ALFACINHA

translation: (1) little lettuce; (2) nickname for a native of Lisbon used by Tripeiros (tripe-eaters) from the north

Khadija Benis, Sera Tolgay, Irmak Turan

DESIGN APPROACH + GOALS

PRODUCTIVE USE OF ROOFTOP SPACES

Program the productive use of outdoor spaces to maximize available rooftop areas for:
greenhouse farming + photovoltaic energy generation

COST-EFFECTIVENESS

Through financial analysis of design interventions within the site, ensure that integration of elements such as building-integrated food production is economically sustainable

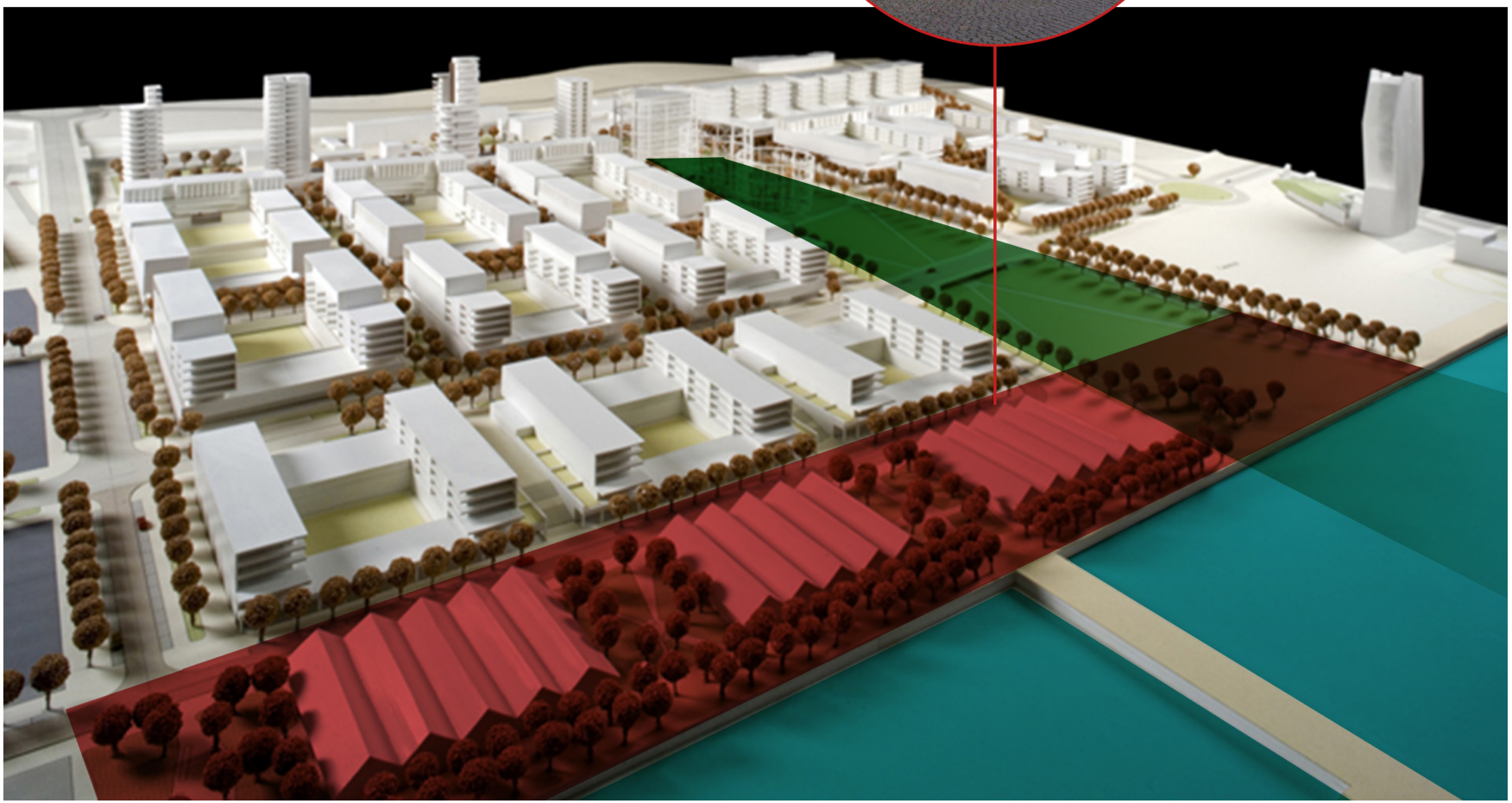
DESIGN GOAL

Maximize onsite food production with net zero additional operational energy

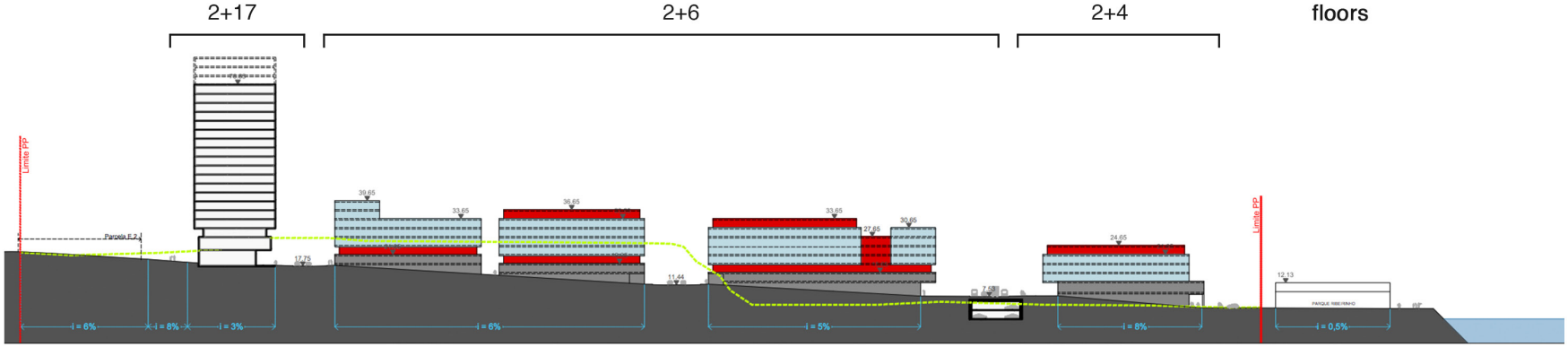
EXISTING PROPOSAL

EXISTING PROPOSAL

EXISTING PROPOSAL



EXISTING PROPOSAL



EXISTING PROPOSAL

Mixed use

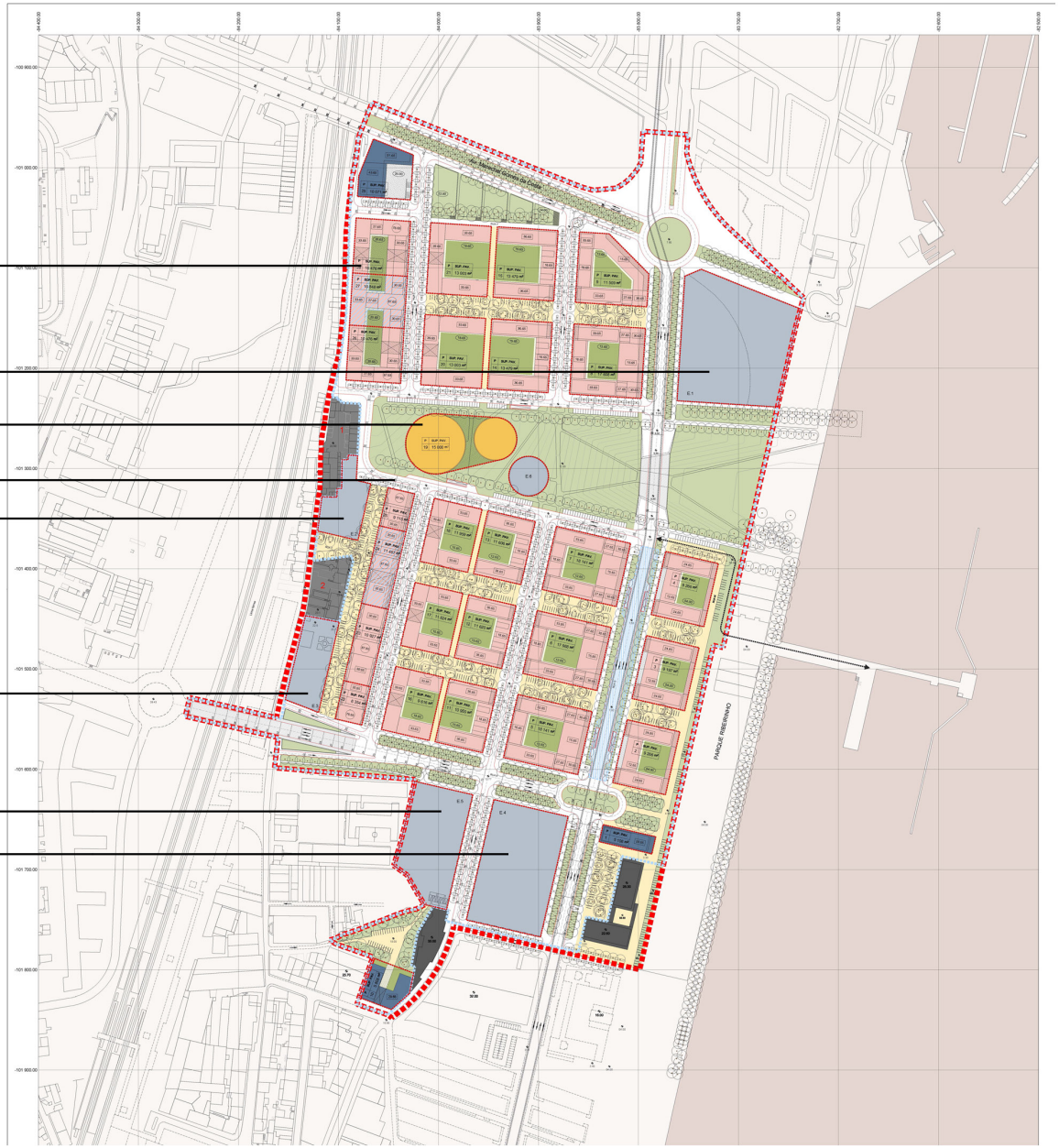
Church

Hotel

Park

Other amenities

School



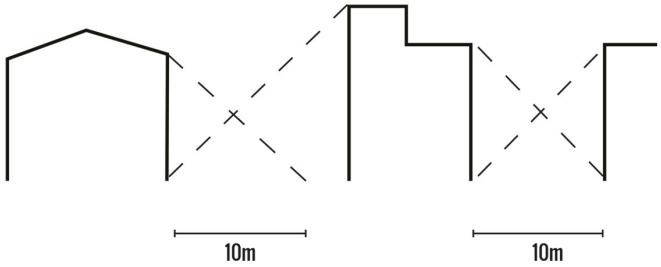
PROTOBLOCK DEVELOPMENT

PROTOBLOCK DESIGN: REGULATIONS & EVOLUTION

LISBON'S REGULATIONS

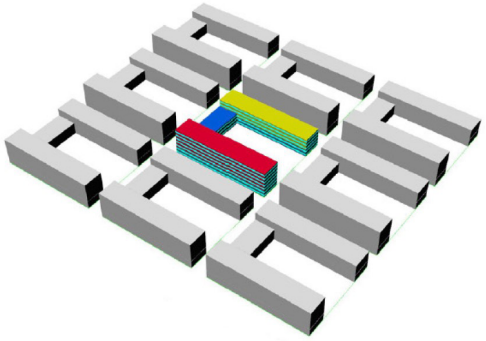
45 DEGREE RULE

No vertical wall of the building can be over the limit defined by the 45º line between the adjacent buildings separated by a street

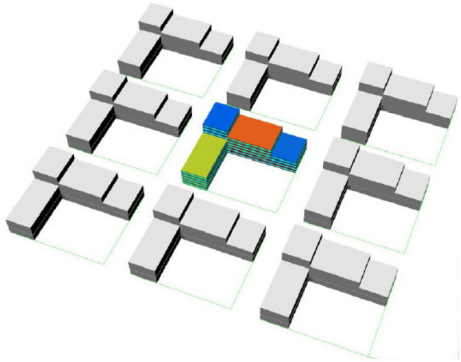


15M DEPTH

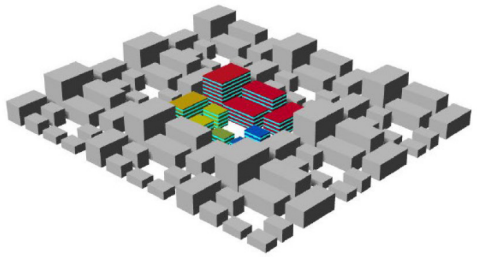
Maximum depth of buildings (not including balconies) is 15m
Hotels and public facilities can be 18m wide



