AMB Àrea Metropolitana de Barcelona

Energy Transition at Barcelona Metropolitan Area

Gil Lladó, energy transition officer
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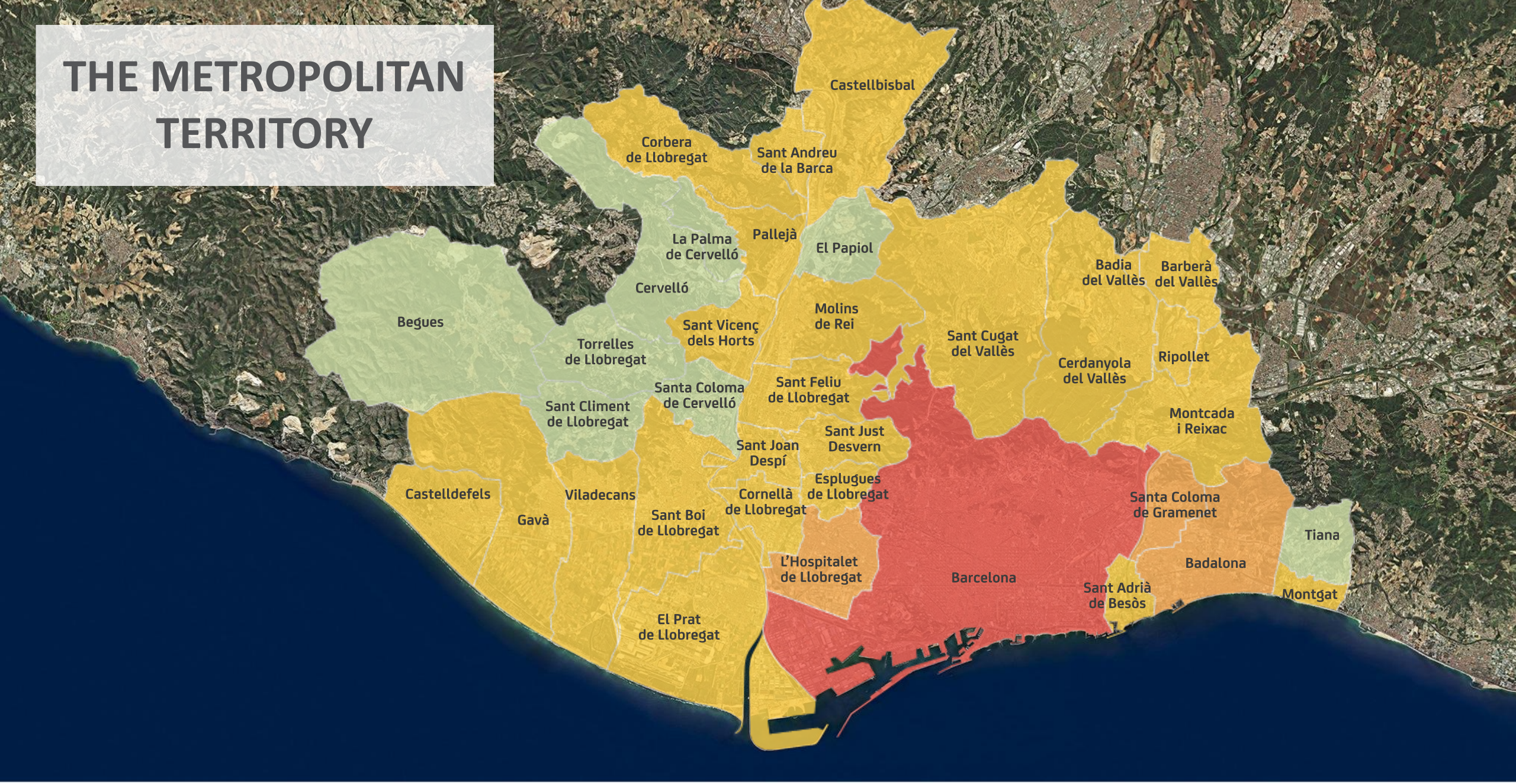
Environment Area

IESE Energy Club 9-11/11/2016

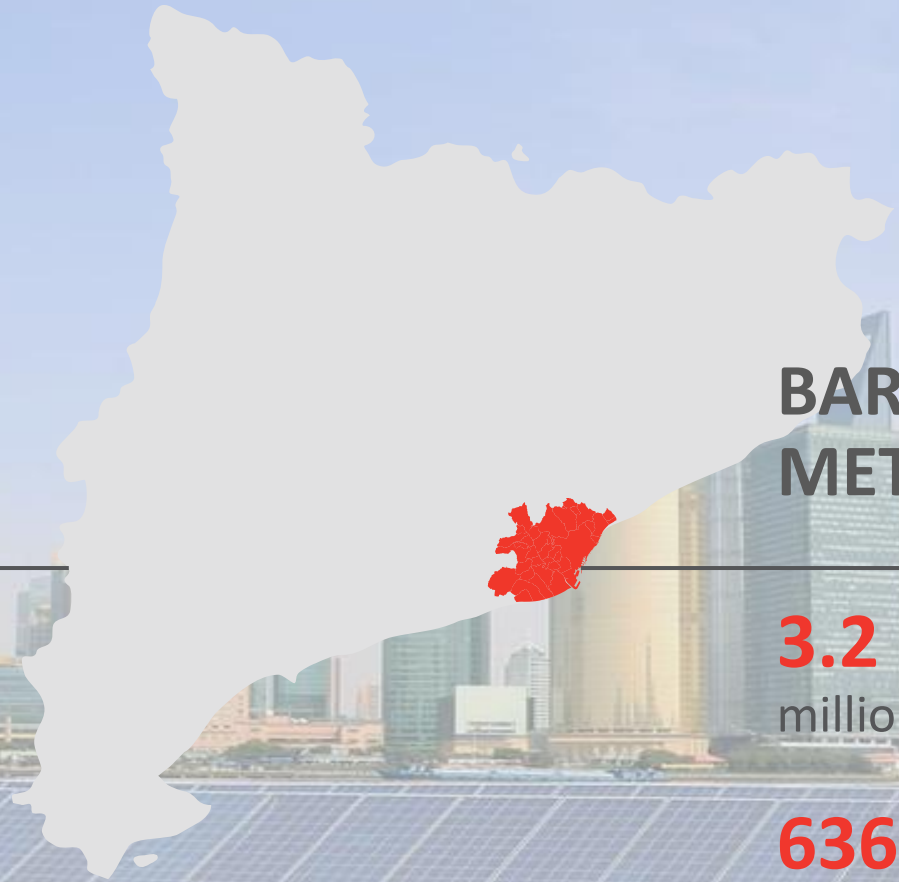
0. AMB, the institution
1. Energy transition projects
    1.1. Renewables
    1.2. NZEB: building and city scales

THE METROPOLITAN TERRITORY



- Over 1 million people
- 100,000 to 1 million inhabitants
- 10,000 to 100,000 inhabitants
- Fewer than 10,000 inhabitants

CATALONIA AND THE METROPOLITAN AREA



CATALONIA

7.5
million people

32,108
km²

236
Inhabitants per km²

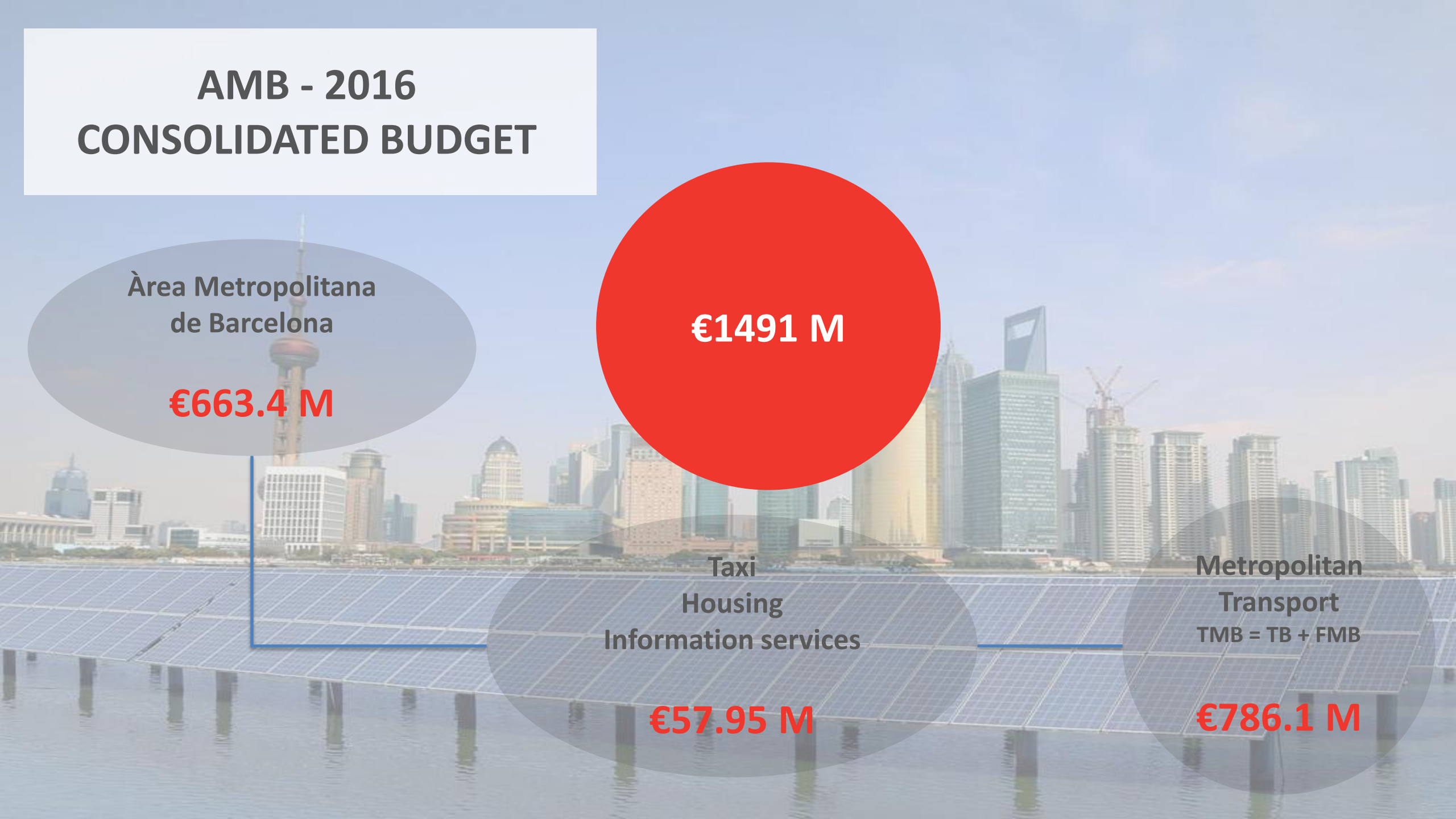
BARCELONA METROPOLITAN AREA

3.2 (42,6%)
million people

636 (1,9%)
km²

5,093
Inhabitants per km²

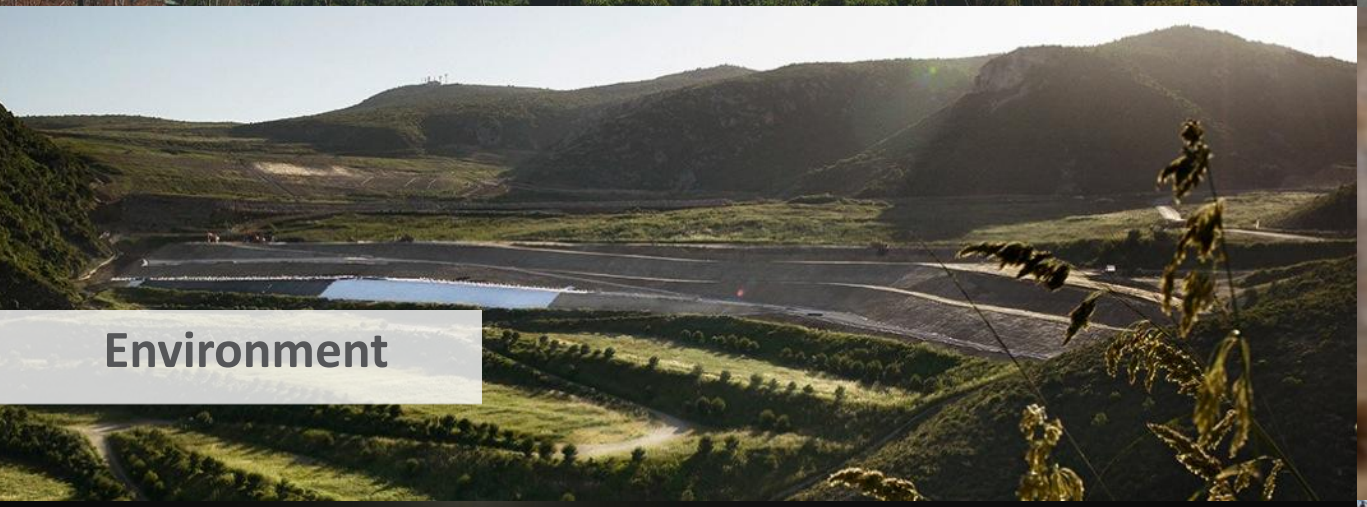
AMB - 2016
CONSOLIDATED BUDGET



POWERS

Spatial Planning and Housing

Transport and Mobility



Environment

Strategic Planning

Social and Economic Development

International Relations

POWERS

Spatial Planning and Housing

Transport and Mobility

Environment → Energy transition-OME

Strategic Planning

Social and Economic Development

International Relations

0. AMB, the institution
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Unsustainability of current energy model

Environmental (CAT)
Energy cycle = 76% GHG emissions

Economic (SP)
45000M€/year fossil import

Geopolitics (SP)
Energy import= 74%

Public Health (EU)
430m pollution deaths/year

Social (SP)
4th EU country electricity price (1st non isl)

