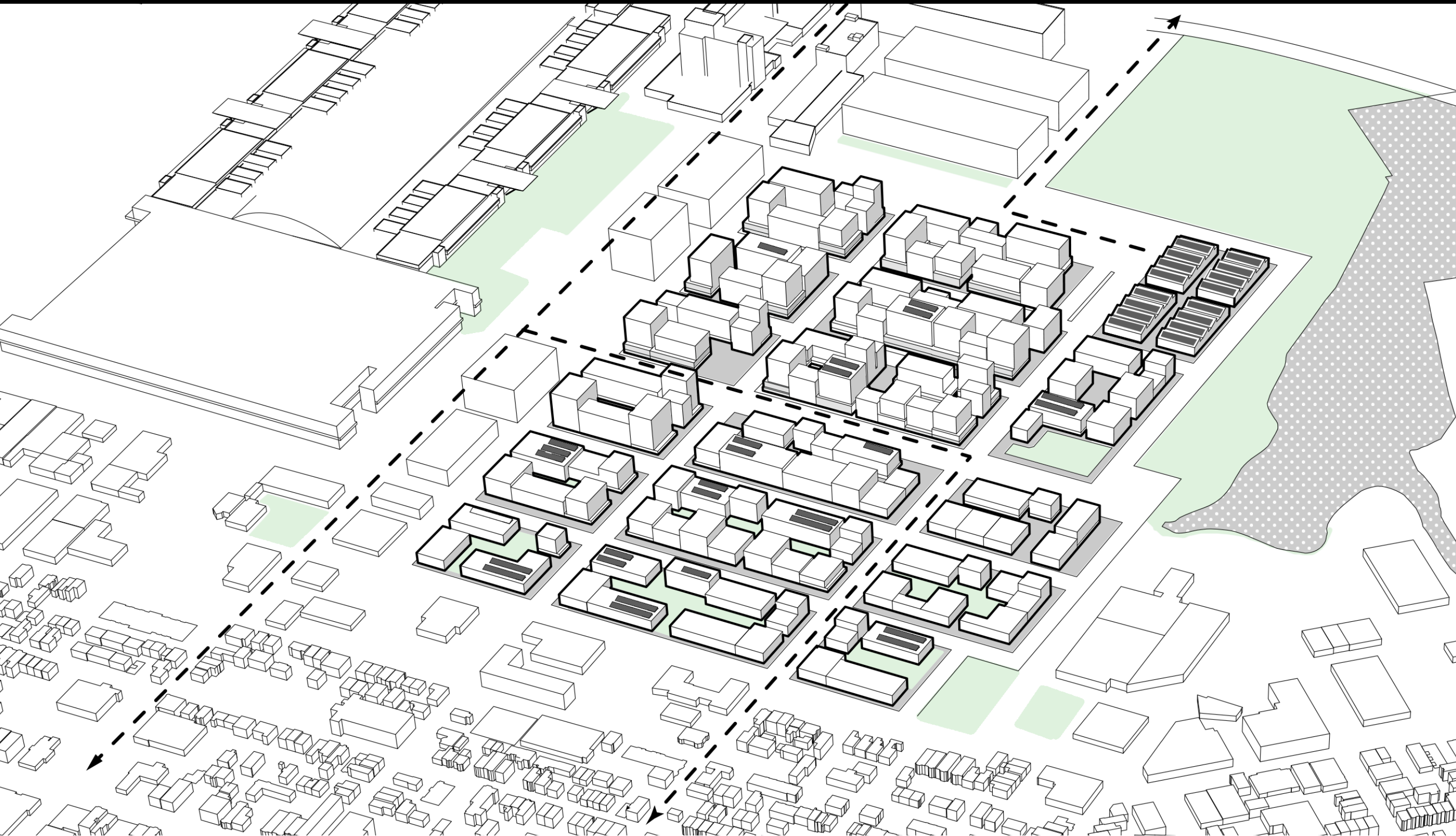


# BOSTON - SEAPORT SMARTGRID

Jamie Farrell, Samantha Cohen + Stephany Lin  
May 3rd, 2016

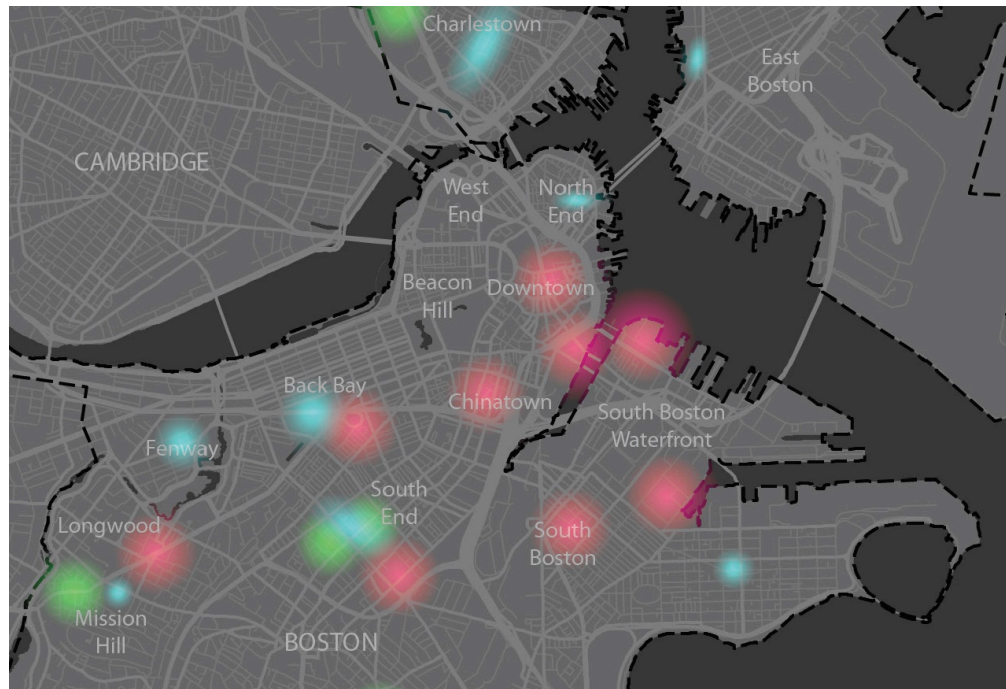


- 1. DESIGN GOALS**
- 2. PROTOBLOCK DEVELOPMENT**
- 3. SITE DESIGN**
  - A. PUBLIC REALM**
  - B. BUILT ENVIRONMENT**
- 4. MICROGRIDS**
- 5. SITE SCORECARD**



# DESIGN GOAL 1 - MICROGRID

## Why microgrids?



**BRA Energy Study**



**reduce carbon footprint**



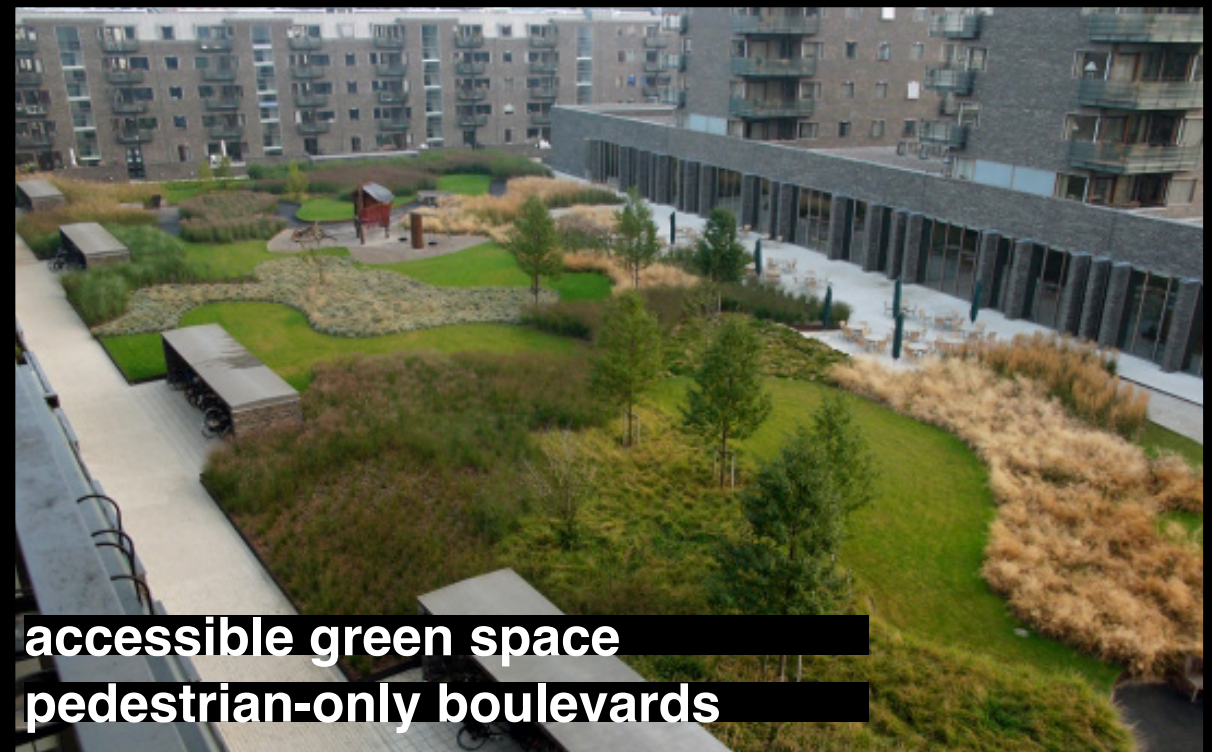
**produce net positive energy  
great ROI**



**better incorporate renewable  
energy + storage**



## DESIGN GOAL 2 - PUBLIC REALM





# DESIGN GOAL 3 - RESPOND TO SITE CONTEXT

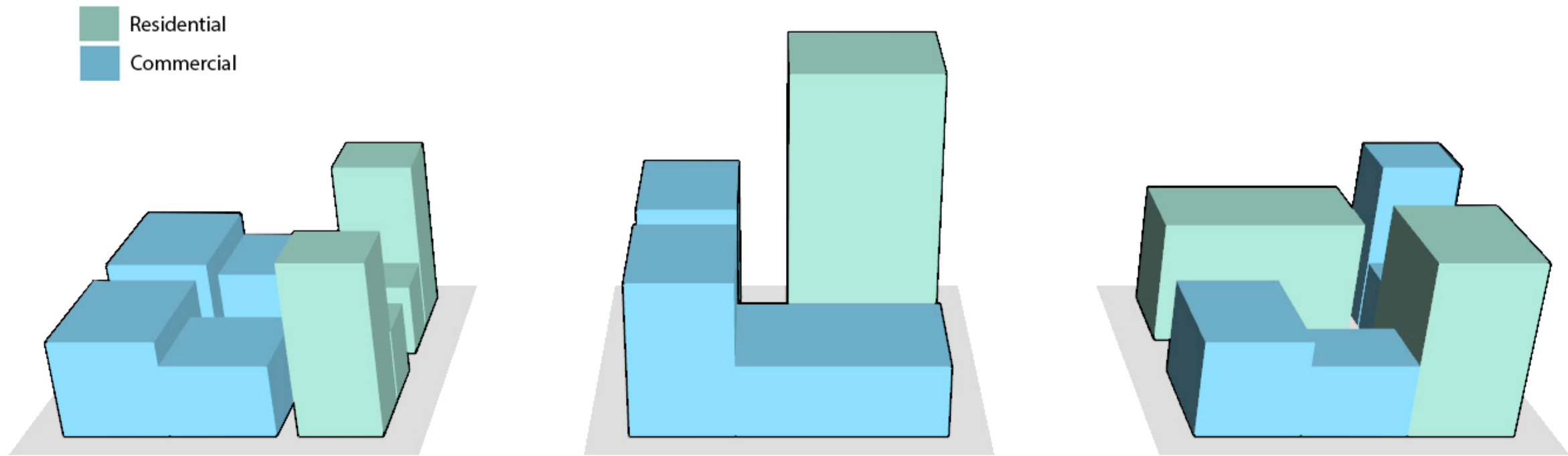
## Mediate Site Scales - Commercial, Innovation, Industry + Residential





# PROTOBLOCK DEVELOPMENT

## protoblock types



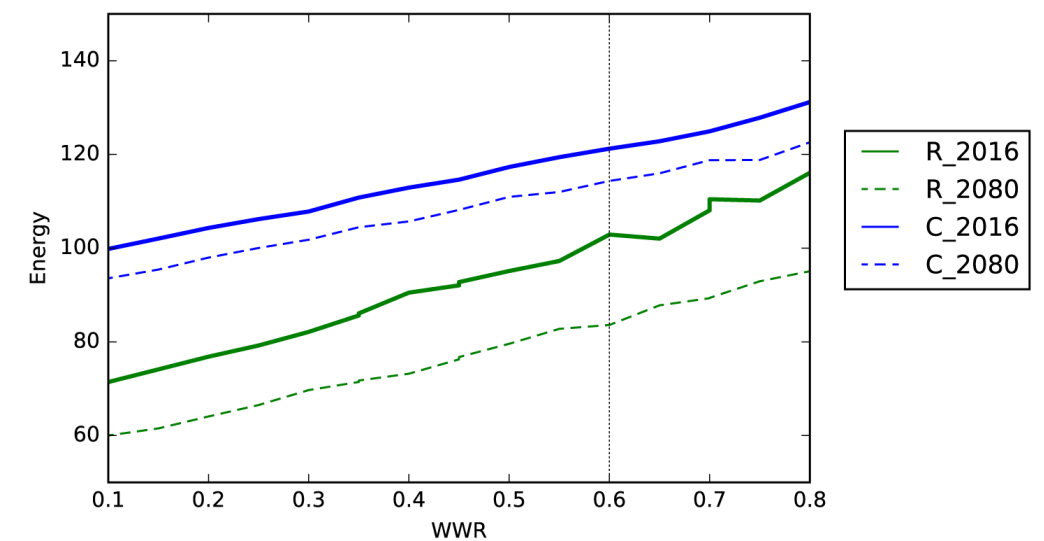
## simulation results

Table of Key Values

Factor	Proto 1	Proto 2	Proto 3
Occupants (R and C)	R 134, C 670	R 390, C 858	R 223, C 660
FAR	1.67	2.91	1.99
OR	0.49	0.52	0.47
Occupant density	0.12/ m2	0.16/ m2	0.12/per m2
Maximum Stories	12	20	12
EUI [kWh/m2]	111.63	92.63	102.01

