



4.433 Modeling Urban Energy Flows

Lisbon

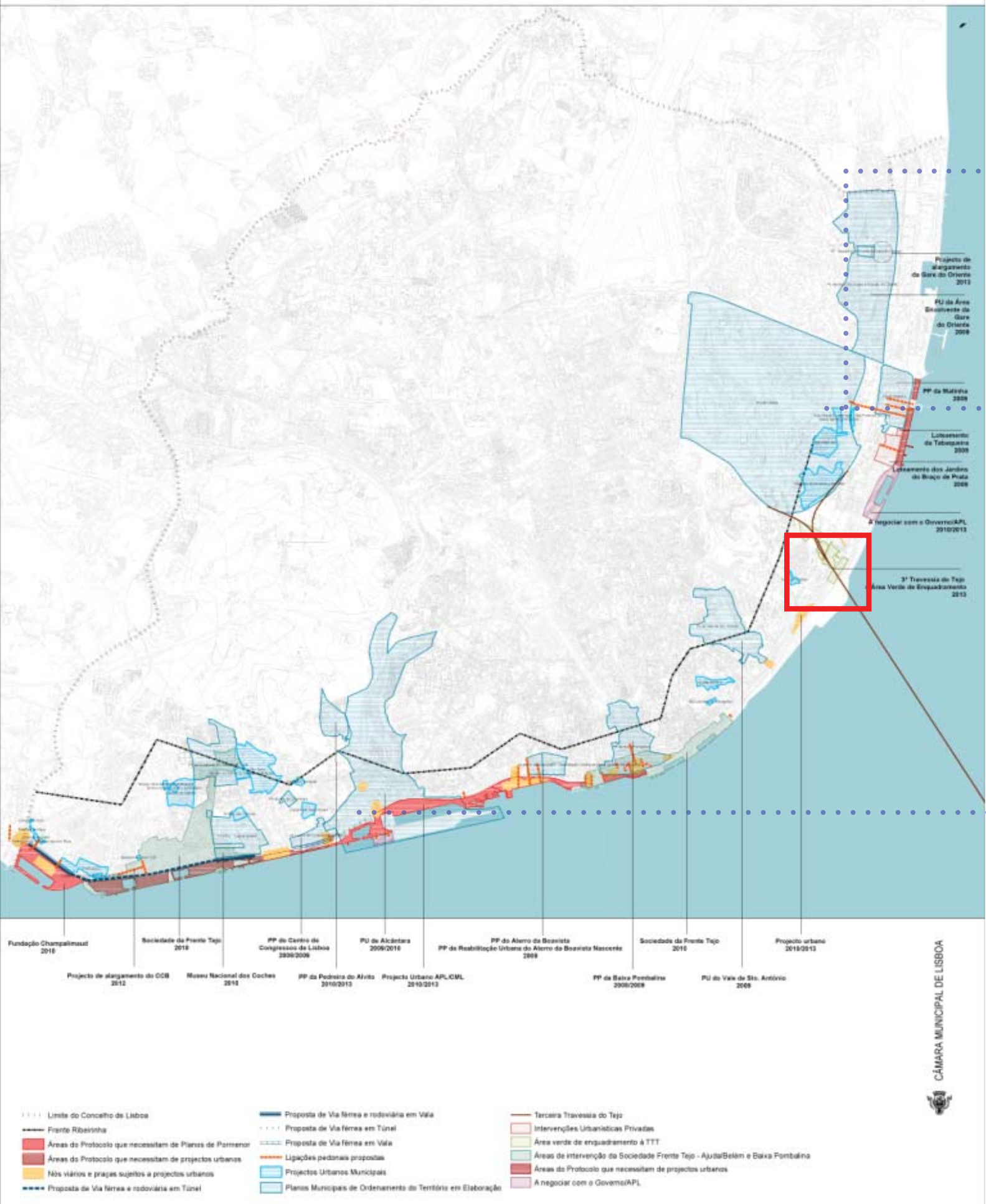
Final Presentation

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General Plan of Interventions in the waterfront of Lisbon

Planta Geral de Intervenção



1998
PAVILION OF PORTUGAL



1998
ORIENTE STATION



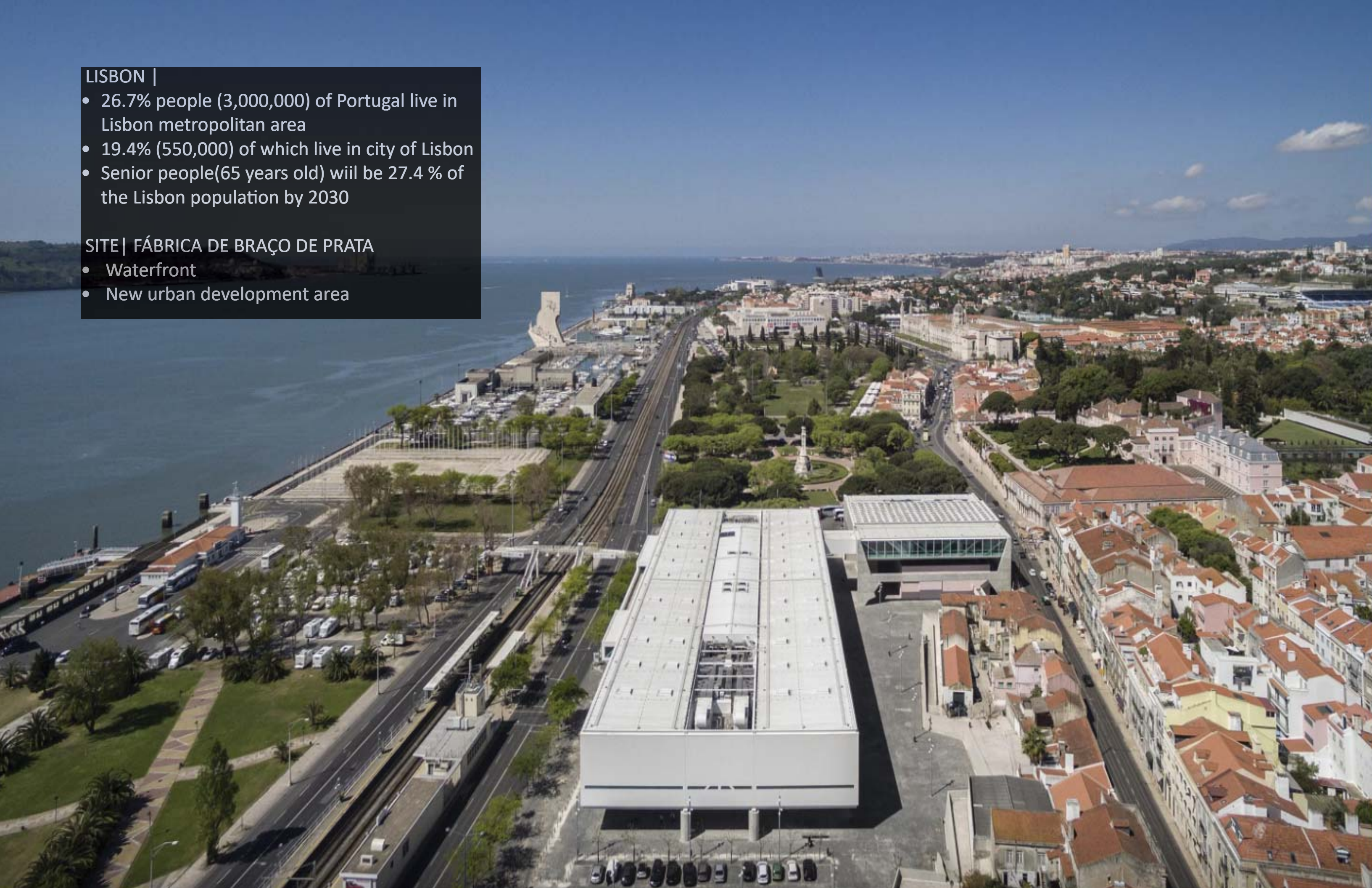
2015
MUSEU NACIONAL DOS COCHES

LISBON |

- 26.7% people (3,000,000) of Portugal live in Lisbon metropolitan area
- 19.4% (550,000) of which live in city of Lisbon
- Senior people(65 years old) will be 27.4 % of the Lisbon population by 2030

SITE| FÁBRICA DE BRAÇO DE PRATA

- Waterfront
- New urban development area



A photograph of a modern courtyard. In the center, two people are sitting on a white ledge in front of a building with large windows. One person is wearing an orange top, and the other is wearing a dark top and holding a small white dog. To the left, there is a tree with yellow-green leaves. In the foreground, there is a light blue metal chair. To the right, there is a glass-enclosed area, possibly a kitchen or dining area, with a table and chairs. The overall scene is bright and modern.

What is a Sustainable Neighborhood?