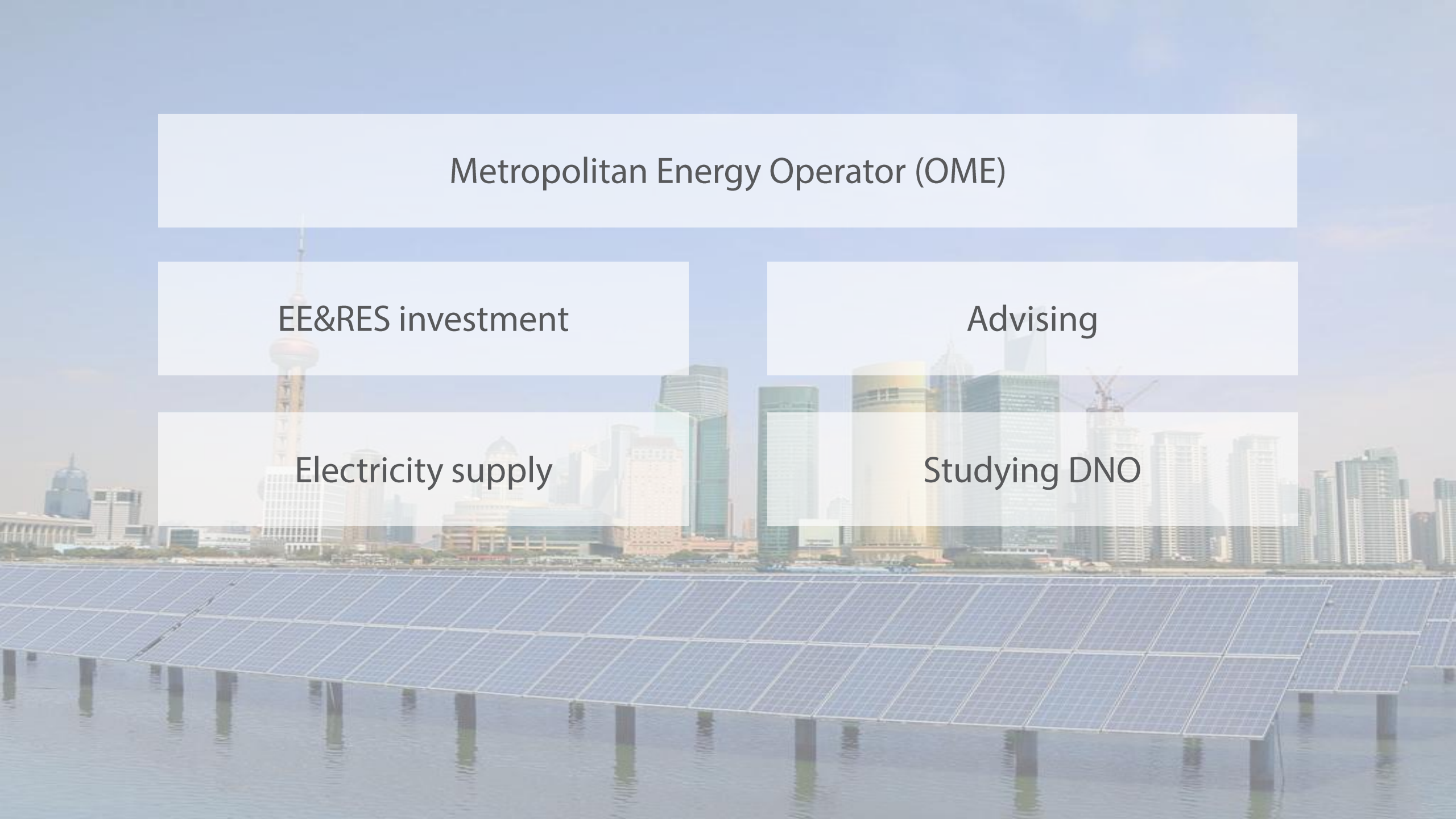
Social (SP)
1.4M fuel poverty families

1. Decentralized production based on renewable tech

2. Self-sufficiency

3. EU targets on renewables, efficiency and emissions

4. Environmentally, economically and socially sustainable model


Metropolitan Energy Operator (OME)
EE&RES investment
Advising
Electricity supply
Studying DNO

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0. AMB, the institution
1. Energy transition projects
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EMPLOYEE SOLAR CHARGING STATIONS:
(*fotolineres laborals metropolitanes*)
A comprehensive energy transition project

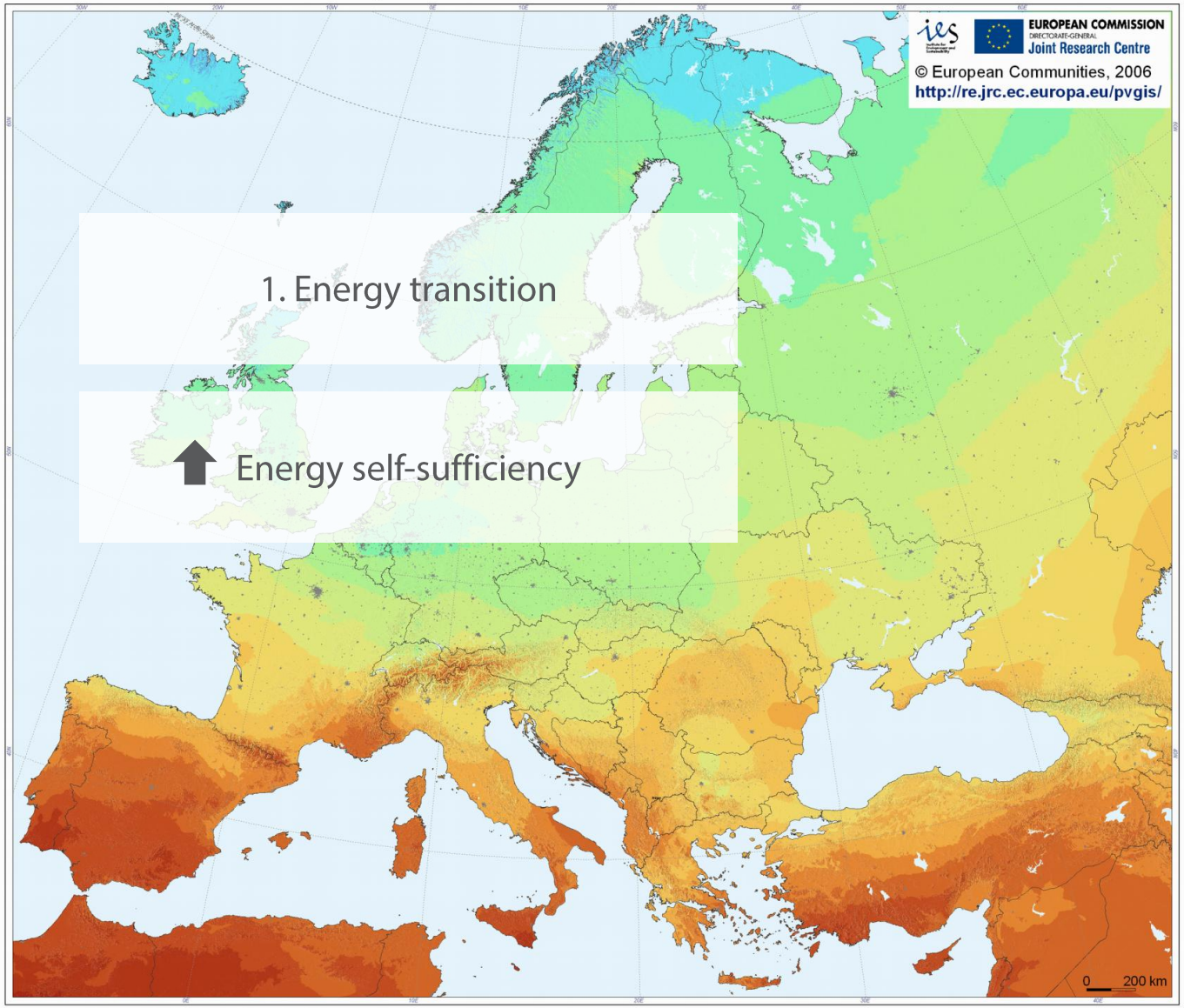
A comprehensive energy transition project

Photovoltaic self-consumption unit for

Public buildings

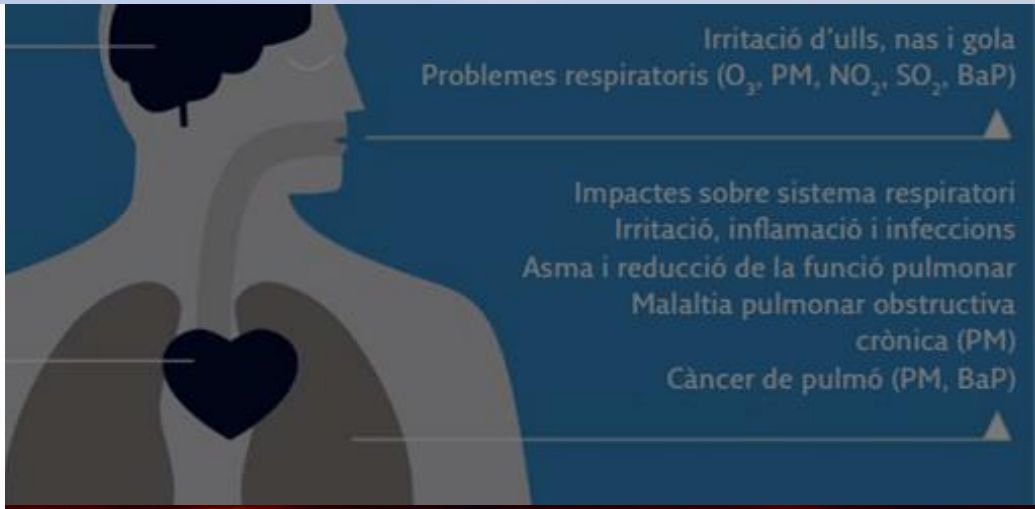
Linked slow charging station for employee electric vehicles

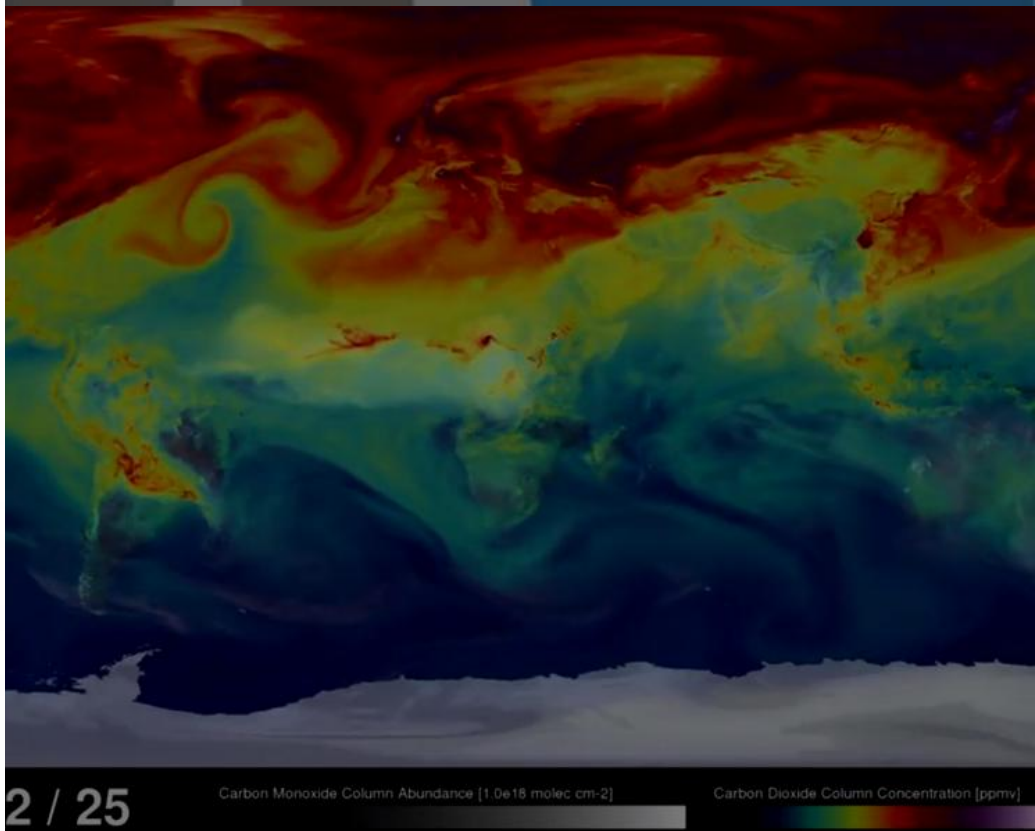
Photovoltaic Solar Electricity Potential in European Countries



