‘The Bornova (Izmir) Roadshow’

4th April to 8th April 2016

The Bornova City Archive & Museum
& Yasar Universitesi

For more information on how to get involved with the Bornova (Izmir) Roadshow, and to contribute to a sustainable City Vision contact:

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Roadshow Coordinator
See link: http://www.cityzen-smartcity.eu

CITYZEN INVOLVEMENT

The goal is to **motivate** and **empower end-users** to a long term energy saving attitude via:

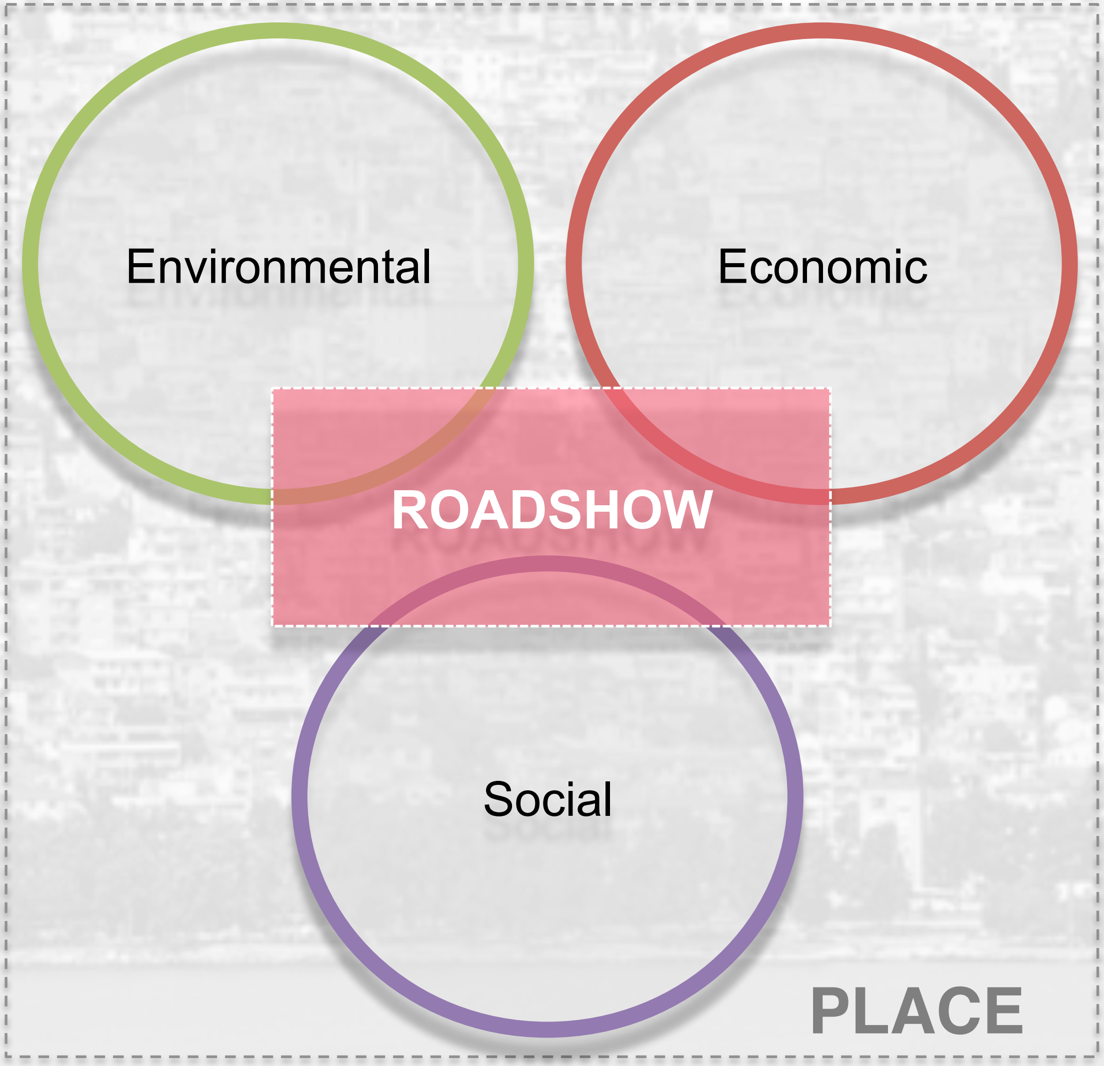
- serious games
- an energy savings challenge
- monitoring their own energy
- retrofitting houses
- usage of district heat and cold sources
- using an electrical car to store energy
- using home batteries to increase self consumption of solar power

- **Roadshow**

1. THE ROADSHOW

BACKGROUND

- Context for roadshow:
  The Trias Energetica



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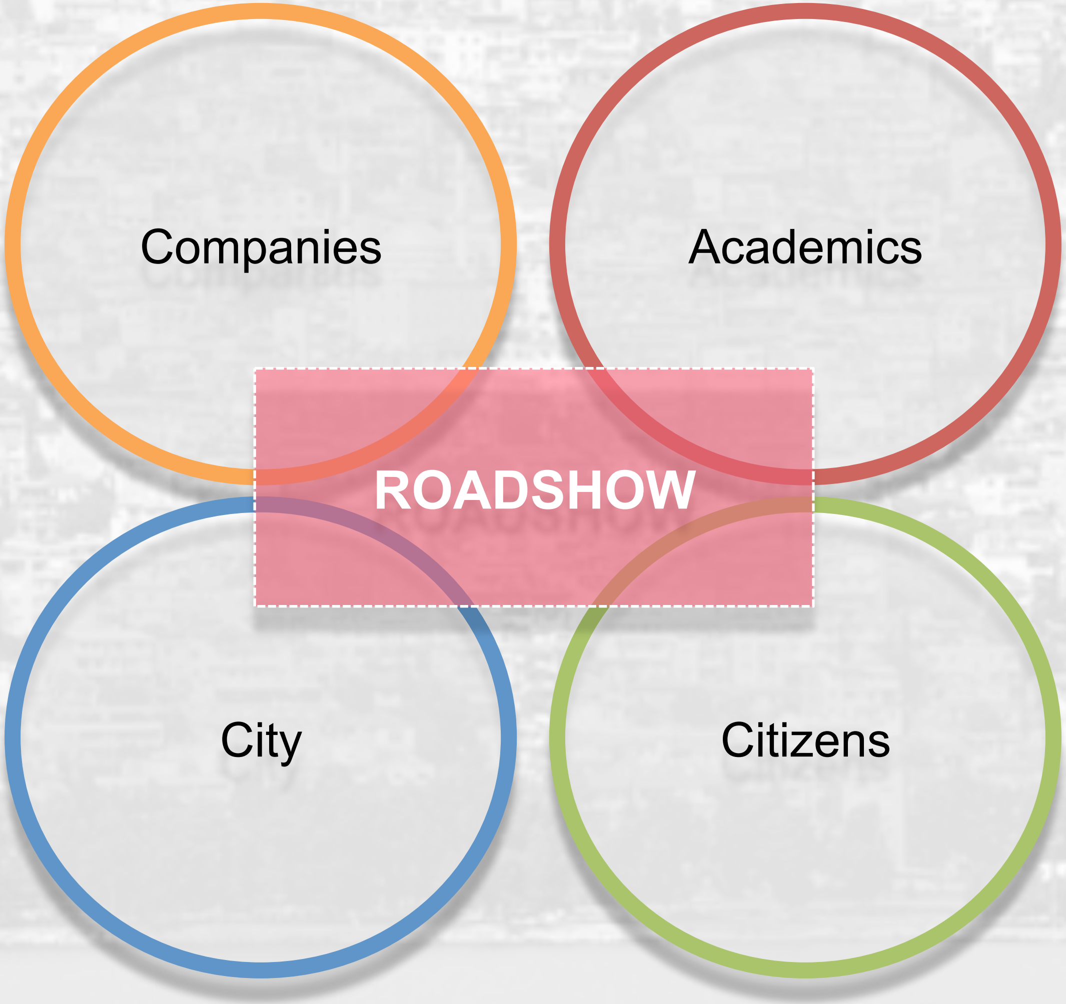
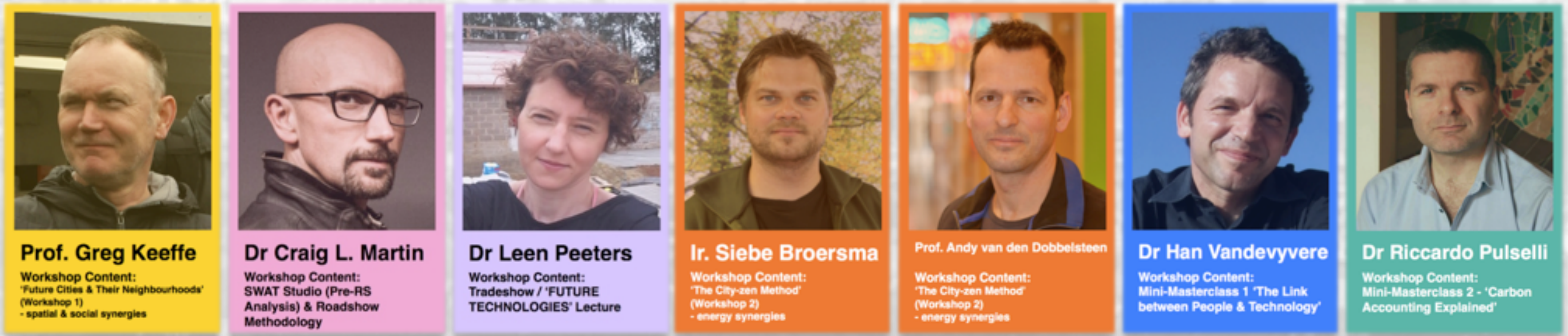


1. THE ROADSHOW

THE 'ROADIES':

- Travelling with the Roadshow is an experienced team of internationally renowned sustainability experts, whose specialisms will combine with multidisciplinary stakeholder groups and students from each hosting city.



1. THE ROADSHOW

BACKGROUND

- Roadshow activities & events over the 5 Day programme include:

  Energy Mapping

  Design workshops

  Mini-Masterclasses

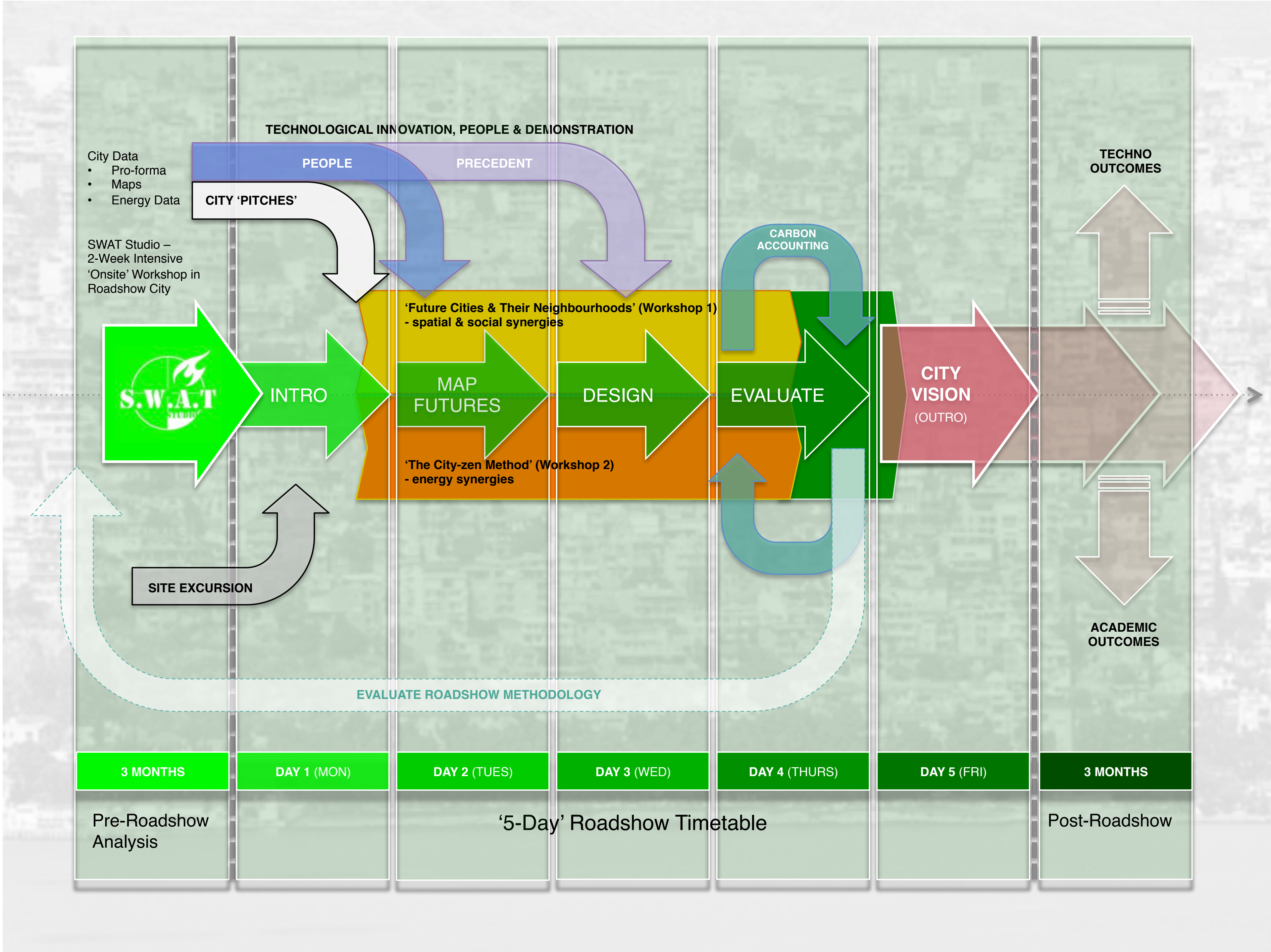
  Future Innovation Technology lectures

  Tradeshows

  Carbon Accounting

  Serious Gaming

  ITS NOT A COMMUNITY CONSULTATION SESSION!


TECHNOLOGICAL INNOVATION, PEOPLE & DEMONSTRATION
City Data
• Pro-forma
• Maps
• Energy Data
SWAT Studio –
2-Week Intensive
'Onsite' Workshop in
Roadshow City
PEOPLE
PRECEDENT
CITY 'PITCHES'
TECHNO
OUTCOMES
CARBON
ACCOUNTING
'Future Cities & Their Neighbourhoods' (Workshop 1)
- spatial & social synergies
S.W.A.T
INTRO
MAP
FUTURES
DESIGN
EVALUATE
CITY
VISION
(OUTRO)
'The City-zen Method' (Workshop 2)
- energy synergies
SITE EXCURSION
ACADEMIC
OUTCOMES
EVALUATE ROADSHOW METHODOLOGY
3 MONTHS
DAY 1 (MON)
DAY 2 (TUES)
DAY 3 (WED)
DAY 4 (THURS)
DAY 5 (FRI)
3 MONTHS
Pre-Roadshow
Analysis
'5-Day' Roadshow Timetable
Post-Roadshow

1. THE ROADSHOW – DAILY ACTIVITIES

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THE ROADSHOW – DAILY ACTIVITIES

- Impactful Academic, Technical & Societal Outcomes
- Final Presentation to a High-ranking Audience
- Methodologies for design collaborations & working processes
- A City agenda, not a blueprint.
- A ‘City Vision’, facilitated by the Roadshow, but holistically ‘owned’ by the City and its citizens.