ENVIRONMENT

OUTDOOR ENVIRONMENT

- EXERCISE
- LEISURE
- THERMAL COMFORT



GREEN SPACE / OPEN SPACE

- PARK
- COMMUNITY SPACE



INTERIOR ENVIRONMENT

- FRESH AIR
- NATURAL VENTILATION



ENERGY

ENERGY

- REDUCING ENERGY CONSUMPTION
- USING RENEWABLE ENERGY



CARBON EMISSION

- NETURAL CARBON EMISSION



CLIMATE

CLIMATE RESILIENCE

- TEMPERATURE IN-CRESING
- SEA LEVEL RISE
- FLOOD



CARDIO COMMUNITY



ZERO CARBON FITNESS

**NATURAL
VENTILATION**

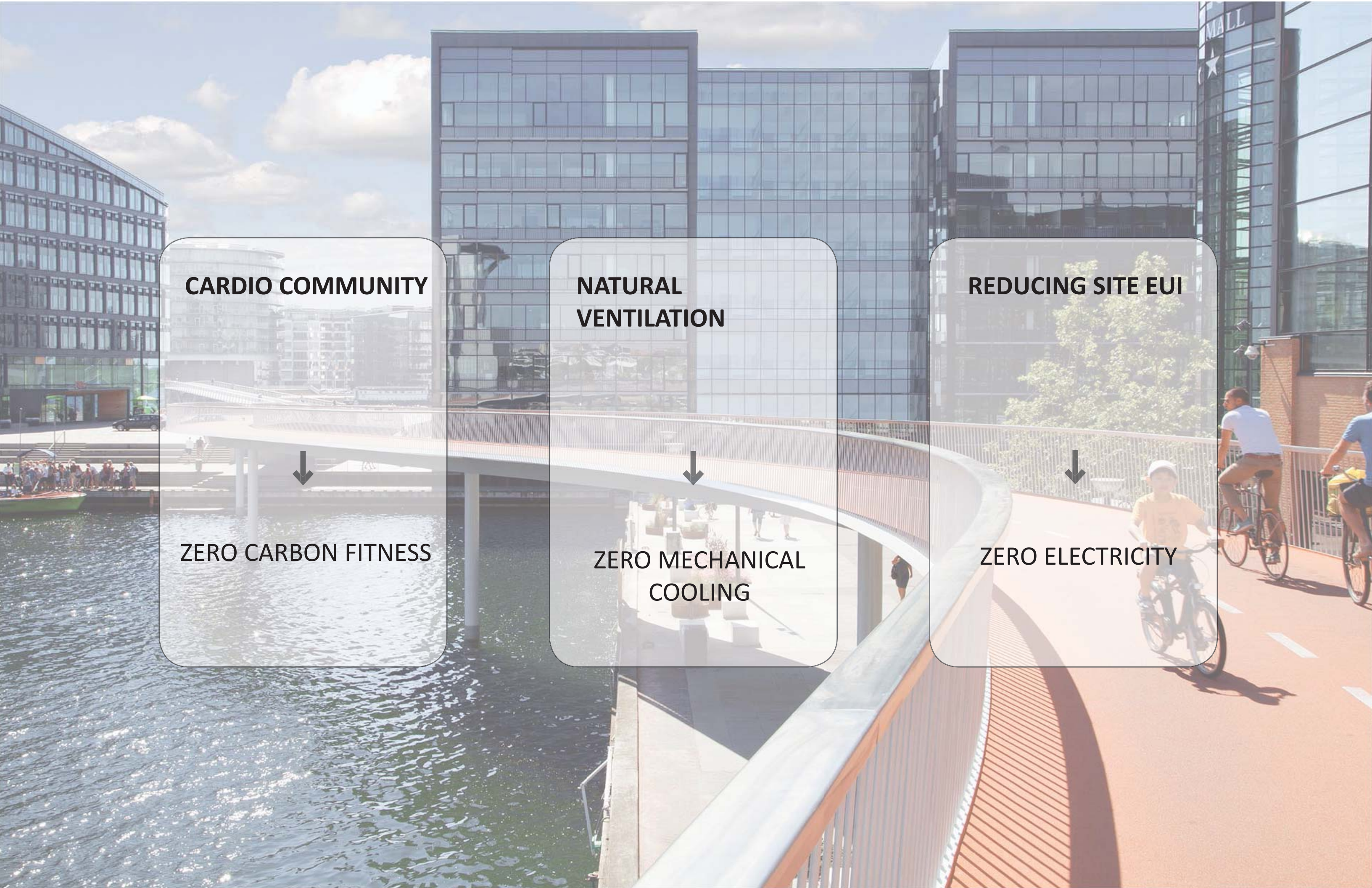


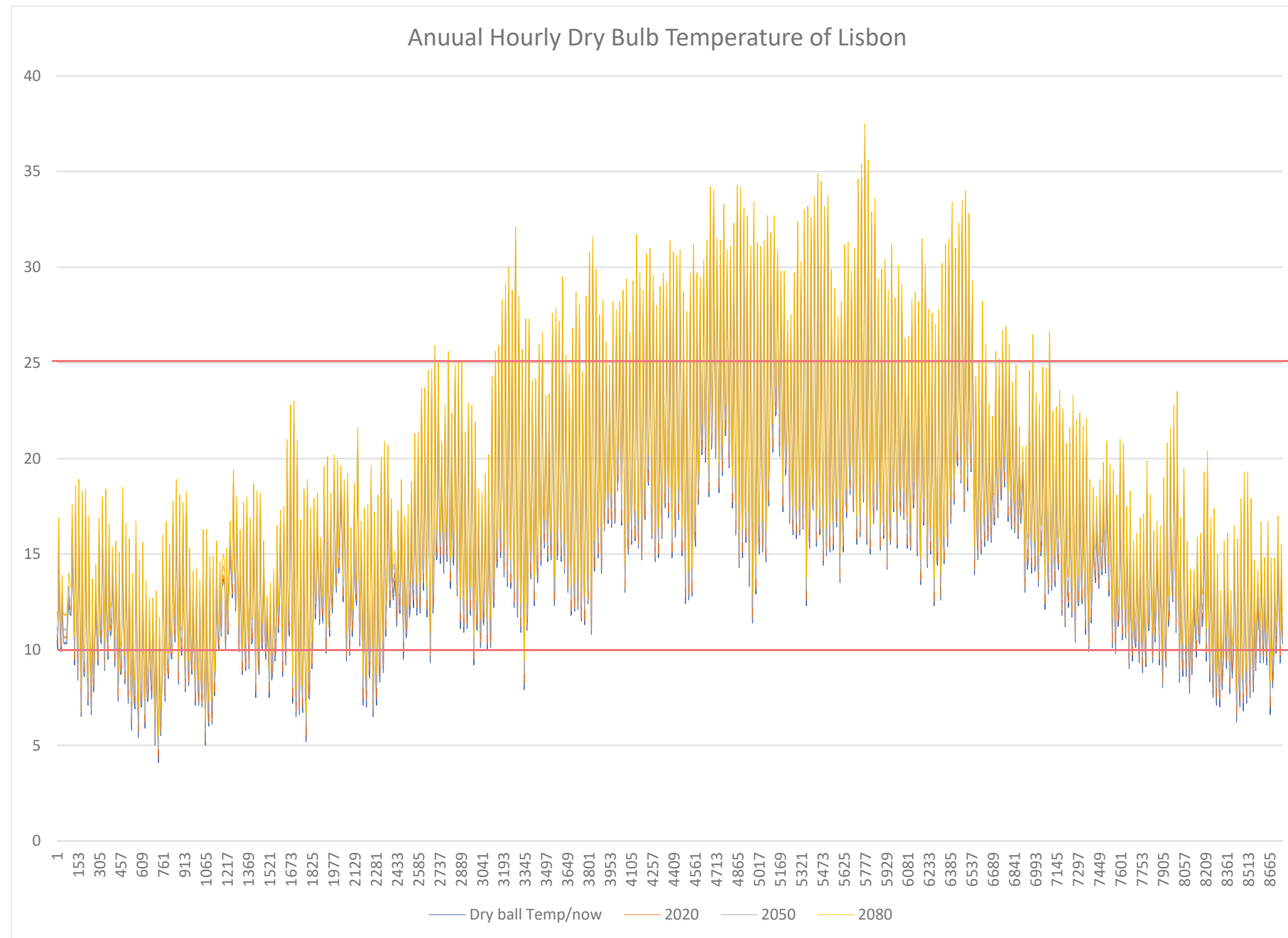
**ZERO MECHANICAL
COOLING**

REDUCING SITE EUI

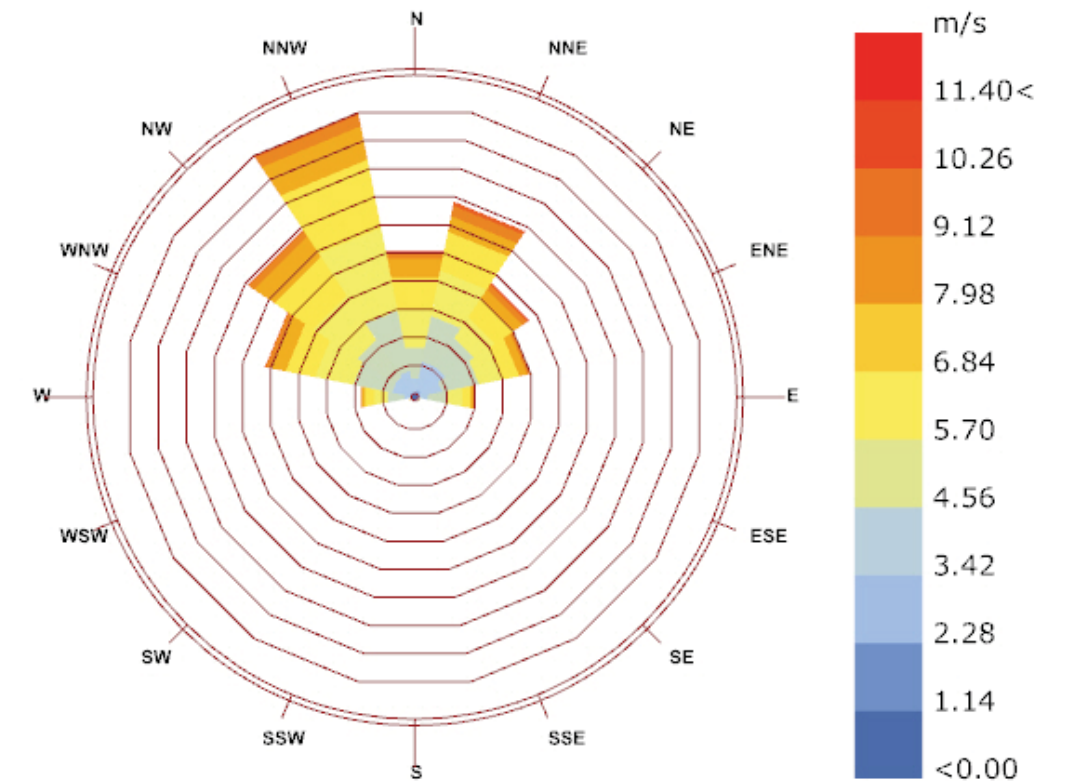


ZERO ELECTRICITY





ANNUAL TEMPERATURE AND FUTURE WEATHER DATA



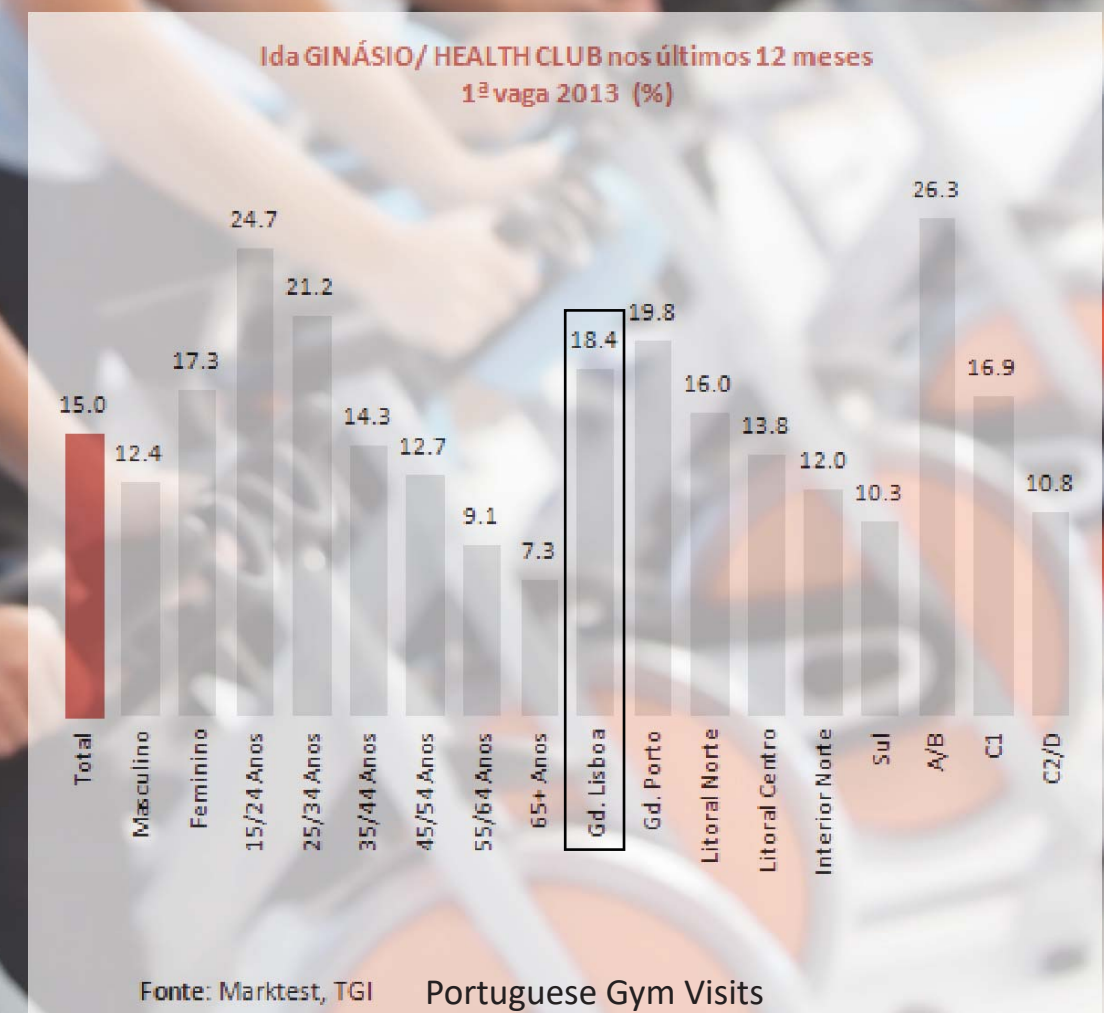
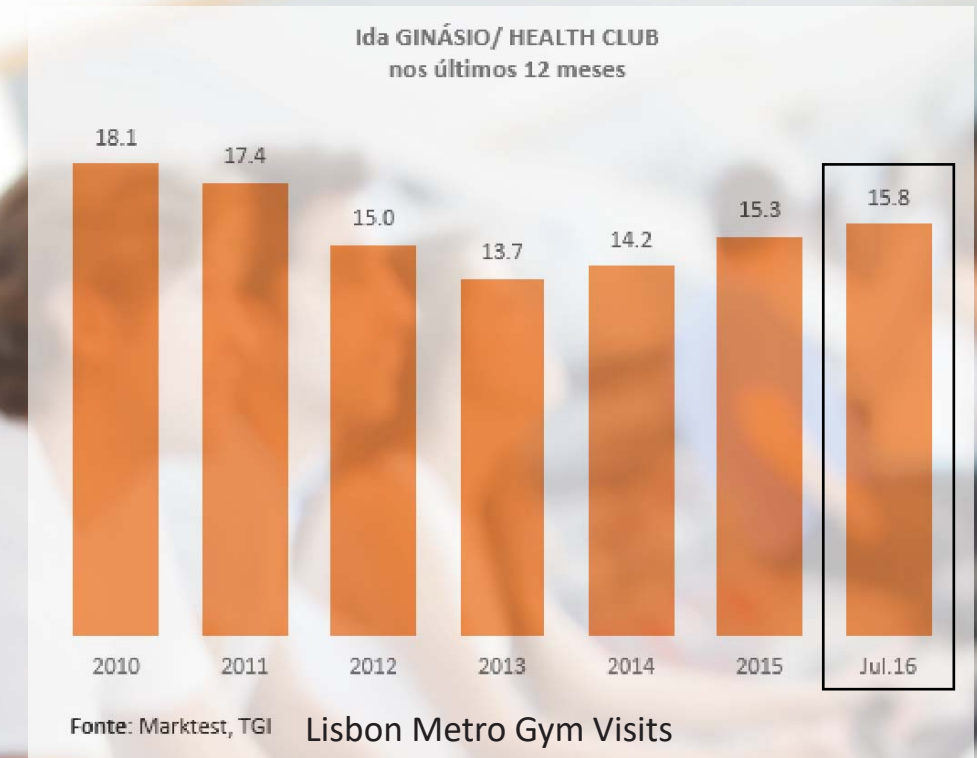
ANNUAL WIND SPEED and DIRECTION

Wind Speed: 1m/s_ Light air (1)
10m/s_ Fresh breeze(5)

GYM

Statistics on indoor gyms:

- In 2016: **15.8%** of the Portuguese (15 years old and more) frequented indoor fitness clubs
- Lisbon Metropolitan Area: **18.4%** of the population with 15+ years old (2014)

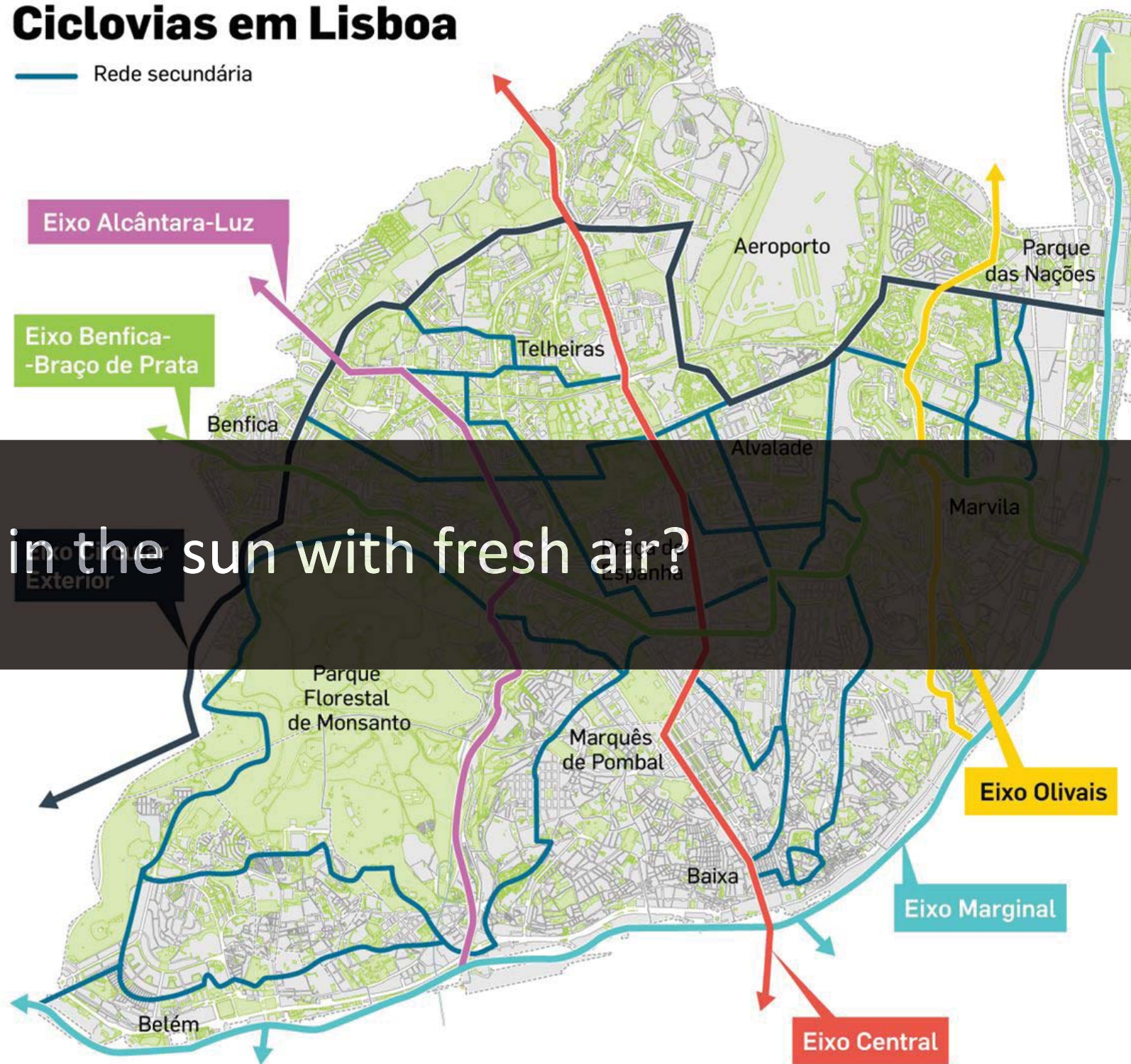




How about biking in the sun with fresh air?

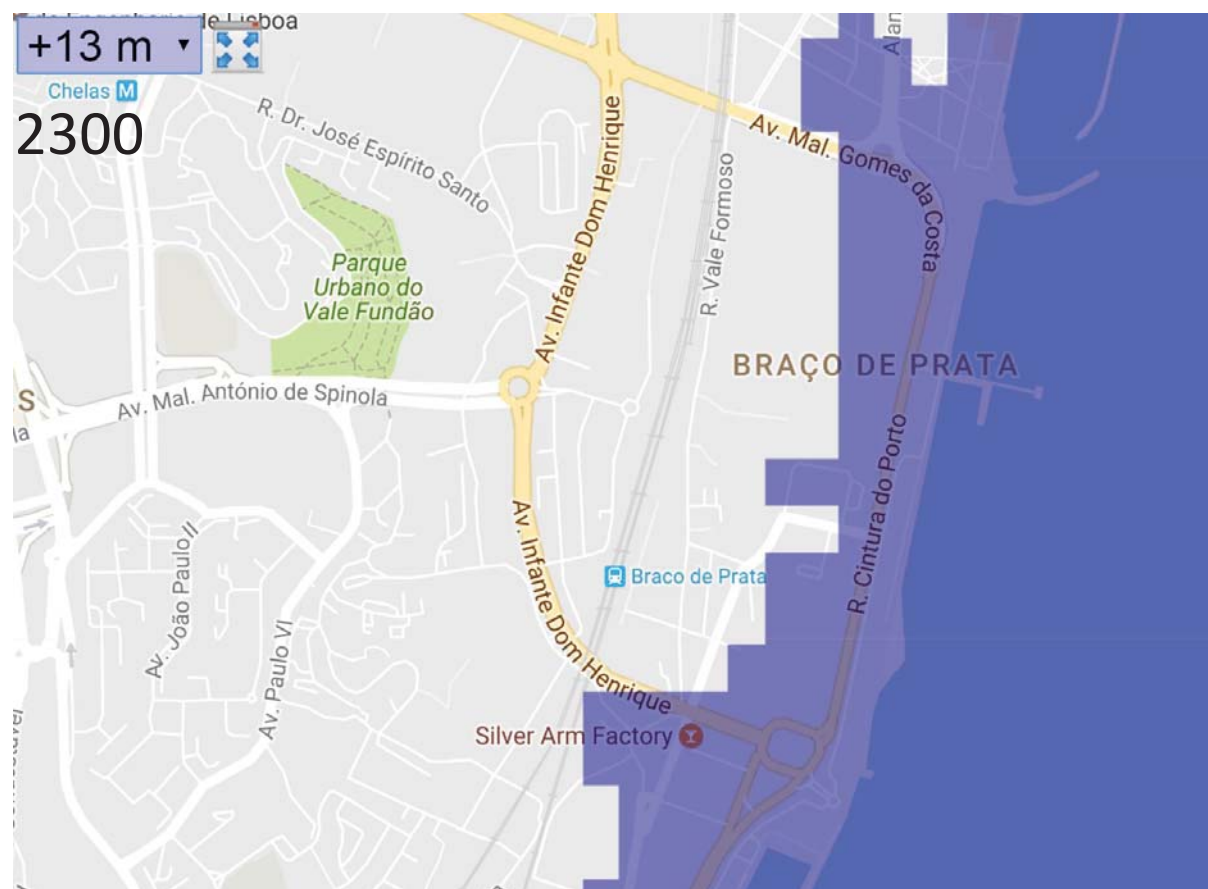
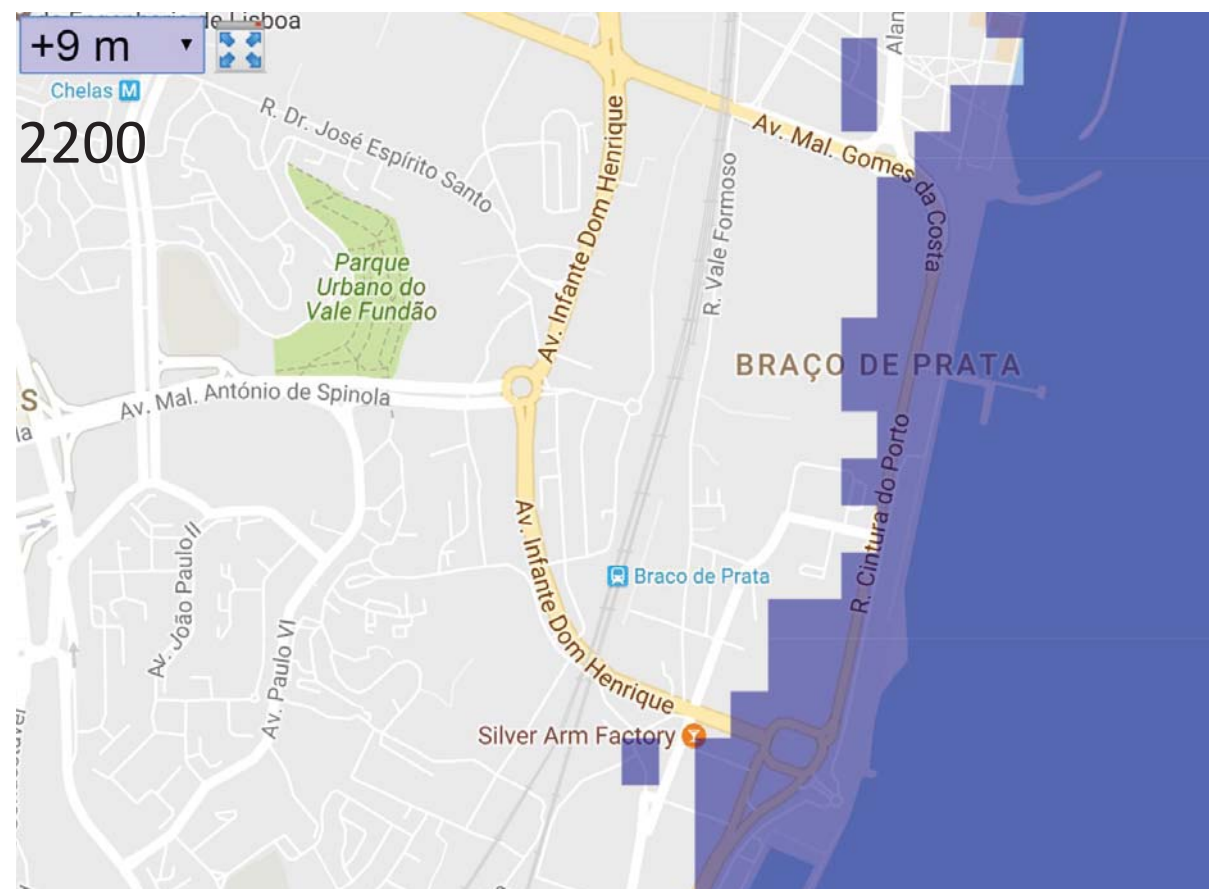
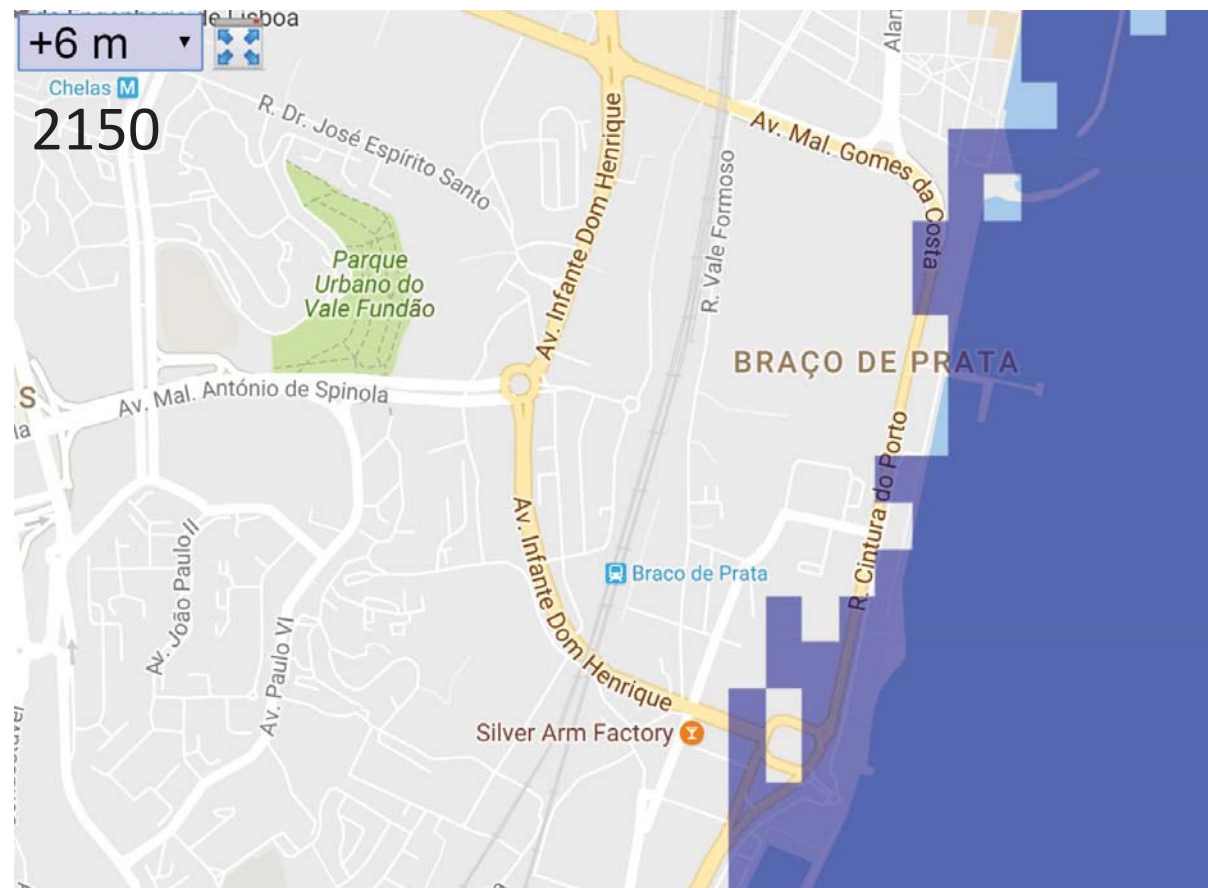
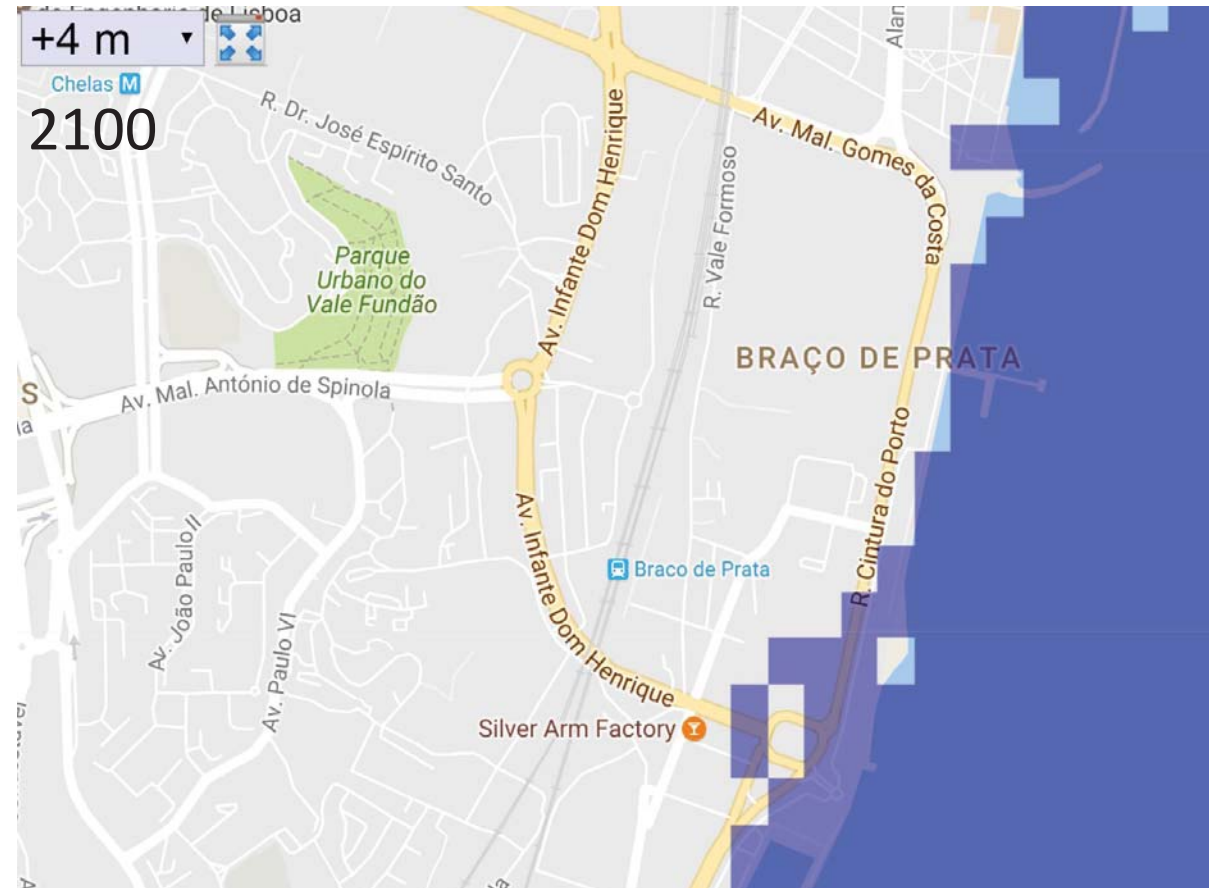
Ciclovias em Lisboa

