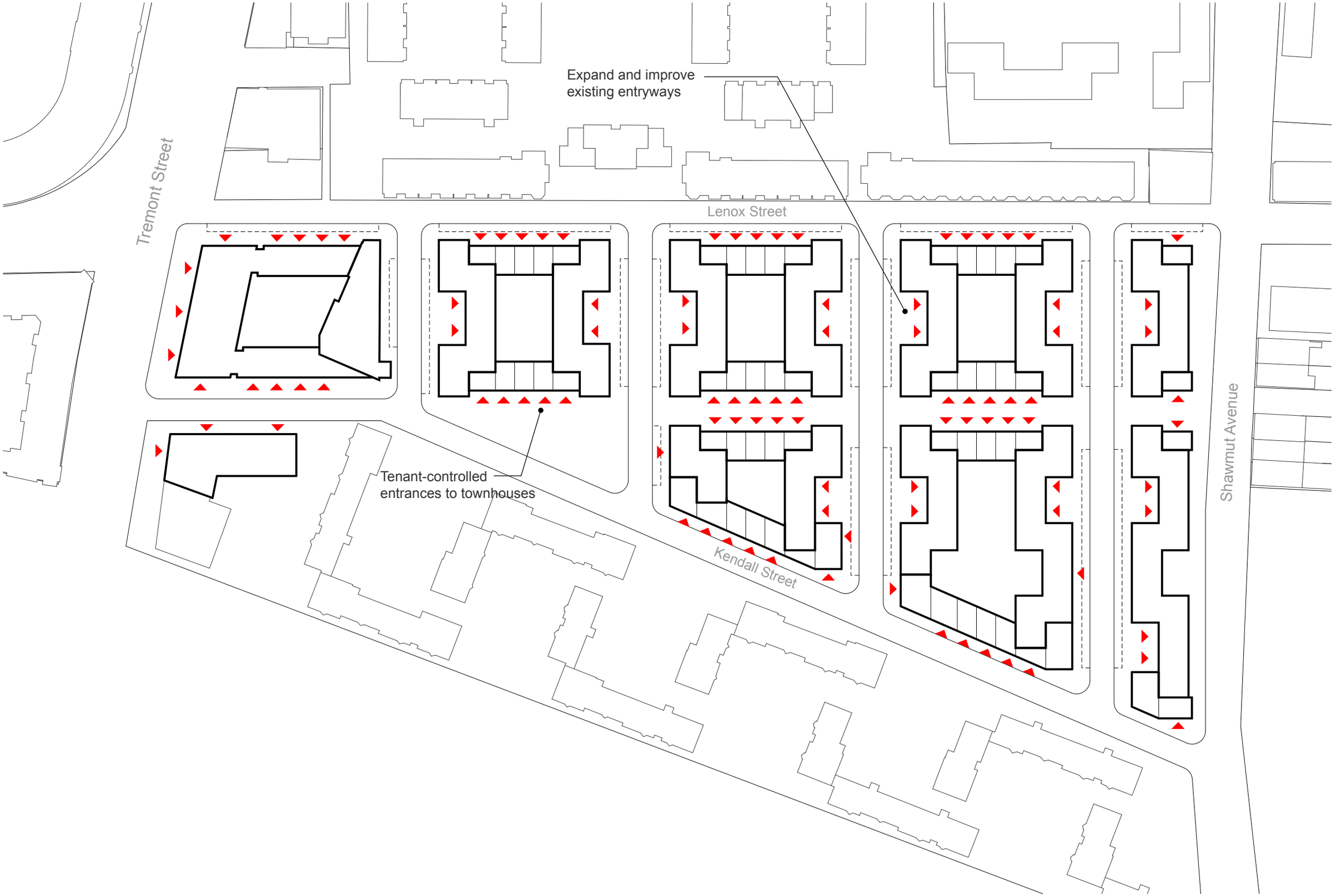
Reinforce the street edge

Activate sidewalk frontage with “eyes on the street”