Reference Block Plan
Planta de Implantaçao Proposal



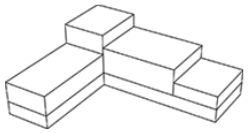
Design Alternative 1
L-shaped



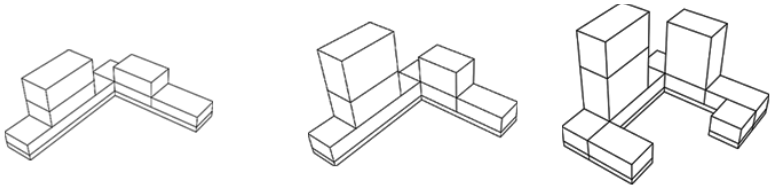
Design Alternative 2
Clustered

PROTOBLOCK DESIGN: EVOLUTION

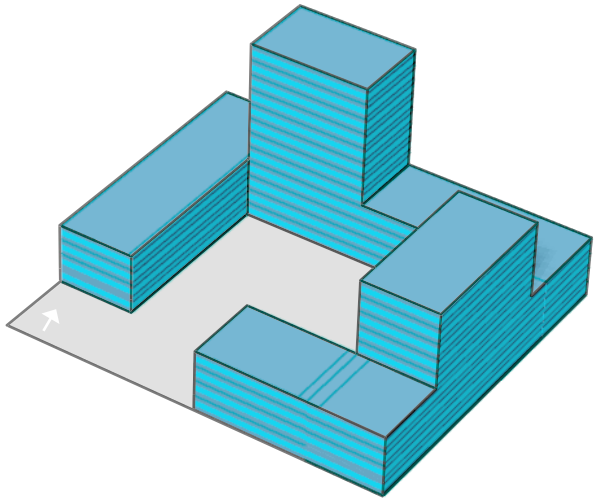
initial concept
HIGH AND DENSE



test different FARs, WWR, HVAC systems

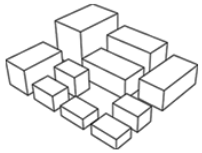


2 3 4

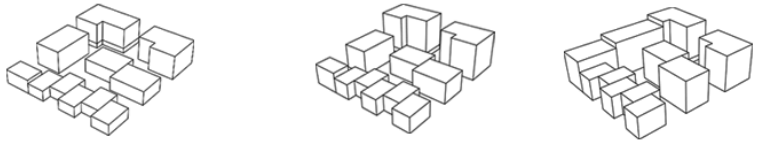


Tower Block
residential, office

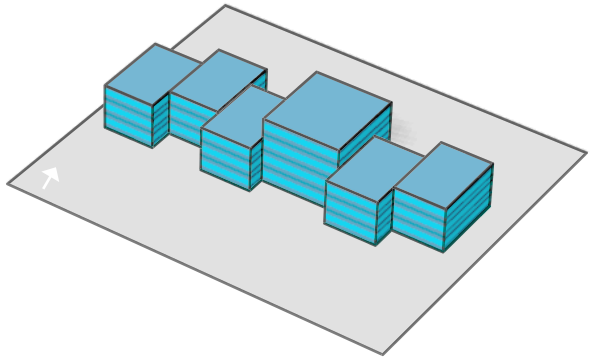
initial concept
LOW AND CLUSTERED



test different FARs, WWR, HVAC systems



2 3 4



Cluster Block
office, school, retail

PROTOBLOCK DESIGN: EUI

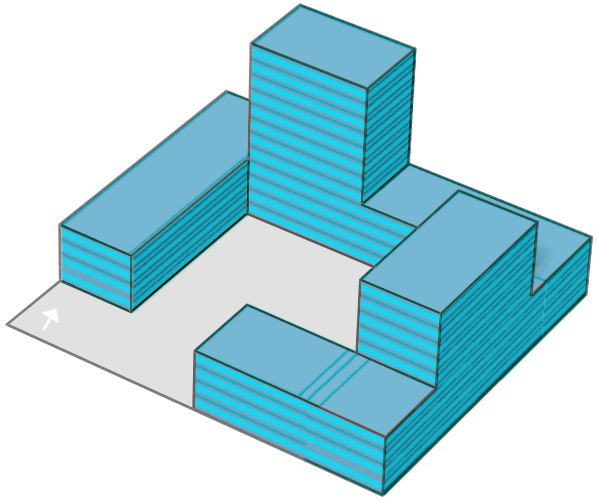
Residential: Hybrid (natural vent. + cooling)

Office & School: Hybrid (natural vent. + cooling)

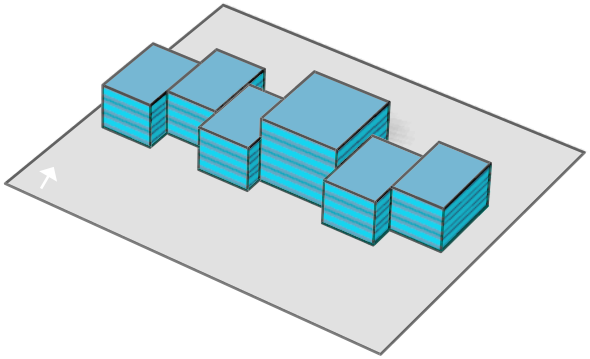
Retail: Cooling only

	SETPOINTS (°C)		
	Cooling	Heating	Natural Vent
Residential	24	18	20-24
Office & School	22	20	20-21
Retail	22	20	-

Tower Block
residential, office



Cluster Block
office, school, retail

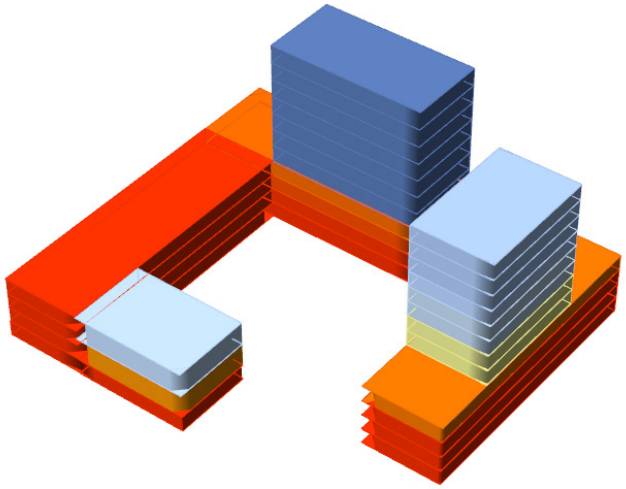


	Residential Block	Office Block	Office Cluster	Retail Cluster
	kWh/m2	kWh/m2	kWh/m2	kWh/m2
System	Hybrid	Hybrid	Hybrid	Cooling only
Total energy	76	102	101	102
Lighting	12	25	20	37
Equipment	16	27	27	26
Heating	2	4	6	0
Cooling	6	31	33	34
DHW	40	15	15	6

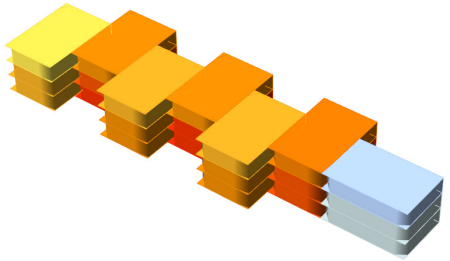
PROTOBLOCK DESIGN: DAYLIGHT AUTONOMY

WWR options tested:
20, 20, 20, 20
40, 40, 40, 40
60, 60, 60, 60
80, 80, 80, 80

Tower Block
residential, office

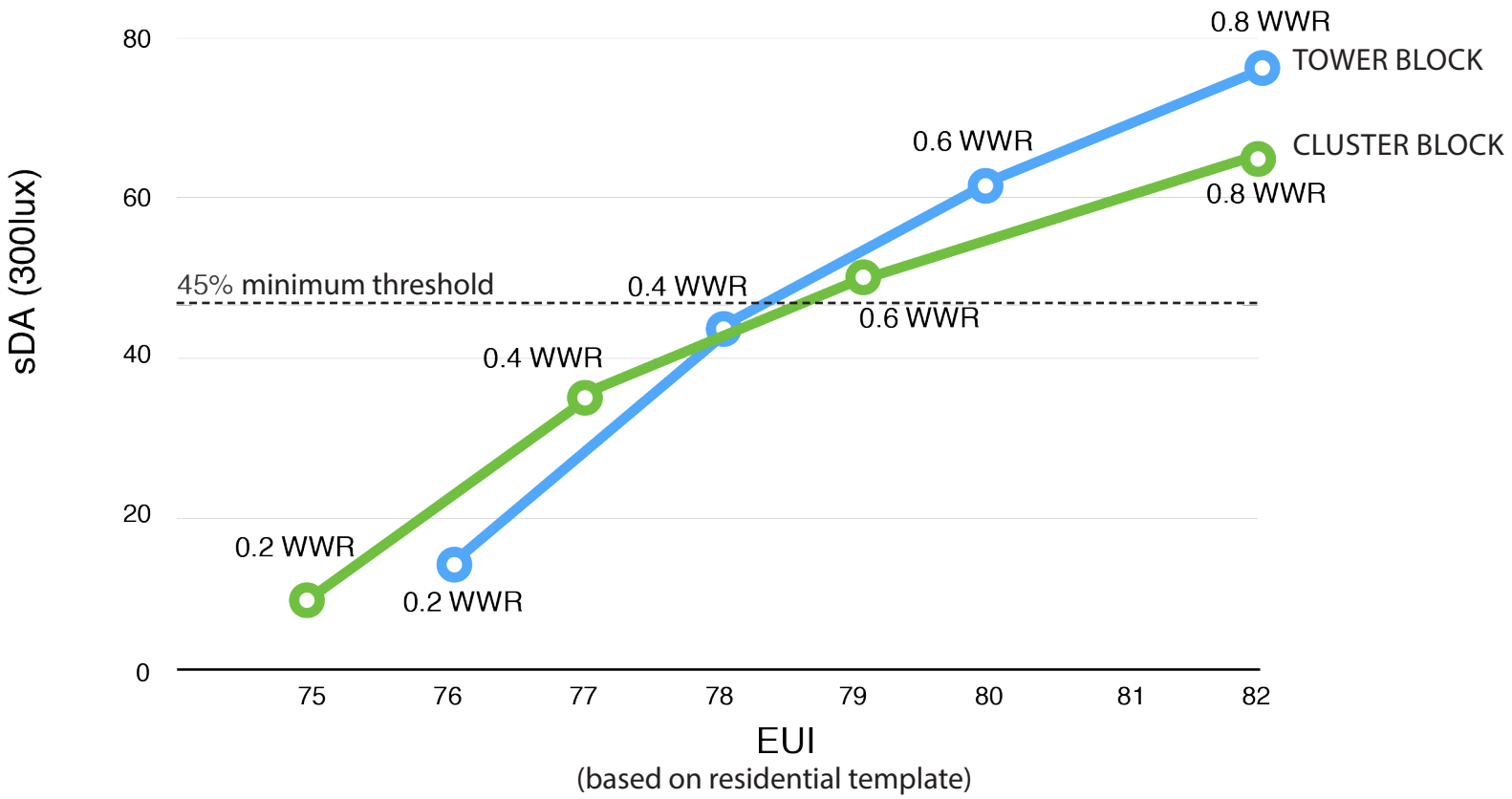


Cluster Block
office, school, retail



	Prototype 1: Tower Block	Prototype 2: Cluster
Windows	Double, air filled, Low-E Coating	Double, air filled, Low-E Coating
WWR (N, S, E, W)	40, 80, 60, 40	60, 60, 60, 60
sDA (300 lux)	57%	52%

PROTOBLOCK DESIGN: EUI -VS- DAYLIGHT AUTONOMY



	Prototype 1: Tower Block	Prototype 2: Cluster
Windows	Double, air filled, Low-E Coating	Double, air filled, Low-E Coating
WWR (N, S, E, W)	40, 80, 60, 40	60, 60, 60, 60