— Rede secundária

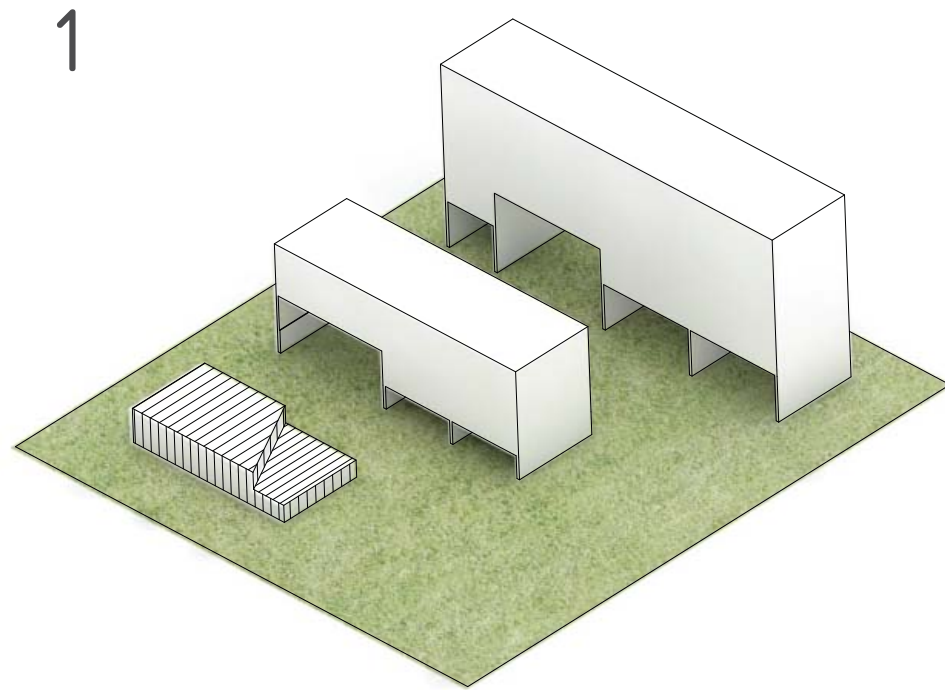


Existing Bike Lane in Lisbon

FLOOD ZONE ANALYSIS



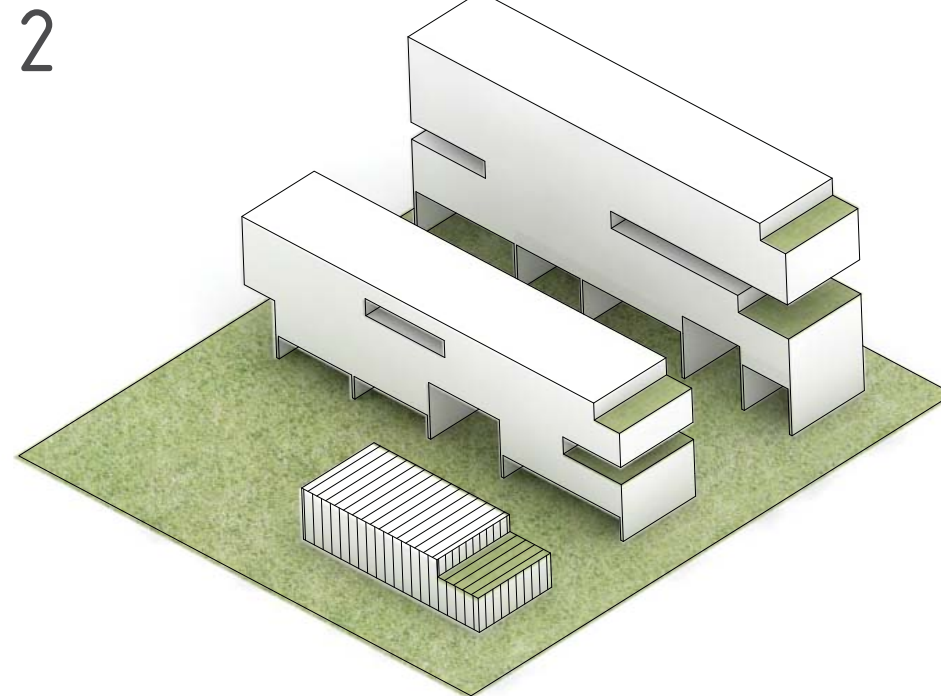
PROTObLOCK DESIGN



Protoblock 1

Retail: 2 Floors
Residential: 5 Floors, 8 Floors
EUI: 42 kWh/m²
sDA: 49
FAR: 1.23
WWR: 40%

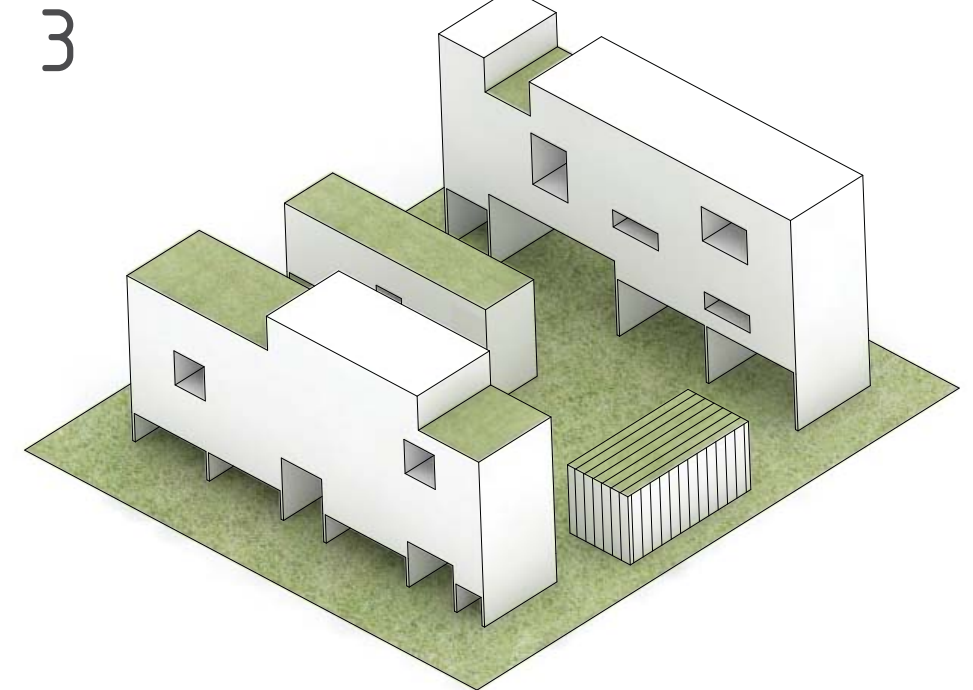
- Incremental Change of Height for Minimizing Daylight Blockage.
- Maximize South Orientation
- Elevated Incrementally For Wind Penetration And Flood Resistance.



Protoblock 2

Retail: 3 Floors
Residential: 6 Floors, 9 Floors
EUI: 71 kWh/m²
sDA: 45
FAR: 2.54
WWR: 40%

- Higher FAR with setbacked floor plans
- Providing balconies with ocean views.
- Single floor height common space for better natural ventilation.

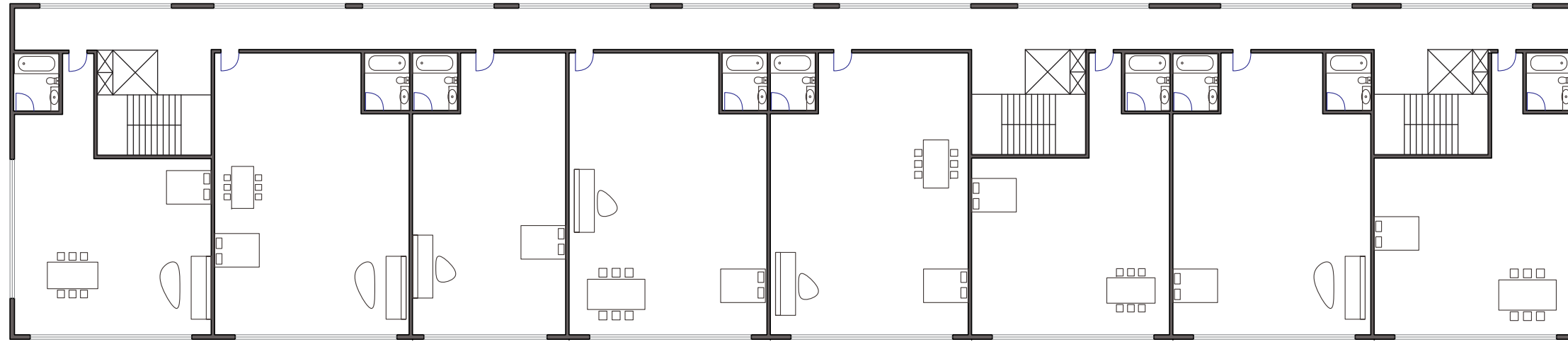


Protoblock 3

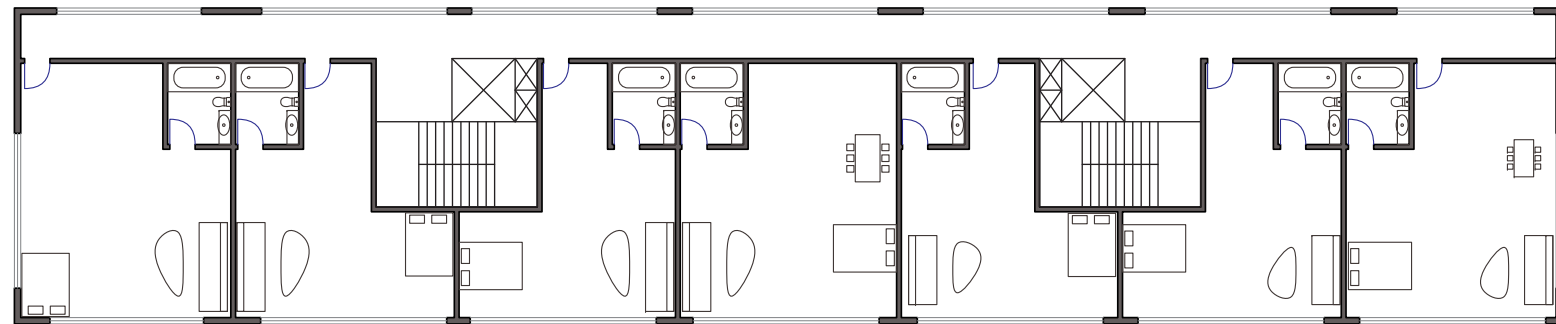
Retail: 4 Floors
Residential: 4 Floors, 8 Floors, 9 Floors
EUI: 75 kWh/m²
sDA: 50
FAR: 2.12
WWR: 40%

- Create inner block courtyard
- Sky courtyard for common space and wind penetrating.
- Free the ground level for the potential of activities and better walkability.