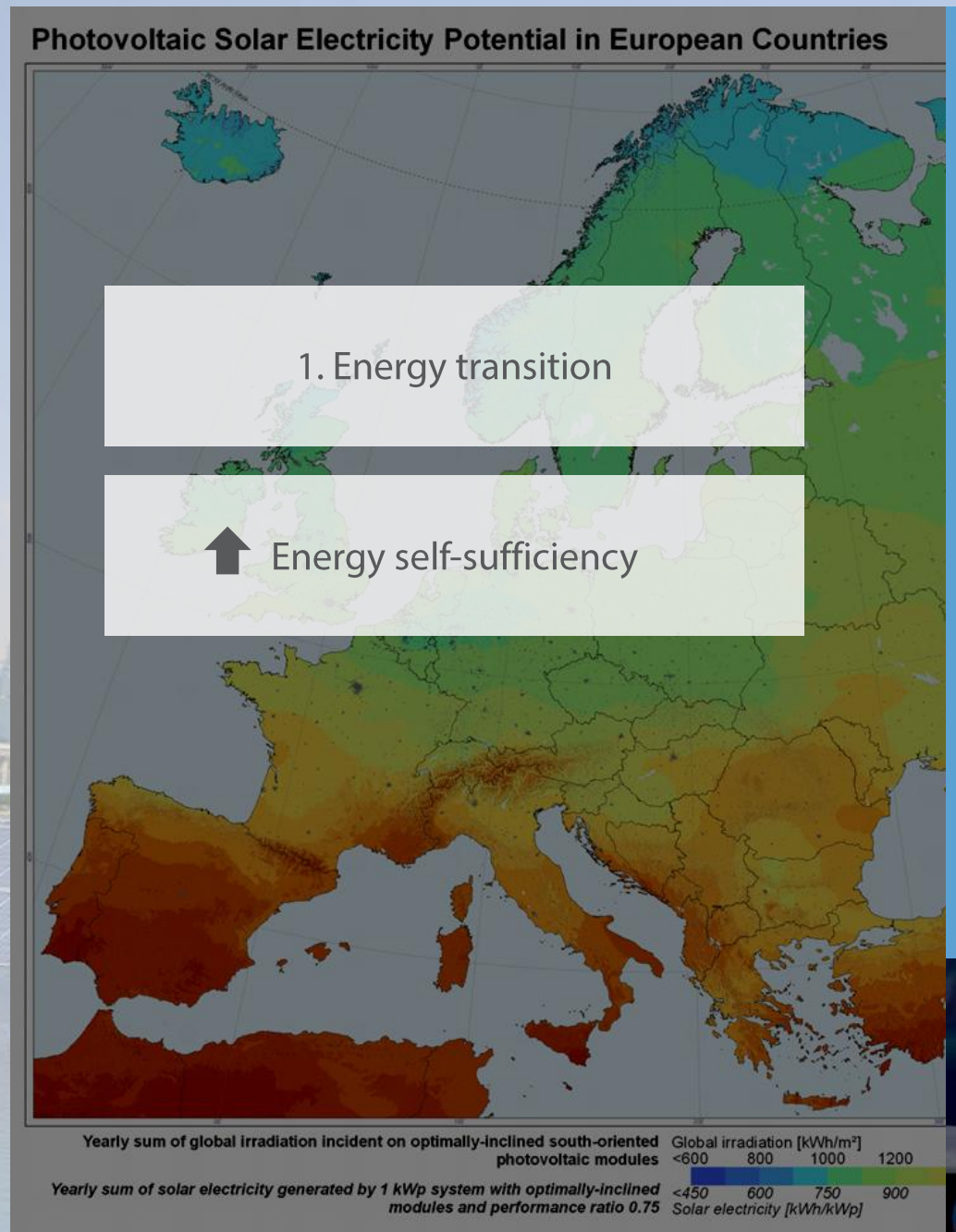
Yearly sum of global irradiation incident on optimally-inclined south-oriented photovoltaic modules
Global irradiation [kWh/m²]
<600 800 1000 1200 1400 1600 1800 2000 2200>

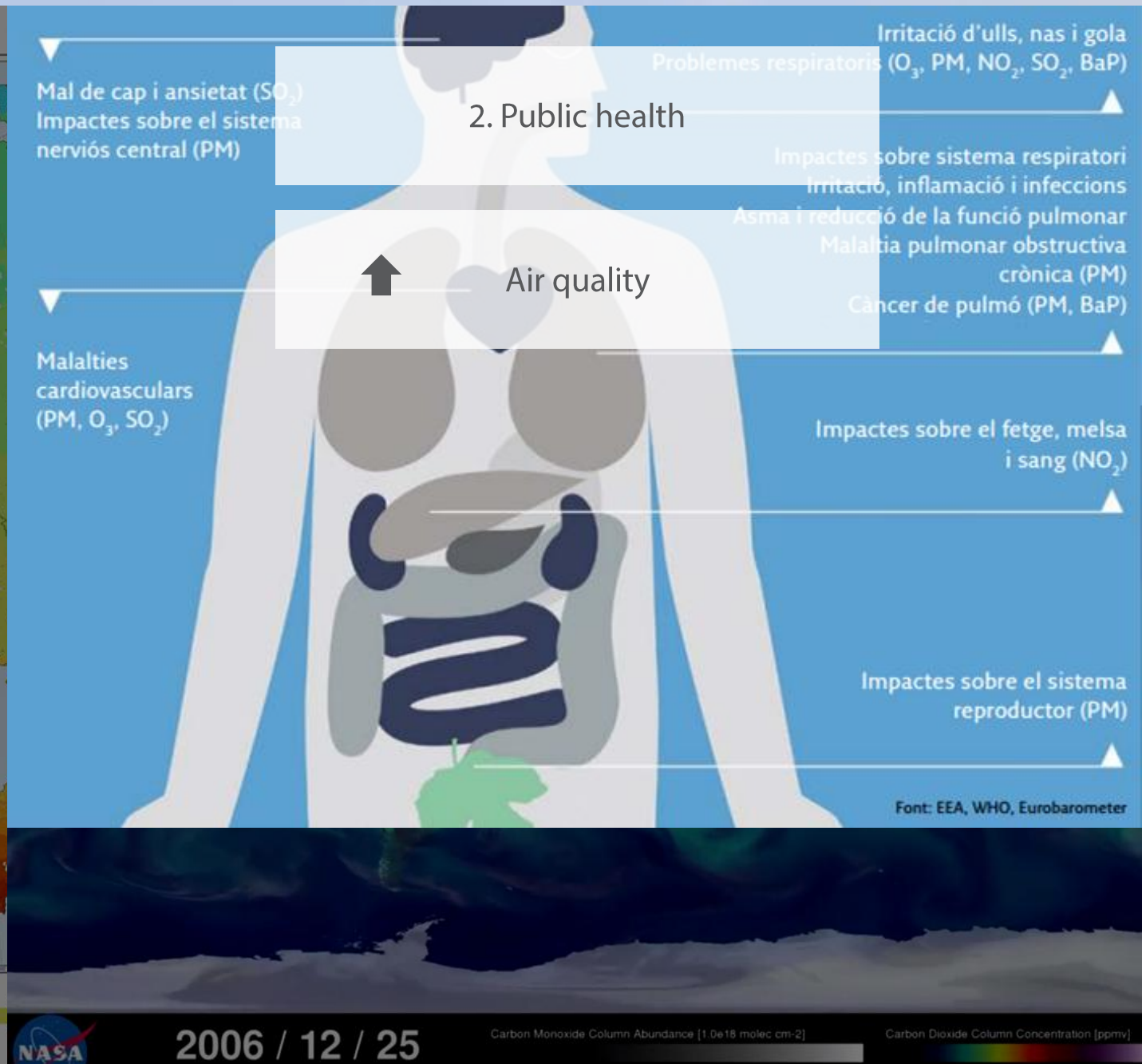
Yearly sum of solar electricity generated by 1 kWp system with optimally-inclined modules and performance ratio 0.75
<450 600 750 900 1050 1200 1350 1500 1650>
Solar electricity [kWh/kWp]





3 faced challenges





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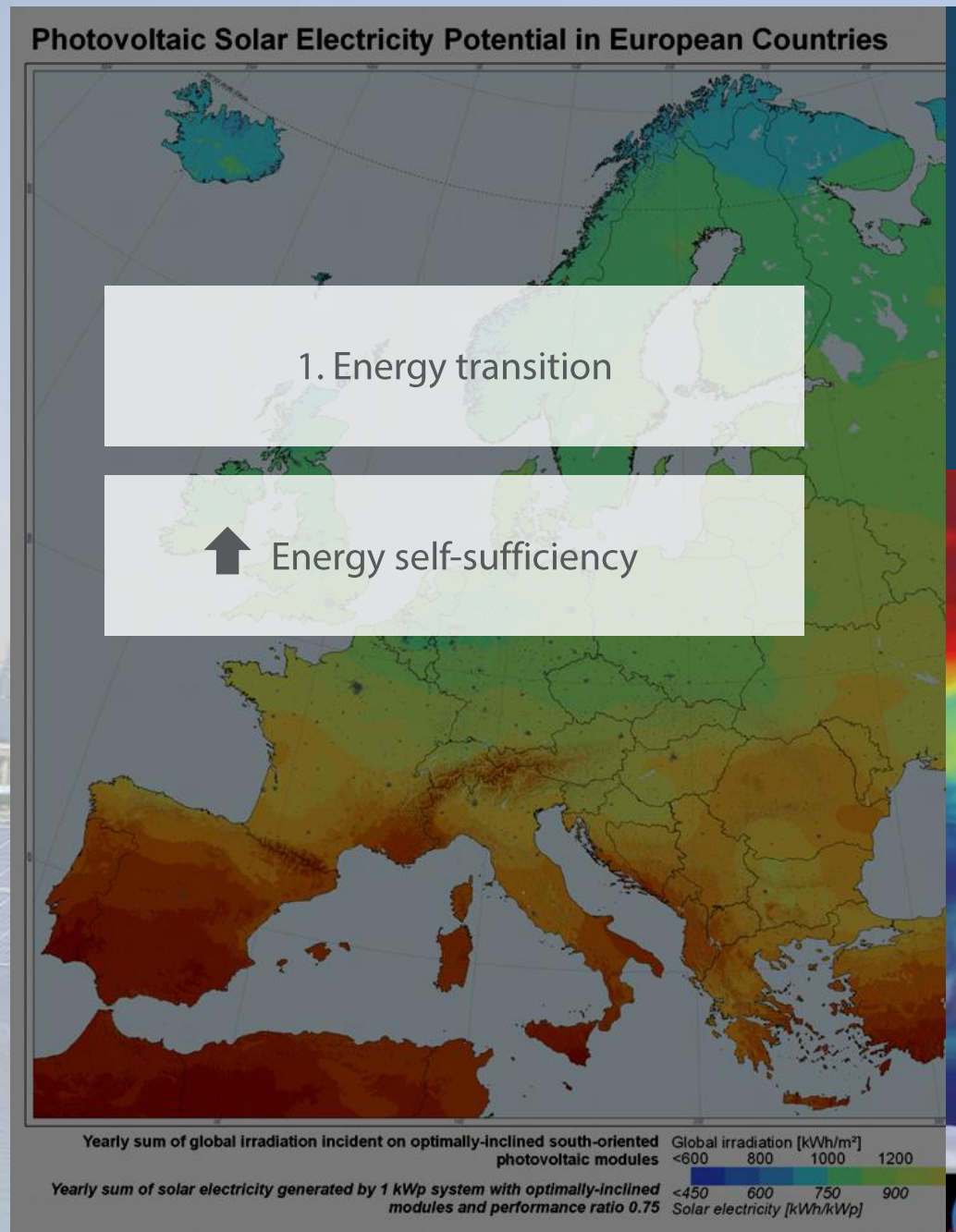
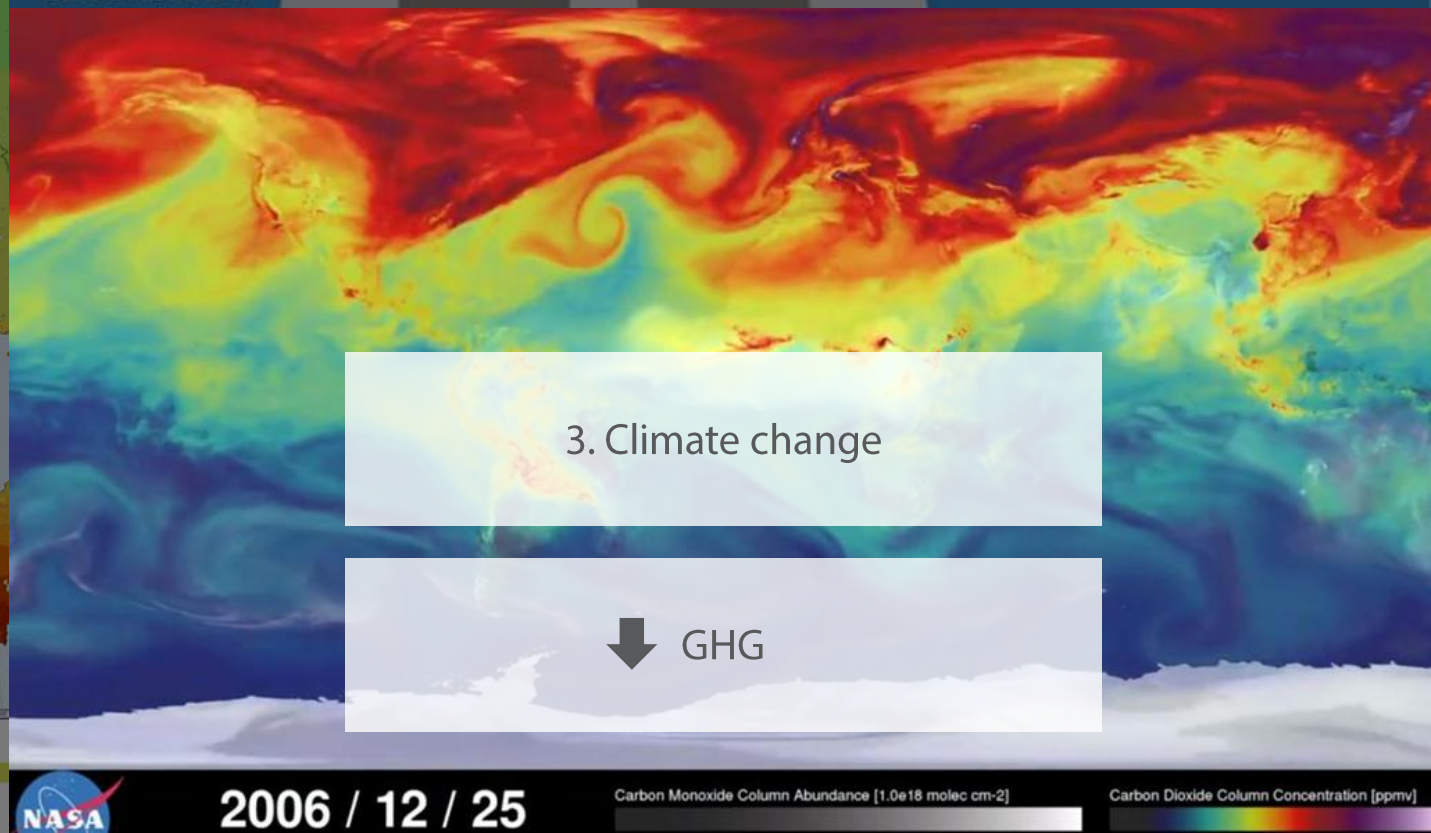