SITE DESIGN

SITE DESIGN: SURROUNDING CONDITIONS

RAILWAY

HIGHWAY

RIVER

SITE DESIGN: CREATING ACCESS

GAS HOLDERS

DOCKS

SITE DESIGN: MAKING USE OF EXISTING STRUCTURES

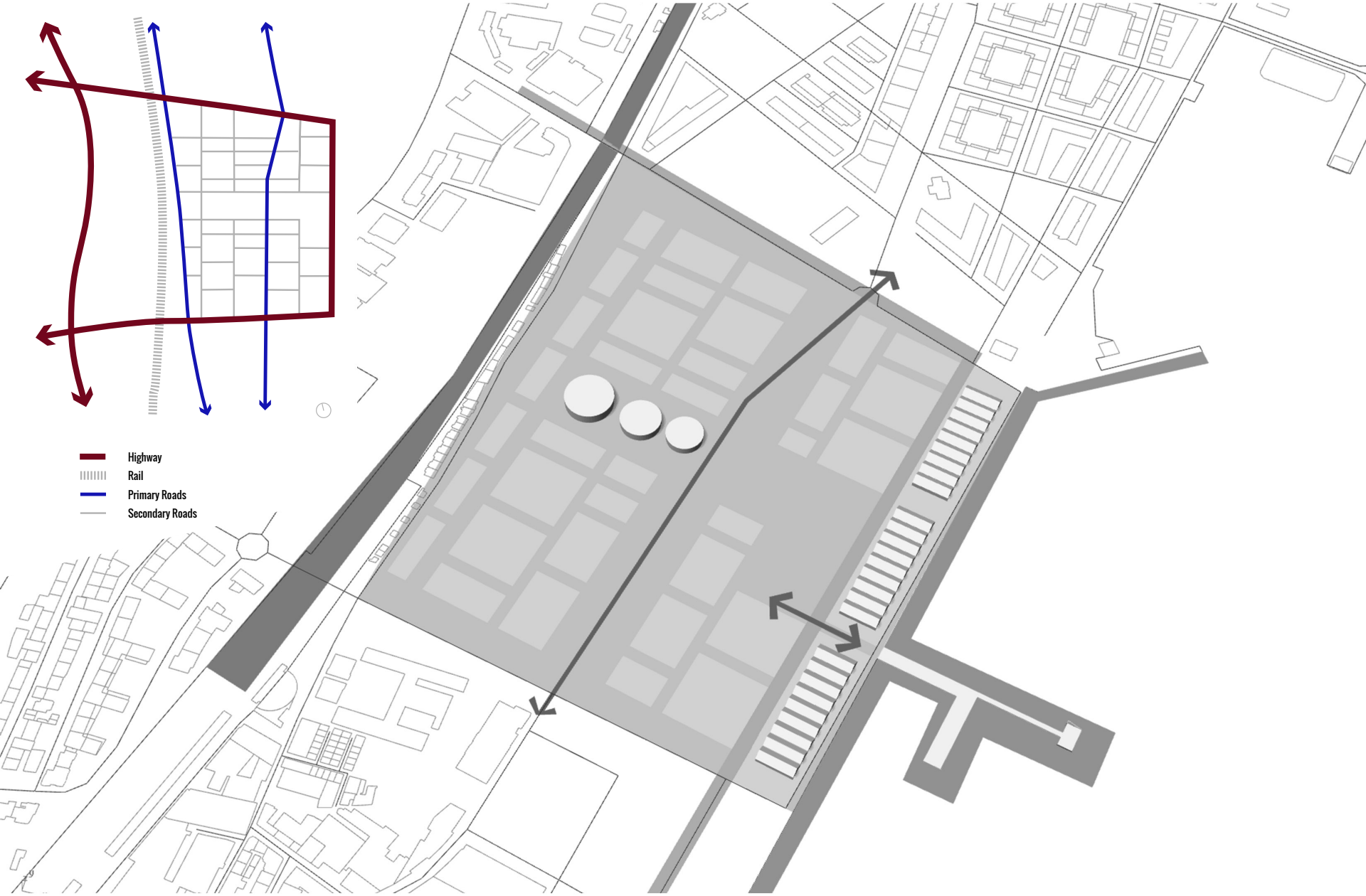
MARKET

AMENITIES

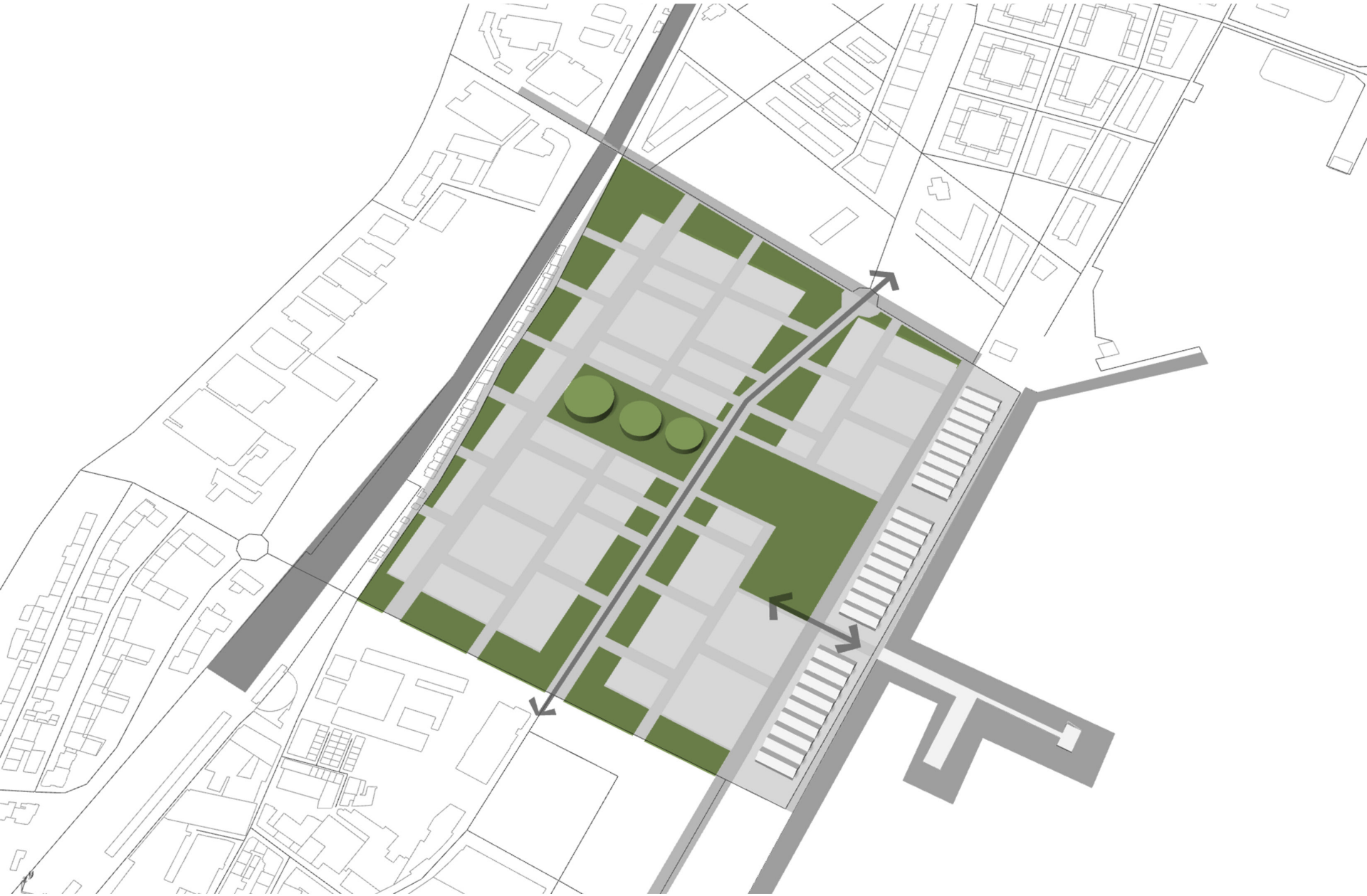
GAS HOLDERS

DOCKS

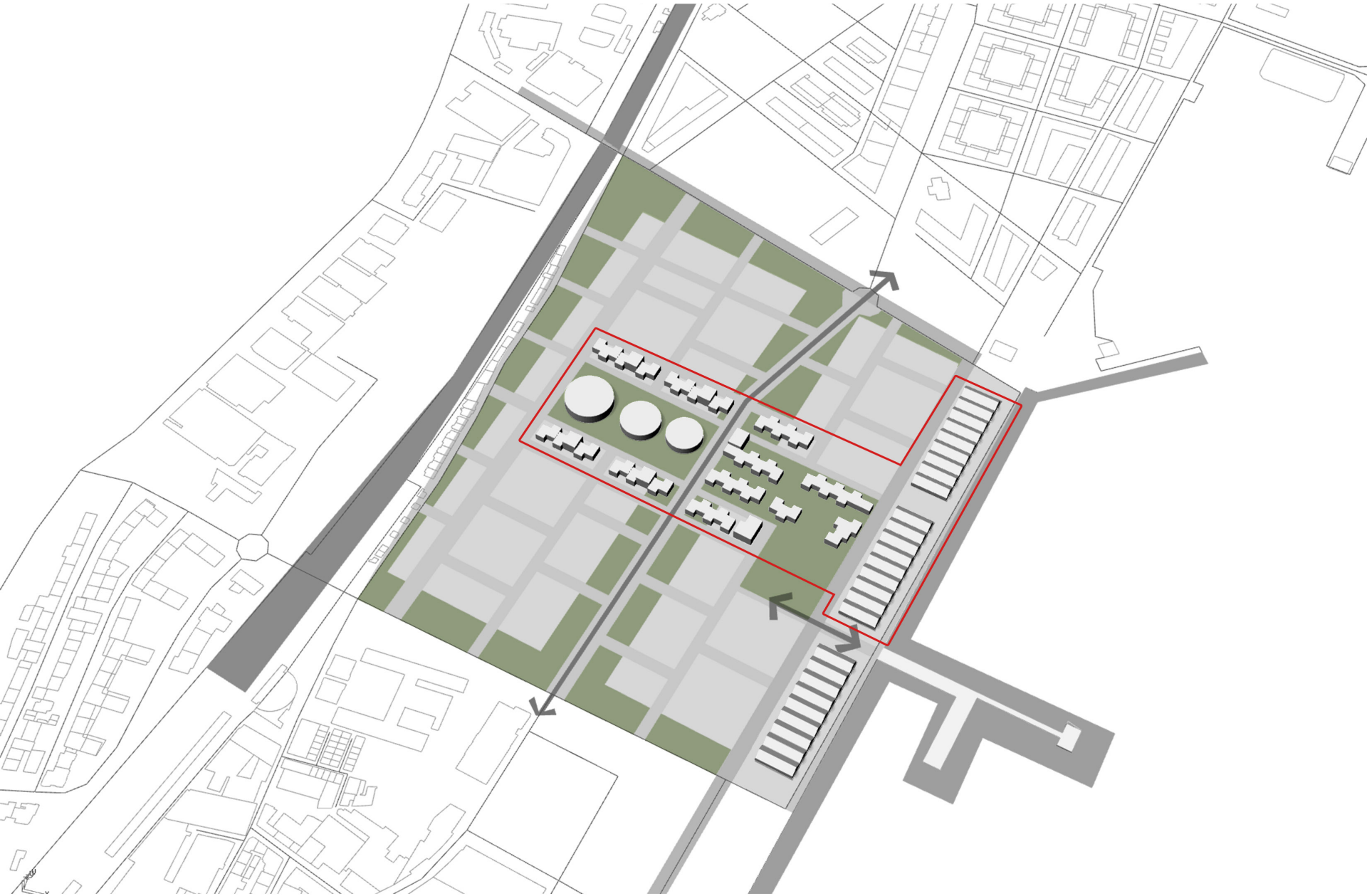
SITE DESIGN: CIRCULATION



SITE DESIGN: GREEN SPACES



SITE DESIGN: RETAIL AND AMENITIES



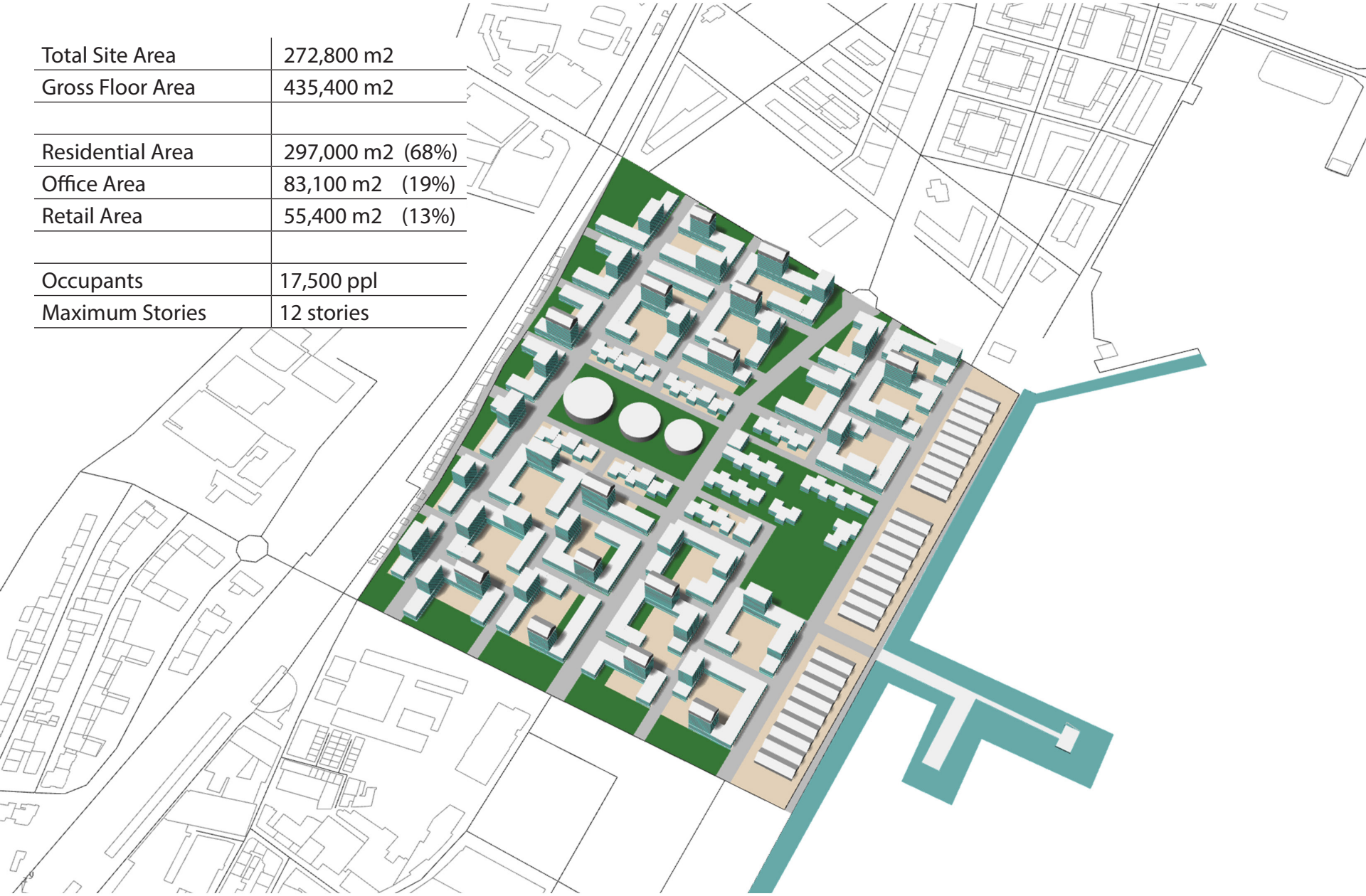
SITE DESIGN: OFFICE AREAS

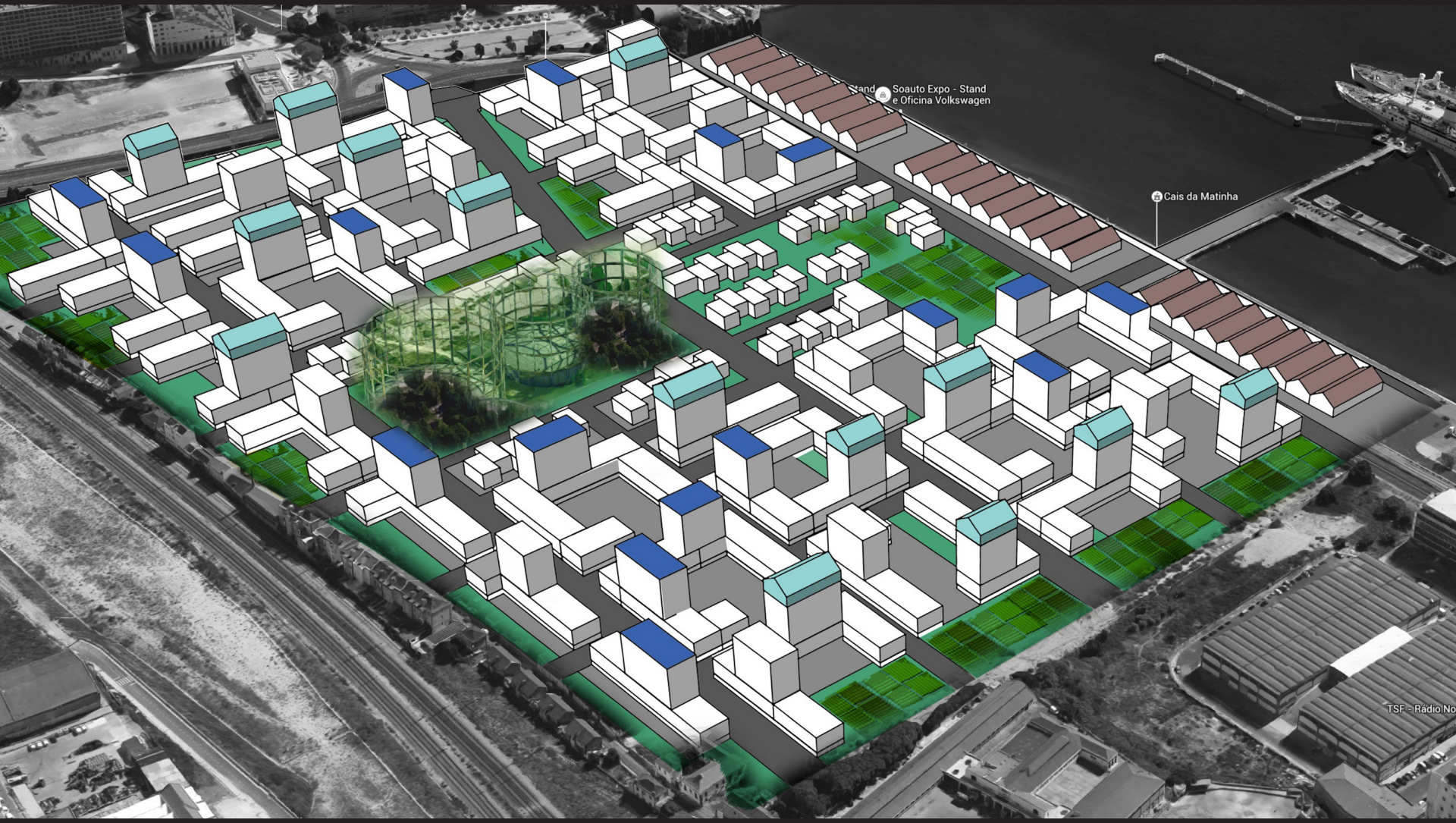
SITE DESIGN: RESIDENTIAL AREAS

SITE DESIGN: FOOD PRODUCTION

FINAL SITE DESIGN