Future Cities & Their Neighbourhoods' (Workshop 1)
- spatial & social synergies

THE CHALLENGE

- THE CITY
- NEXT GENERATIONS
- CHALLENGES
  - Local
  - Global
- INFRASTRUCTURES
  - Mobility
  - Green
  - Energy
  - Water
  - Food

Dangerous crossroads

Unused pedestrian routes

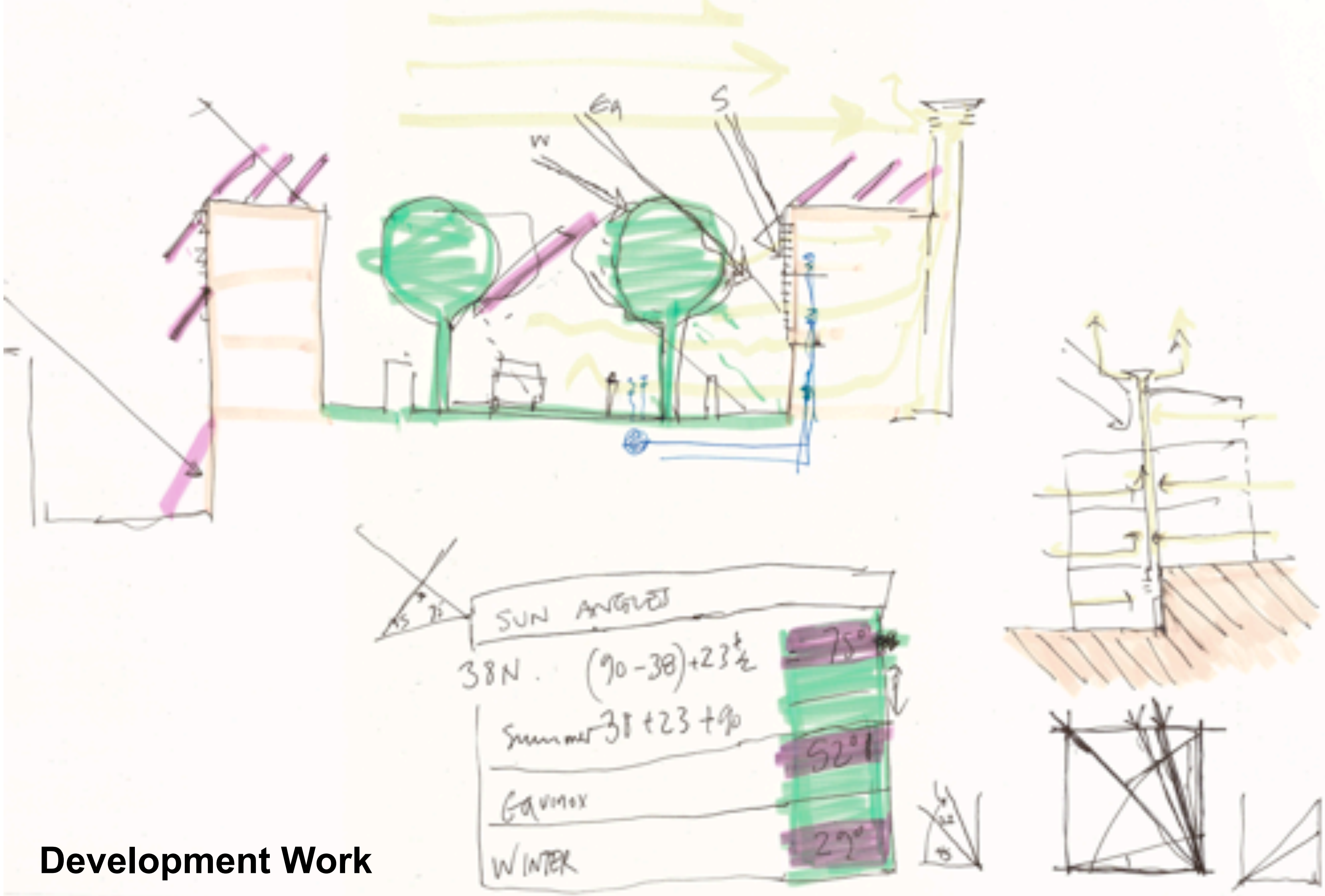
Devoid of pedestrian routes

Ineffective pedestrian routes

No green in family park

Unused potential of green areas

The pedestrian is disadvantaged



Development Work

Development Work

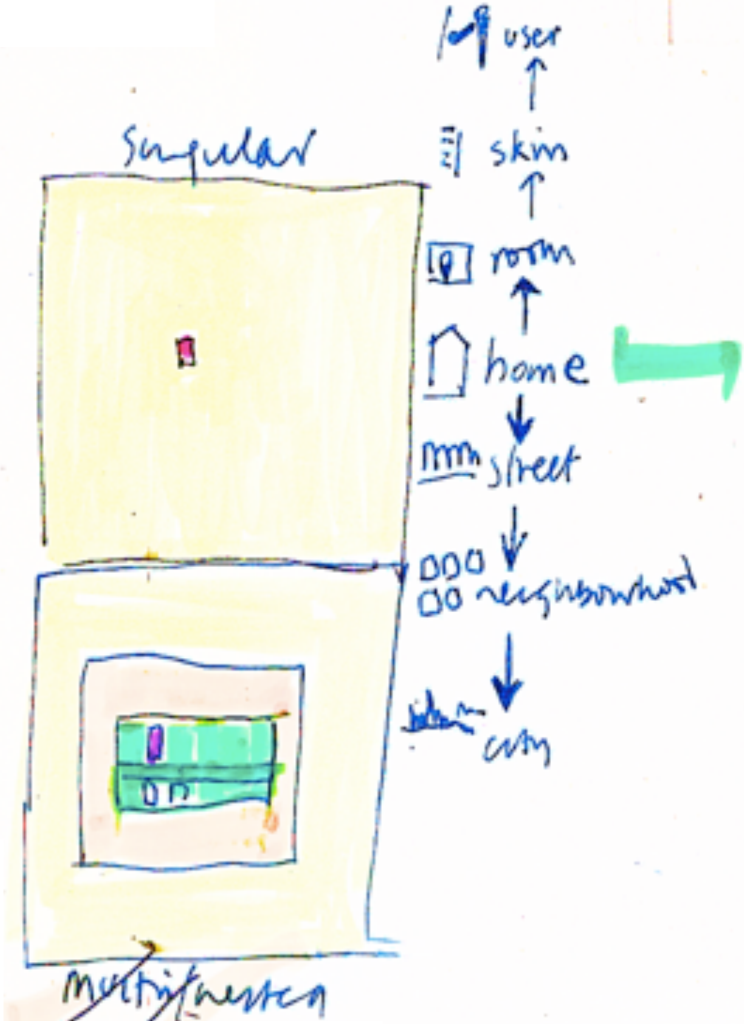
Development Work

Development Work

Development Work

- Urban design happens at several scales,
- Key is at the moment infrastructure.

- Infrastructure comprise Policy and Form creation at various scales.
-
- A main aim is to create a series of Policies that embody good behavior that leads to form within the existing context.



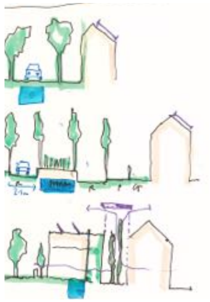
Urban strategy

THE AIMS

- RAPID CARBON DECENT
- 5 KEY AREAS BEING:

  A. MOBILITY
  B. ENERGY USE
  C. WATER
  D. FOOD
  E. MATERIALS

- Concrete responsible for Climate Change, Careful management of its use is critical.

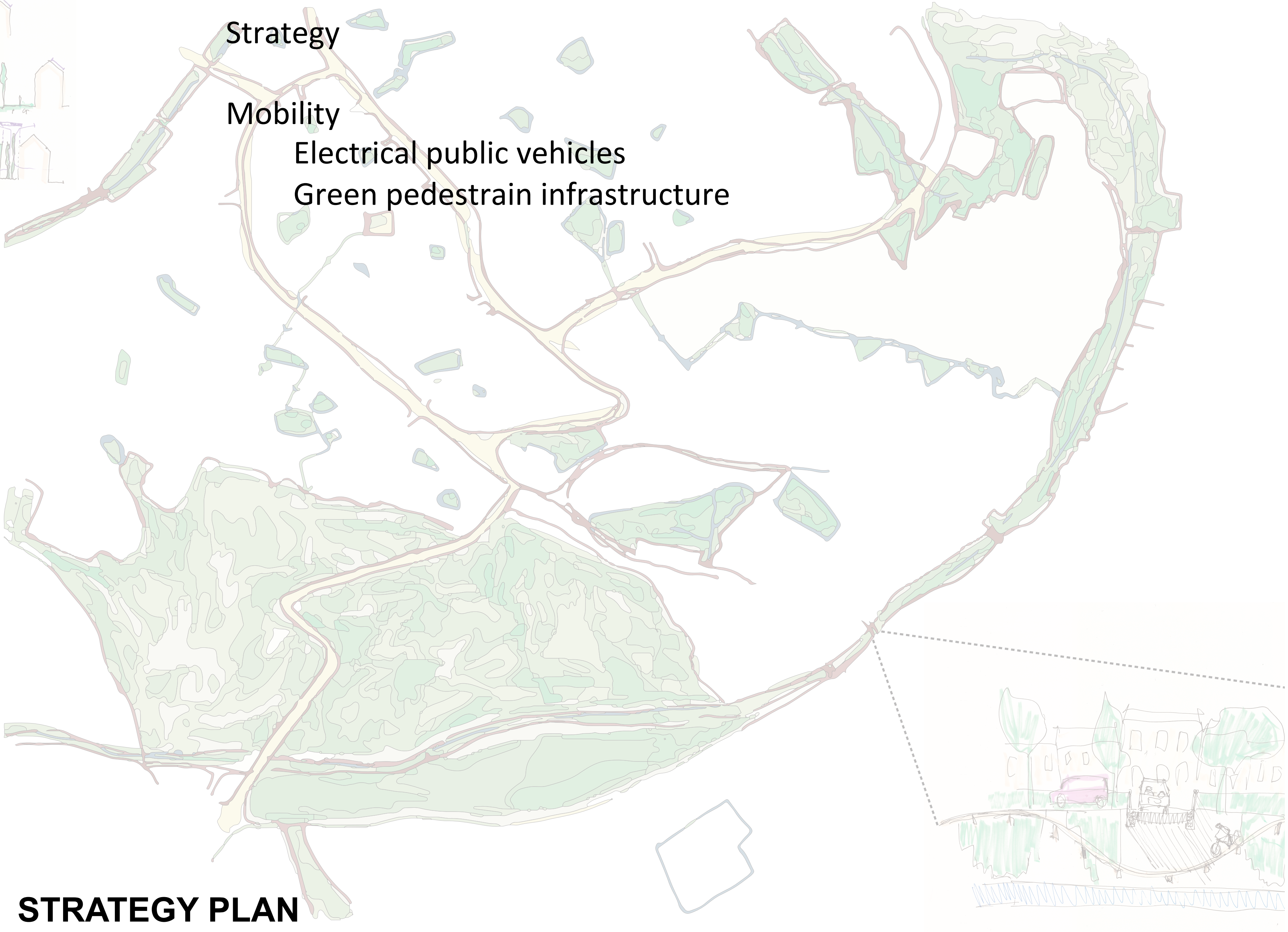


STRATEGY PLAN

Strategy

Mobility

- Electrical public vehicles
- Green pedestrain infrastructure



STRATEGY PLAN

Green Block Facade

‘Illicit planning gain’ - Energy Amnesty

Illegal development is impossible to stop…

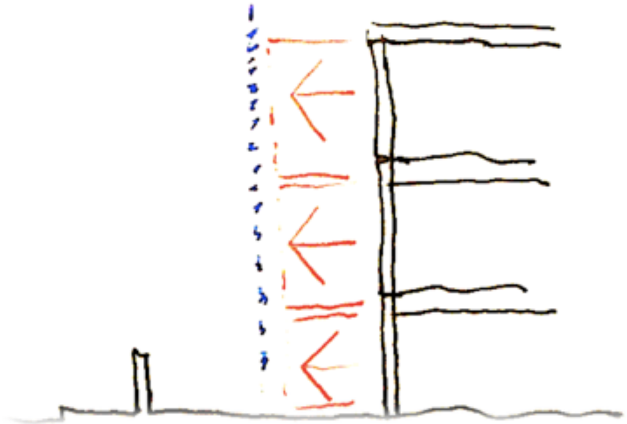
So work with it by getting residents to build sustainable infrastructure for the city.

Compliance granted to people who create common benefits.

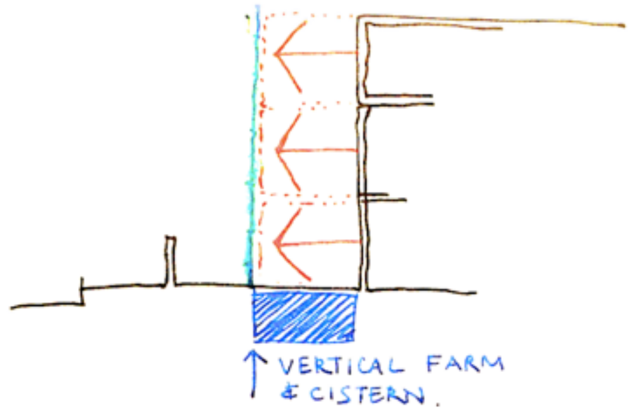
Benign Facades.

Houses can be extended forwards towards the street by 3m if.

1. Residents build a passively-cooled street façade



2. Residents develop a vertical farm façade



The space between the existing house and the façade, can then be occupied by the householder.

Super-roof

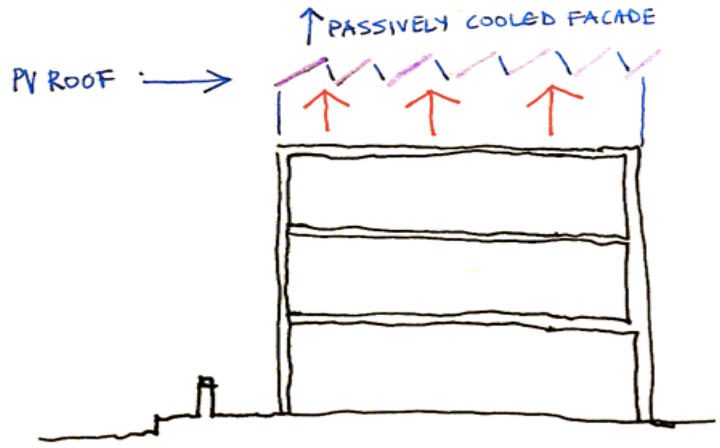
An extra 3 metre height can be gained by:

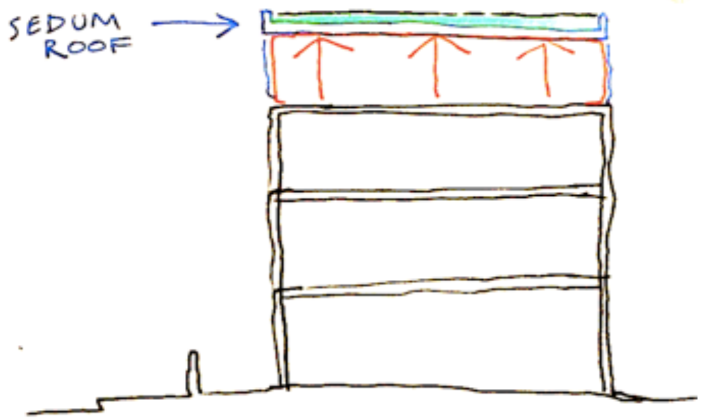
1 Building a Photovoltaic roof

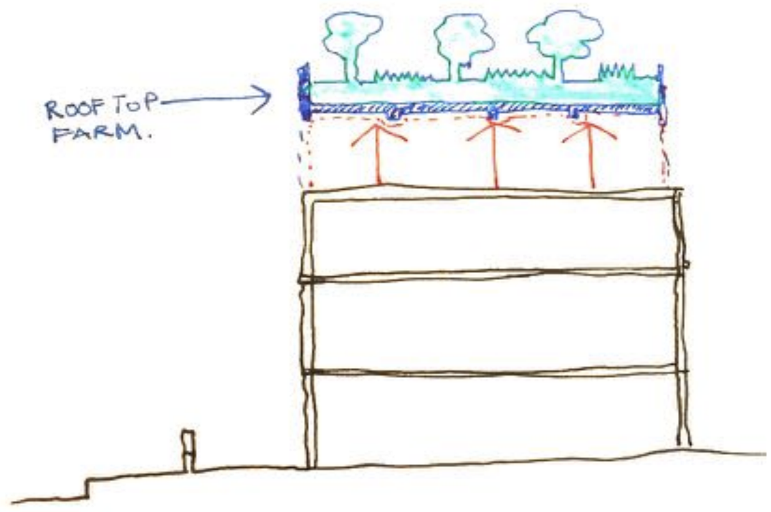
2 Installing a sedum or turf roof

3 Creating a roof-top urban farm

The space under this new surface can then be occupied by the householder

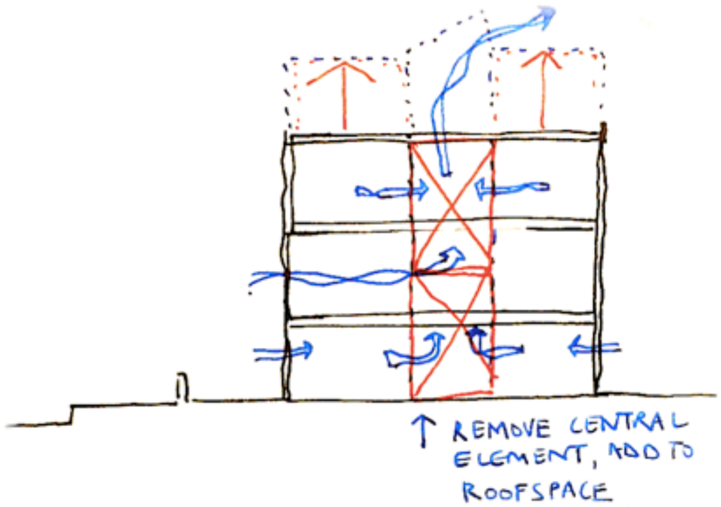






Ventilation voids

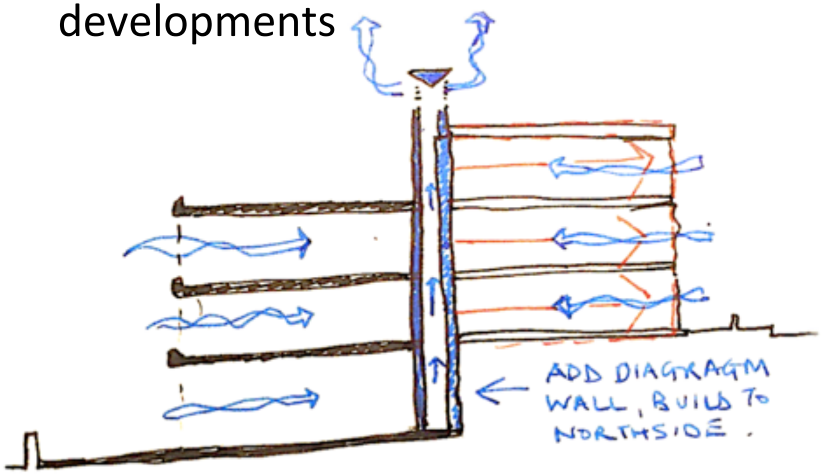
Areas that encourage stack or wind assisted ventilation:

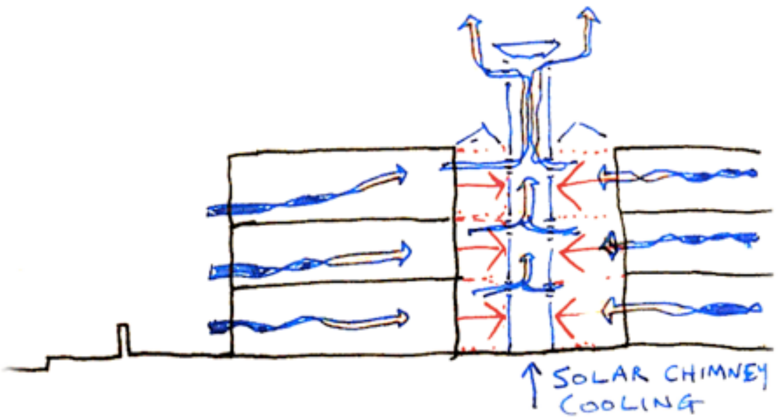


1 Can be exempt from planning volumes

2 Can be used as occupiable space

3 Can be used as structure for back-to-back developments





Illicit gains.