Permeate the Superblock

Create + improve pedestrian and vehicular thoroughfares

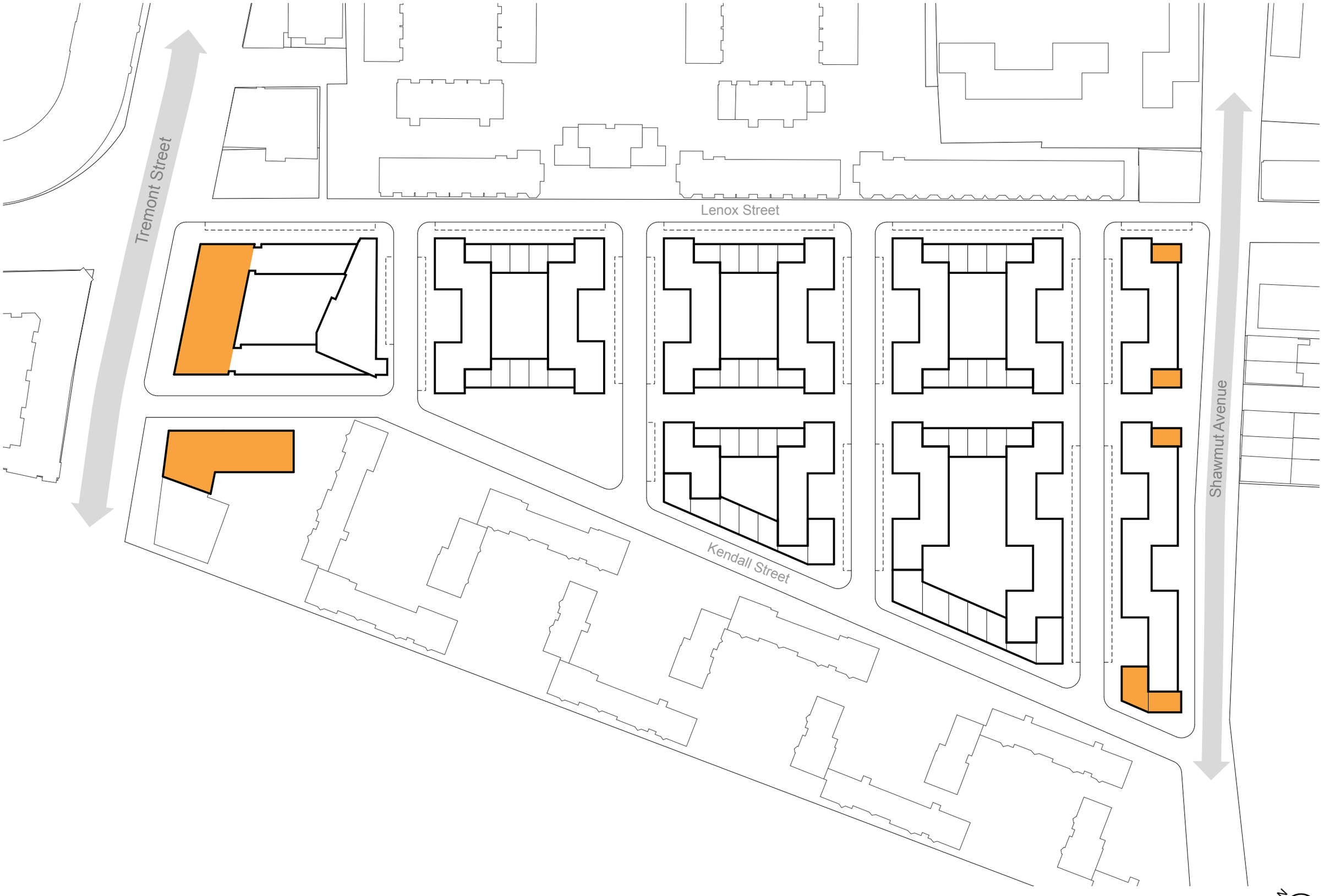


Create multiple points of entry

Foster a sense of individual ownership of the streetscape

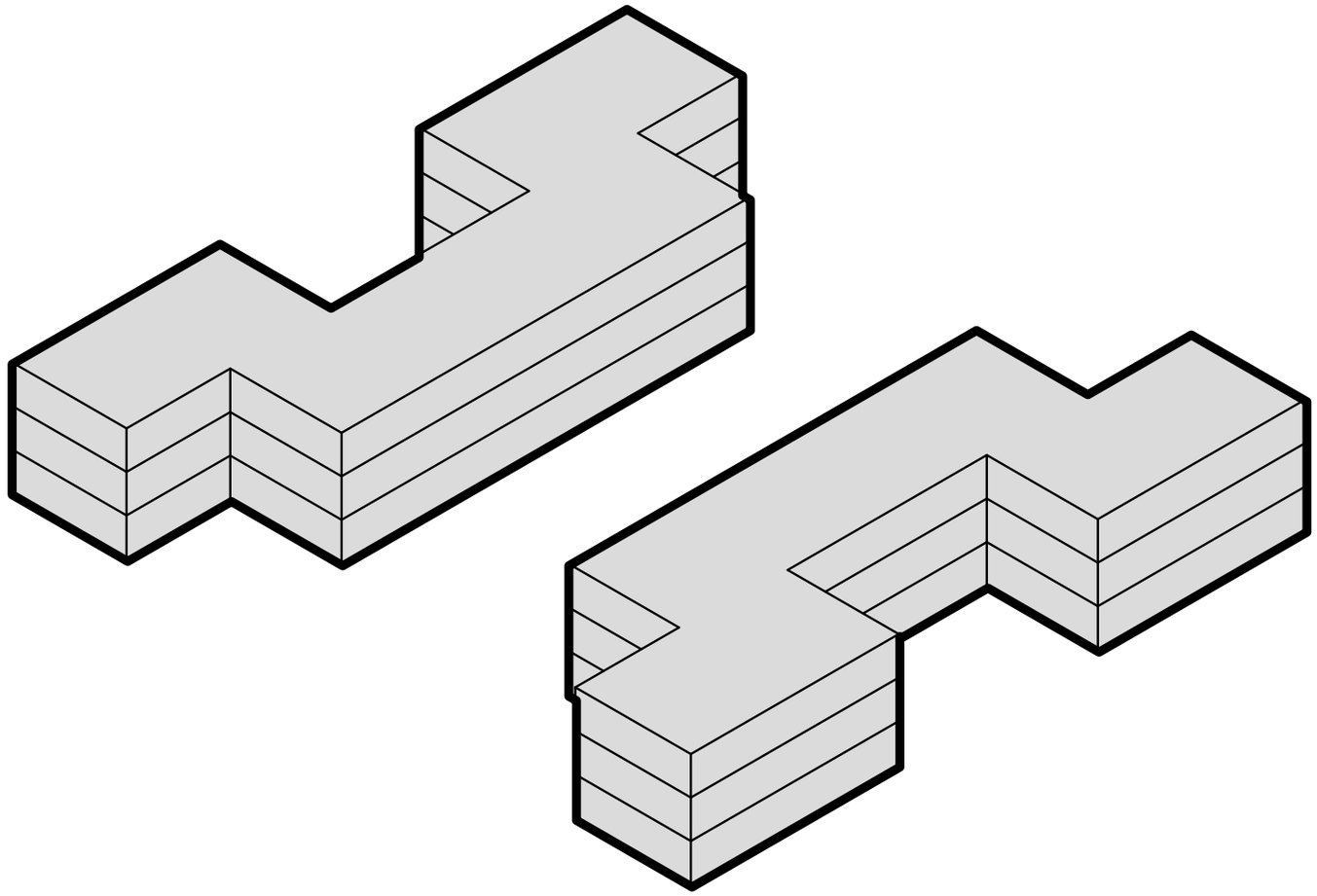
Create new + protected green spaces

Engender a mix of public, semi-public, and private outdoor areas

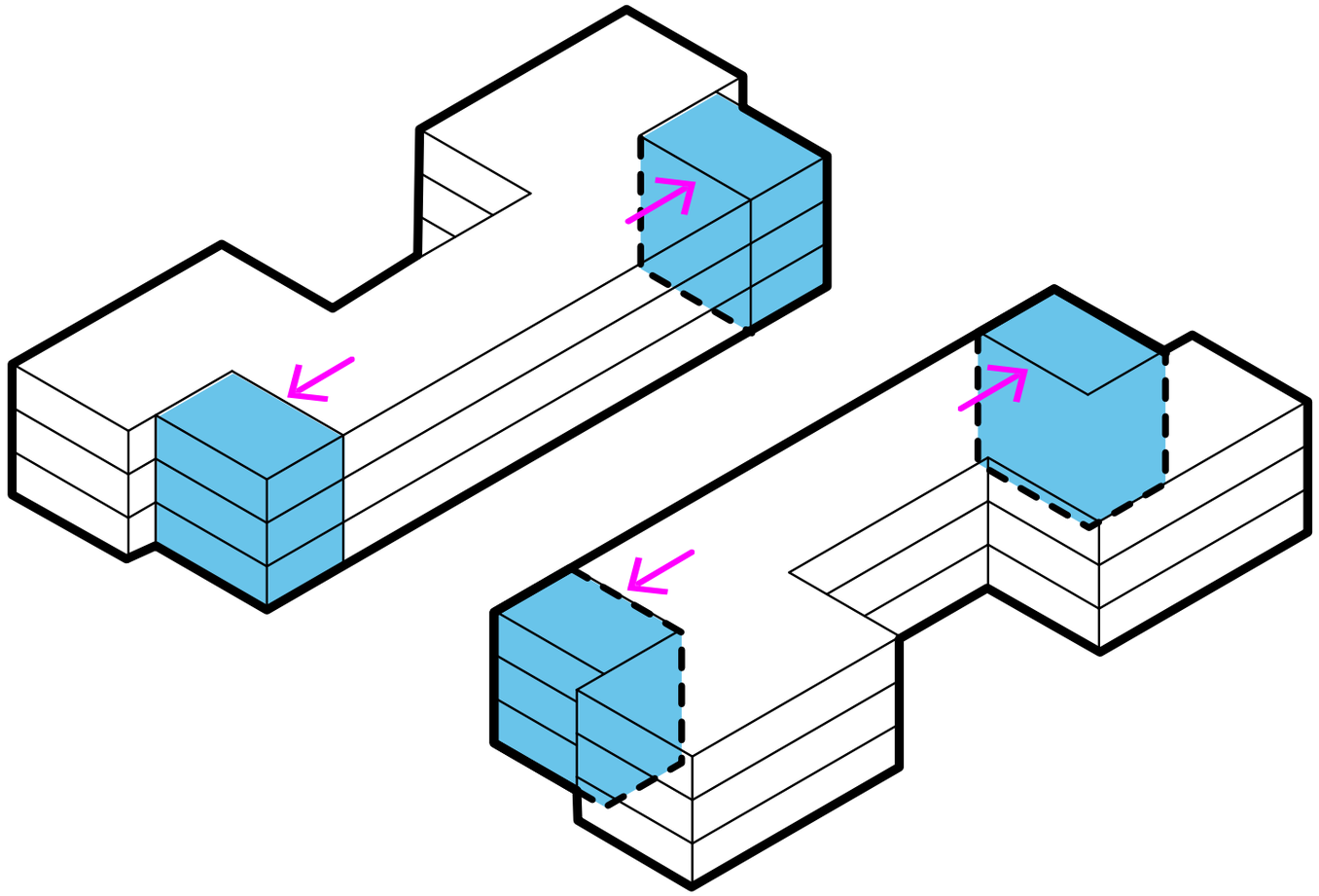


Introduce new retail spaces

Engender a mix of public, semi-public, and private outdoor areas

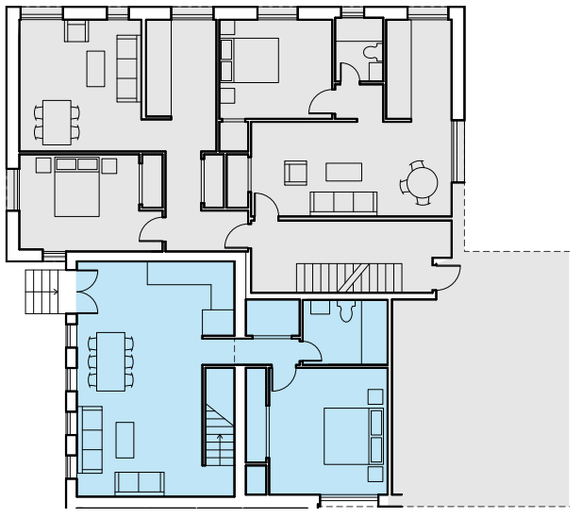


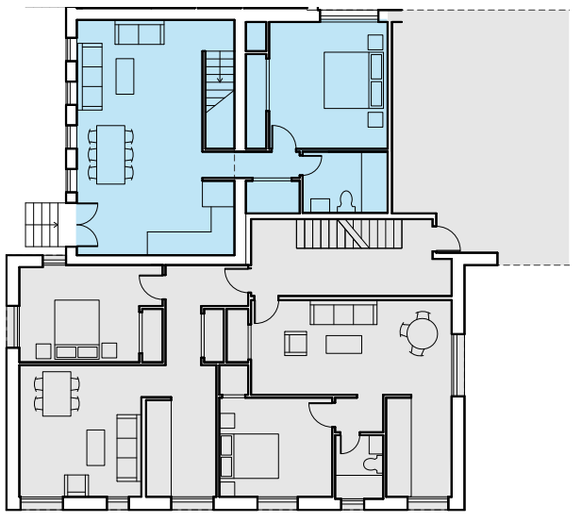
Existing
Representative Housing Block



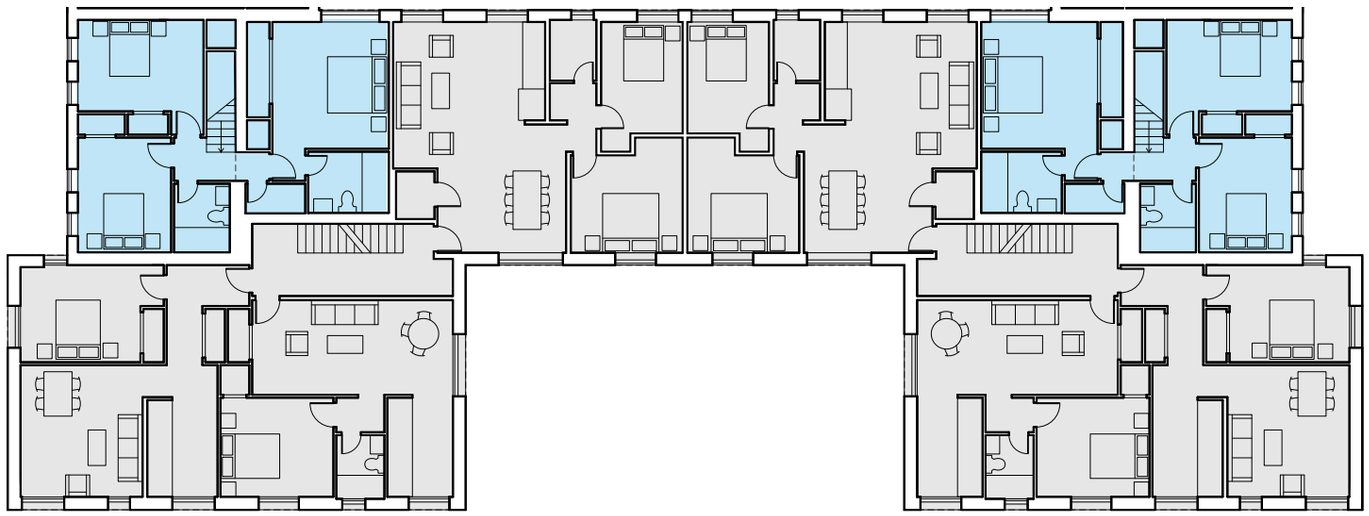
Expand

New annex to bring existing apartments to today’s space recommendations





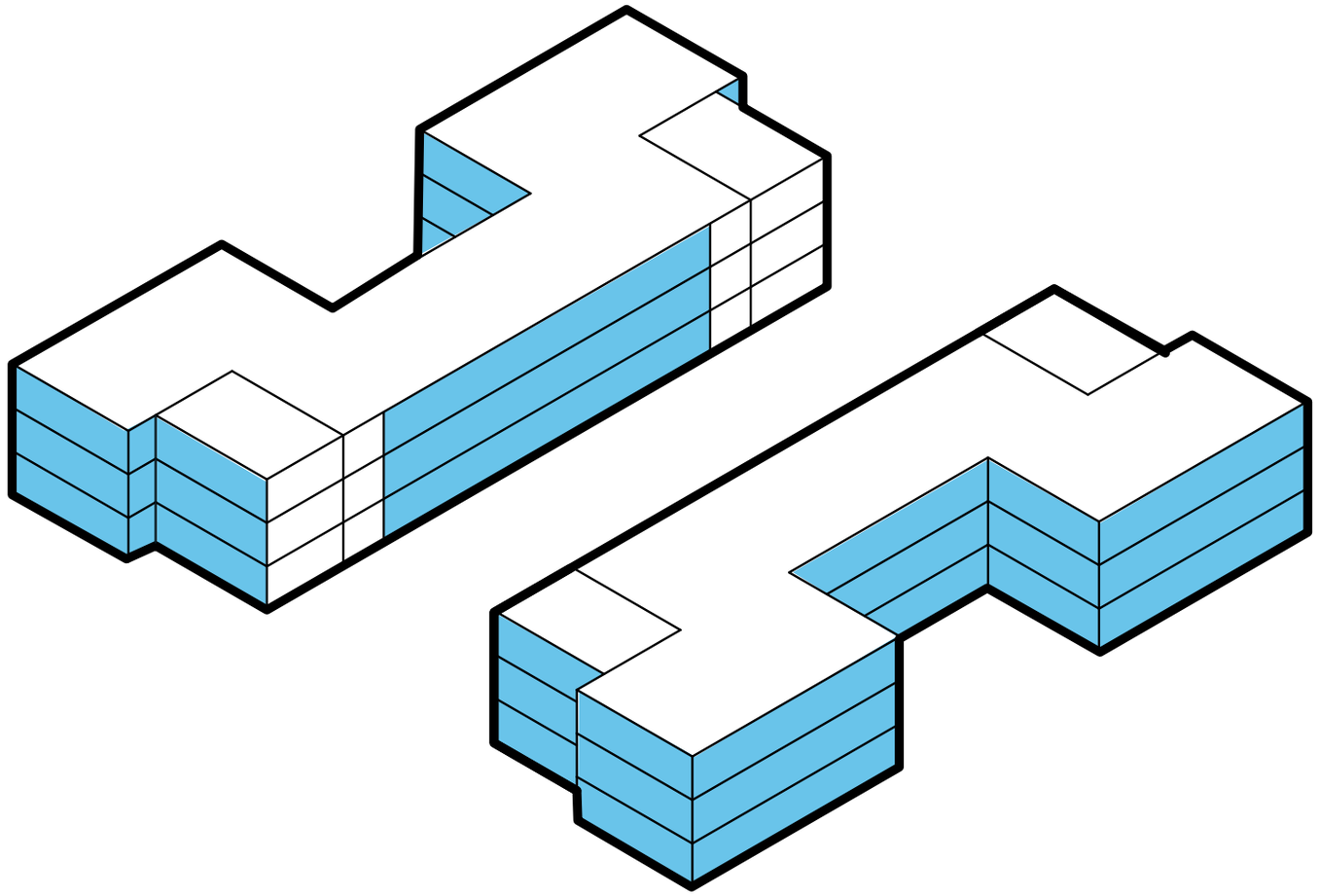
First Floor



Second Floor

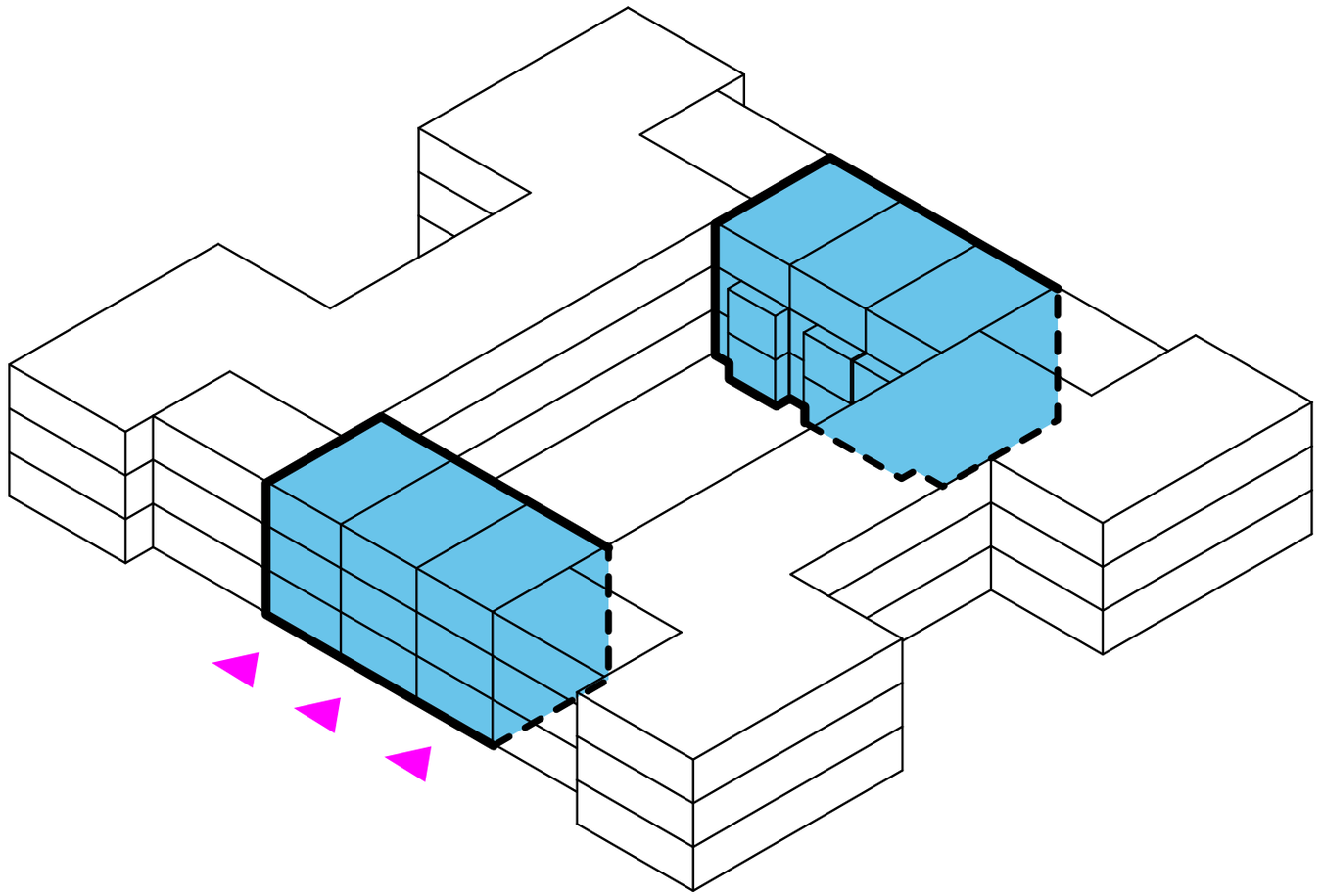
Floor Plans - Expansion

0 5 10 m



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

