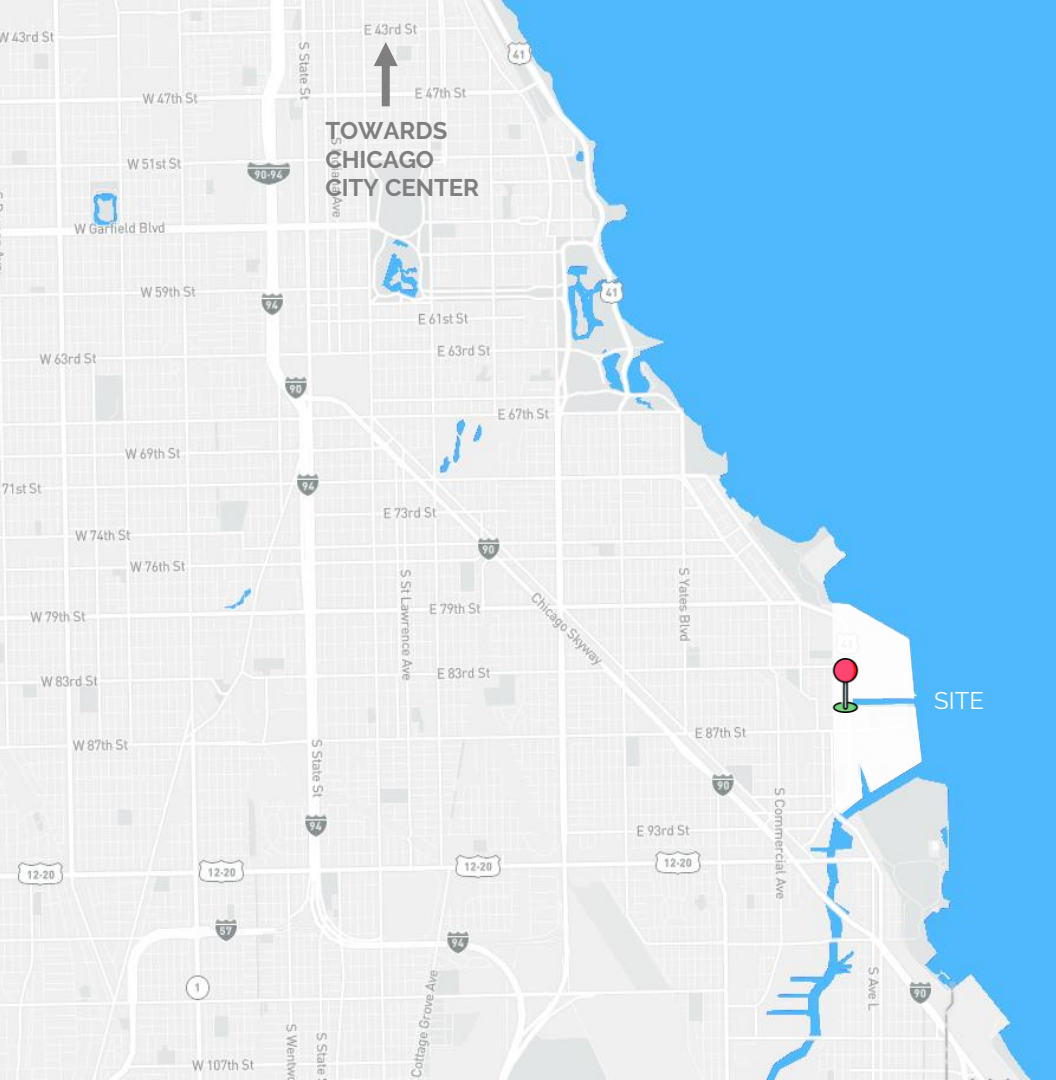


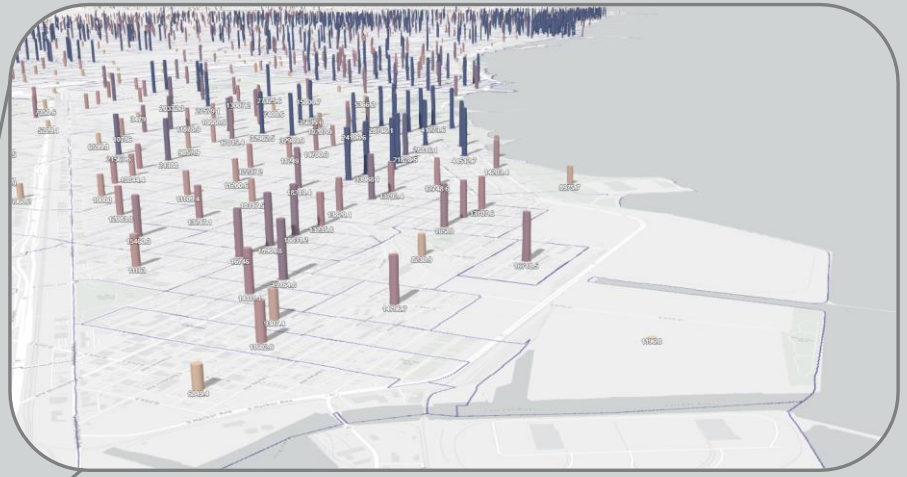

# SOUTH CHICAGO MASTERPLAN

Yu Qian Ang | Jakub Tomasz Szcesniak | Tessa Weiss | Moulshree Mittal

CHICAGO

FINAL PRESENTATION

# CONTEXT



Population Density (3D)

2018 Population Density (Pop per Square Mile)

> 25,000

13,000

< 1,000

Hoffman Estates

Glenview

Wheaton

Woodridge

Lemont

Lockport

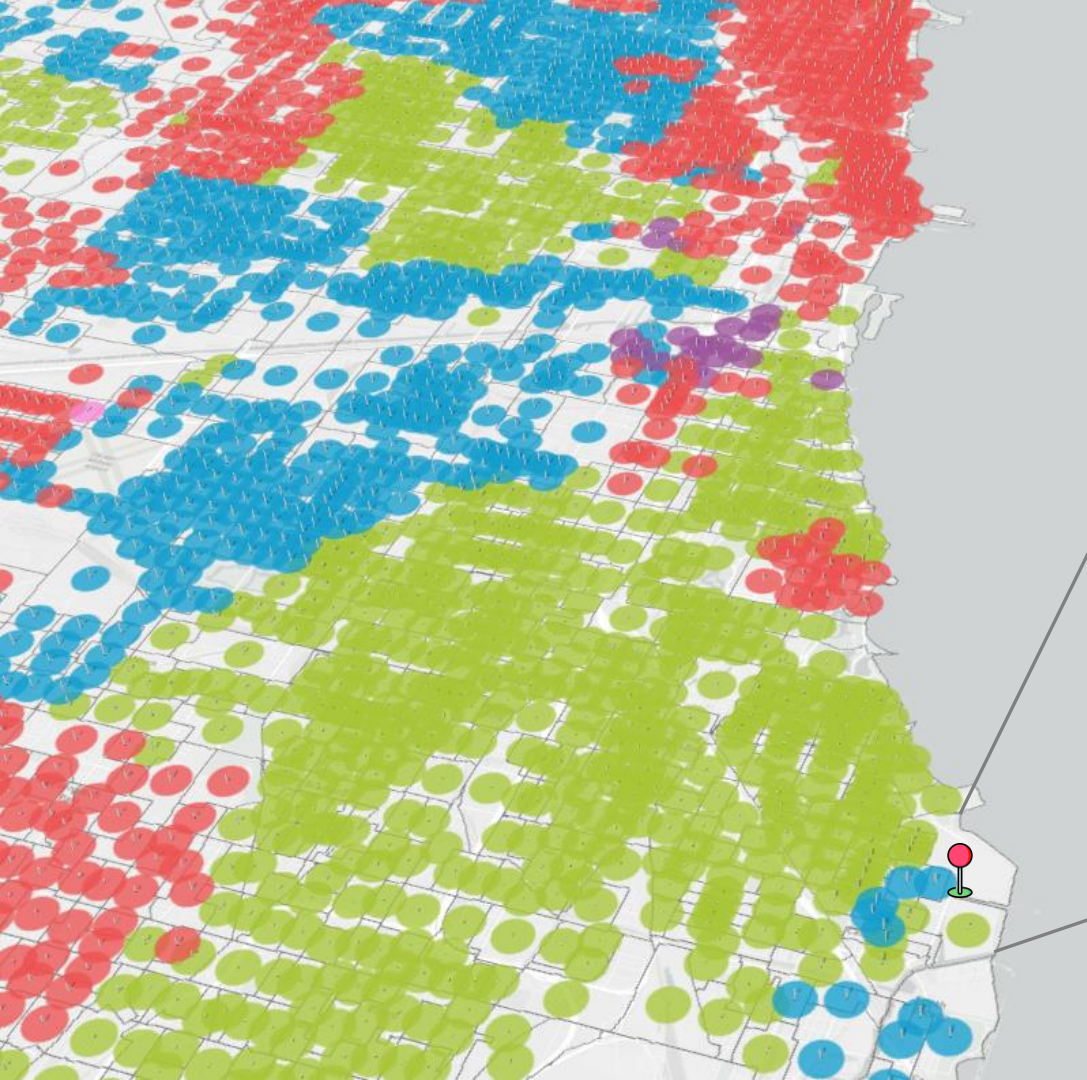
Tinley Park

Gary

Chesterton

# CONTEXT

- Lack diversity
- Less vibrant
- Less economic opportunities
- Less accessible



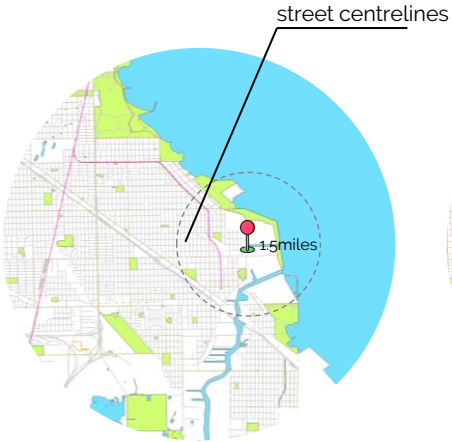

# CONTEXT

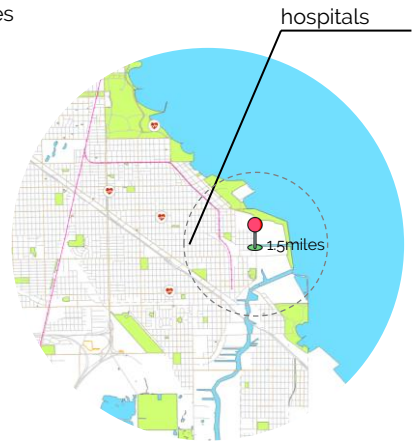

neighbourhoods
1.5miles


parks
1.5miles


sidewalks
1.5miles


rail line
1.5miles


street centrelines
1.5miles


hospitals
1.5miles


schools
1.5miles


full with topo
1.5miles

# PLANNING GOALS

## SUSTAINABLE

*Energy efficient planning and design, balancing resource demands and supply (such as having buildings respond smartly to load on the grid)*

To achieve **lower EUI and embodied energy** than the average,

Stretch goal of having **net-zero operational energy**

## DIVERSE

*Economically and socially equitable, welcoming to diverse groups of people from various demographics and professions*

To create a **vibrant mixed-use district**

Affordable housing, start-ups, **innovation** district

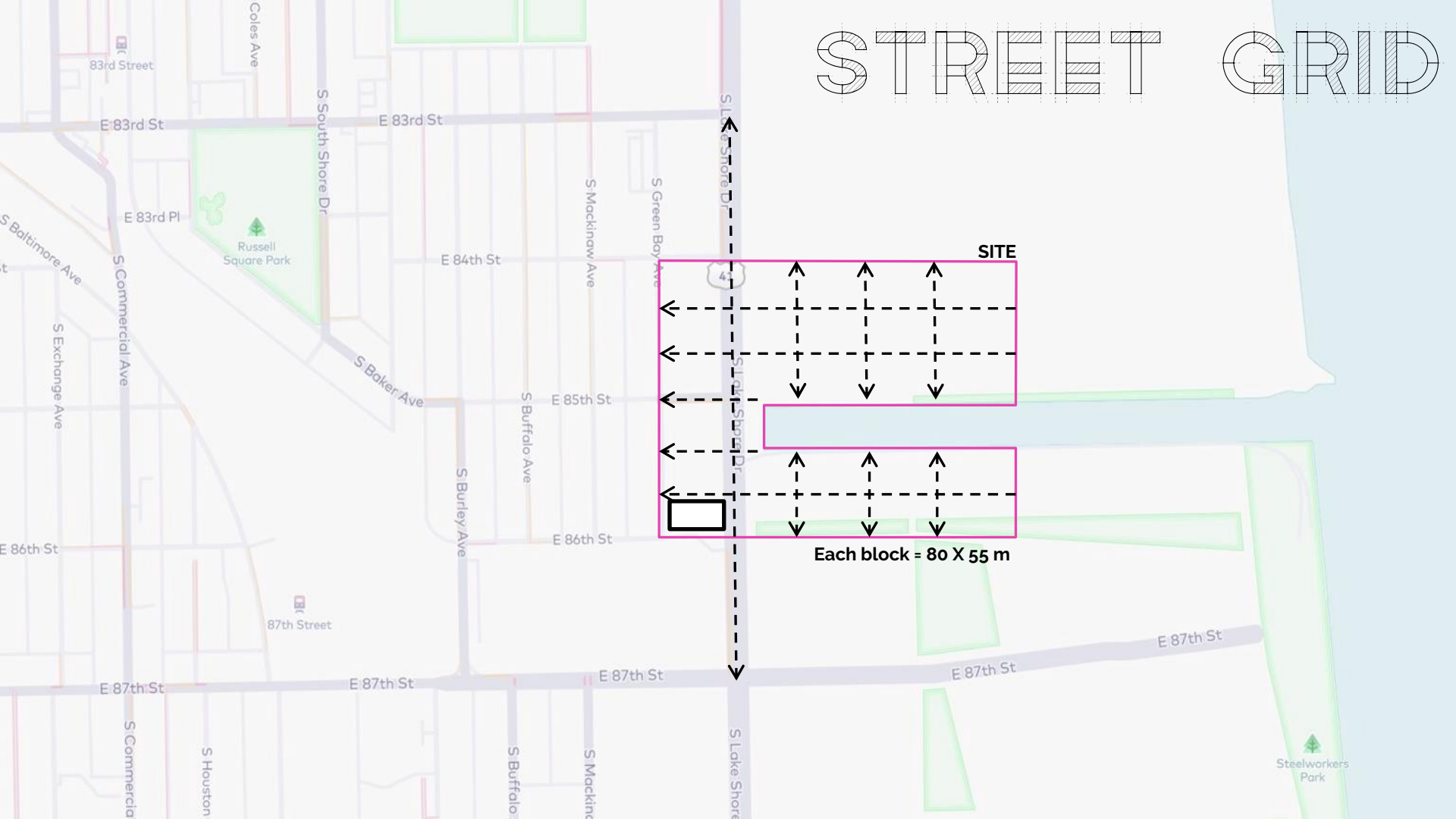
## LIVEABLE

*A localized, self-sustaining district where people work, live, and play, but with a low carbon footprint*

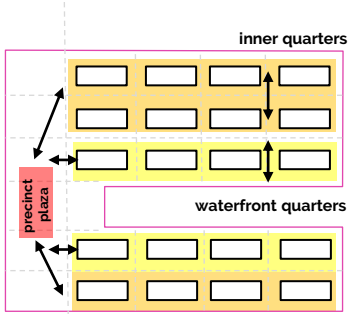
To incorporate **green areas** such as parks and urban farming/gardens,

to have a car-lite district planned for **walkability**

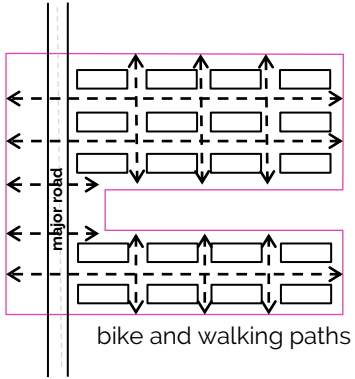
# STREET GRID


SITE
Each block = 80 X 55 m
E 83rd St
E 84th St
E 85th St
E 86th St
E 87th St
S Commercial Ave
S Baker Ave
S Buffalo Ave
S Burley Ave
S Mackinaw Ave
S Green Bay Ave
S Lake Shore Dr
S Exchange Ave
S Baltimore Ave
Russell Square Park
Steelworkers Park
83rd Street
87th Street