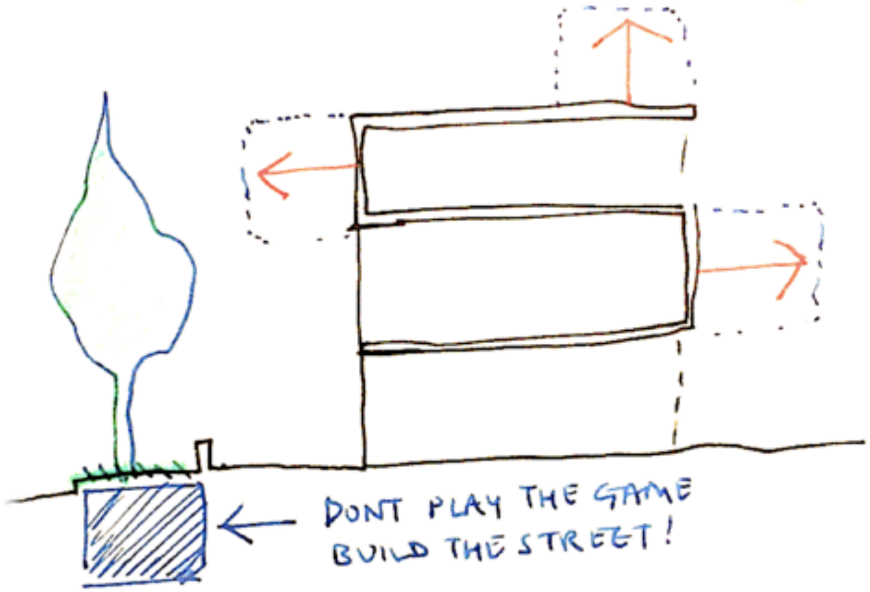
Constructions that do not meet the above, can gain approval through:

1 Street canopy development (street trees)

2 Creating Urban farming infrastructure

3 Greening by perforating the street surface

4 Cistern construction for grey/rain water storage.



CITY VISION

Block façade existing

Block façade Legal

CITY VISION

Green Block Facade

Land swap – green infrastructure

Small vacant land parcels in the city should be swapped with City-owned land elsewhere, more suitable for development.

These small land parcels should be developed into green infrastructure: These 'Pocket parks' will include

1. Water storage:
2. Public space
3. Play space
4. Green refuge
5. Transpirational anti-heat island – super cooler

6. Every resident should be within 200m of a pocket park

Land-swap Pocket park infrastructure

Bornova

Energy scenarios

Problem statement

How much energy is being lost, and how much can we produce on site?

(an example)

CITY-zen

EXAMPLE: VENTILATION LOSSES

A typical Bornova dwelling unit loses 46 kWh/day by ventilation

How much energy is that on a yearly basis, taking into account heating and cooling?

Foodstuff	**Energy content** (kWh/kg or kWh/l)	**Unit**	**Ventilation losses on yearly basis** (120 heating & cooling days)
Chocolate	6.6	chocolate bars	9324
Chips	6.3	bags of chips	5160
Snickers	5.6	Snickers	19680
Pinda	6.9	bags of pinda	4560
Cola	0.5	bottles of cola	10560

EXAMPLE: VENTILATION LOSSES

A typical Bornova dwelling unit has 46 kWh/day ventilation losses

How much energy could we produce on a 100 m² roof filled with PV panels?

Foodstuff	Energy content (kWh/kg or kWh/l)	Unit	Ventilation losses on yearly basis (120 heating & cooling days)	PV yearly yield on typical roof of 100 m² = 18700 kWh
Chocolate	6.6	**chocolate bars**	9324	**31587**
Chips	6.3	**bags of chips**	5160	**17480**
Snickers	5.6	**Snickers**	19680	**66670**
Pinda	6.9	**bags of pinda**	4560	**15448**
Cola	0.5	**bottles of cola**	10560	**35774**

Problem statement

What is the Bornova environmental performance?

(Carbon Footprint)

CITY-zen

BORNOVA (IZMIR) HOUSEHOLD

households 4
avg floor area 100 m^2
avg built area 100m^2

ENERGY **3.78 t CO_2eq**

electricity demand 5200 kWh/yr
heat demand 7570 kWh/yr
gas for heating (100% of households) 986 m^3/yr

CF electricity = 2488 kg CO2eq
CF heating syst. = 1291 kg CO2eq

WASTE MANAGEMENT **1.5 t CO_2eq**

waste production 1503 kg/yr
waste to landfill 70%
waste to energy 0%
waste to recycling & compost 30%

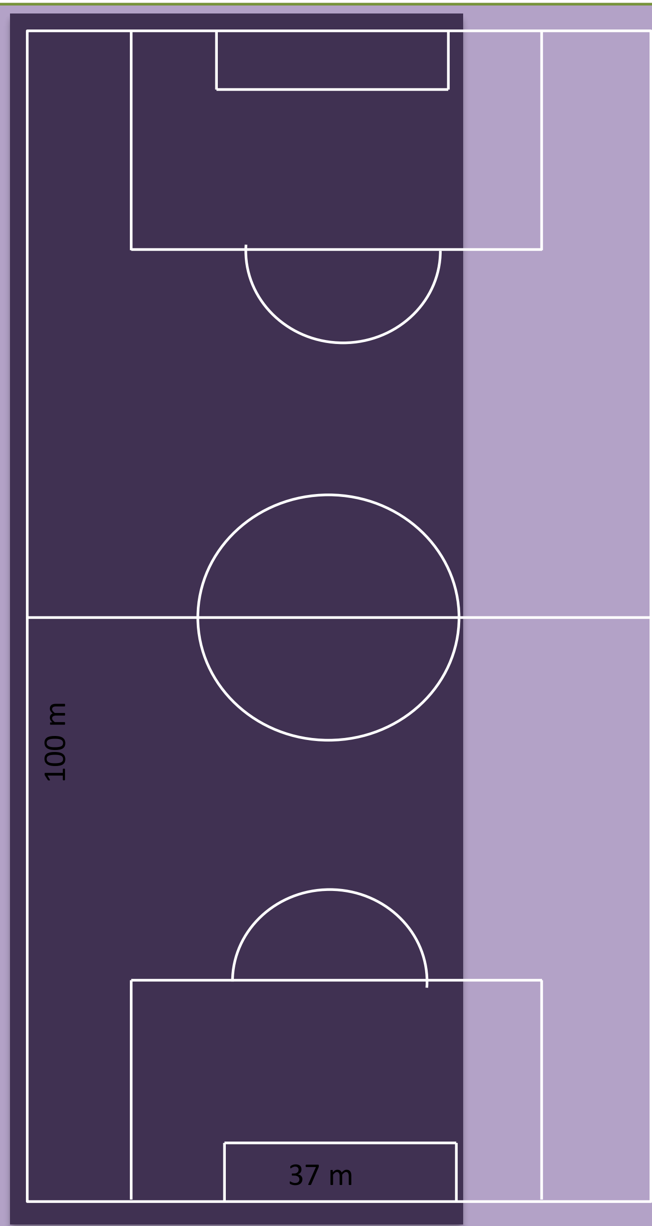
WATER USE **0.06 t CO_2eq**

water use 96 m^3/yr
i.e. 65L/day per capita

CO_2eq | **CARBON FOOTPRINT** **5.04 t CO_2eq/yr**

CARBON FOOTPRINT OFFSET

carbon uptake by urban forestry (i.e. 1.35 kg CO_2/m^2)



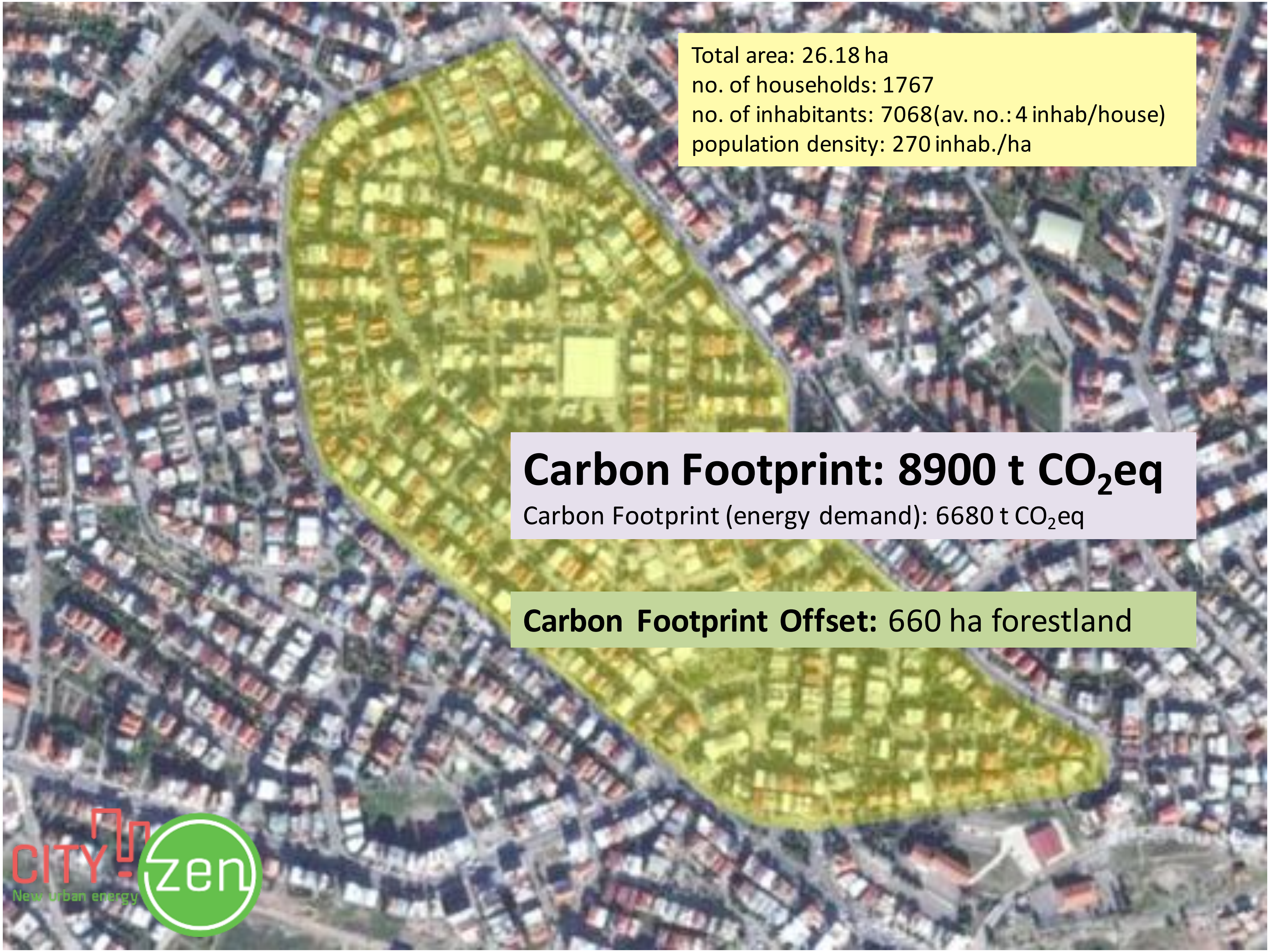
CARBON FOOTPRINT = 5.04 t CO_2eq

CARBON OFFSET = 3737 m^2


CITY-zen
New urban energy


CITY zen
New urban energy


Total area: 26.18 ha
no. of households: 1767
no. of inhabitants: 7068(av. no.: 4 inhab/house)
population density: 270 inhab./ha
CITY-zen
New urban energy

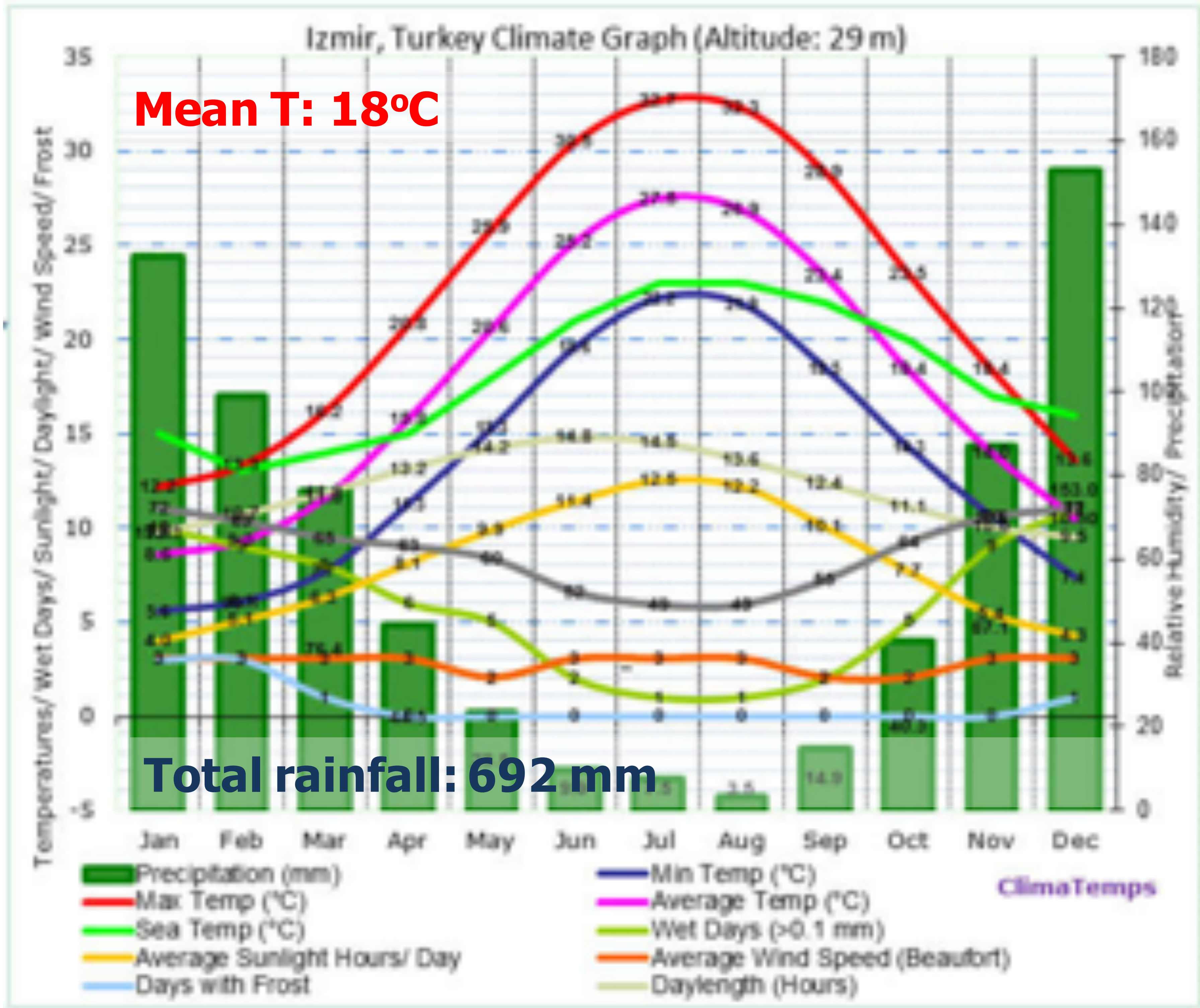


Total area: 26.18 ha
no. of households: 1767
no. of inhabitants: 7068(av. no.: 4 inhab/house)
population density: 270 inhab./ha
Carbon Footprint: 8900 t CO_2eq
Carbon Footprint (energy demand): 6680 t CO_2eq
Carbon Footprint Offset: 660 ha forestland
CITY-zen
New urban energy