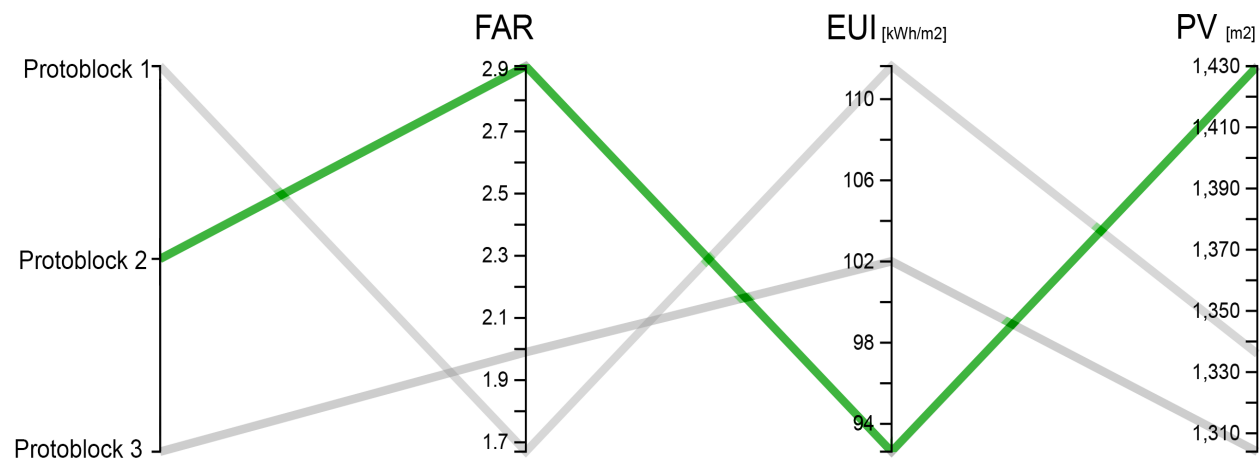
## sensitivity analysis

Energy (kWh) v. Window To Wall Ratio



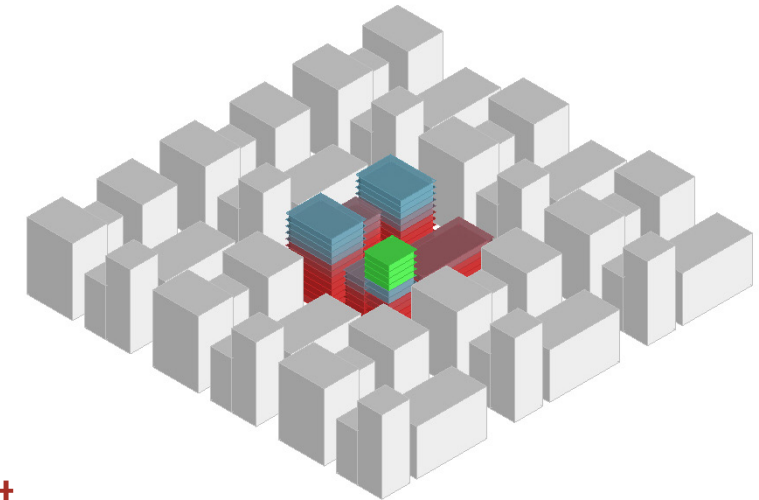
# PROTOBLOCK ANALYSIS

## protoblock selection

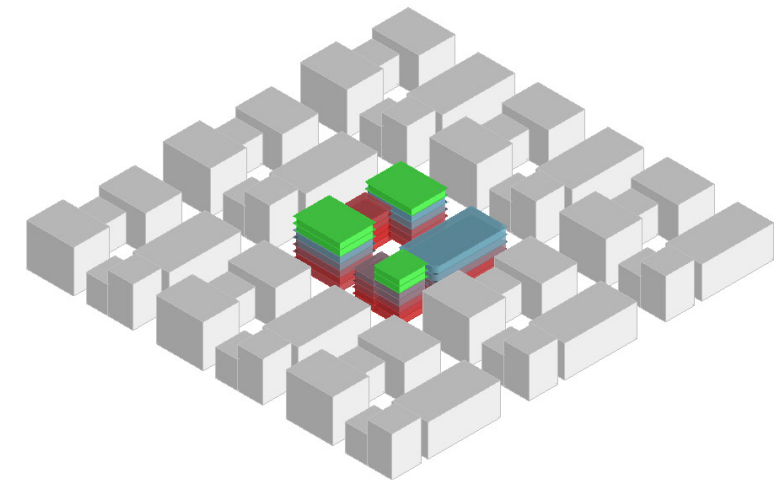


## daylight autonomy study

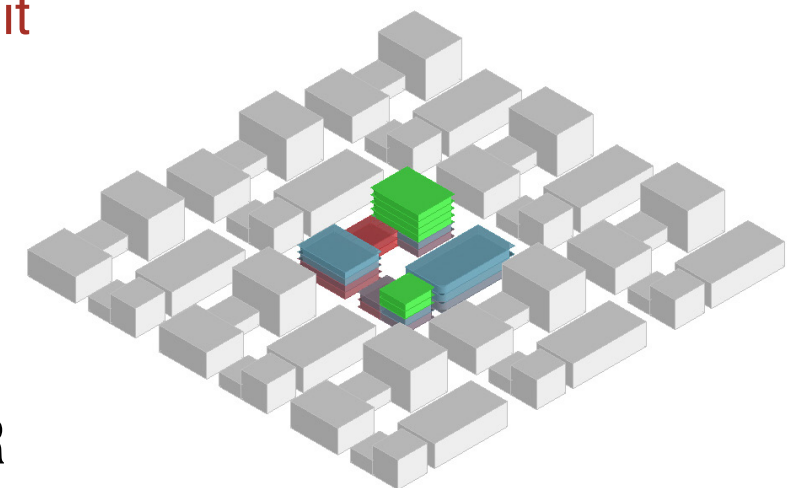
\* 40% WWR



4.0 FAR  
15% daylight



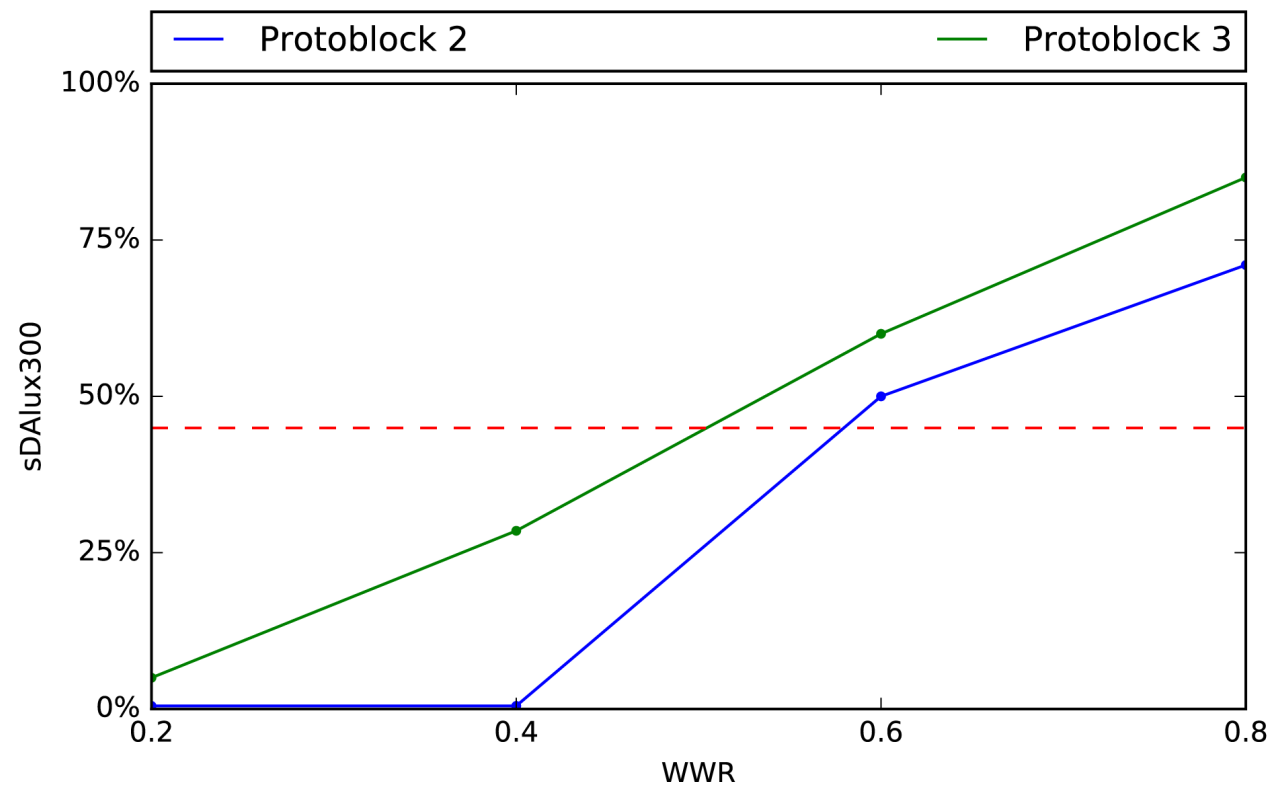
3.0 FAR  
24% daylight



2.0 FAR  
40% daylight

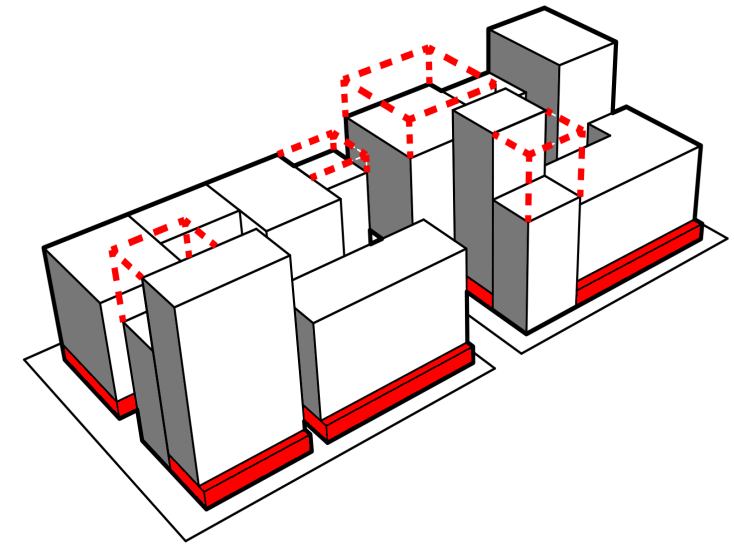
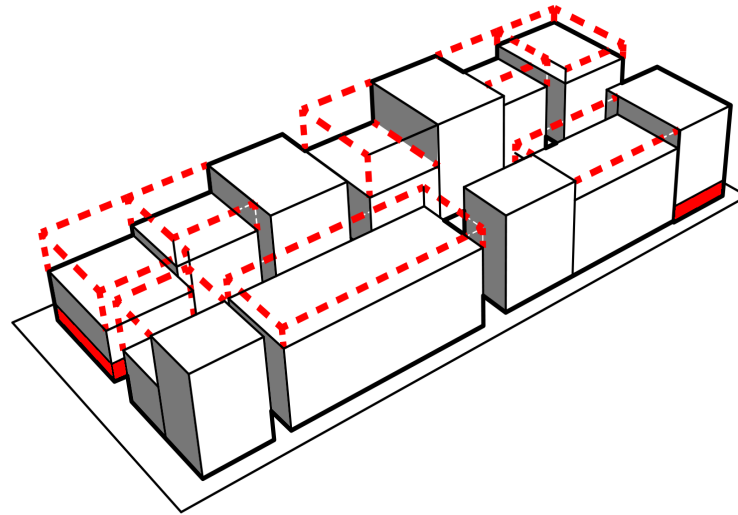
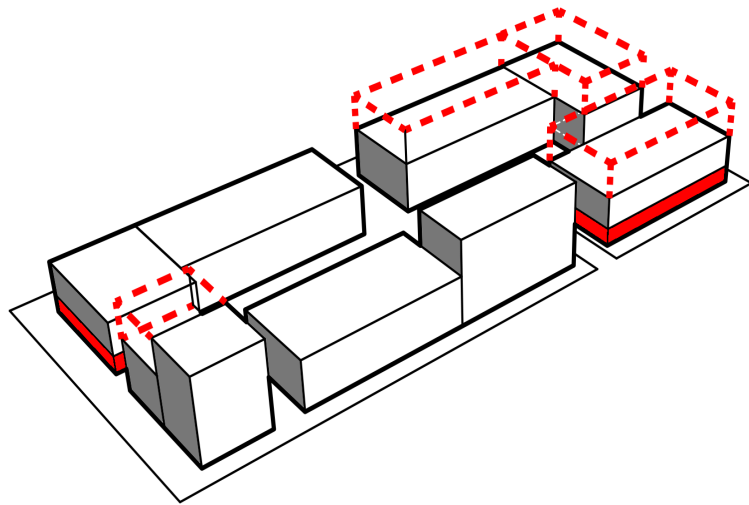
(sDA<sub>300lux</sub>) 0.0 0.45 1.0