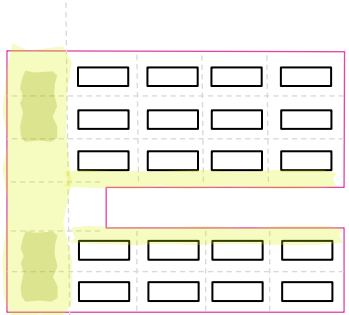
# STREET GRID



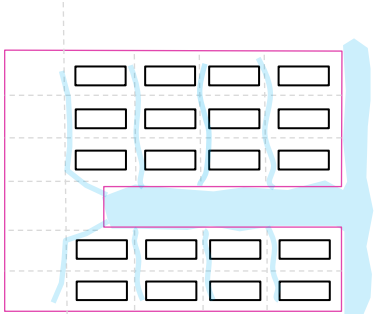

precinct + protoblock layout



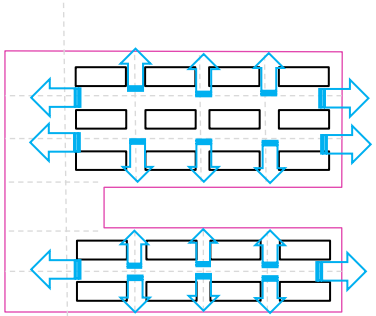

bike and walking paths



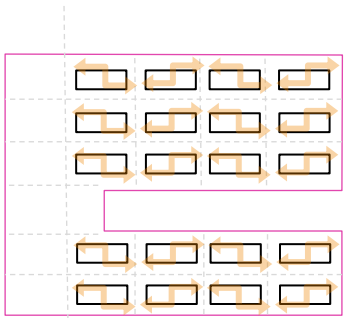
main public green



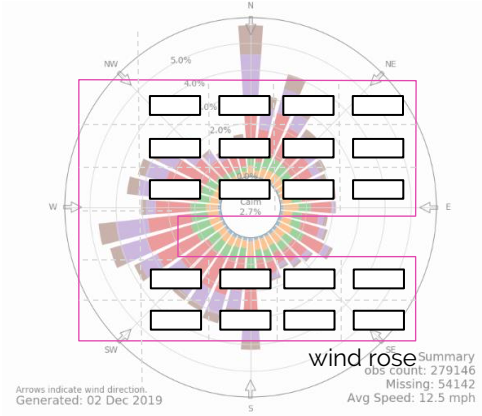
sustainable urban drainage



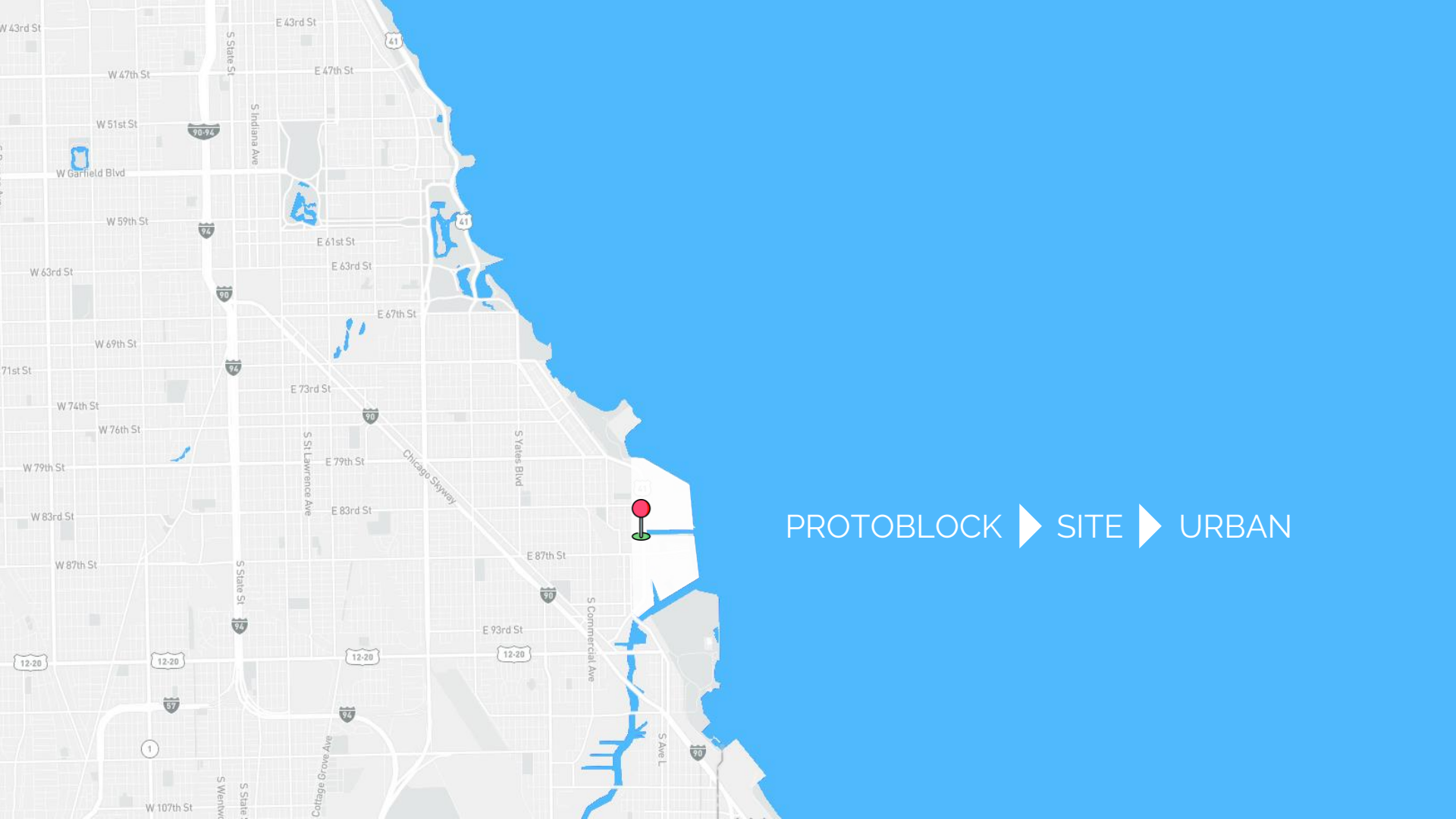
view axis

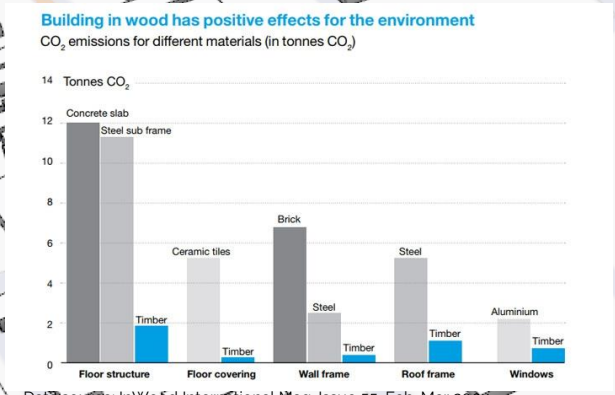


walkability



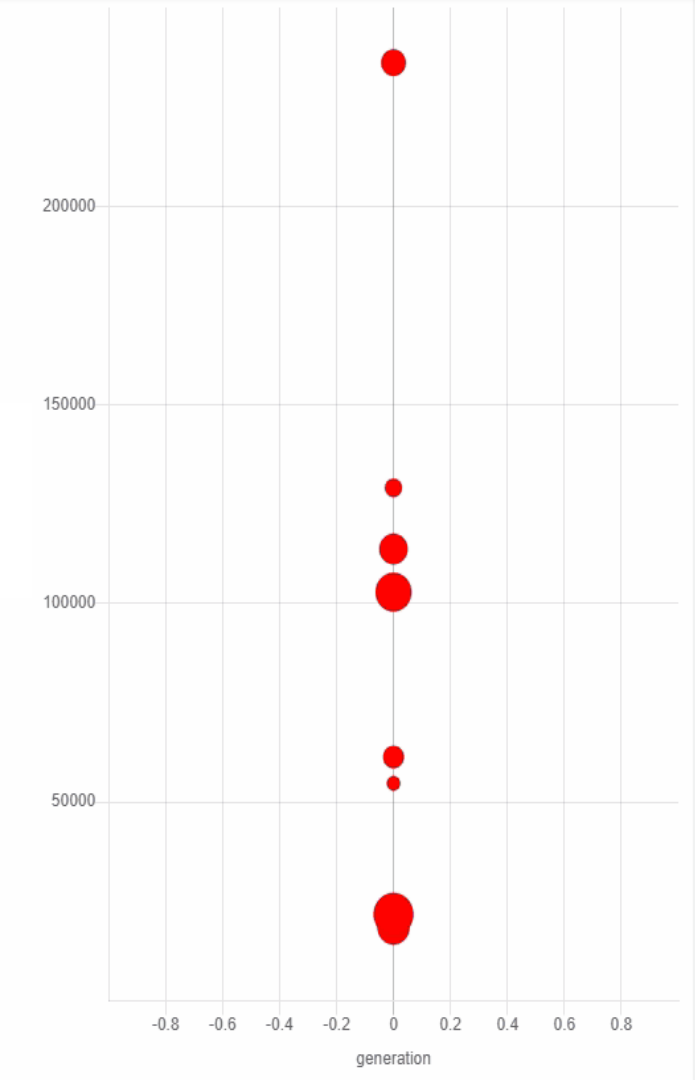

wind rose

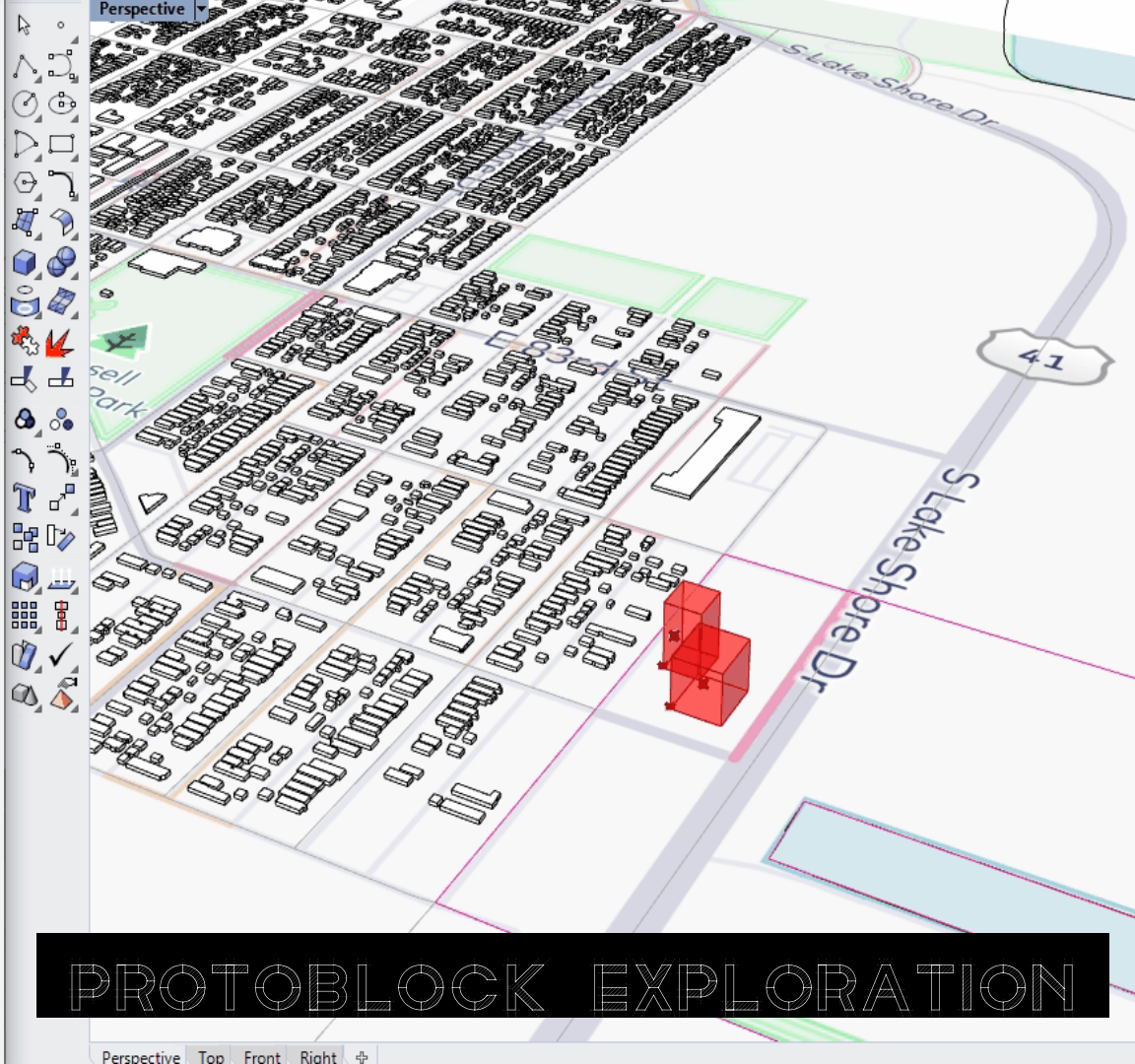

W 43rd St
E 43rd St
S State St
W 47th St
E 47th St
W 51st St
S Indiana Ave
W Garfield Blvd
W 59th St
E 61st St
E 63rd St
W 63rd St
E 67th St
W 69th St
71st St
E 73rd St
W 74th St
W 76th St
S St Lawrence Ave
E 79th St
Chicago Skyway
S Yates Blvd
W 79th St
E 83rd St
W 83rd St
E 87th St
W 87th St
S State St
S Commercial Ave
E 93rd St
S Ave L
Cottage Grove Ave
W 107th St
PROTOBLOCK
SITE
URBAN



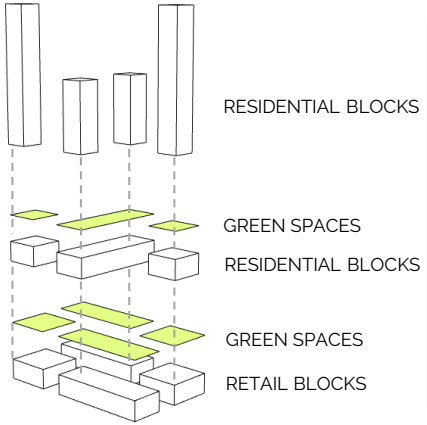

Datasource: InWood International Mag. Issue 55, Feb-Mar 2004

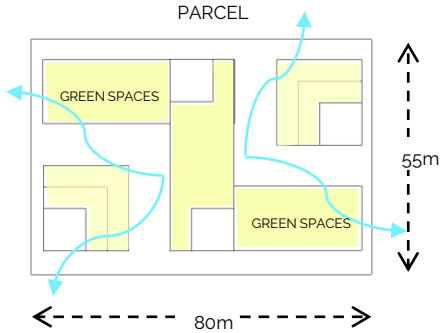
# PROTOBLOCK FABRICATION


200000
150000
100000
50000
-0.8
-0.6
-0.4
-0.2
0
0.2
0.4
0.6
0.8
generation

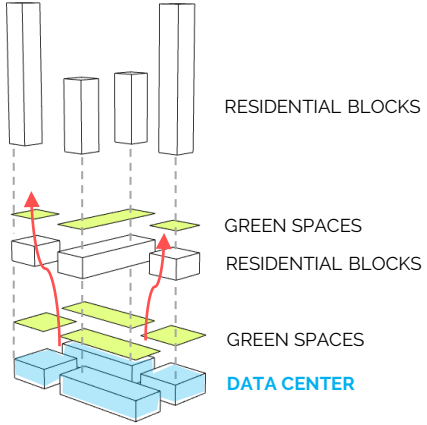

Perspective
S Lake Shore Dr
41
PROTOBLOCK EXPLORATION
Perspective
Top
Front
Right

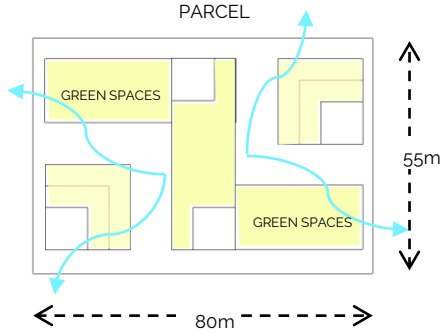
# PROTOBLOCK ONE



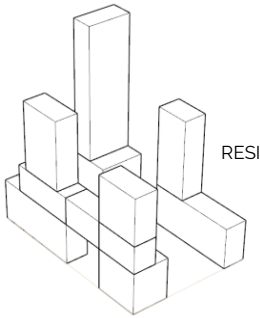

- Mixed use interspersed with **green spaces**
- Residential blocks with unobstructed view
- Slim tower blocks for **daylight penetration**
- Circulation spaces **encourages walking**

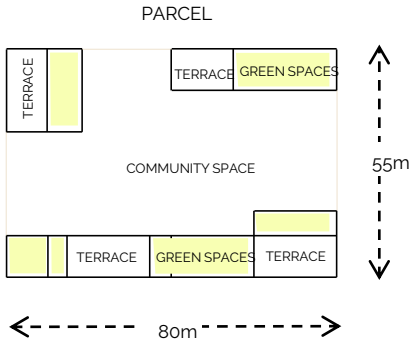


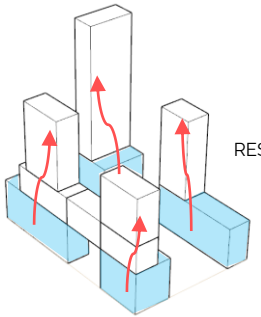

- Variant with **data centre**
- Allows **heat recovery** to upper storeys

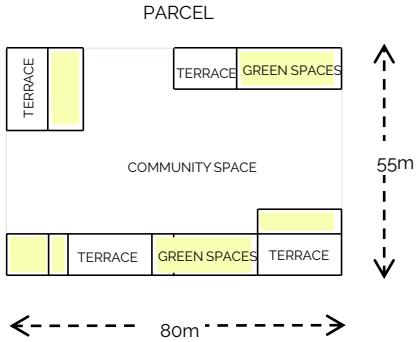
# PROTOBLOCK TWO




- Mixed use with **green spaces**
- Residential blocks with unobstructed view
- Slim tower blocks for **daylight penetration**
- Space within the block for community activities
- South facing facades for **potential BIPV use**
- **Green spaces** for food production




