General Plan of Interventions in the waterfront of Lisbon | Planta Geral de Intervenção
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
What is a Sustainable Neighborhood?
CARDIO COMMUNITY  
ZERO CARBON FITNESS

NATURAL VENTILATION  
ZERO MECHANICAL COOLING

REDUCING SITE EUI  
ZERO ELECTRICITY
GYM
Statistics on indoor gyms:
- In 2016: **15.8%** of the Portuguese (15 years old and more) frequent-ed 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?

Existing Bike Lane in Lisbon
FLOOD ZONE ANALYSIS

+4 m
2100

+6 m
2150

+9 m
2200

+13 m
2300
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.
Building Depth: 15 meters

Building Depth: 10 meters

Building Depth: 15 meters
OUTDOOR THERMAL COMFORT

- **April 9:00**
- **July 9:00**
- **December 9:00**

Legend:
- **Extreme Heat Stress**
- **50°C**
- **No Thermal Stress**
- **Extreme Cold Stress**
- **-50°C**
OUTDOOR THERMAL COMFORT

APRIL 15:00

JULY 15:00

DECEMBER 15:00

Extreme Heat Stress

No Thermal Stress

Extreme Cold Stress
*According to local residents’ life pattern, 18:00 is the frequent choice of time for outdoor activities.
Elevation PV Shading
Annual Generated Electricity: 303656.3 kWh

Roof Top PV
Annual Generated Electricity: 282945.2 kWh
PV PANEL VS. DAYLIGHTING CONDITION

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

Daylight Autonomy

PV Annual Generation

Section Diagram

Daylight Autonomy

PV Electricity Generation
CFD ANALYSIS

Pressure Differences Color Coding:
- Blue: 0 - 1 Pa
- Yellow: 1 - 4 Pa
- Red: > 4 Pa
CFD ANALYSIS

SOLID BUILDING BLOCKS

Pressure Differences

- Blue: 0 - 1 Pa
- Yellow: 1 - 4 Pa
- Red: > 4 Pa
Permeable Building Blocks

Pressure Differences

- Blue: 0 - 1 Pa
- Yellow: 1 - 4 Pa
- Red: > 4 Pa
CFD ANALYSIS

OPTIMIZED BUILDING BLOCKS

Pressure Differences
- Blue: 0 - 1 Pa
- Yellow: 1 - 4 Pa
- Red: > 4 Pa
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.
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
Annual Energy Consumption

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

Electricity Consumption vs. Electricity Generation (kWh/year)

- Lighting Electricity Consumption: 2534240 kWh/year
- Equipment Electricity Consumption: 3460365 kWh/year
- Electricity Generation by PV panels: 5963600 kWh/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.
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 on 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 Scooter - Ecooltra
new start-up, but successful business with already 170 scooters in Lisbon

Shared Cars - City Drive

Citydrive in 5 steps
The easiest way to travel around Lisbon
For Residential:
Assuming: 1 Parking / 100 m²
40 m² 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
40 m² 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