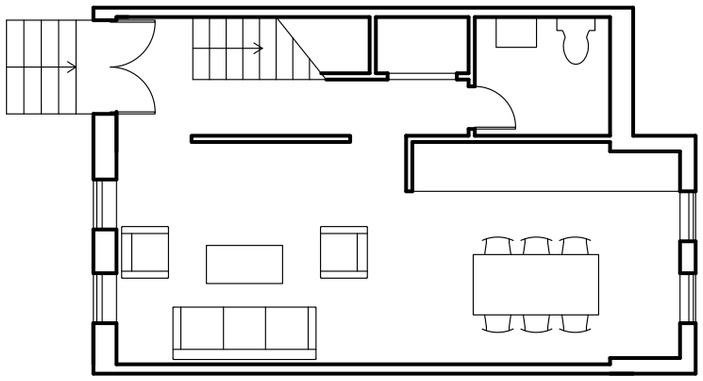
First Floor

Second Floor

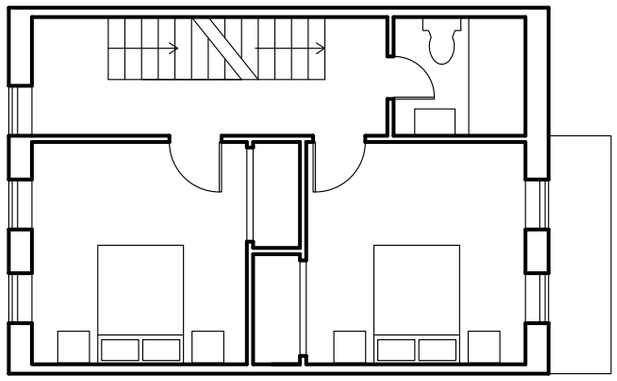
Floor Plans - Infill

0 5 10 m

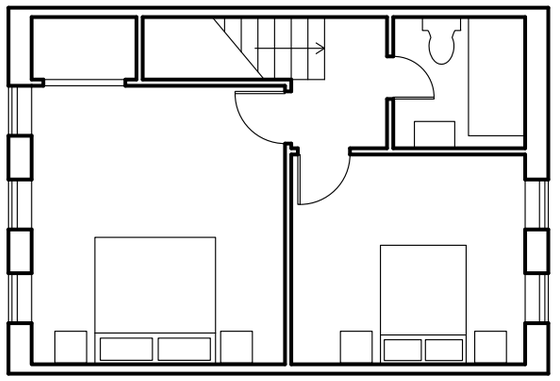
4br Triplex



First Floor

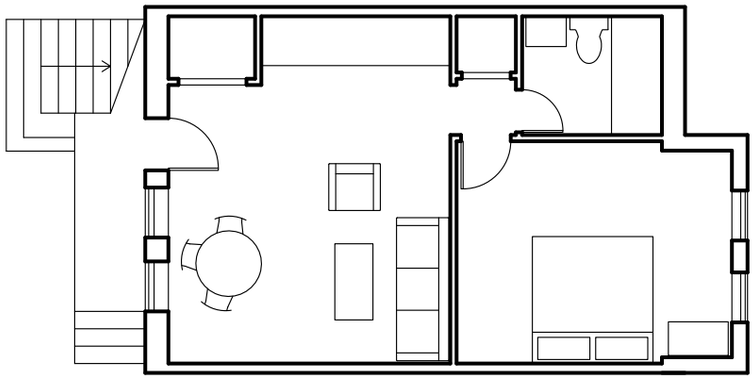


Second Floor



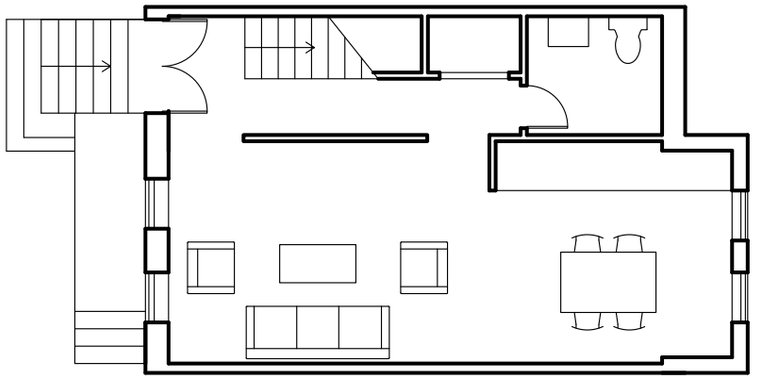
Third Floor

1br Garden

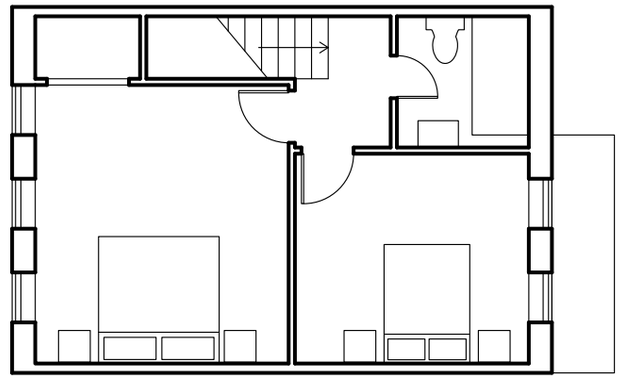


First Floor

2br Duplex



Second Floor

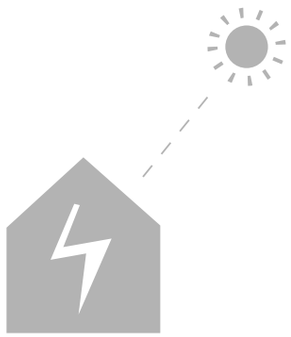


Third Floor

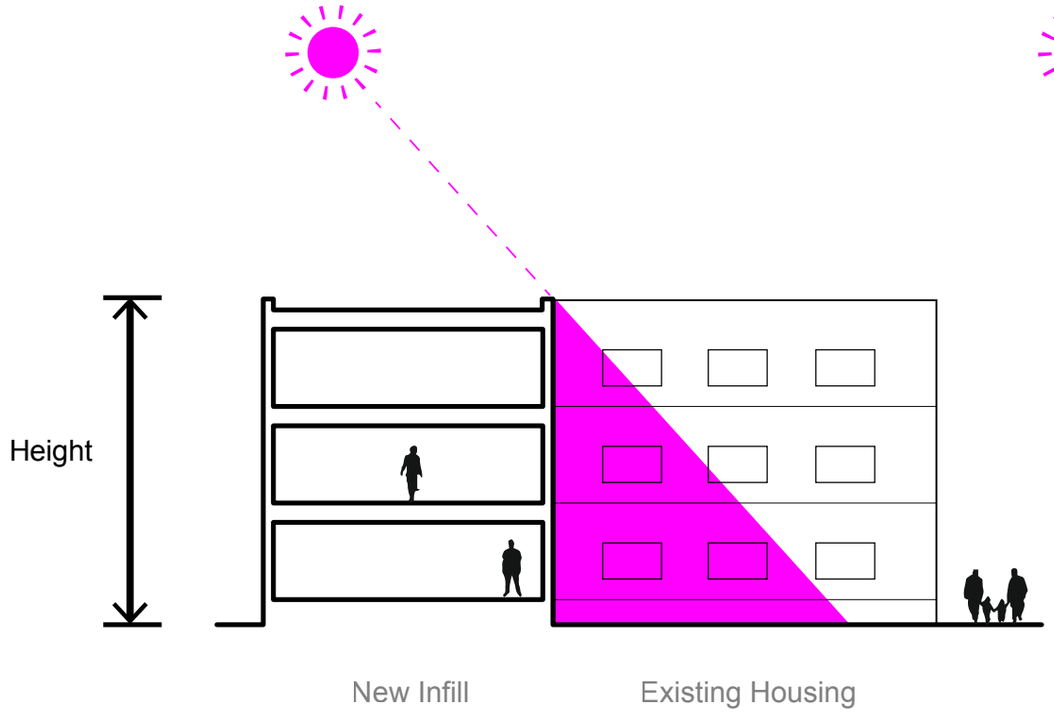
Individual Housing Layouts

New market-rate and workforce housing

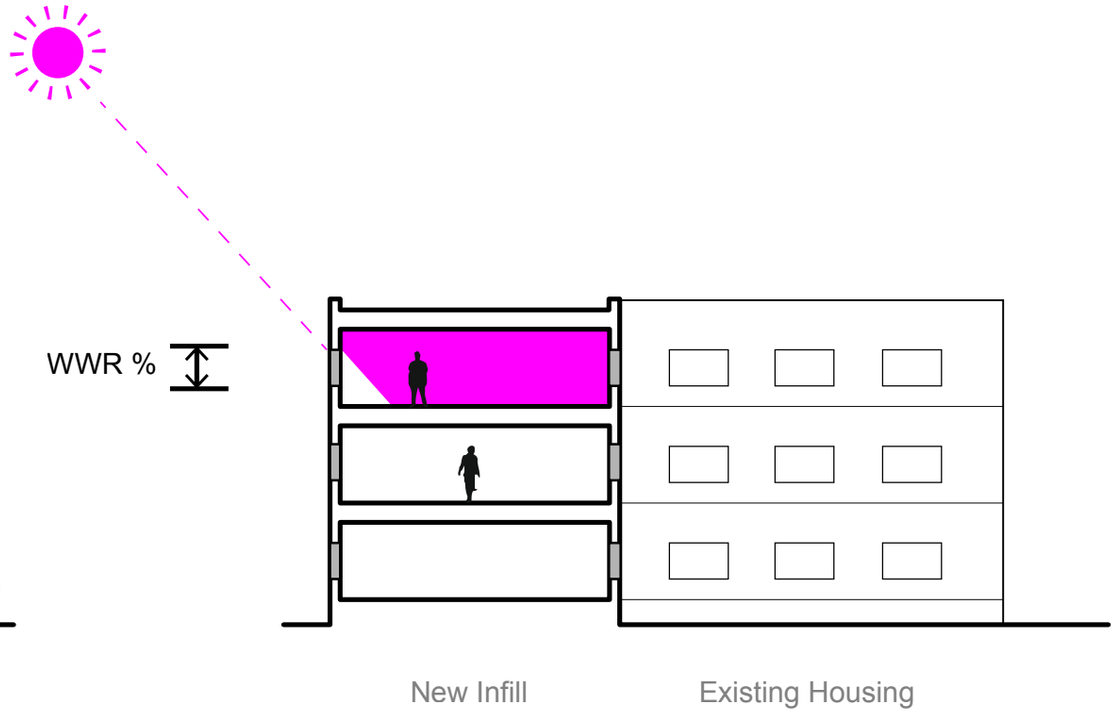
0 5 10 m



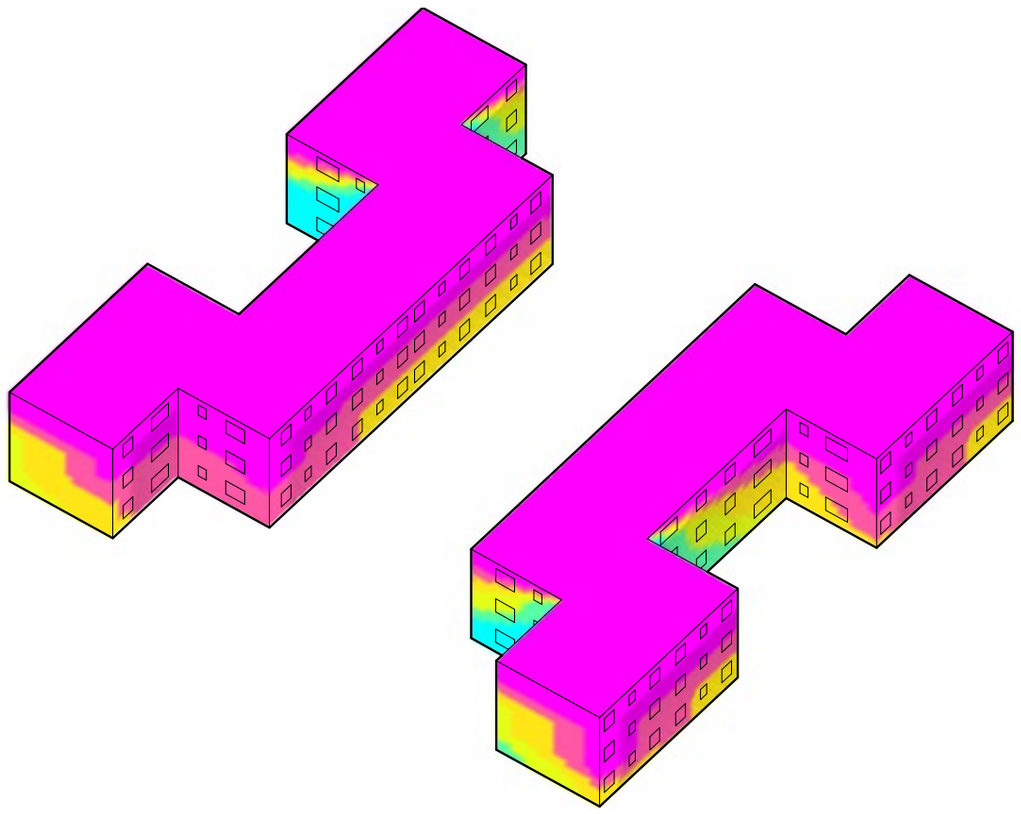
Daylight + Energy Performance Strategies



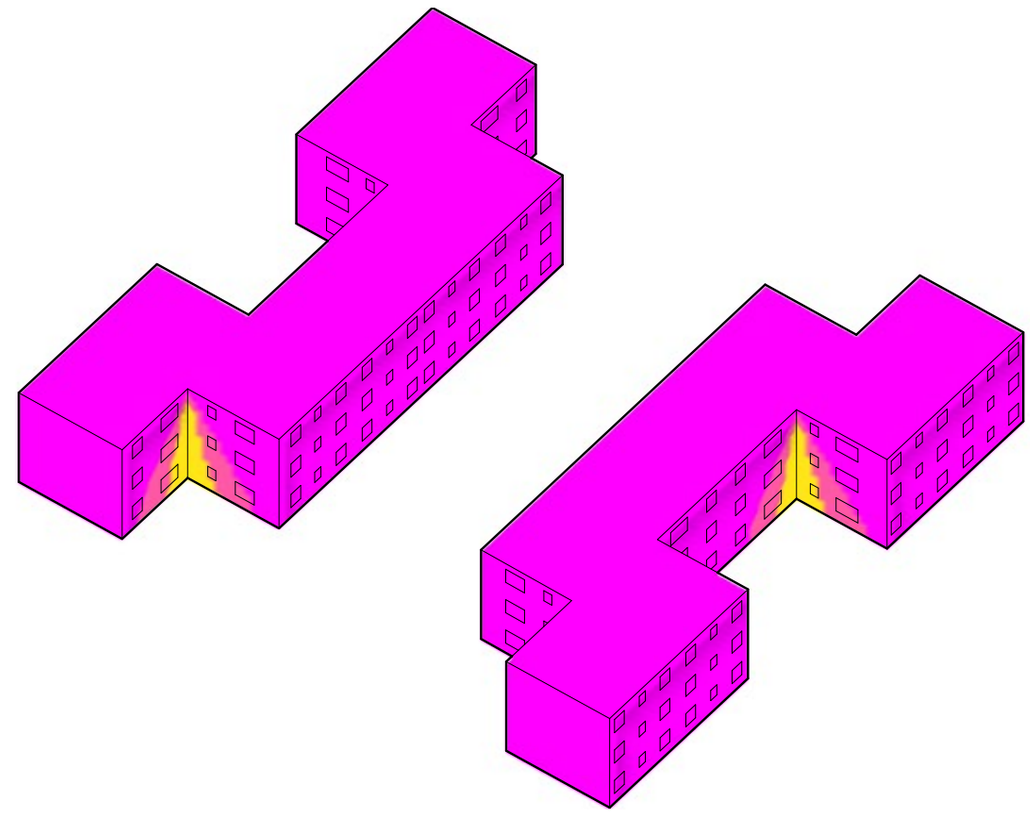
Effect of Infill on Existing Housing



Daylight + Energy Potential of Infill



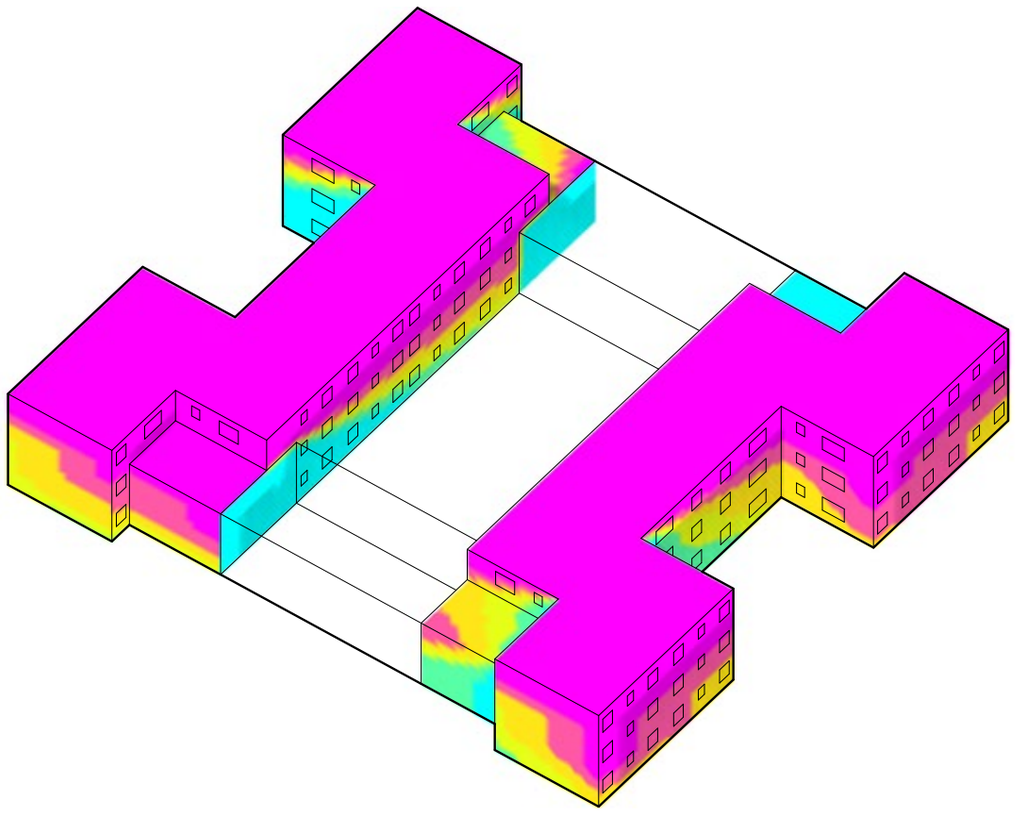
Winter (Dec. 21st)