- Variant with **data centre**
- Allows **heat recovery** to upper storeys

# FLOORPLANS + LAYOUTS

## RESIDENTIAL

### Typical Studio


1 zone
+ Core

### Typical 1 Bedroom

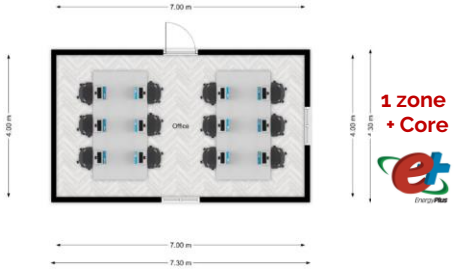

2 zones
+ Core

### Typical 2 Bedroom


2 zones
+ Core

## COMMERCIAL

### Typical Meeting Room

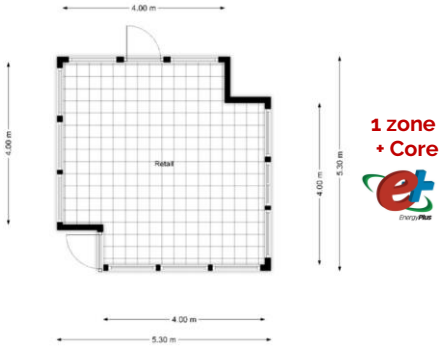



1 zone
+ Core

### Typical Office


1 zone
+ Core

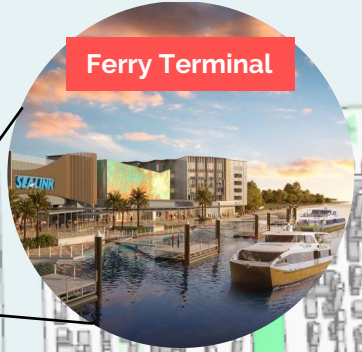
### Typical Retail




1 zone
+ Core

‘Mini Central Parks’
Carparks
Urban farm rooftops

Ferry Terminal



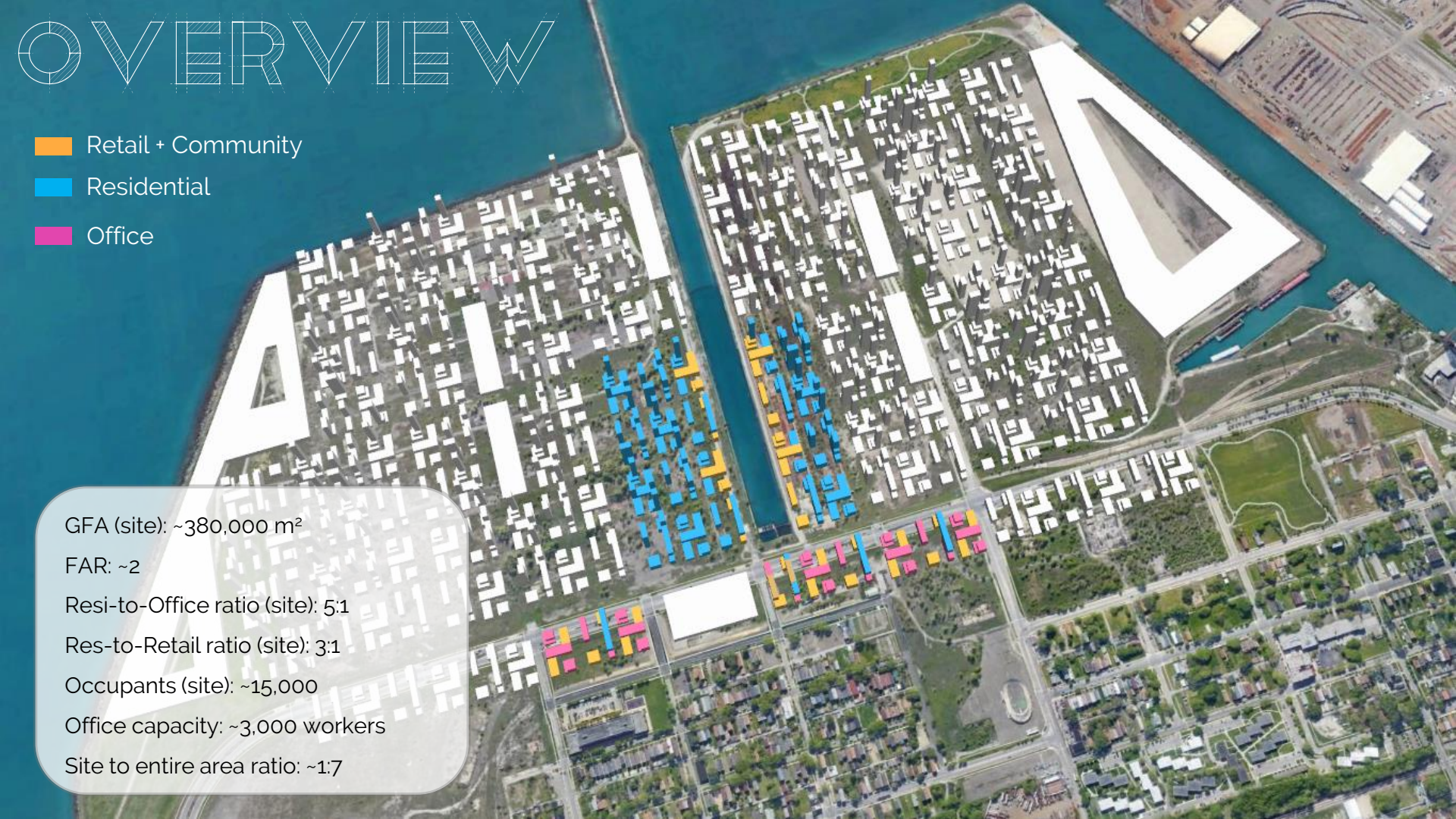
Green Spaces/Farms

Main Waterfront

Carpark with
Solar PV Rooftops

Transport Terminal

# OVERVIEW




GFA (site): ~380,000 m²

FAR: ~2

Resi-to-Office ratio (site): 5:1

Res-to-Retail ratio (site): 3:1

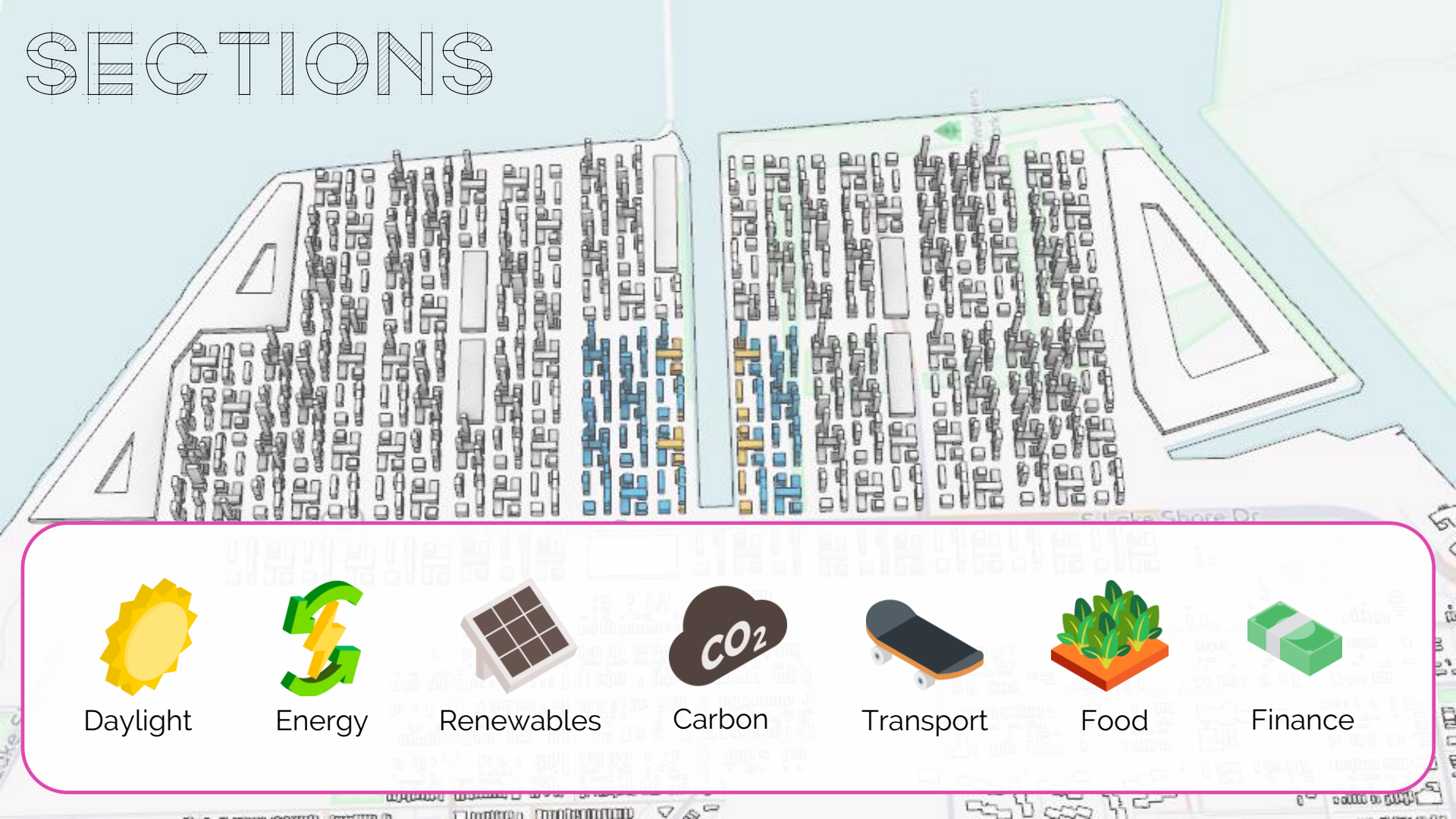
Occupants (site): ~15,000

Office capacity: ~3,000 workers

Site to entire area ratio: ~1:7


# VIEW EXPLORATION

# SECTIONS



Daylight

Energy