26 ha built area
Carbon Footprint
8900 t CO_2eq
30 ha green area
Carbon Footprint Offset
405 t CO_2eq
= 5% CF
CITY-zen
New urban energy

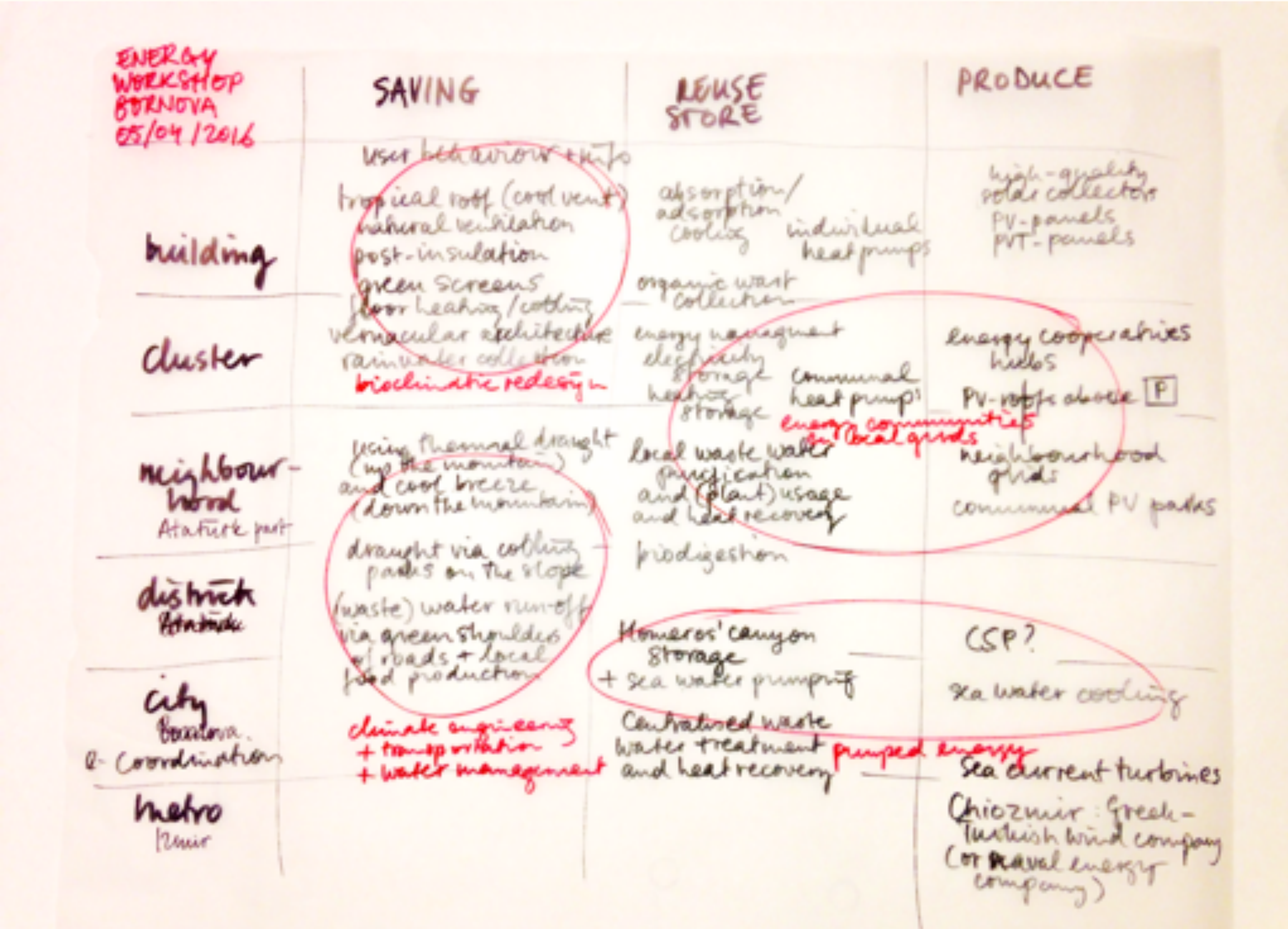

1,4km
Carbon Footprint Offset: 660 ha of forestland
CITY-zen
New urban energy

STARTING CONDITIONS

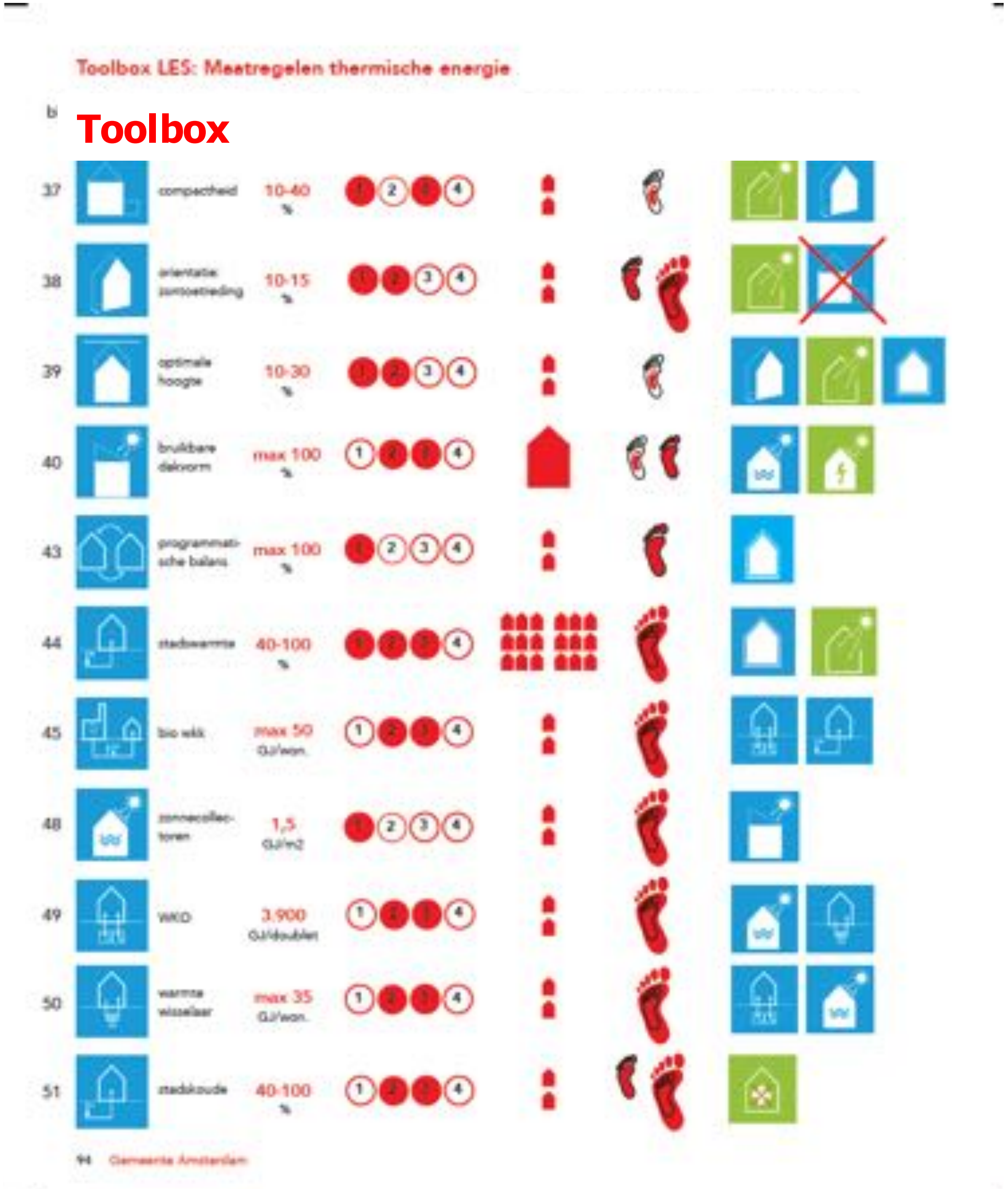


Izmir, Turkey Climate Graph (Altitude: 29 m)
Mean T: 18ºC
Total rainfall: 692 mm
Temperatures/ Wet Days/ Sunlight/ Daylight/ Wind Speed/ Frost
Relative Humidity/ Precipitation/
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Precipitation (mm)
Max Temp (°C)
Sea Temp (°C)
Average Sunlight Hours/ Day
Days with Frost
Min Temp (°C)
Average Temp (°C)
Wet Days (>0.1 mm)
Average Wind Speed (Beaufort)
Daylength (Hours)
ClimaTemps

Bornova energy interventions scheme



Final goal: İzmir energy guidelines



Concept:

1. **Different scale levels** of agglomeration, each one accommodating its most suitable technological and process-wise set up.
2. **Passive (energy efficiency) and active (renewable) energy measures** at every scale level, preferably combined with water, materials and community-related issues.
3. **The most appropriate level of application** shall be chosen in consultation with all parties, depending on the opportunities (budget, stakeholders, regulatory issues, …).

Scenarios for change

What can we do both about energy losses and producing energy on site?

(‘Bornova energy interventions’)

New Stepped Strategy

1. **Reduce (the demand)**
   - User behaviour
   - Bioclimatic design
   - Passive design measures

2. **Reuse (waste energy)**
   - Heat recovery
   - Functional programming
   - Energy exchange
   - Storage
   - Smart energy management

3. **Produce (renewable energy)**
   - Solar energy
   - Soil energy
   - Water
   - Biomass

REDUCE THE DEMAND

- **User behaviour**
  - ❑ Information, guidelines
  - ❑ Stimulation, correction
- **Bioclimatic design**
  - ❑ Temperatures: mean temperature, seasonal differences, diurnal differences
  - ❑ Sun: solar course in different seasons, solar intensity, admission or obstruction
  - ❑ Air: wind directions, wind forces, thermal draughts, cool breezes
  - ❑ Water: rainfall throughout the seasons, evaporation, humidity
  - ❑ Earth: soil build-up, constitution, ground water table, aquifers
- **Passive design**
  - ❑ Orientation: north-south, east-west
  - ❑ Internal zoning: north-south, above-below, depending on the function
  - ❑ Compartmentalisation: isolation of rooms with special demands
  - ❑ Facades: thermal insulation, permeability, mass, albedo
  - ❑ Roofs: pitched/flat, thermal insulation, mass, albedo, tropical roof
  - ❑ Shading: overhangs, screens, blinds, green

REUSE RESIDUAL ENERGY

- **Heat recovery**
  - from exhaust air (air → air via heat exchanger; air → water via heat pump)
  - from waste water (water → water, via shower heat exchanger or heat pump)
- **Functional programming**
  - Energy balance between urban functions or functions in a building complex
- **Energy exchange**
  - Inter-exchange of surpluses and shortages between buildings
  - Heat cascading between urban functions
- **Storage**
  - Heat: high-caloric (60+ degrees), low-caloric (25-55 degrees)
  - Cold (5-20 degrees)
  - Electricity: batteries, electric vehicles, water storage
- **Smart energy management**
  - Attuning supply and demand
  - Energy programming and switching, peak-shaving

PRODUCE RENEWABLE ENERGY

- **Solar energy**
  - Photo-voltaics, building-integrated PV, PVT
  - Solar heat: collectors, façade or roof heat collection, road collectors
- **Soil energy**
  - Heat exchange with soil/ground (mean annual temperature)
  - Storage of heat and cold (in aquifers)
  - Geothermal heat (high-caloric)
- **Water**
  - Heat exchange (rivers, lakes, sea)
  - Hydro-electric (storage of excess electric energy)
- **Biomass**
  - Bio-organic waste for bio-fermentation to biogas
  - Waste water to biogas, or via algae to biodiesel

New buildings

- **Construction**
  - ❑ Concrete structure
  - ❑ Porous bricks
  - ❑ Cellular concrete blocks
- **Insulation**
  - ❑ Structure covered with 3-4 cm of styrofoam (against thermal bridging)
  - ❑ No insulation added to porous bricks or cellular concrete blocks
  - ❑ Façade covered with plaster

❑ **Balconies**
  - ❑ A lot of balconies

Future houses

STRATEGY

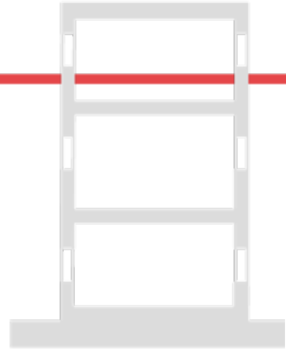
- **Solar, solar, solar**
  - İzmir: one of the best locations for solar energy
  - Energy saving (often difficult) becomes less urgent
  - Solar will make İzmir independent from centralised fossil energy
  - Converted solar energy will decrease urban temperatures

- **Large-scale active solar**
  - Large PV roofs: market square, industrial buildings
  - PV fields on steep slopes of the Atatürk ice-skate park
  - Elevated tropical PV roofs on houses
  - Vertical PV on facades/on glass?
  - Building-integrated solar collectors

- **Heat pump systems**
  - Fed by PV power
  - Air-, water- or (best:) ground-source
  - Coupled to floor heating/cooling (good when there are air leakages)

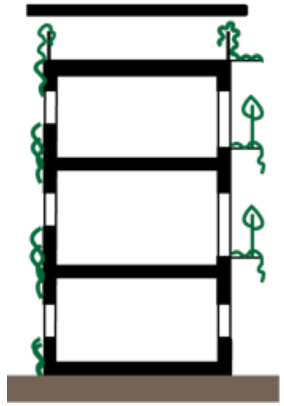
BUILDING SCALE

BORNOVA ENERGY INTERVENTIONS



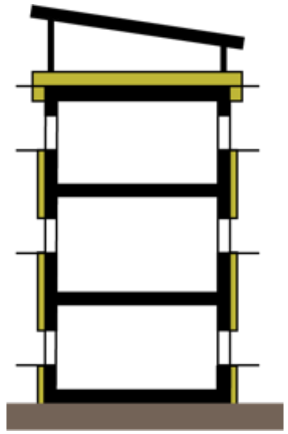
Level 1: the individual dwelling unit (apartment, house)

Passive measures:



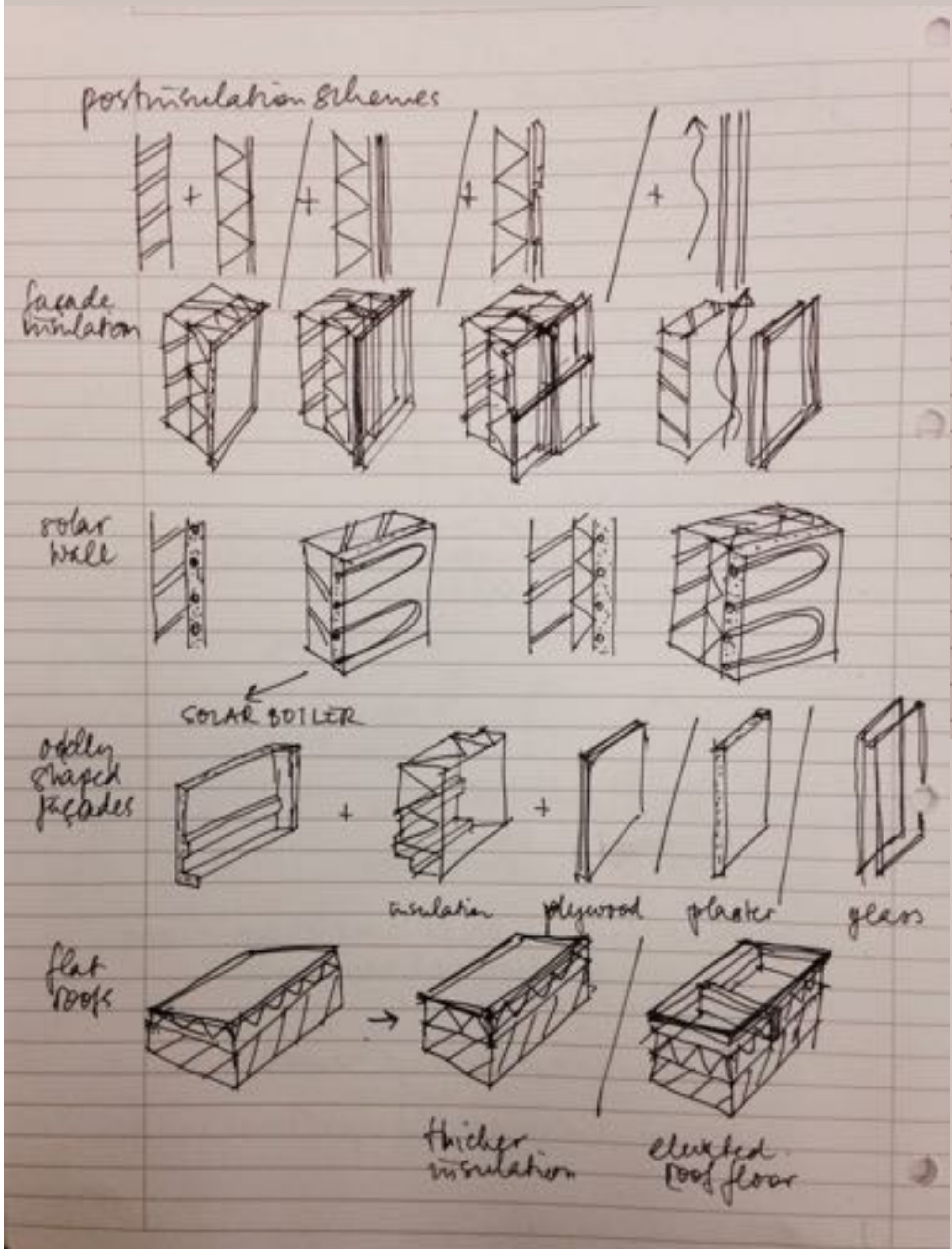
- Roof and facade shading measures
- Greening (roofs, facades & blind walls, balconies, private outdoor spaces)
- Retrofit insulation: (1) roofs, (2) windows, (3) facades