## window to wall ratio versus spatial daylight autonomy

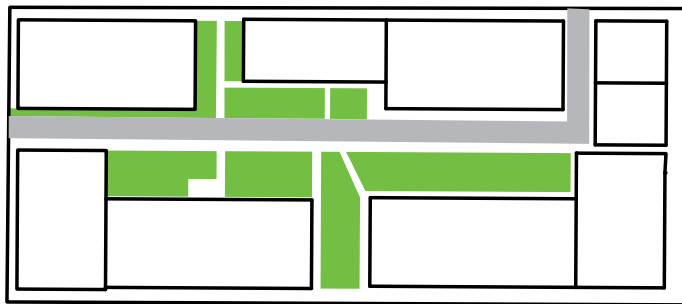


# FINAL BLOCK DESIGN

## block massing



## public realm



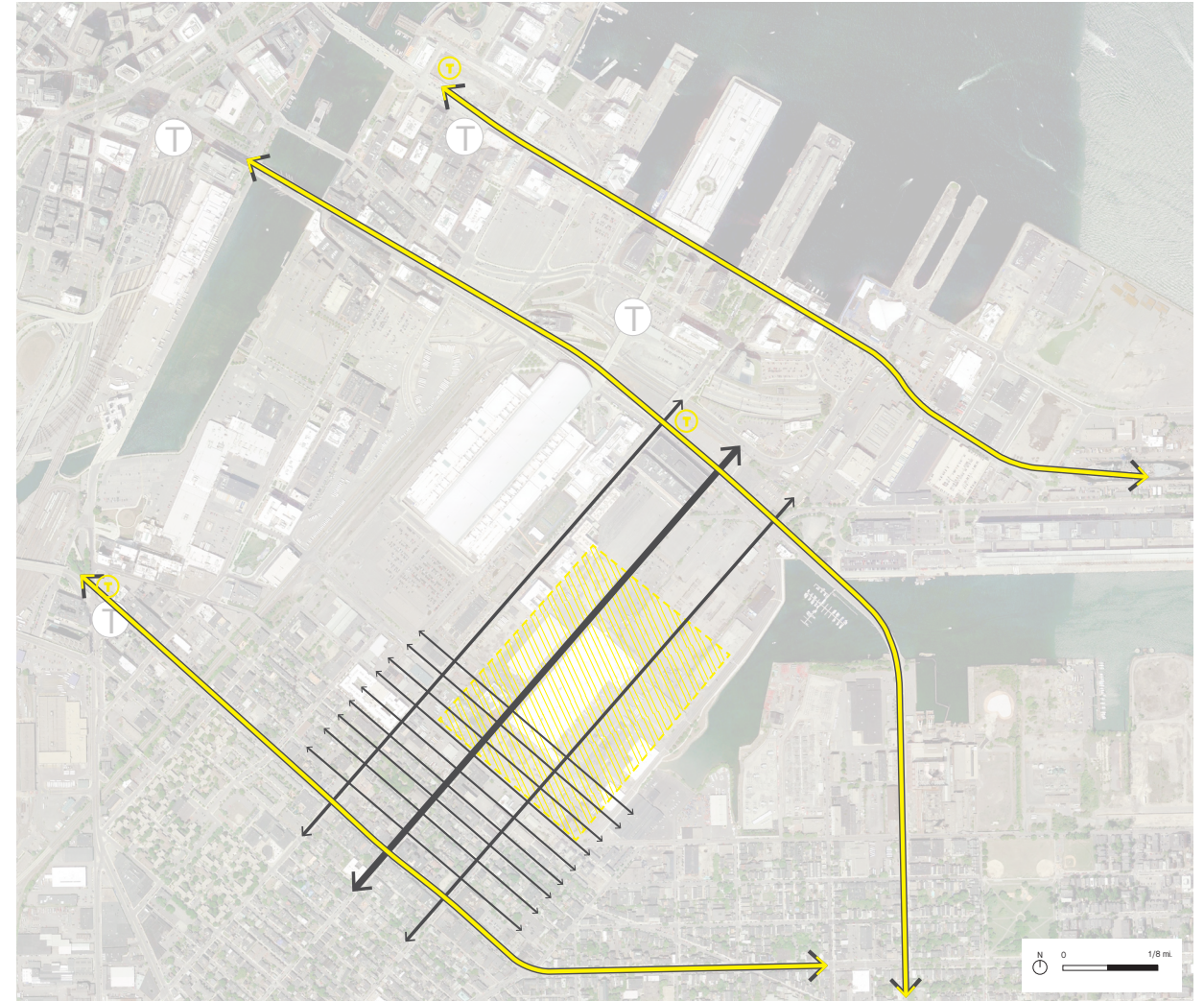


# NEIGHBORHOOD DESIGN

existing connections



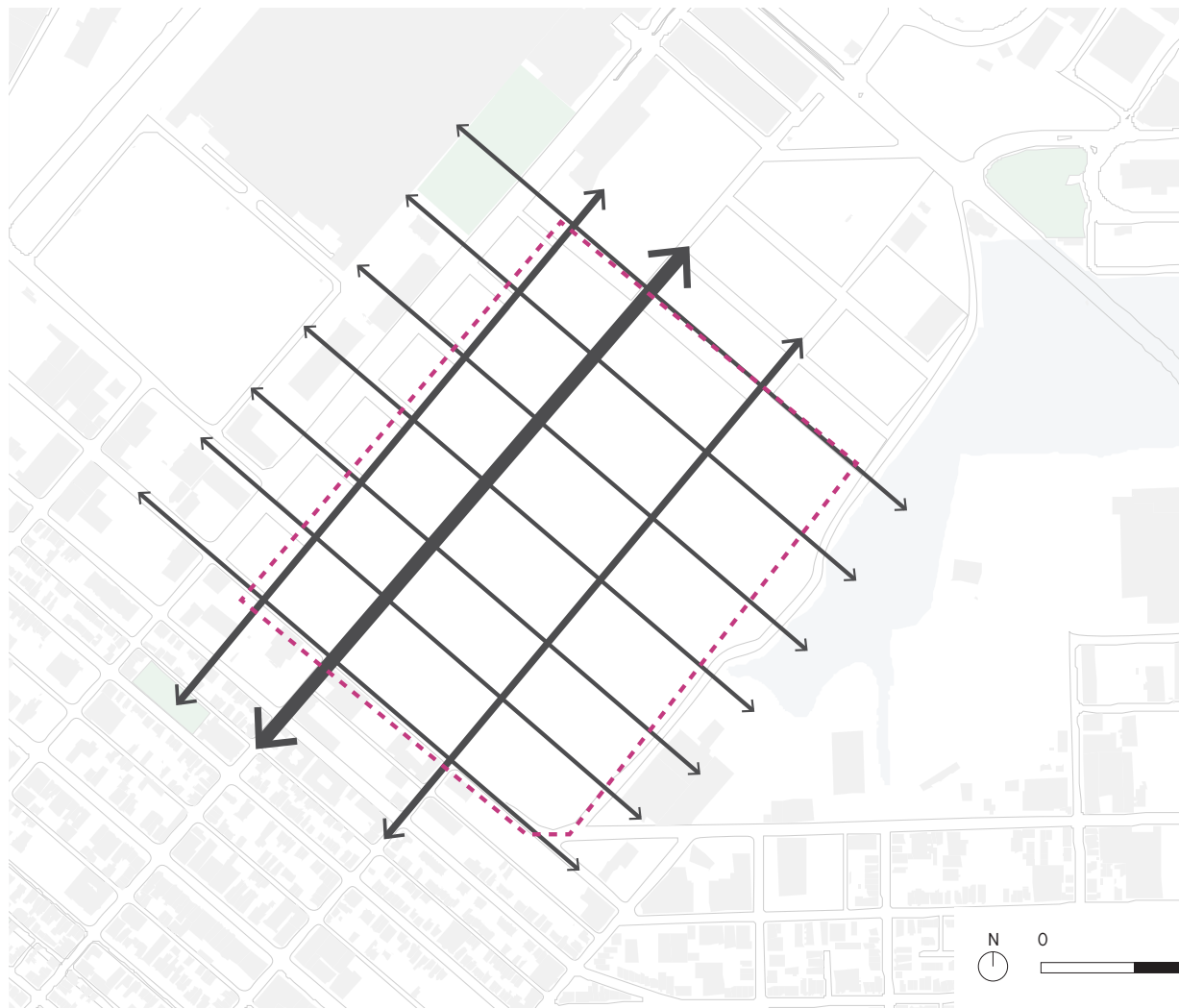
extend street network



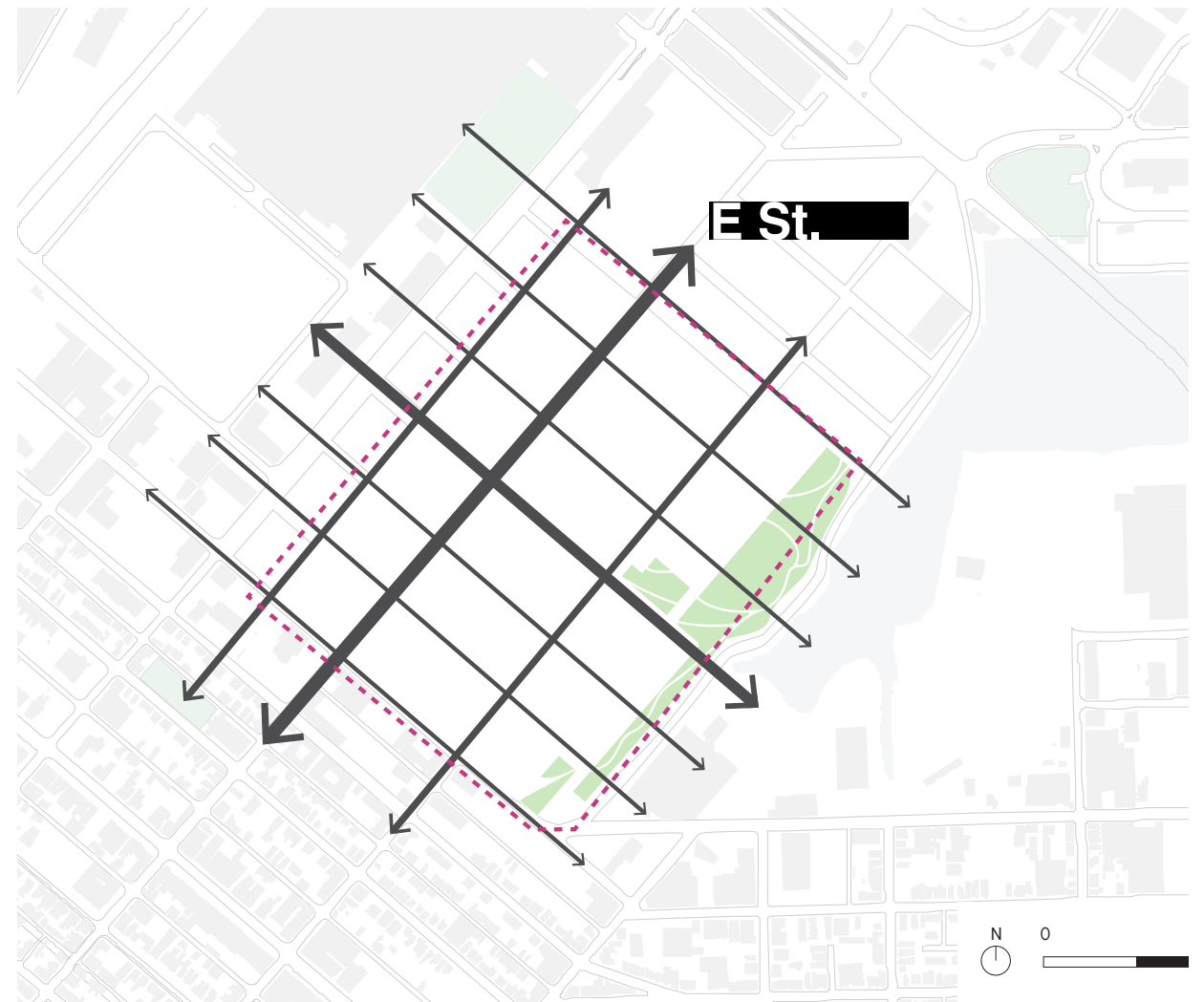


# NEIGHBORHOOD DESIGN

## establish grid

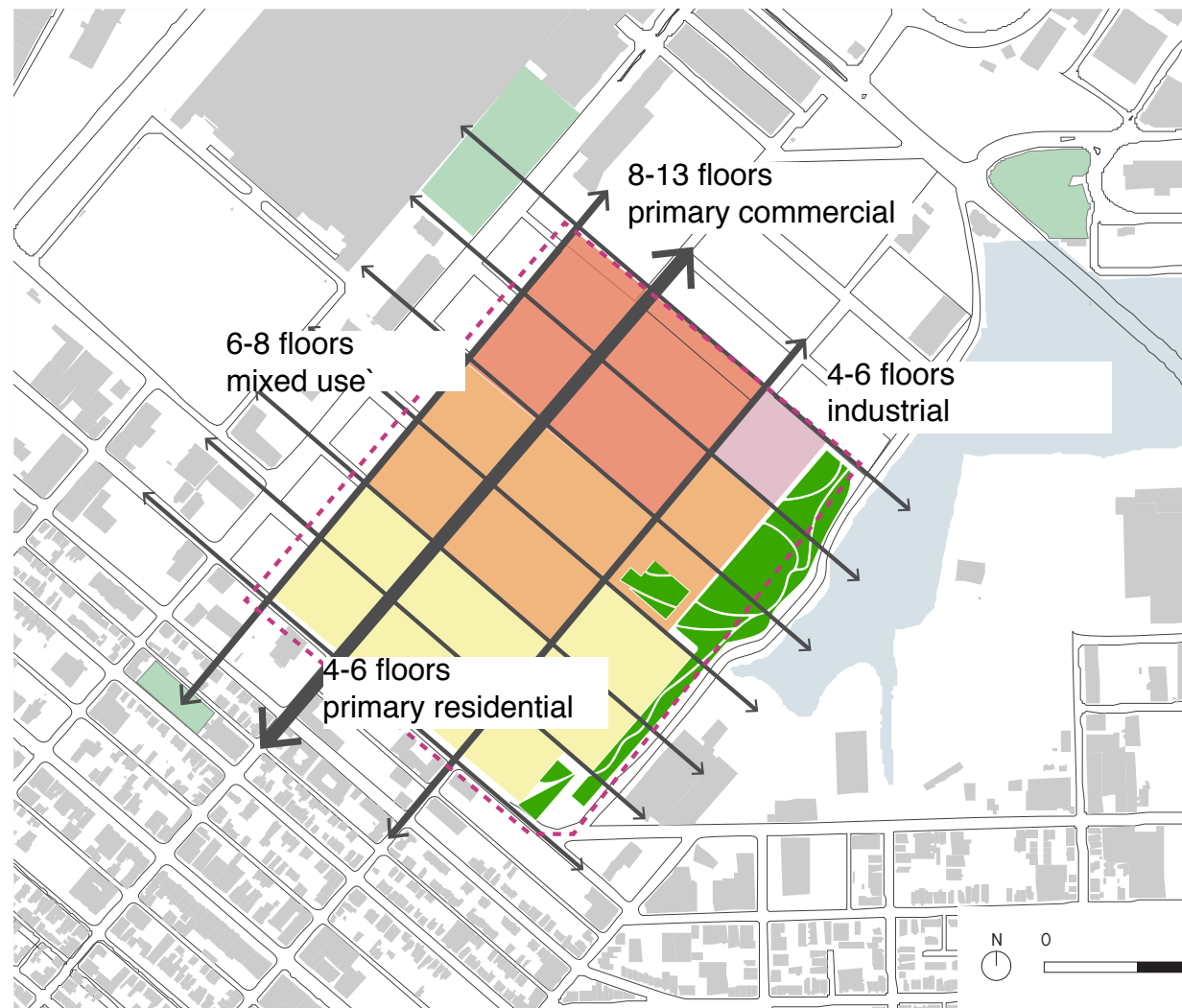


## develop street hierarchy

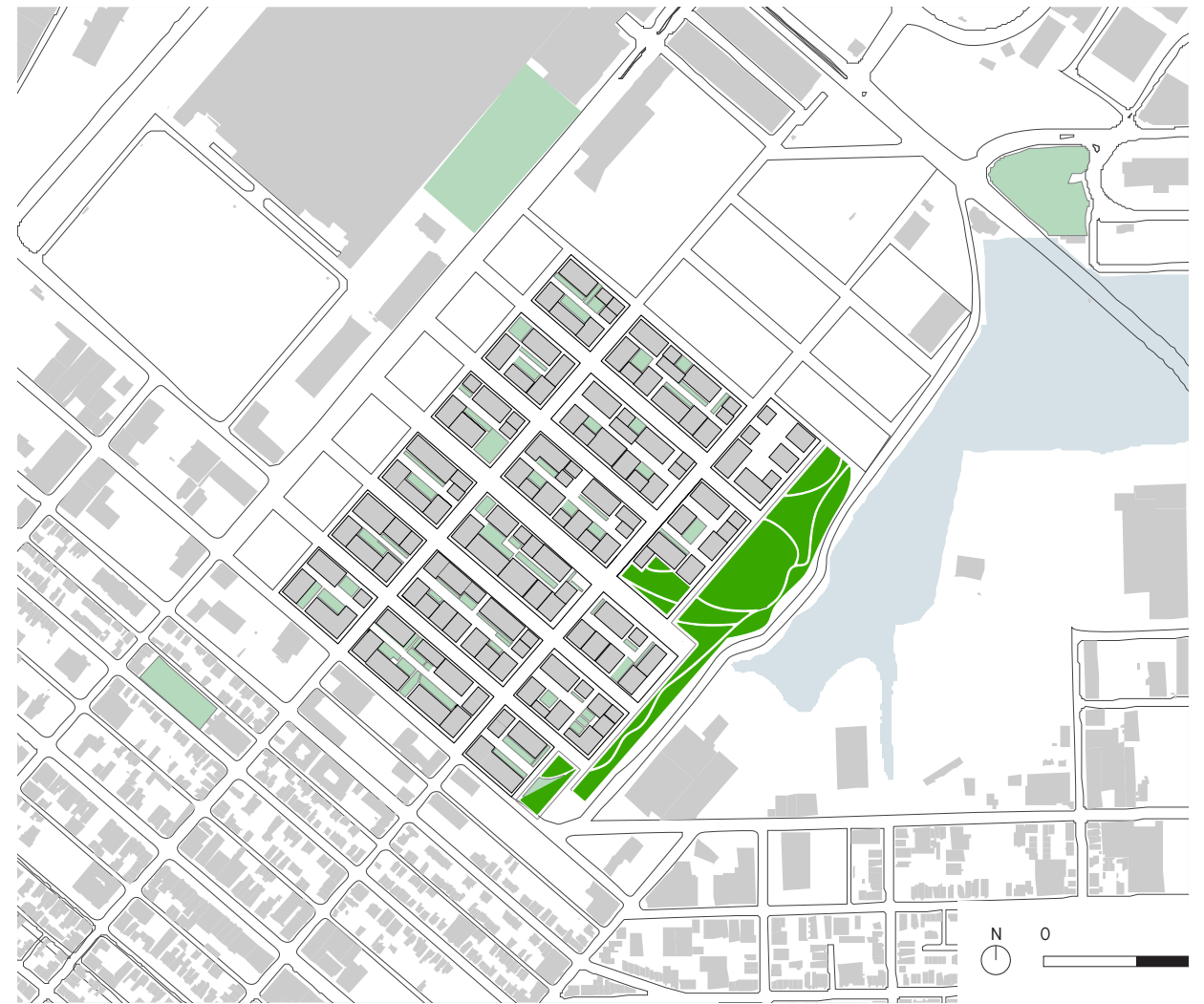


# NEIGHBORHOOD DESIGN

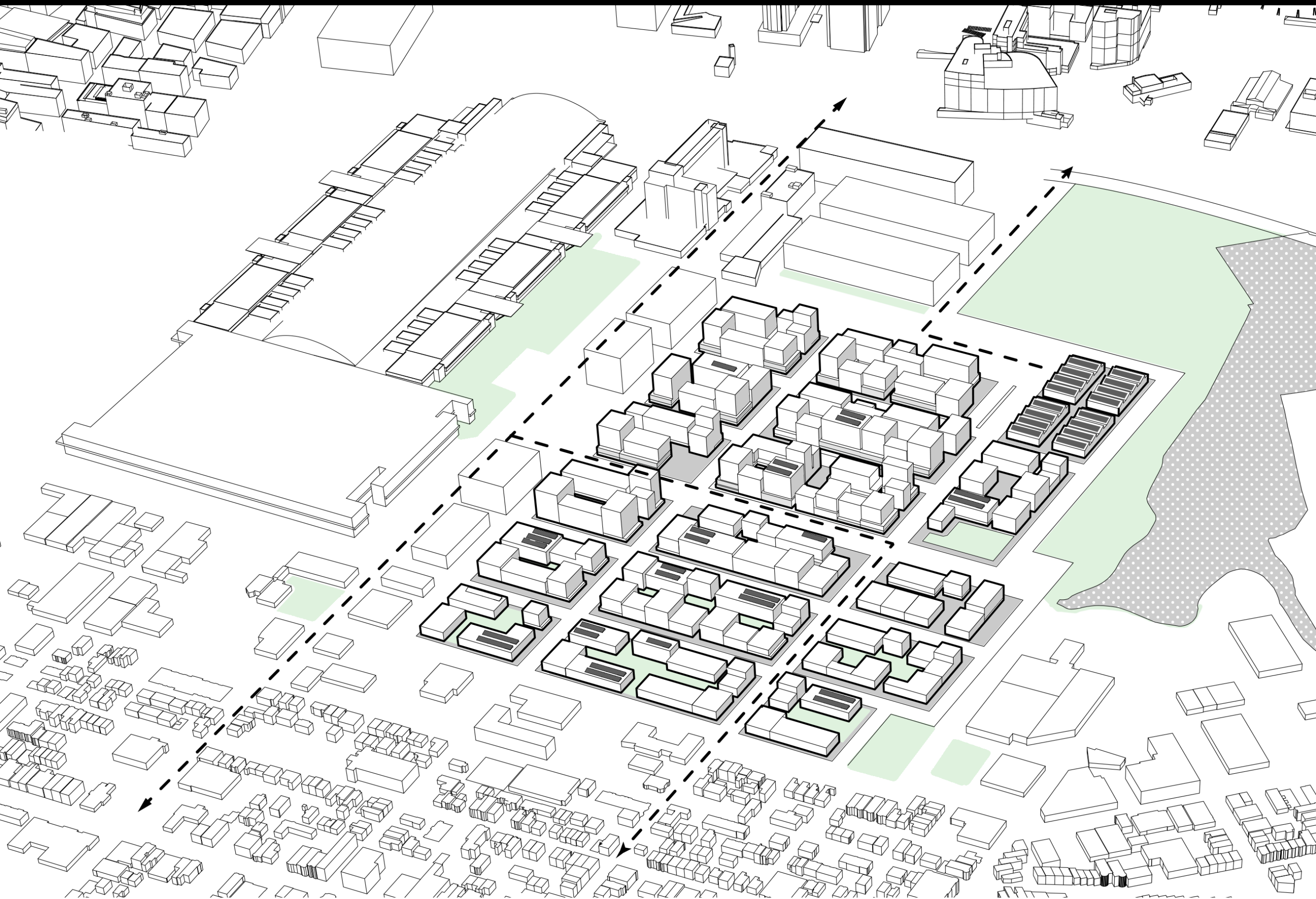
develop zones



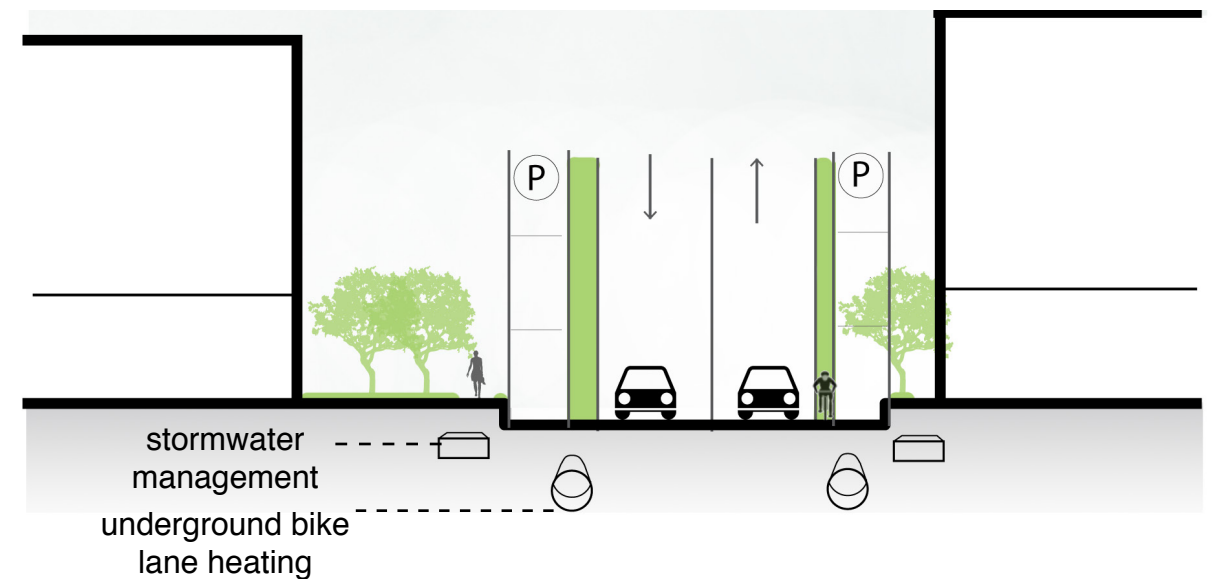
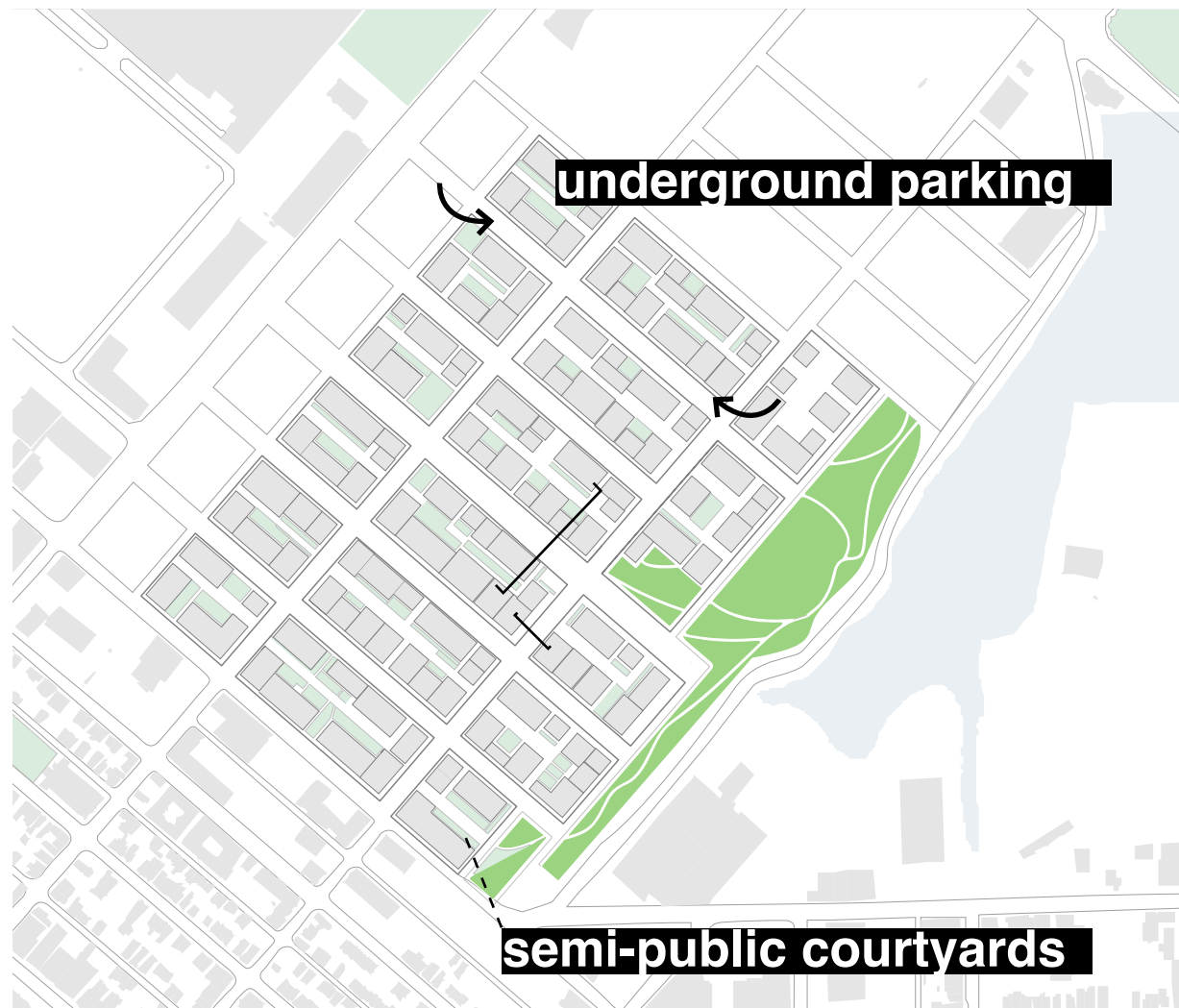
final site plan