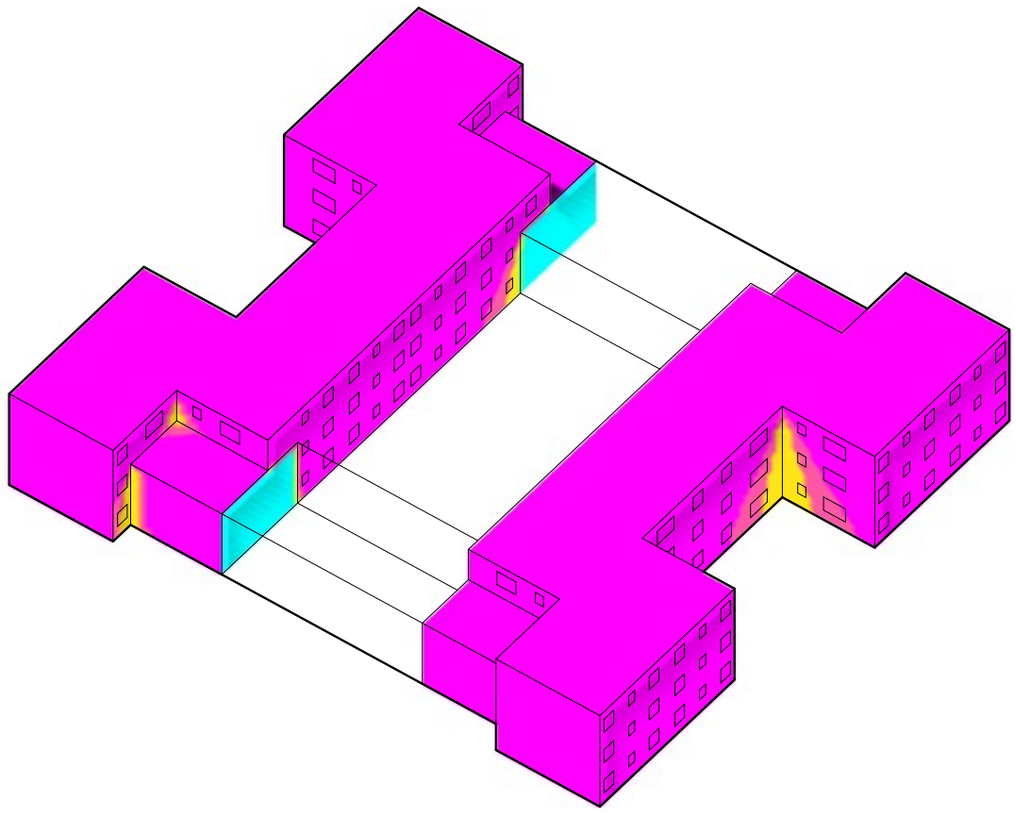
Summer (June 21st)

No Infill

Direct Solar Hours Comparison



Winter (Dec. 21st)

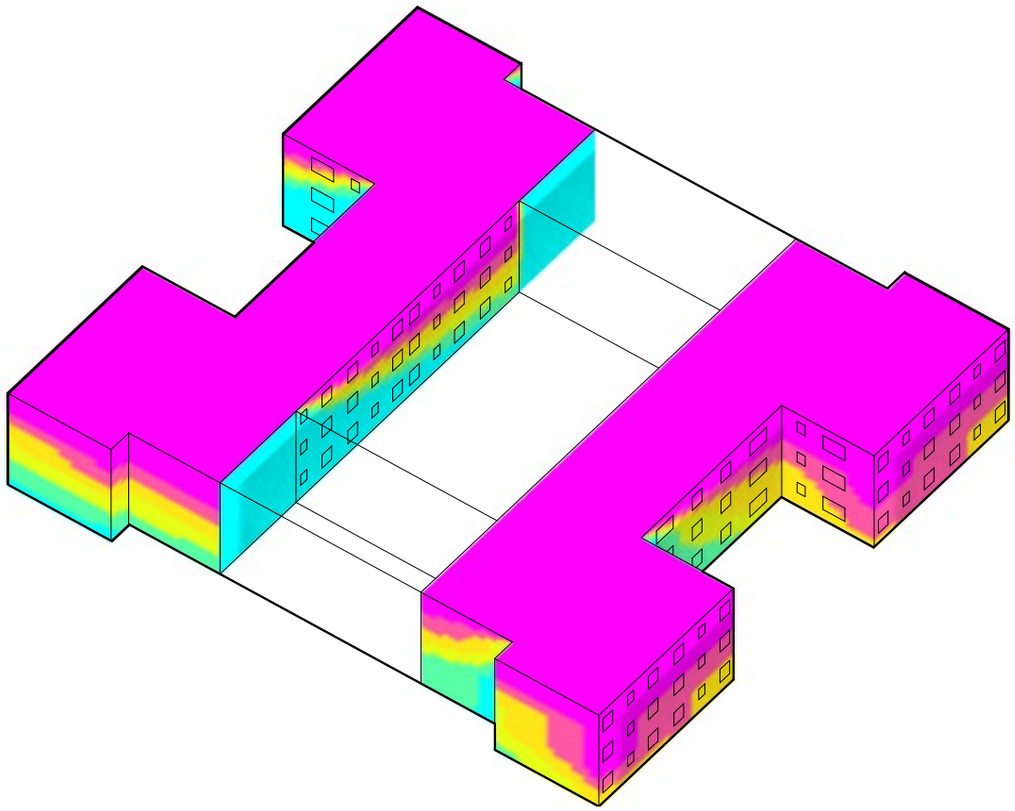


Summer (June 21st)

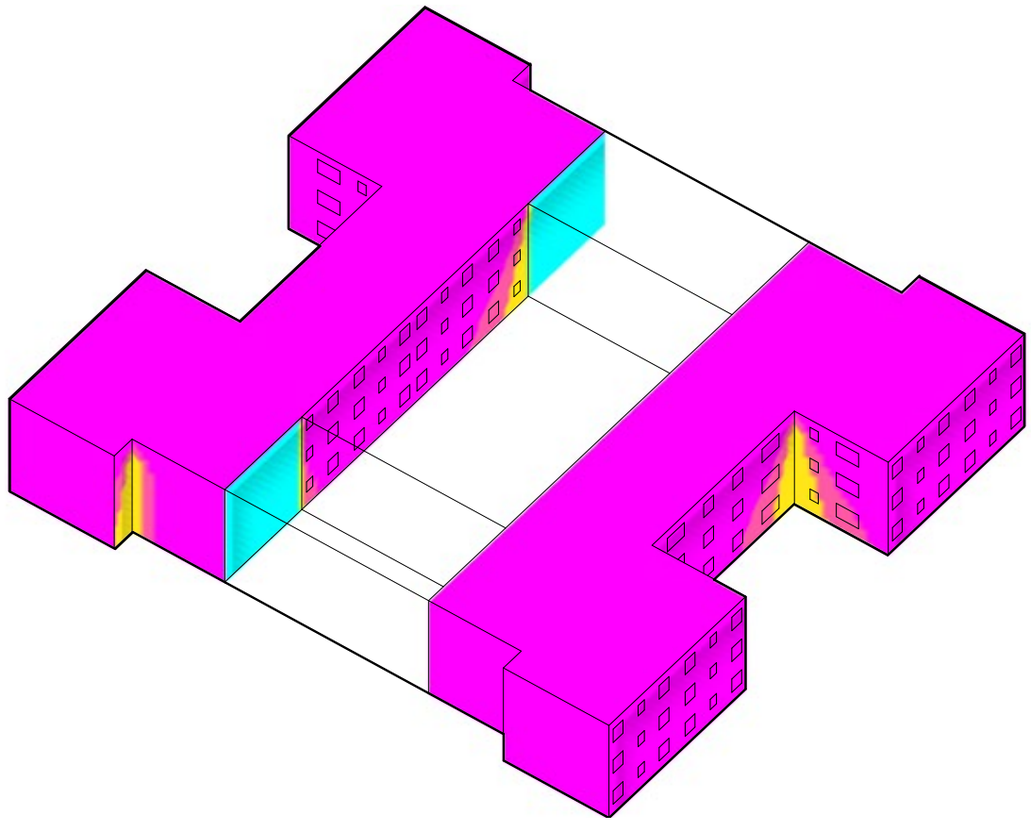
Two-Story Infill

Direct Solar Hours Comparison

0h 6h+



Winter (Dec. 21st)

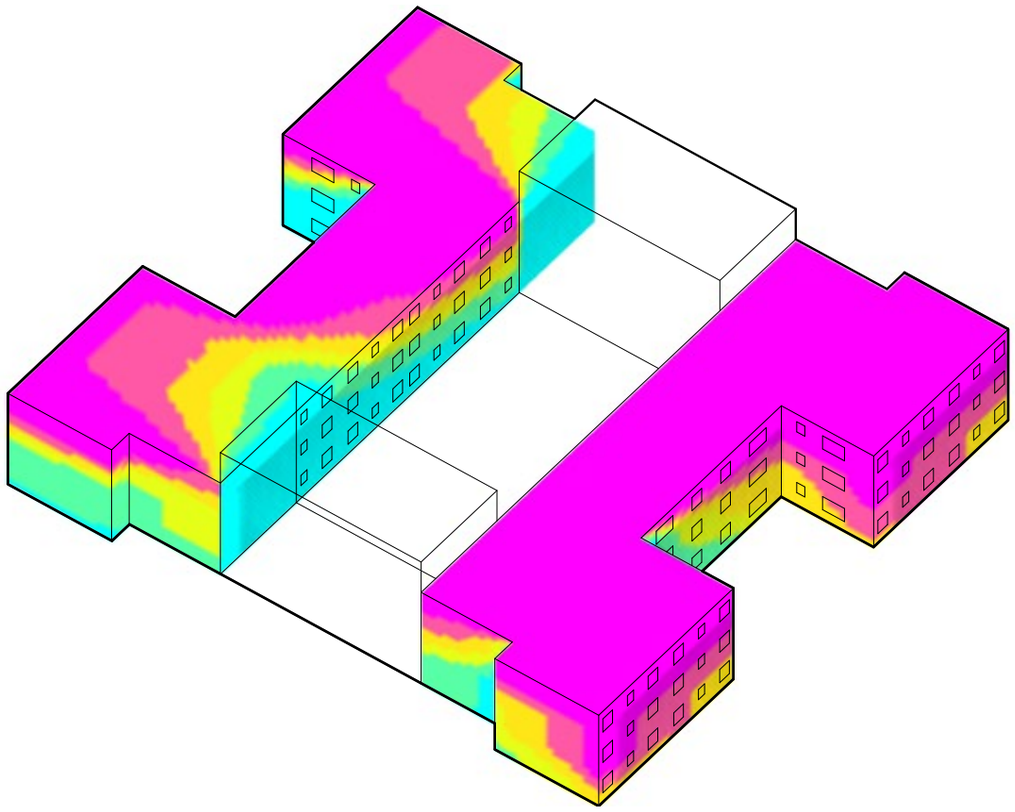


Summer (June 21st)

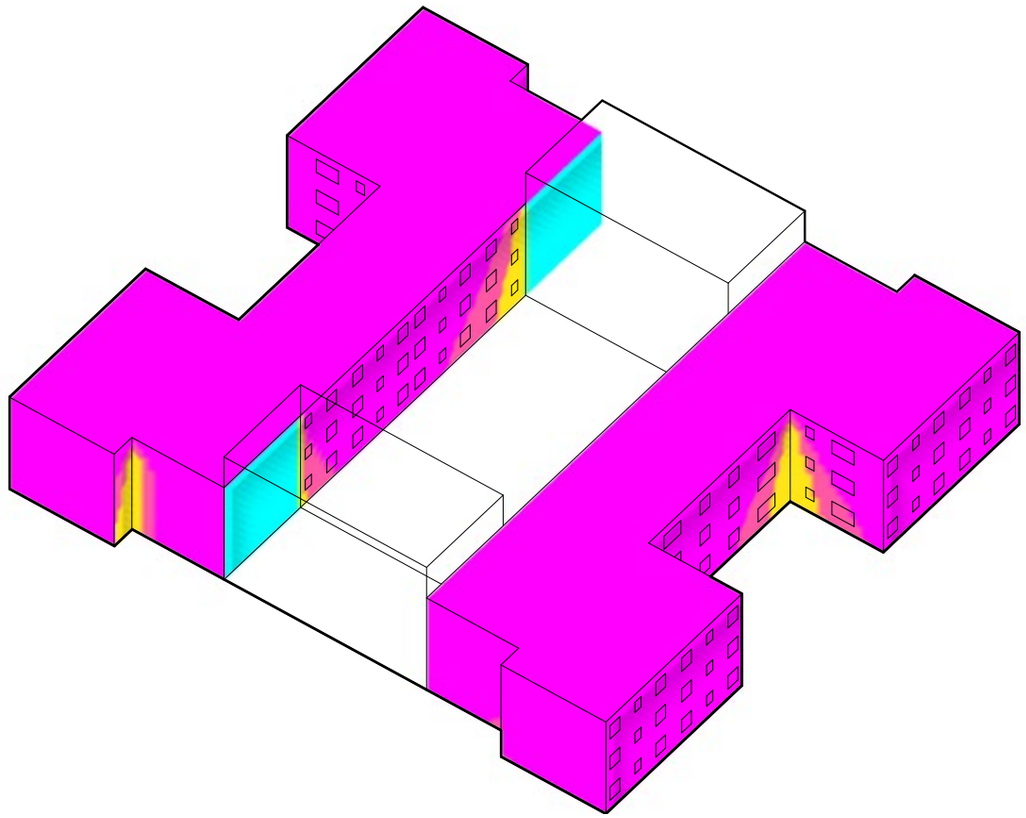
Three-Story Infill

Direct Solar Hours Comparison

0h 6h+



Winter (Dec. 21st)

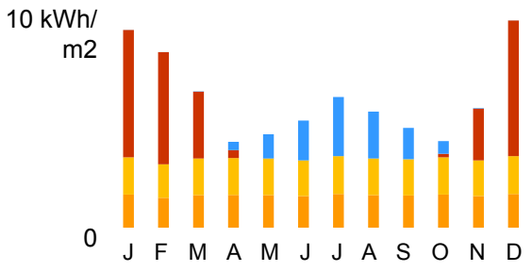


Summer (June 21st)