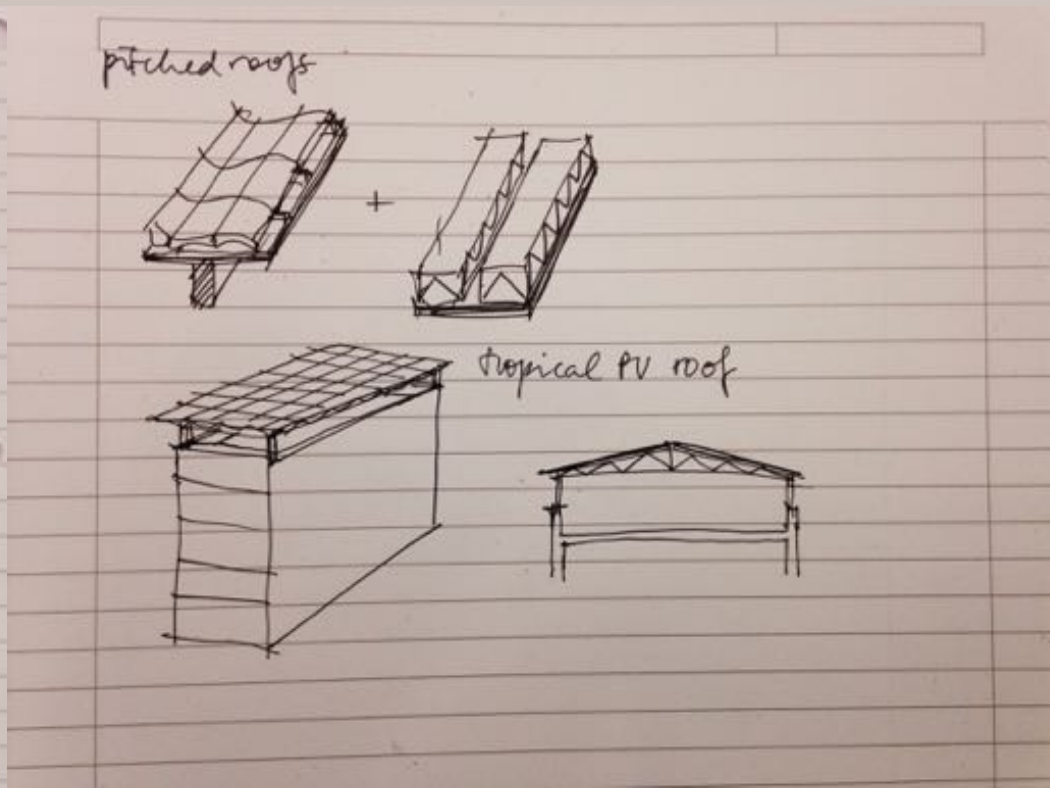
Active measures:



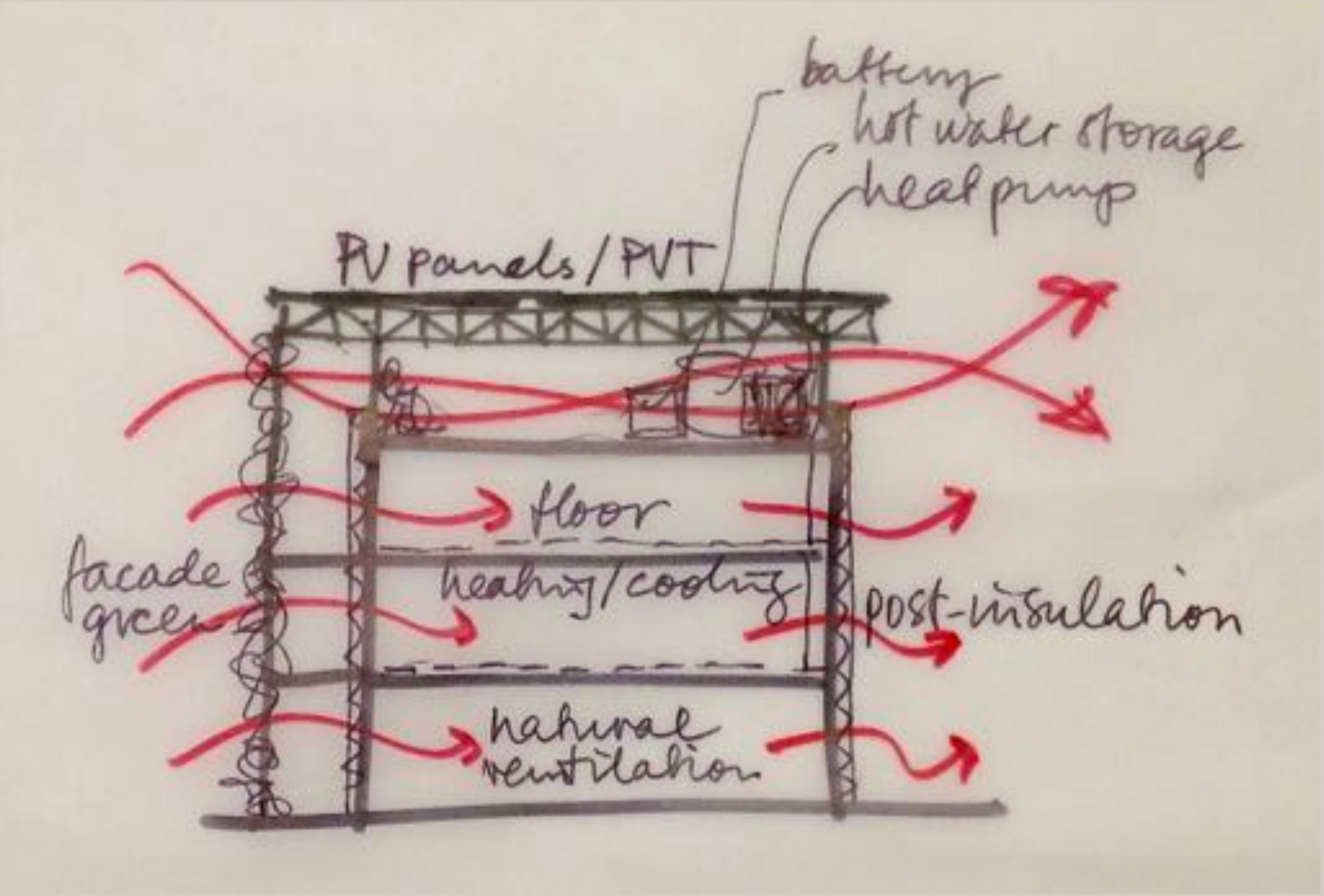
- Produce DHW (domestic hot water) with solar collector + small scale storage
- Individual PV on rooftops

Overview of post-insulation options





Smart & bioclimatic re-design



APARTMENT BLOCK SCALE

BORNOVA ENERGY INTERVENTIONS

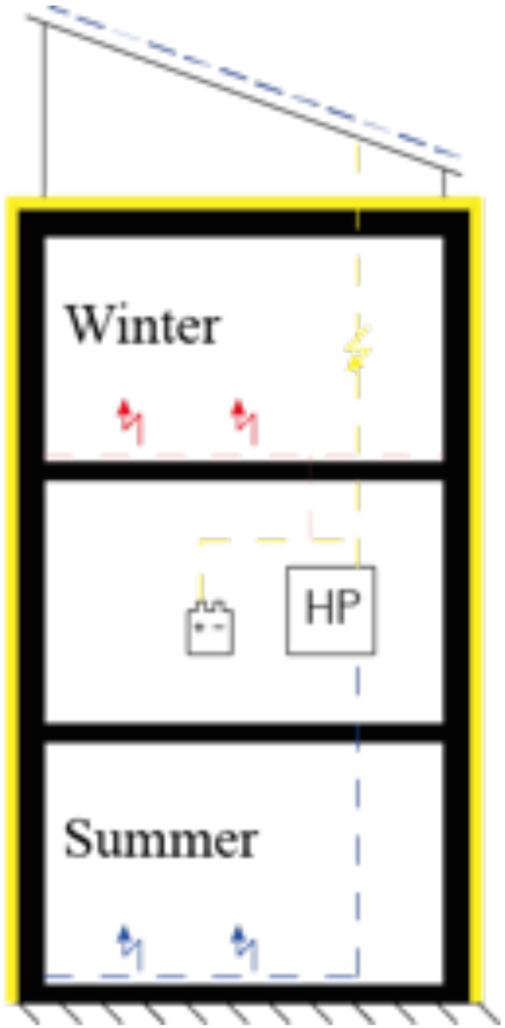
Level 2: the apartment block

Passive measures:

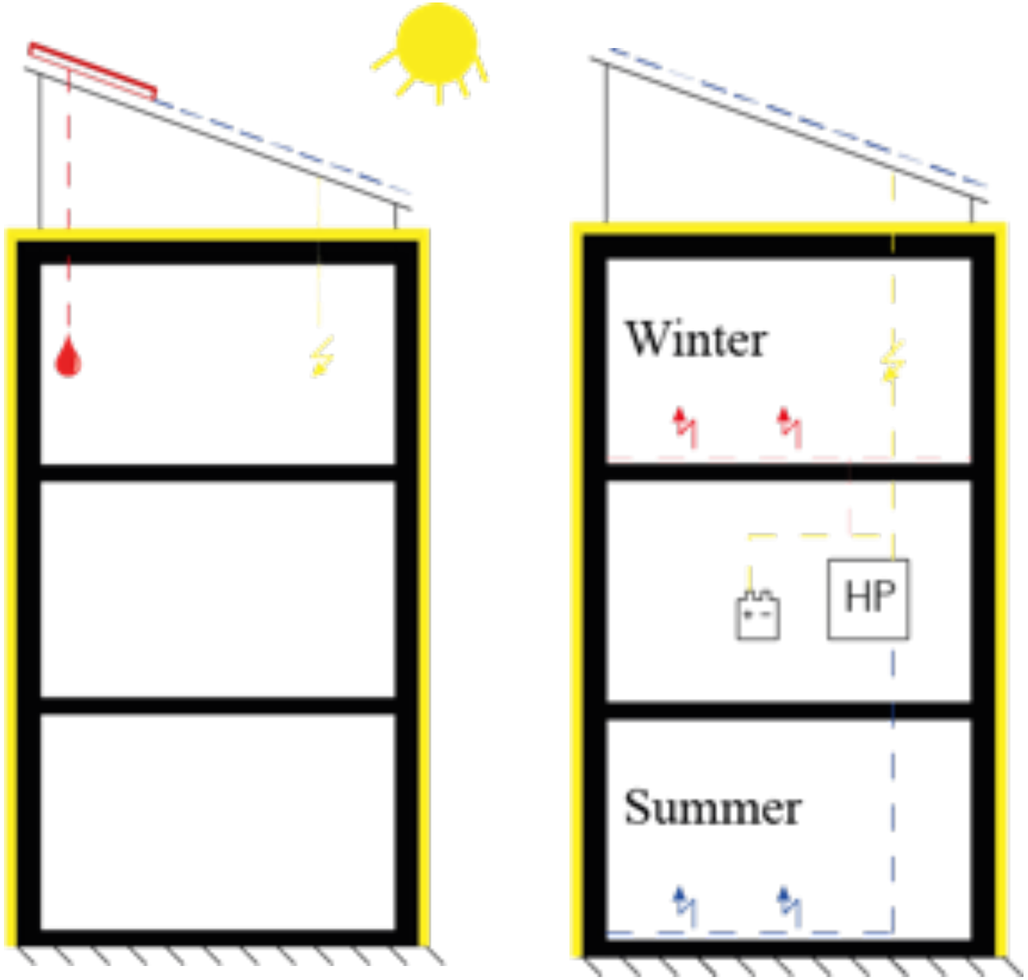
- Roof and facade shading measures
- Greening (roofs, facades & blind walls, balconies, private outdoor spaces)
- Retrofit insulation: (1) roofs, (2) windows, (3) facades

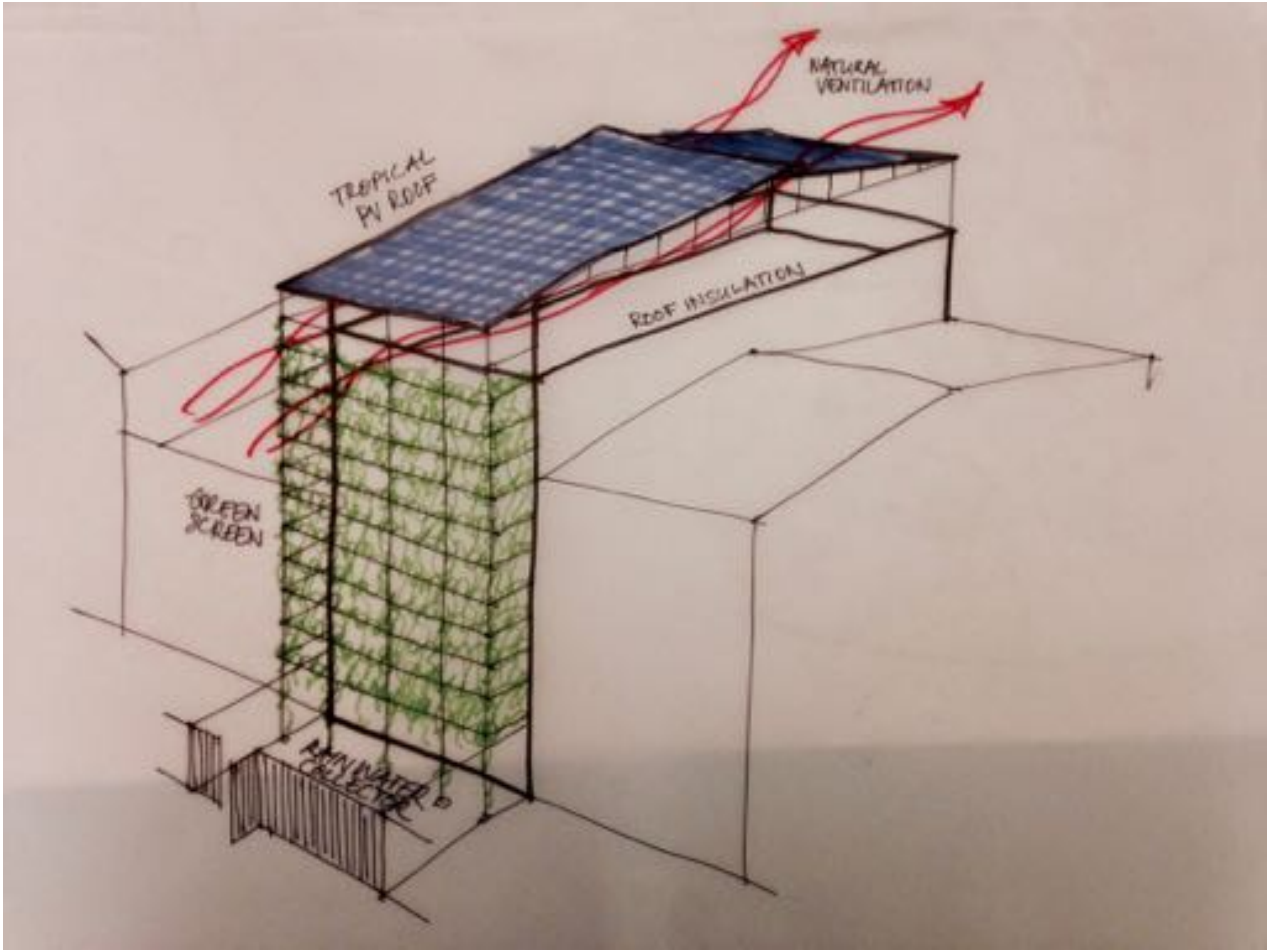
Active measures:

- Air source based heat pumps (+ PV) + retrofit floor cooling and heating for LT heat pump
- Electricity storage in batteries, if feasible



Level 2: the apartment block

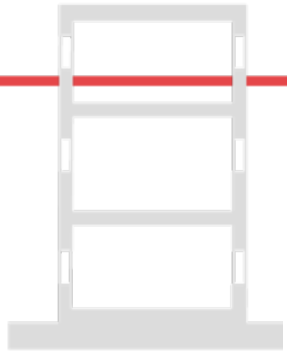


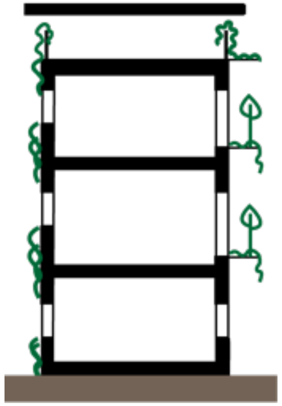

NATURAL VENTILATION
TROPICAL PV ROOF
ROOF INSULATION
GREEN SCREEN
RAINWATER COLLECTOR

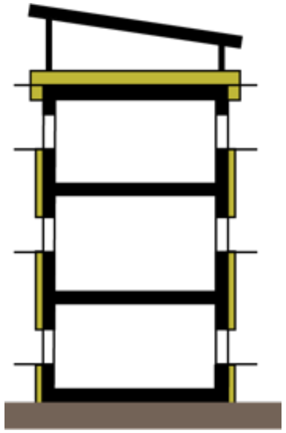
BORNOVA ENERGY INTERVENTIONS

Level 1: the individual dwelling unit (apartment, house)

level 1 Individual appartment energy upgrade			energy demand	energy saved	CO2 emmision	Car FP
Bornova			(MWh/y)	(MWh/y)	(t CO2eq/y)	%
0 **Appartment**	1					
heat demand	7570	kWh	7570		1294	
electricity demand	5200	kWh	5200		2486	
of which cooling demand	2600	kWh	2600			
Total:			12770		3780	100%
1 **roof and façade shading**						
heat demand	7500	kWh	7570		1294	
electricity demand	5200	kWh	2600		1243	
cooling demand remainder	90%		2340		1119	
Total:			12510		3656	96,7%
2 **greening up**						
heat demand			7570		1294	
electricity demand			2600		1243	
cooling demand	90%		2106		1007	
Total:			12276		3544	93,8%
3 **insulation roof/windows/glazing: reduction**						
heat demand remainder	75%		5678		971	
electricity demand			2600		1243	
cooling demand remainder	95%		2001		956	
Total:			8278		3170	83,9%
4 **Rooftop energy production**						
avg solar insolation	1300	kWh/m2	avg PV system efficiency			15%
projected hor surface area buildings	100	m2	AVG Solar DHW system efficiency			25%
av available part for solar PV production	20%		av available part for solar heat production			5%
available surface per house	20,0	m2				
annual elctricity production on roofs	3900	kWh				
annual DHW production on roofs	1625	kWh				
heat demand			4053		693	
electricity demand incl cooling			701		335	
Total:			4753		1028	27,2%

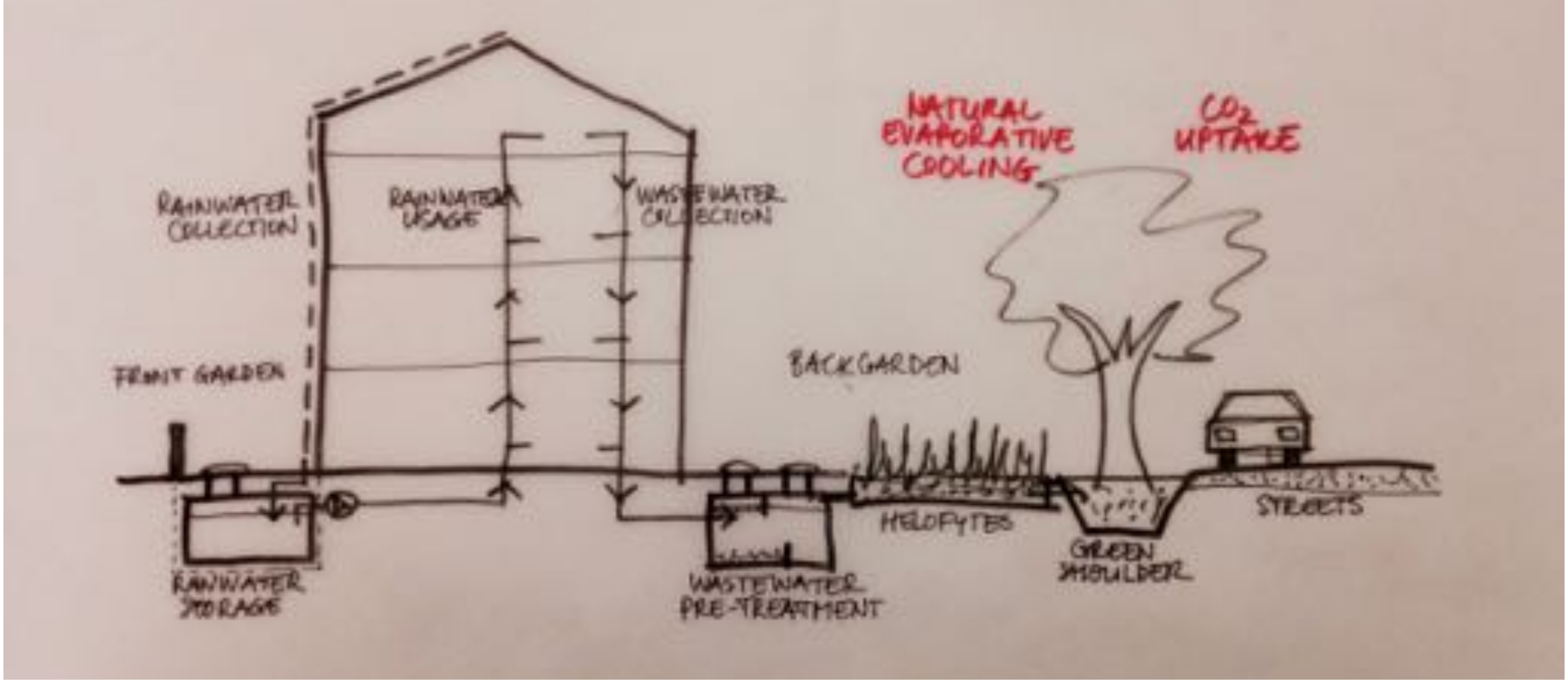






Sustainable water system

- **Drinkwater consumption (for toilets, washing machine and plants)**
  - Approximately 200 litre per day per family → 73 m3 per year
- **Rainwater collection**
  - 100 m2 roof, 700 mm per year → 70 m3 per year; storage of 10-15 m3 needed
- **Wastewater production**
  - Approximately 500 litre per day per family → 180 m3 per year = 2 big trees



STREET BLOCK SCALE

BORNOVA ENERGY INTERVENTIONS

Level 3: the street block

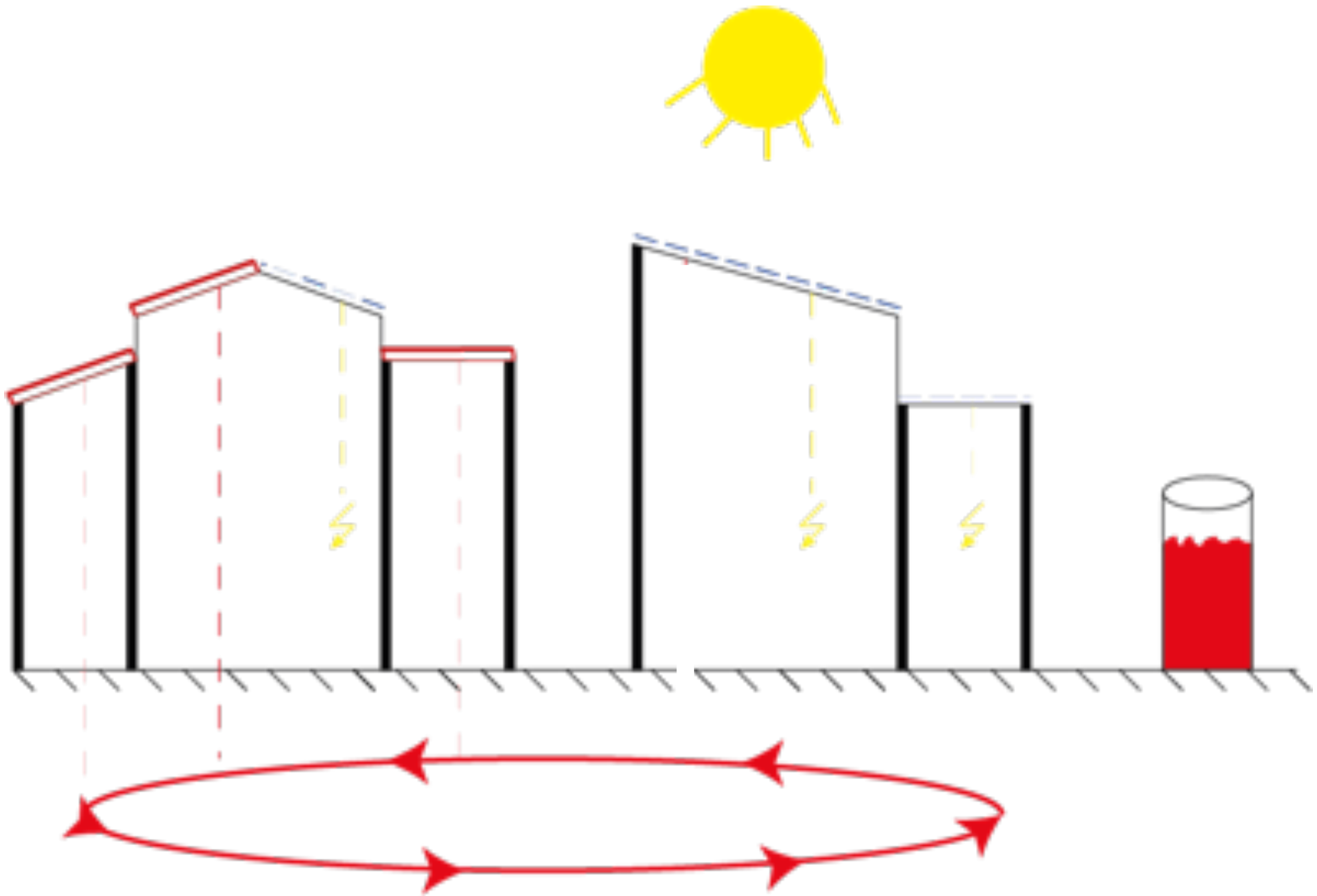
Passive measures:

- **Energy cooperative** and support from the municipality (advice to shareholders/participants)
- **Greening and unsealing streets and open spaces** (ground surfaces) promoting rain water penetration and evaporative cooling, diminishing the urban heat island, plus social and psychological advantages

Active measures:

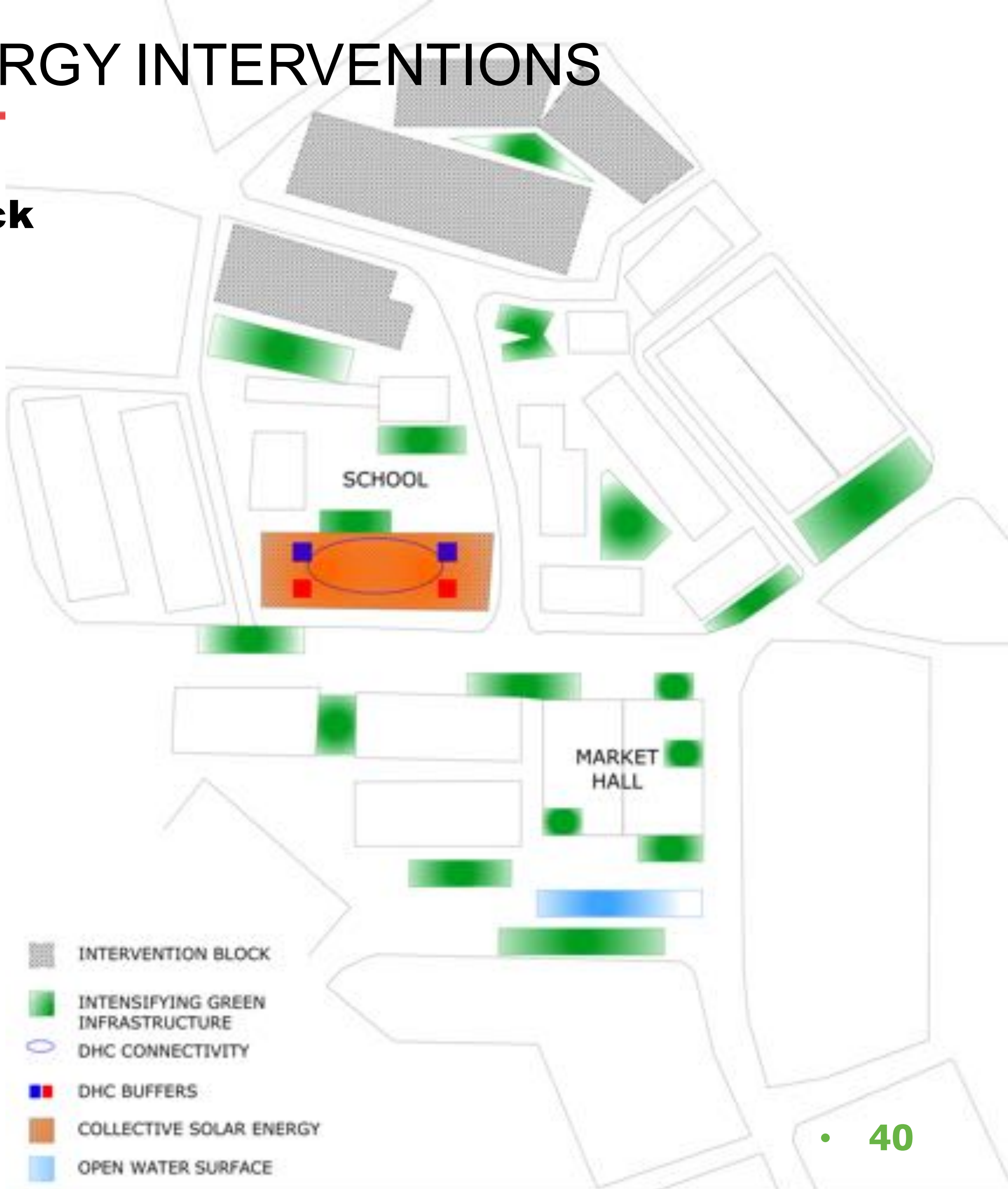
- **Mini district heating & cooling** based on heat pumps
- **Storage** (heat in winter, cold in summer): water, brine, PCMs
- **Solar**: collective PV and/or solar collectors and/or PVT

Level 3: the street block



BORNOVA ENERGY INTERVENTIONS

Level 3: the street block



BORNOVA ENERGY INTERVENTIONS

Level 3: the street block

level 2 & 3 Street block with small heat-cold network			energy demand	energy saved	CO2 emmision	Car FP
Bornova			(kWh/y)	(kWh/y)	(t CO2eq/y)	%
0 **Street block**						
Appartments	24					
heat demand	4053	kWh	97260		16631	
electricity demand incl cooling	701	kWh	16817		8038	
of which cooling demand	2001	kWh	48017		22952	
Total:			**114077**		**24670**	**27,2%**
1 **air source based heatpump per app. block**						
COP heating season	3					
COP cooling season	4					
heat demand			0		0	
electricity demand			61241		29273	
cooling demand			0		0	
Total:			**61241**		**29273**	**32,3%**
2 **greening and desealing the surface around streetblock**						
remaining cooling demand	95%					
heat demand	0	kWh	0		0	
electricity demand incl cooling	0	kWh	60641		28986	
of which cooling demand	45616	kWh	0			
Total:			**60641**		**28986**	**32,0%**

BORNOVA ENERGY INTERVENTIONS

Level 3: the street block

level 3 Street block with small heat-cold network			energy demand	energy saved	CO2 emmision	Car FP
Bornova			(kWh/y)	(kWh/y)	(t CO2eq/y)	%
mini heat-cold grid between blocks						
Appartments	**24**					
buiding blocks	7					
heat demand	136260	kWh			23300	
electricity demand ex cooling	62400	kWh			29827	
of which cooling demand	45616	kWh			21804	
					53128	**100%**
high performance solar collectors + PV						
avg solar insolation	1300	kWh/m2	avg PV system efficiency			13%
projected hor surface area buildings	100	m2	AVG Solar DHW system efficiency			35%
av available part for solar PV production	75%		av available part for solar PV production			25%
available surface per house	100,0	m2				
annual elctricity production on roofs	88725	kWh	COP heating season			3,5
annual heat production on roofs	11375	kWh	COP cooling season			4
heat demand in electricity for HP	16181	kWh				
electricity demand	-26325	kWh				
cooling demand in electricity for HP	11404	kWh				
heat demand			0		0	
electricity demand			1260		602	
cooling demand			0		0	
Total:			**1260**		**602**	**1,13%**