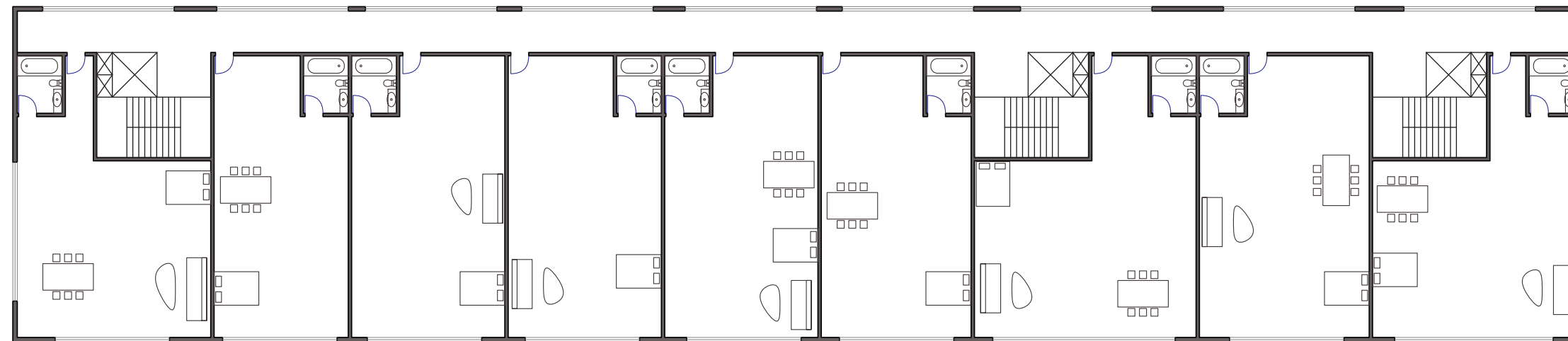
FLOOR PLANS



Building Depth: 15 meters

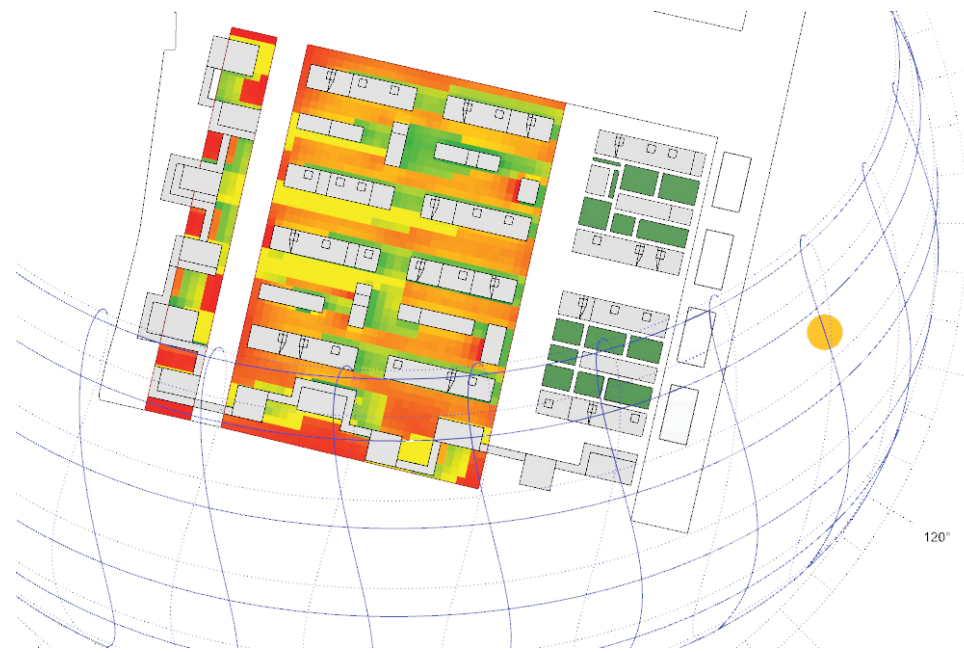


Building Depth: 10 meters

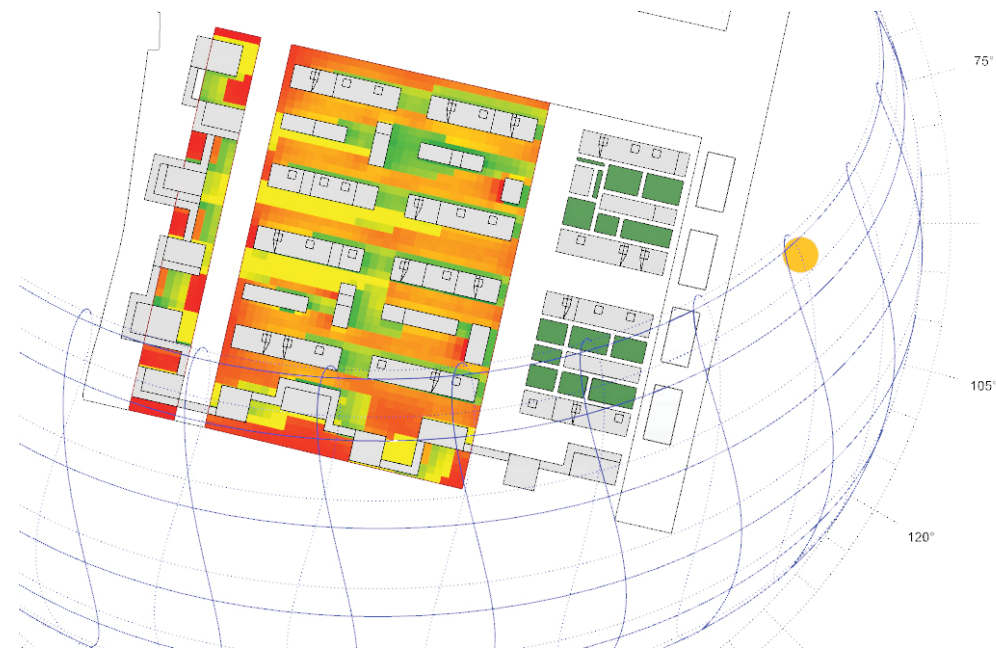


Building Depth: 15 meters

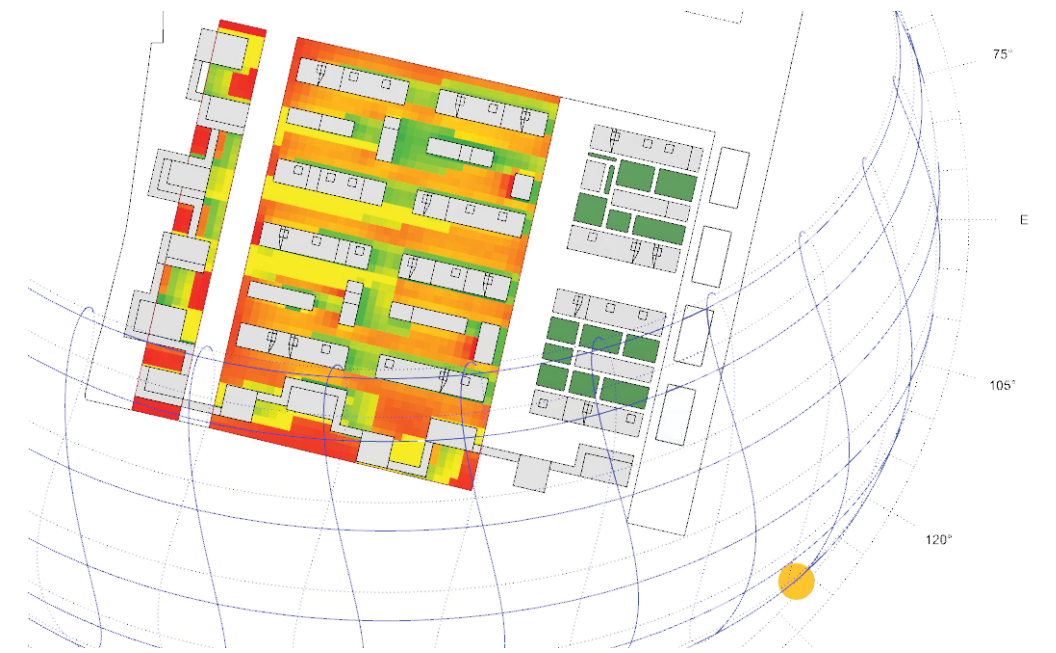
OUTDOOR THERMAL COMFORT



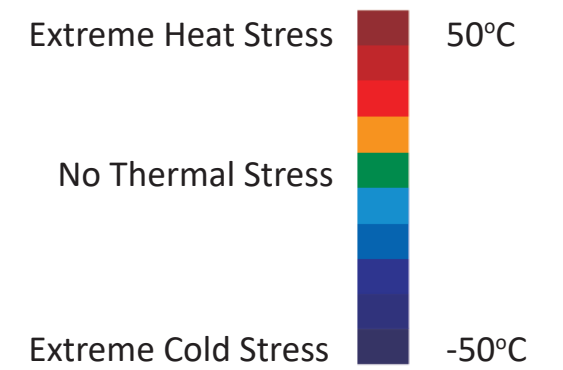
APRIL 9:00



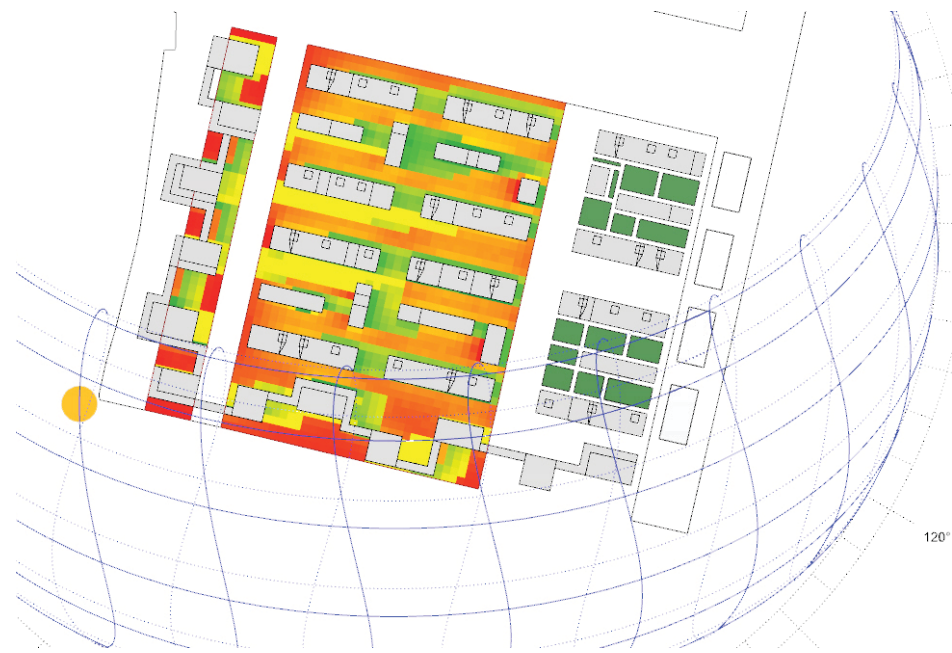
JULY 9:00



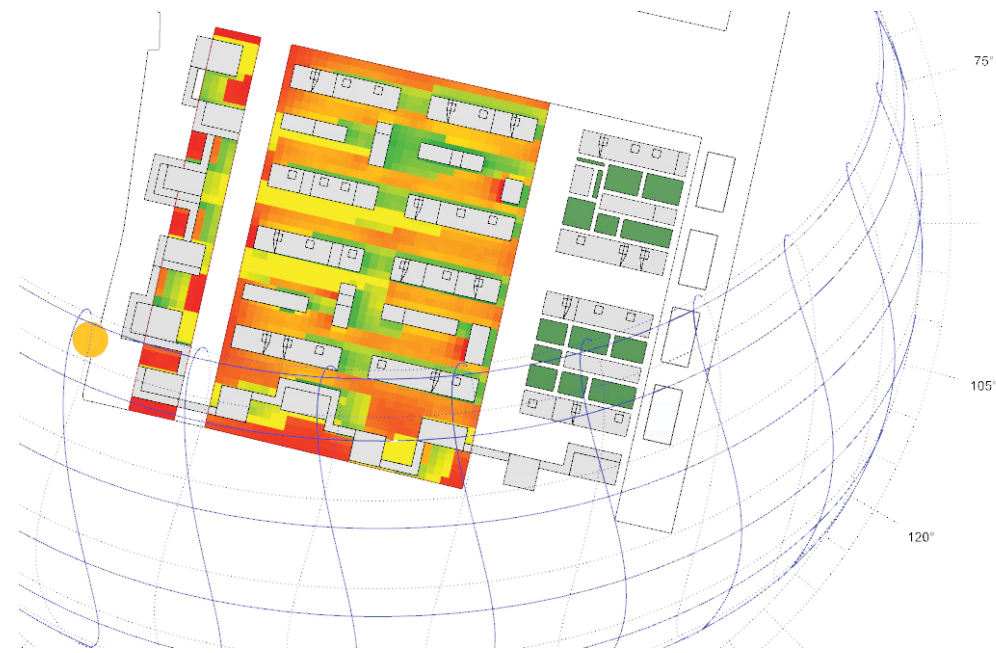
DECEMBER 9:00



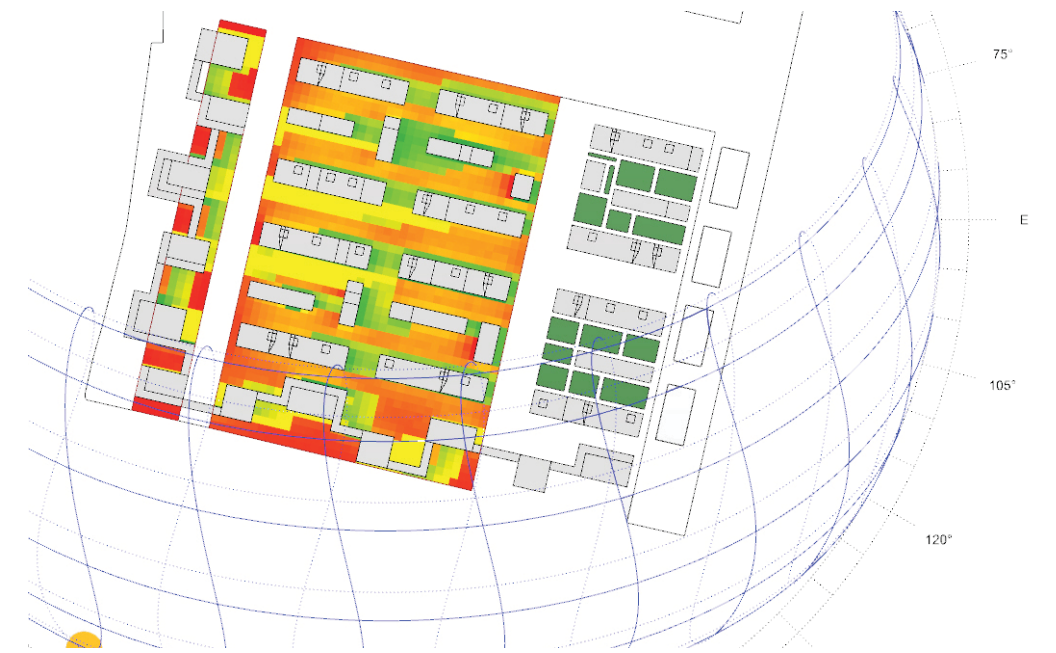
OUTDOOR THERMAL COMFORT



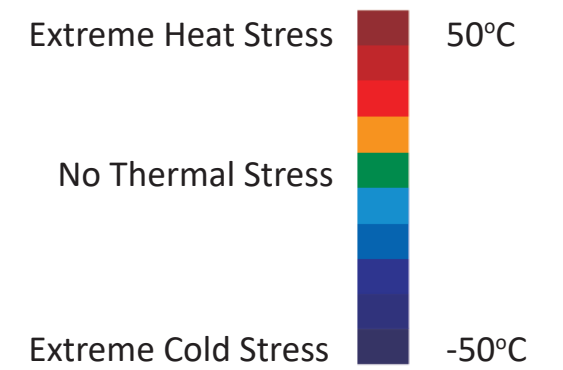
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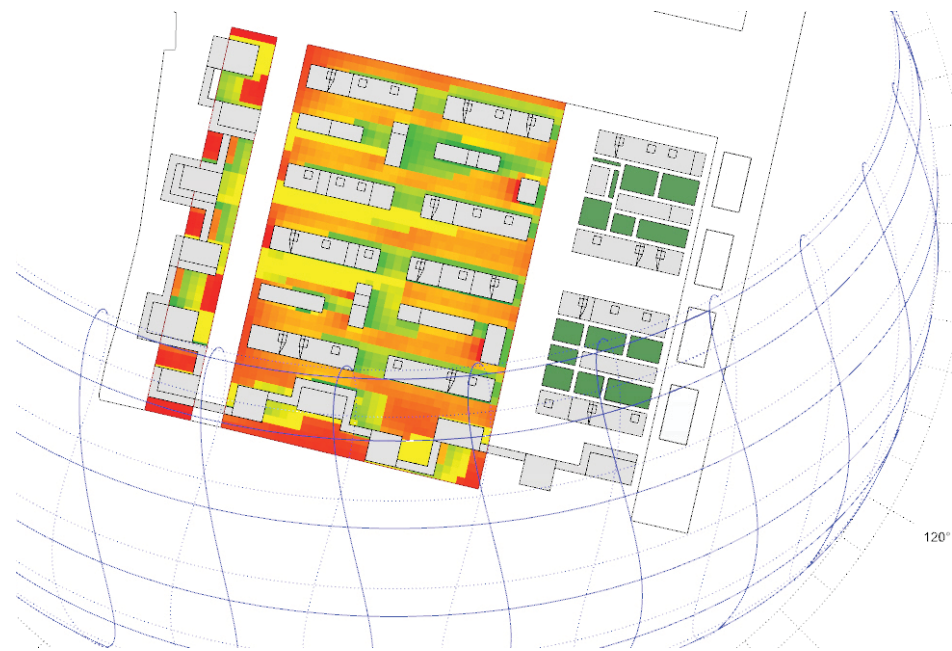
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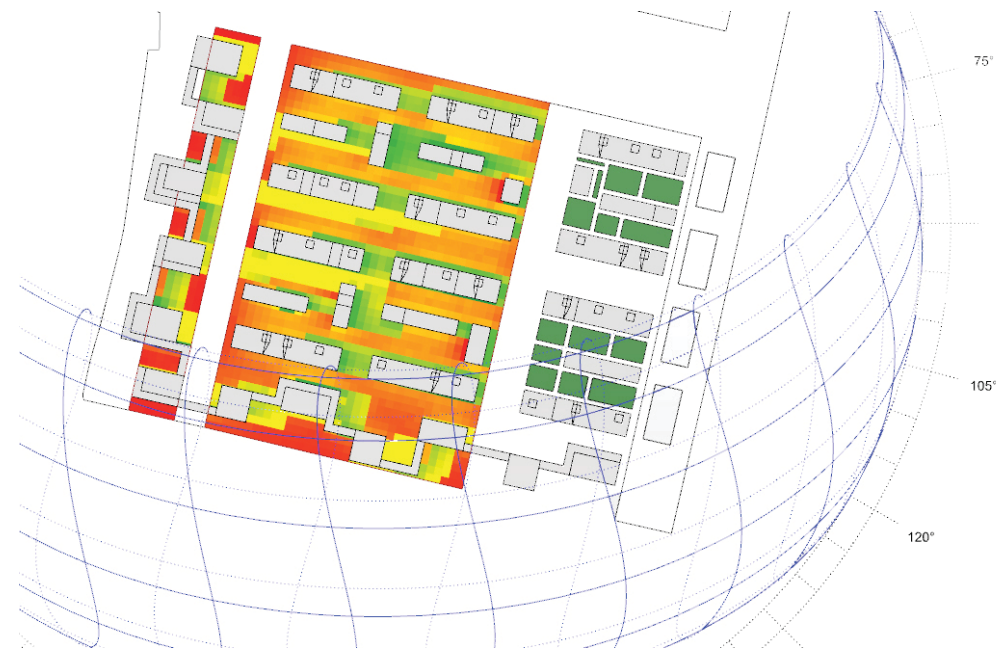
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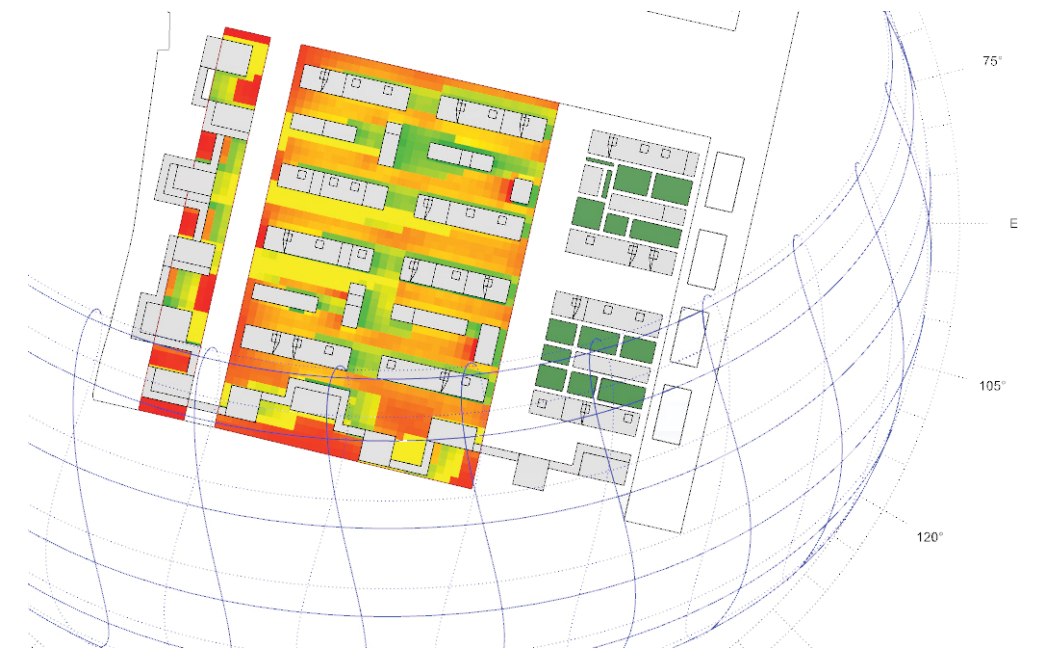
OUTDOOR THERMAL COMFORT



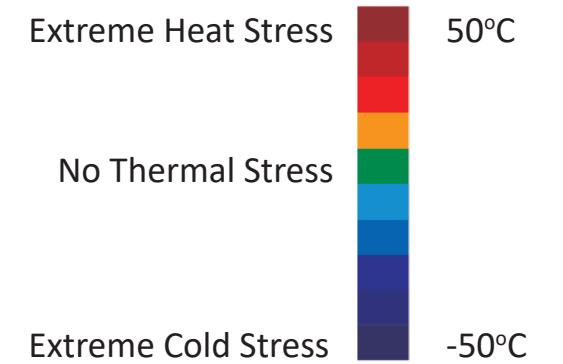
APRIL 18:00



JULY 18:00

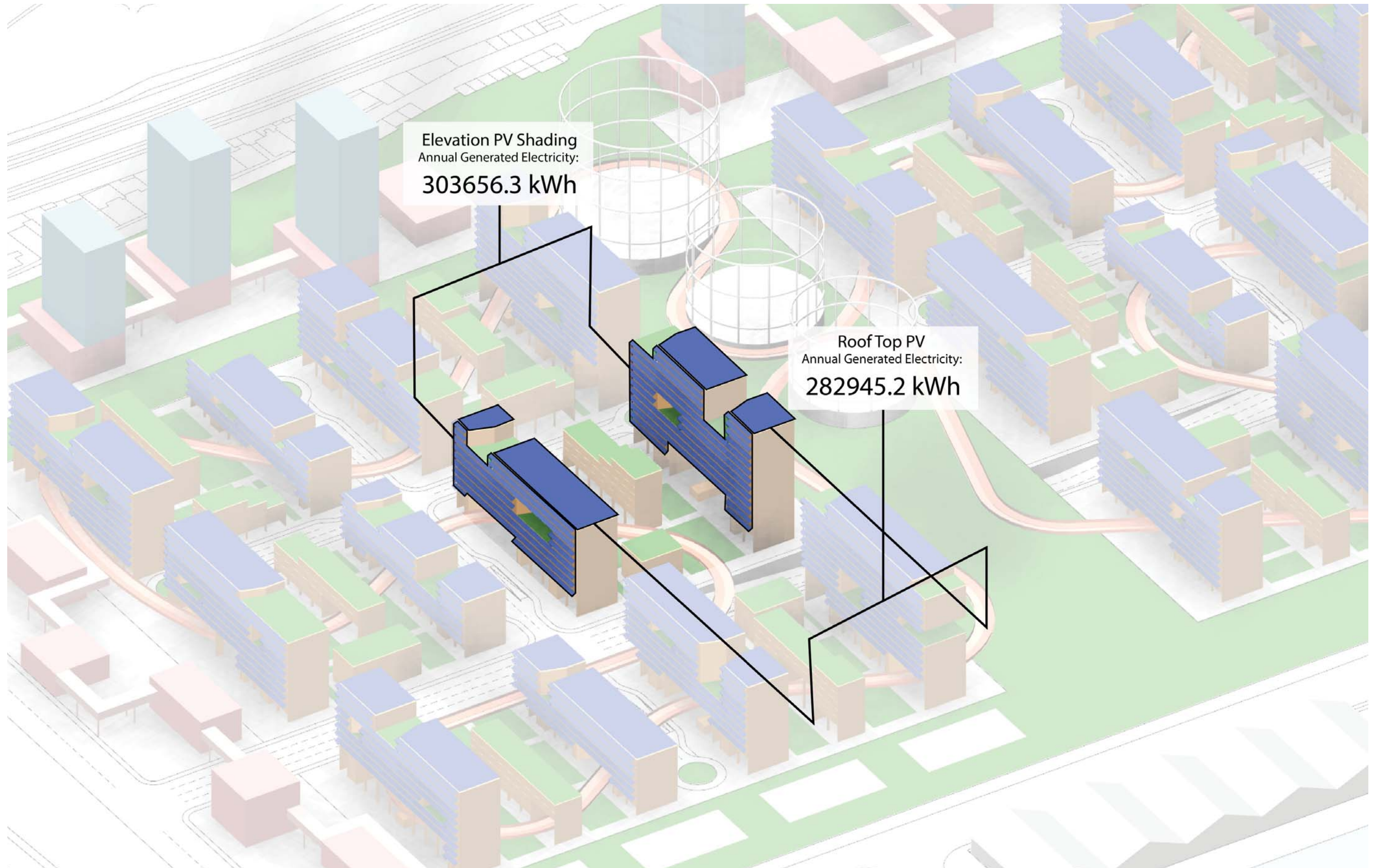


DECEMBER 18:00

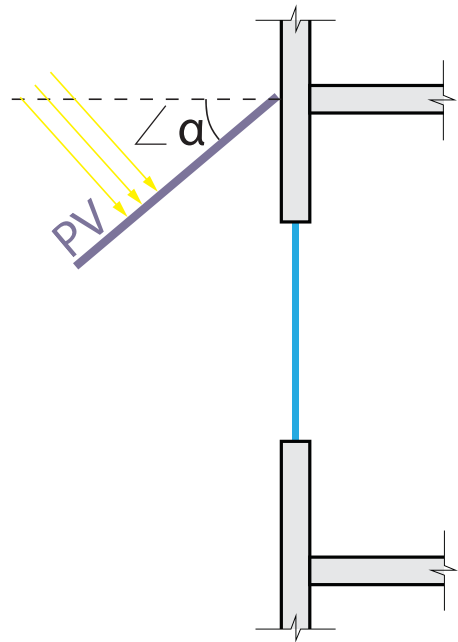


*According to local residents' life pattern, 18:00 is the frequent choice of time for outdoor activities.