1. Energy transition

↑ Energy self-sufficiency

2. Public health

↑ Air quality



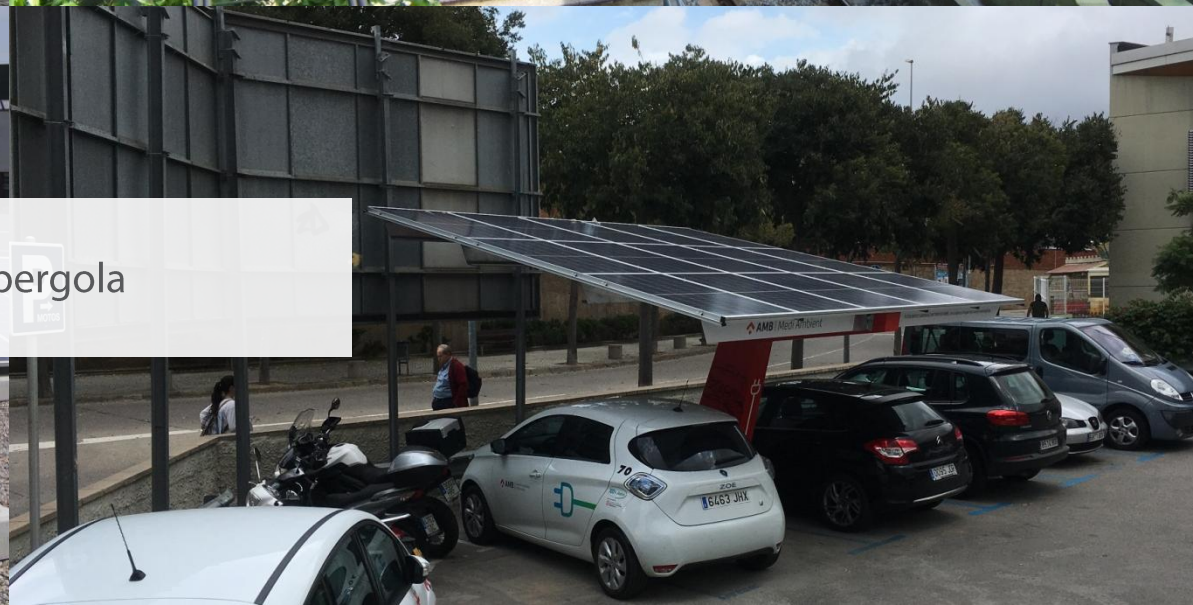
3. Climate change

↓ GHG

2 concepts + 2 configurations

Public officers vs any citizen

Roof vs pergola

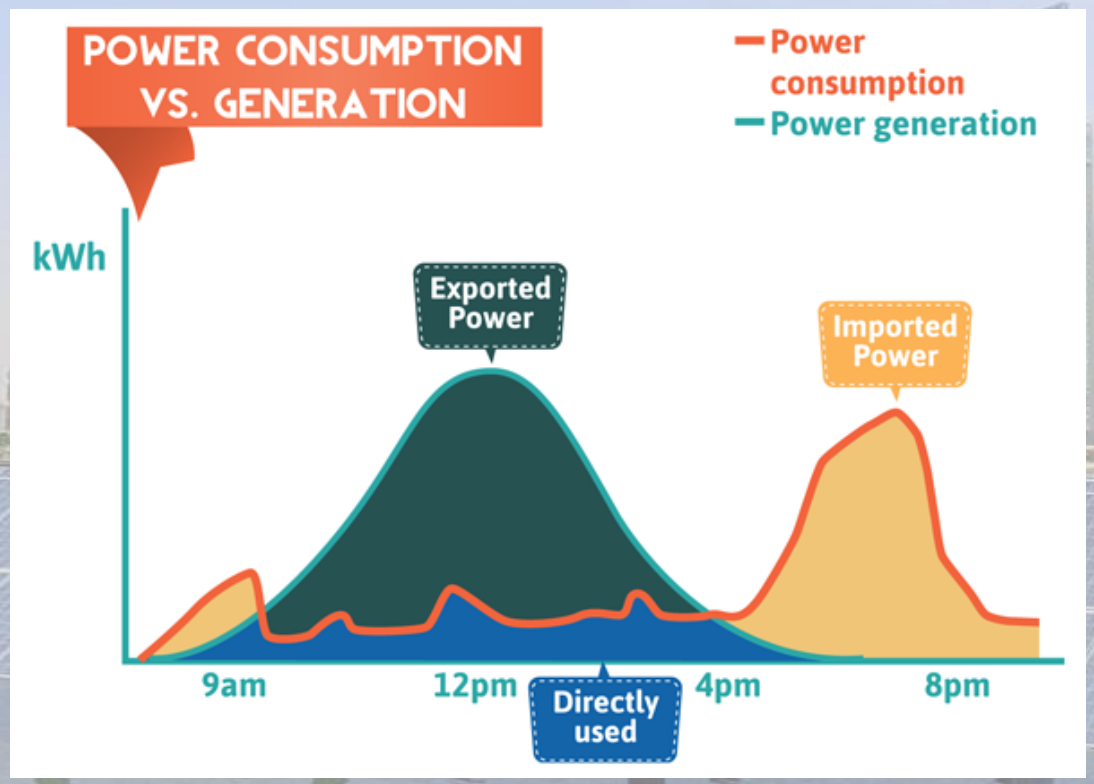


1.ASSOCIATED WITH OBLIGATORY MOBILITY (from home to work)

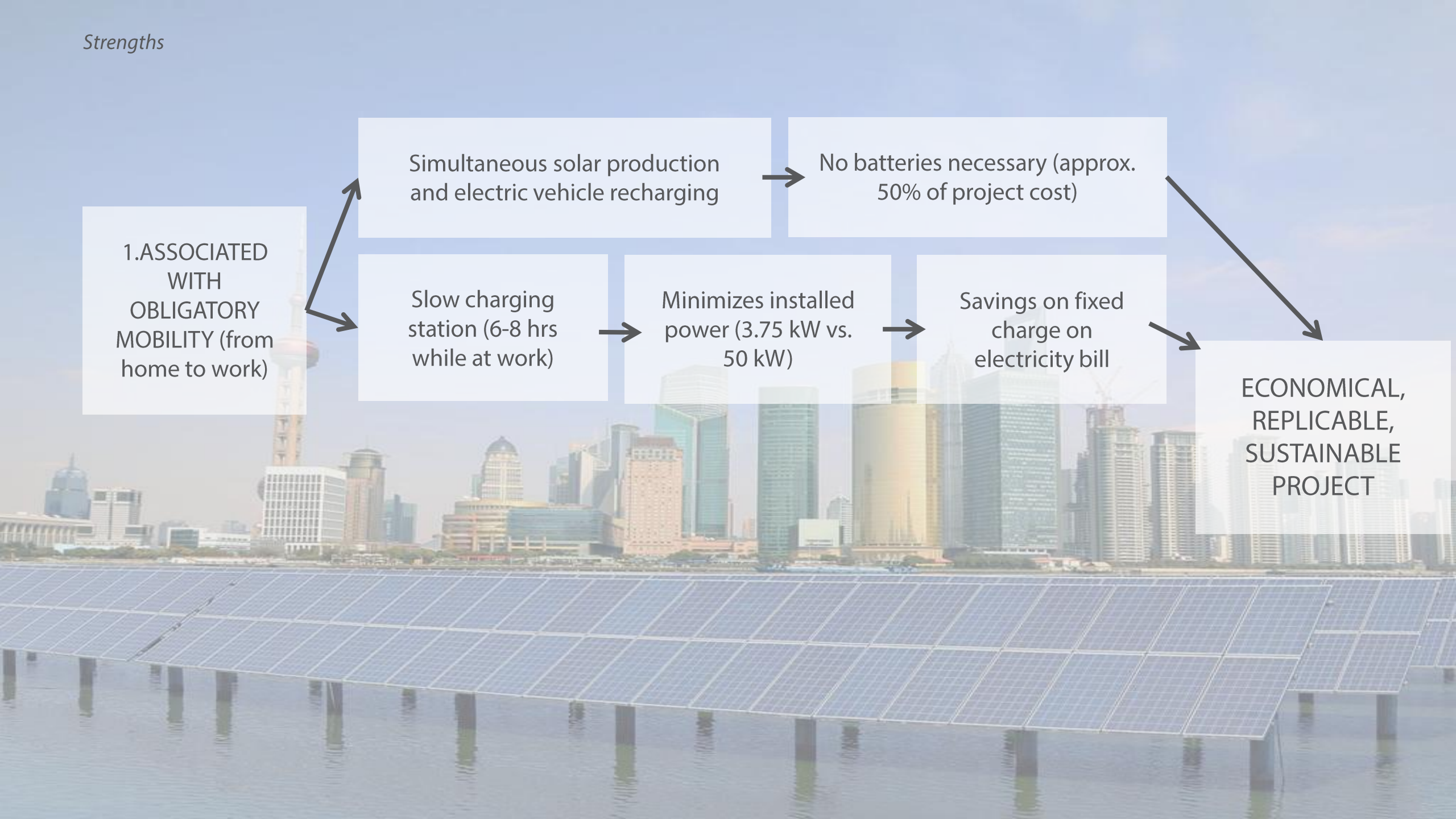
Simultaneous solar production and electric vehicle recharging

No batteries necessary (approx. 50% of project cost)

ECONOMICAL, REPLICABLE, SUSTAINABLE PROJECT



Strengths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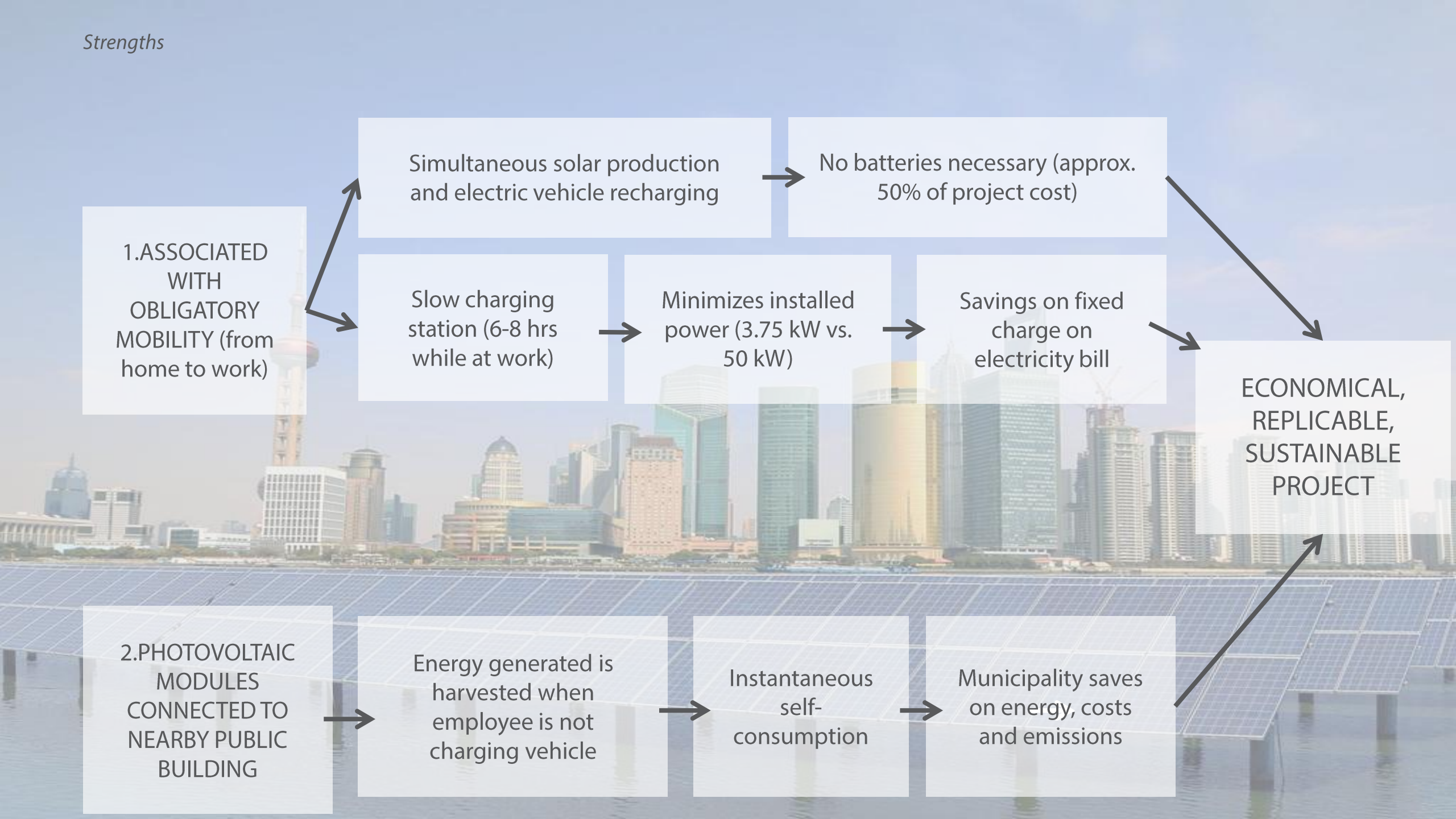
Simultaneous solar production and electric vehicle recharging
No batteries necessary (approx. 50% of project cost)
Slow charging station (6-8 hrs while at work)
Minimizes installed power (3.75 kW vs. 50 kW)
Savings on fixed charge on electricity bill
ECONOMICAL, REPLICABLE, SUSTAINABLE PROJECT