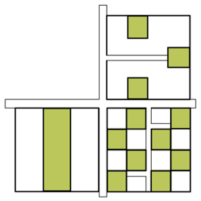
Total Site Area	272,800 m2
Gross Floor Area	435,400 m2
Residential Area	297,000 m2 (68%)
Office Area	83,100 m2 (19%)
Retail Area	55,400 m2 (13%)
Occupants	17,500 ppl
Maximum Stories	12 stories



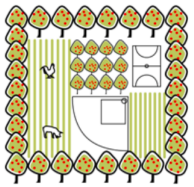

Soauto Expo - Stand
e Oficina Volkswagen
Cais da Matinha
TSF - Rádio No

URBAN REGULATION

URBAN REGULATION: ONSITE PRODUCTIVE (GROWING) AREAS

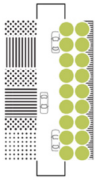


Garden Block

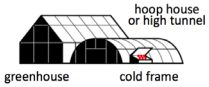


Edible Park

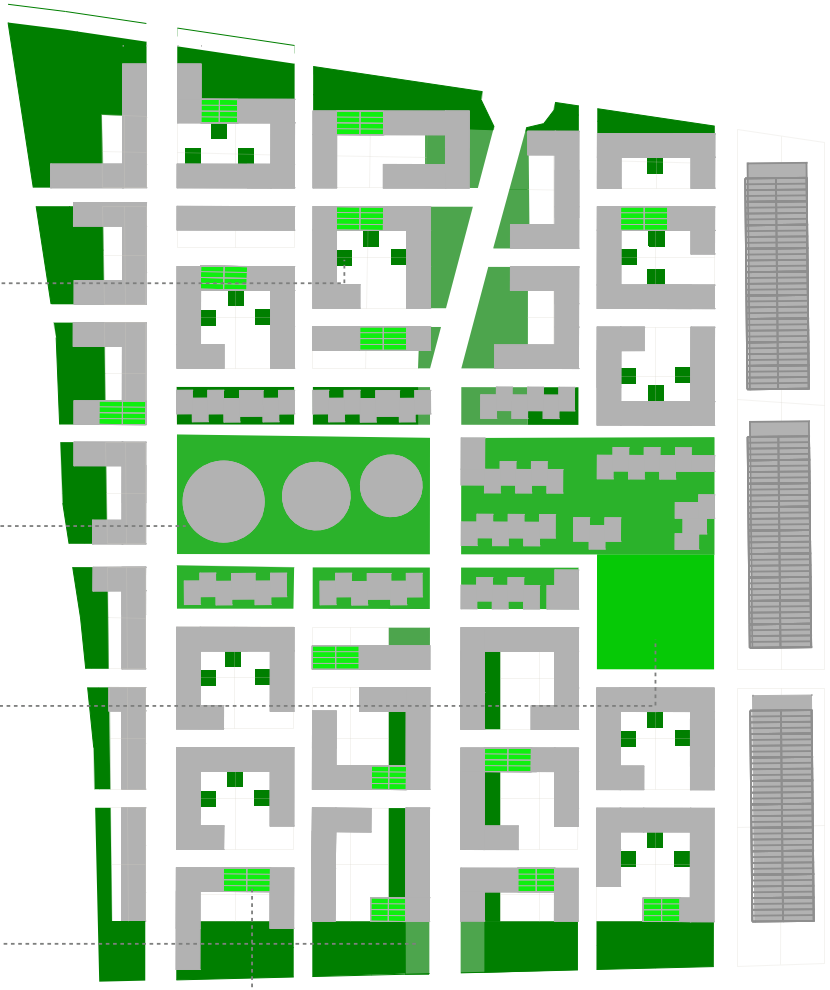
Community Garden



GROW street (Gardened Right-of-Way)