BORNOVA ENERGY INTERVENTIONS

BORNOVA ENERGY INTERVENTIONS

Level 4: the mini-neighbourhood (a small group of street blocks)

Passive measures:

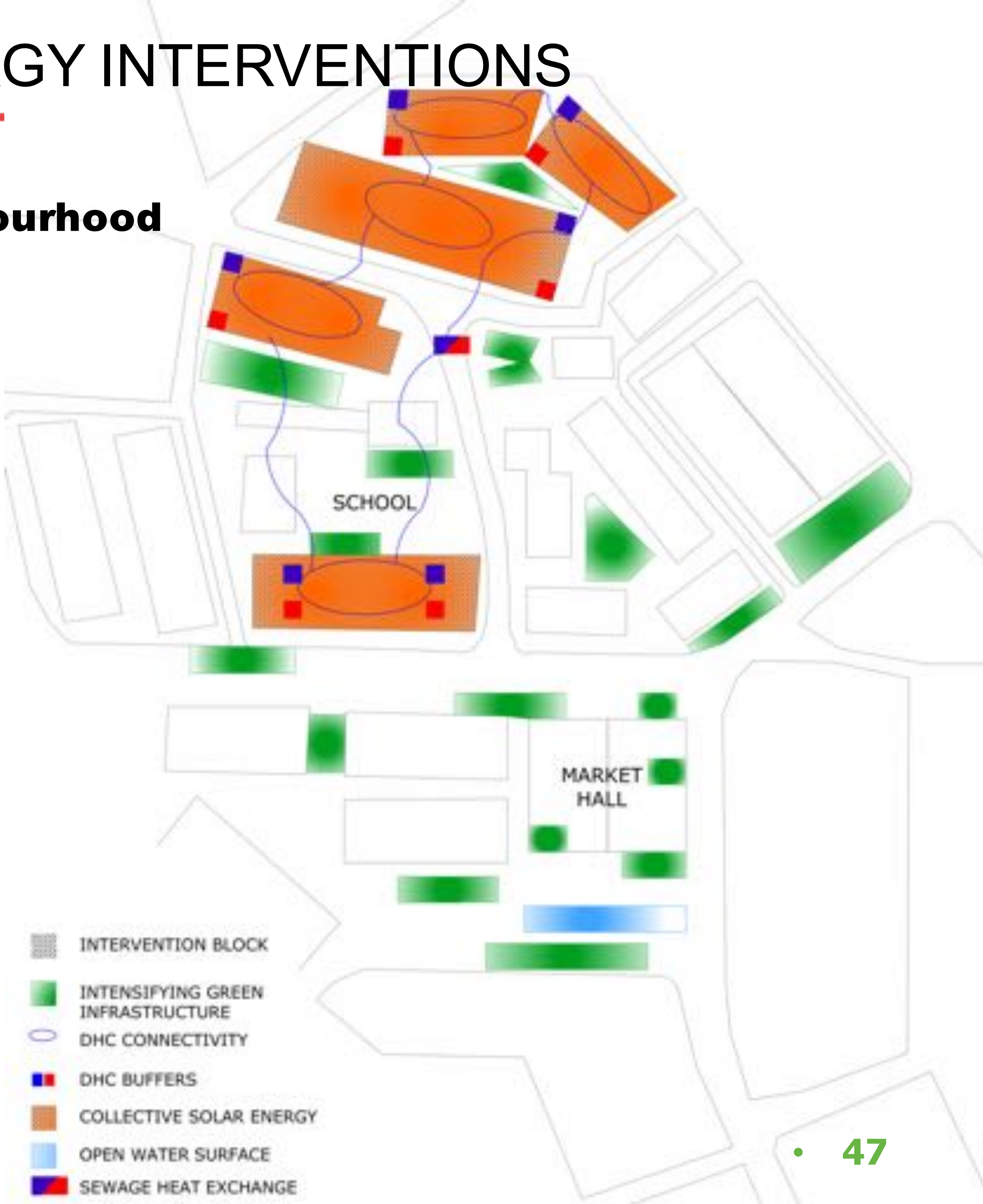
- **Greening and unsealing streets and open spaces** (ground surfaces) promoting rain water penetration and evaporative cooling, diminishing the urban heat island, plus social and psychological advantages
- **Planting trees** and creating green (hanging) street covers / green community terraces and squares / …
- Streets as solar ventilation shafts
- **Rain water capture and storage**

Active measures:

- Connect street blocks to mini DHC grid (winter heating, summer cooling)
- Sewage water heat exchange with heat pump systems

BORNOVA ENERGY INTERVENTIONS

Level 4: the mini-neighbourhood



BORNOVA ENERGY INTERVENTIONS

level 4 Street block small heat-cold networks connected			energy demand	energy saved	CO2 emmision	Car FP
Bornova			(kWh/y)	(kWh/y)	(t CO2eq/y)	%
mini neighbourhood original demand						
Appartments	100					
buiding blocks	7					
heat demand	567750	kWh			97085	
electricity demand ex cooling	260000	kWh			124280	
of which cooling demand	190067	kWh			90852	
					221365	**100%**

high performance solar collectors + PV		
avg solar insolation	1300	kWh/m2
projected hor surface area buildings	100	m2
av available part for solar PV production	**90%**	
available surface per house	100,0	m2
annual elctricity production on roofs	380250	kWh
annual heat production on roofs	113750	kWh
heat demand in electricity for HP	28188	kWh
electricity demand	-120250	kWh
cooling demand in electricity for HP	42237	kWh

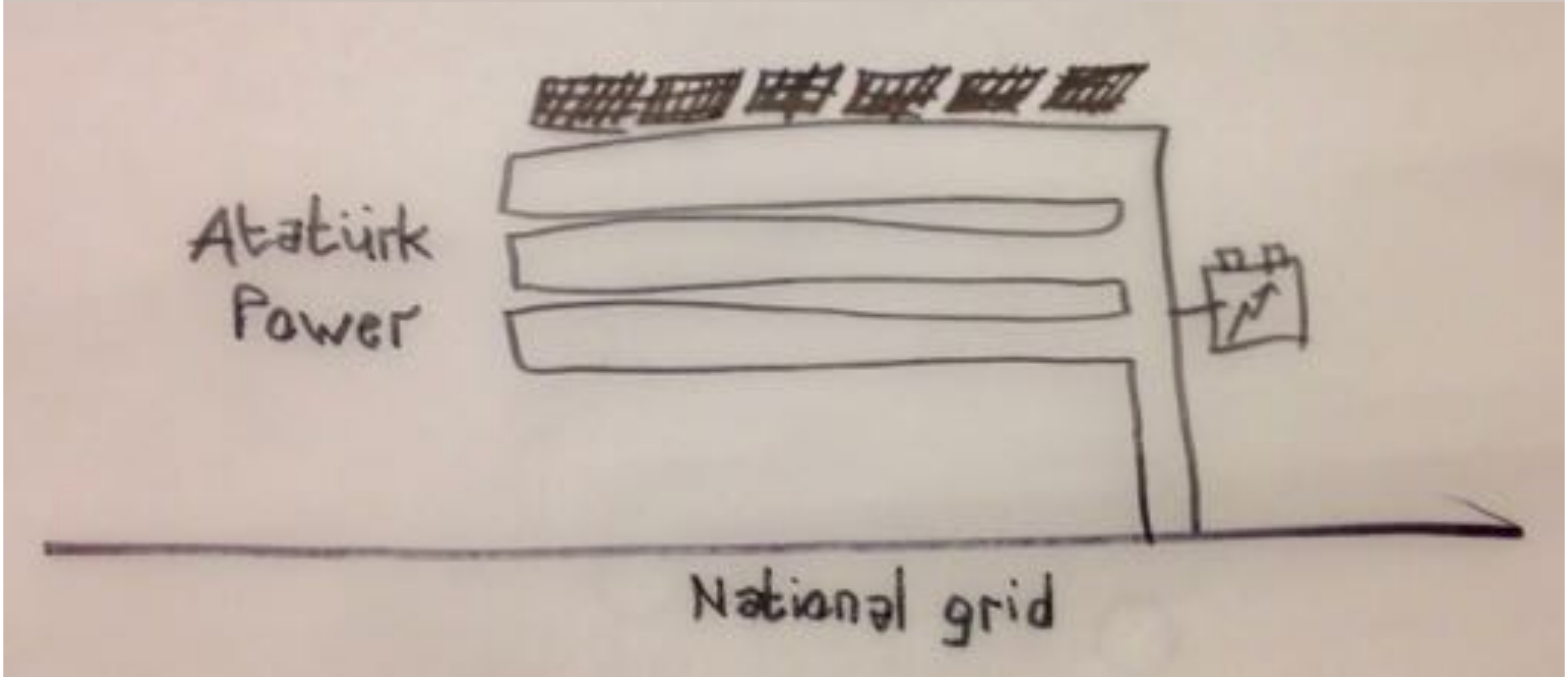
avg PV system efficiency	13%
AVG Solar DHW system efficiency	35%
av available part for solar heat production	**10%**
sewage water heat exchanger:	
COP heating season	4
COP cooling season	4,5

	energy demand (kWh/y)	energy saved (kWh/y)	CO2 emmision (t CO2eq/y)	Car FP %
heat demand	0		0	
electricity demand	-49826		-23817	
cooling demand	0		0	
Total:	**-49826**		**-23817**	**-10,76%**

BORNOVA ENERGY INTERVENTIONS

Level 5: the neighbourhood
(a large group of street blocks with different community assets)

Atatürk energy community



Level 5: the neighbourhood

Passive measures:

- **Connecting green patches** – green/blue network including storm water drainage in wadi/vadi concept, integrating parks and other infrastructure.
- **Open water streams** combined with local water purification scenarios.
- **Neighbourhood rain water storage spaces** – half underground or accommodating greenery, community uses, etc.
- **Community centre**, demonstration building and information point – ‘one stop shop’ concept for citizens, cooperations etc. seeking advice on energy, retrofitting, and related matters.

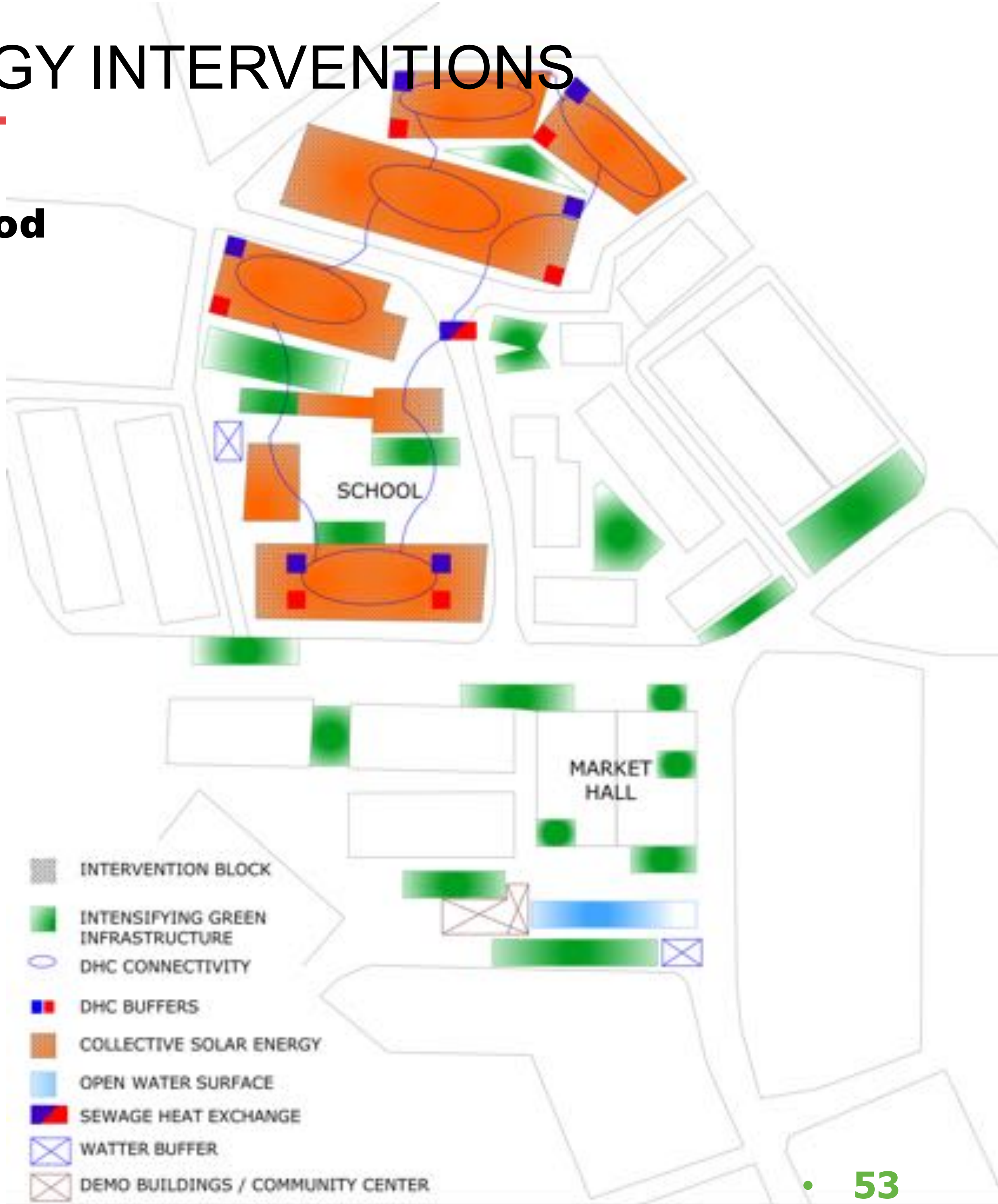
Level 5: the neighbourhood

Active measures:

- **Parking facilities with PV roof** (tropical roof concept, shading, electric charging, other PV applications)
- **Roofs for collective energy production** (PV, PVT, solar collectors) with commercial and office buildings
- **V2G (vehicle to grid):** from cars to include electric bikes and motorcycles. See plan Craig & Greg.
- **Smart grids** / active demand control
- **Adsorption** cooling with high performance/high-T solar collectors