Four-Story Infill

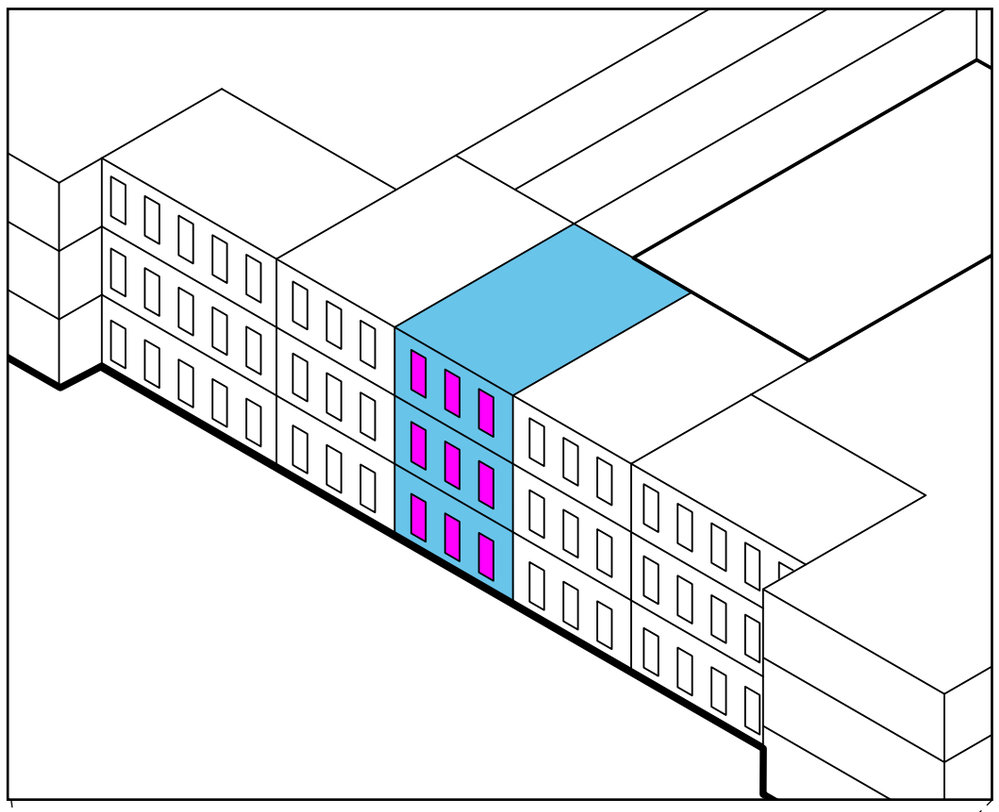
Direct Solar Hours Comparison

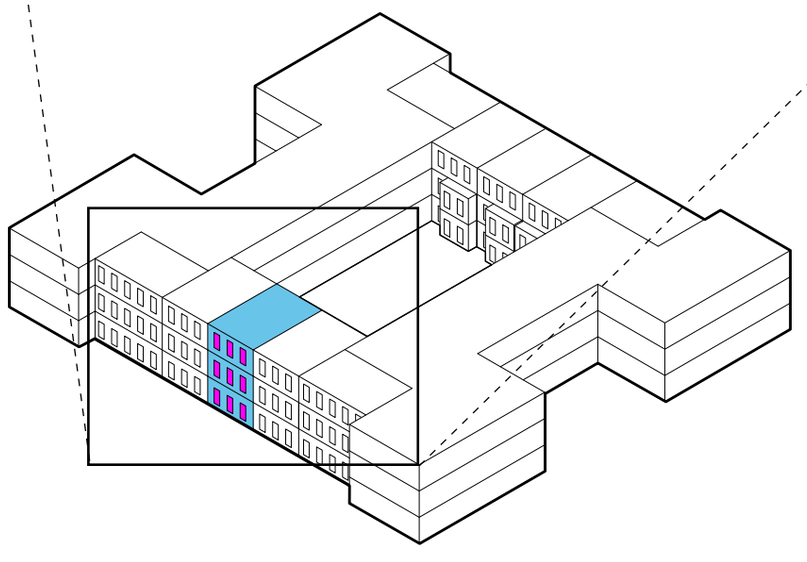
0h 6h+



Monthly Energy Use Intensity breakdown
(heating, cooling, lighting, equipment)

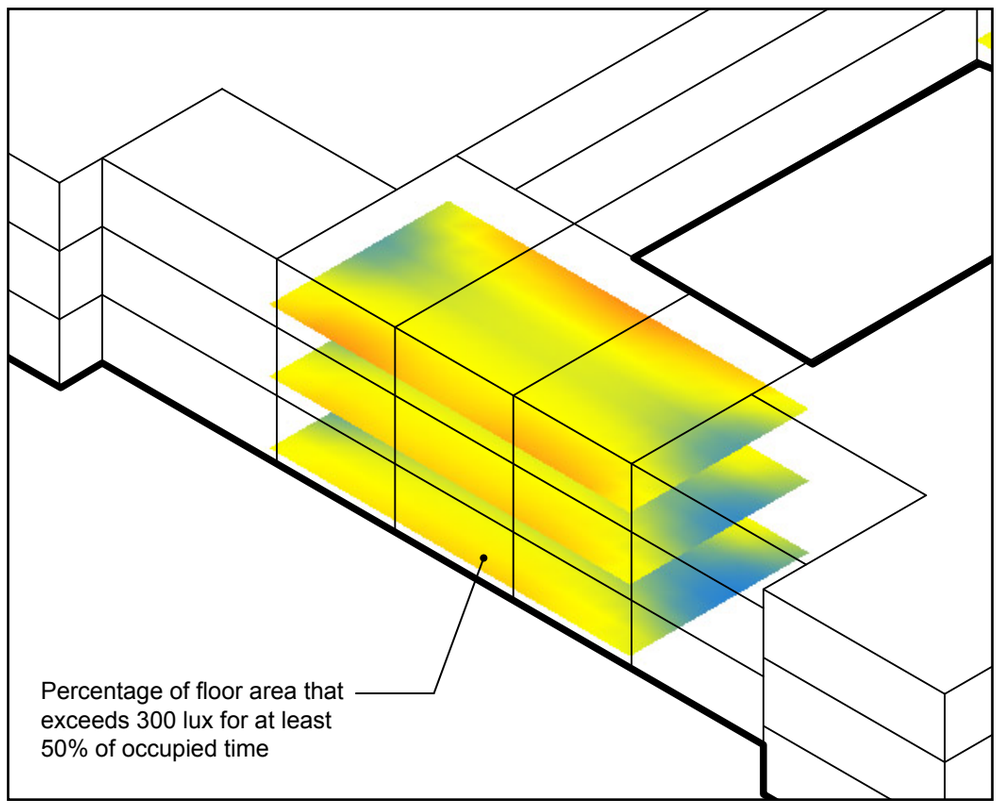
EUI
93.5 kWh/m2





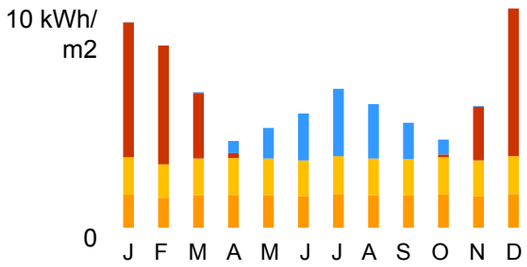
0% 100%

Average cDA
0.43



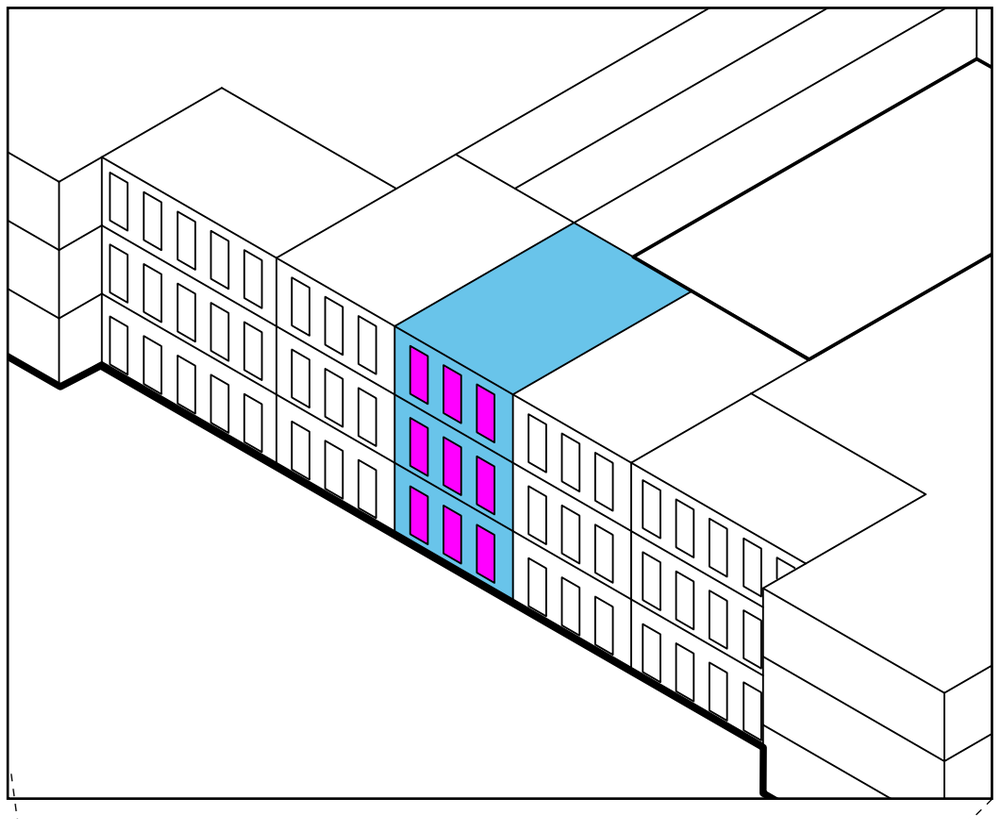
Window-to-Wall Ratio 20%

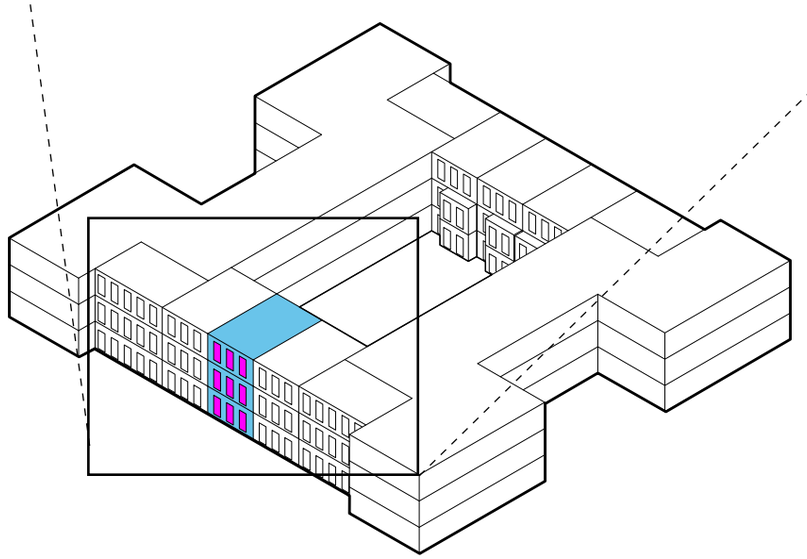
Energy and Daylight Analysis



Monthly Energy Use Intensity breakdown
(heating, cooling, lighting, equipment)