Hydroponic Greenhouse



Source: Fayetteville 2030 Food Security Scenario Plan

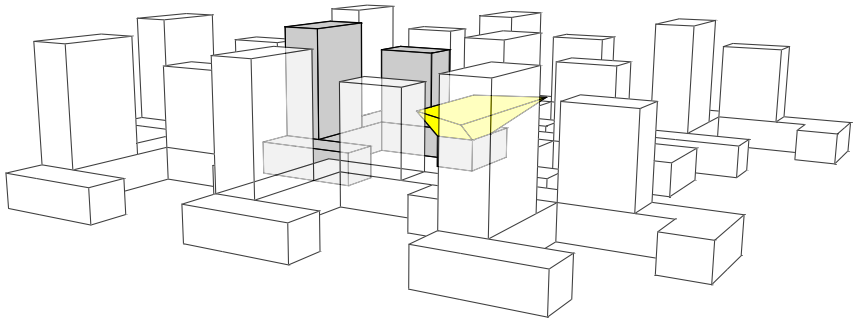
URBAN REGULATION: FARM SCORE

URBAN DESIGN GUIDELINE

Analyzing the farming potential of roof surfaces

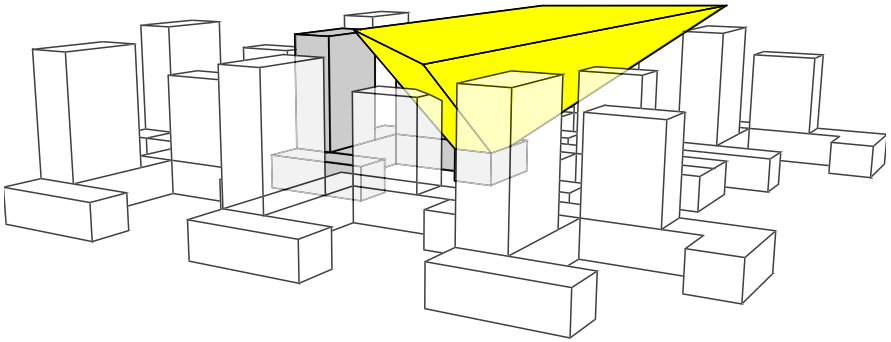
DESIGN APPROACH

Identify the surfaces with growing potential above 50 % based on solar exposure

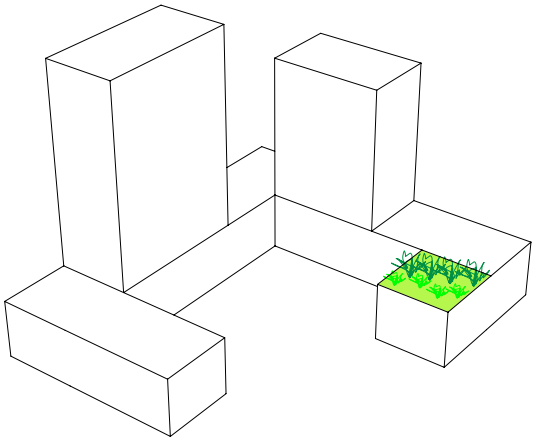


less access to solar radiation = less food production

more access to solar radiation = more food production

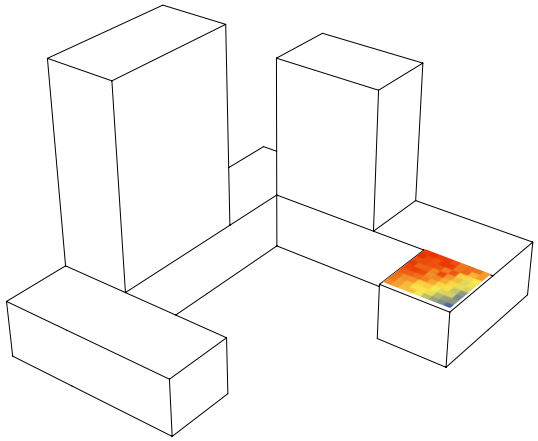


URBAN REGULATION: PERFORMATIVE RULE



(1)
Identify potential farming area

→



(2)
Perform solar radiation analysis

→

Average Solar Radiation (kWh/m2/yr)	Production Score (%)
<850	0
850-999	17%
1000-1149	33%
1150-1299	50%
1300-1449	67%
1450-1599	83%

(3)
Only install a hydroponic greenhouse if average solar radiation of area is above **1150 kWh/m2/yr**

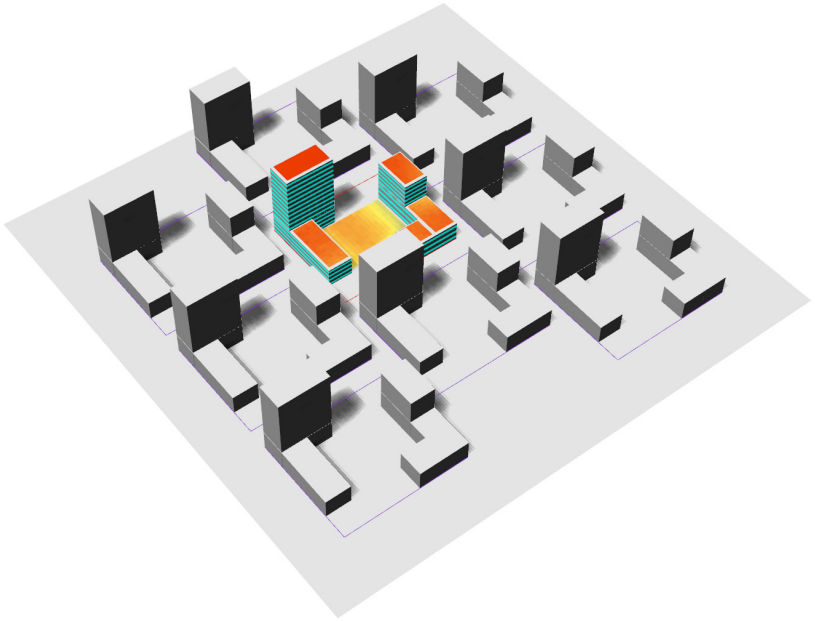
URBAN REGULATION: PERFORMATIVE RULE

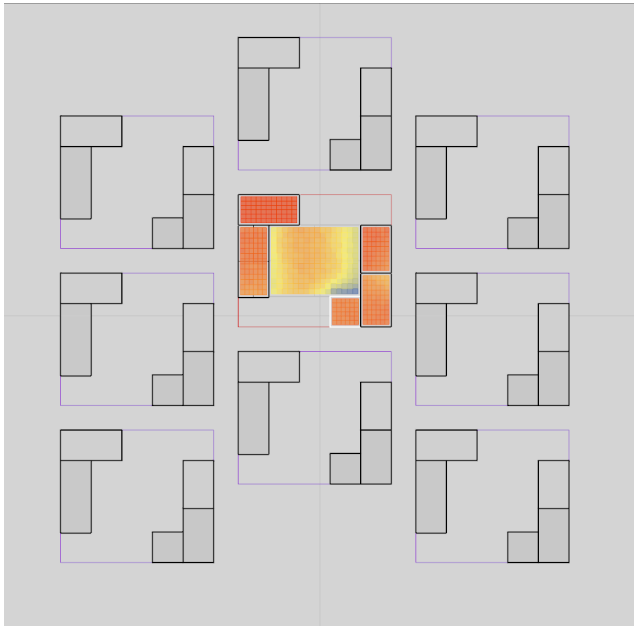
PROTOBLOCK ANALYSIS

top roofs: 1600 kWh/m2

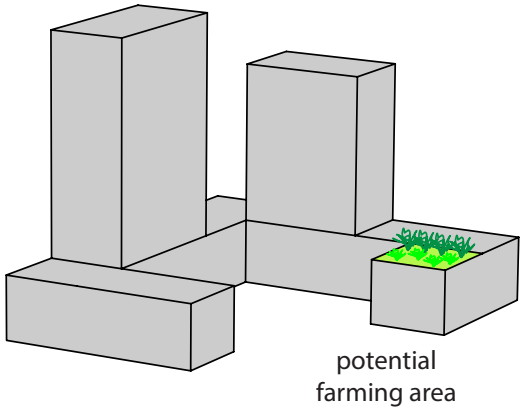
low roofs: 1450 kWh/m2

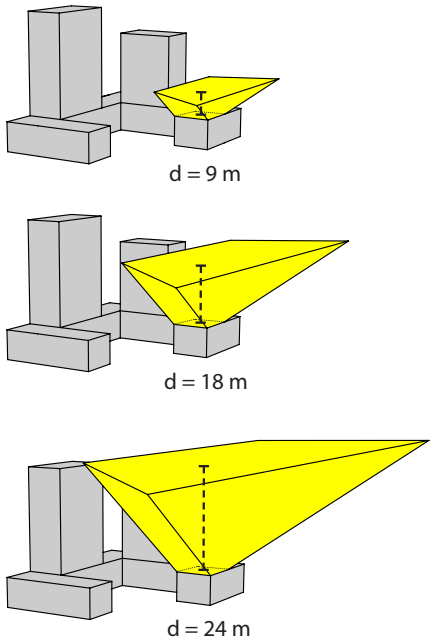
ground: 1000 kWh/m2





URBAN REGULATION: PRESCRIPTIVE RULE





Solar Fan Height (m)	Average Solar Radiation (kWh/m2/yr)	Production Score (%)
9 or less	<850	0
10-12	850-999	17%
13-15	1000-1149	33%
16-18	1150-1299	50%
19-21	1300-1449	67%
22-24	1450-1599	83%
24 and above	1600	100%

(1)
Identify potential farming area

→

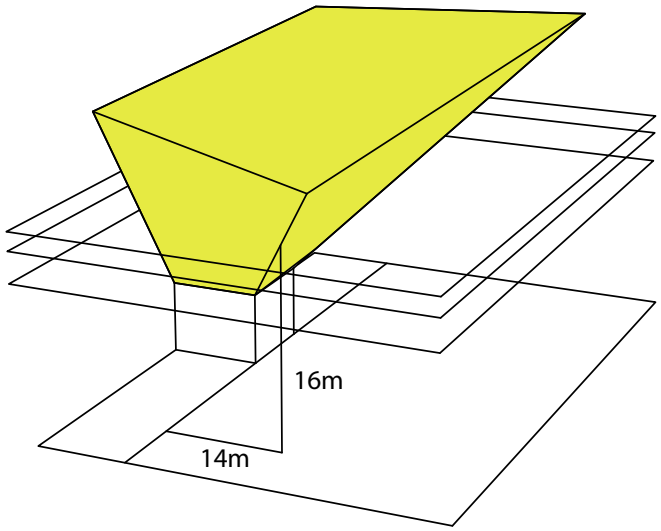
(2)
Place solar fan on site. Measure maximum height that the fan can reach before intersecting a surrounding surface.

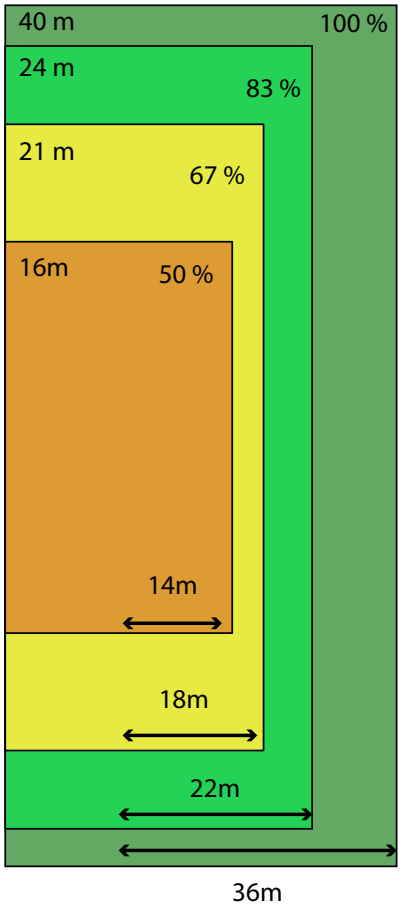
→

(3)
Only install a hydroponic greenhouse if the solar fan can reach **16 meters** or above before intersecting a surrounding surface.

URBAN REGULATION: PRESCRIPTIVE RULE

To achieve a minimum production score of 50%, there should be a minimum of **14 m in distance and 16 m in height differential** between the potential farming area and adjacent buildings.





FARMING -VS- PV PRODUCTION

PRODUCTION SCORE

based on performative or prescriptive analysis

X

POTENTIAL YIELD

rooftop hydroponic greenhouse farming or PV installation

X

PERCENTAGE OF ROOFTOP AREA

rooftop hydroponic greenhouse farming or PV installation

=

ON-SITE FOOD OR ENERGY PRODUCTION

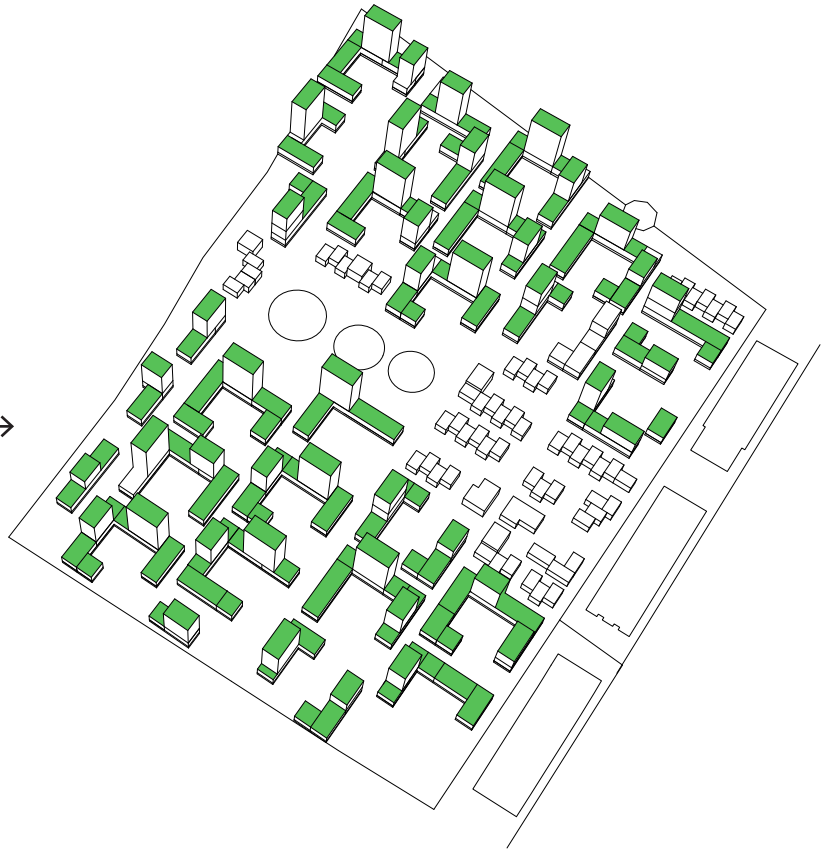
result to compare to occupant consumption needs