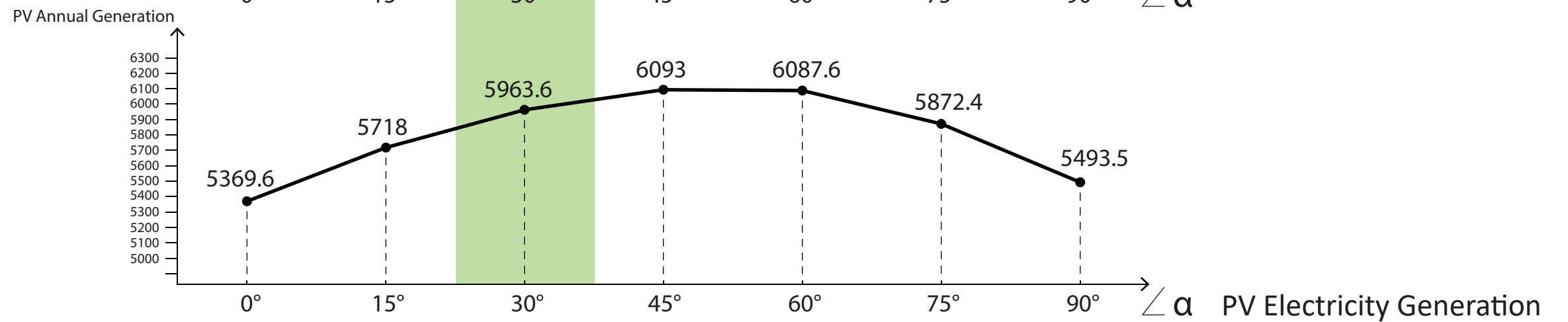
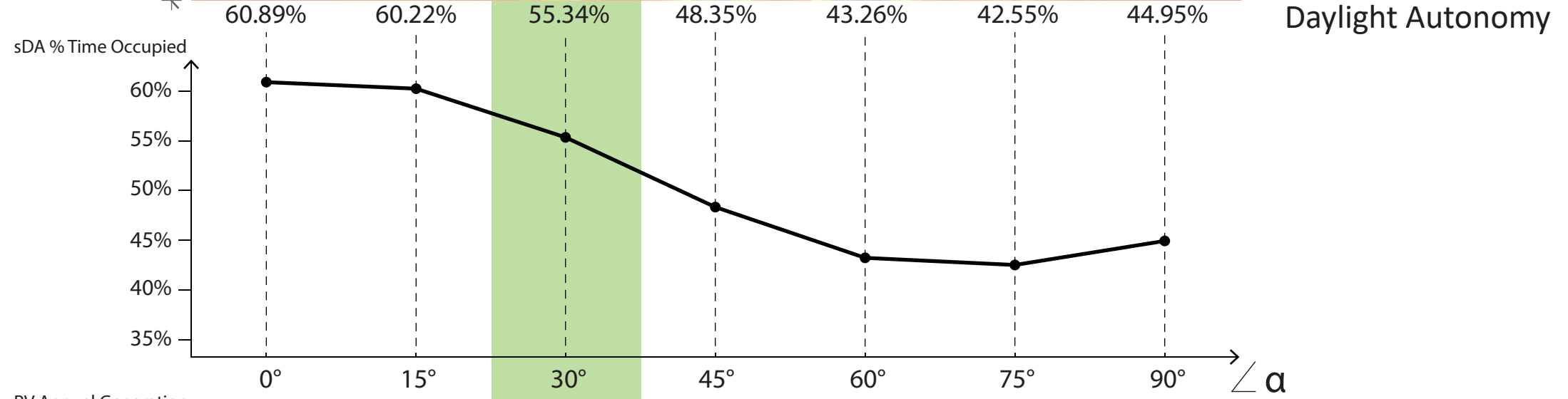
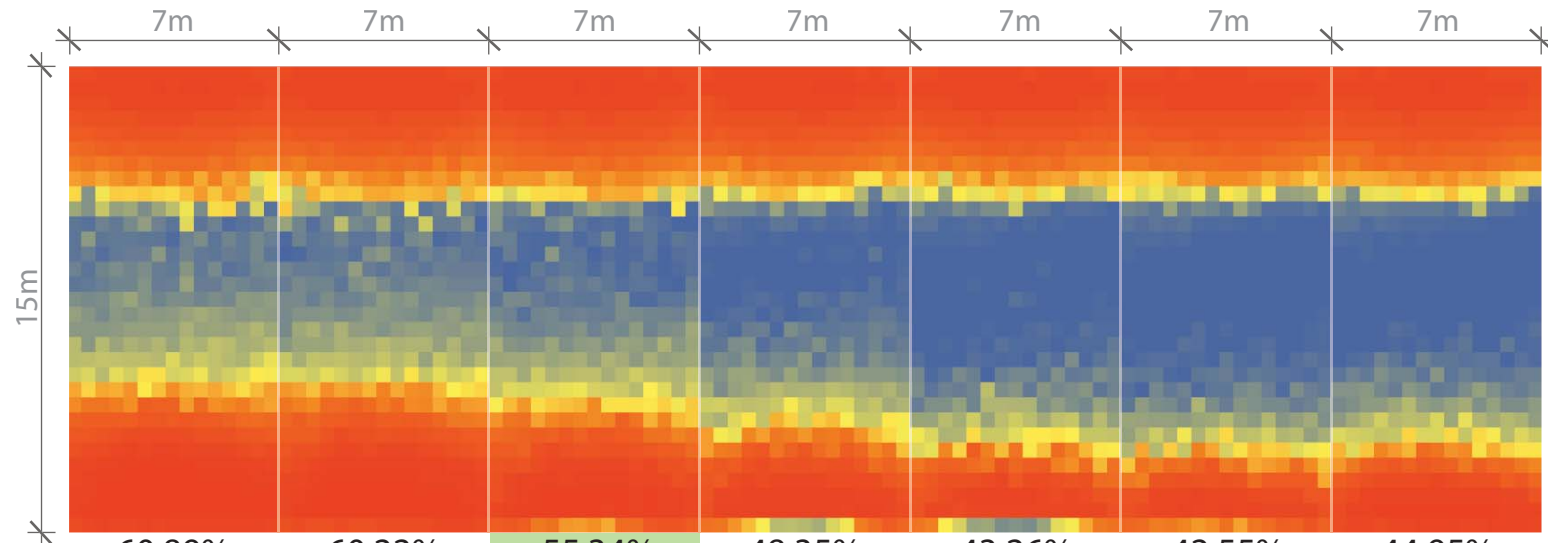
PHOTOVOLTAIC POTENTIAL ANALYSIS



PV PANEL VS. DAYLIGHTING CONDITION

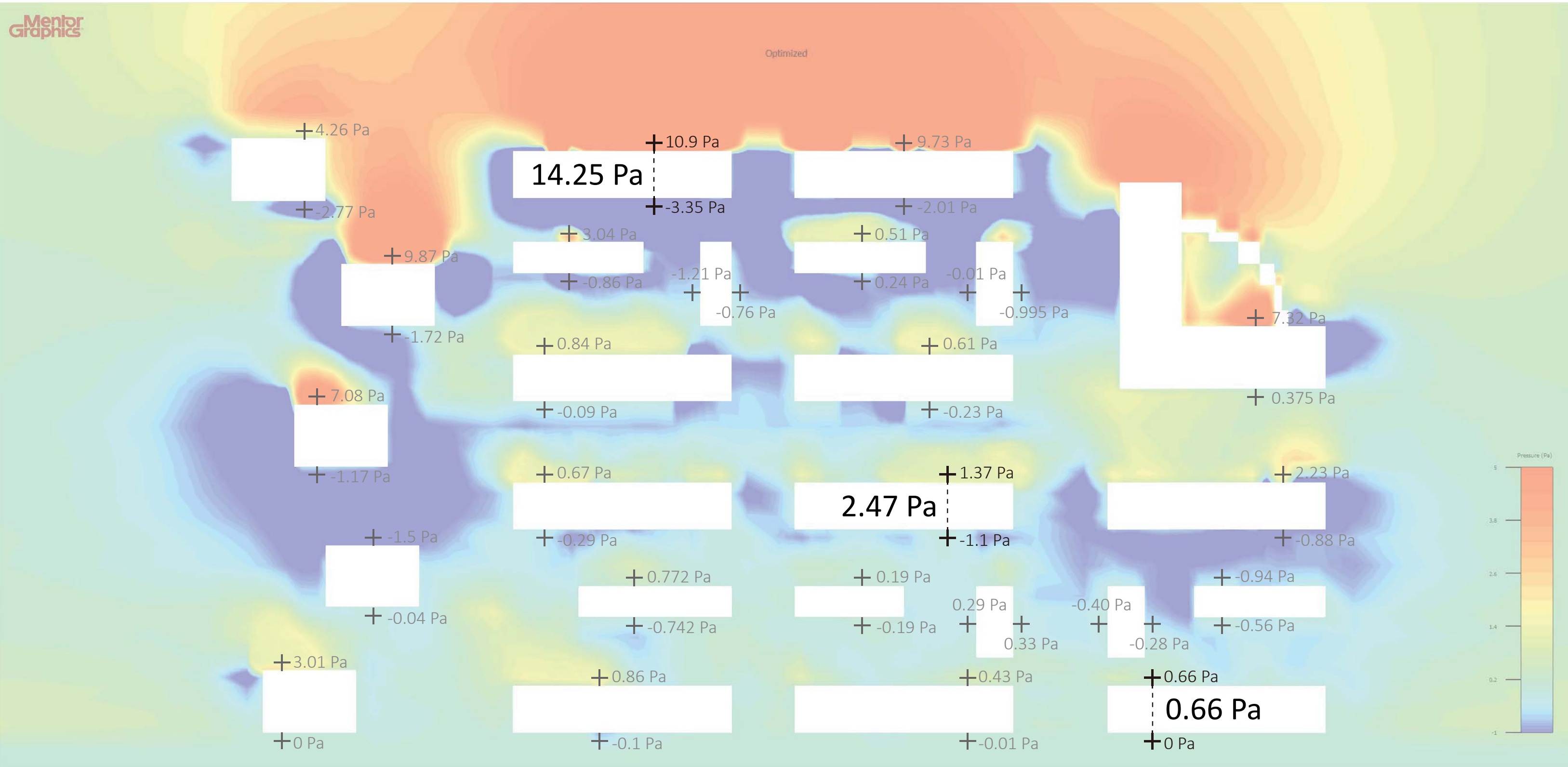
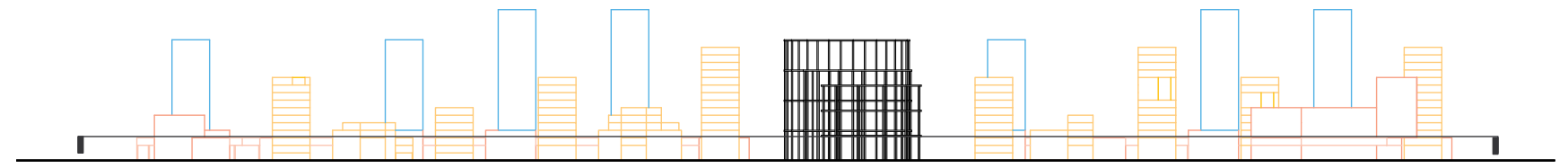