Strengths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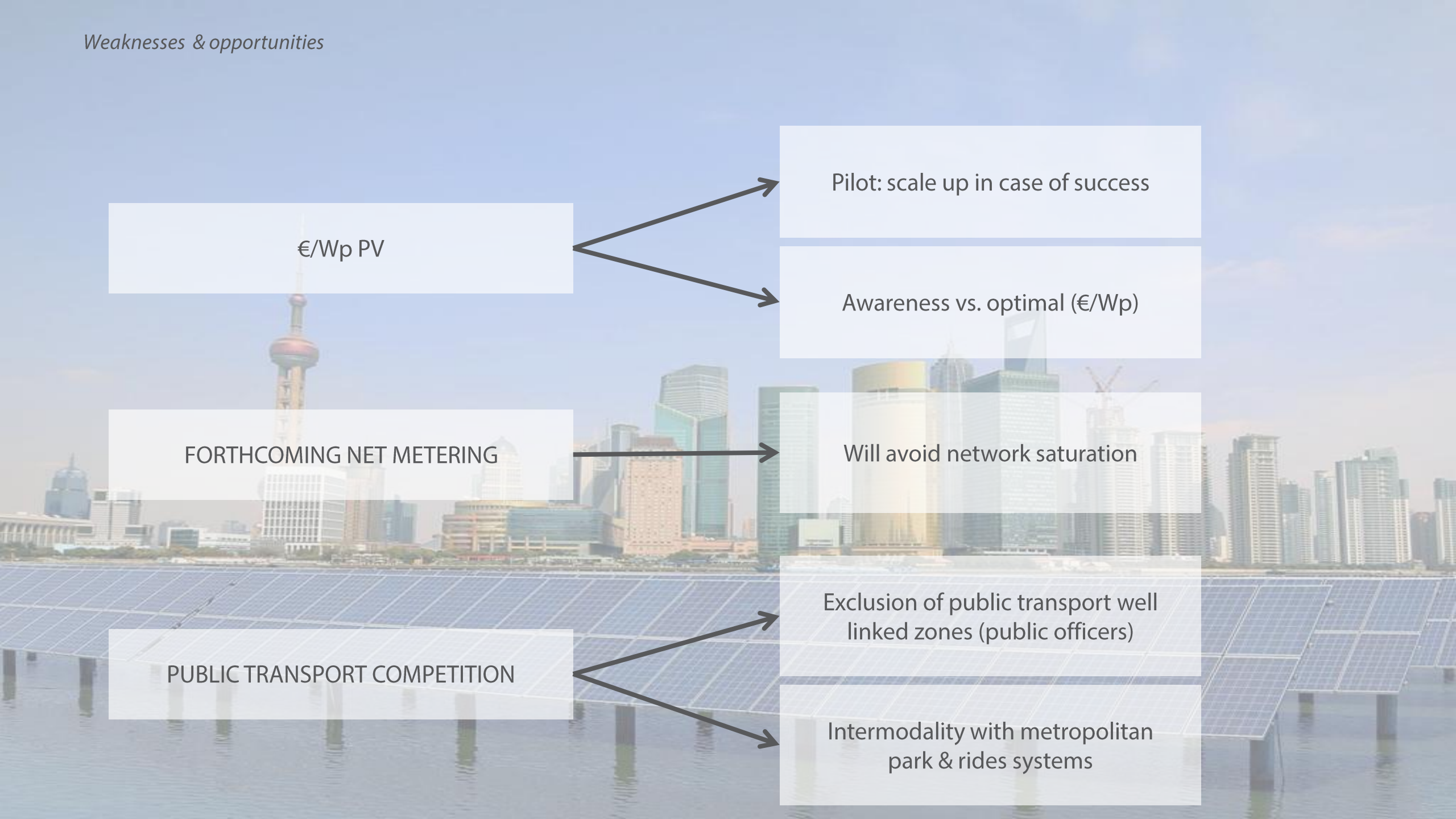
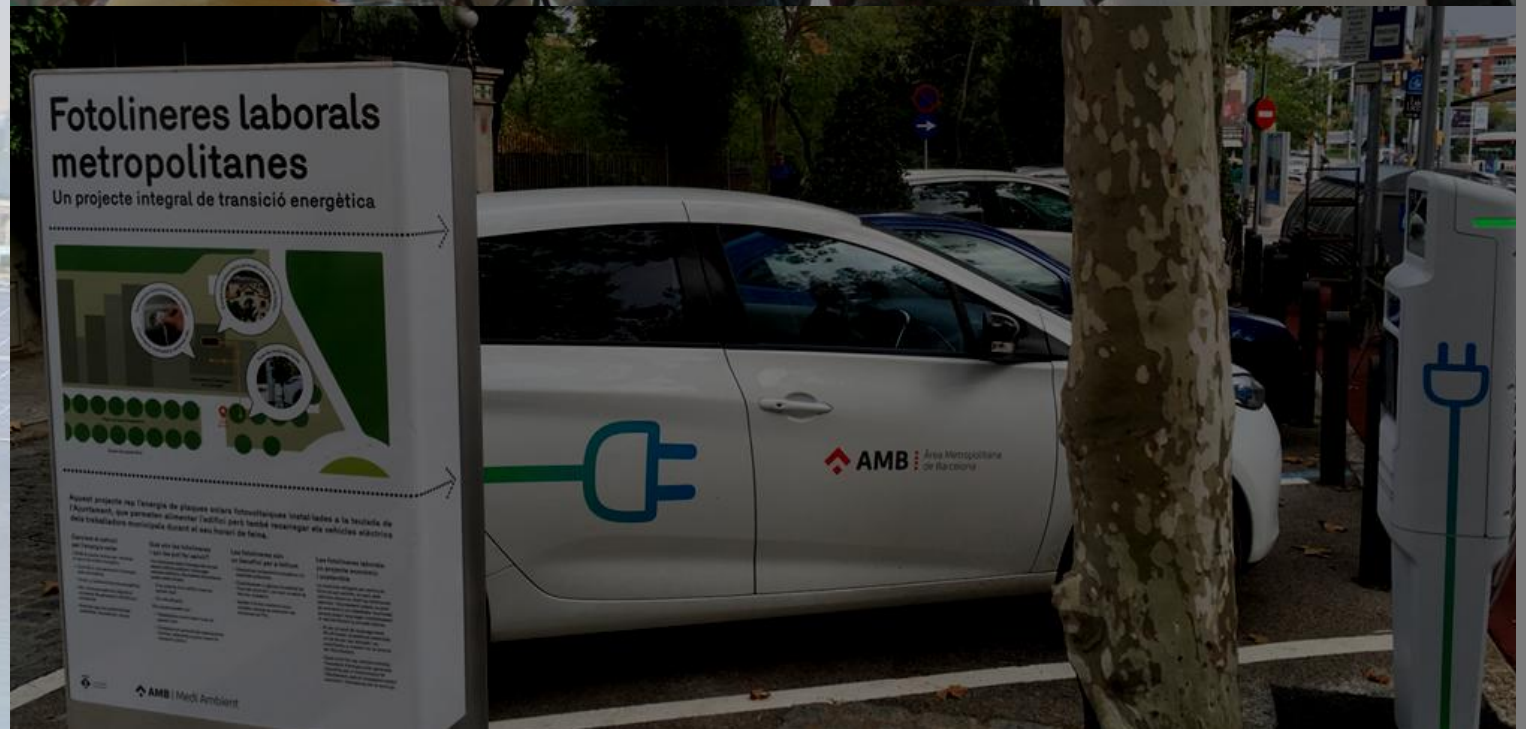
Slow charging station (6-8 hrs while at work)
Minimizes installed power (3.75 kW vs. 50 kW)
Savings on fixed charge on electricity bill
ECONOMICAL, REPLICABLE, SUSTAINABLE PROJECT
2.PHOTOVOLTAIC MODULES CONNECTED TO NEARBY PUBLIC BUILDING
Energy generated is harvested when employee is not charging vehicle
Instantaneous self-consumption
Municipality saves on energy, costs and emissions


€/Wp PV
Pilot: scale up in case of success
Awareness vs. optimal (€/Wp)
FORTHCOMING NET METERING
Will avoid network saturation
PUBLIC TRANSPORT COMPETITION
Exclusion of public transport well linked zones (public officers)
Intermodality with metropolitan park & rides systems

AMB gives up the charging point to a officer for a full recharge while he is at work