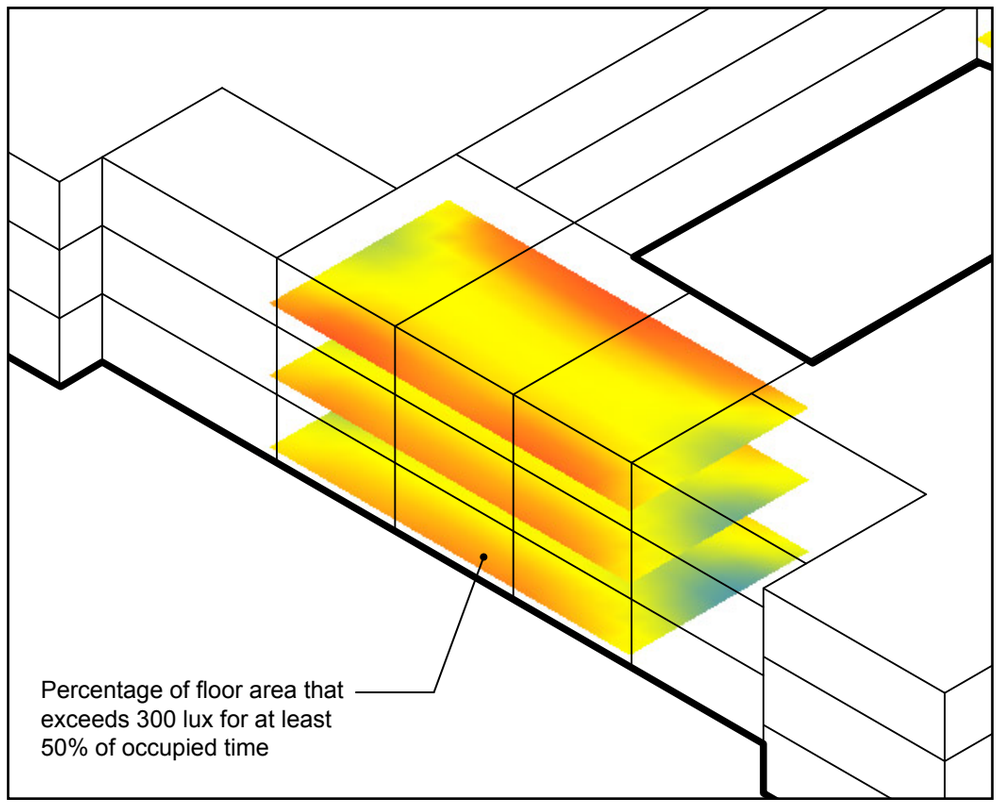
EUI
98.2 kWh/m2





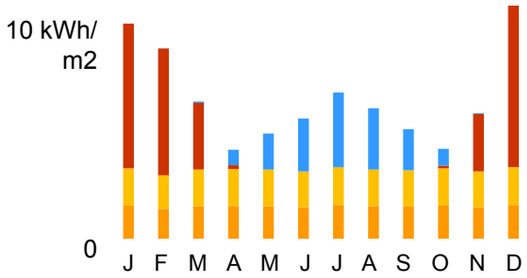
0% 100%

Average cDA
0.55



Window-to-Wall Ratio 30%

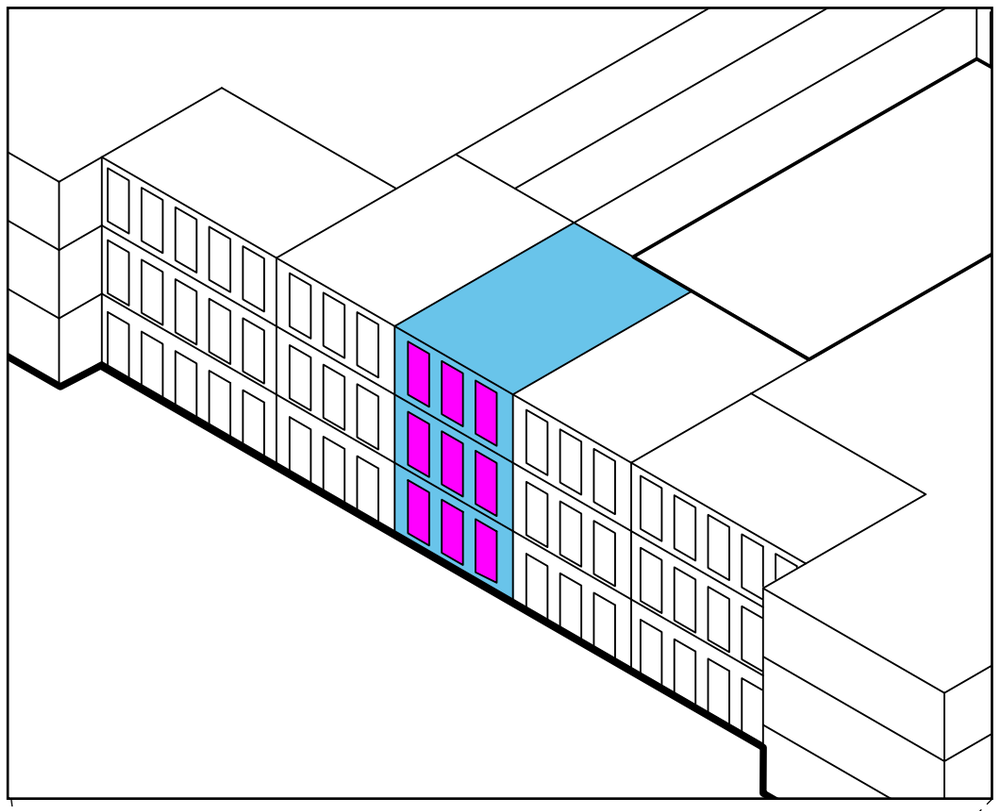
Energy and Daylight Analysis

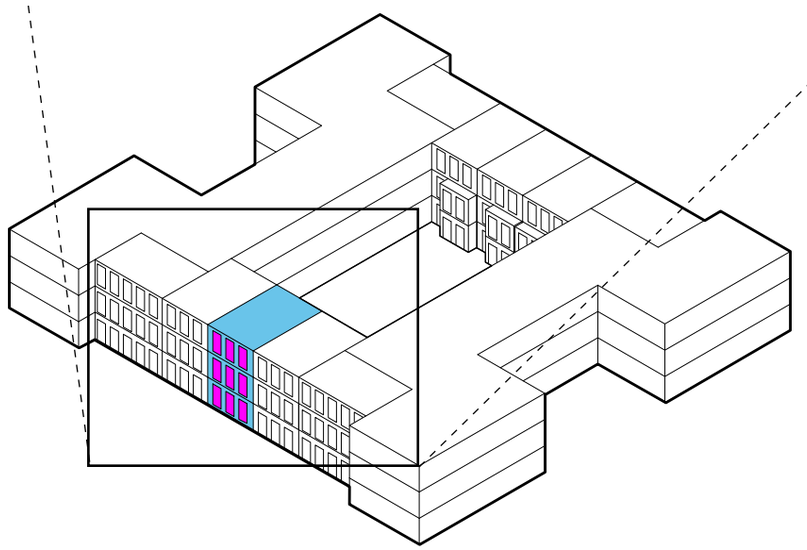


Monthly Energy Use Intensity breakdown
(heating, cooling, lighting, equipment)

EUI

103.3 kWh/m2



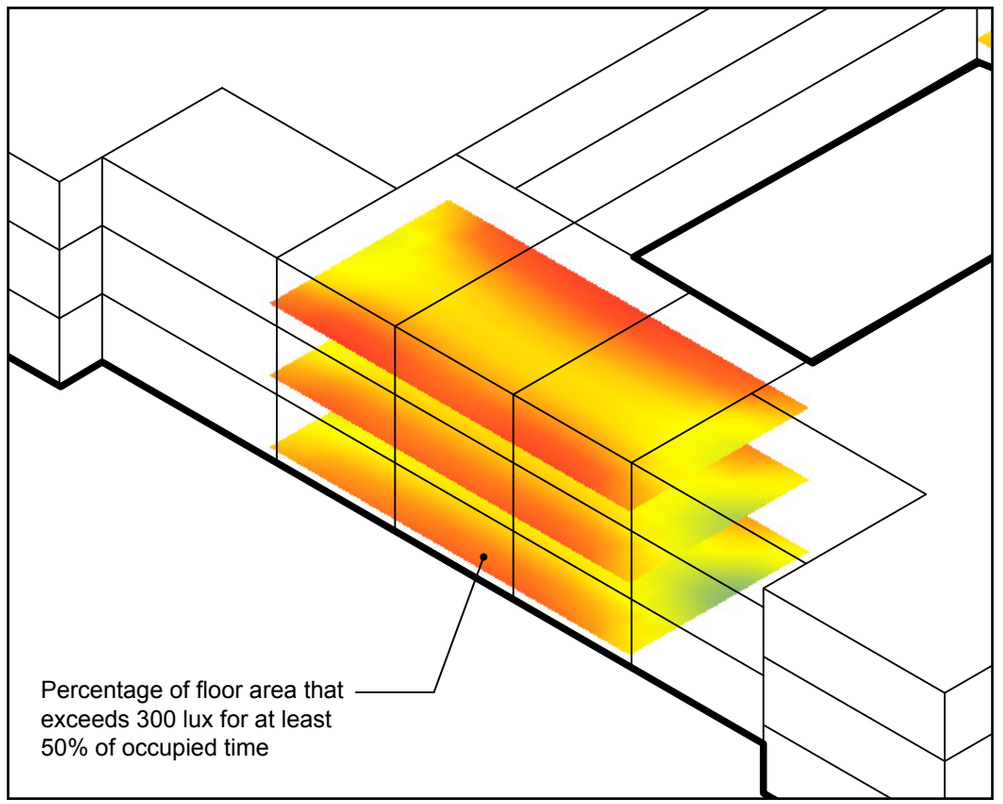


0%

100%

Average cDA

0.64



Window-to-Wall Ratio 40%

Energy and Daylight Analysis

Urban + Architectural Character

Relating Performance, Design, and Existing Neighborhood Fabric

New + Existing

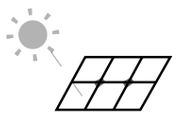
View across Lenox Street

Retrofitting
Consider the feasibility of adapting **existing assets** to today's performance and space standards. Measures could include:

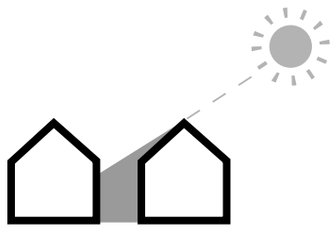
Adding **insulation** to roof and, where applicable, walls. Seal all wall openings such as doors and windows to prevent **infiltration** losses.

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.

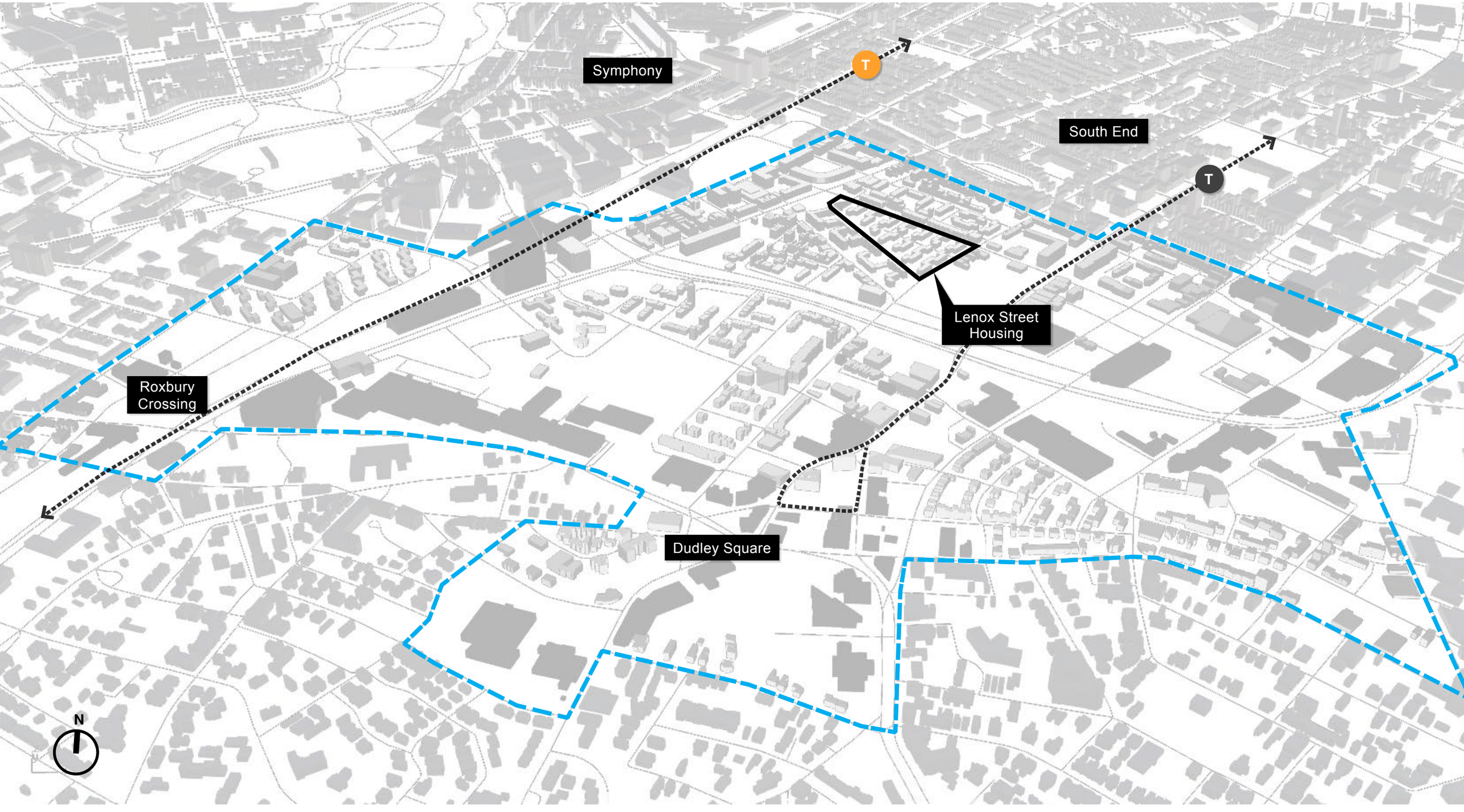


Daylight
In order to provide **equitable daylight** for existing and new construction, the **height, depth, and orientation** of new structures should be studied, as well as the effects of **overshadowing.**

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.