PV Panel Angle 0° 15° 30° 45° 60° 75° 90°

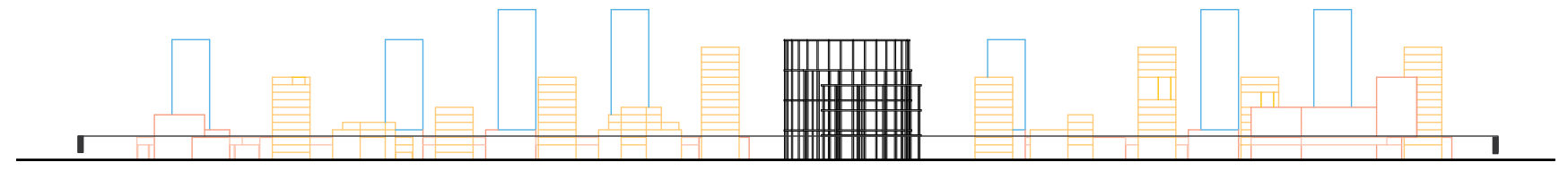


CFD ANALYSIS

WIND PRESSURE DIFFERENCE DISTRIBUTION

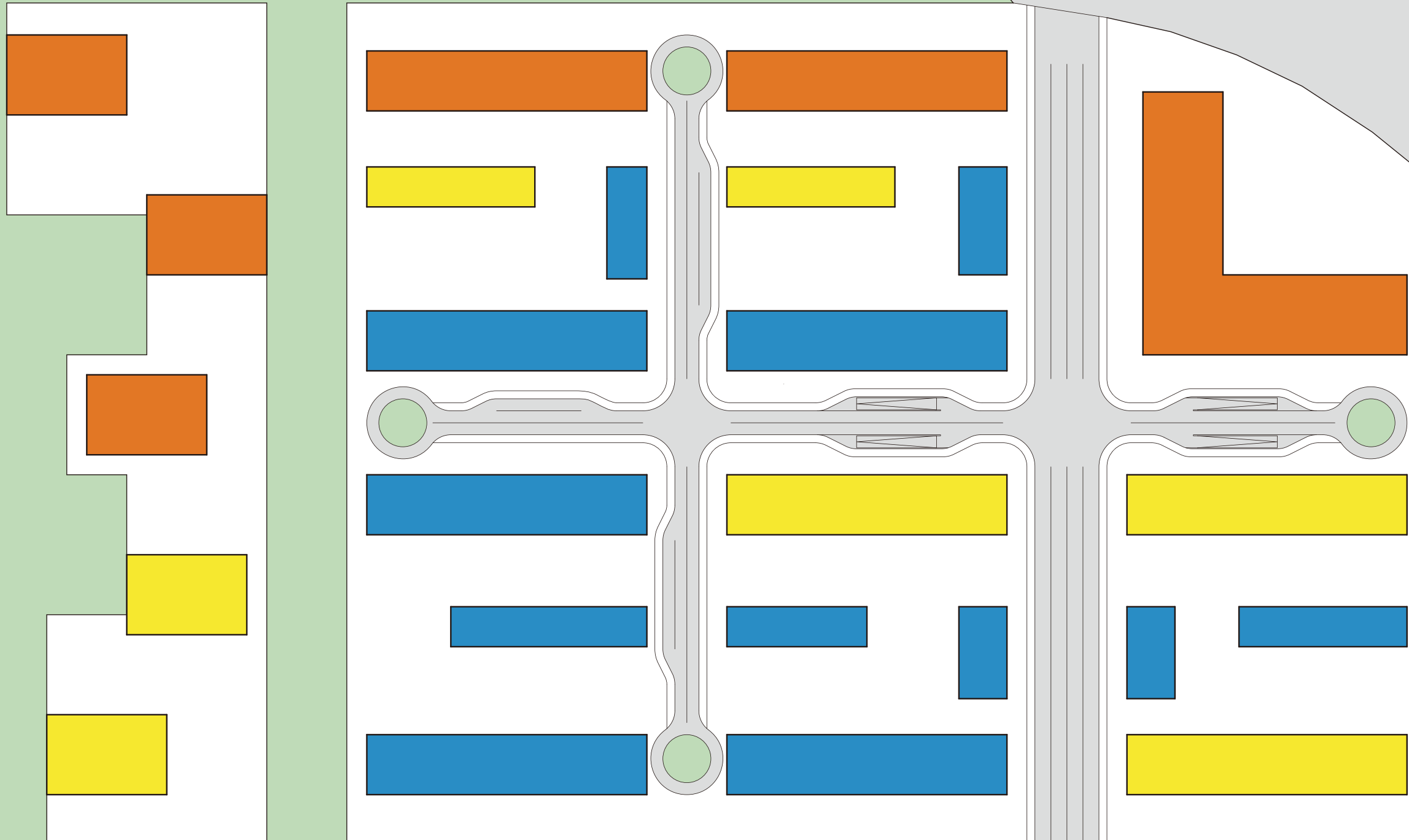


CFD ANALYSIS



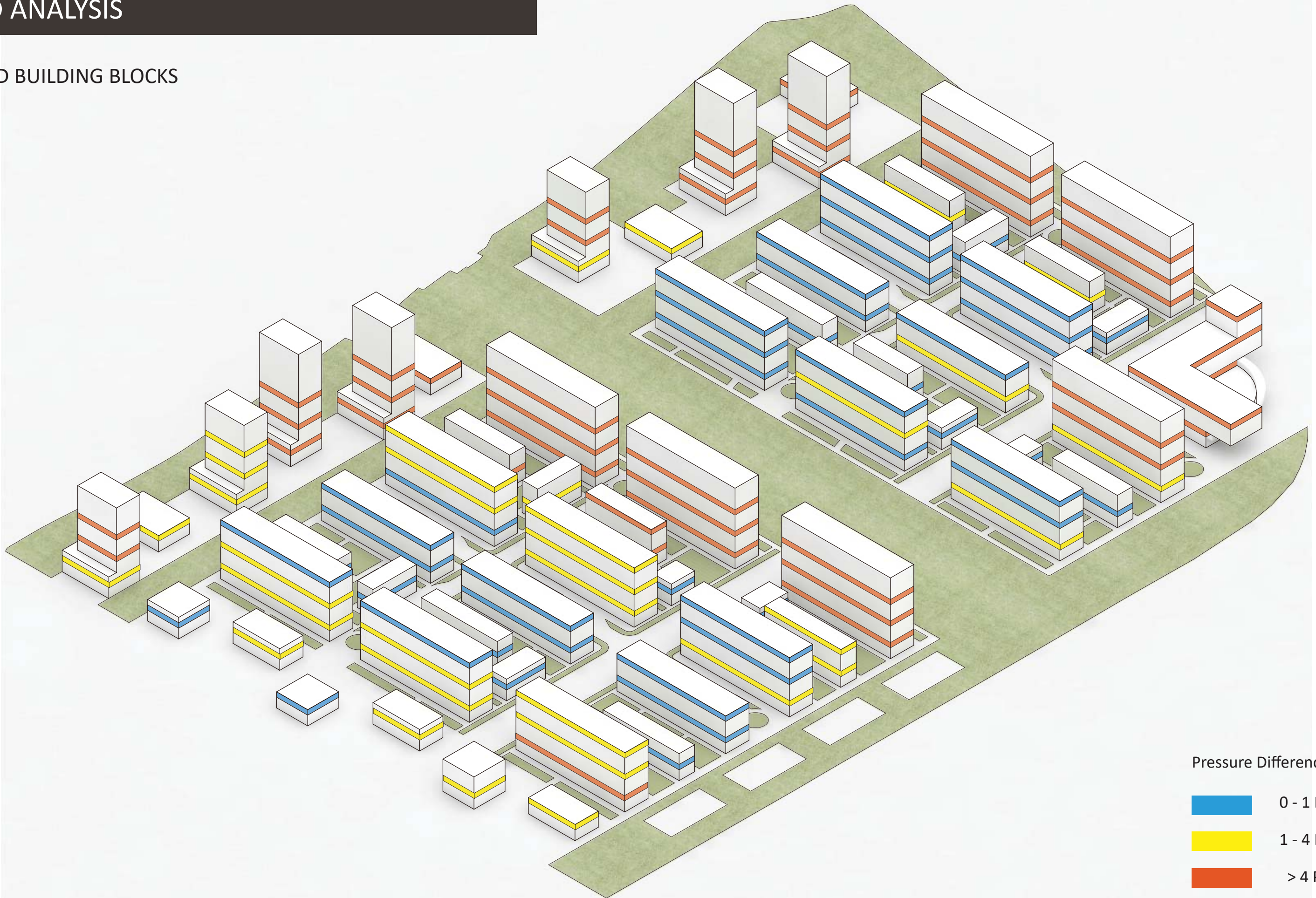
Pressure Differences Color Coding

- 0 - 1 Pa
- 1 - 4 Pa
- > 4 Pa



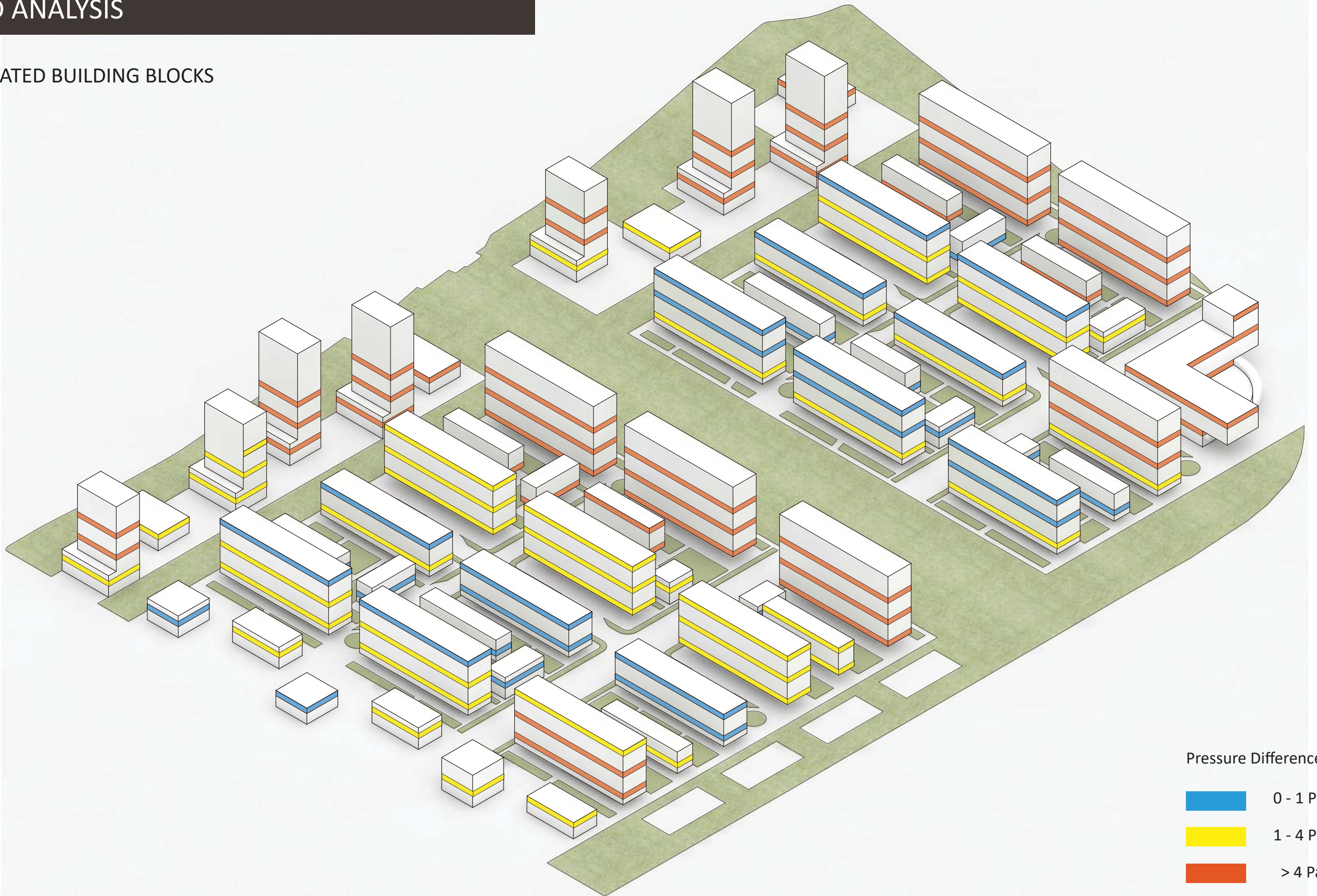
CFD ANALYSIS

SOLID BUILDING BLOCKS



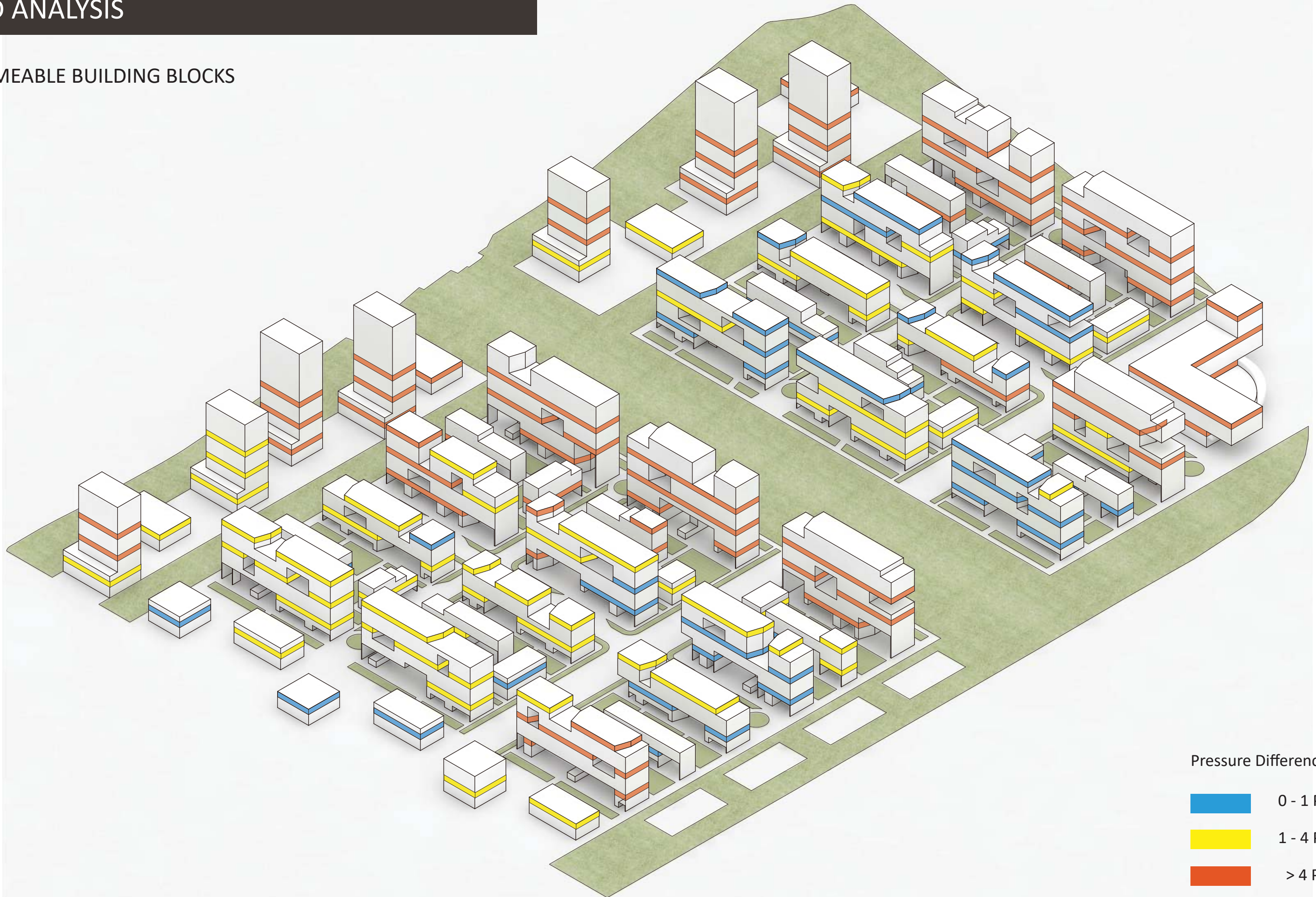
CFD ANALYSIS

ELEVATED BUILDING BLOCKS



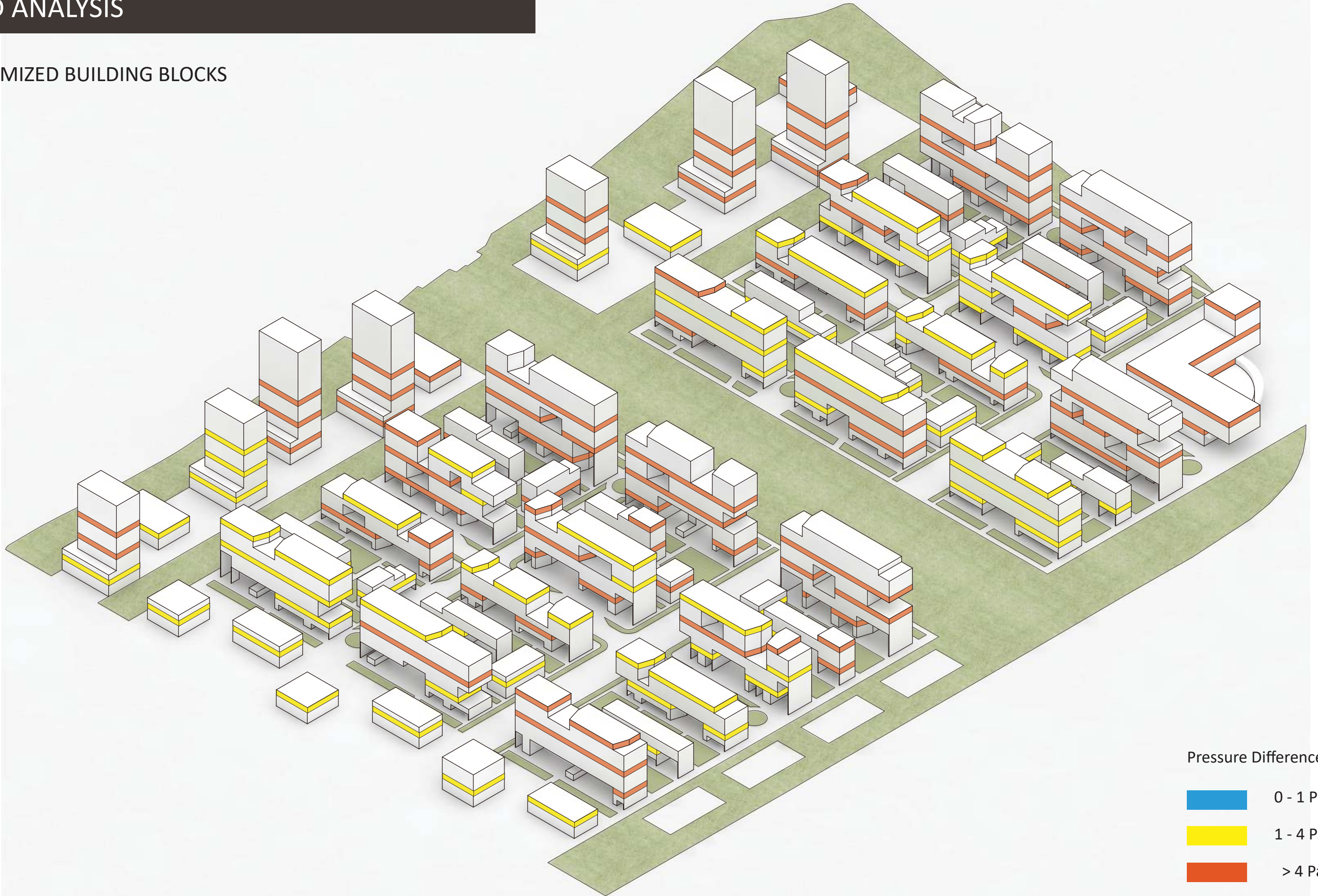
CFD ANALYSIS

PERMEABLE BUILDING BLOCKS

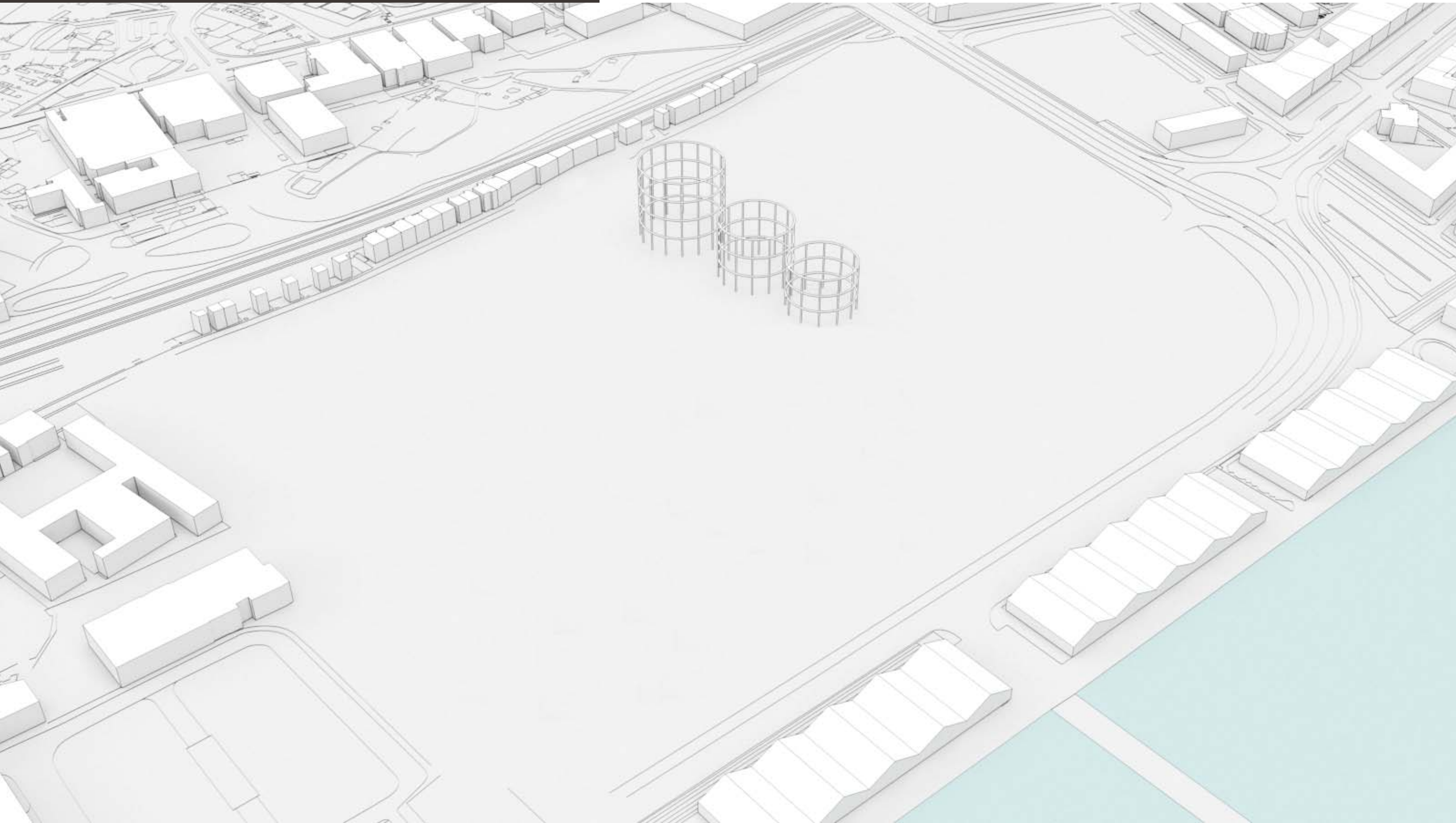


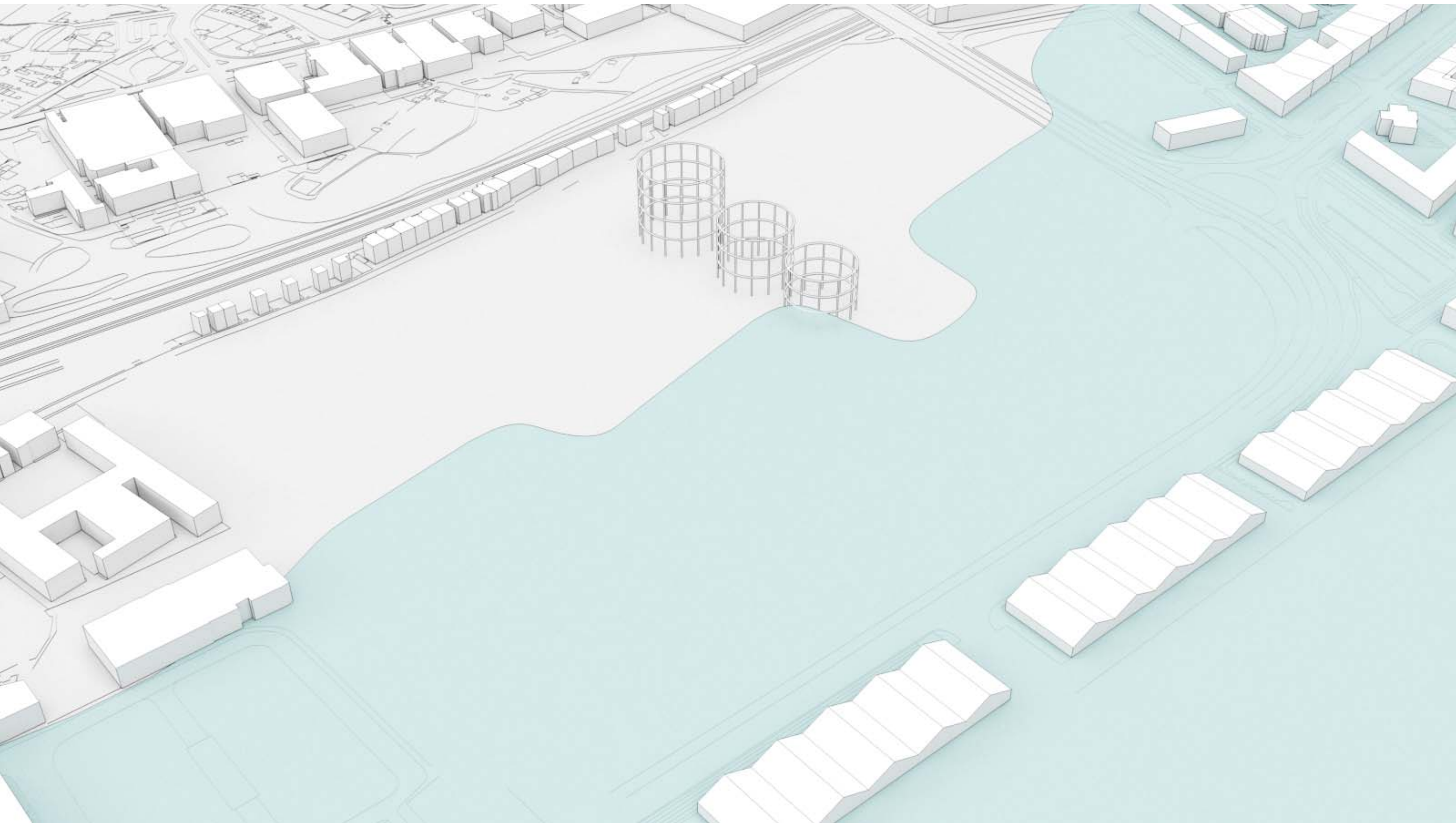
CFD ANALYSIS

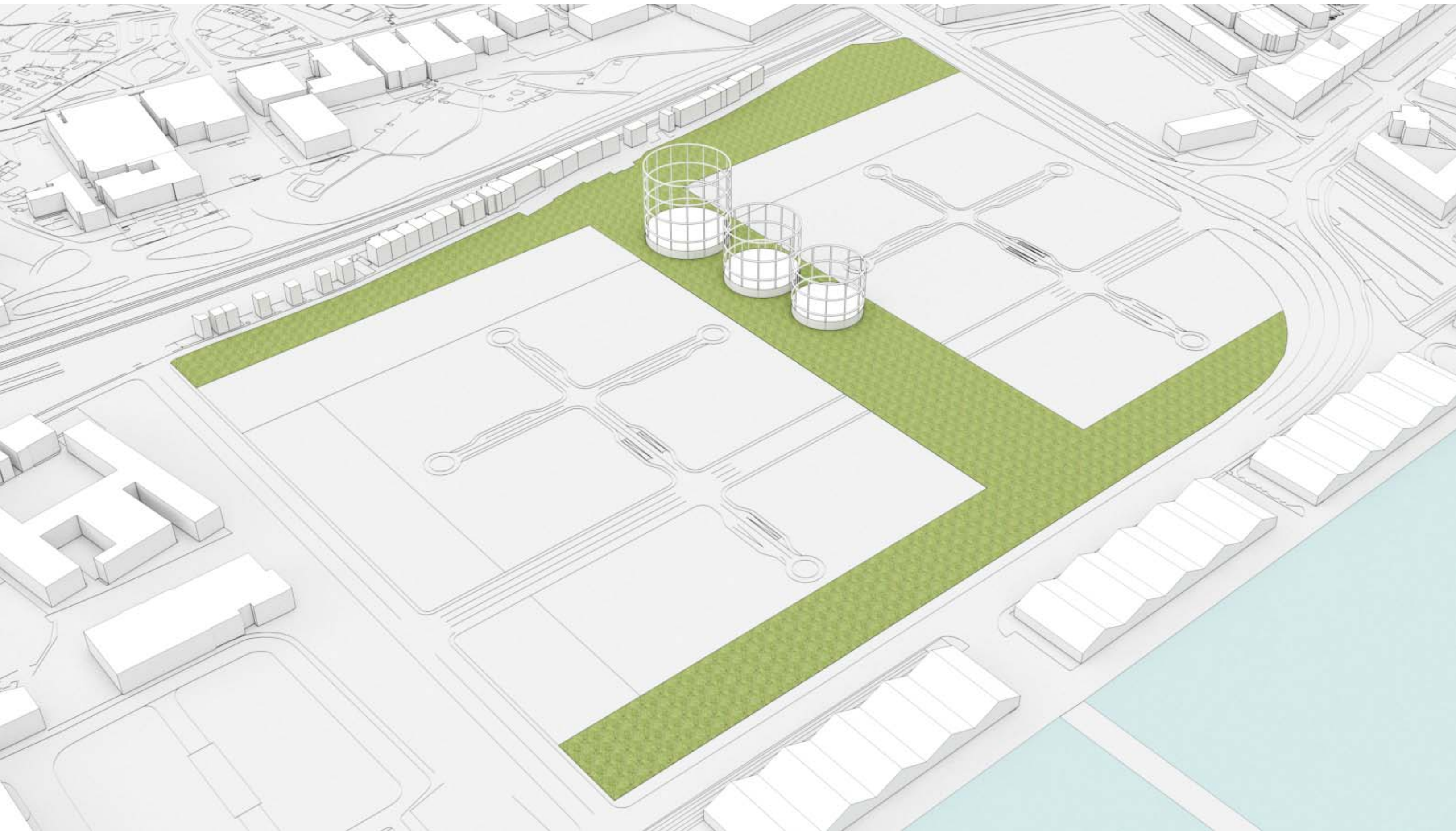
OPTIMIZED BUILDING BLOCKS



DESIGN PROCESS





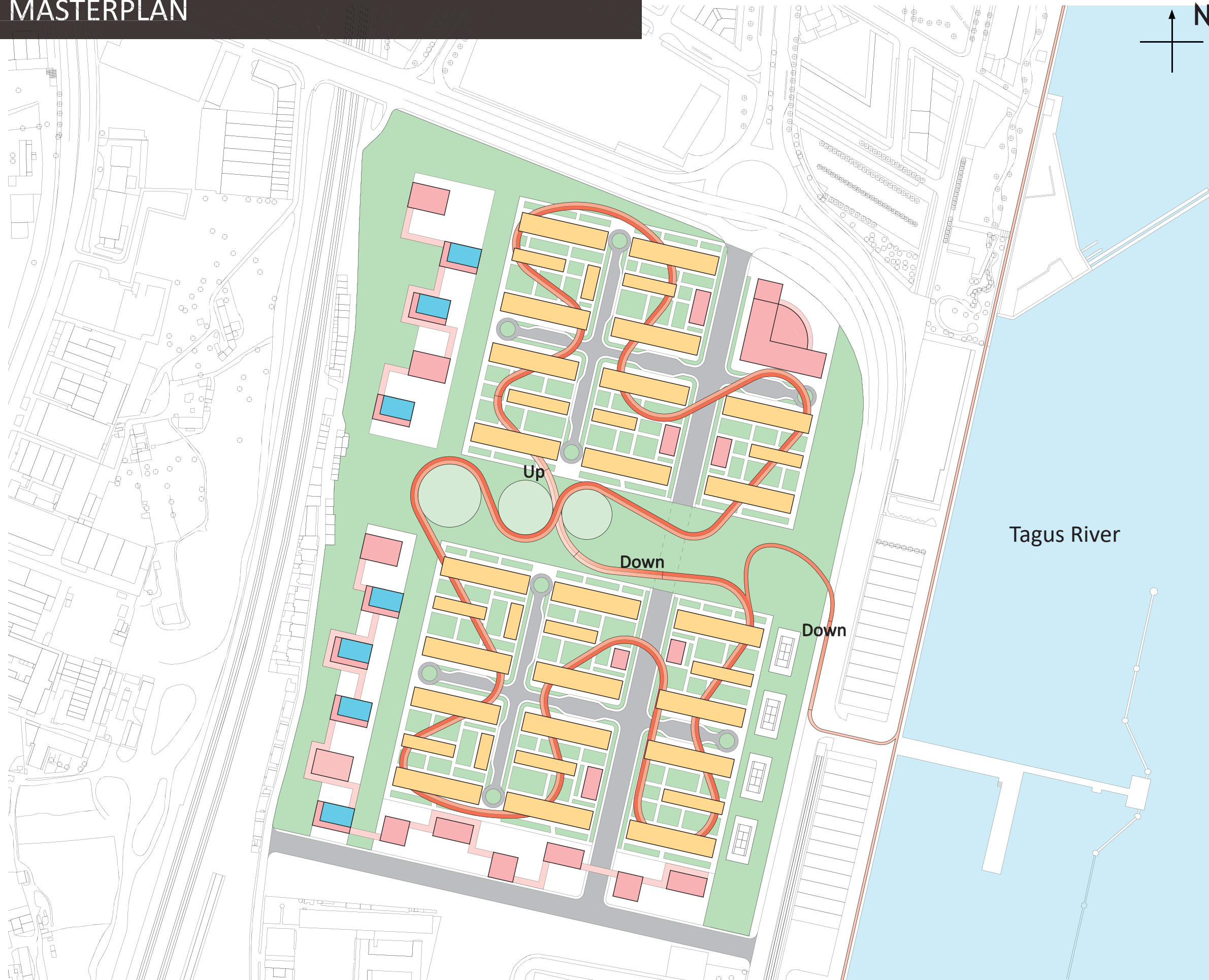








MASTERPLAN



Block Dimension:
90m x 100m
Main Street Width: 16m
Sub Street Width: 6m
Park Width: 70m