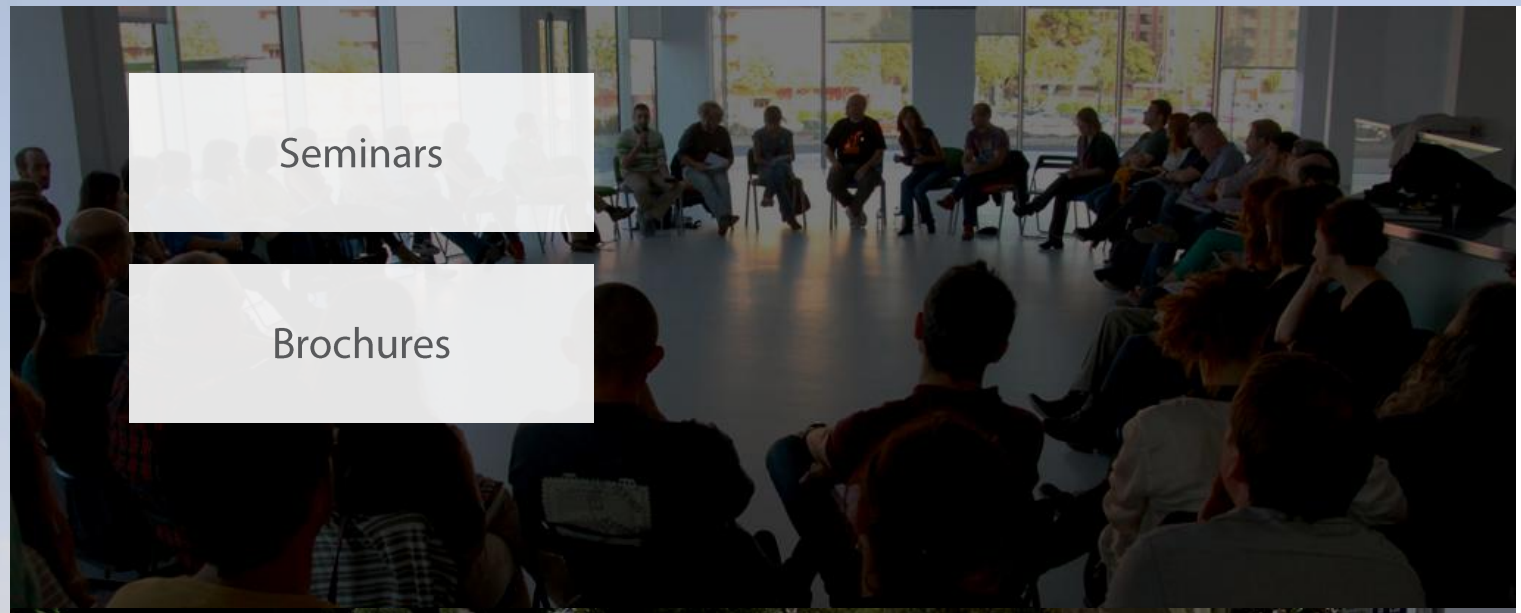
Seminars

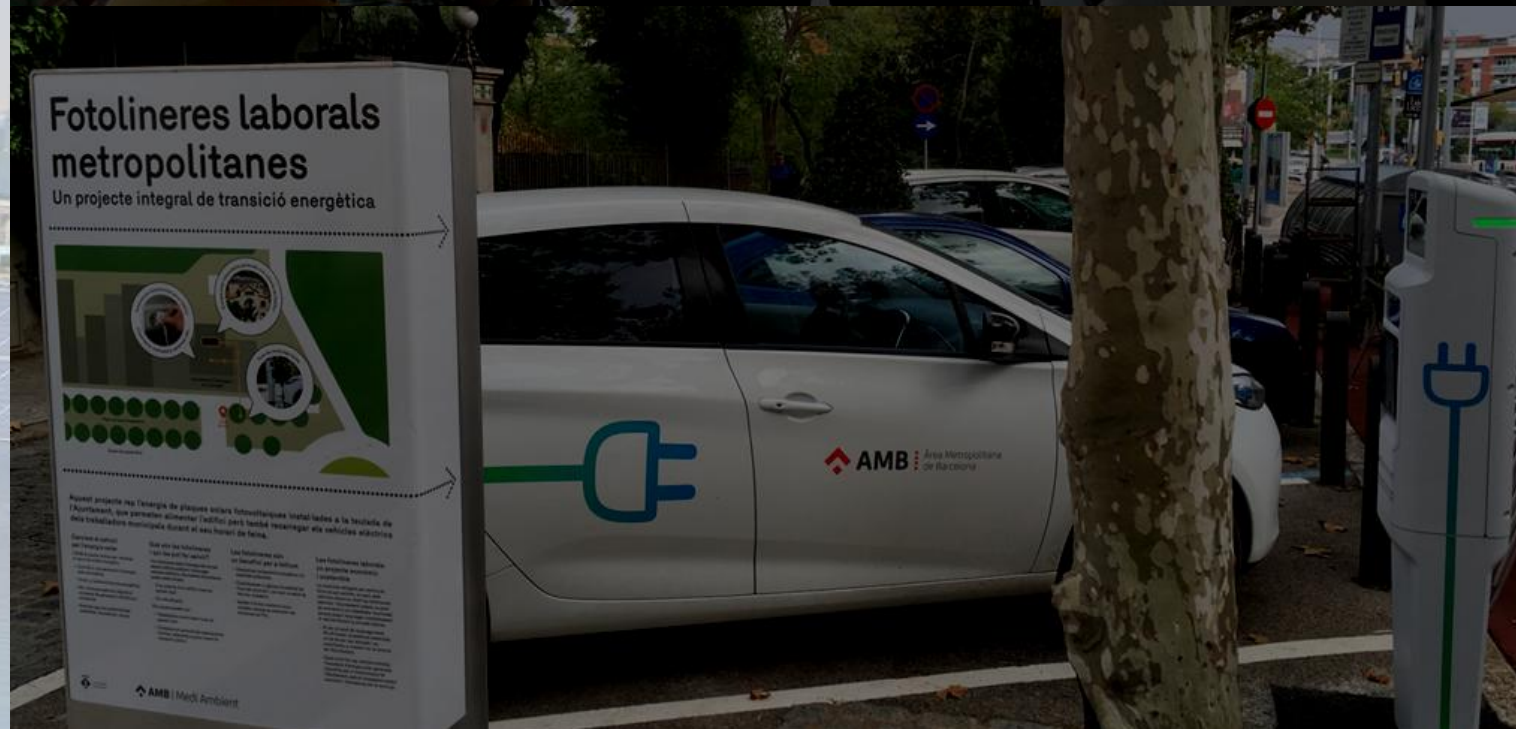

Fotolineres laborals metropolitanes
Un projecte integral de transició energètica
AMB
Àrea Metropolitana de Barcelona
AMB | Medi Ambient

Si tu hi poses el vehicle elèctric,
l'AMB t'omple el dipòsit d'energia solar.
CADA DIA!
www.amb.cat/medi-ambient
AMB | Medi Ambient

Seminars

Brochures





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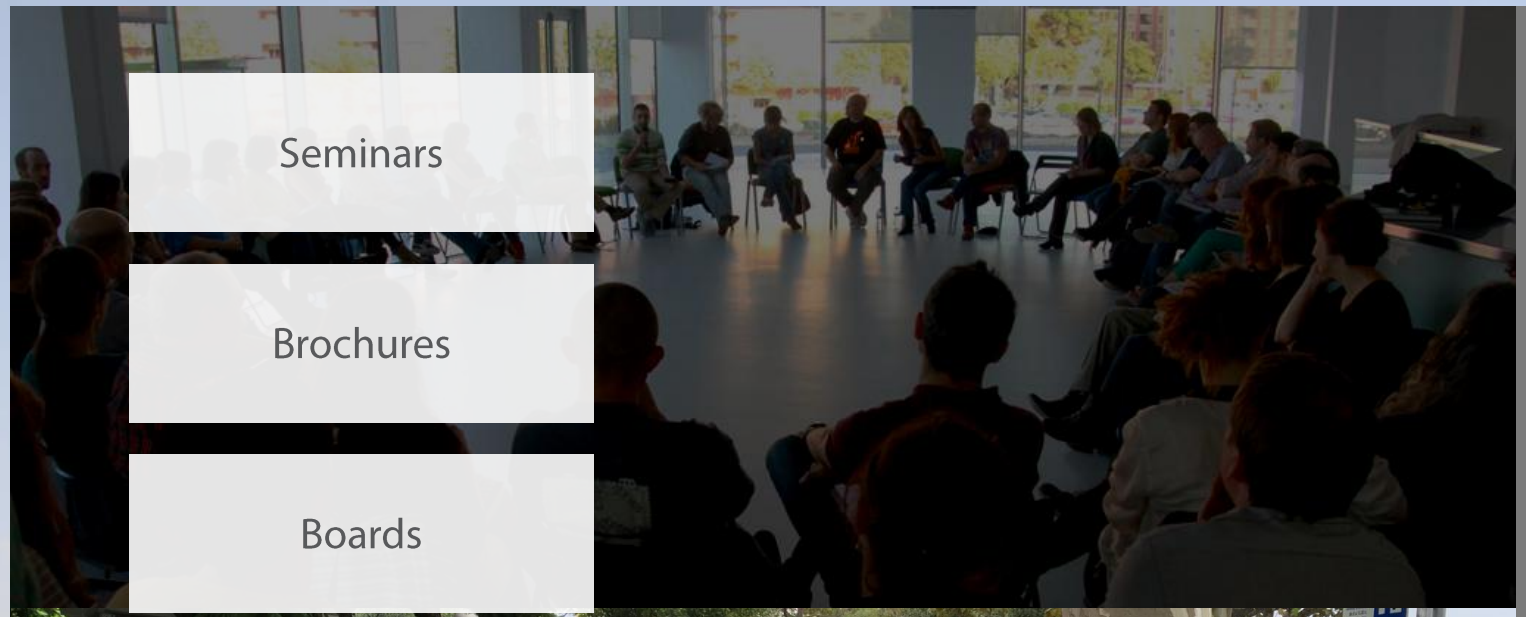
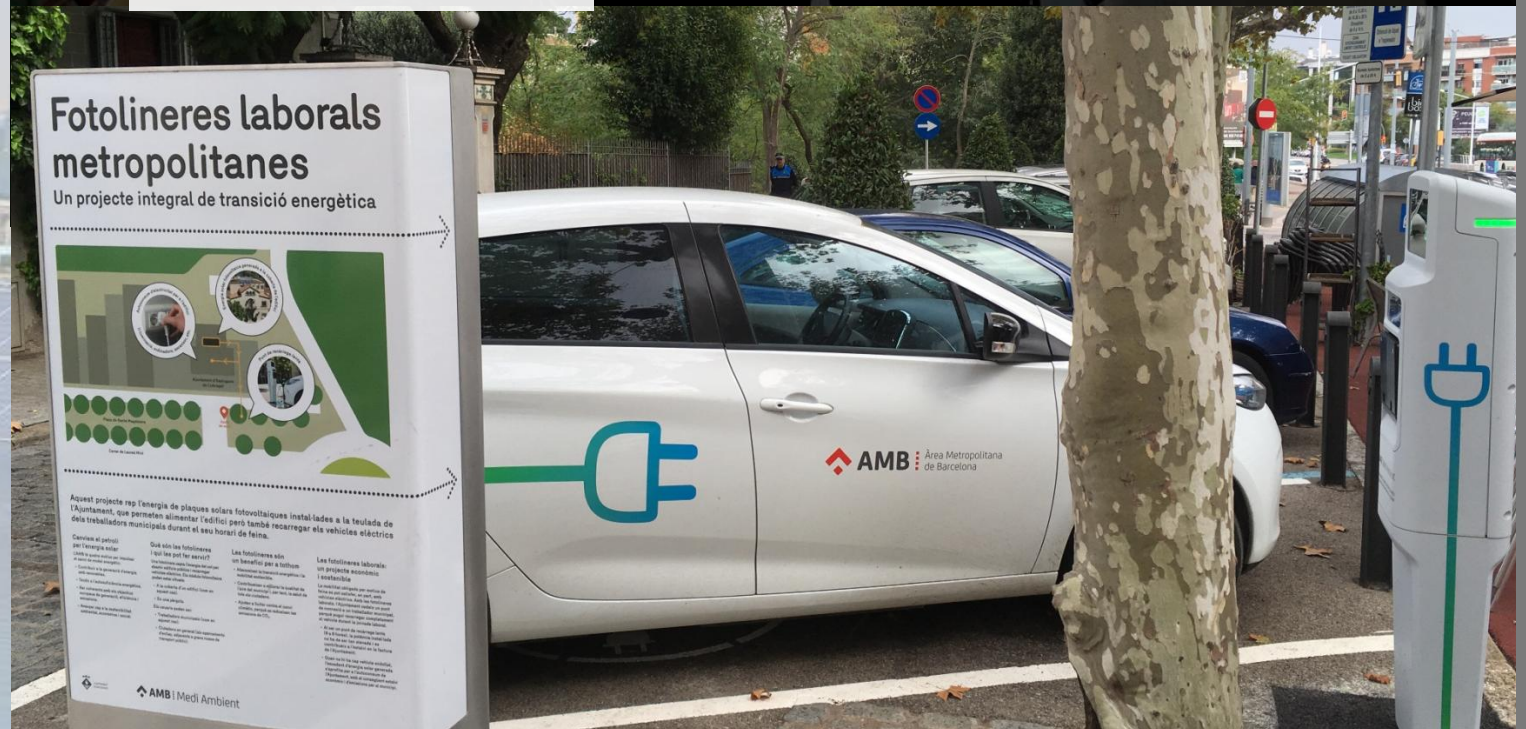