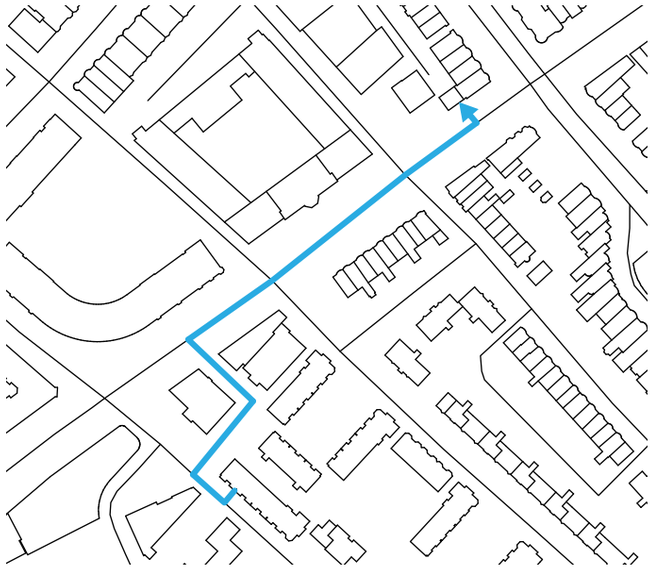
Walkability of Lower Roxbury

Present and future

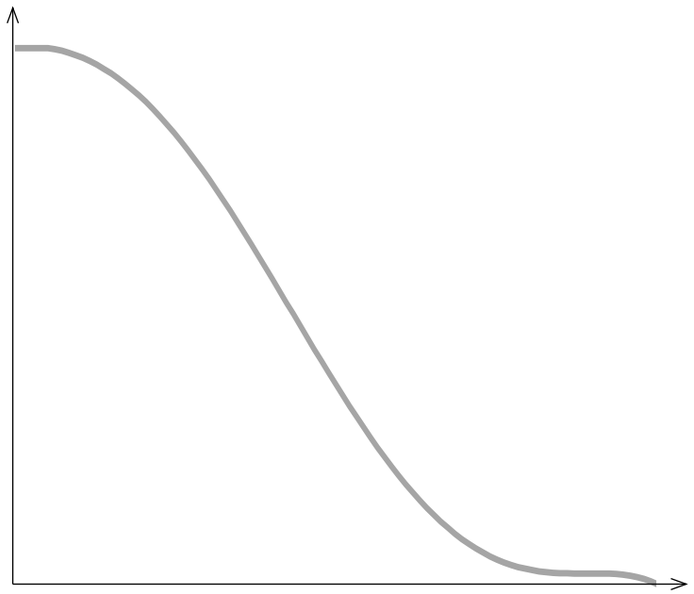


Lower Roxbury Revitalization Area

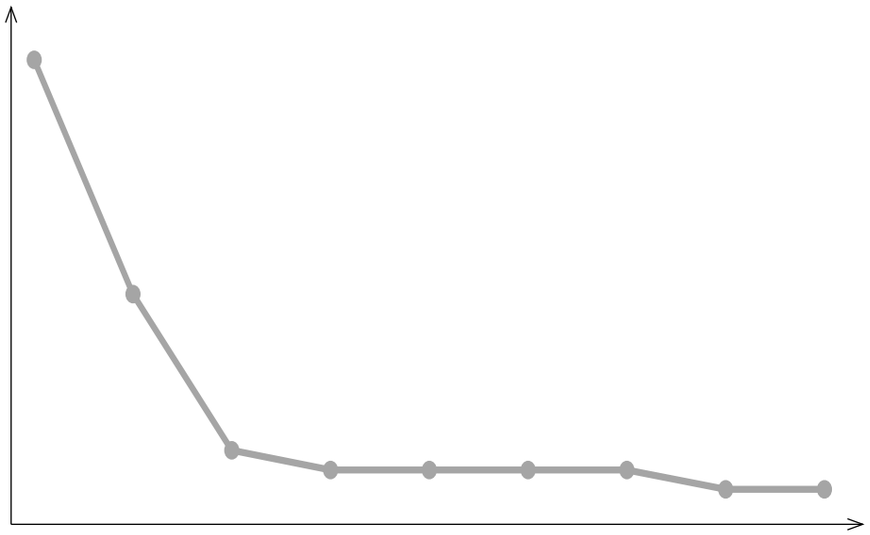
Destinations within Lower Roxbury only



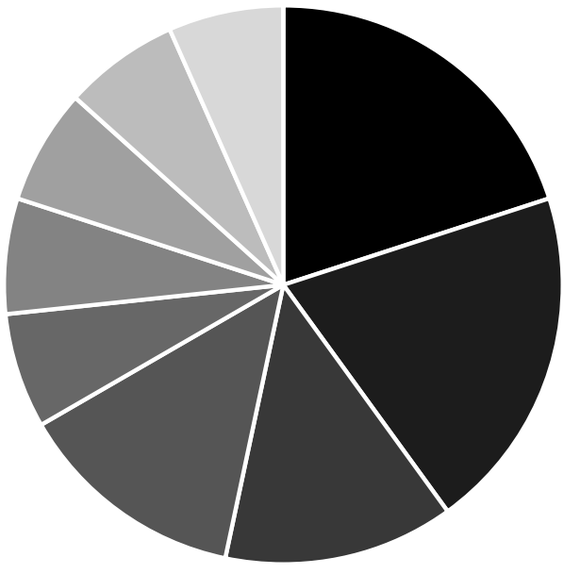
Shortest-path routing



Distance-based scoring



Score aggregation within amenity types



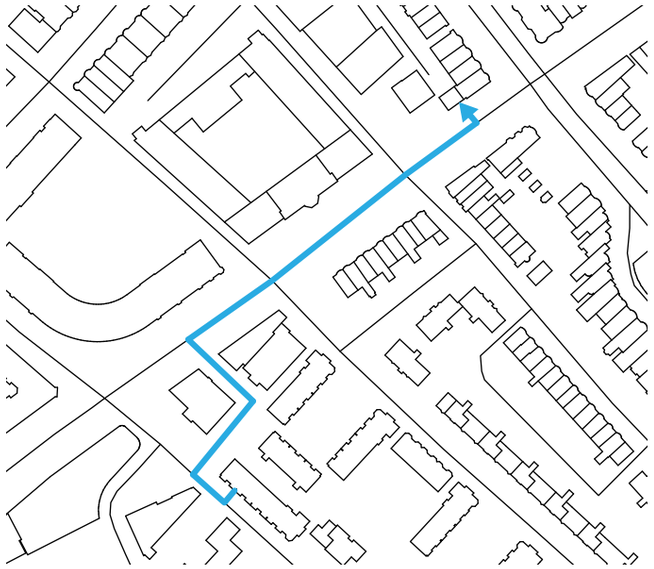
Score aggregation across amenity types

Walkability metric

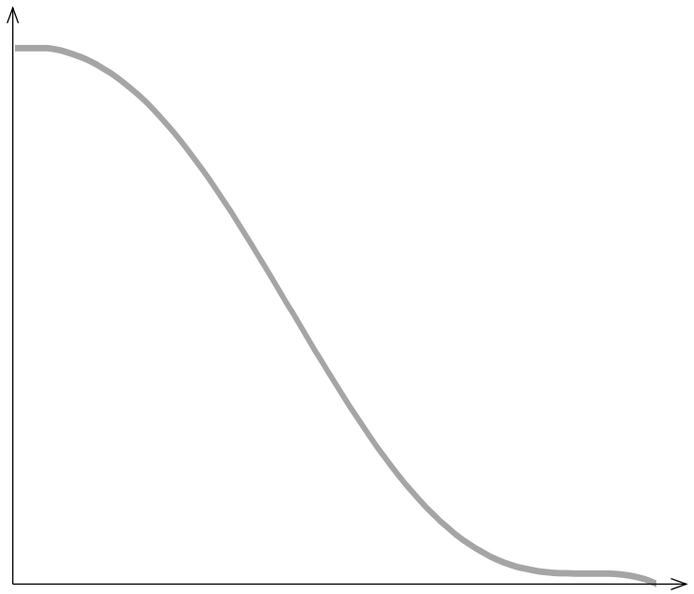
Source: *Walk Score*, Walk Score, 2011

Walk Score (2011)

Our metric



Shortest-path routing



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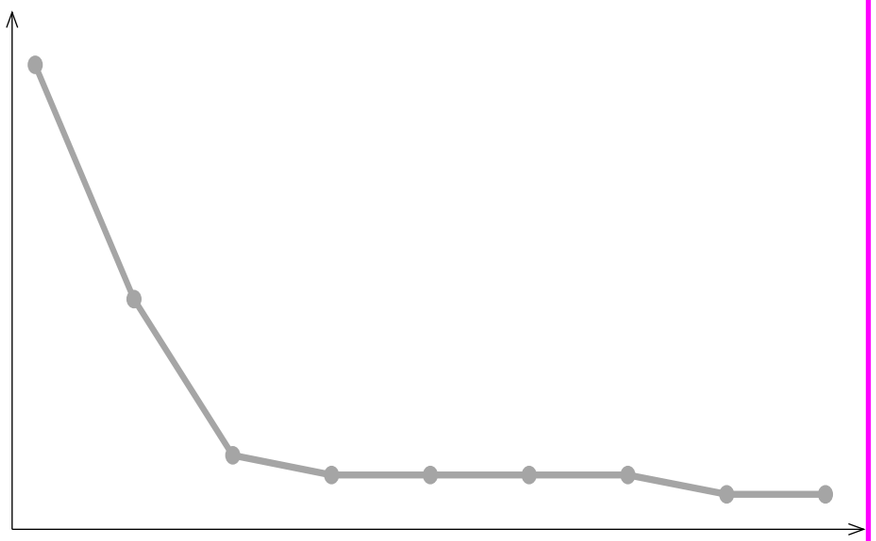
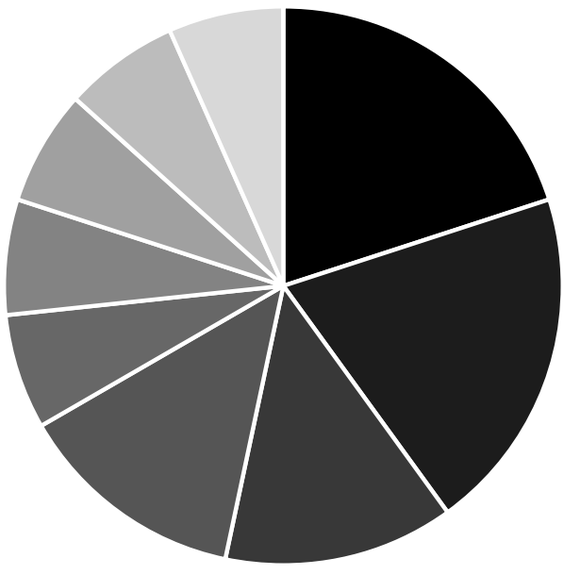