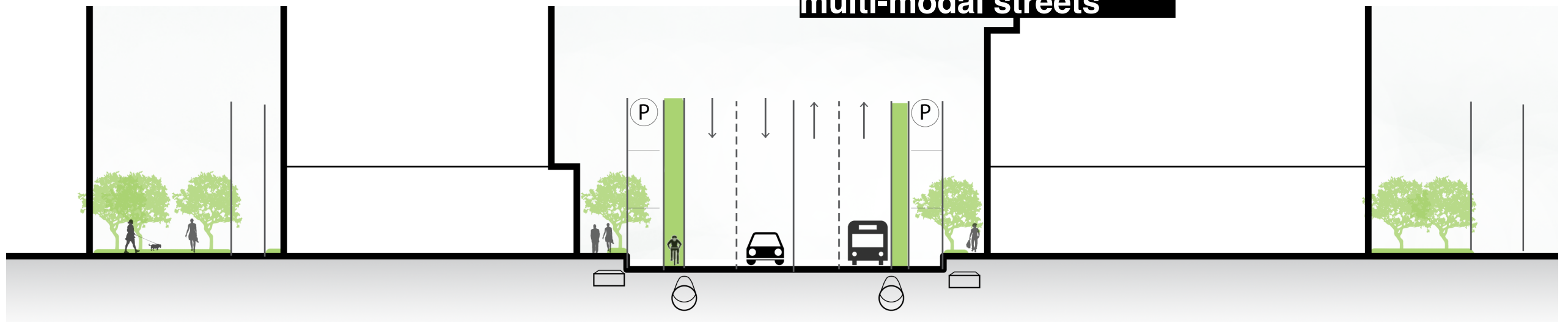




# PUBLIC REALM - CIRCULATION

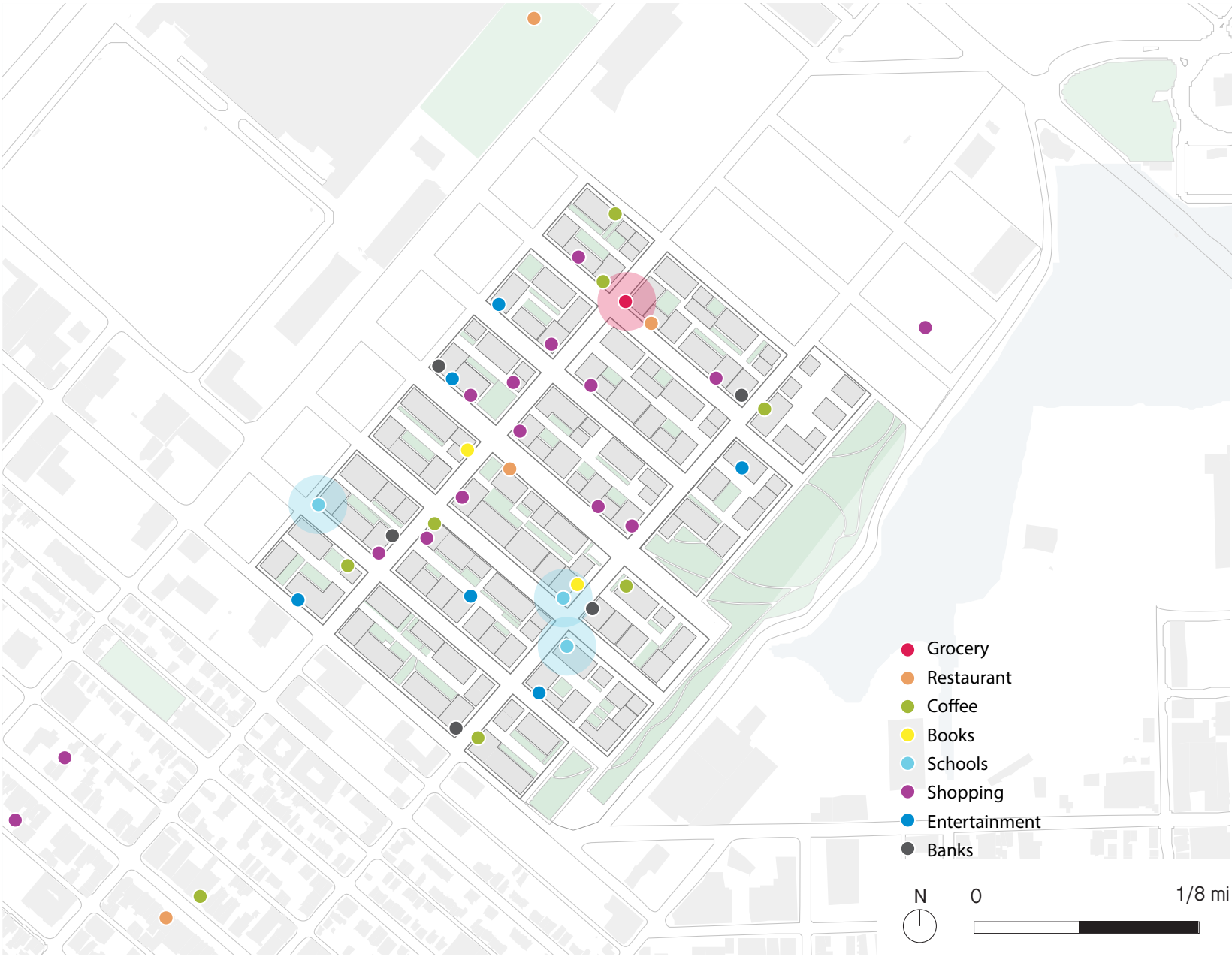


**multi-modal streets**





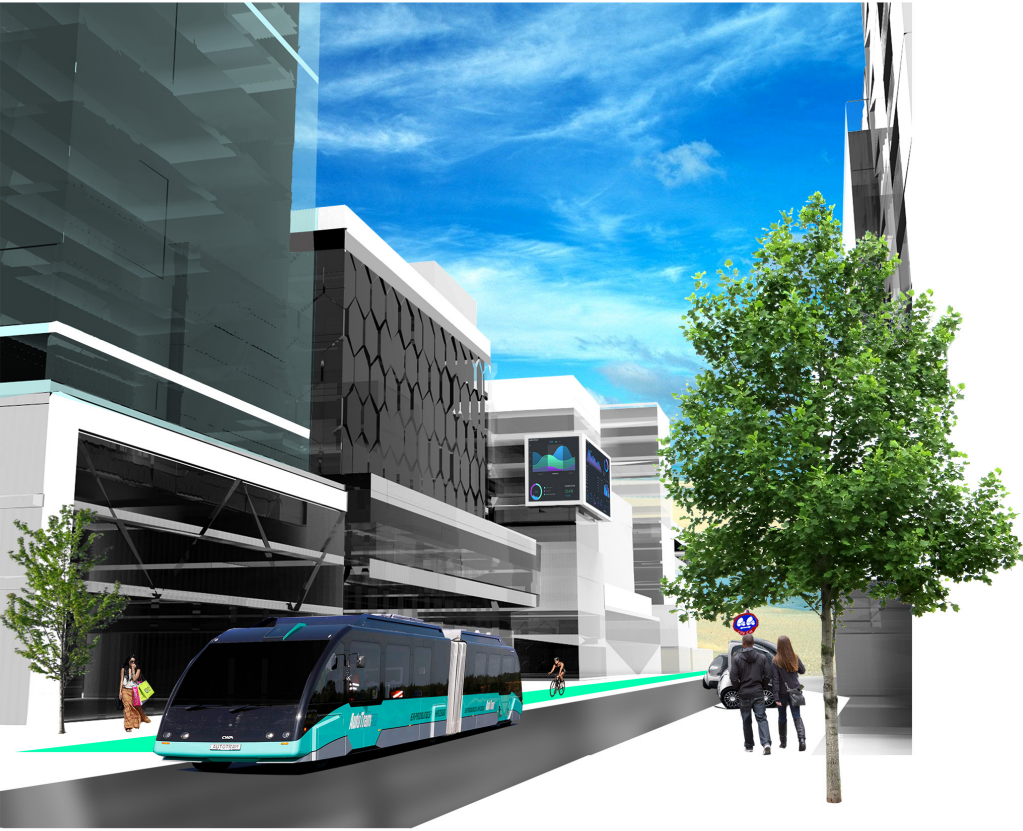
# PUBLIC REALM - AMENITIES



walkability score: 92/100



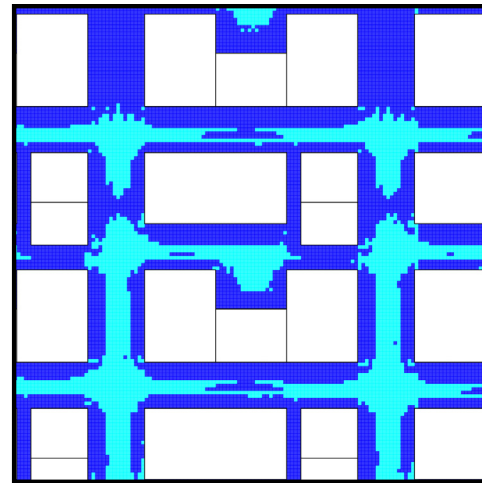
courtyard



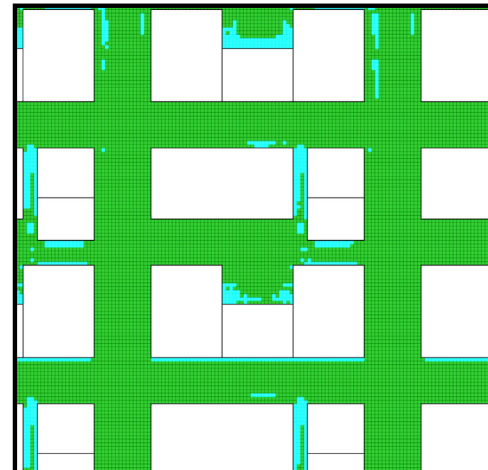
street level retail corridor



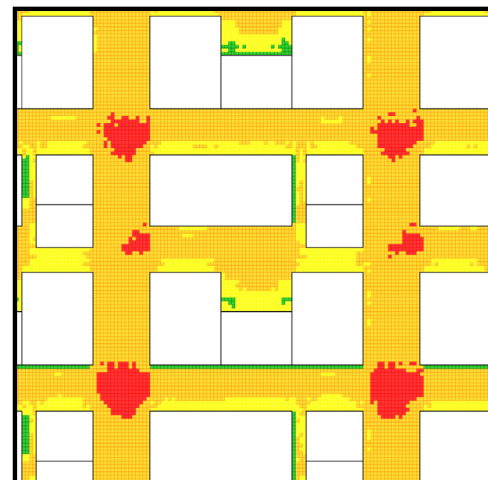
January UTCI



April UTCI



July UTCI



# FLOODING CONSIDERATIONS



**floodable parking garage**



**floodable parkspace + green infra**



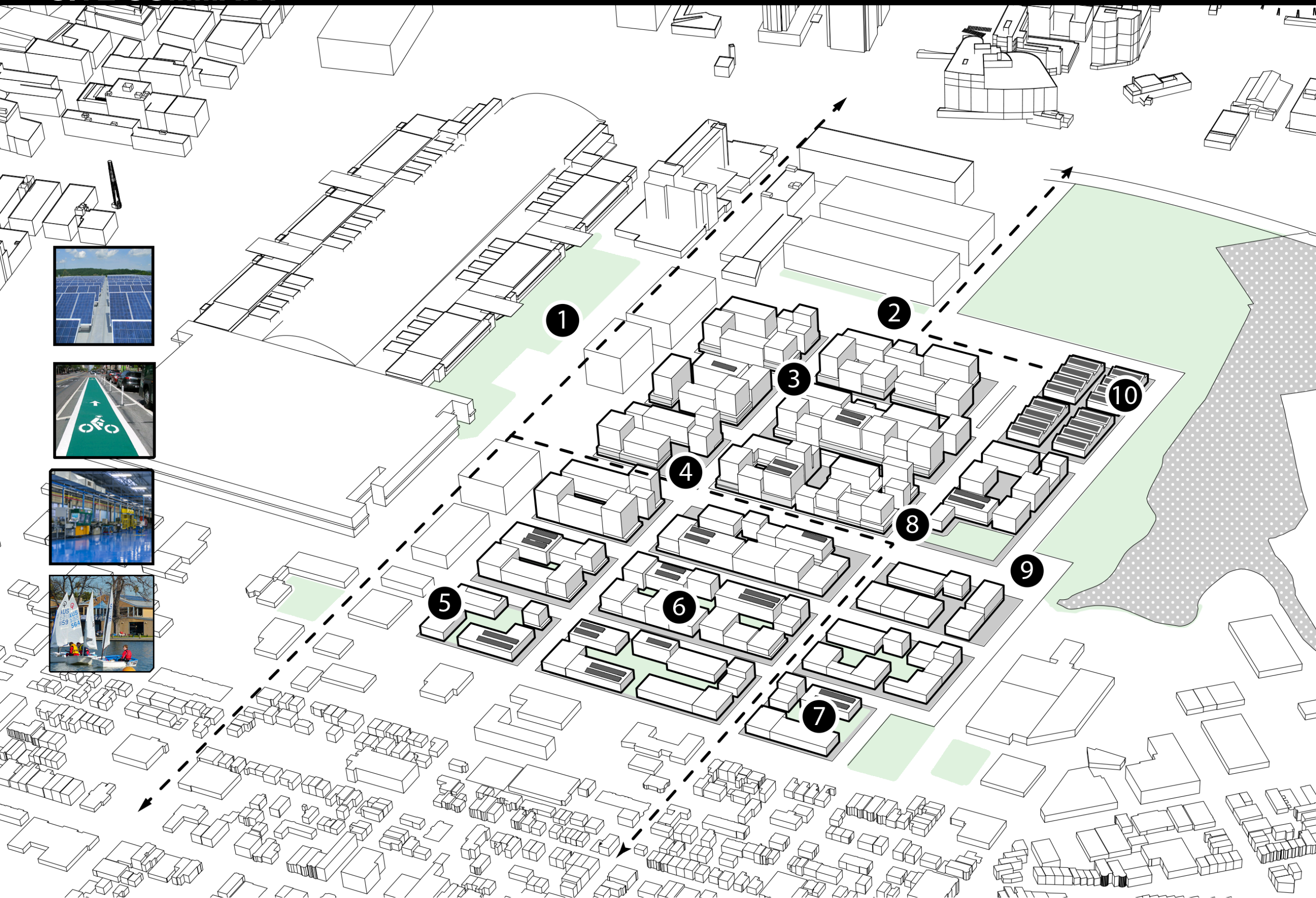
**canal flood park**

## Policies + Building Codes

- Floodproof mechanical rooms
- Sacrificial ground floors for future adaptability

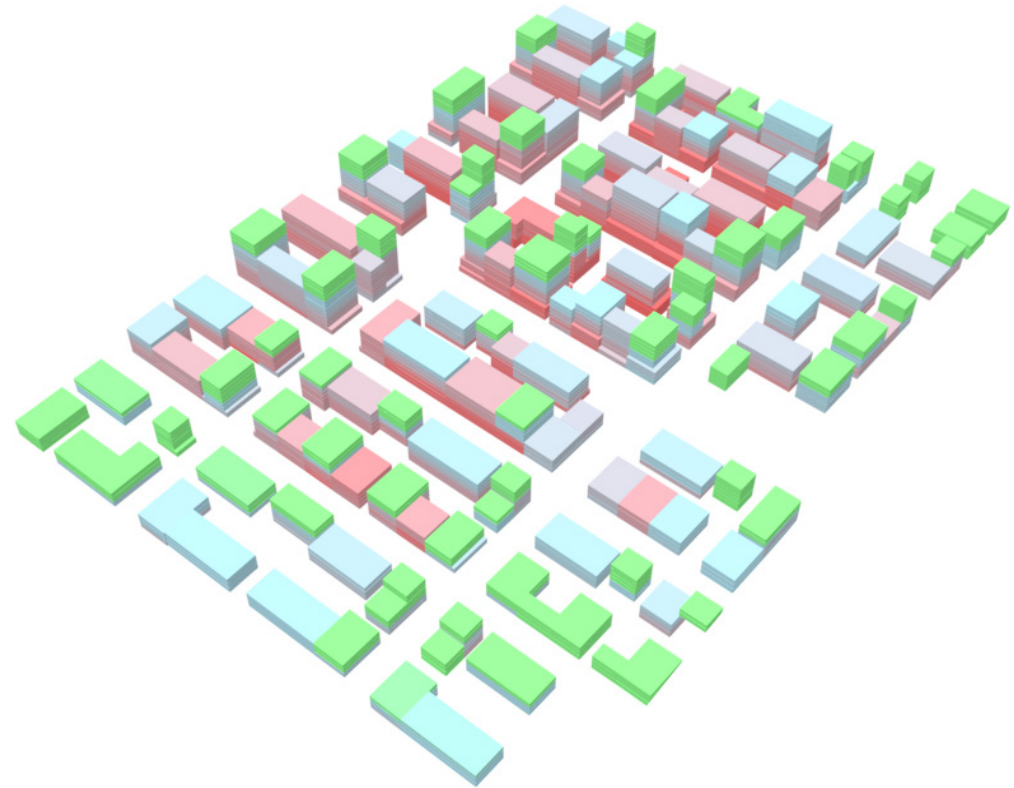
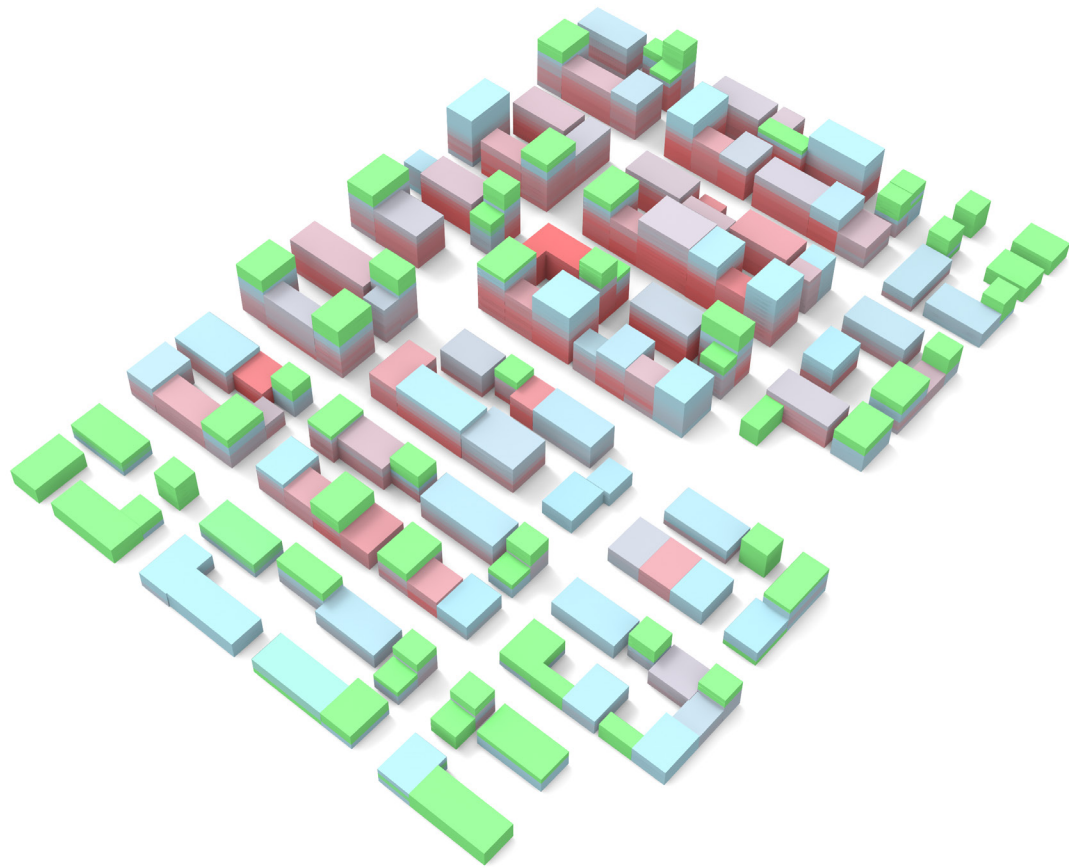


# SITE SUMMARY



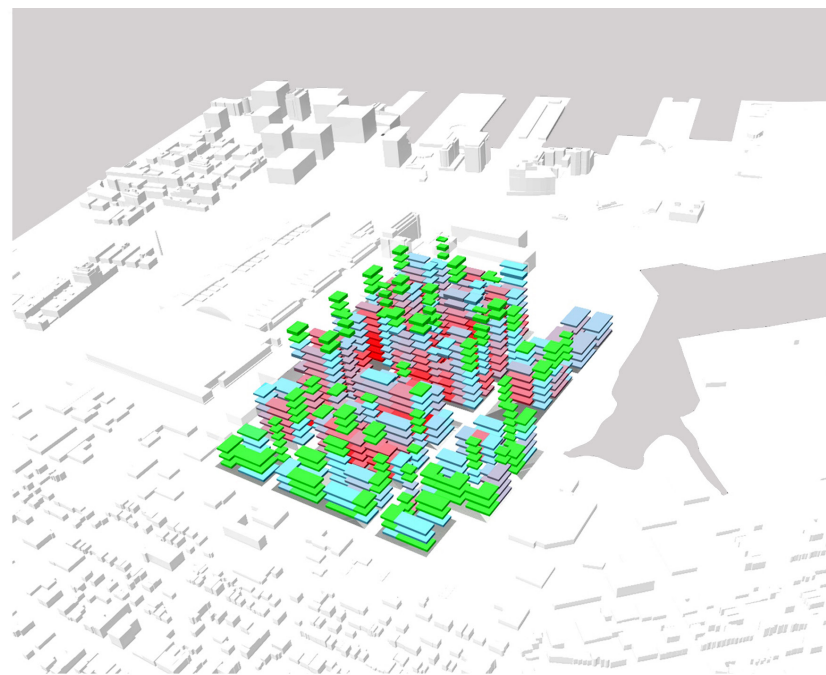
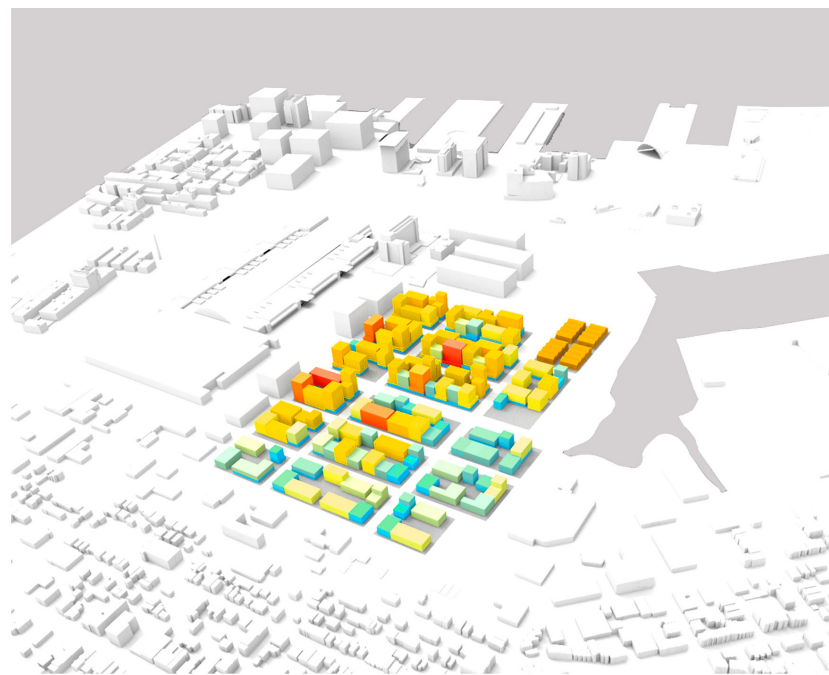
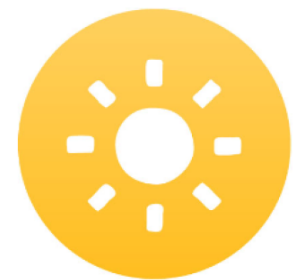