Renewables

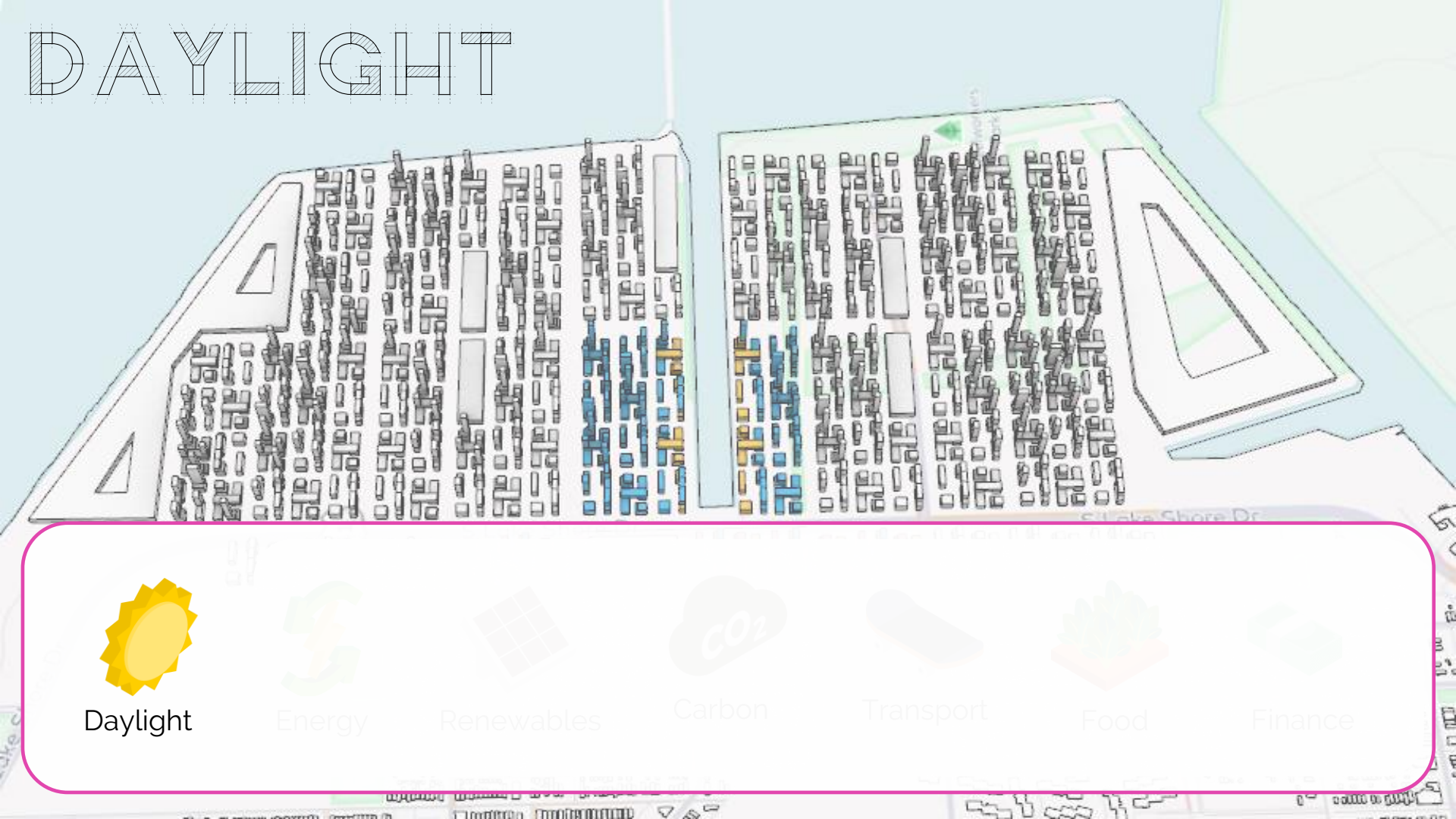
Carbon

Transport

Food

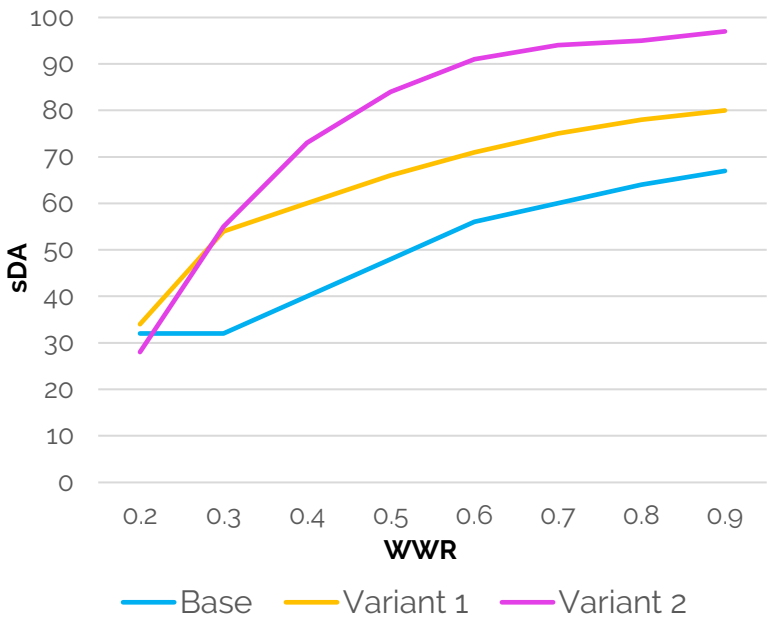
Finance

# DAYLIGHT

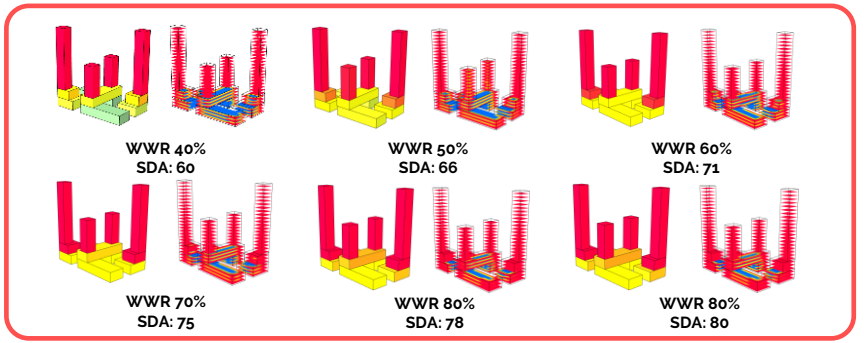


Daylight

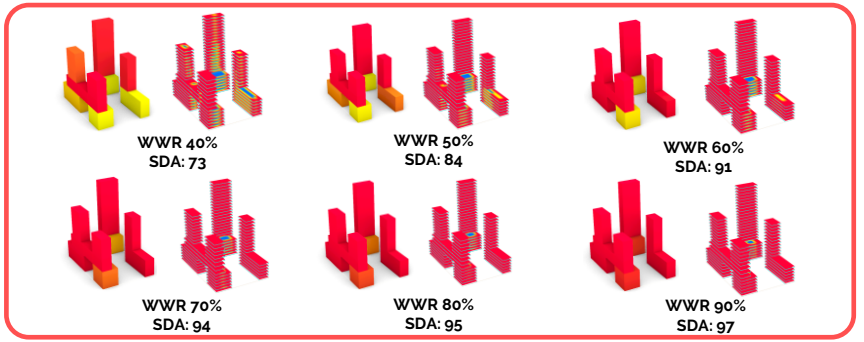
# DAYLIGHT PARAMETRIC




## Variant 1

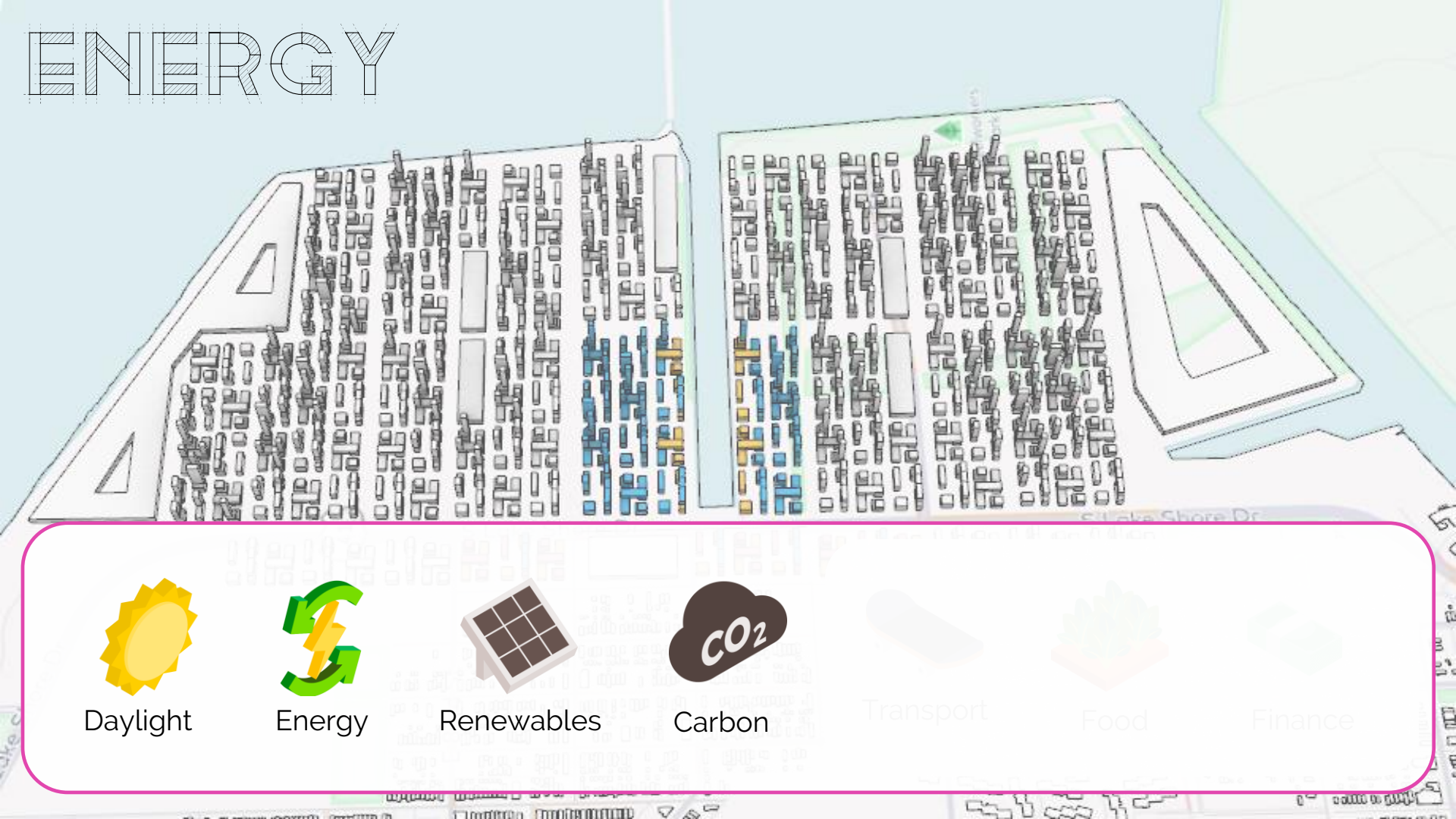



## Variant 2



# DAYLIGHT PRECINCT

# ENERGY



Daylight

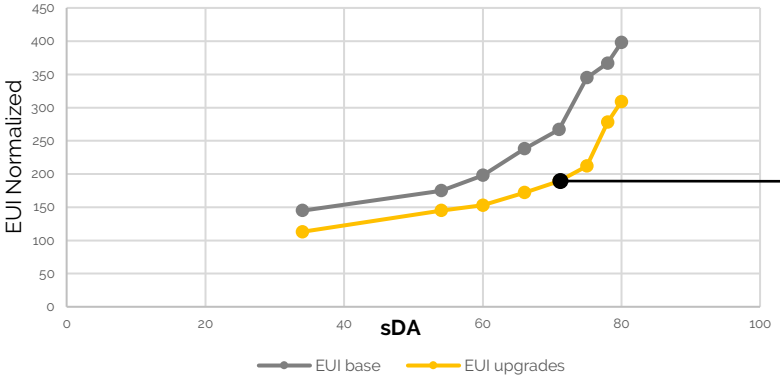
Energy

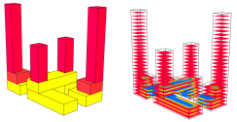
Renewables

Carbon

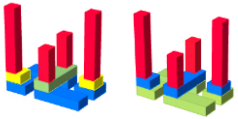
# ENERGY PARAMETRIC

## Variant 1



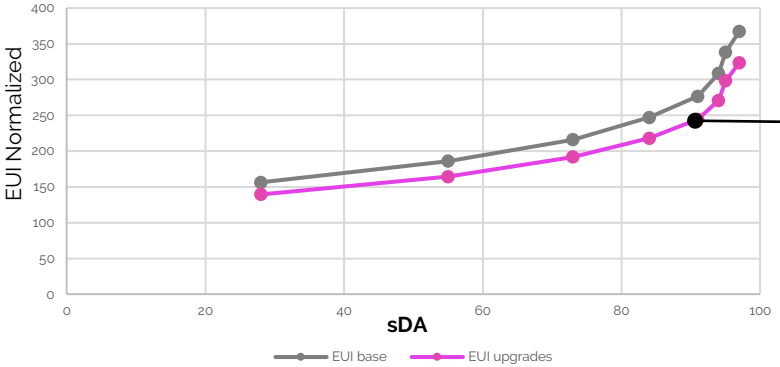



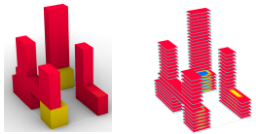
WWR 60%
SDA: 71



| Base | Advance |
|---|---|
| Office: 270 kW/m² | \| Office: 101 kW/m² |
| Retail: 187 kW/m² | \| Resi: 163 kW/m² |
| Resi: 372 kW/m² | \| Resi: 331 kW/m² |

## Variant 2

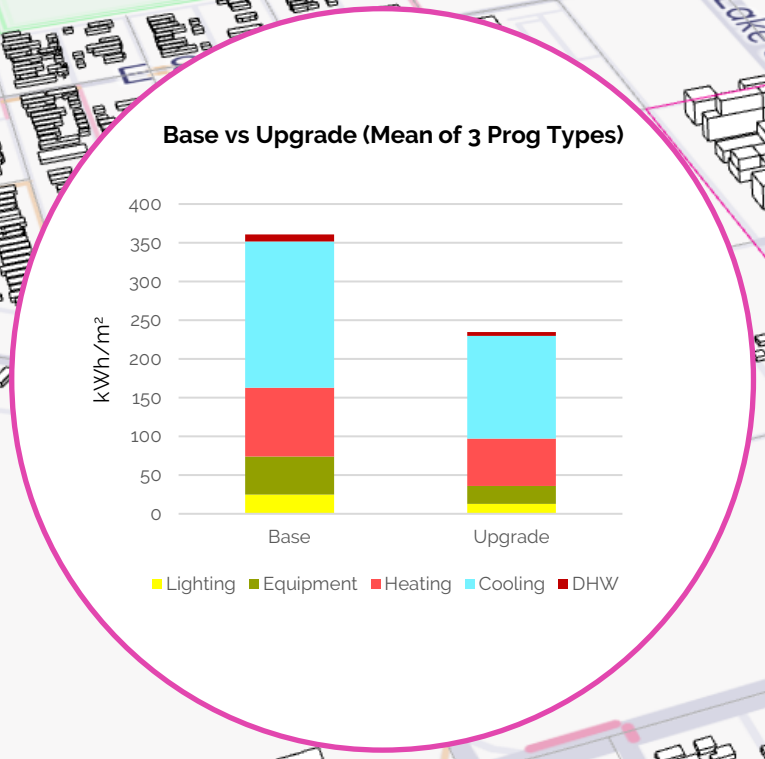


WWR 60%
SDA: 91

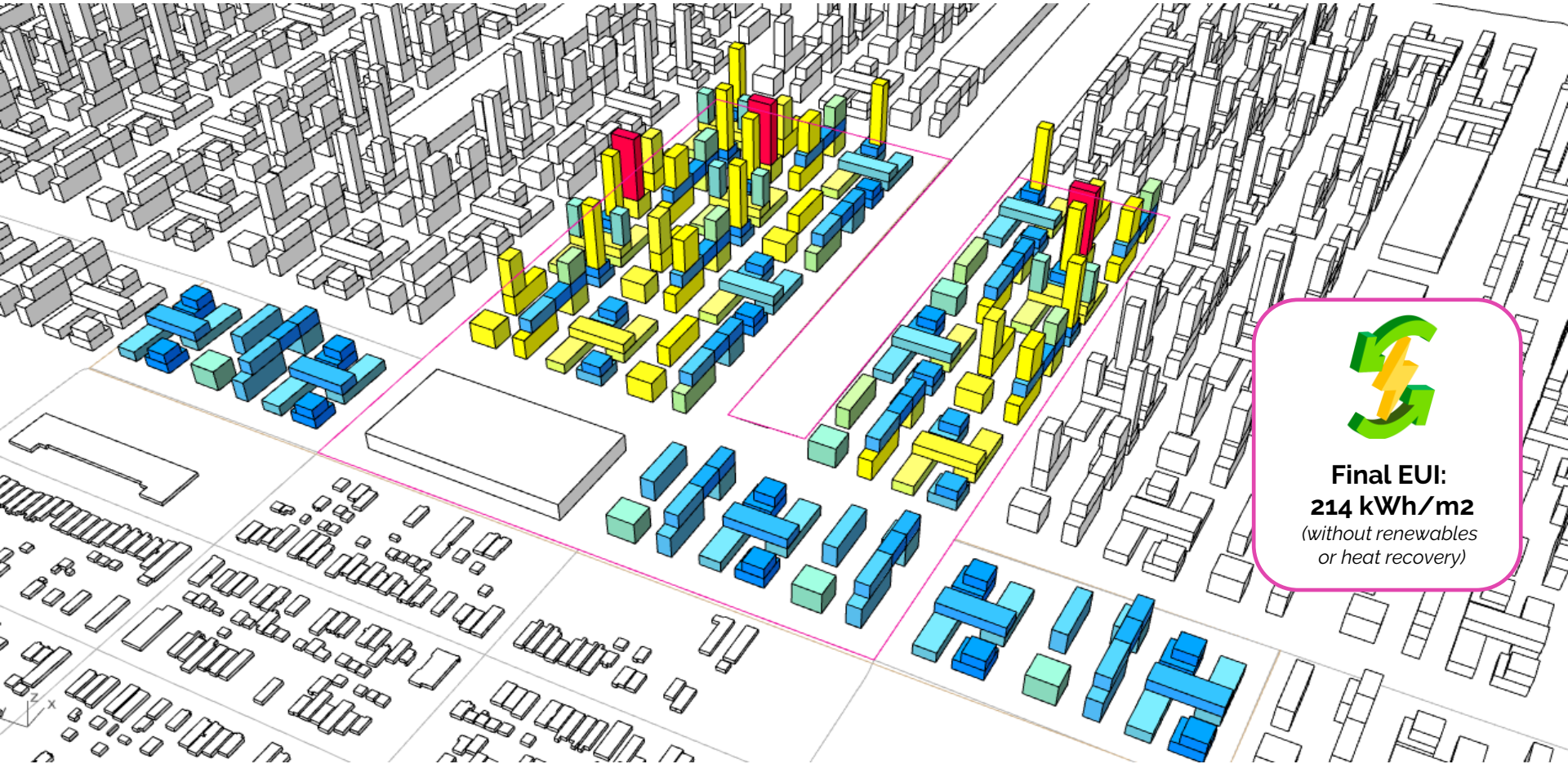
EUI base: 276 kWh/m2
EUI upgrade: 244 kWh/m2