- Seminars
- Brochures
- Boards

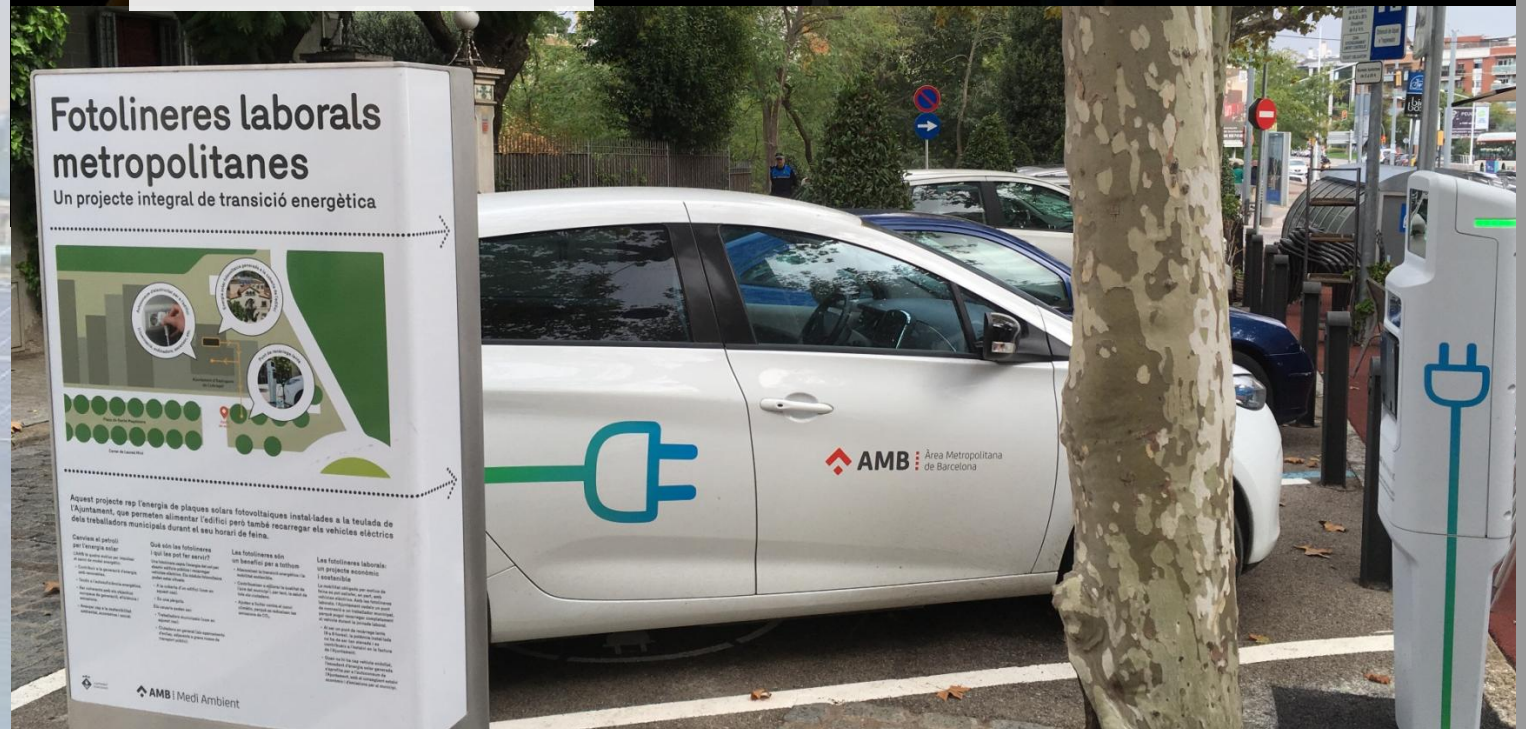


Seminars

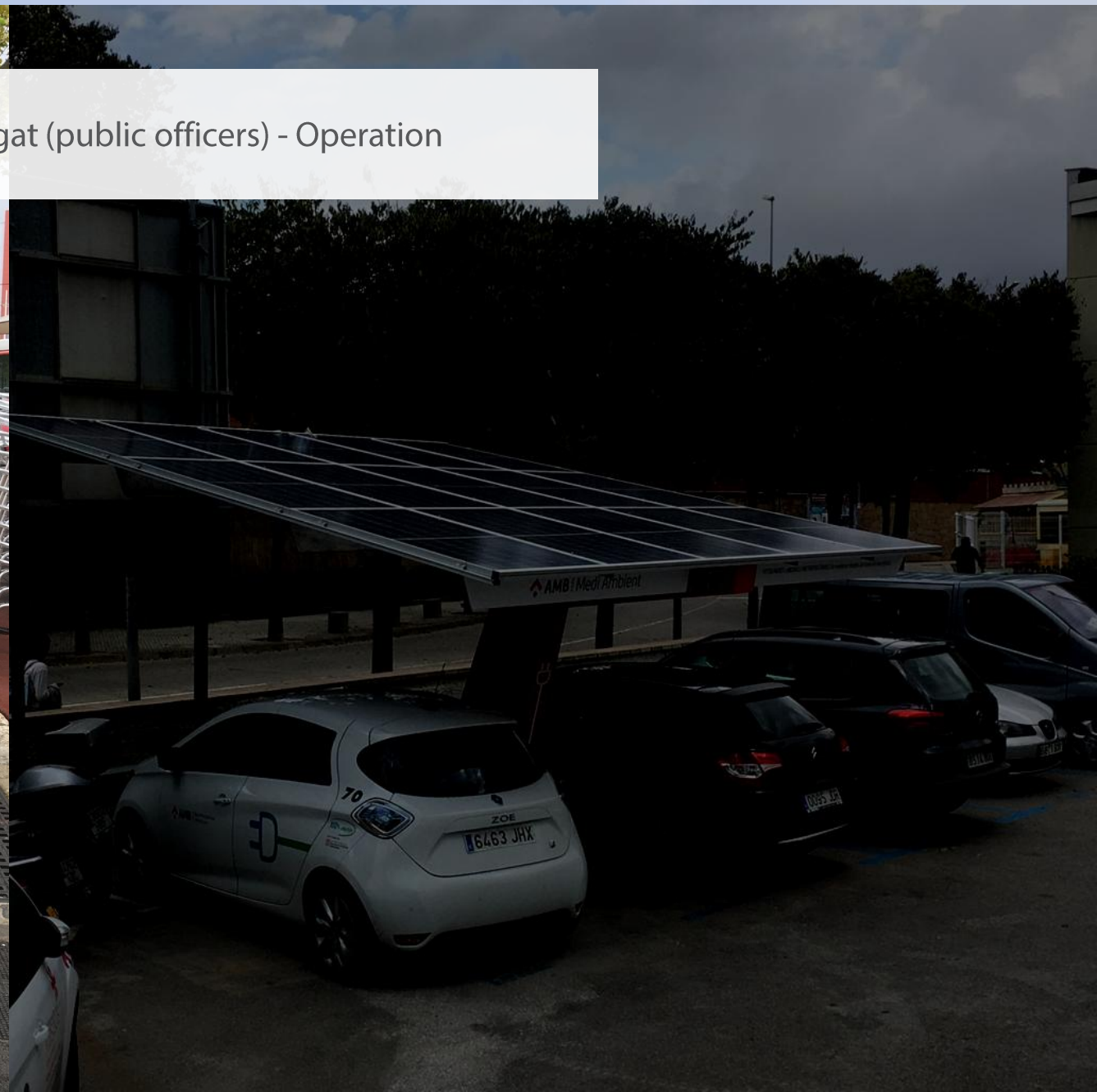
Brochures

Boards

Any kWh is lost until we didn't convince a single user

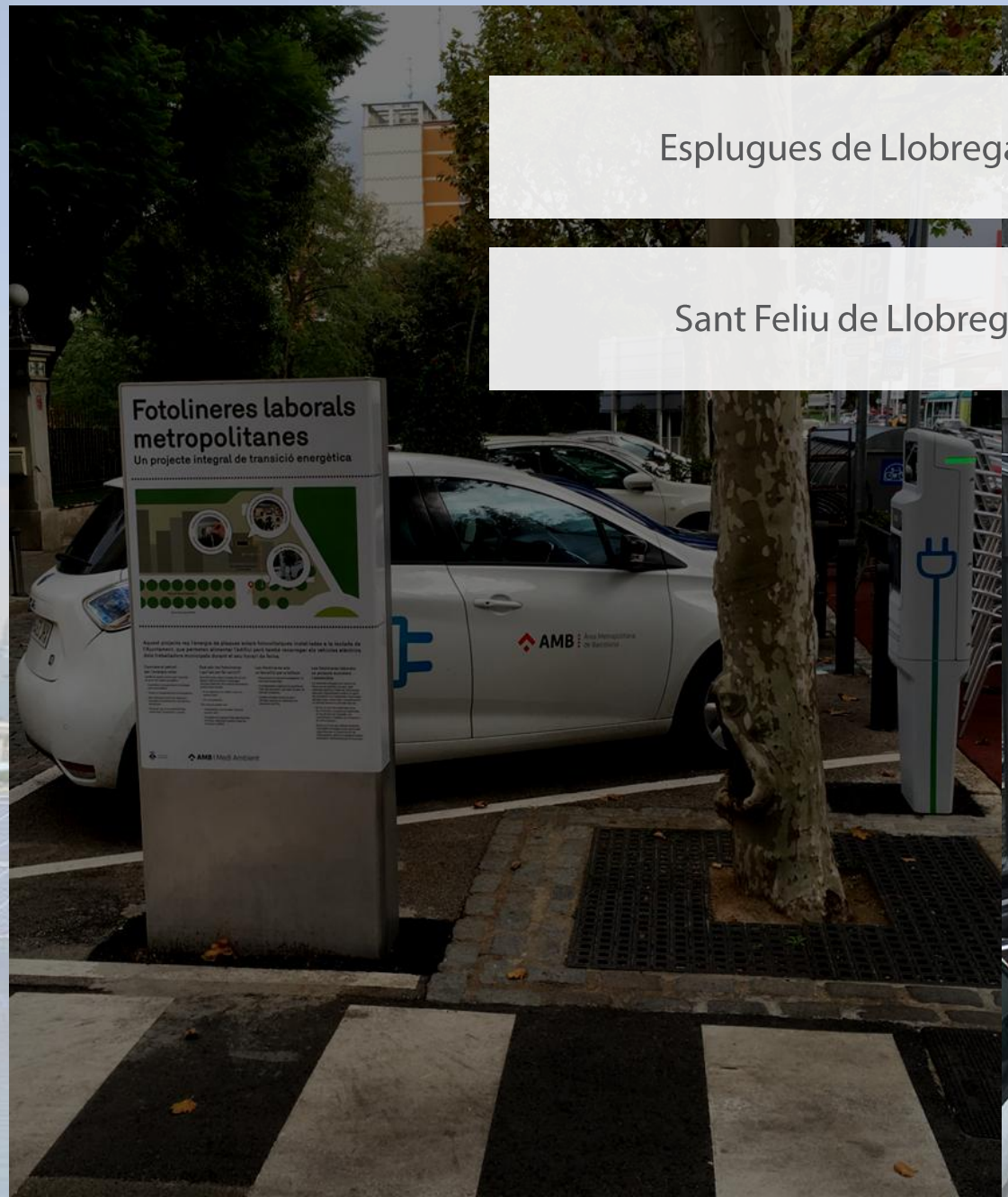


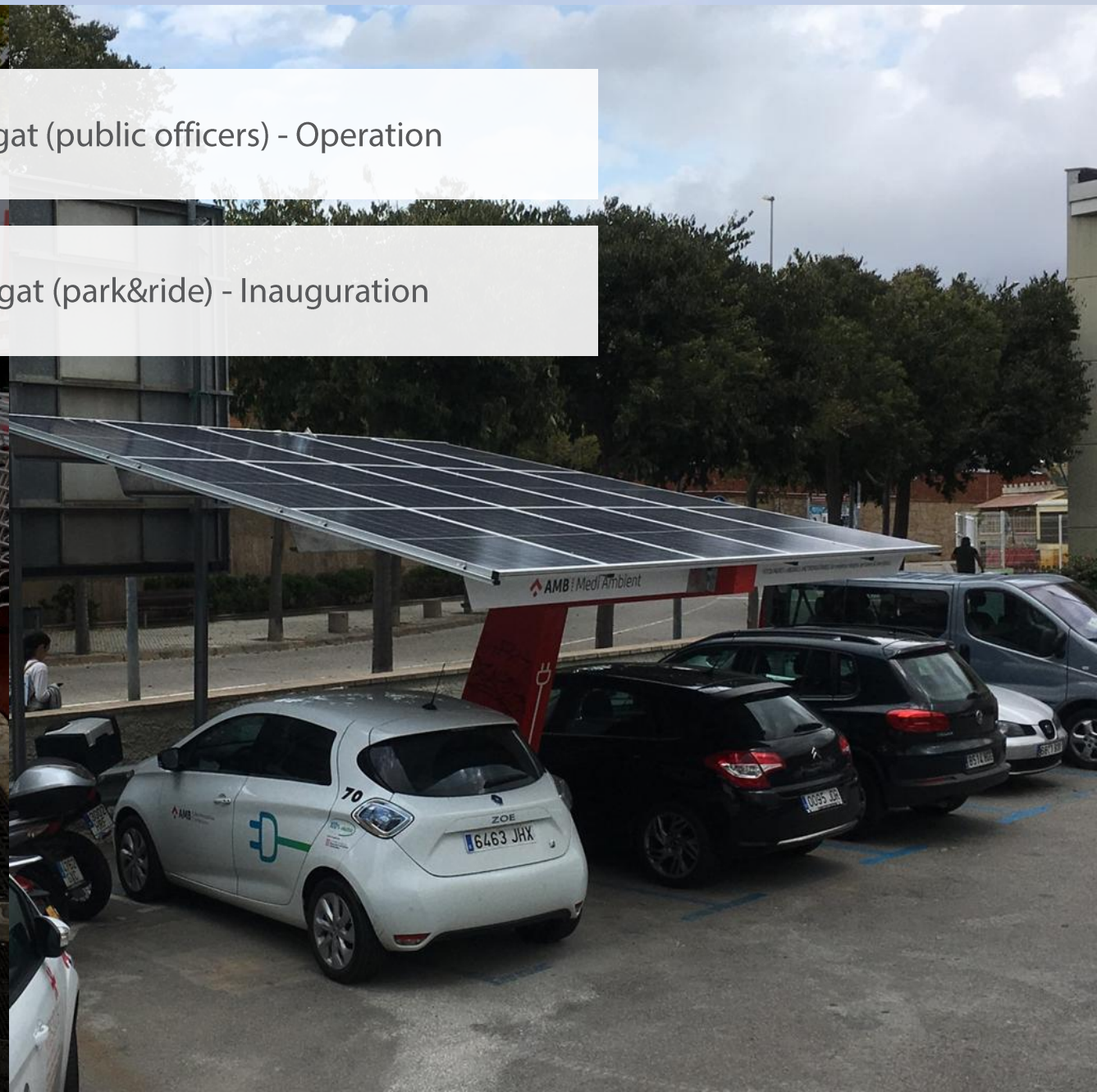
Esplugues de Llobregat (public officers) - Operation