## spatial daylight autonomy

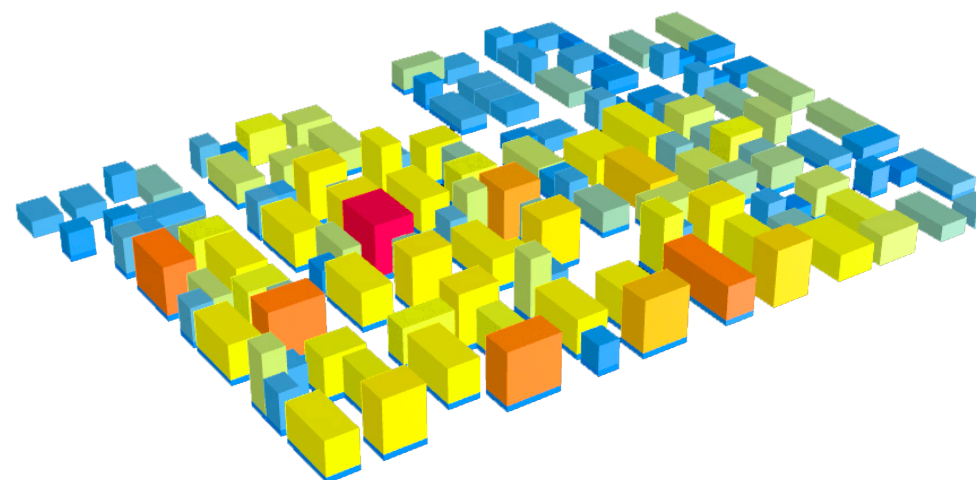
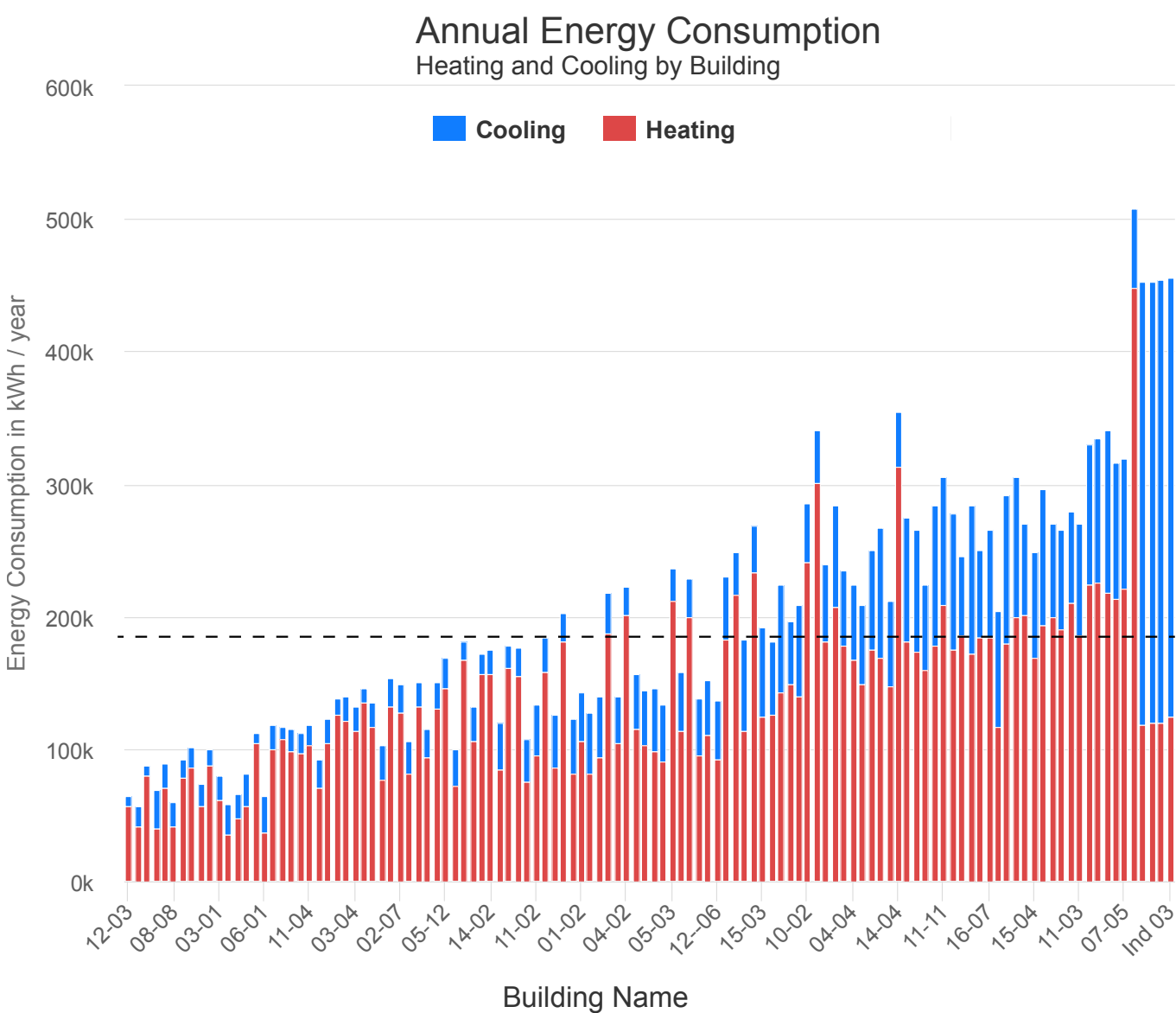


**49**

**% DA**  
**DAYLIGHT**  
**AREA**



# BUILDINGS - EMBODIED + OPERATIONAL ENERGY



2700

kWh/m2  
EMBODIED  
ENERGY (50y)



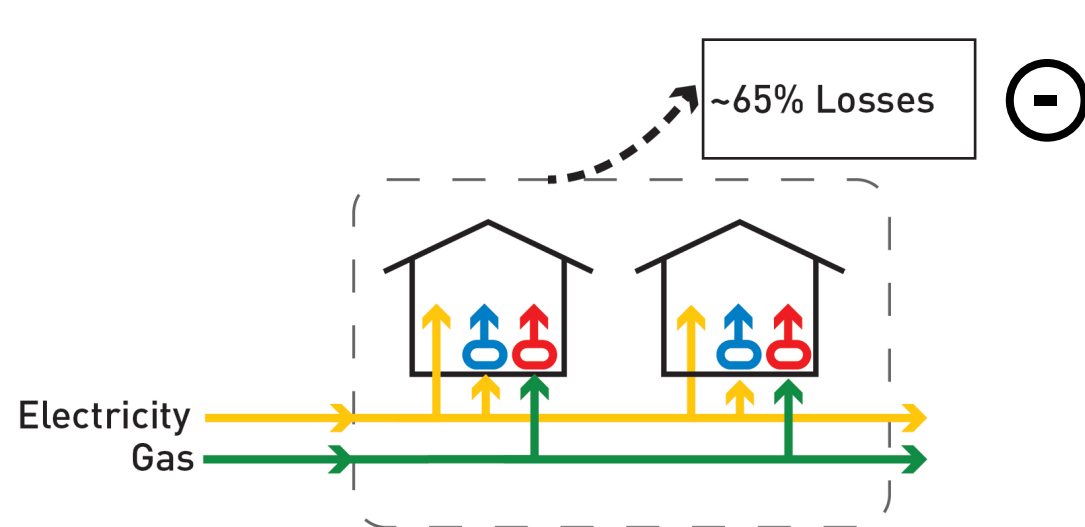
4950

kgCO2/m2  
BUILDING GHG  
EMISSIONS (50y)

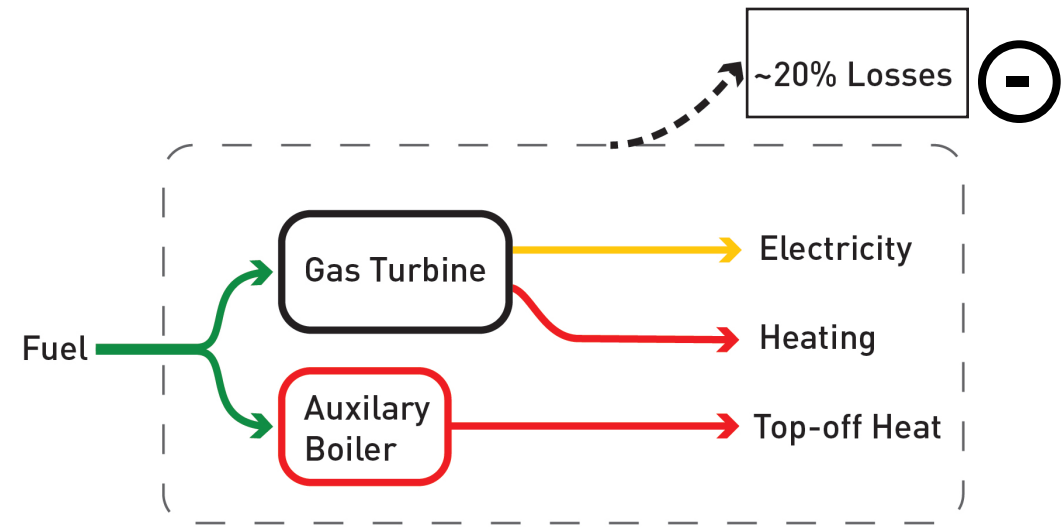




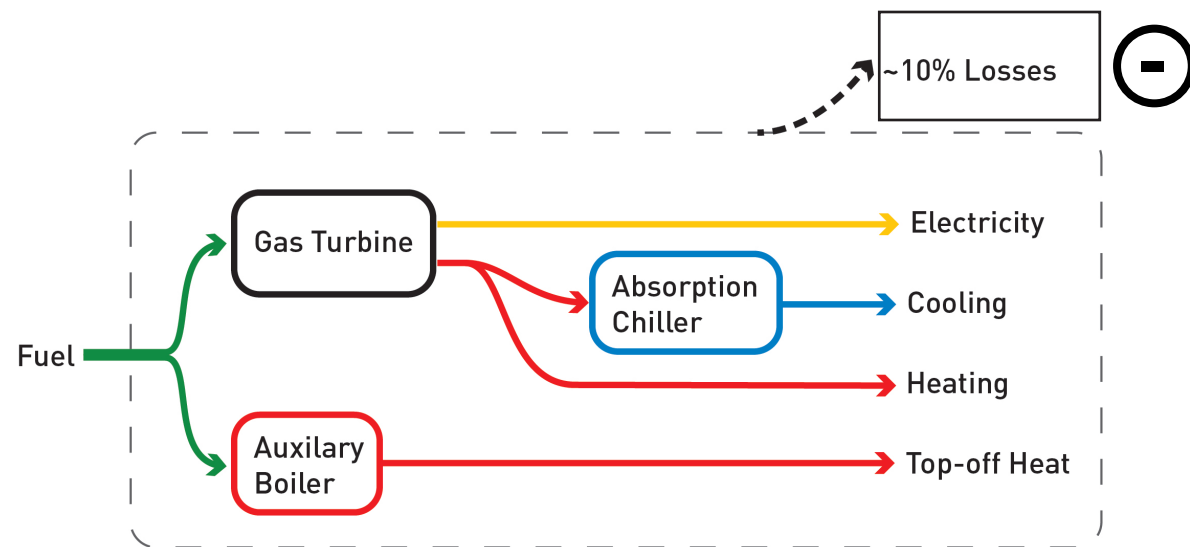
# MICROGRID - GRID VS. CHP, CCHP + RENEWABLES



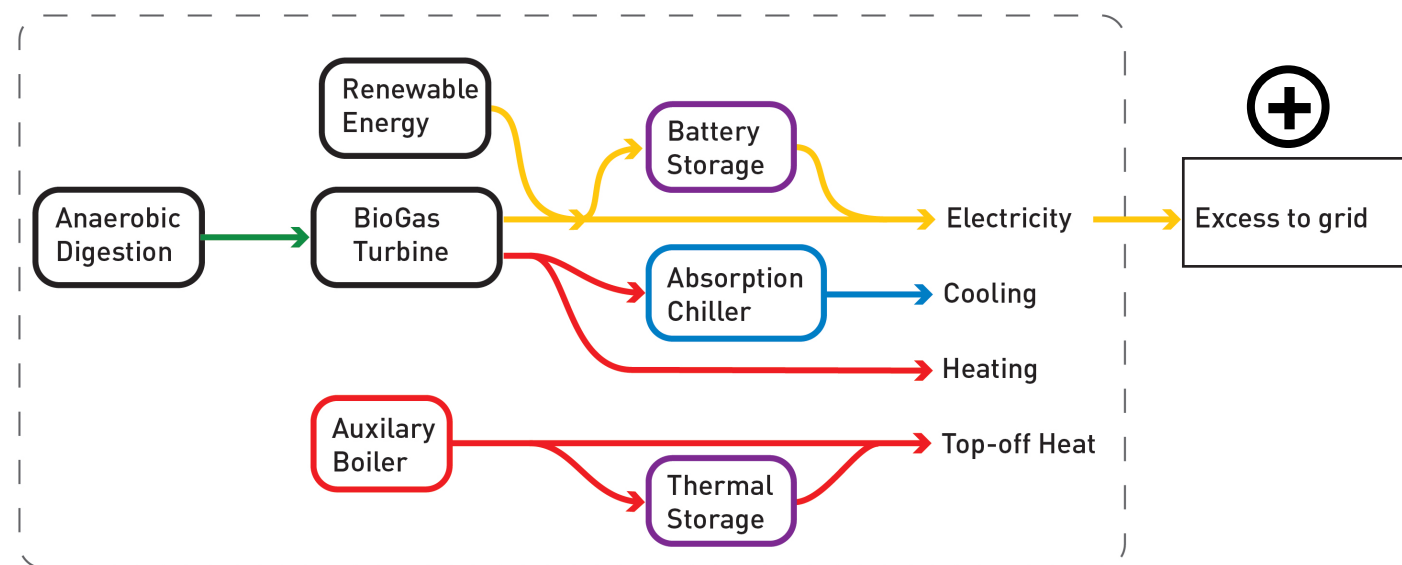
**1 grid supplied energy**



**2 combined heat + power (CHP)**



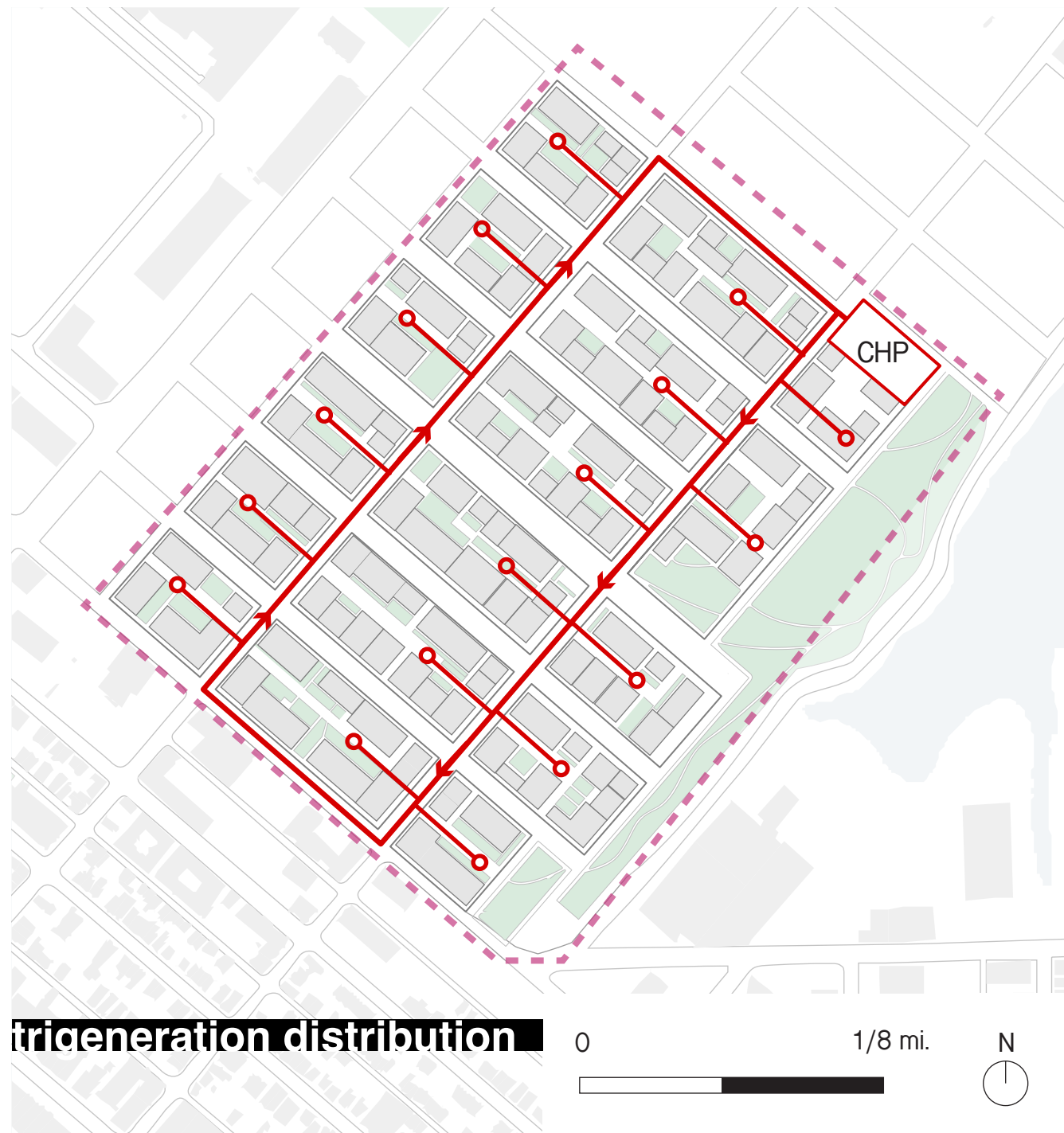
**3 combined cooling, heat + power (CCHP)**