# EVOLVED PROTO URBAN



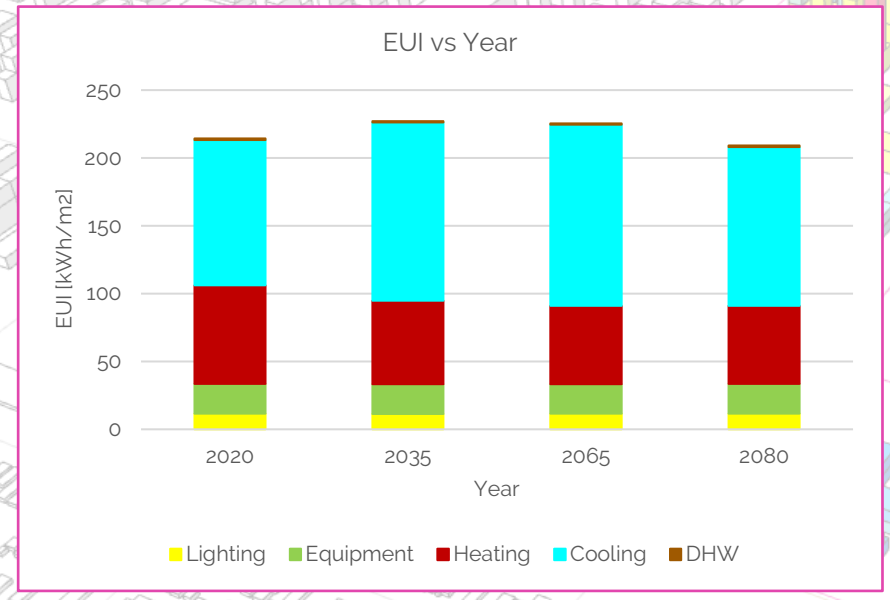

Mixture of variants

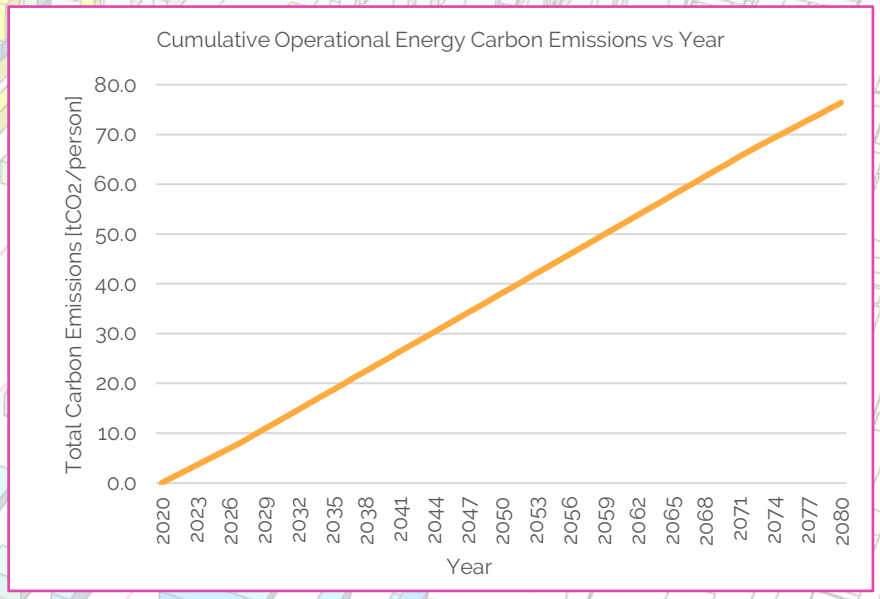
# ENERGY PRECINCT



**Final EUI:**
**214 kWh/m2**
*(without renewables or heat recovery)*

# ENERGY CONSUMPTION

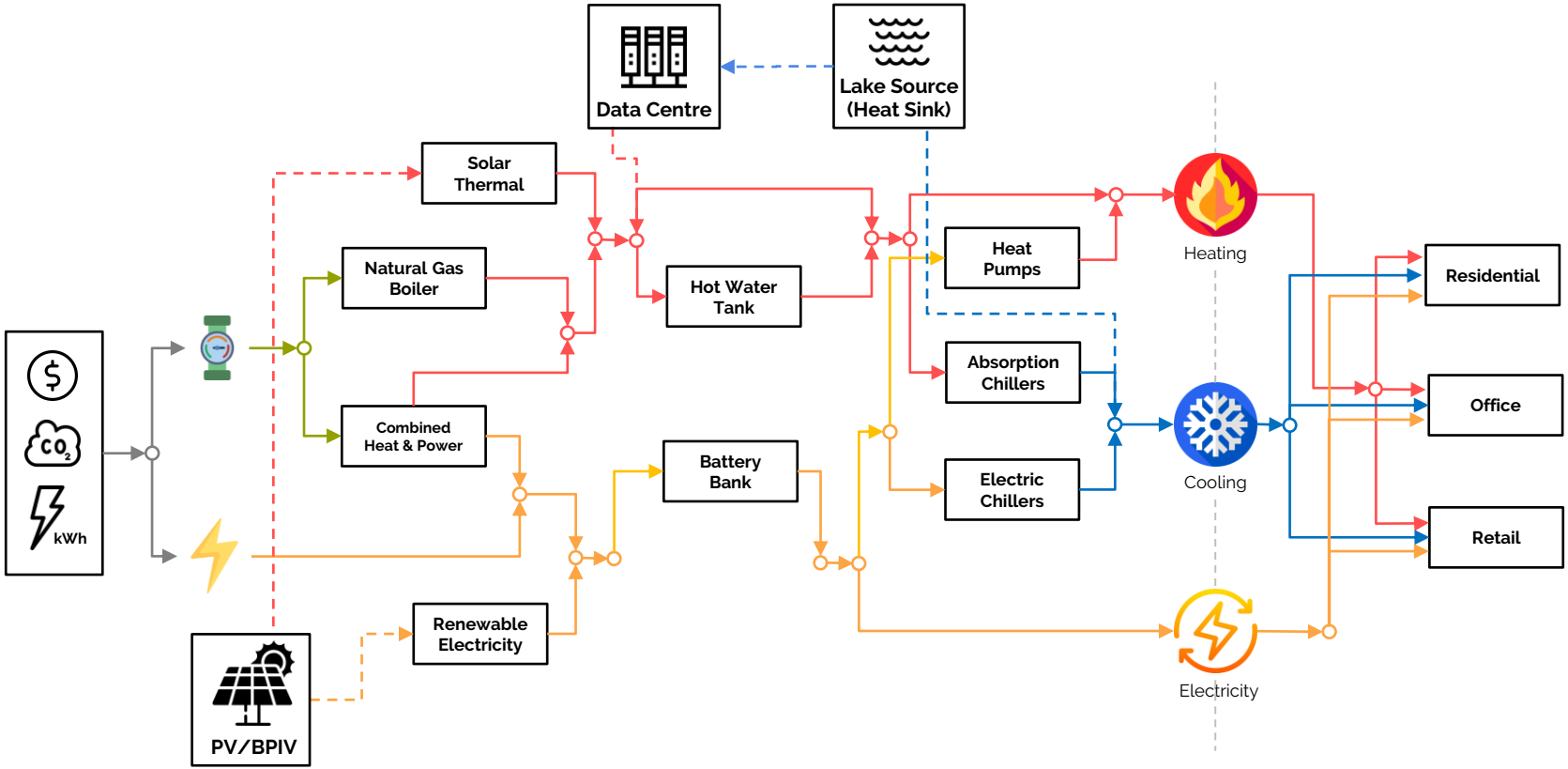


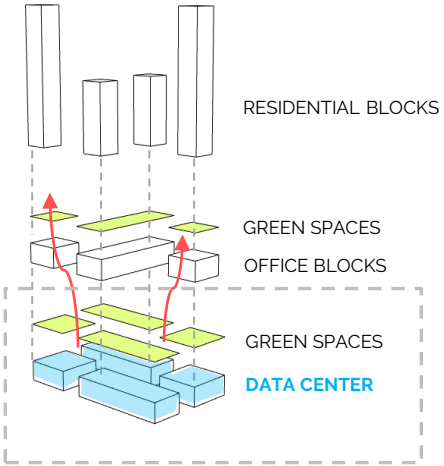
# DISTRICT ENERGY SYSTEM

SUPPLY SIDE

DEMAND SIDE

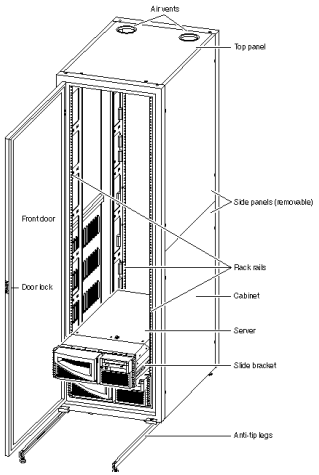


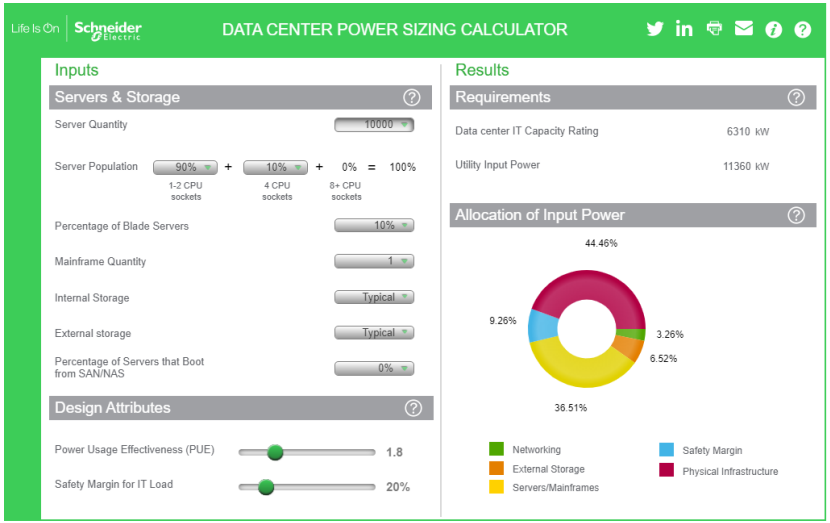
# DATA CENTRE




- 4 Base blocks per proto-block (up to 6500 m²)

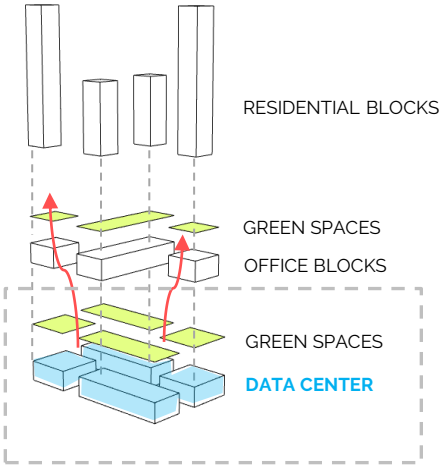
- ~3m² per server rack
- Average power consumption per rack today is around 7kW (higher density or peak demand can hit 15 kw/rack
- Assume allocation of 2,000 server racks/proto-block (i.e 30,000 kw)



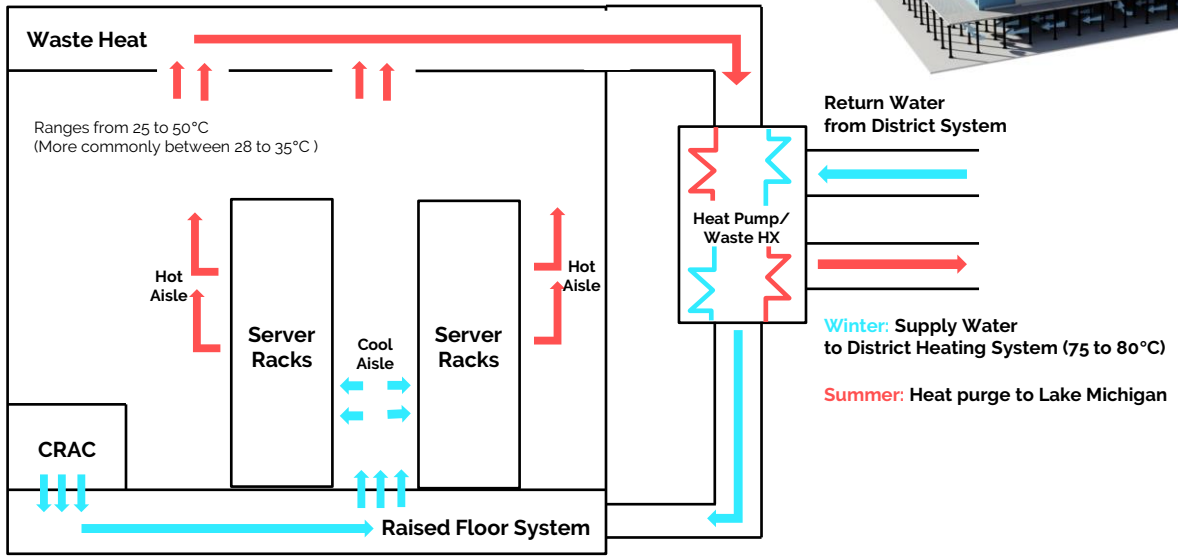



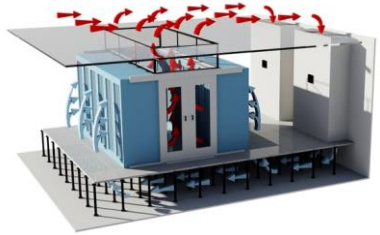
# WINTER

## Waste Heat Extraction




Typical Server Room CRAC Design

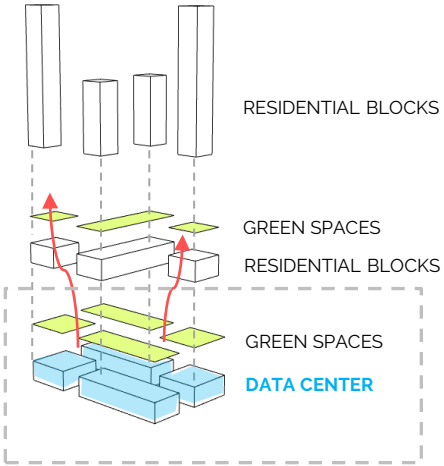


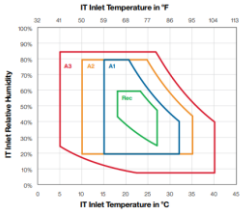



- Augment with heat pumps to boost 70 to 80°C sufficient for district heating purposes
- Modern heat pumps for such purposes highly efficient (COP of 3 to 5)
- In ongoing air stream, no effect on architectural or structural design

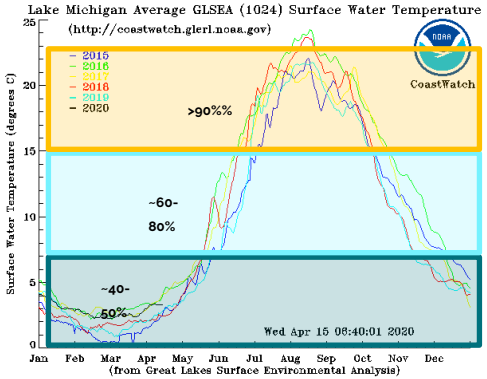
# SUMMER

## Lake Source Cooling for District Cooling & Data Centre




## Lake Michigan Temperature

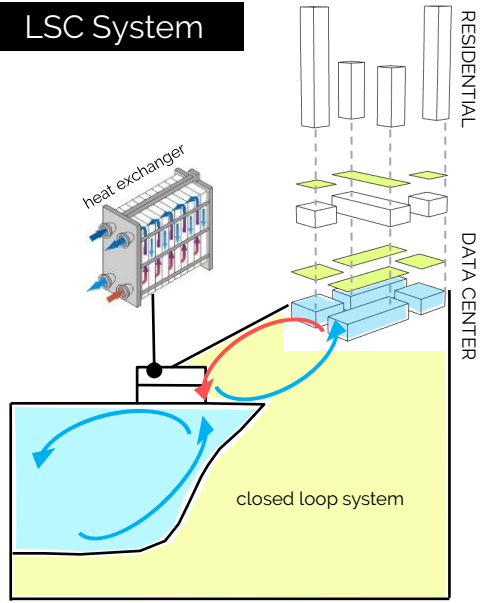



ASHRAE TC9.9 Guidelines (25°C)

Modern optimized data centers set-point (10-15°C)

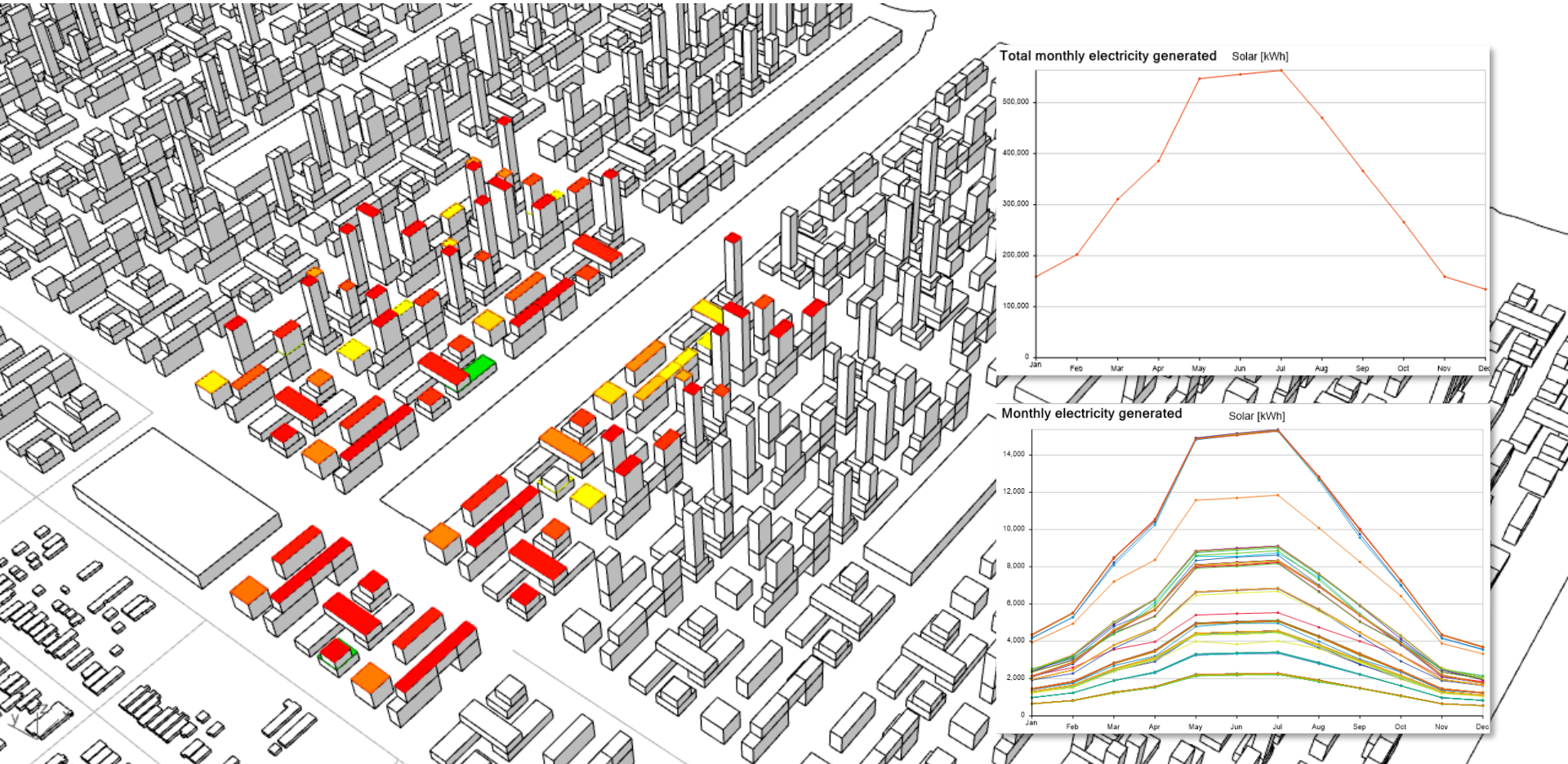
Legacy data center chilled water set-point (6-7°C)