POTENTIAL PRODUCTIVE AREAS

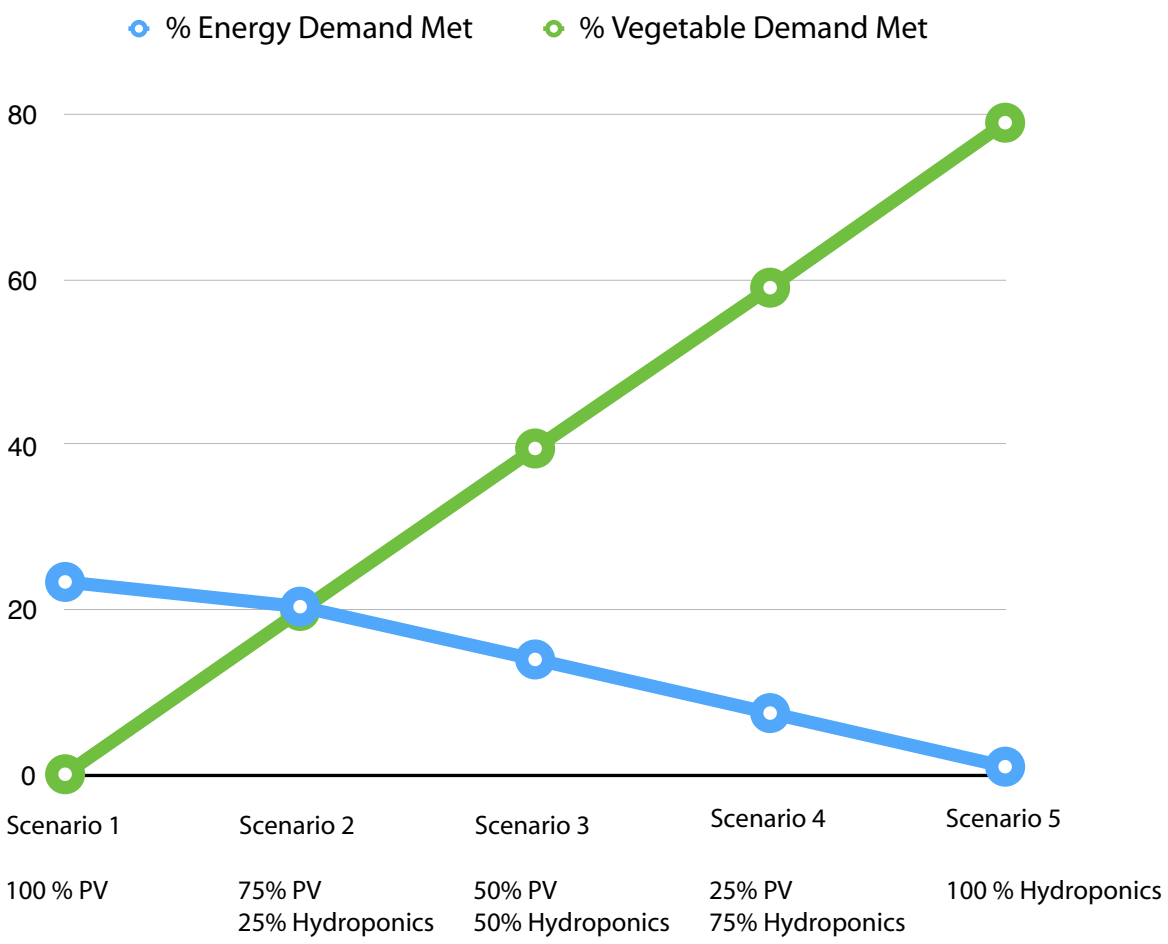
↓

ROOFTOPS OF RESIDENTIAL TOWER BLOCKS

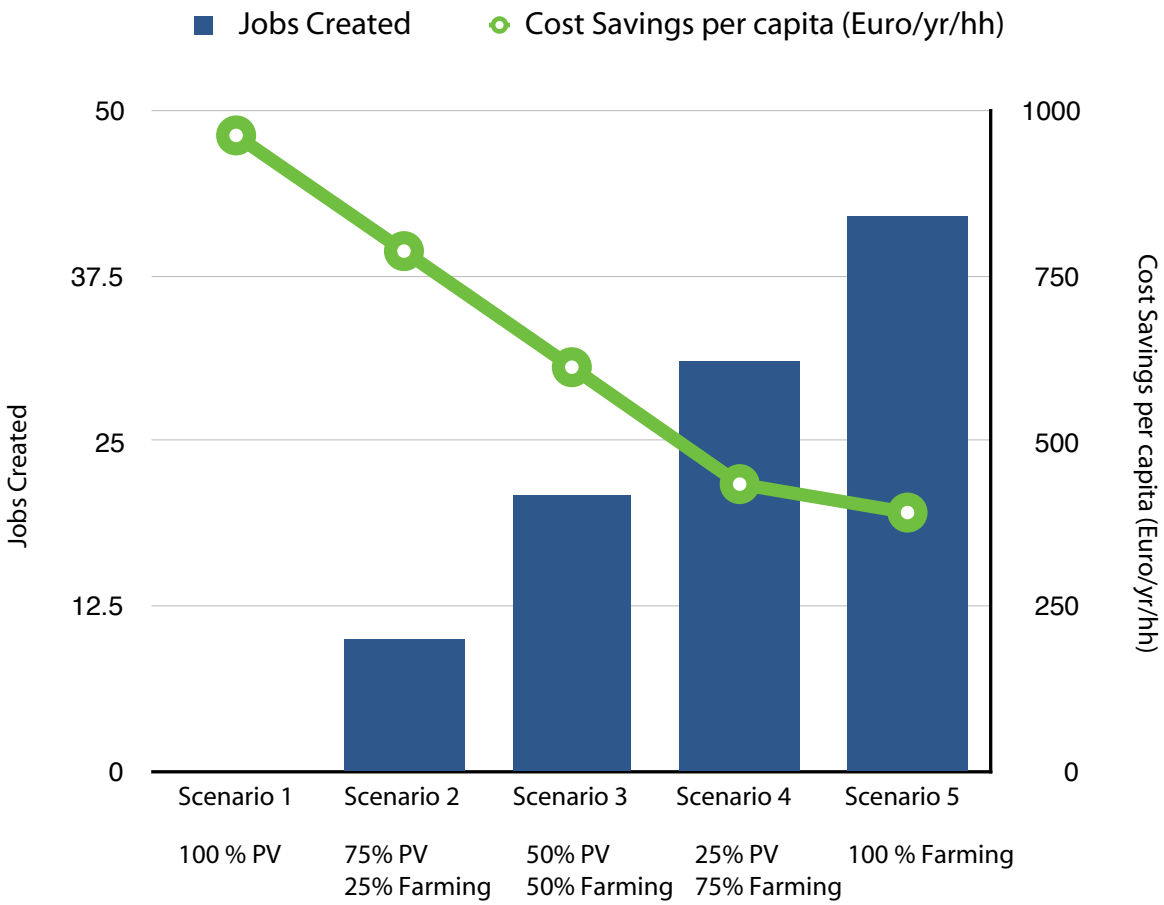
→



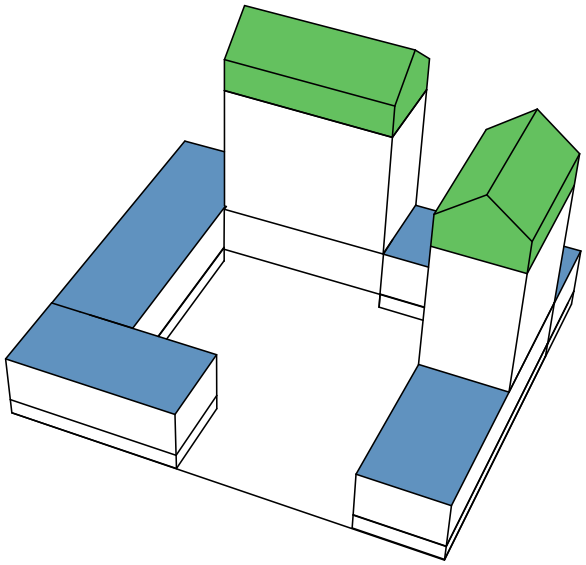
FARMING -VS- PV PRODUCTION



FARMING -VS- PV PRODUCTION



FARMING -VS- PV PRODUCTION



Chosen Scenario:

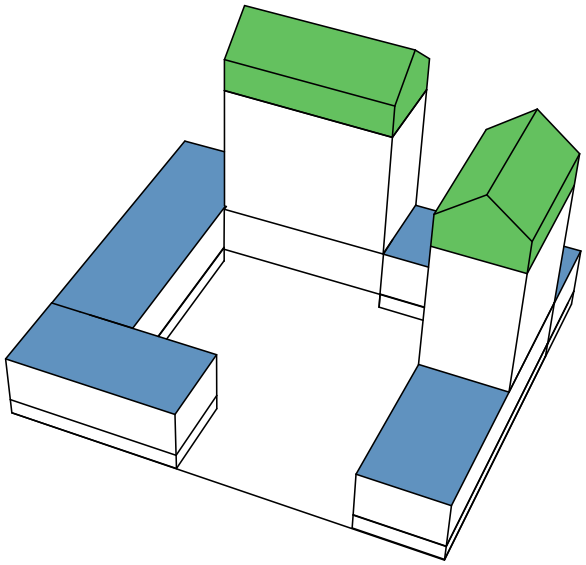
35.2 % Hydroponic Greenhouses
(all high roofs for hydroponic farming)

64.8 % PV
(all low roofs)

RESULTS

% Energy Demand Met	% Vegetable Demand Met	Cost Savings	Jobs Created
16	41	752 euro/yr/hh	15

NEW METRIC: FARM SCORE



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64.8 % PV
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RESULTS

% Energy Demand Met	% Vegetable Demand Met	Cost Savings	Jobs Created
16	41	752 euro/yr/hh	15

New Metric:
FARM SCORE

SITEWIDE ENERGY PERFORMANCE

BUILDING SYSTEMS

Residential: Hybrid (natural vent. + cooling)