**4 CCHP + renewables + storage**



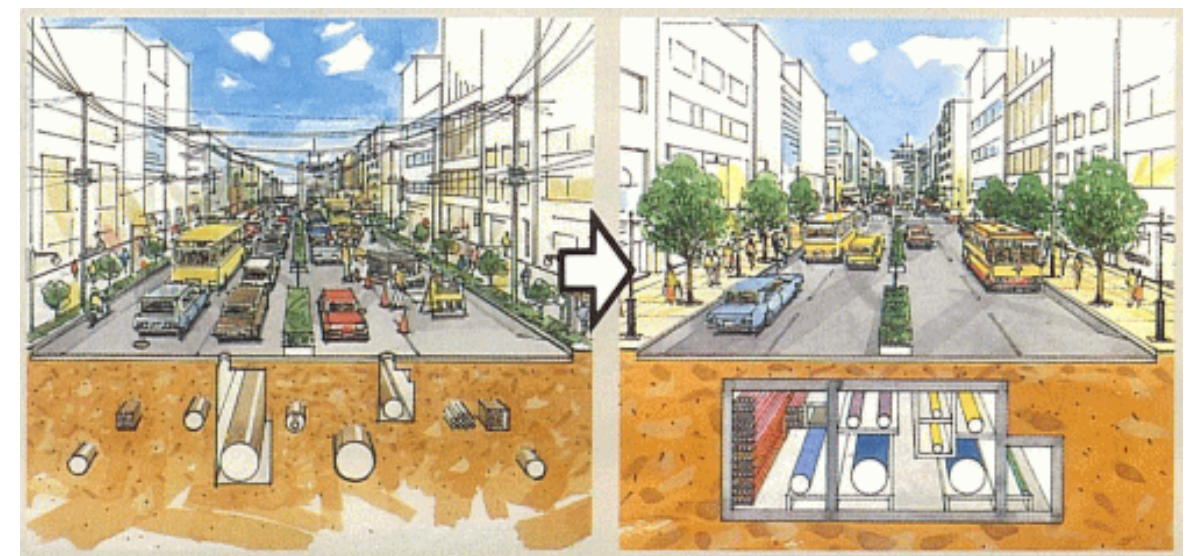
heating - steam



trigeneration distribution



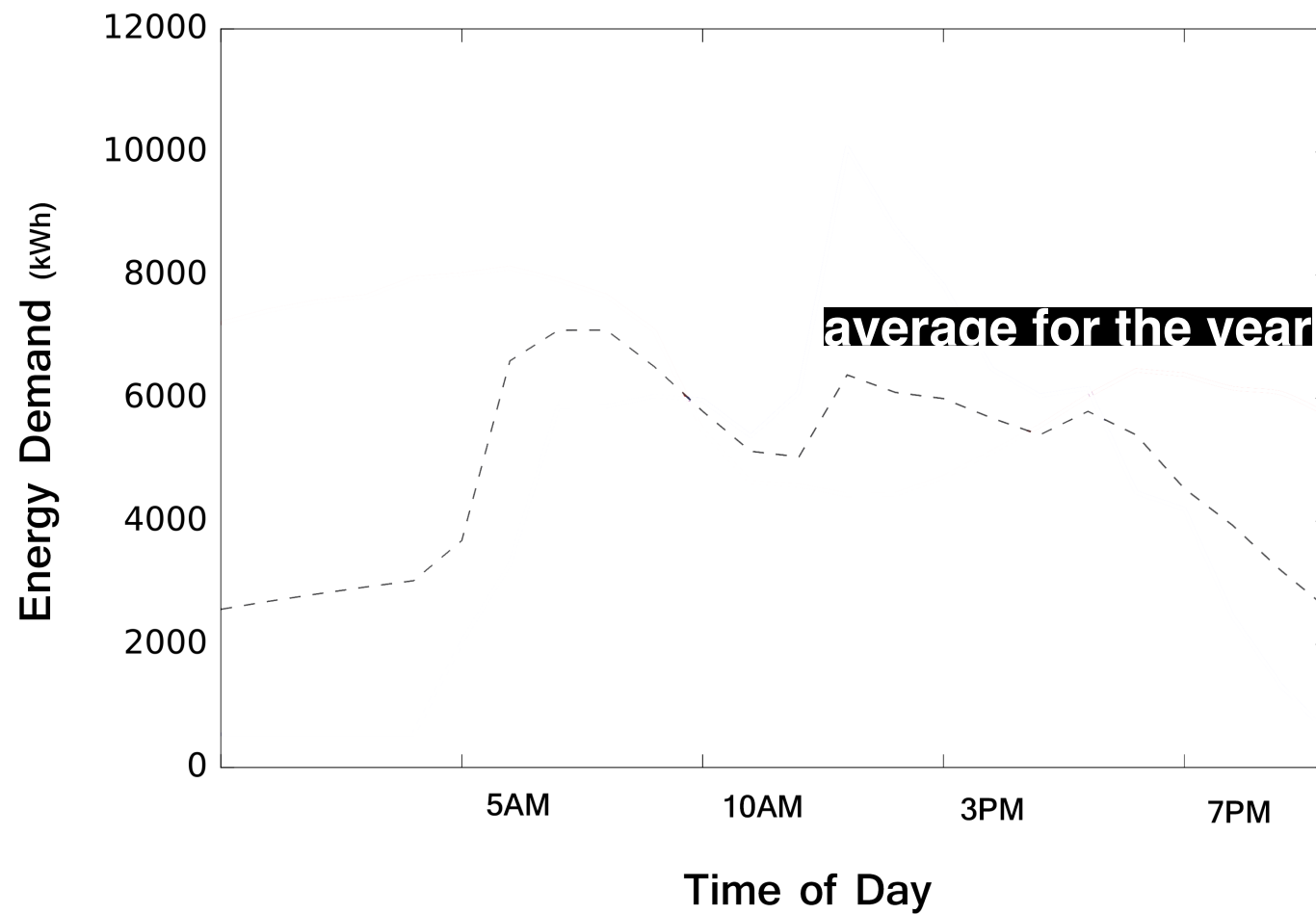
20 MW trigeneration facility



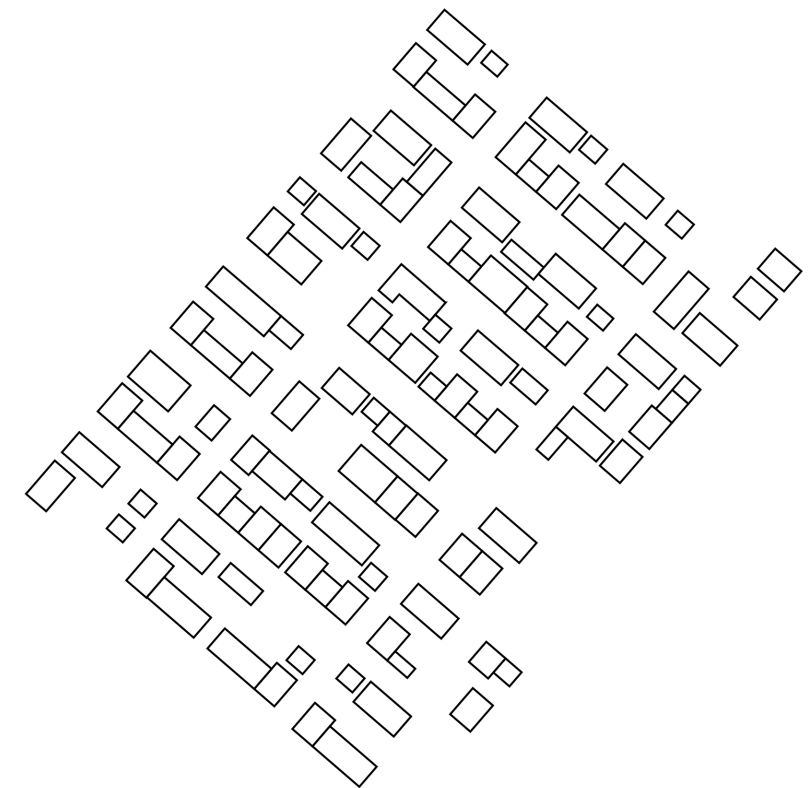
combined utility tunnel



# MICROGRID SIZING



site-wide average daily load profiles

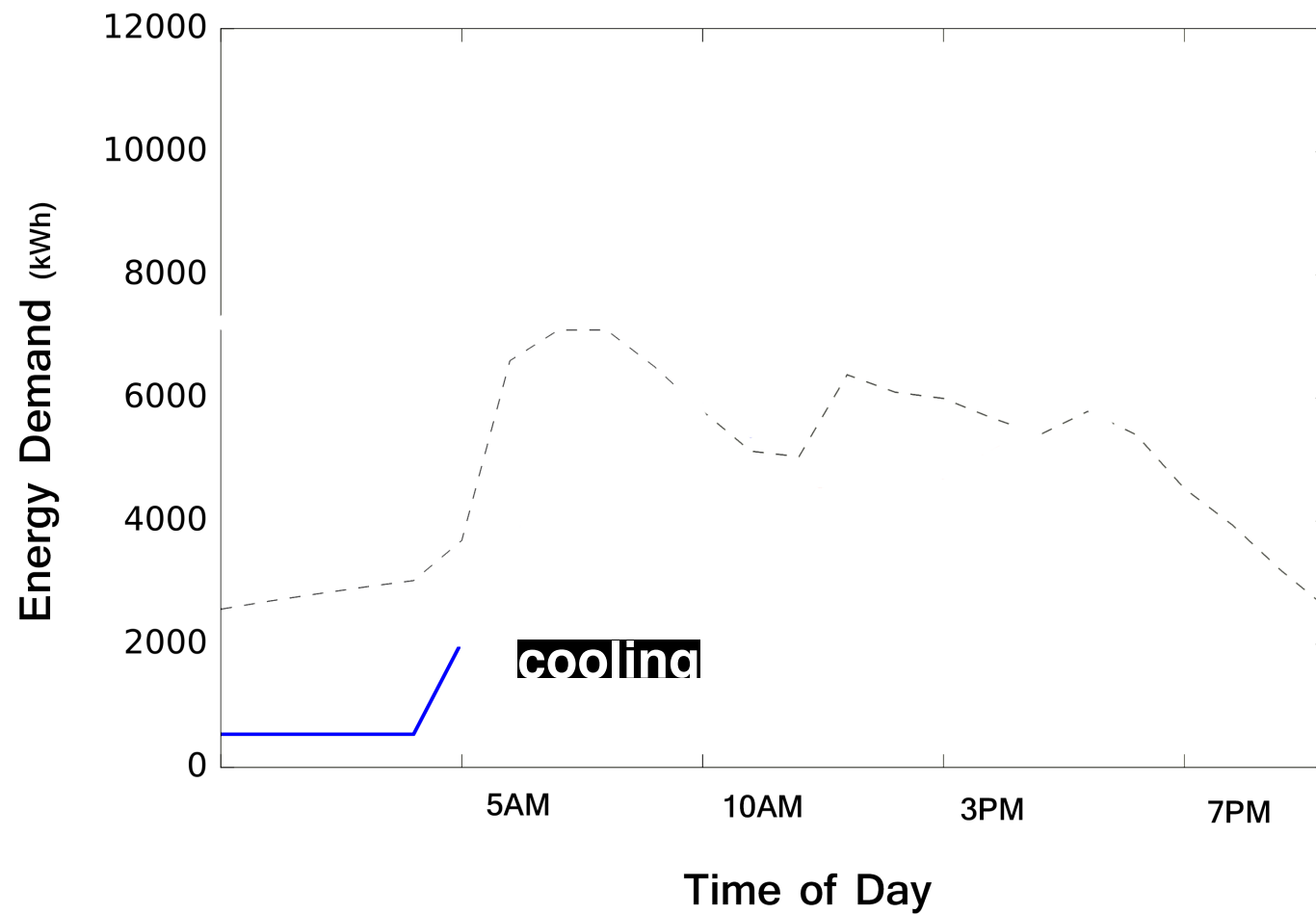


Demand map

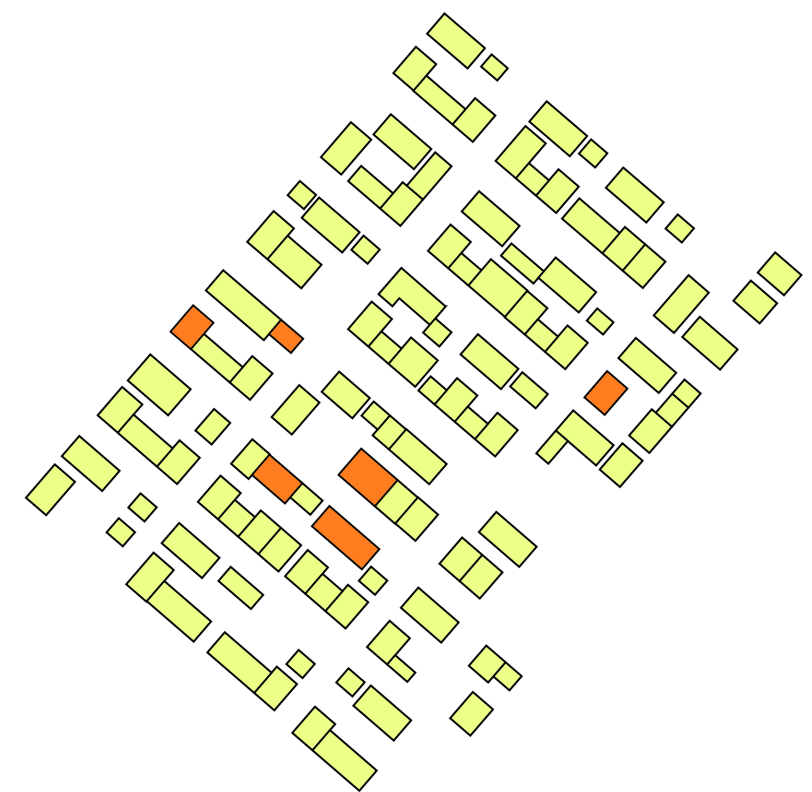
site demand animation



# MICROGRID SIZING



site-wide average daily load profiles

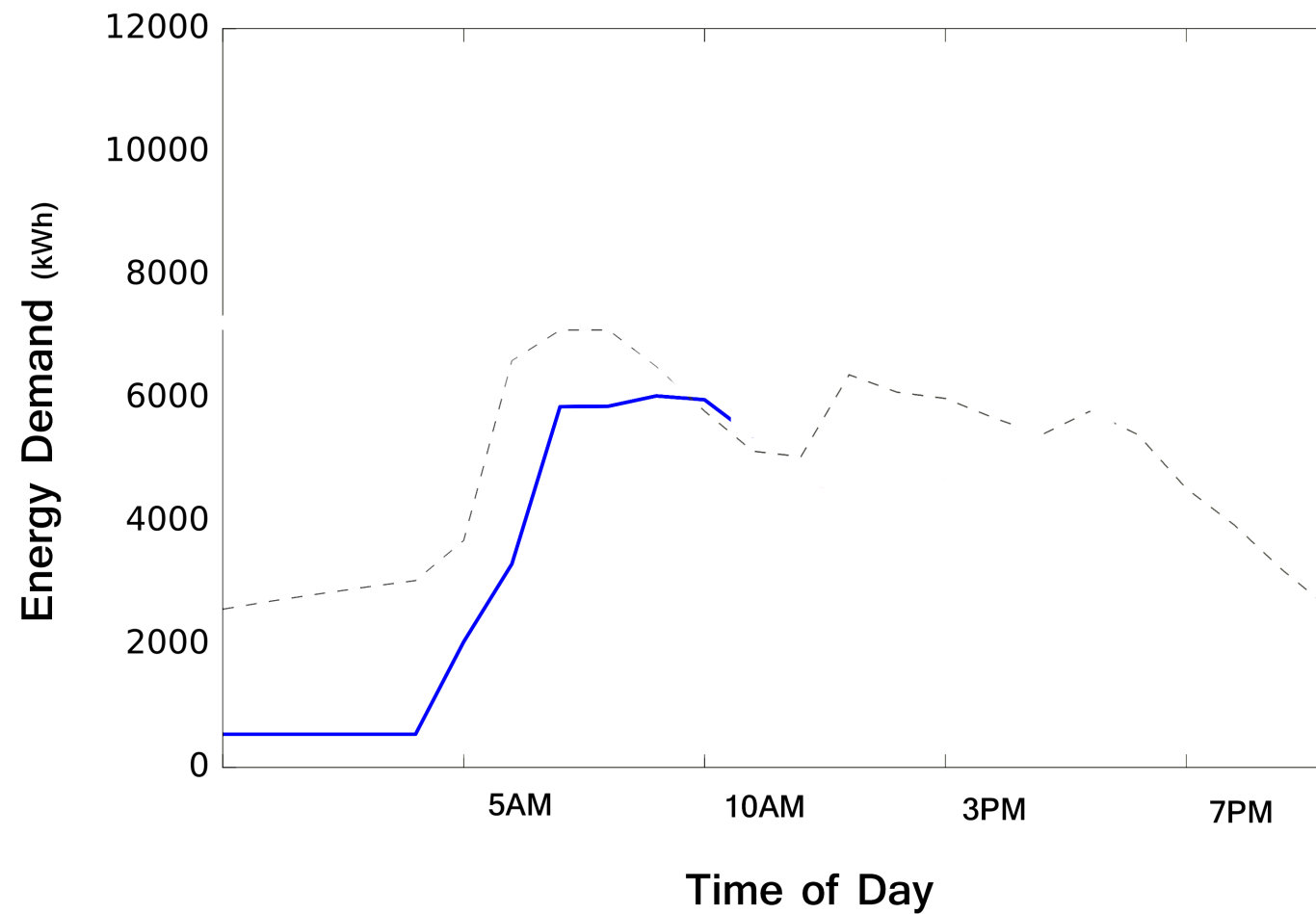


Demand map

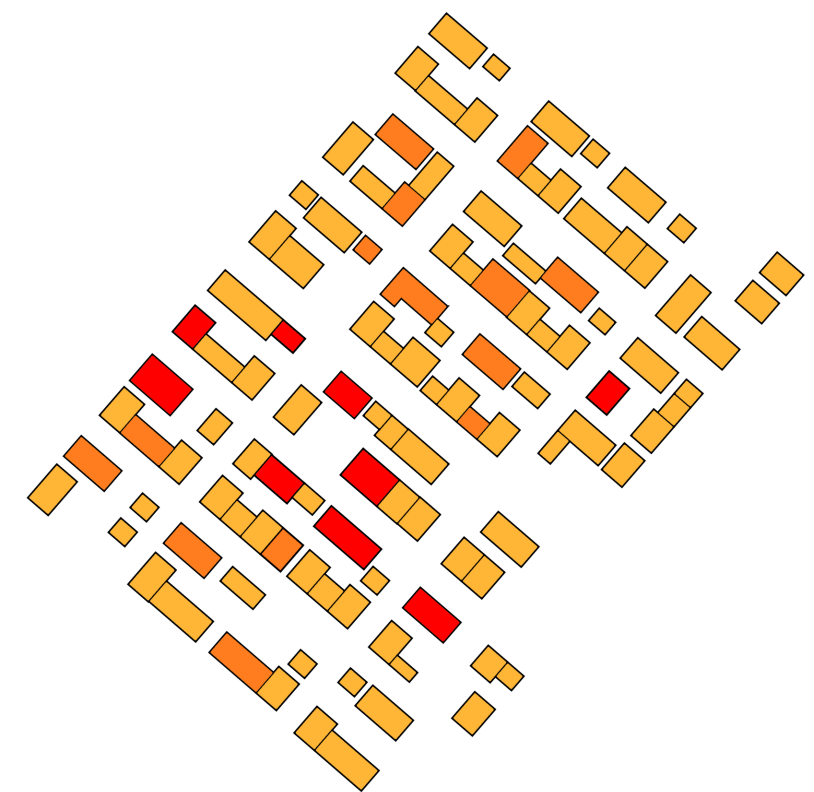
site demand animation

5 AM

# MICROGRID SIZING



site-wide average daily load profiles