## LSC System

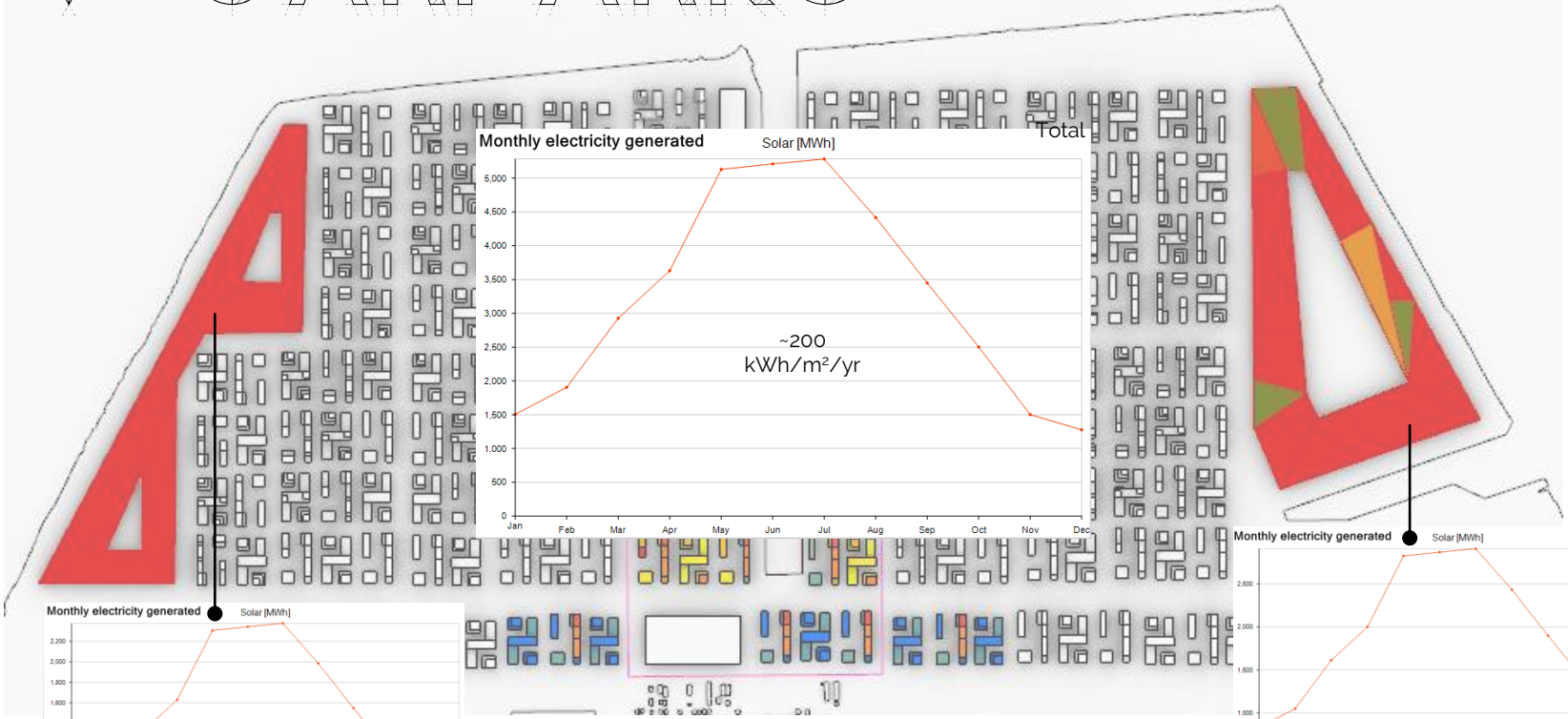



- Cold lake water pumped to heat exchanger at shore, where it absorbs some of the heat used to cool the district. Utilises gravity
- closed loop of chilled water circulating through buildings and data center will collect heat removed by air conditioning

# PV PROTOBLOCKS



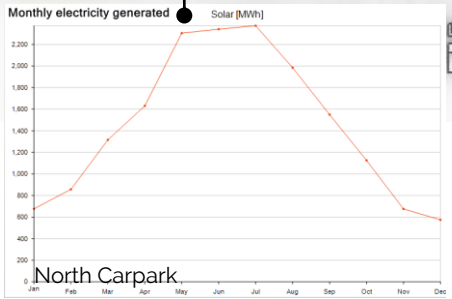
# PV CARPARKS



Total




~200
kWh/m²/yr



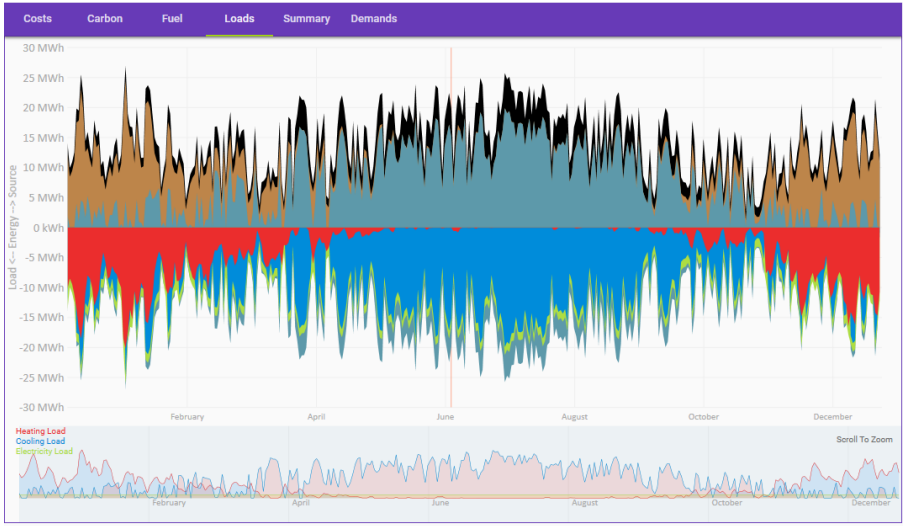

North Carpark

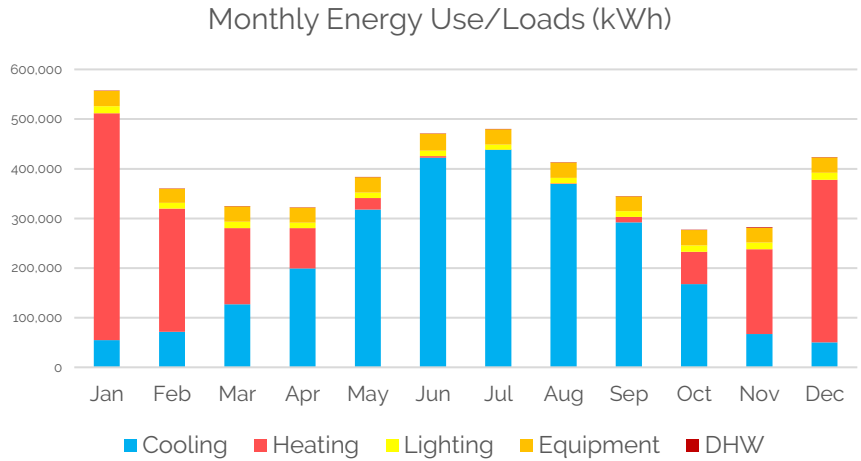



South Carpark

# PROTO ENERGY

## Single Protoblock breakdown

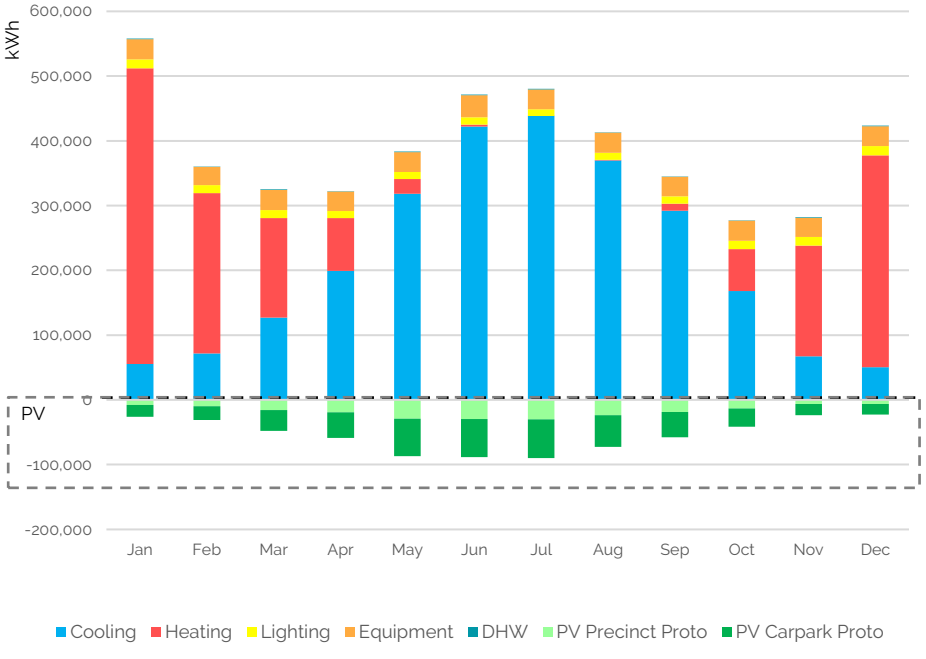


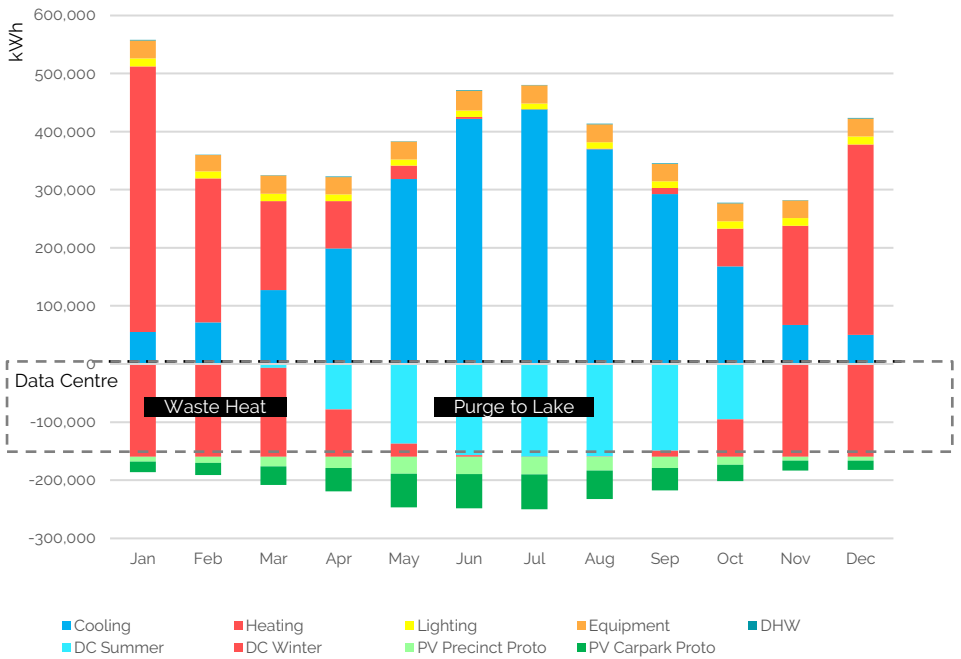
# PROTO ENERGY

## Single Protoblock breakdown

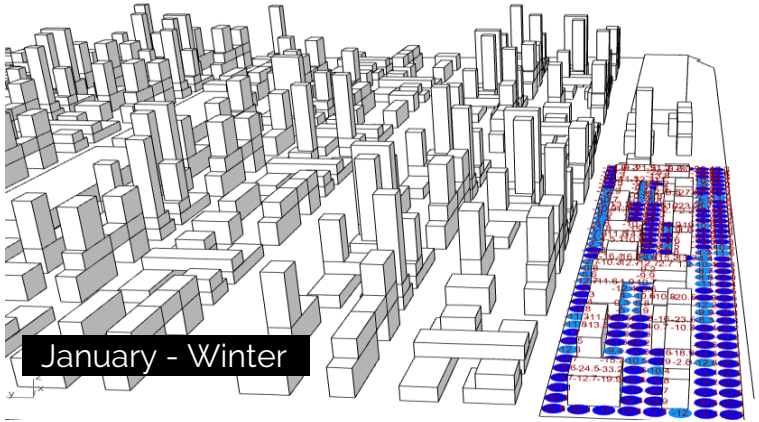
### Monthly Energy Use/Loads (No Data Centre)

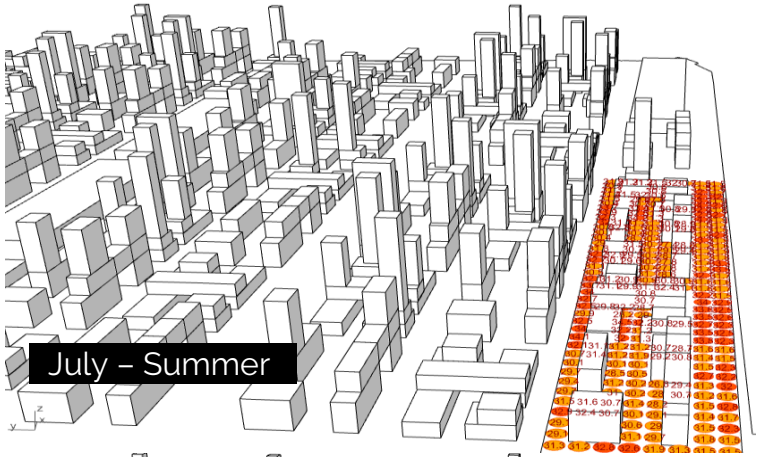


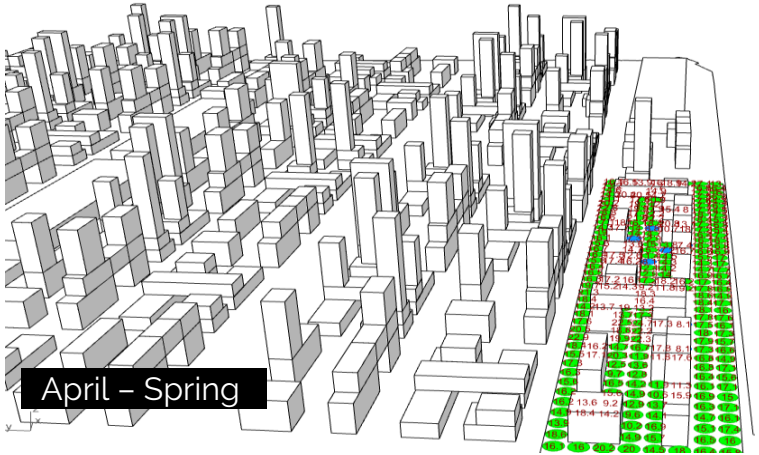

### Monthly Energy Use/Loads (With Data Centre)

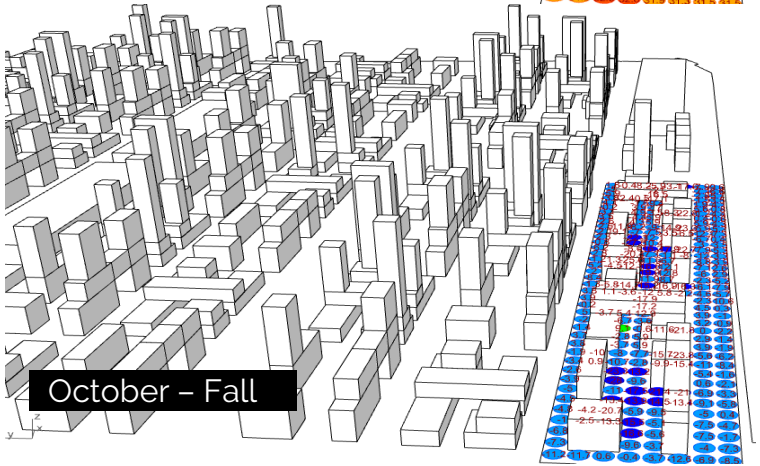


# OUTDOOR THERMAL COMFORT



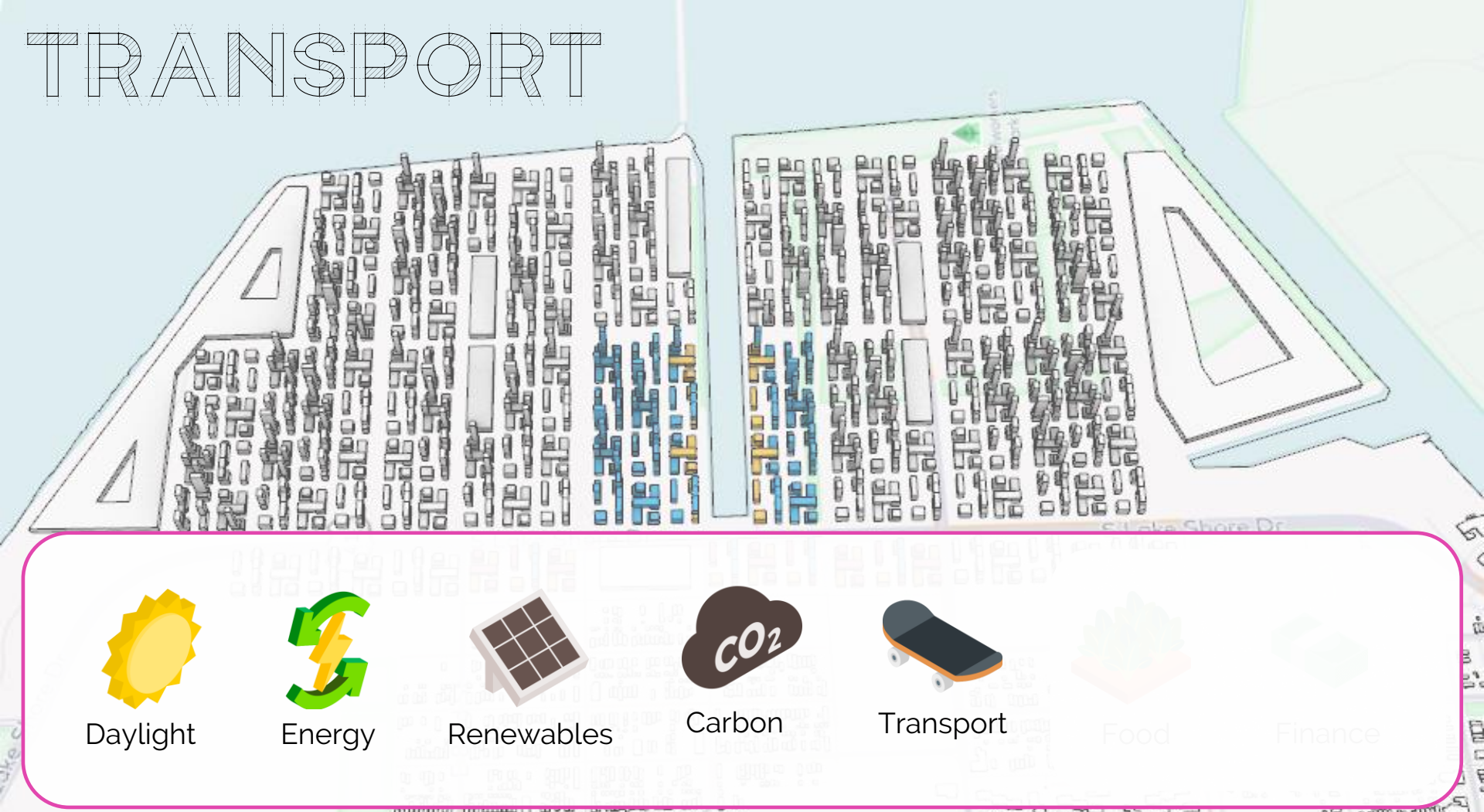




| UTCI (°C) range | Stress Category |
|---|---|
| above +46 | extreme heat stress |
| +38 to +46 | very strong heat stress |
| +32 to +38 | strong heat stress |
| +26 to +32 | moderate heat stress |
| +9 to +26 | no thermal stress |
| +9 to 0 | slight cold stress |
| 0 to -13 | moderate cold stress |
| -13 to -27 | strong cold stress |
| -27 to -40 | very strong cold stress |
| below -40 | extreme cold stress |