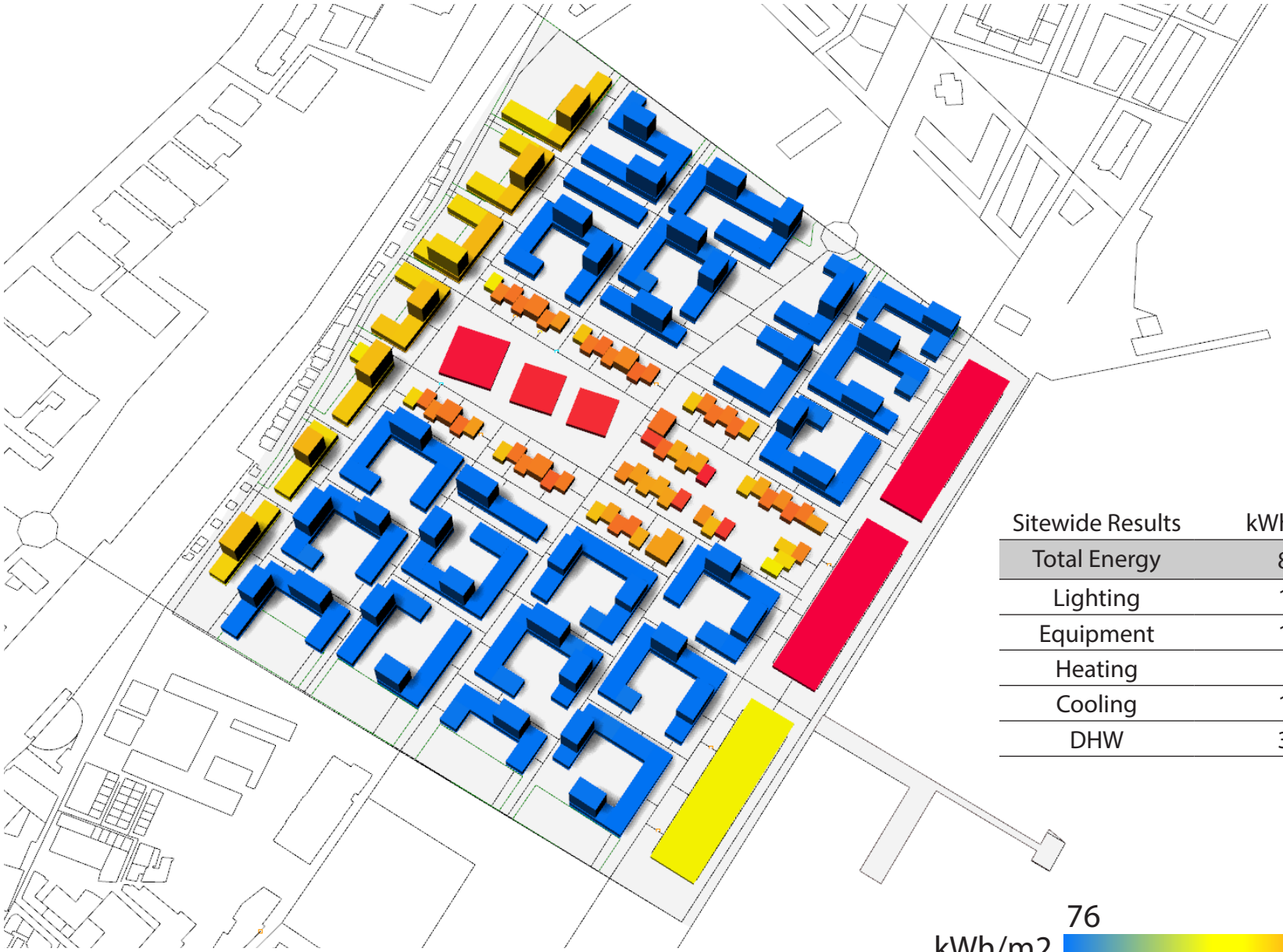
Office & School: Hybrid (natural vent. + cooling)

Retail: Cooling only

SETPOINTS (°C)

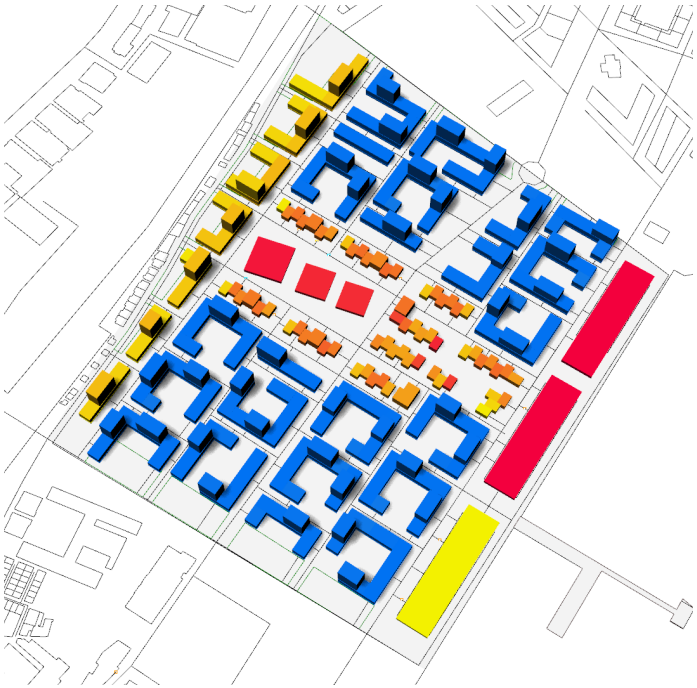
	Cooling	Heating	Natural Vent
Residential	24	18	20-24
Office & School	22	20	20-21
Retail	22	20	-

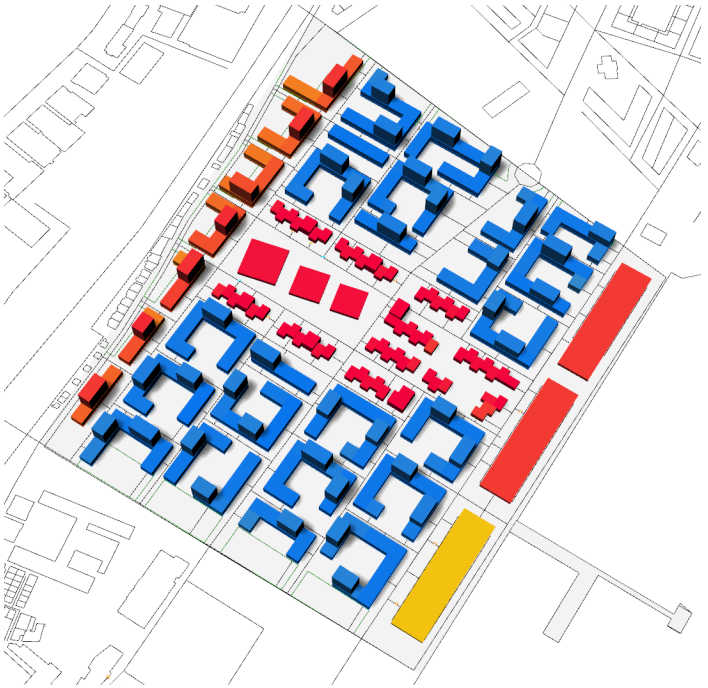
SITE EUI



Sitewide Results	kWh/m2
Total Energy	84
Lighting	19
Equipment	19
Heating	2
Cooling	12
DHW	32

CLIMATE CHANGE: 2016 VS 2080





Sitewide Results	2016 kWh/m2	2080 kWh/m2
Total Energy	84	88
Lighting	19	19
Equipment	19	19
Heating	2	0
Cooling	12	17
DHW	32	32
% Overheating Hours (25°C)	19%	33%

SITEWIDE DAYLIGHT POTENTIAL

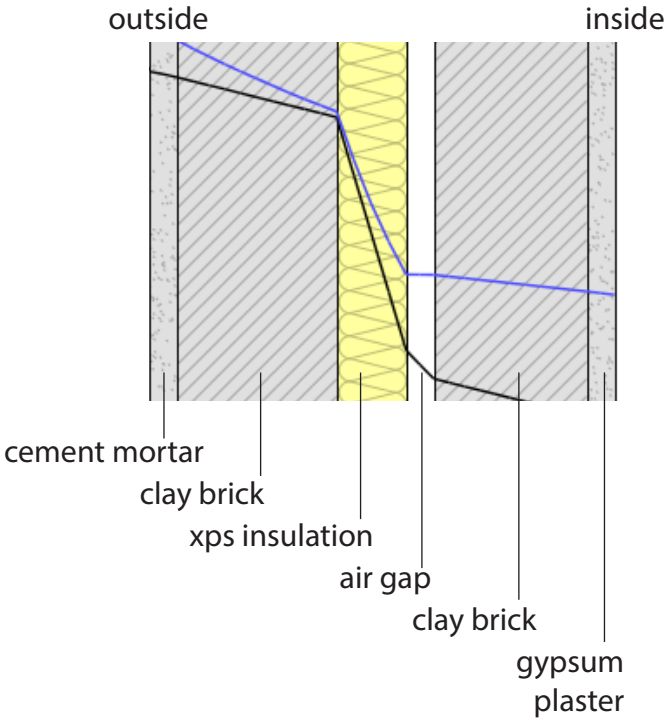
SITE DAYLIGHT POTENTIAL

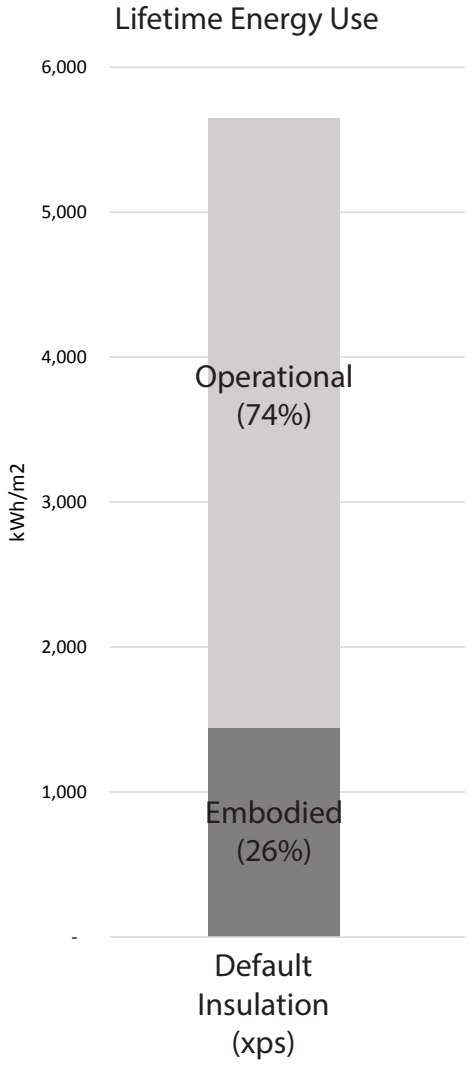
LIFECYCLE IMPACTS & COST

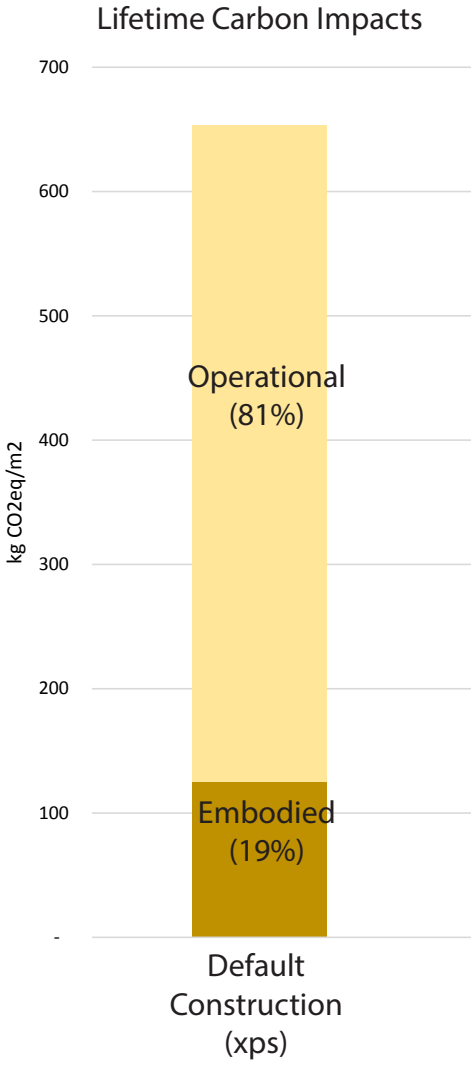
LIFECYCLE IMPACTS (50 YR)

Wall Construction

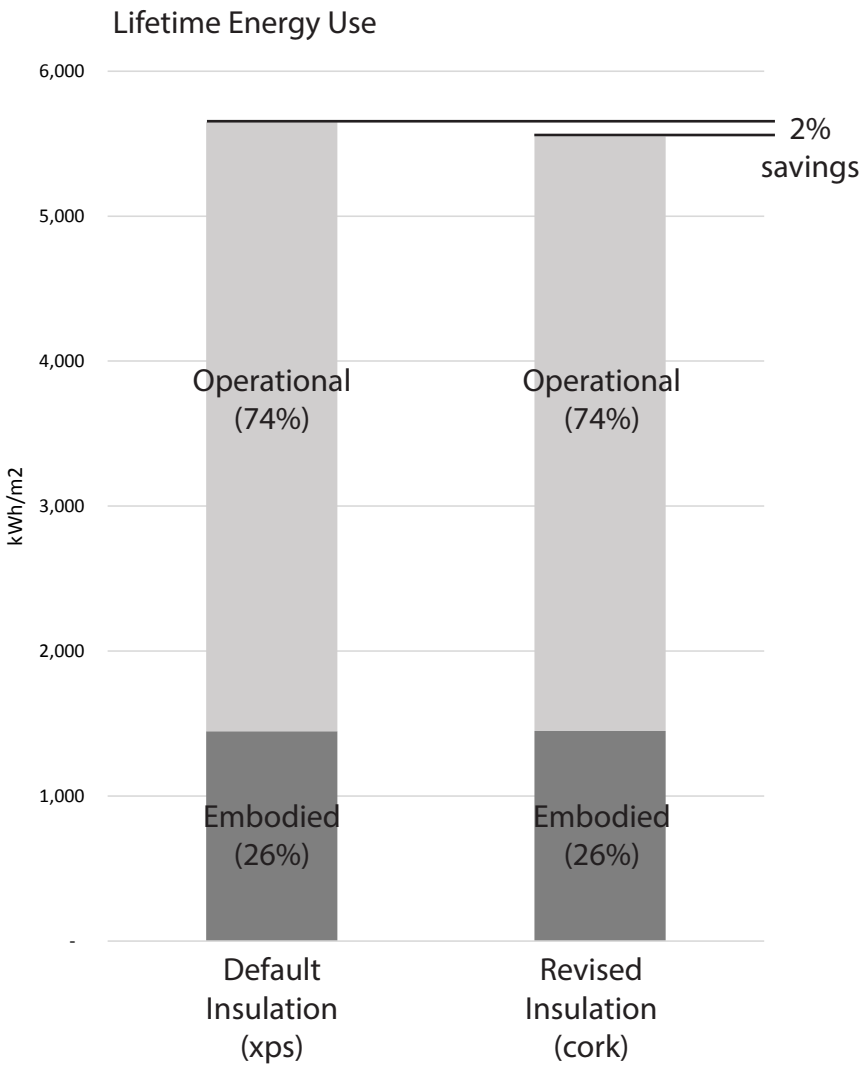
(u-value: 0.43 W/m2k)