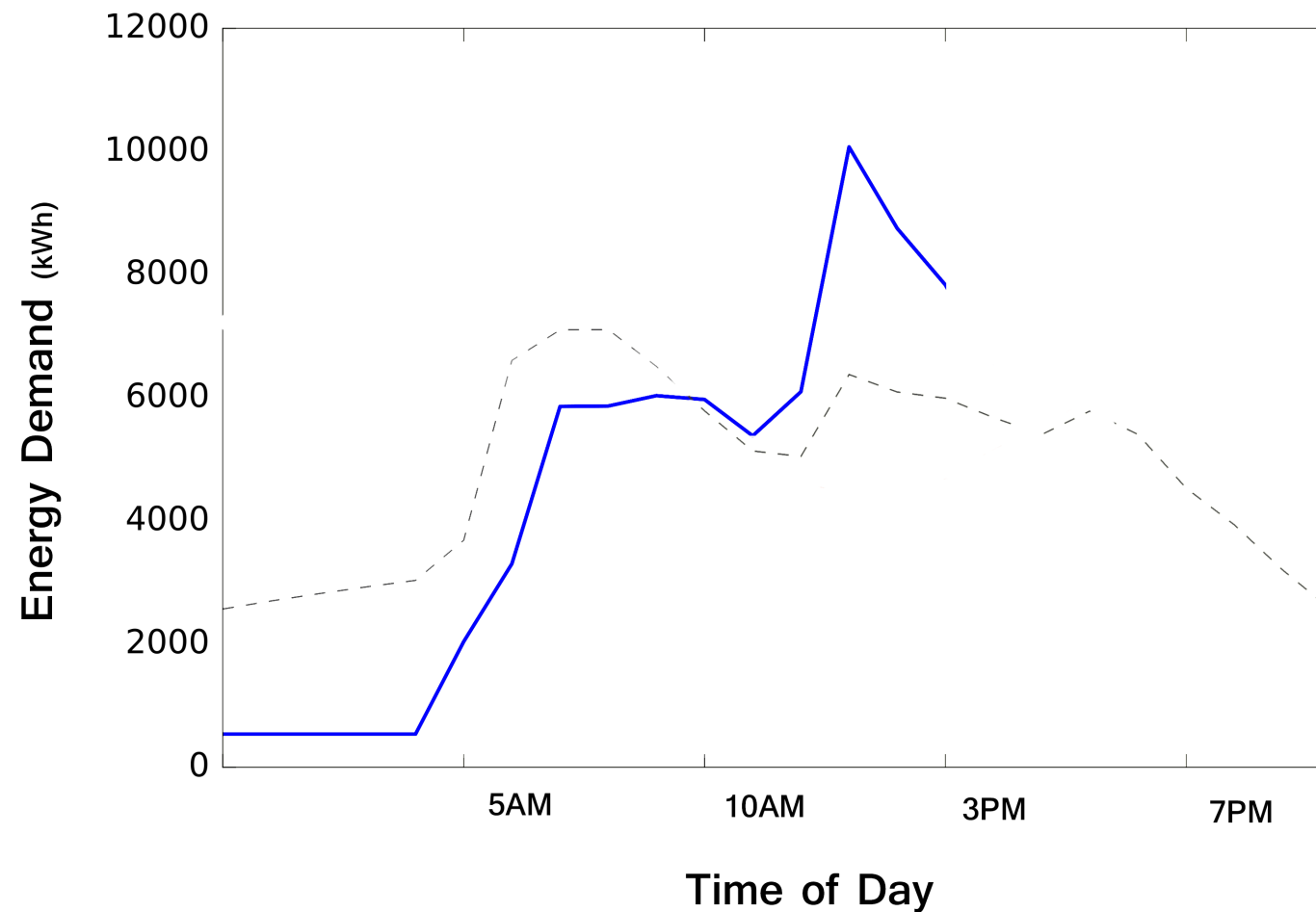
Demand map

site demand animation

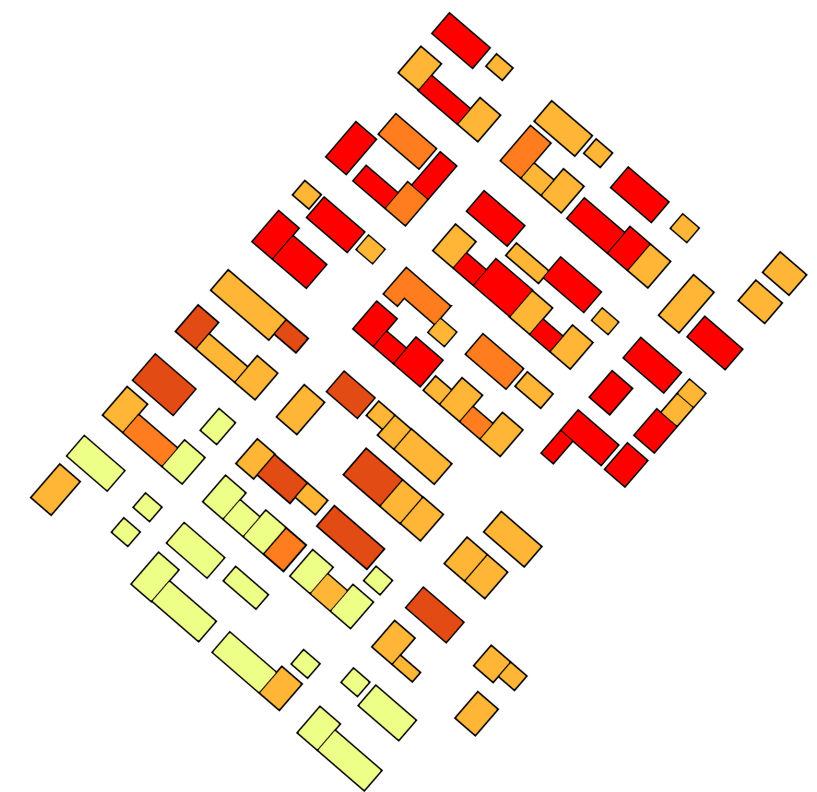
10 AM



## District Load Profile



site-wide average daily load profiles

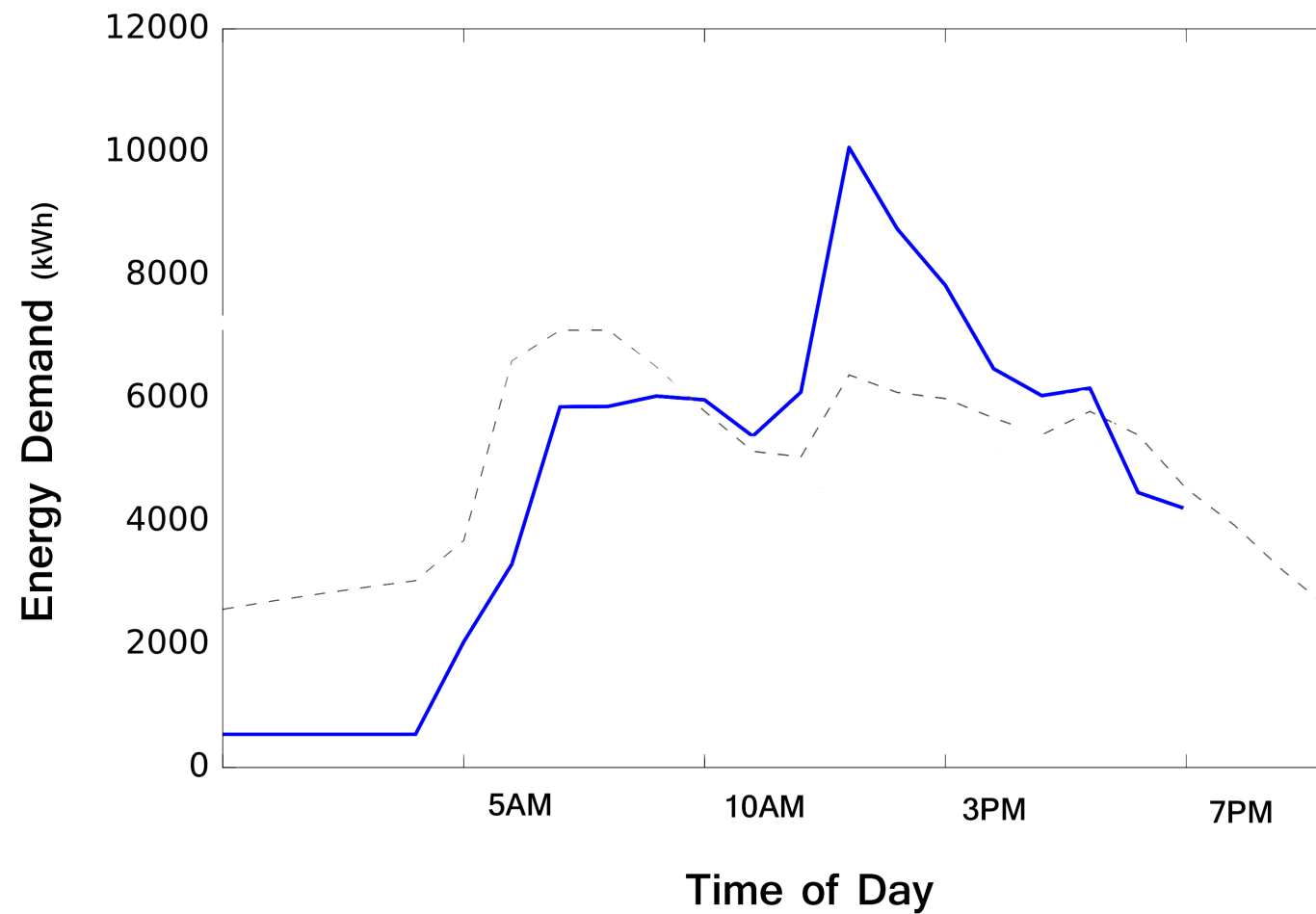


Demand map

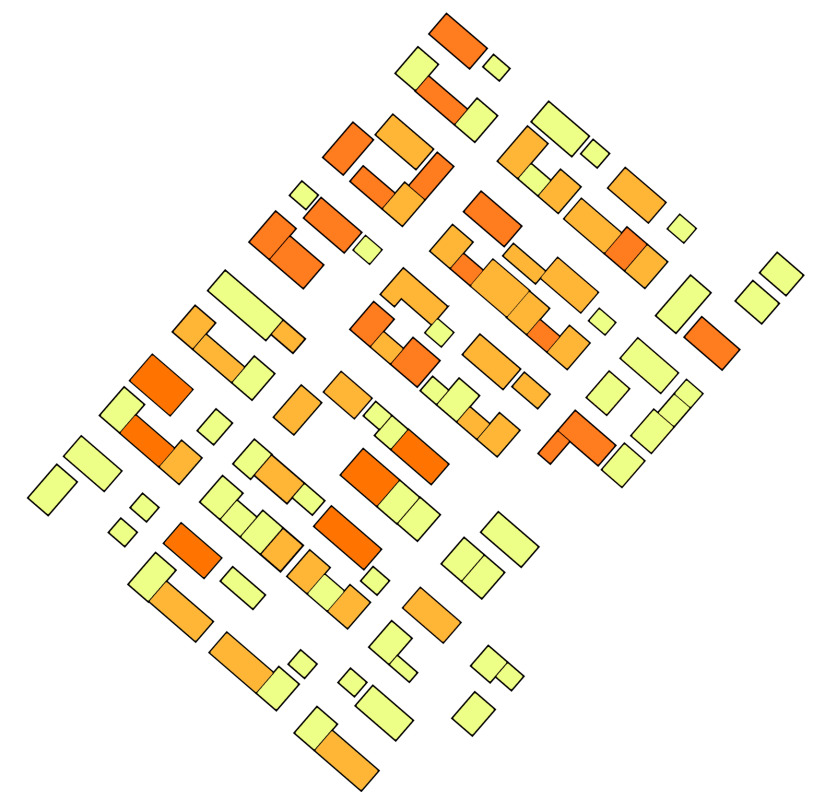
site demand animation

3 PM

# MICROGRID SIZING



site-wide average daily load profiles



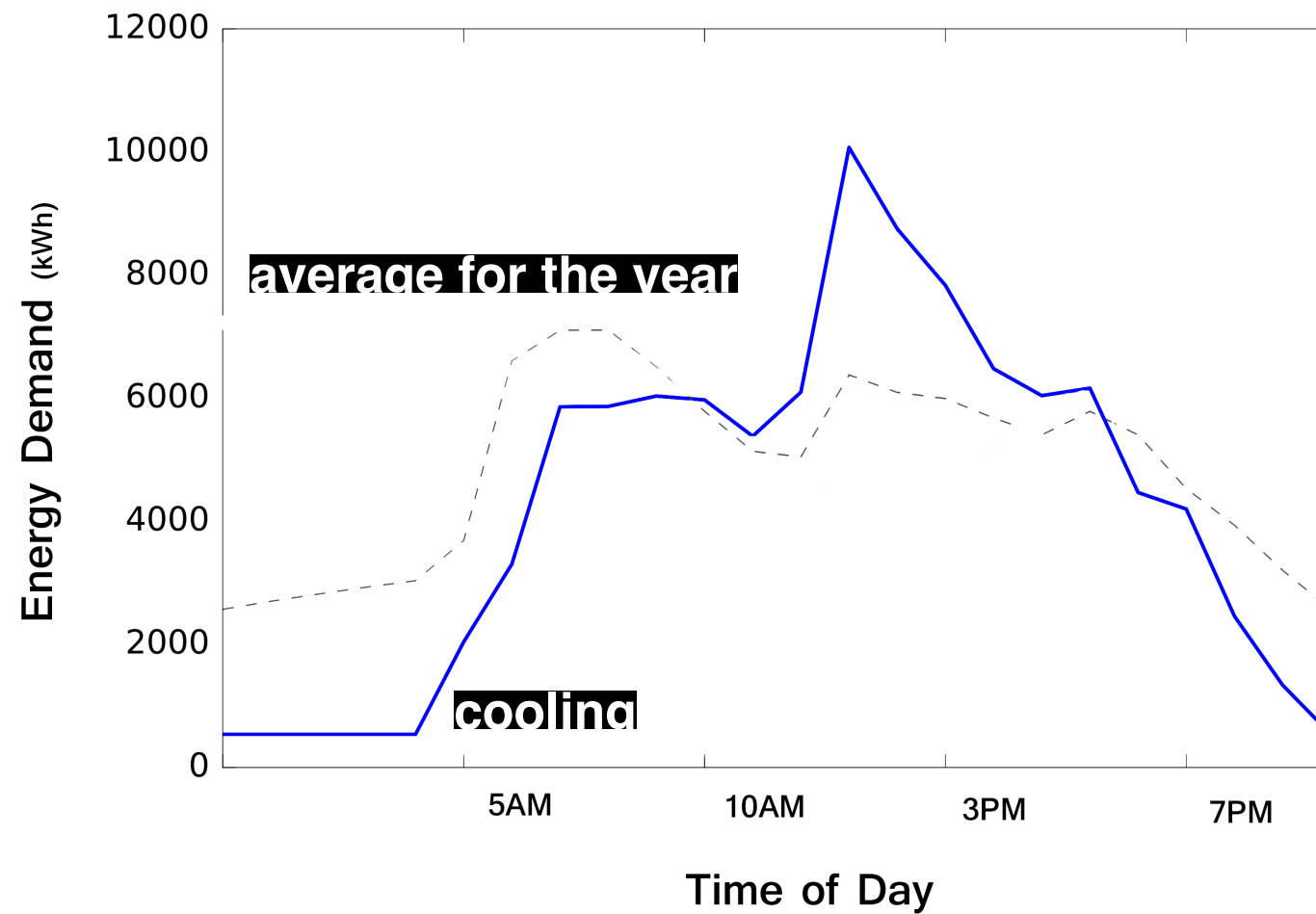
Demand map

site demand animation

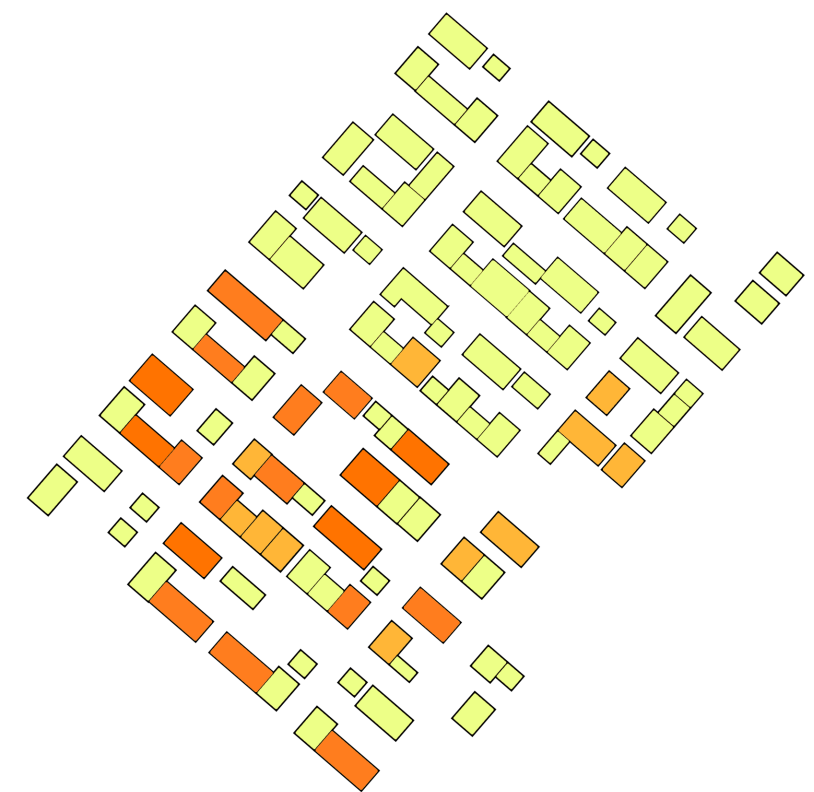
7 PM



# MICROGRID SIZING



site-wide average daily load profiles

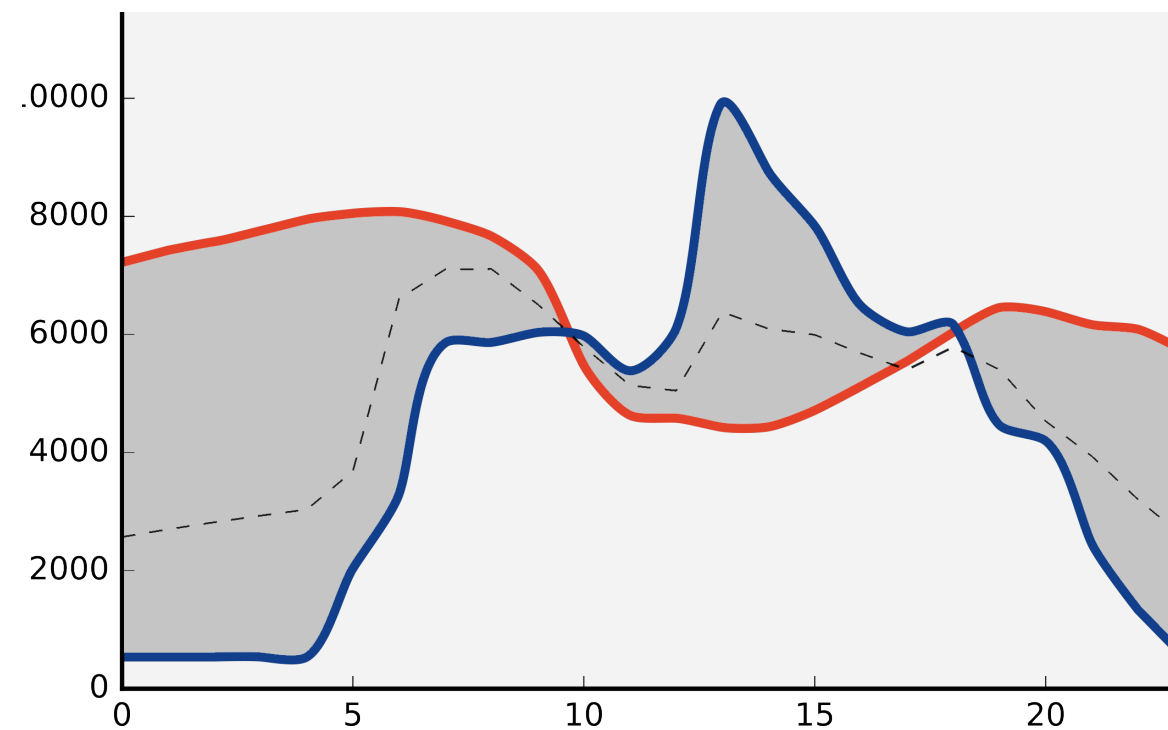
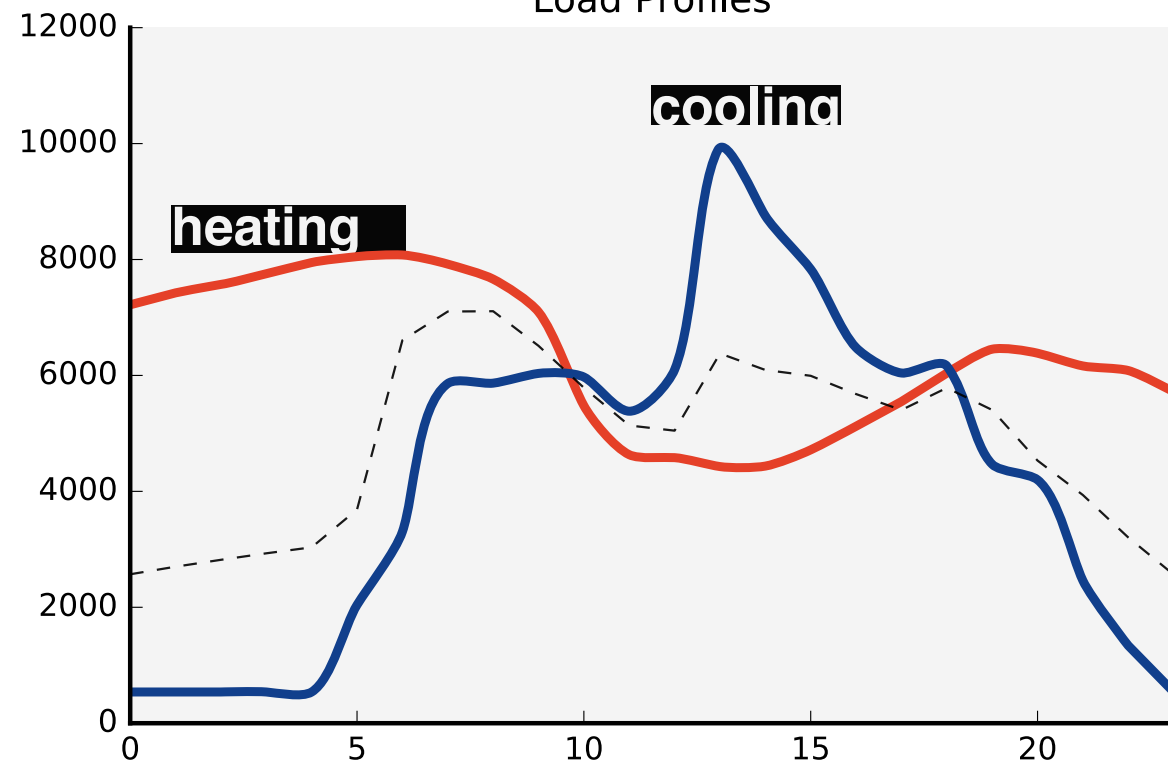