# TRANSPORT



Daylight

Energy

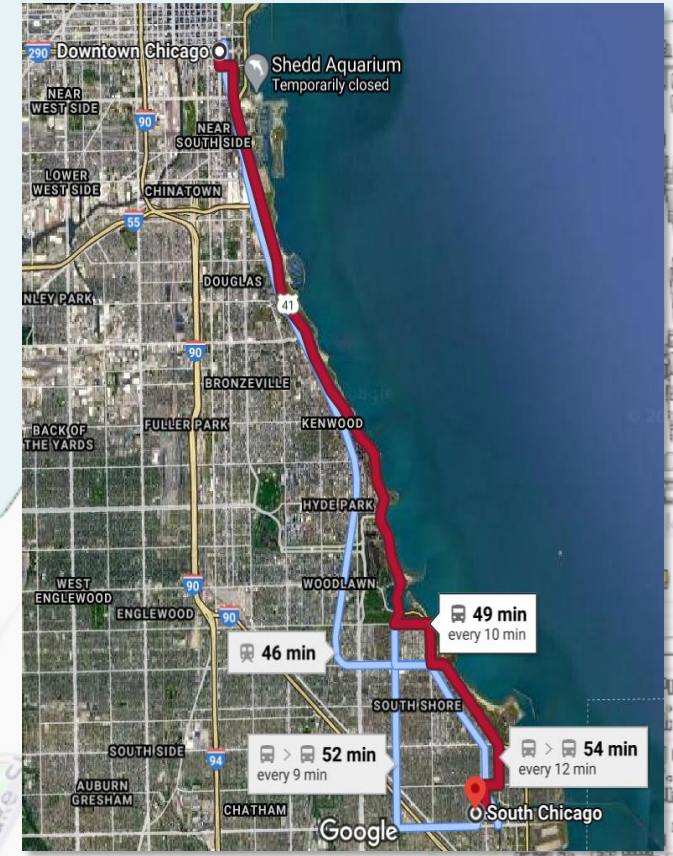
Renewables

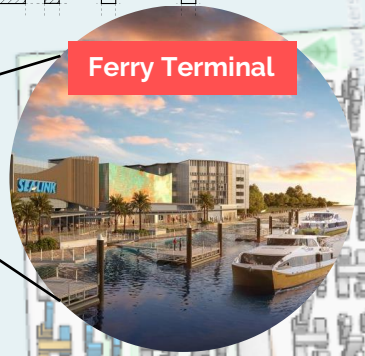
Carbon

Transport

# MACRO MOBILITY

## Public Transit to Central Chicago





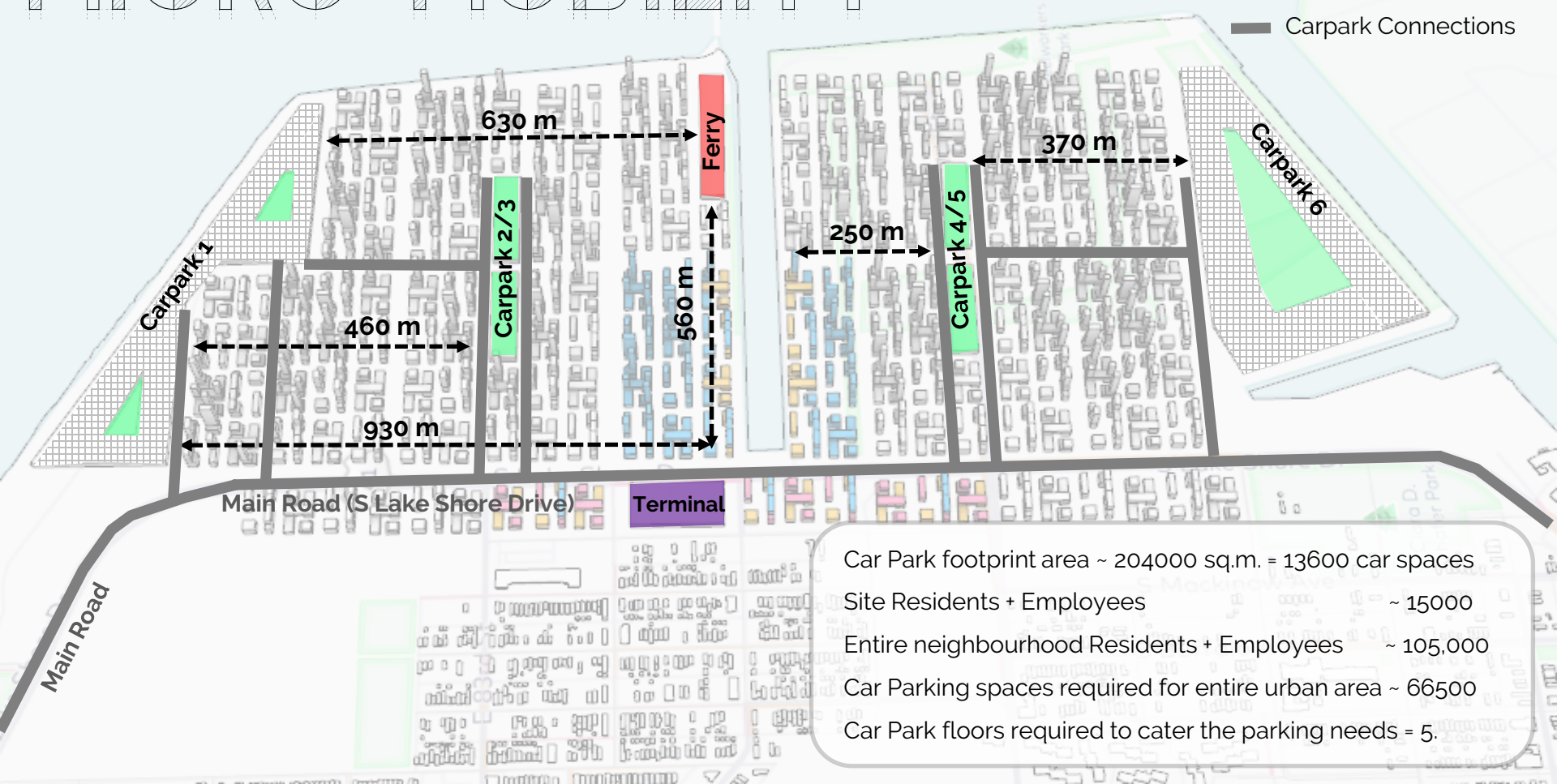
Ride duration to Chicago Downtown:

- **Ferry** – 30- 40 minutes.
- **CTA bus/train** – 45 minutes to 1 hour.

# MICRO MOBILITY

Carparks

Carpark Connections




Car Park footprint area ~ 204000 sq.m. = 13600 car spaces

Site Residents + Employees ~ 15000

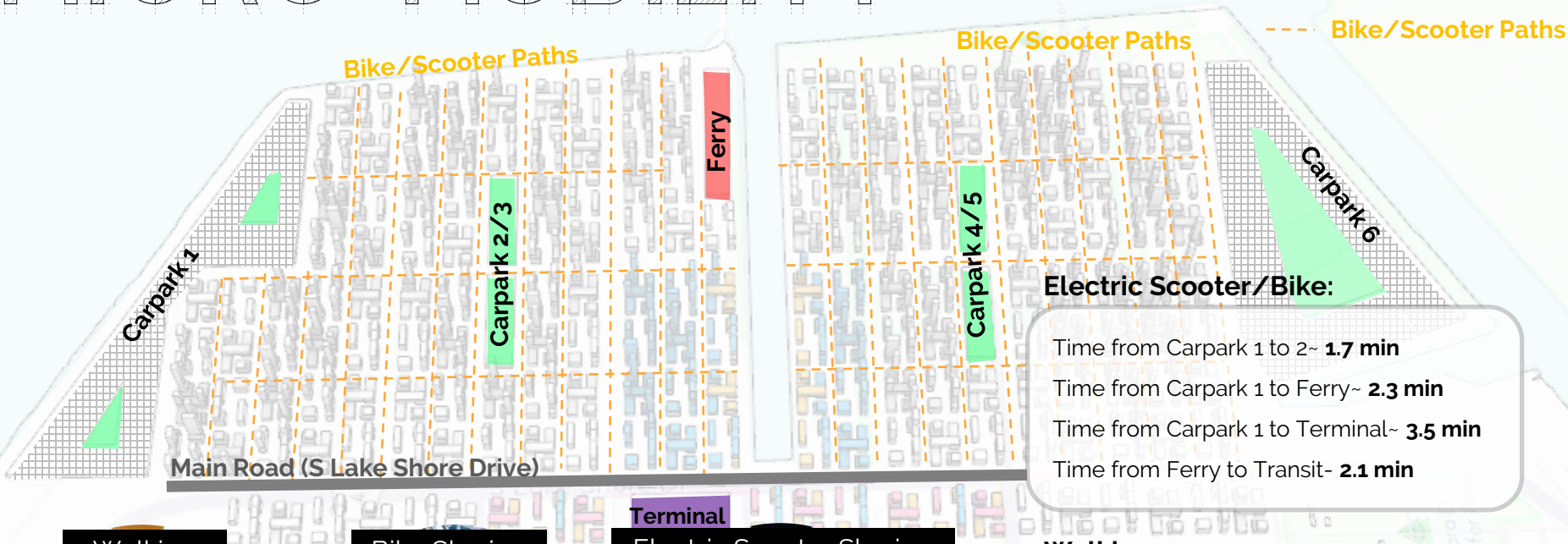
Entire neighbourhood Residents + Employees ~ 105,000

Car Parking spaces required for entire urban area ~ 66500

Car Park floors required to cater the parking needs = 5.