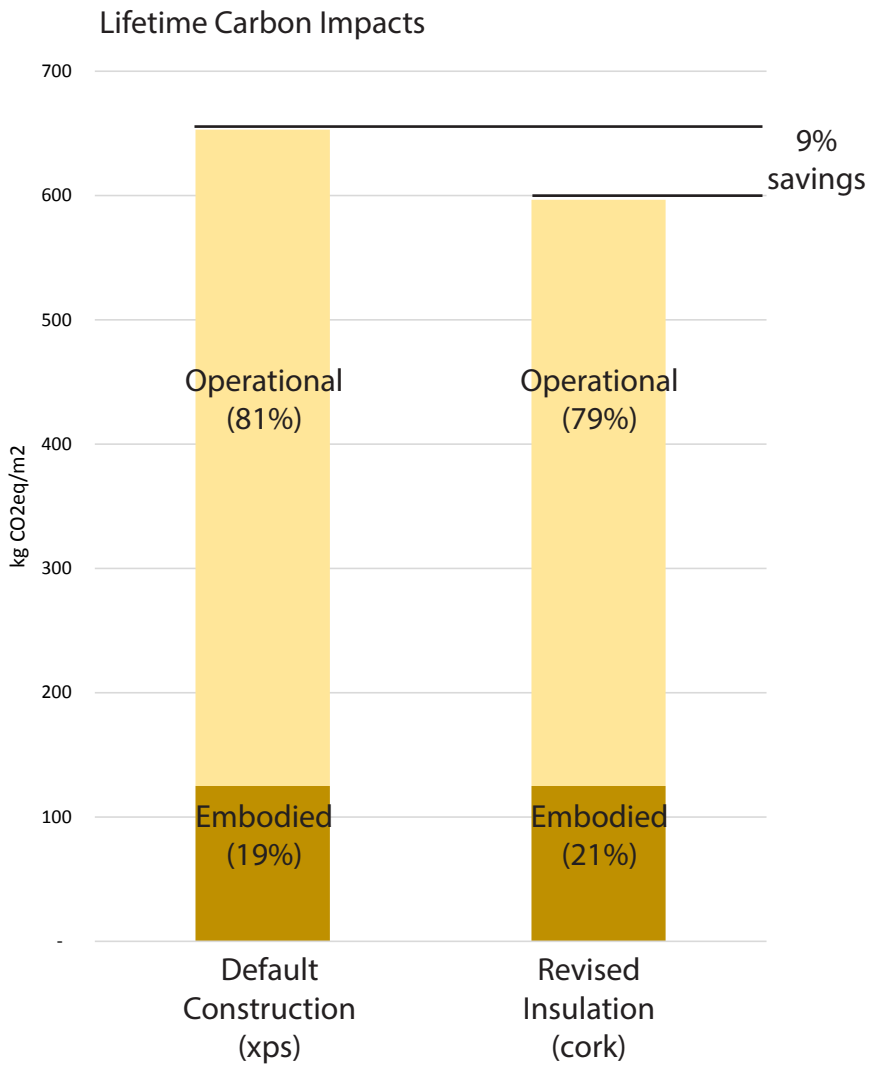






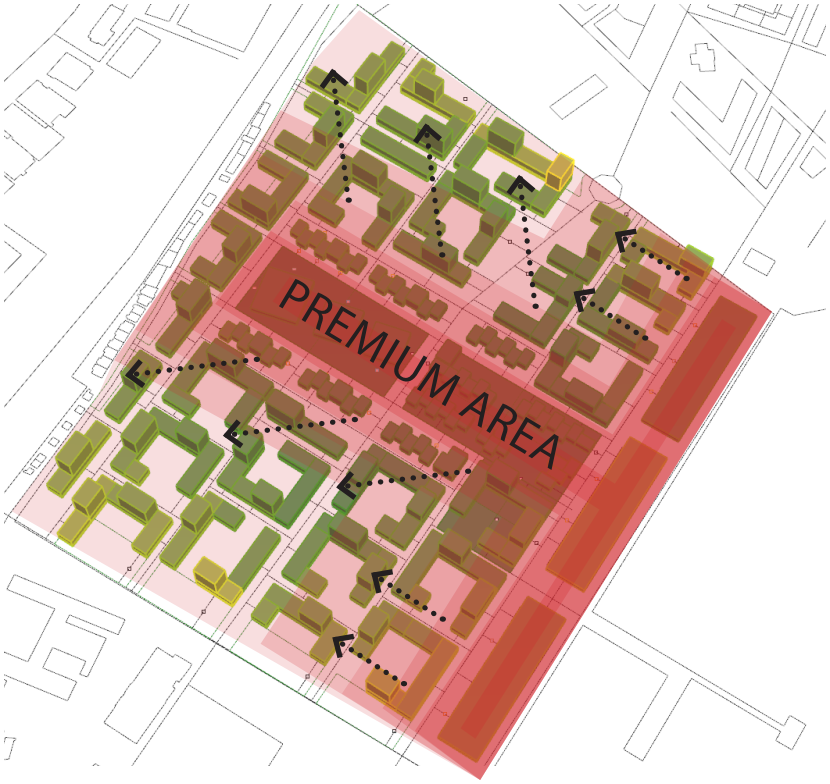
LIFECYCLE IMPACTS (50 YR), SUBSTITUTE: XPS (5cm) ⟶ Cork (7cm)





	EE (MJ/kg)	EC (kg Co2/kg)
xps insulation (5cm)	109	3.45
cork insulation (7cm)	4	0.19

SITE-WIDE FINANCE



POTENTIAL RETURNS

Walkability Premium	ROI (1-yr)	Added Annual Revenue
0% (no-premium)	7.95%	-
5%	8.42%	5.2M €
10%	8.88%	10.3M €

	costs/expenses				income
	Construction Costs (€/m2)	Total Energy Costs (€/yr)		Maintenance Costs (€/yr)	Rent (€/m2/yr)
		Electricity	Gas		
Residential	€ 2,200.00	7.1M €	0.08M €	23.7M €	€ 122.00
Office/School	€ 1,700.00				€ 218.00
Retail	€ 1,700.00				€ 1,060.00

WALKABILITY AND OUTDOOR COMFORT

WALKABILITY

ASSUMPTIONS

MOBILITY RADIUS 300m

AMENITIES

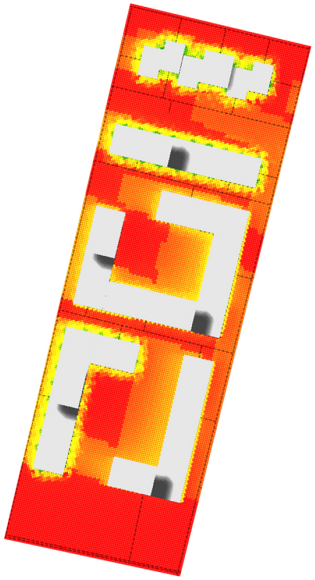
	Global weight	Destination weights
FOOD		
Grocery store	3	1
Community garden	2	1
OTHER SERVICES		
Restaurant	3	50, 30, 20
Coffee	2	80, 20
Shopping	1	1
Bank	1	1
School	1	1
RECREATION		
Park	2	1
Entertainment	1	1
TRANSPORTATION		
Bus stop	2	1
Bike hub	2	1

WALKABILITY SCORE
88%

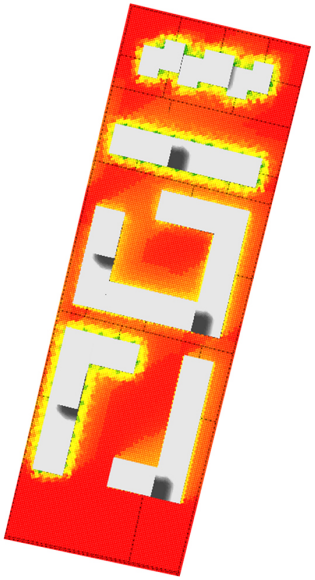
OUTDOOR COMFORT (UTCI)

MARCH

9:00 AM

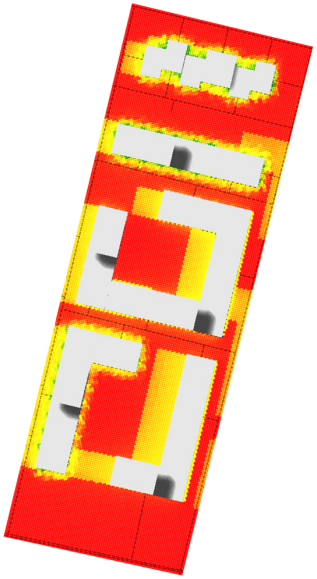


4:00 PM



AUGUST

9:00 AM



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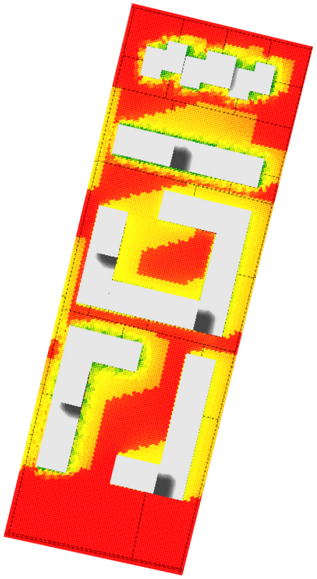


SCORECARD

ALFACINHA

LISBON

Land area (m2)	**272,700**
Building area (m2)	**435,400**
Residents (pp/m2 land)	**0.027**
Workers (pp/m2 land)	**0.017**

*occupancy values exclude retail spaces

84
kWh/m2y
OPERATION ENERGY

5,647
kWh/m2
EMBODIED ENERGY (50y)

653
kgCO2/m2
BUILDING GHG EMISSIONS (50y)

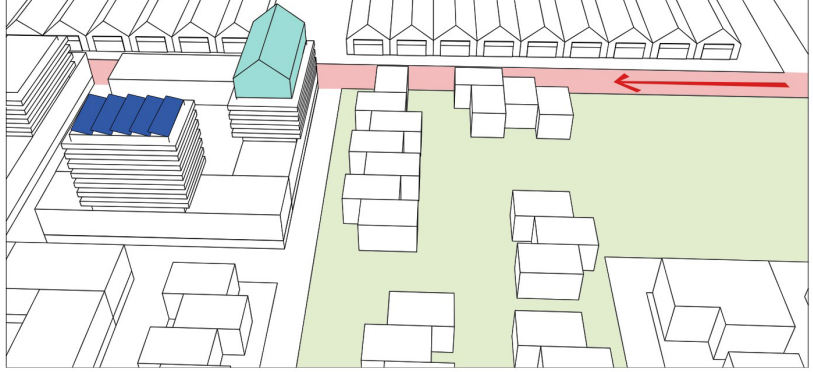
46
% DA
DAYLIGHT AREA

88
% WS
WALKABILITY SCORE

8.4
% ROI
FINANCIAL RETURN (1y)

41
% FS
VEGGIE DEMAND

FINAL THOUGHTS



ALFACINHA

translation: (1) little lettuce; (2) nickname for a native of Lisbon used by Tripeiros (tripe-eaters) from the north