BORNOVA ENERGY INTERVENTIONS

Level 5: the neighbourhood

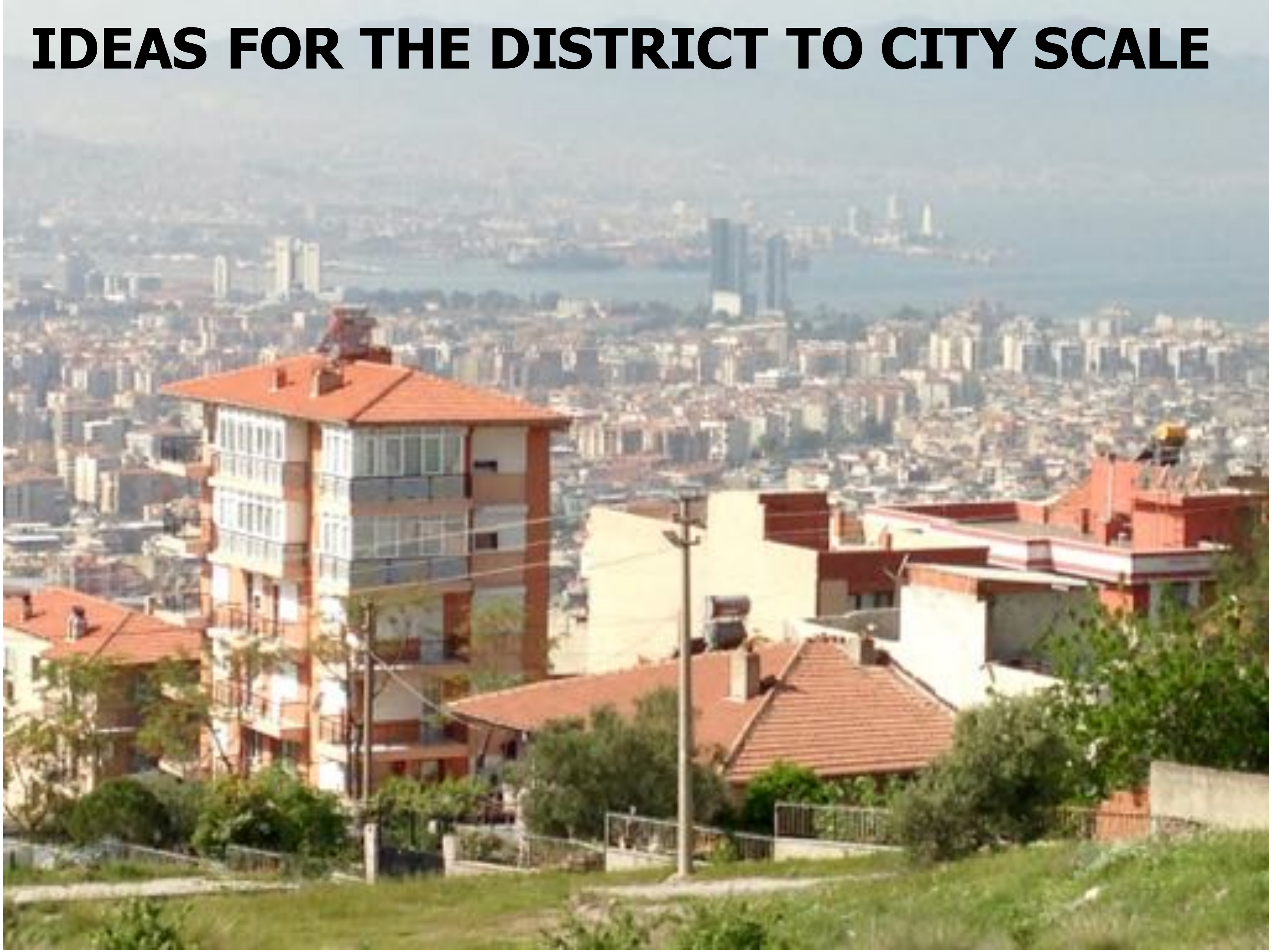


BORNOVA ENERGY INTERVENTIONS

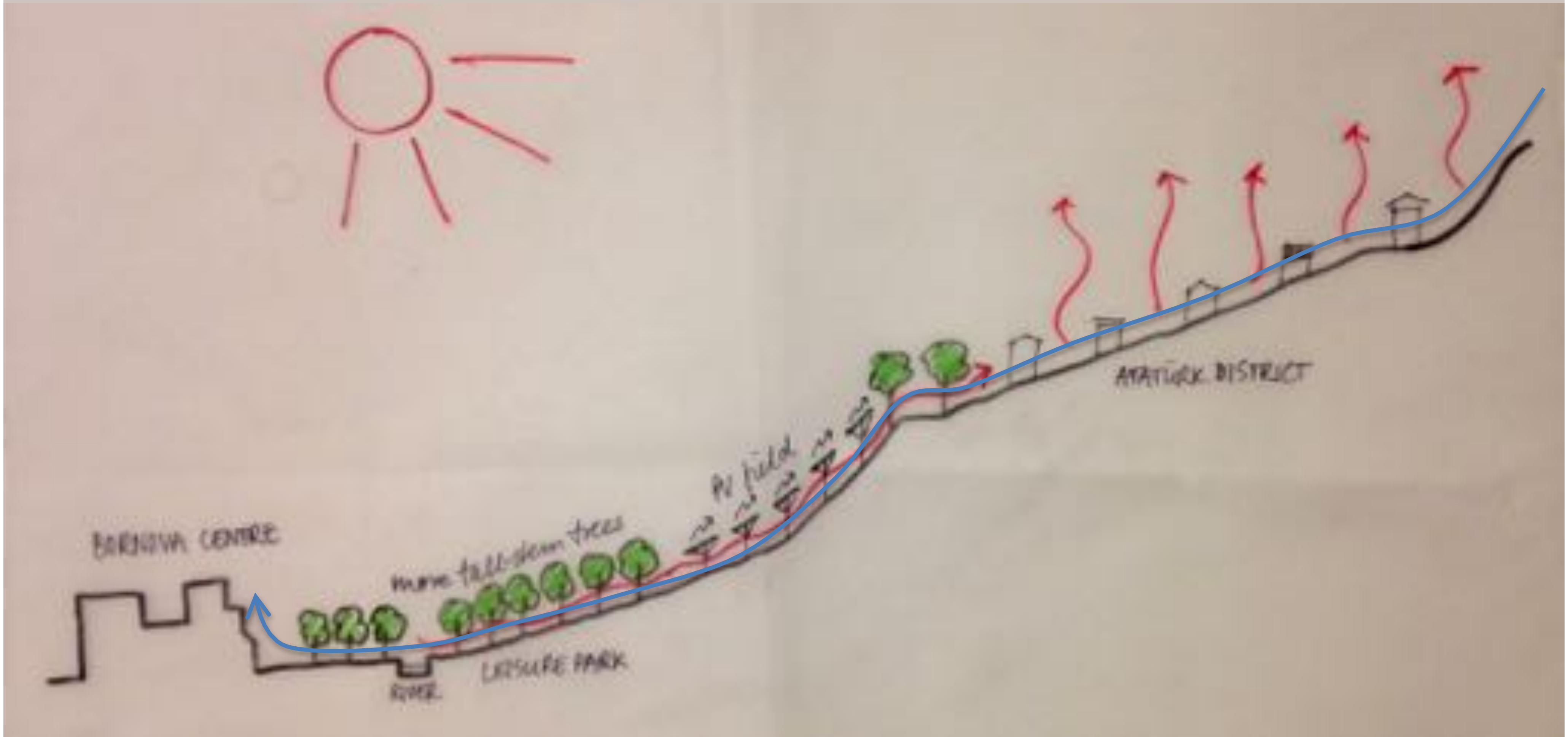
Level 5: the neighbourhood

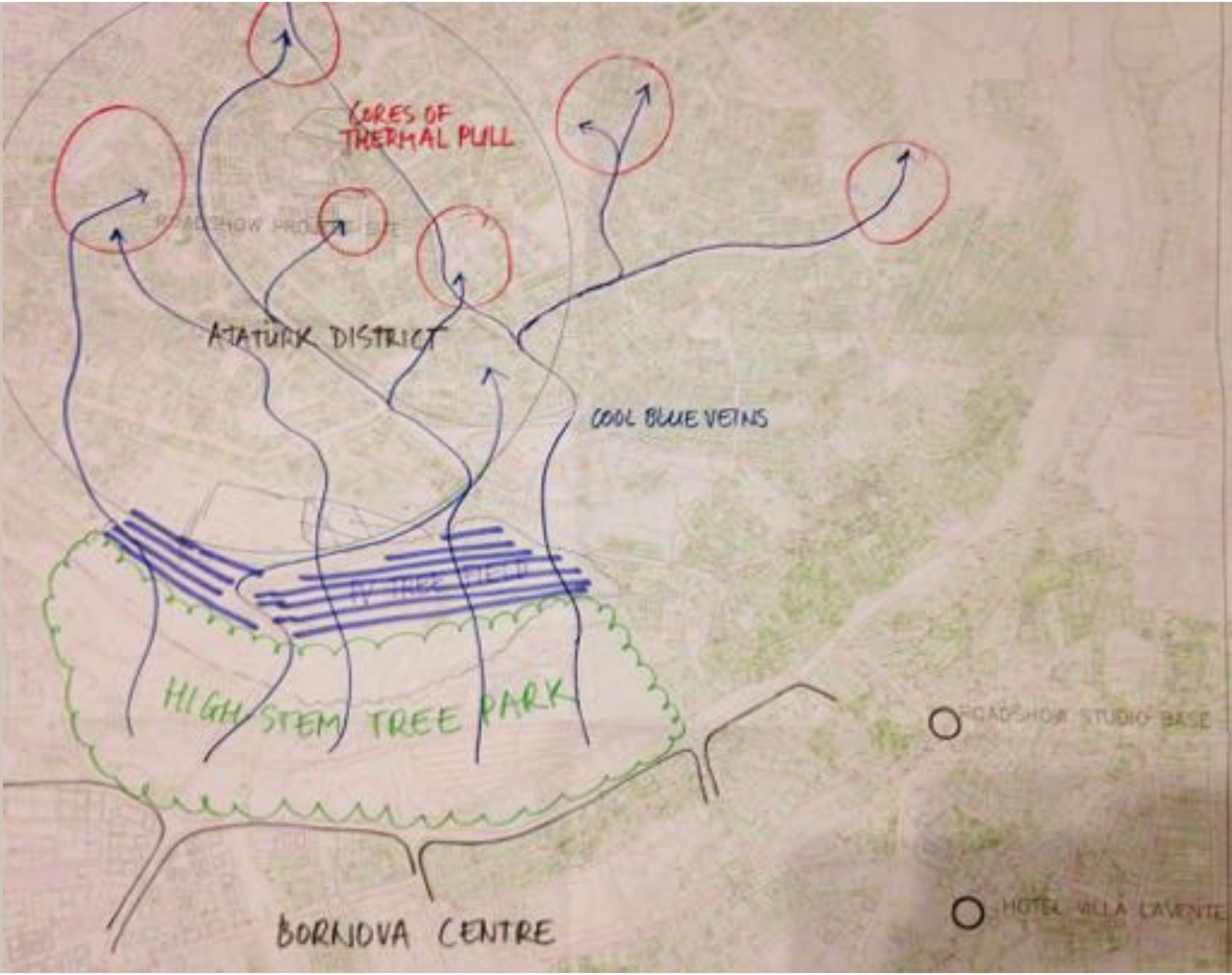
level 5 Street block small heat-cold networks connected + market place			energy demand	energy saved	CO2 emmision	Car FP
Bornova			(kWh/y)	(kWh/y)	(t CO2eq/y)	%
PV production Market roofrop						
avg solar insolation	1300	kWh/m2	avg PV system efficiency			15%
rooftop area	3000	m2	av available part for solar PV production			90%
annual elctricity production on market roof			526500	kWh		
overproduction electricity			576326		-275484	**-124,45%**

IDEAS FOR THE DISTRICT TO CITY SCALE

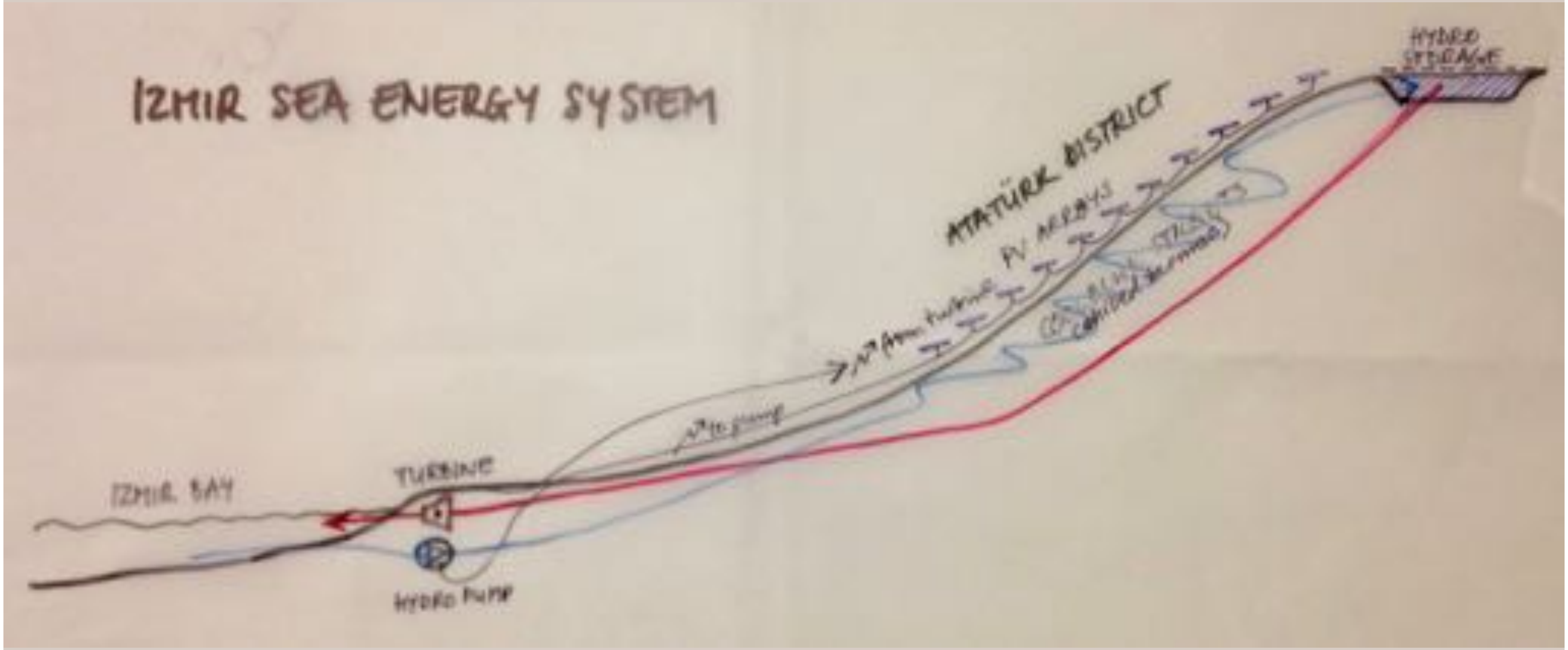


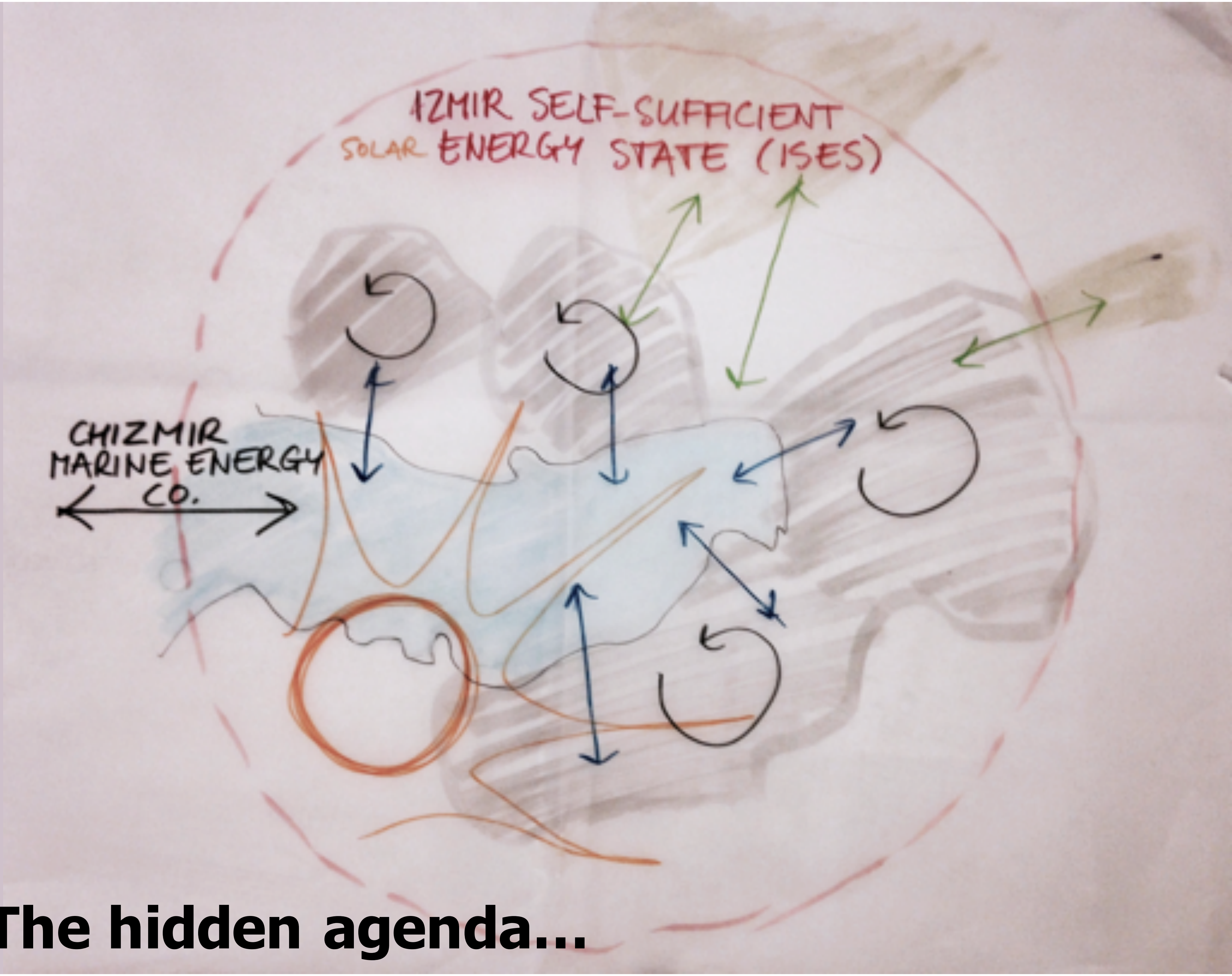
Create cool flows by thermal day draught
(and cool breezes from the hill at night)




CORES OF THERMAL PULL
ATATÜRK DISTRICT
COOL BLUE VEINS
HIGH STEM TREE PARK
ROADSHOW STUDIO BASE
HOTEL VILLA LAVENTE
BORNOVA CENTRE

Pavement cooling and hydro-power





The hidden agenda...

Bornova

Thank you!

CITY-zen
New urban energy

Universiteit van Amsterdam

alliander

vito
vision on technology

aeb
amsterdam

Westpoort Warmte

Ville de Grenoble

Atos
Worldgrid

DNV·GL

GEG

Compagnie de chauffage
le confort durable, tout simplement

SRB
ENERGY

C+L Clicks + Links

Universitatis Senarum MCCXXXX

DAIKIN

GREENSPREAD

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Th!nk E

SIEMENS

Queen's University Belfast

TU Delft
Technische Universiteit Delft