# MICRO MOBILITY

Within Chicago South Area




## Electric Scooter/Bike:

Time from Carpark 1 to 2~ **1.7 min**

Time from Carpark 1 to Ferry~ **2.3 min**

Time from Carpark 1 to Terminal~ **3.5 min**

Time from Ferry to Transit- **2.1 min**

## Walking:

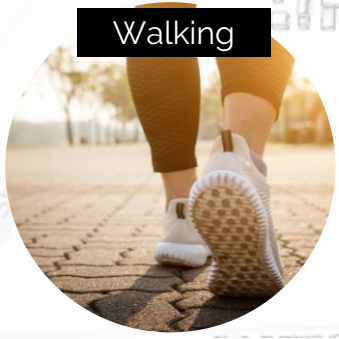
Time from Carpark 1 to 2~ **5.7 min**

Time from Carpark 1 to Ferry~ **7.8 min**

Time from Carpark 1 to Terminal~ **11.5 min**

Time from Ferry to Transit- **6.9 min**

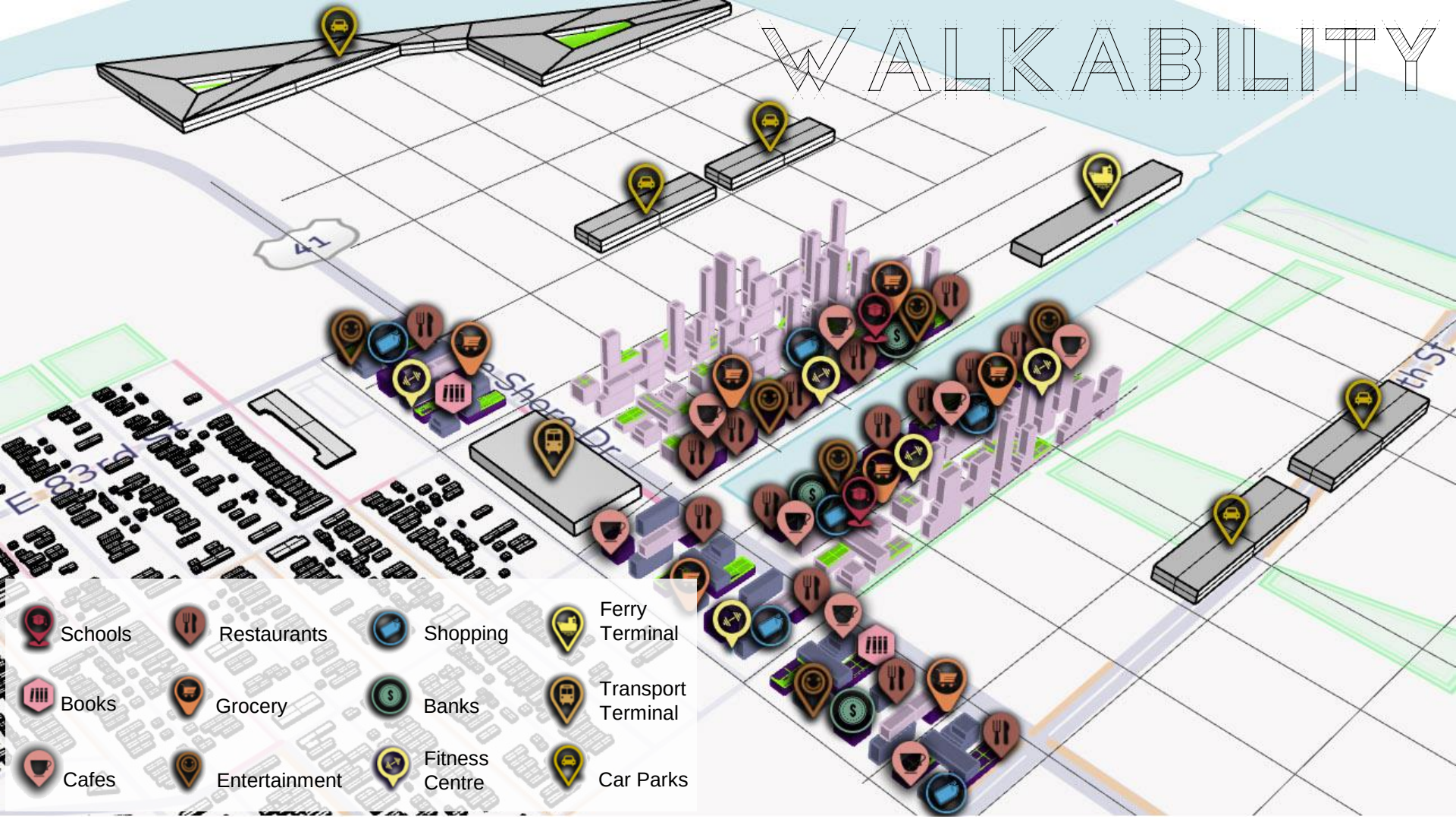
Walking



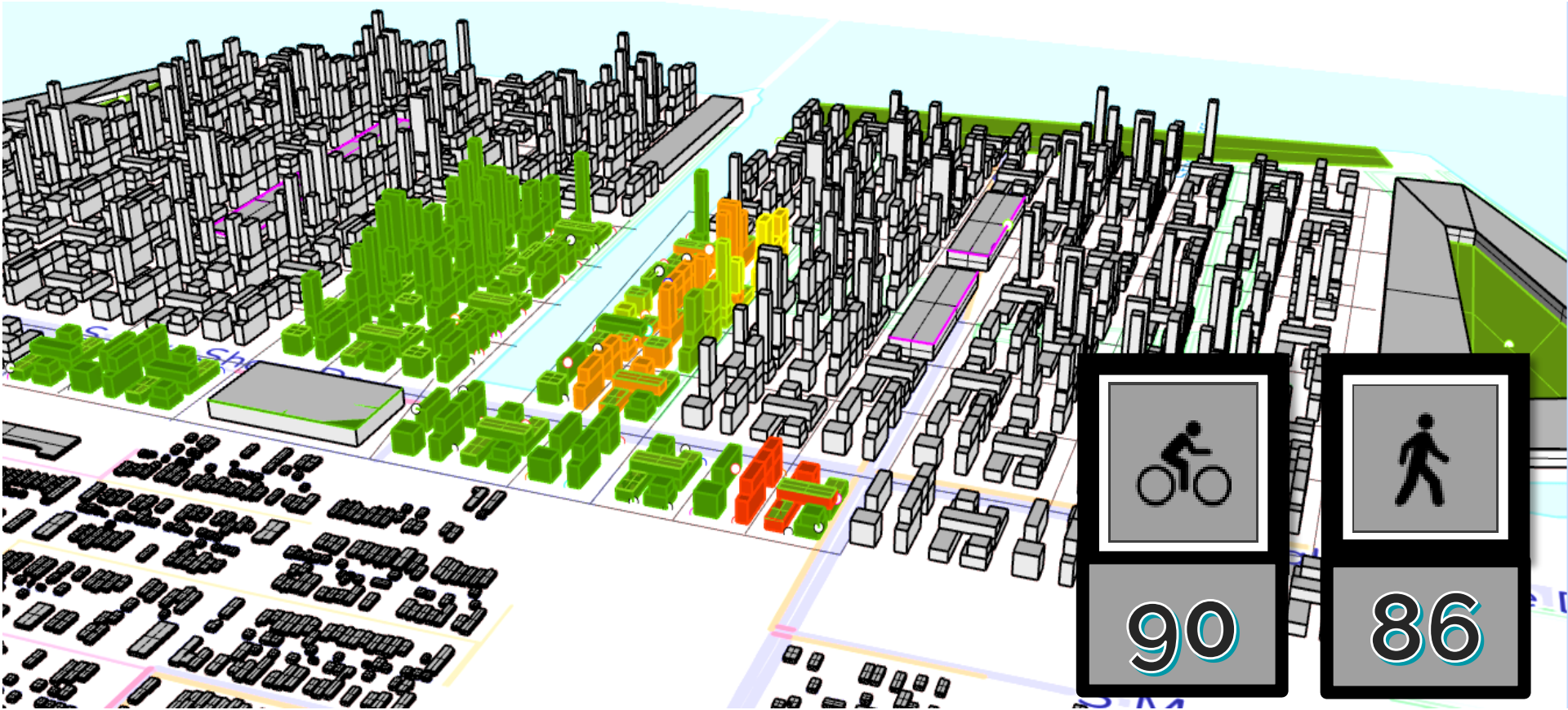
Bike Sharing

Electric Scooter Sharing

# WALKABILITY



# WALKABILITY



# FOOD PRODUCTION

Local food

Jobs

Carbon reduction

Business

Community & Education

Food consumption

(t/year)

7,571

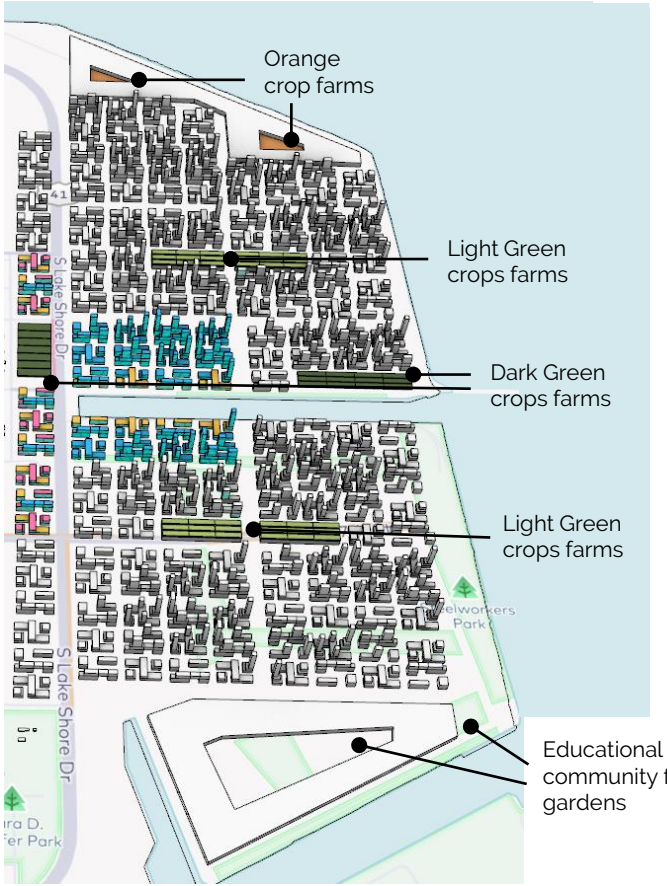
Food expenditure

(k$/year)

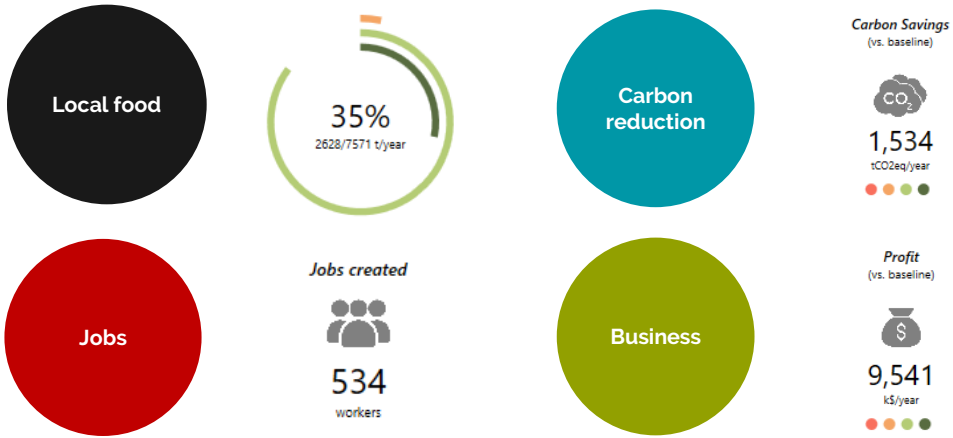
52,192



# FOOD PRODUCTION




1,900 shipping container farms equipvalent
~60,000 m2

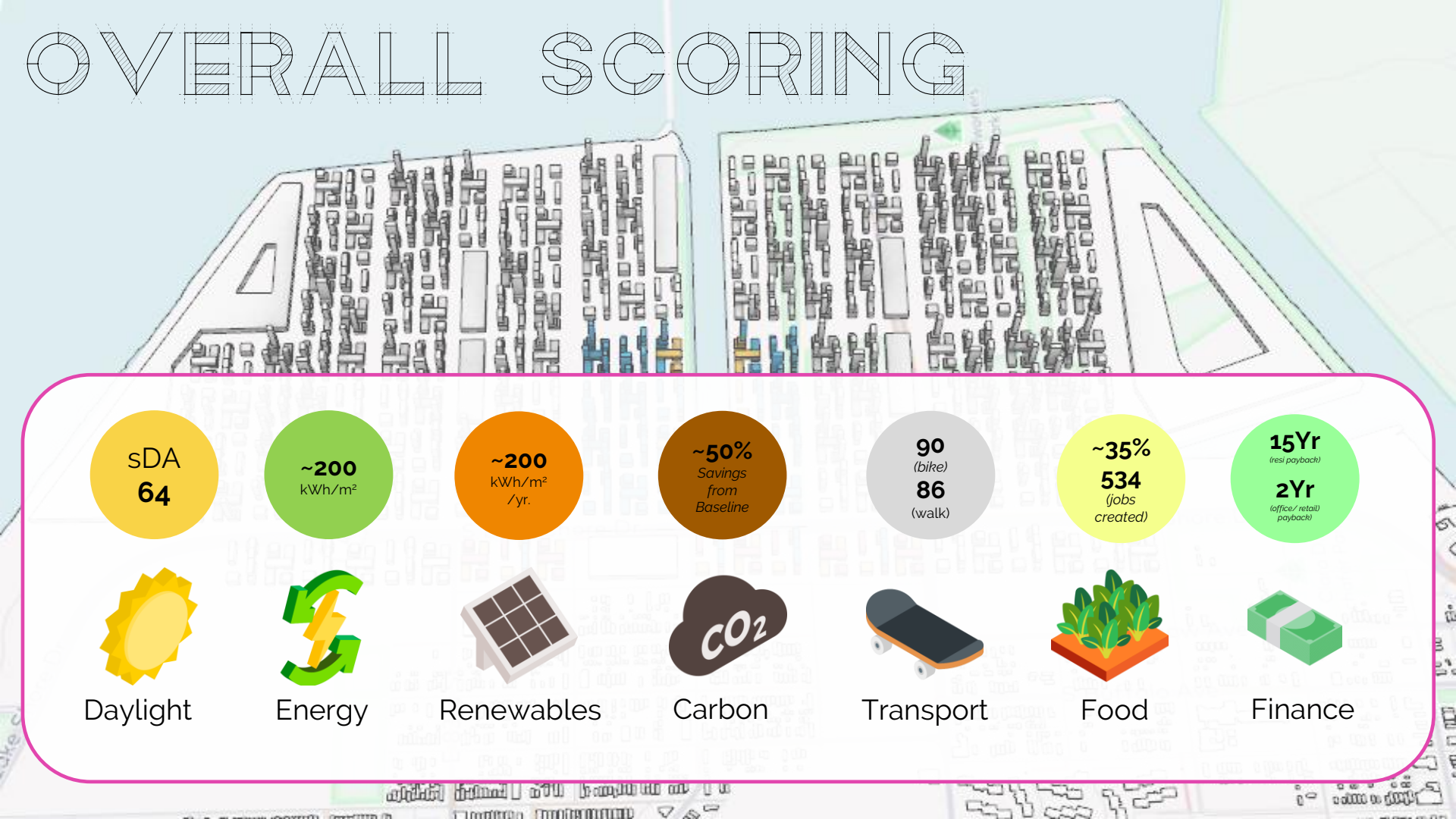


# FINANCES AND PAYBACK

| | Square foot (m2) | Monthly Rents ($/m2) | Average Construction ($/m2) | LEED Construction ($/m2) | Average Construction Payback Period |
|---|---|---|---|---|---|
| **Residential** | 242,174 | 29 | 5113 | 6135 | 15 years |
| **Commercial** | 48,075 | 418 | 7858 | 9429 | < 2 years |
| **Retail** | 78,282 | 276 | 6028 | 7233 | < 2 years |

* Rental data from the Chicago Tribune, RentCafe. Construction data from Cummings

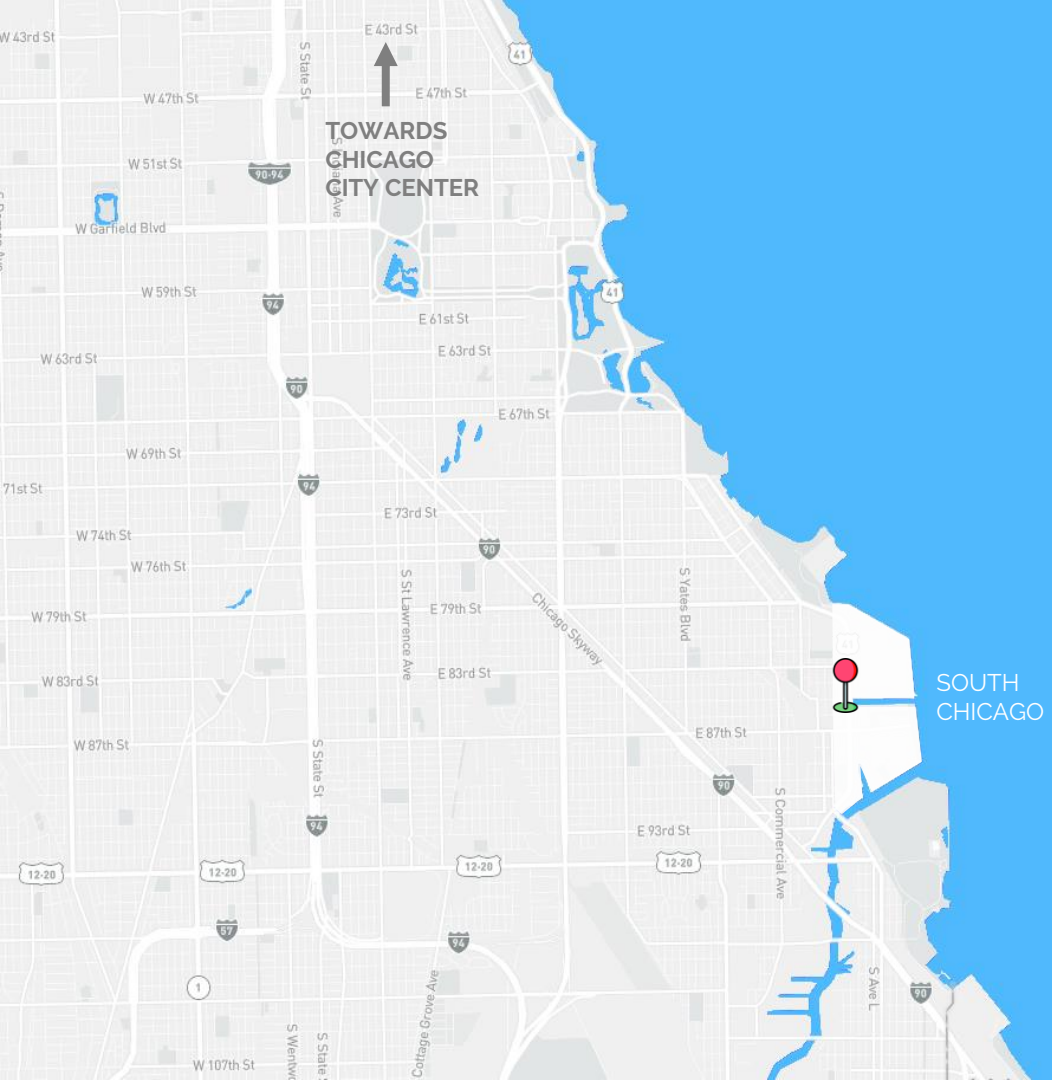
# OVERALL SCORING



| Daylight | Energy | Renewables | Carbon | Transport | Food | Finance |
|---|---|---|---|---|---|---|
| sDA **64** | **~200** kWh/m² | **~200** kWh/m² /yr. | **~50%** *Savings from Baseline* | **90** *(bike)* **86** (walk) | **~35%** **534** *(jobs created)* | **15Yr** *(resi payback)* **2Yr** *(office/ retail) payback)* |

# SOUTH CHICAGO

THANK YOU




# TEMPLATE PARAMETERS

| | Office Base | Office Upgraded | Retail Base | Retail Upgraded | Resi. Base | Resi. Upgraded |
|---|---|---|---|---|---|---|
| People Density | 0.05 p/m² | 0.4 p/m² | 0.2 p/m² | 0.2 p/m² | 0.03 p/m2 | 0.05 p/m2 |
| Equip. Power Density | 11 W/m² | 6 W/m² | 5 W/m² | 4 W/m² | 5.4 W/m2 | 4 W/m2 |
| Light. Power Density | 12 W/m² | 8 W/m² | 20 W/m² | 12 W/m² | 5.4 W/m2 | 4 W/m2 |
| Glazing | Single Pane (5.9 UVal) | Triple Pane (0.9 UVal) | Single Pane (5.9 UVal) | Triple Pane (0.9 UVal) | Single Pane (5.9 UVal) | Triple Pane (0.7 UVal) |
| Occupancy Schedule | 9am – 6pm | 9am – 6pm | 9am – 6pm | 9am – 6pm | 6pm-8am | 6pm-8am |
| Heat Recovery | None | Enthalpy | None | Enthalpy | None | Enthalpy |
| Cooling Set Point | 25C | 25C | 25C | 25C | 26C | 26C |
| Heating Set Point | 20C | 18C | 20C | 18C | 20C | 20C |
| Cooling COP | 3 | 3.5 | 3 | 4 | 3.7 | 4.2 |
| Heating COP | 1 | 1.5 | 1 | 1.5 | 1.25 | 4.2 |
| Bouyancy Driven Flow | Off | On (Set Point 23C) | Off | On (Set Point 23C) | On | On (Set Point 23C) |
| Hot Water | On (Supply Temp 65) | On (Supply Temp 65) | On (Supply Temp 65) | On (Supply Temp 65) | On (Supply Temp 65) | On (Supply Temp 65) |
| Hot Water COP | 1 | 3 | 1 | 3 | 1 | 4.2 |
| Construction | Mainly Concrete Assemblies<br>- 0.357 UVal (Roof)<br>- 0.478 UVal (Wall) | Mainly CLT Assemblies<br>- 0.212 UVal (Roof)<br>- 0.338 UVal (Wall) | Mainly Concrete Assemblies<br>- 0.318 UVal (Roof)<br>- 0.291 UVal (Wall) | Mainly CLT Assemblies<br>- 0.212 UVal (Roof)<br>- 0.338 UVal (Wall) | Steel frame and concrete:<br>- 0.357 UVal (Roof)<br>- 1.577 Uval (Slab)<br>- 0.361 UVal (Wall) | Steel frame/wood sliding/gypsum+insul.<br>- 0.357 UVal (Roof)<br>- 0.171 Uval (Slab)<br>- 0.361 UVal (Wall) |