Score aggregation within amenity types

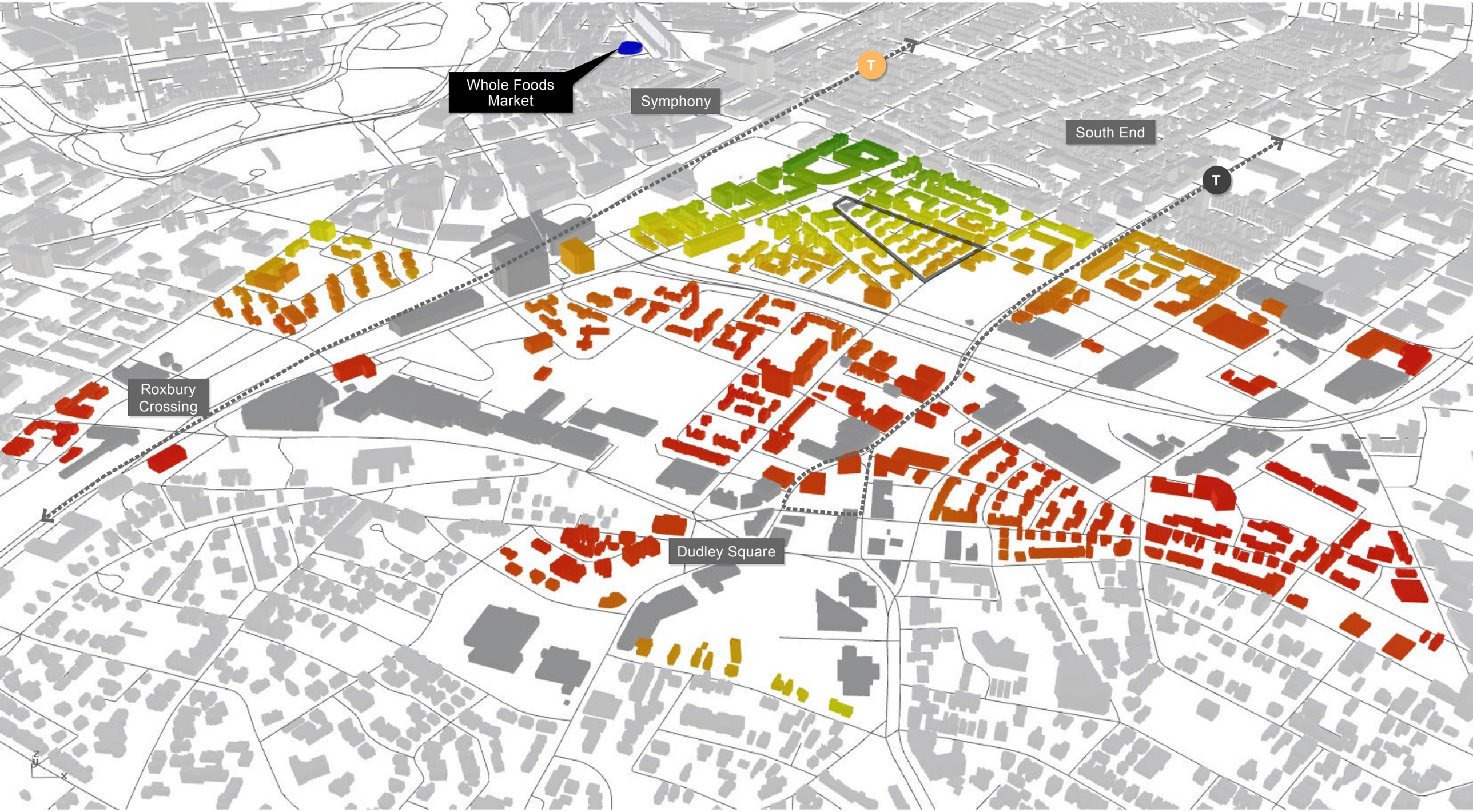


Score aggregation across amenity types

Walkability metric

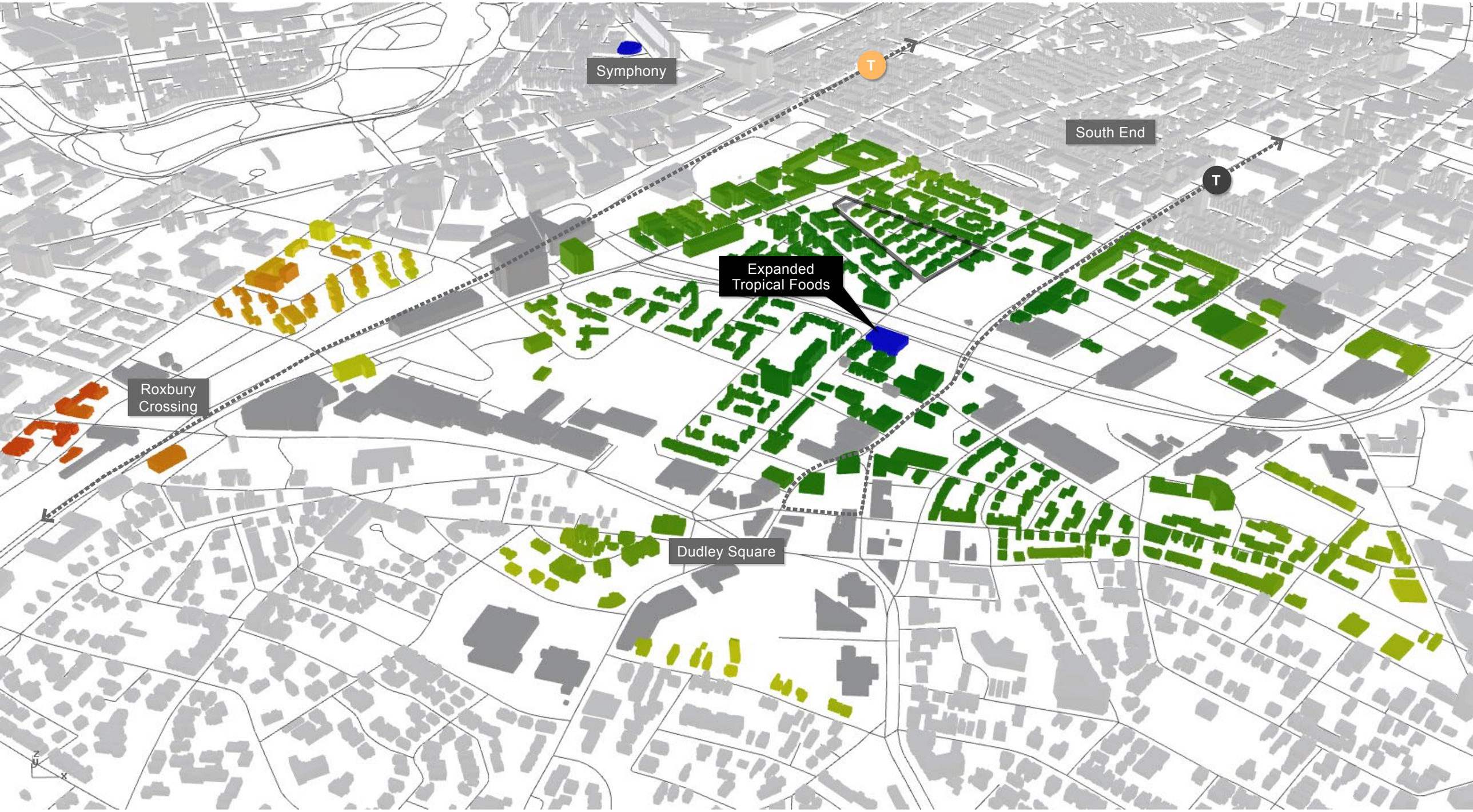
Source: *Walk Score*, Walk Score, 2011

Metric demonstration: grocery stores



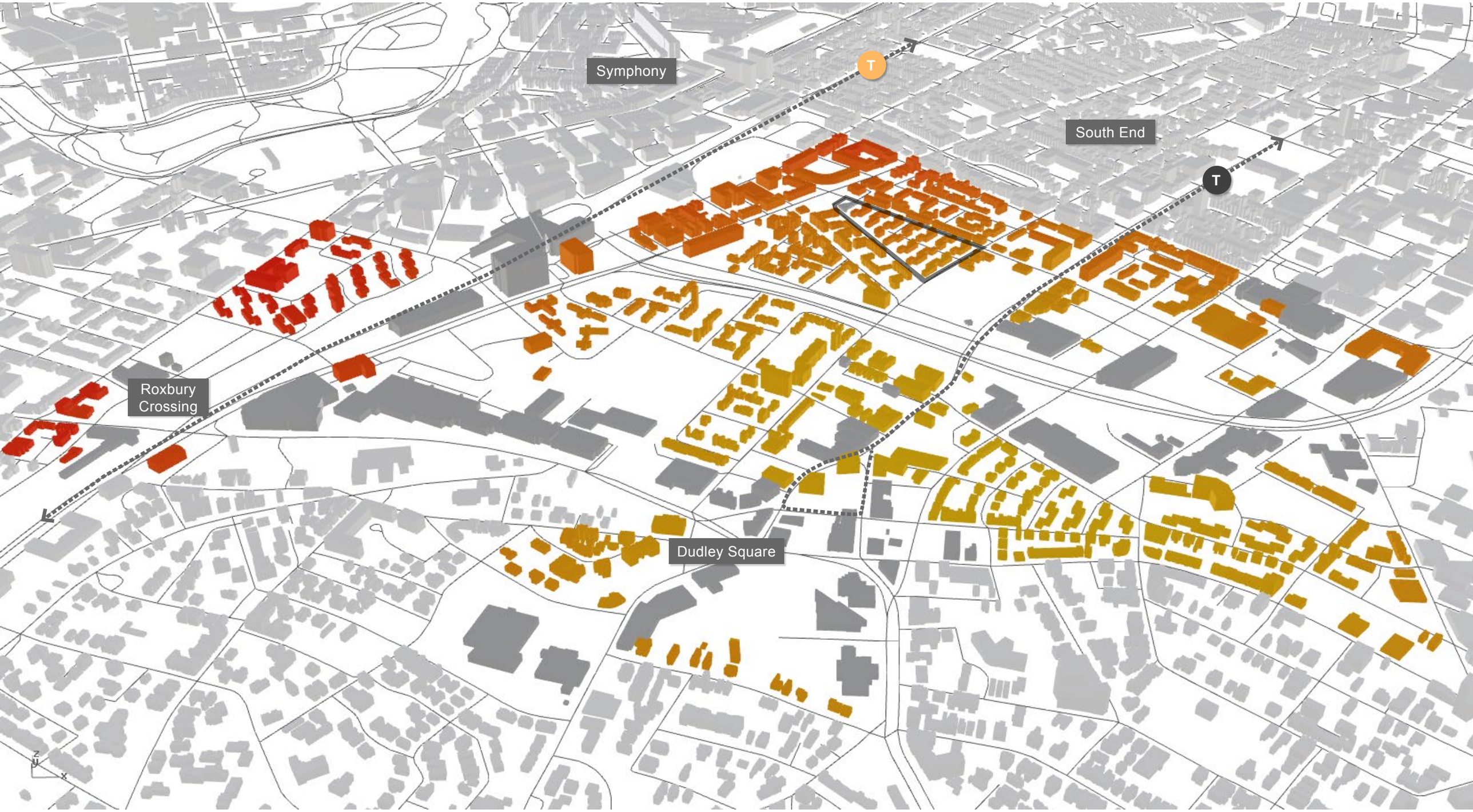
Grocery store access - existing

bad — good



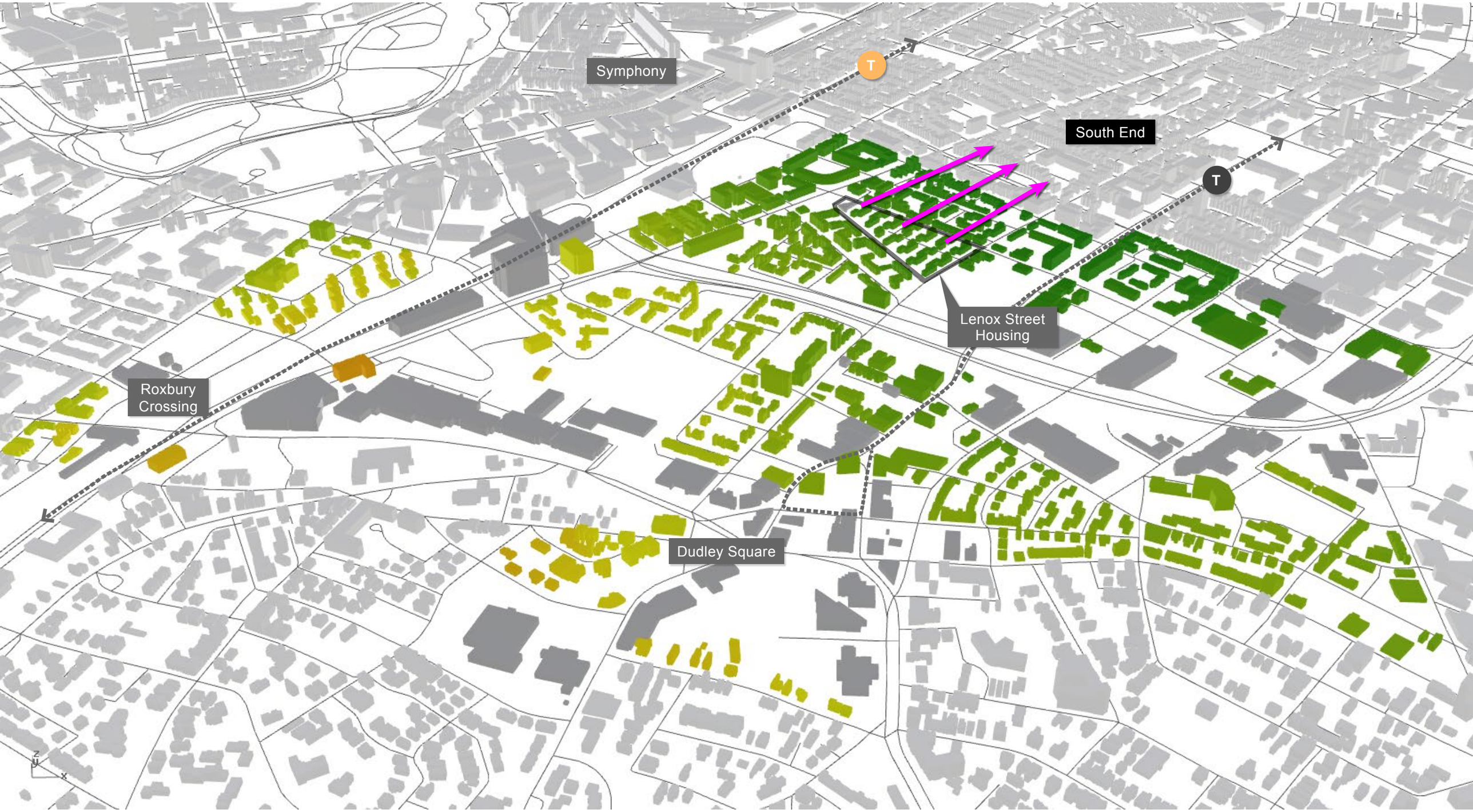
Grocery store access - under construction

Metric exploration: restaurants
(and other restaurant-like destinations)



Current restaurant availability

Destinations within Lower Roxbury only

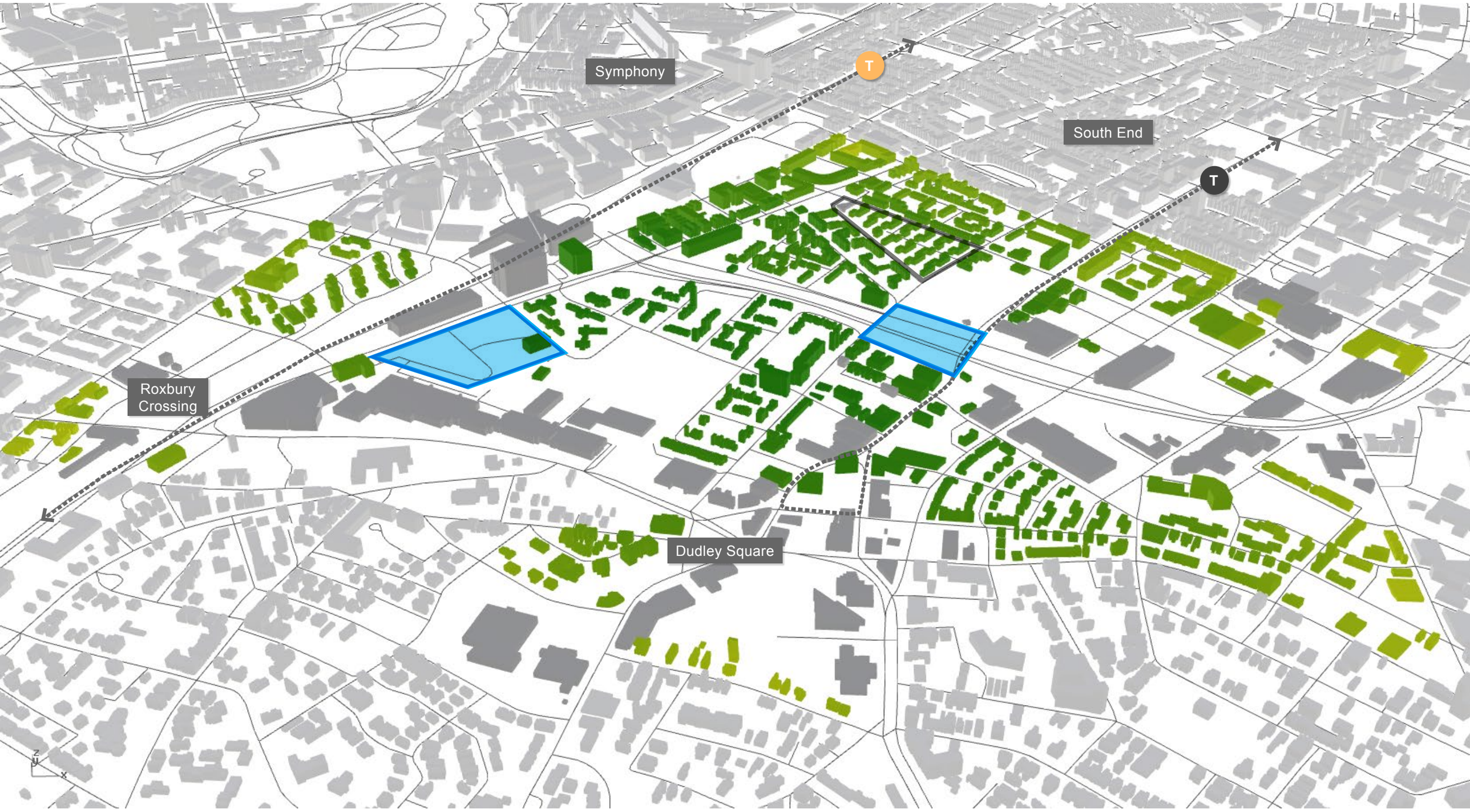


Current restaurant availability

Trips out of Lower Roxbury allowed

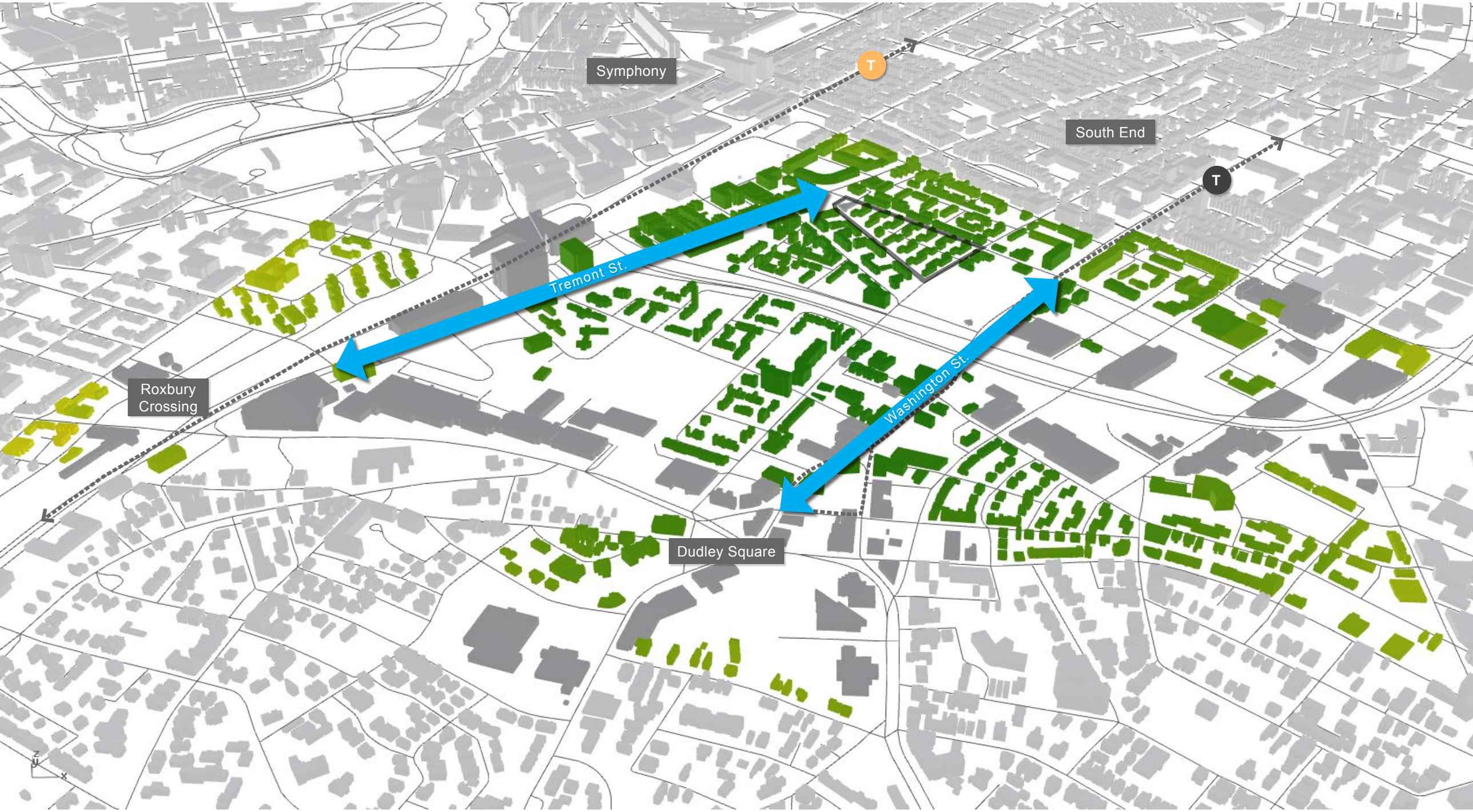
New restaurants

Investigation Method



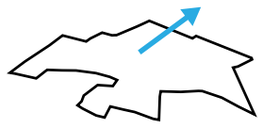
New restaurants - condensed placement

At currently-under-construction redevelopment sites

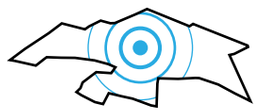


New restaurants - distributed placement

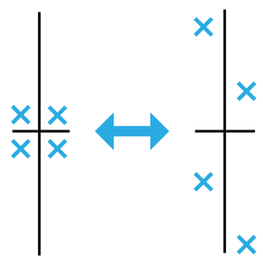
Along nearby plausible future commercial corridors



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.**

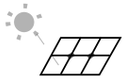
Infill Housing
Recommendations for Environmental Performance

Retrofitting
Consider the feasibility of adapting **existing assets** to today's performance and space standards. Measures could include:

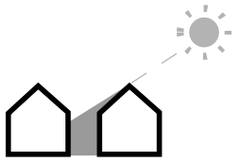
Adding **insulation** to roof and, where applicable, walls. Seal all wall openings such as doors and windows to prevent **infiltration** losses.

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.



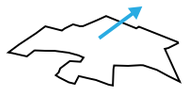
Similarly, implementing **solar PV** on the rooftops can further reduce electrical costs.



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.

Walkability
Recommendations for Neighborhood Amenities



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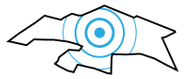

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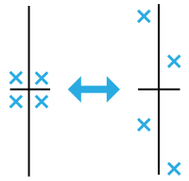

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Recommendations
Neighborhood Guidelines for Infill Housing and Walkability

Thank you.