ZERO CARBON FITNESS: The elevated bike trail demonstrates electricity-free fitness granted by the feasible climate

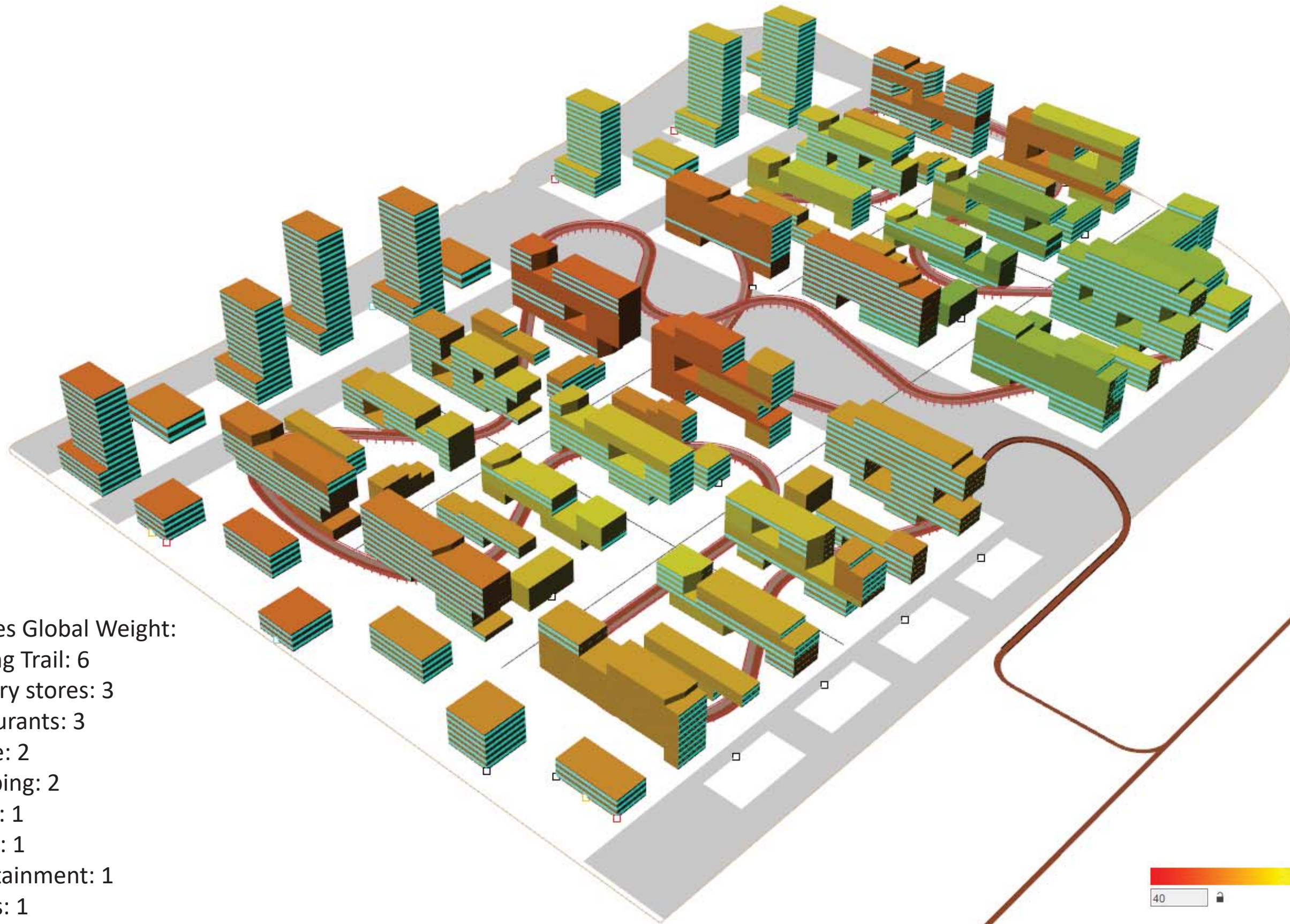
ZERO MECHANICAL COOLING
:the permeable building geometry provides more wind penetration across the site ensuring the required natural ventilation

ZERO ELECTRICITY :the PV panels used as shading device can offset the electricity use while reduce indoor heat load at the same time.



- Retail
- Office
- Residential
- Green Space

WALKABILITY



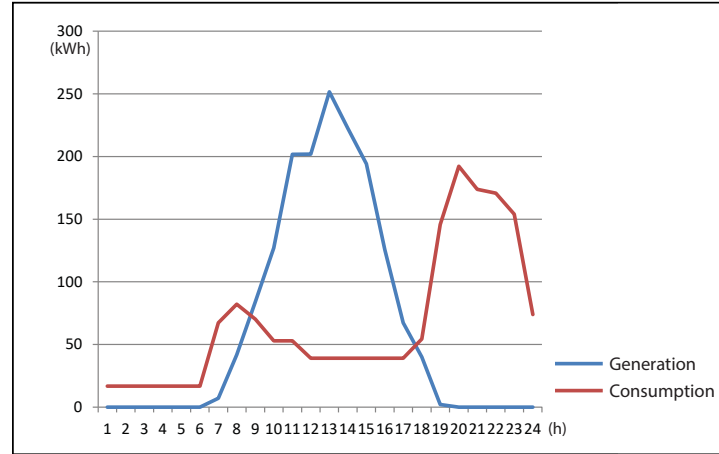
Amenities Global Weight:

- Jogging Trail: 6
- Grocery stores: 3
- Restaurants: 3
- Coffee: 2
- Shopping: 2
- Banks: 1
- Books: 1
- Entertainment: 1
- Tennis: 1

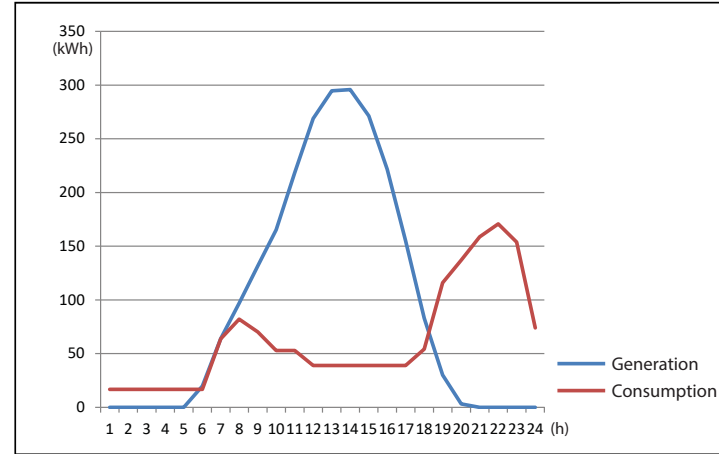


PV DAILY GENERATION VS DAILY ELECTRICITY CONSUMPTION

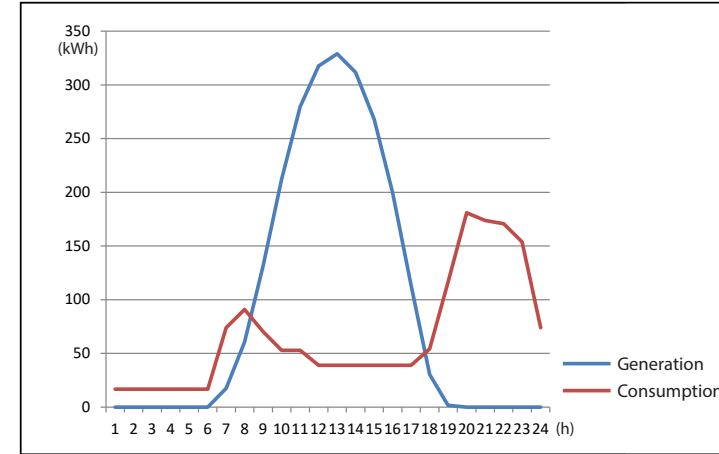
Mar 21st



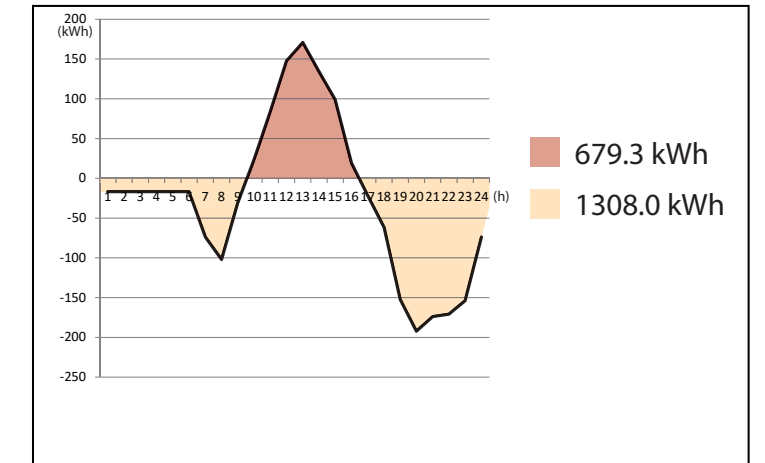
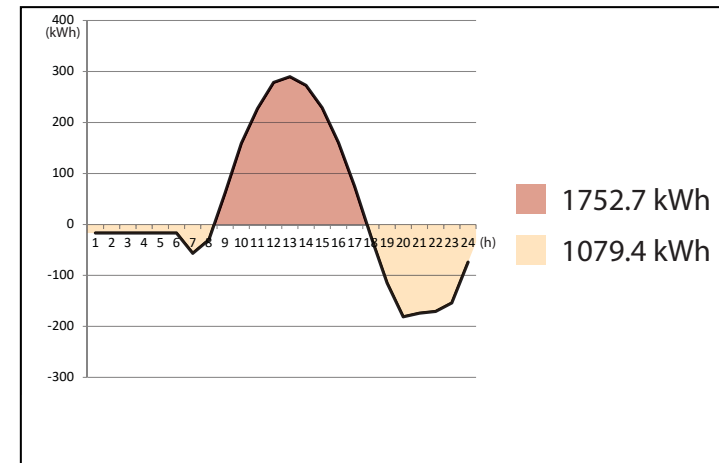
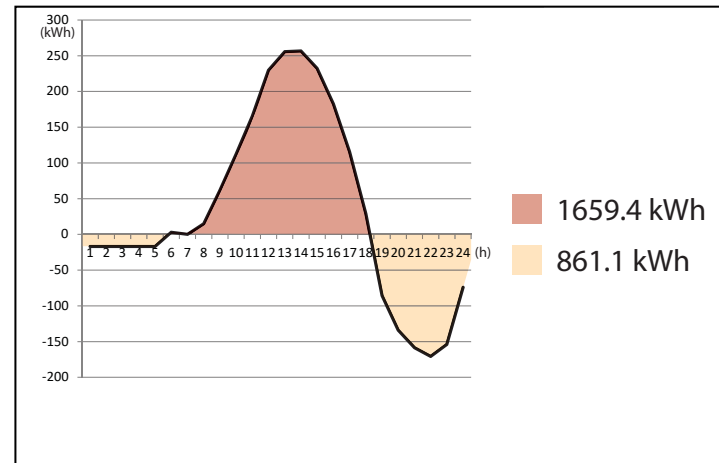
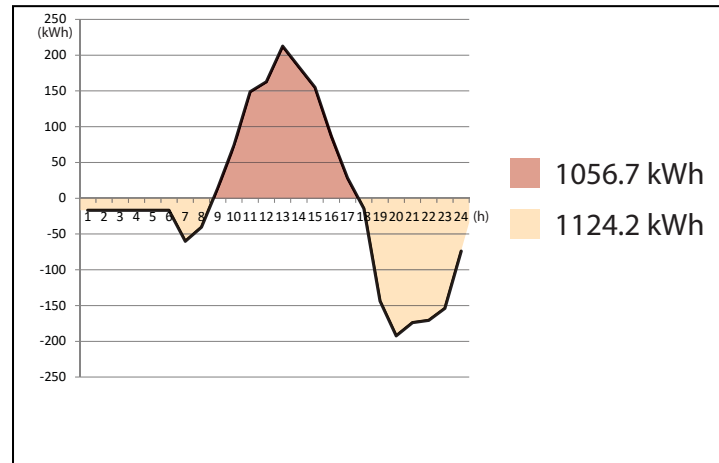
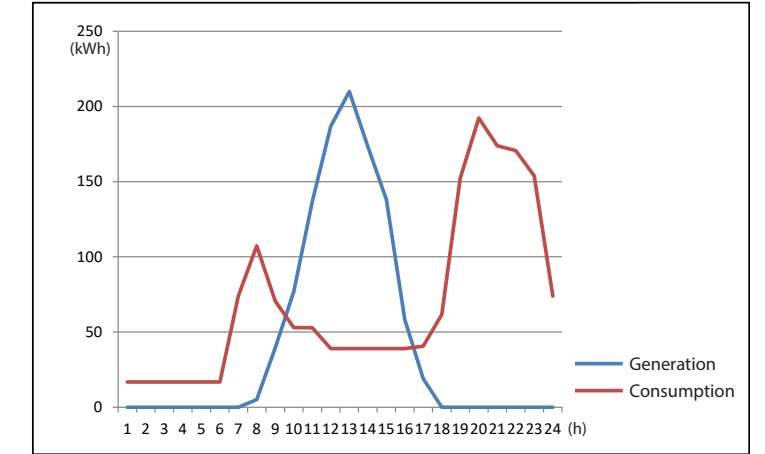
Jun 21st



Sep 21st



Dec 21st



Mismatch Electricity:



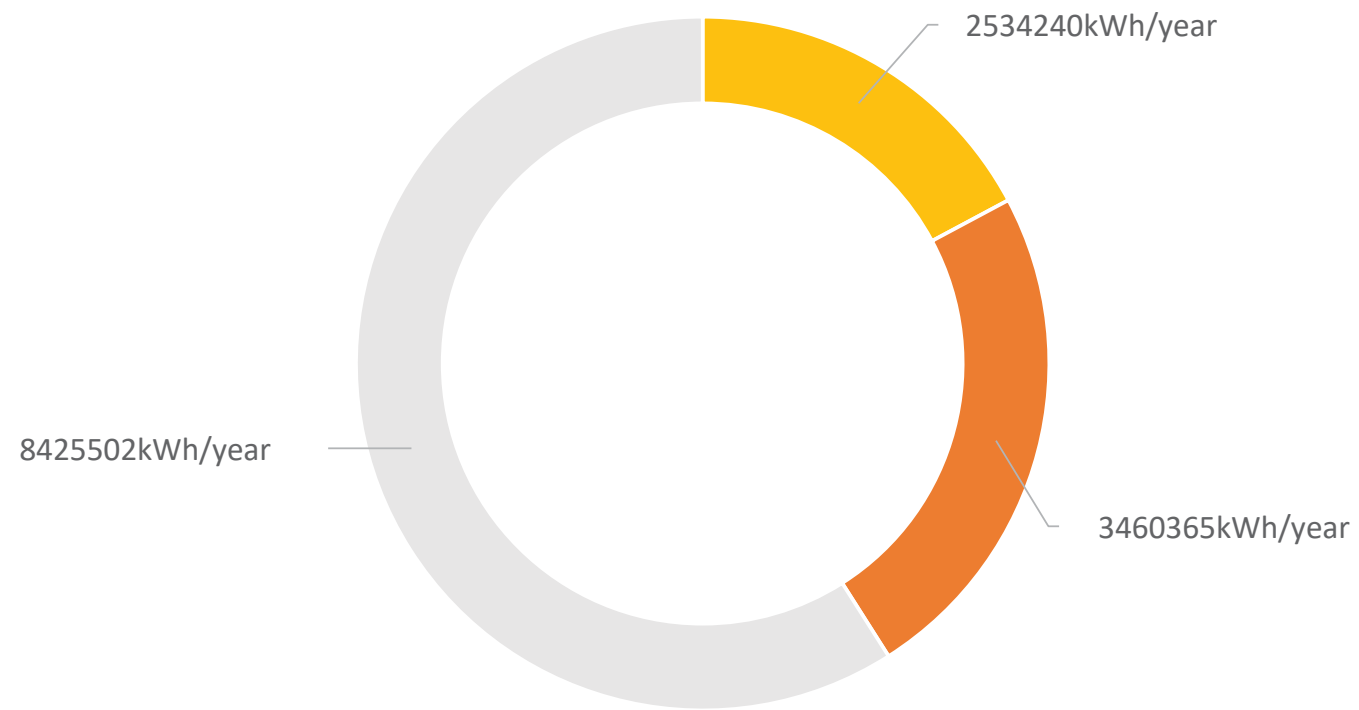
• Sell back to the grid



• Use for electricity sharing car/scooter

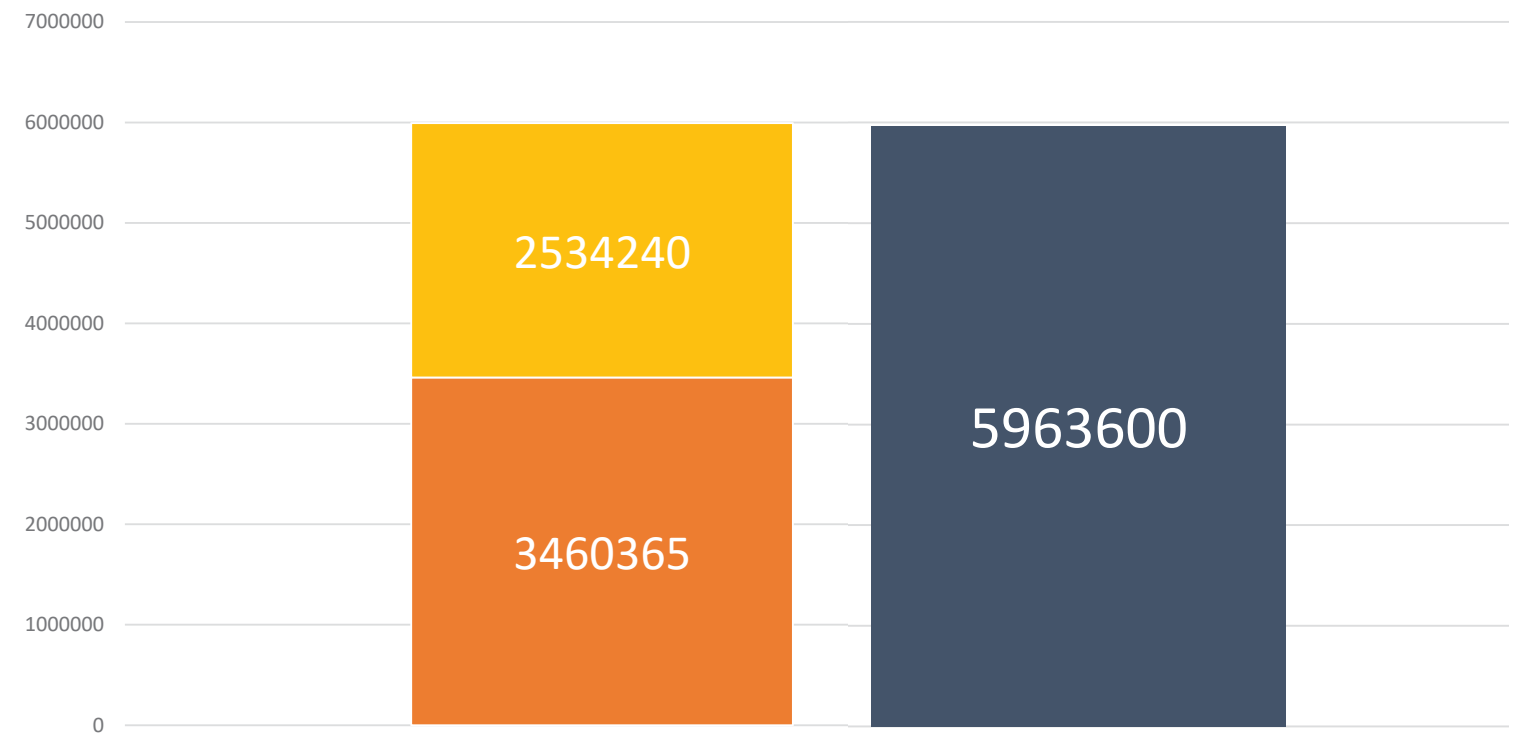
PV ANNUAL GENERATION VS ANNUAL ELECTRICITY CONSUMPTION

Annual Energy Consumption



■ Lighting Electricity Consumption 2534240kWh/year ■ Equipment Electricity Consumption 3460365kWh/year ■ Natural Gas Consumption 8425502kWh/year