Demand map

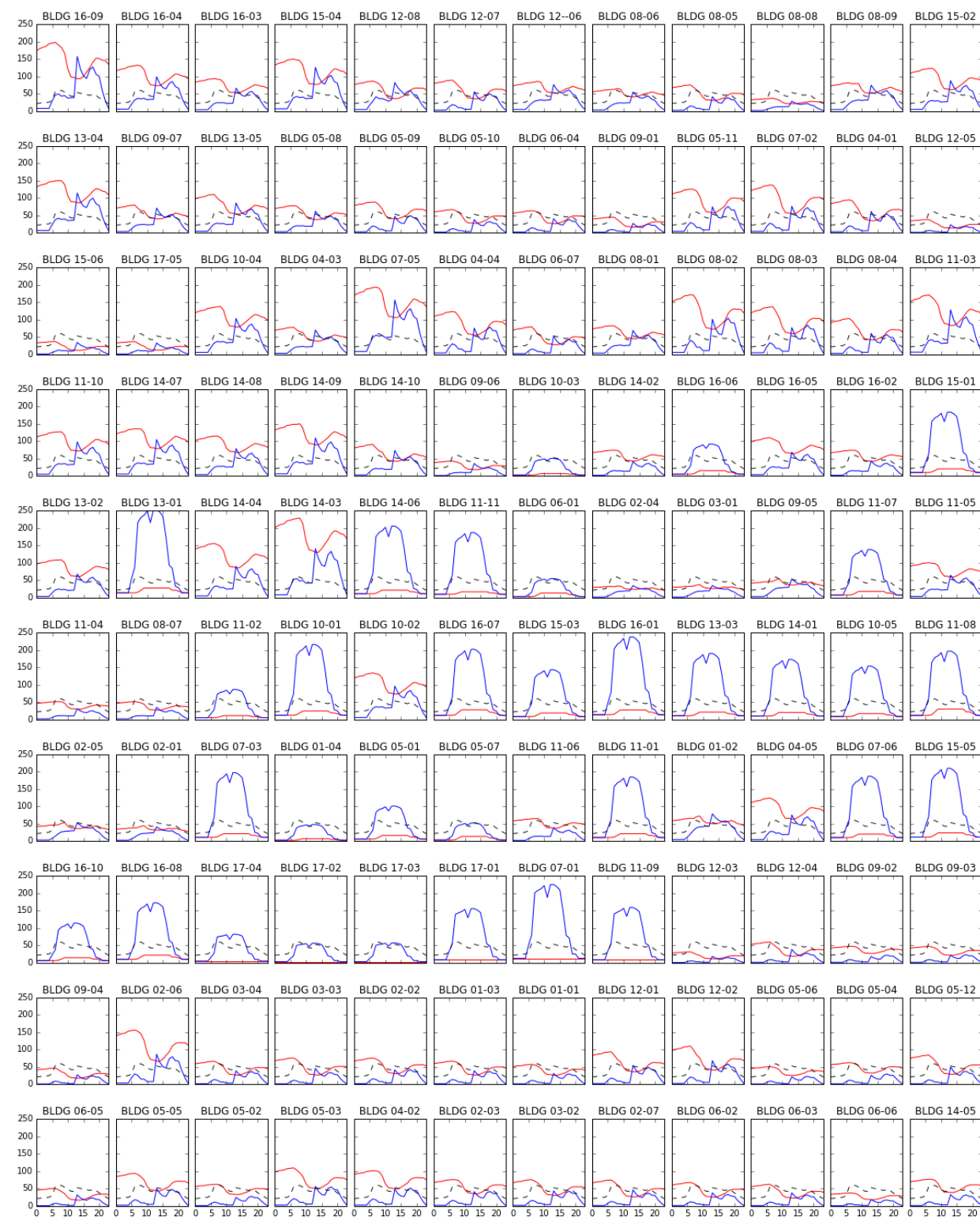
site demand animation

# MICROGRID SIZING

Load Profiles



hourly load profiles





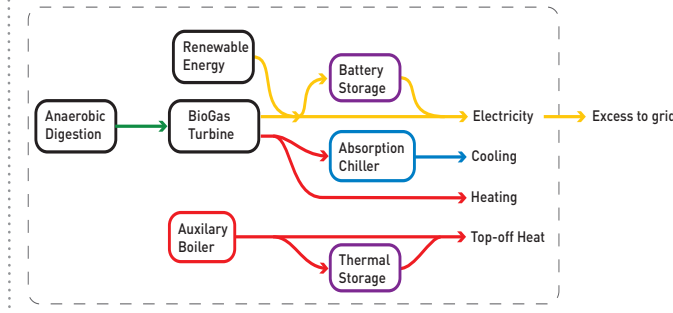
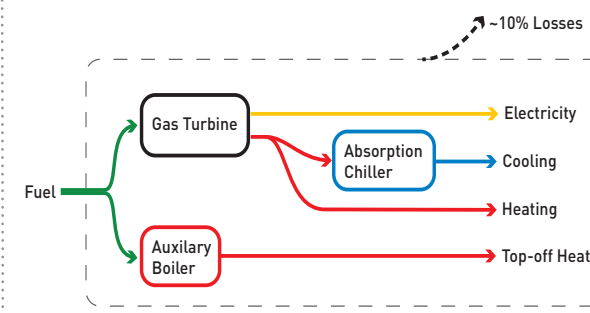
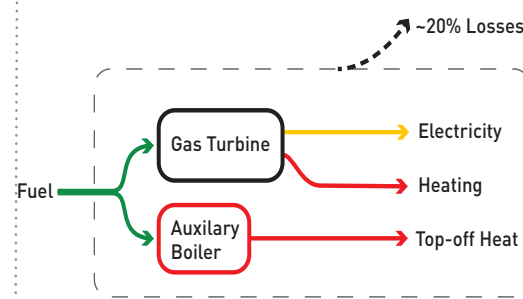
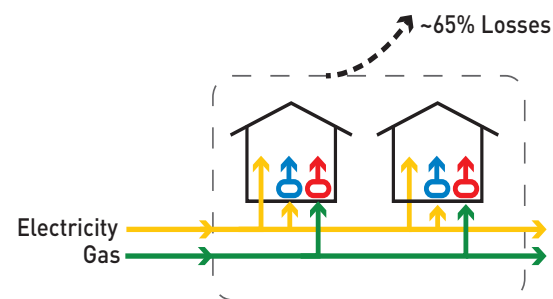
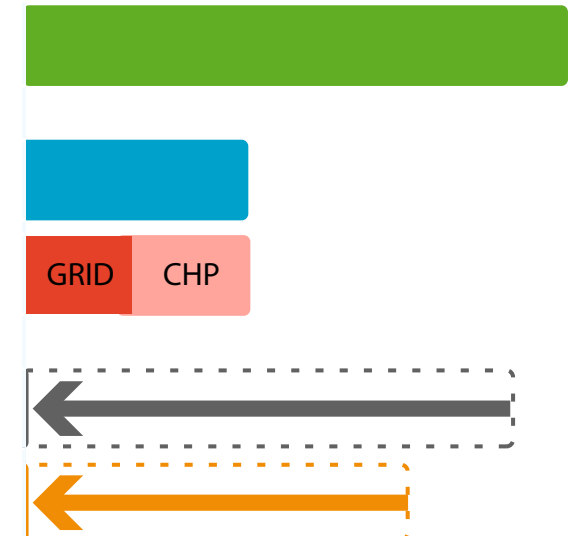
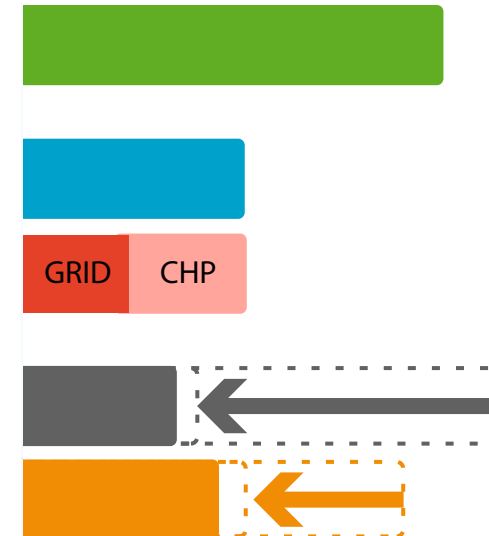
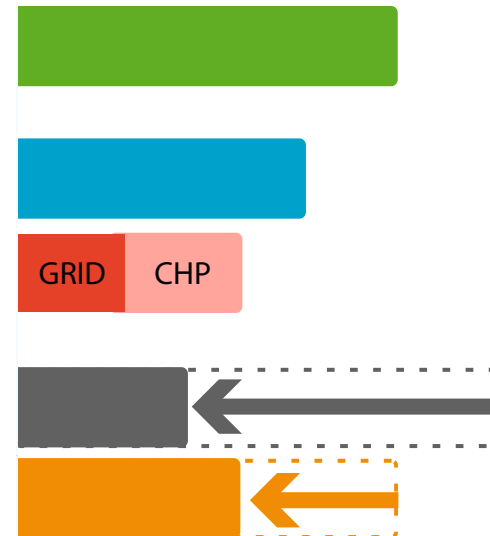
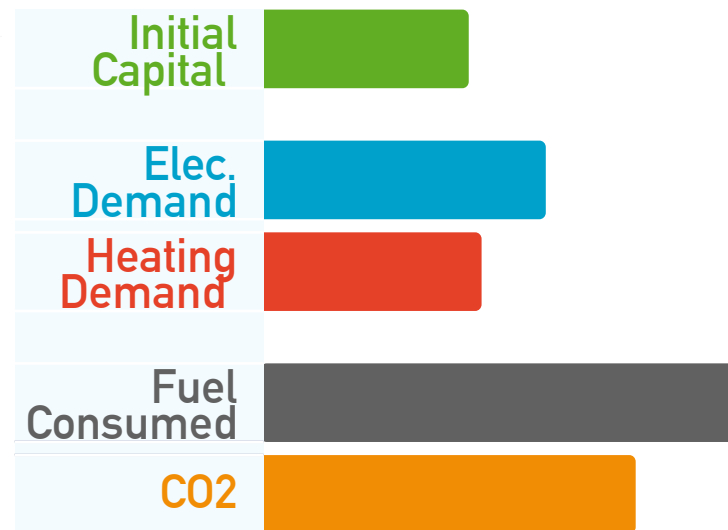
# MICROGRID PERFORMANCE METRICS

**scenario 1 -  
grid supplied  
energy**

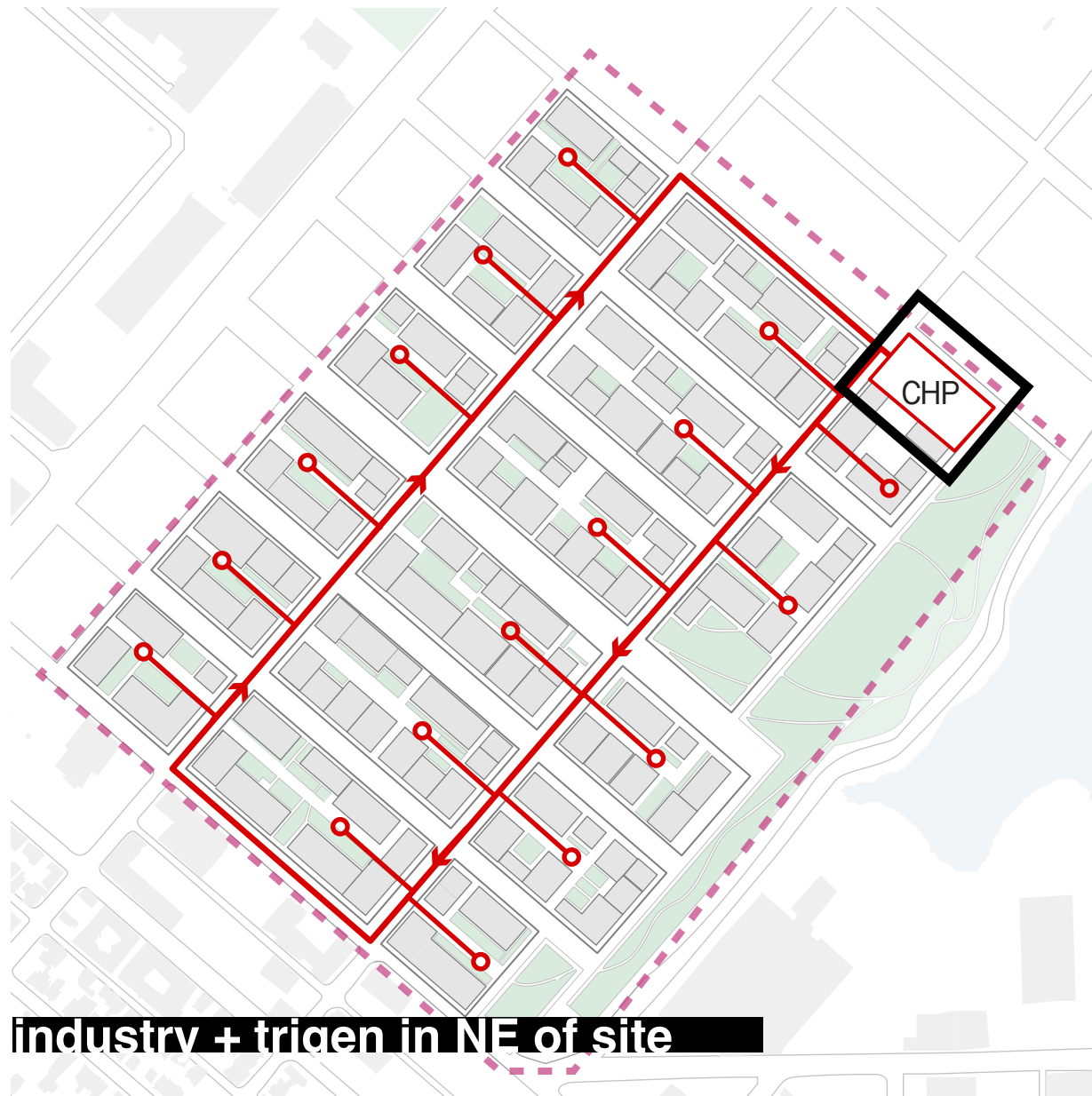
**scenario 2  
combined heat +  
power (CHP)**

**scenario 3  
combined cooling,  
heat + power (CCHP)**

**scenario 4  
CCHP + storage +  
renewables**



## SCENARIO 5 - INDUSTRIAL CONNECTION



trigeneration facility



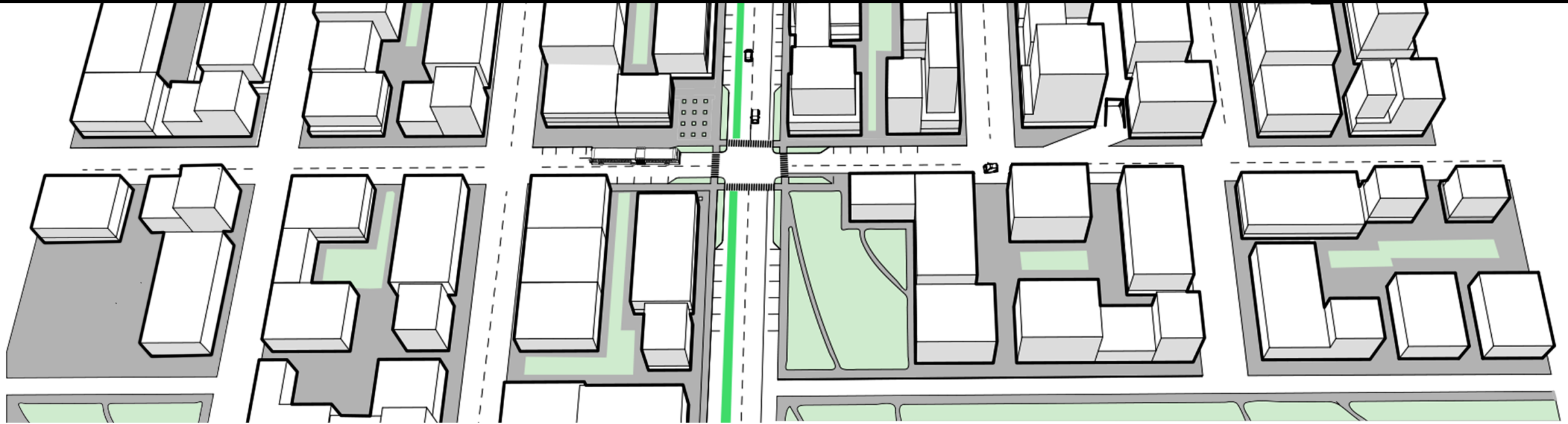
factory facility

**Provide for industrial program on-site to create nighttime loads.**

**This is more relevant when there is little or no energy storage on site.**



# SITE SCORECARD



## Seaport Smart Grid **BOSTON**

Land area (m2)	268,000
Building area (m2)	457,000
Residents (pp/m2 land)	0.018
Workers (pp/m2 land)	0.021

**142**

kWh/m2y  
OPERATION  
ENERGY



**2700**

kWh/m2  
EMBODIED  
ENERGY (50y)



**4950**

kgCO2/m2  
BUILDING GHG  
EMISSIONS (50y)



**49**

% DA  
DAYLIGHT  
AREA



**92**

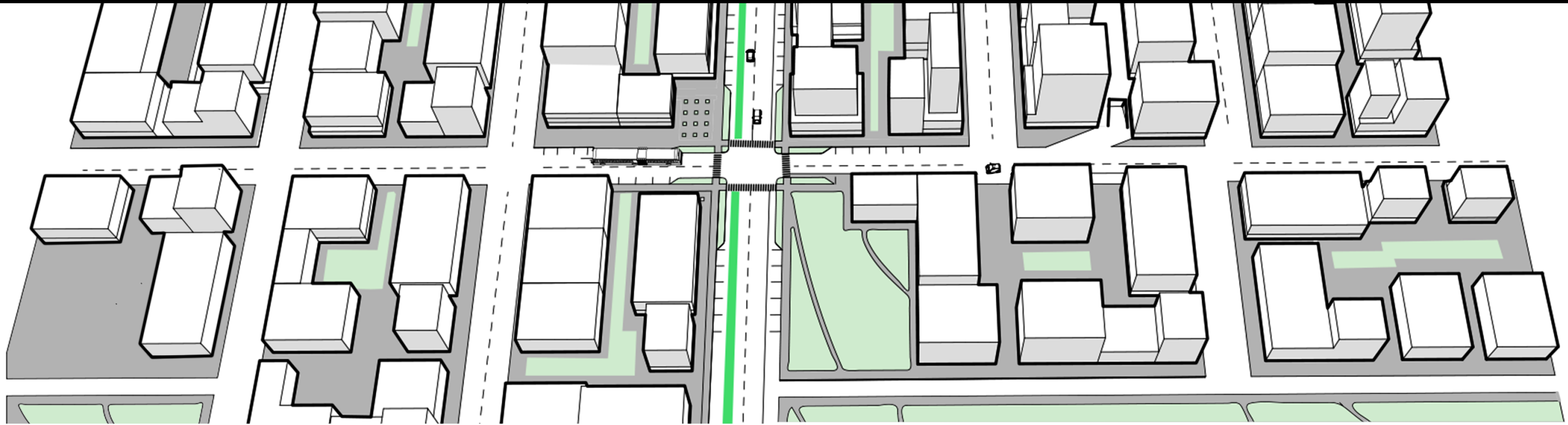
% WS  
WALKABILITY  
SCORE



**12**

% ROI  
FINANCIAL  
RETURN (1y)



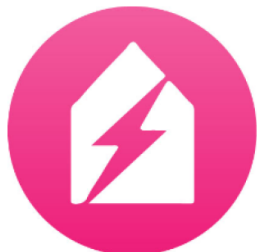


## Seaport Smart Grid **BOSTON**

Land area (m2)	268,000
Building area (m2)	457,000
Residents (pp/m2 land)	0.018
Workers (pp/m2 land)	0.021

**142**

kWh/m2y  
OPERATION  
ENERGY



**1800**

kWh/m2  
EMBODIED  
ENERGY (50y)



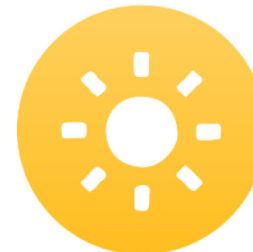
**2100**

kgCO2/m2  
BUILDING GHG  
EMISSIONS (50y)



**49**

% DA  
DAYLIGHT  
AREA



**92**

% WS  
WALKABILITY  
SCORE



**24**

% ROI  
FINANCIAL  
RETURN (1y)