Electricity Consumption vs. Electricity Generation (kWh/year)



■ Lighting Electricity Consumption 2534240kWh/year

■ Electricity Generation by PV panels 5963600kWh/year

■ Equipment Electricity Consumption 3460365kWh/year

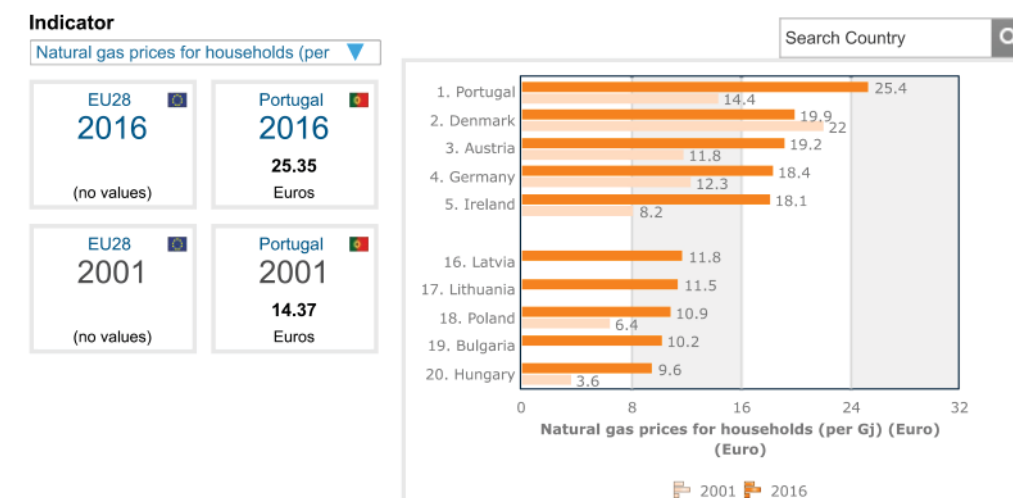
ANNUAL ELECTRICITY COST AND INCOME

- Electricity price for households (2016) = 0.2350 EUR/kWh
- Natural gas price for households (2016) = 25.35 EUR/Gj (= 0.091 EUR/kWh)



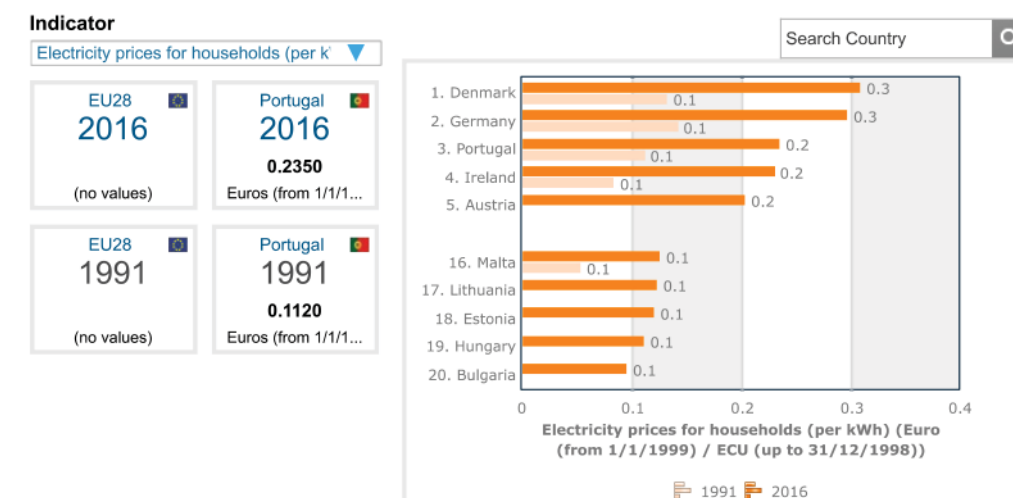
PV generated electricity income covers **70%** of annual operational electricity cost.

Natural gas prices for households and industrial users (Euro) - Europe



Sources/Entities: Eurostat | NSI | Ministries | Energy Agencies | Electricity Companies (in case of monopolies), PORDATA

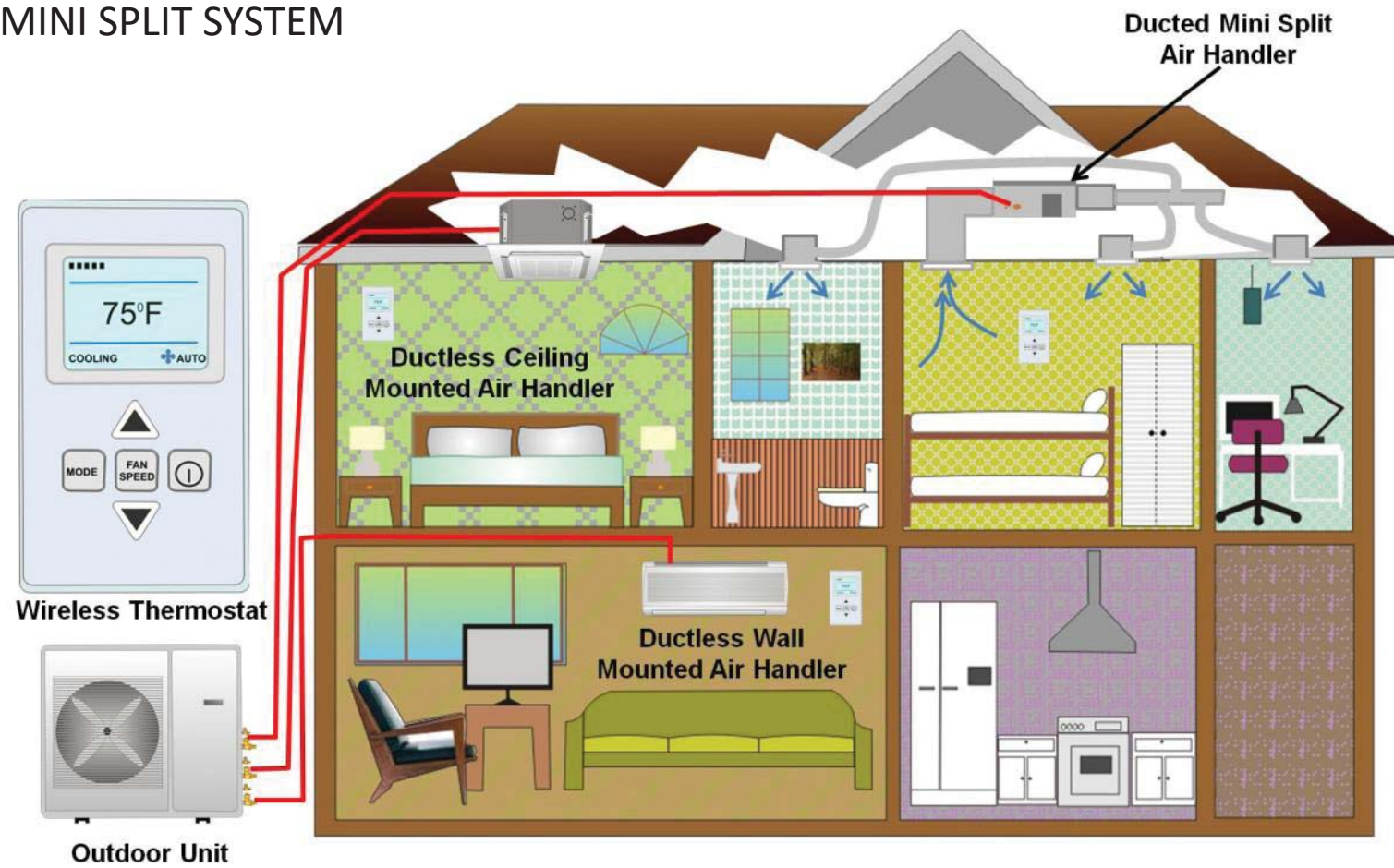
Electricity prices for households and industrial users (Euro/ECU) - Europe



Sources/Entities: Eurostat | NSI | Ministries | Energy Agencies | Electricity Companies (in case of monopolies), PORDATA

ENERGY SUPPLY SYSTEM

MINI SPLIT SYSTEM



Split-system air conditioners come in two forms: central and mini-split

Central Air Conditioning

Inside heat-exchanger inside the central furnace/AC unit of forced air heating system
Used in the summer to distribute chilled air throughout entire building
Usually large and placed in a basement or attic.

Mini-split System or Ductless System

Supplies chilled air to only a single space
Flexible and can have multiple heads attached to the condenser allowing cooling in more than one space.

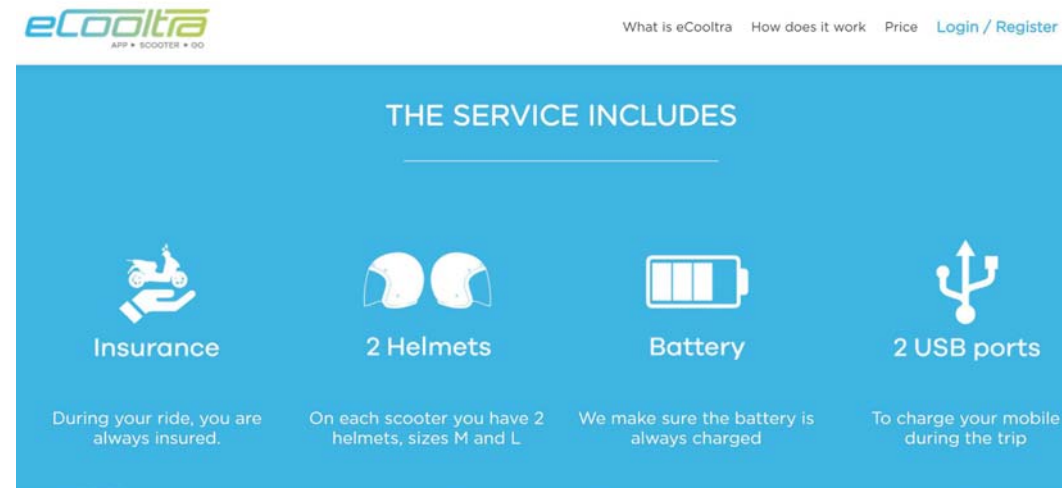
Benefits of Mini-split System

Allows design and installation flexibility
The compressor and heat exchanger can be located further away from the inside space
Central air systems are more difficult and expensive to install in existing homes
efficient, quiet, easy to install
Able to cool only the space you are in at the moment and also can be a heat source.

SHARED ELECTRICAL CAR/SCOOTER

Shared Scooter - Ecooltra

new start-up, but successful business with already 170 scooters in Lisbon

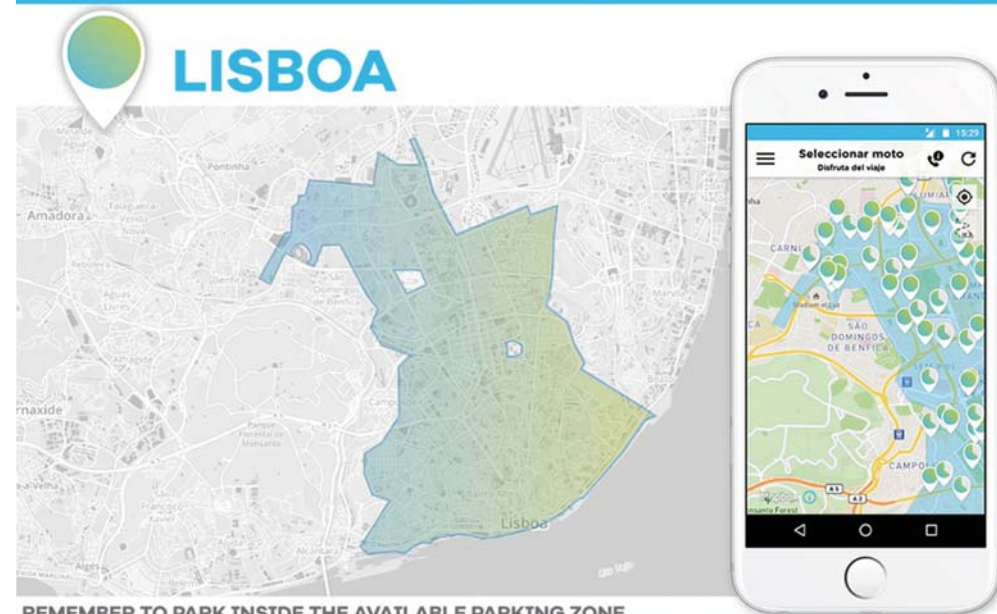


eCooltra APP • SCOOTER • 00

What is eCooltra | How does it work | Price | [Login / Register](#)

THE SERVICE INCLUDES

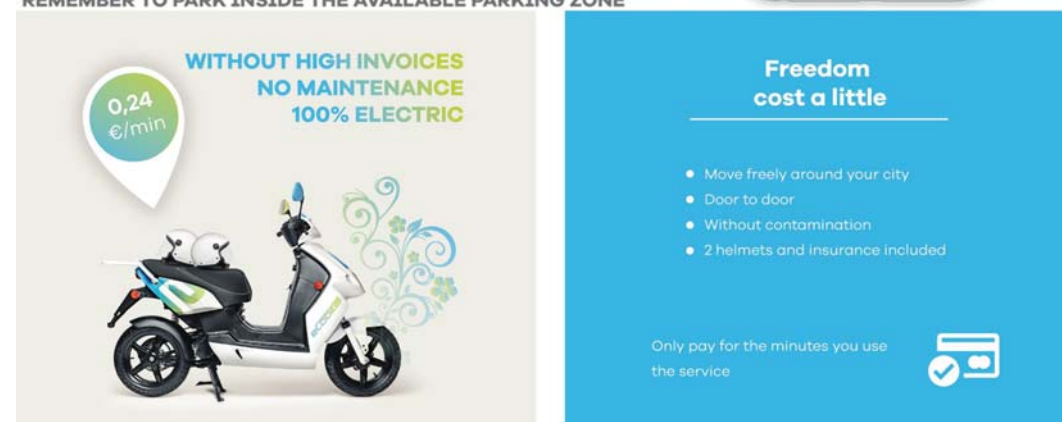
- Insurance**
During your ride, you are always insured.
- 2 Helmets**
On each scooter you have 2 helmets, sizes M and L
- Battery**
We make sure the battery is always charged
- 2 USB ports**
To charge your mobile during the trip



LISBOA

REMEMBER TO PARK INSIDE THE AVAILABLE PARKING ZONE

Smartphone app interface: "Seleccionar moto", "Disfruta del viaje", "19:29"



**WITHOUT HIGH INVOICES
NO MAINTENANCE
100% ELECTRIC**

0,24 €/min

Freedom cost a little

- Move freely around your city
- Door to door
- Without contamination
- 2 helmets and insurance included

Only pay for the minutes you use the service

Shared Cars - City Drive



citydrive Sign Up | Client Area | PT | EN

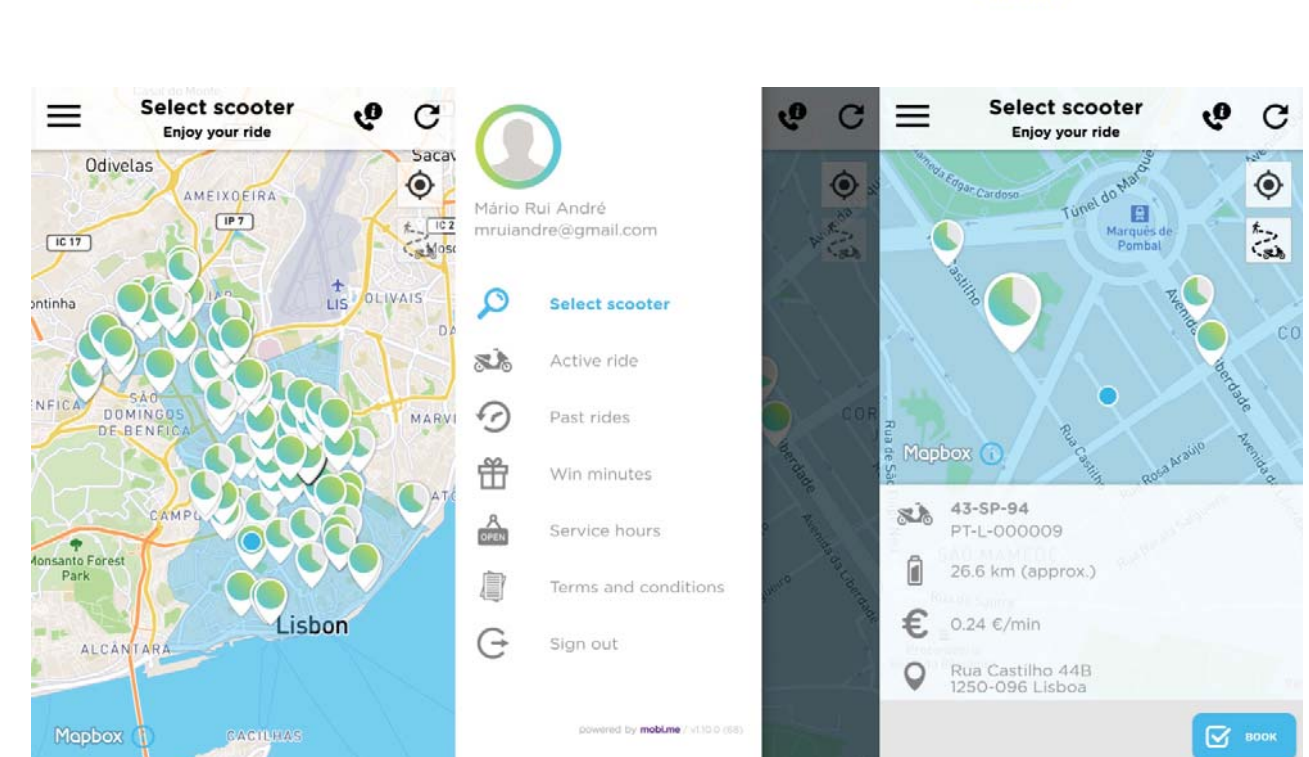
HOW IT WORKS | CARS & PRICES | SERVICE ZONE | COMPANIES | CONTACT

Citydrive in 5 steps

The easiest way to travel around Lisbon



- 1** Join Citydrive!
[+ more info](#)
- 2** Find a car
[+ more info](#)
- 3** Book a car
[+ more info](#)
- 4** Start driving!
[+ more info](#)
- 5** Park the car and leave
[+ more info](#)



Select scooter
Enjoy your ride

Mário Rui André
mruandre@gmail.com

- Select scooter
- Active ride
- Past rides
- Win minutes
- Service hours
- Terms and conditions
- Sign out

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Select scooter
Enjoy your ride

43-SP-94
PT-L-000009

26.6 km (approx.)

€ 0.24 €/min

Rua Castilho 44B
1250-096 Lisboa

BOOK

PARKING

For Residential:

Assuming: 1 Parking / 100 m²

40m² Parking Area/ 40 m²

Total Floor Area: 73,000 m²

Total Parking: 730

Total Parking Area: 29,200 m²

For Commercial & Office:

Assuming: 1 Parking / 30 m²

40m² Parking Area/ 40 m²

Total Floor Area: 71,650 m²

Total Required Parking: 2,400

Total Parking Area: 96,000 m²

Provided Parking Area: 66,000 m²