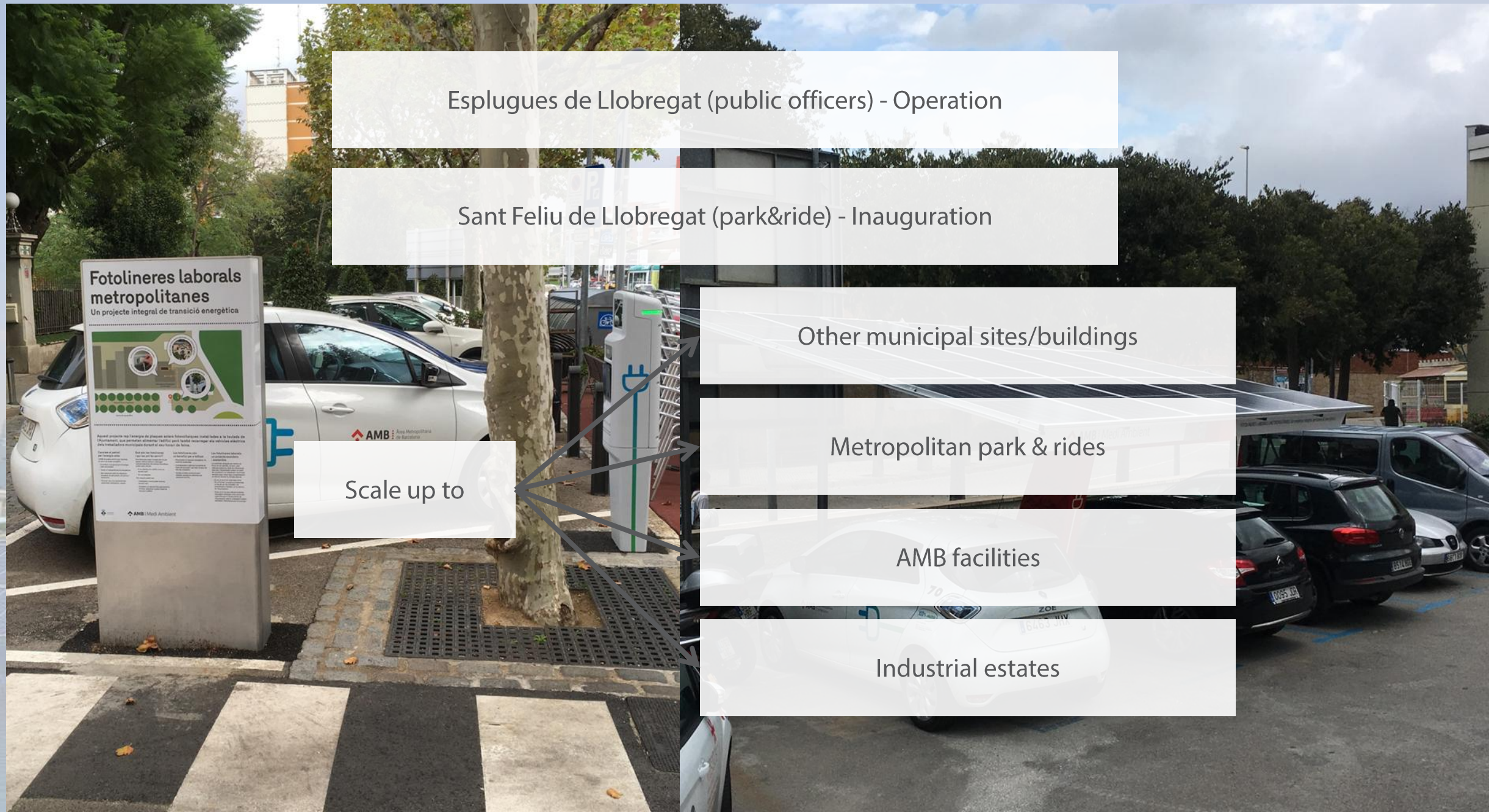
Esplugues de Llobregat (public officers) - Operation

Sant Feliu de Llobregat (park&ride) - Inauguration





Short term



Esplugues de Llobregat (public officers) - Operation

Sant Feliu de Llobregat (park&ride) - Inauguration

Scale up to

- Other municipal sites/buildings
- Metropolitan park & rides
- AMB facilities
- Industrial estates

0. AMB, the institution
1. Energy transition projects
    1.1. Renewables
    1.2. NZEB: building and city scales

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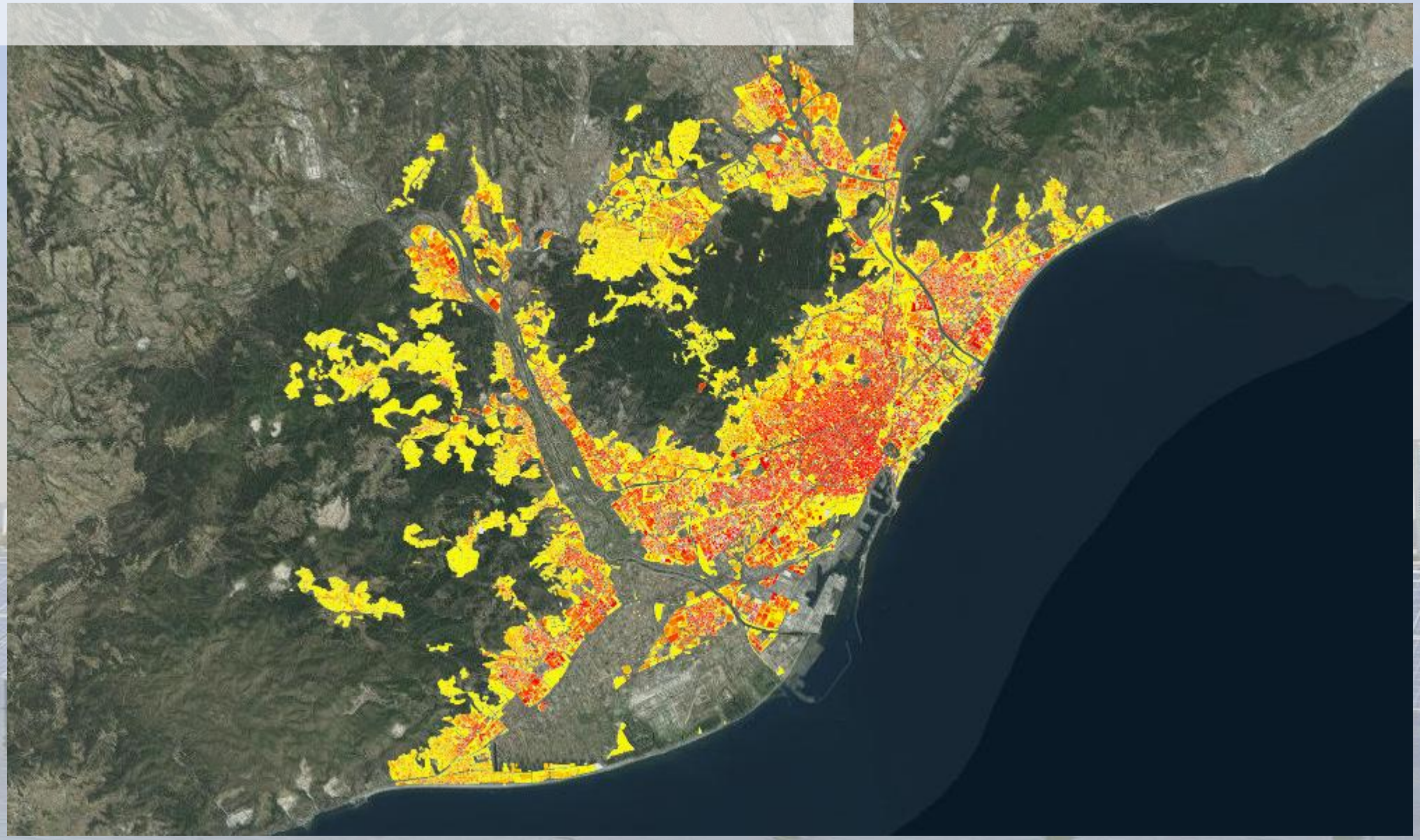
Legal framework: EPBD Directive

AMB Àrea Metropolitana de Barcelona

NZEB obligation by 2018 (public)-2020(private)

The Metropolitan context

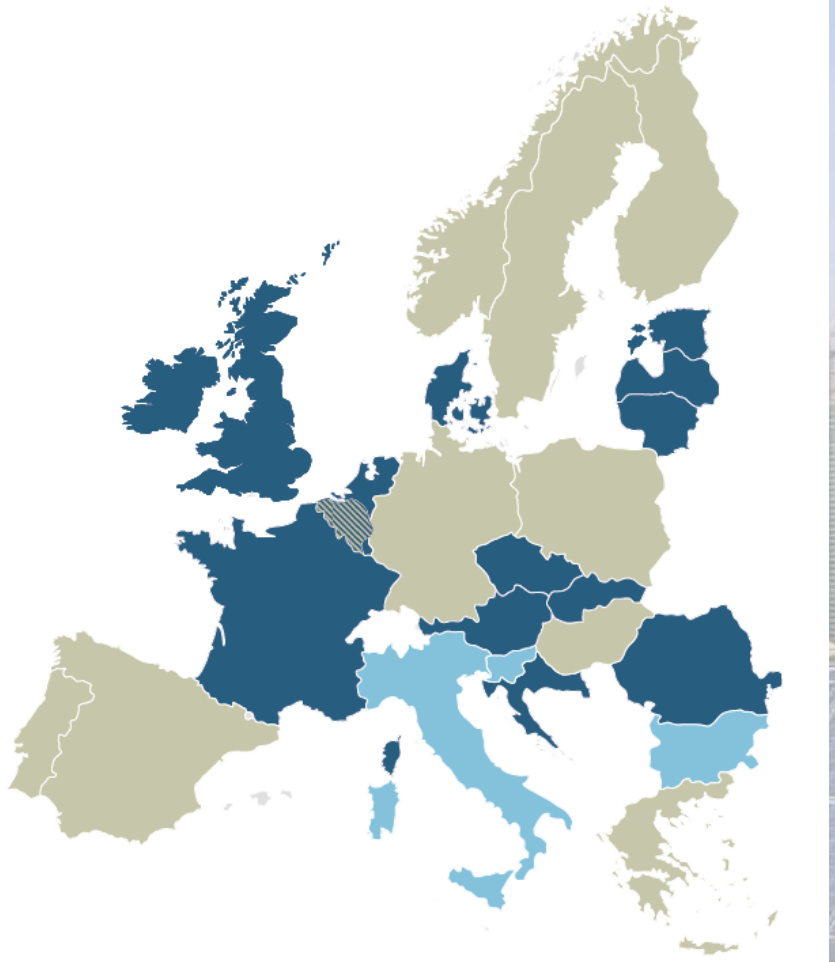
AMB Àrea Metropolitana de Barcelona



State of definition

To date, a definition is available in 15 countries (plus Brussels Capital Region and Flanders). In a further 3 countries, the nZEB requirements have been defined and are expected to be implemented in the national legislation (Figure 4). In the remaining 9 MS (plus Norway and the Belgian Region of Wallonia), the definition is still under discussion and has not been finalised yet.

Figure 5 - Status of nZEB definition for new buildings (Source: BPIE, 2015)



* France - Requirements for buildings with an energy consumption close to zero have already been enforced but it is foreseen that buildings will be positive energy buildings from 2020.

State of definition

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Country	nZEB definition for new buildings									nZEB definition for existing buildings		
	Status of the definition	Main reference(s)	Year of enforcement		EPBD scope of nZEB definition [1]	Numerical indicator	Maximum primary energy [kWh/m²y]		Share of renewable energy	Other indicators	Status of the definition	Maximum primary energy [kWh/m²y]	
			Public	Non-public			Residential buildings	Non-residential buildings				Residential buildings	Non-residential buildings
Italy	Still to be approved (under publication)	Draft of the new EPBD decree	1/01/2019	1/01/2021	✓	Still to be approved	Included in the upcoming updated version of the National nZEB Plan [2,3]		Quantitative	EP, TS	✓ As for new buildings	Included in the upcoming updated version of the National nZEB Plan [2,3]	
Latvia	✓	Regulation 383/2013	1/01/2019	1/01/2021	✓	✓	95	95	✓ Quantitative	EP	✓ As for new buildings	95	95
Lithuania	✓	Regulation STR 2.01.09 :2012	1/01/2019	1/01/2021	✓	✓	Included in the calculation; building needs to comply with class A++		✓ Quantitative	EP	✓ As for new buildings	Included in the calculation; building needs to comply with class A++	
Luxembourg	✓ Details to be fixed	National nZEB Plan	1/01/2019	1/01/2021	✗ [6]	✓	Included in the calculation; building needs to comply with class A-A-A		✓ Qualitative	EP, CO_2	ND		
Malta	Under development	National nZEB Plan	1/01/2019	1/01/2021	✓	Current values to be revised	40	60	Qualitative	EP	ND		
Netherlands	✓	National nZEB Plan	1/01/2019	1/01/2021	✓	✓	Included in the calculation; building needs to comply with energy performance coefficient = 0		✗	EP	ND		
Norway	Under development	Presentation by Research Centre on Zero Emission Buildings	1/01/2021	1/01/2021	✓	Under development			Minimum share in current requirements for all buildings	CO_2 (main indicator), EP, TS	ND		
Poland	Under development	Consolidated report to EC	1/01/2019	1/01/2021	✓	Under development	60-75 [2]	45-70 [2]	✗		ND		
Portugal	Under development	Law 118/2013	1/01/2019	1/01/2021	✓	In current requirements for buildings			✗		ND		
Romania	✓	National nZEB Plan	1/01/2019	1/01/2021	✓	✓	93-217 [2,3]	50-192 [2,3]	✓ Quantitative	CO_2	ND		
Slovakia	✓	Decree 364/2012	1/01/2019	1/01/2021	✗ [6]	✓	32-54 [2]	34-96 [2]	✓ Quantitative	EP	ND		
Slovenia	Still to be approved	Official Journal 17/14, National nZEB Plan	1/01/2019	1/01/2021	✓	Still to be approved	45-50 [2]	70	Under development	EP	Still to be approved	70-90 [2]	100
Spain	Under development	Decree 235/2013	1/01/2019	1/01/2021	✓	Under development	Included in the calculation; it is foreseen that buildings will need to comply with class A		Minimum share in current requirements for all buildings	CO_2 (main indicator)	Under development		
Sweden	Under development	National nZEB Plan	1/01/2019	1/01/2021	✓	Under development	30-75 [2,3]	30-105 [2,3]	✗		ND		
UK (England)	✓ Details to be fixed	National nZEB Plan, presentation by Zero Carbon Hub	1/01/2018 (from 2016 for residential buildings) [9]	1/01/2019 (from 2016 for residential buildings) [9]	✓	✓	~ 44 (2)	ND	✓ Qualitative	CO_2 (main indicator), EP, TS	ND		
							Included in the calculation; building will need to comply with carbon emissions ~ 0						

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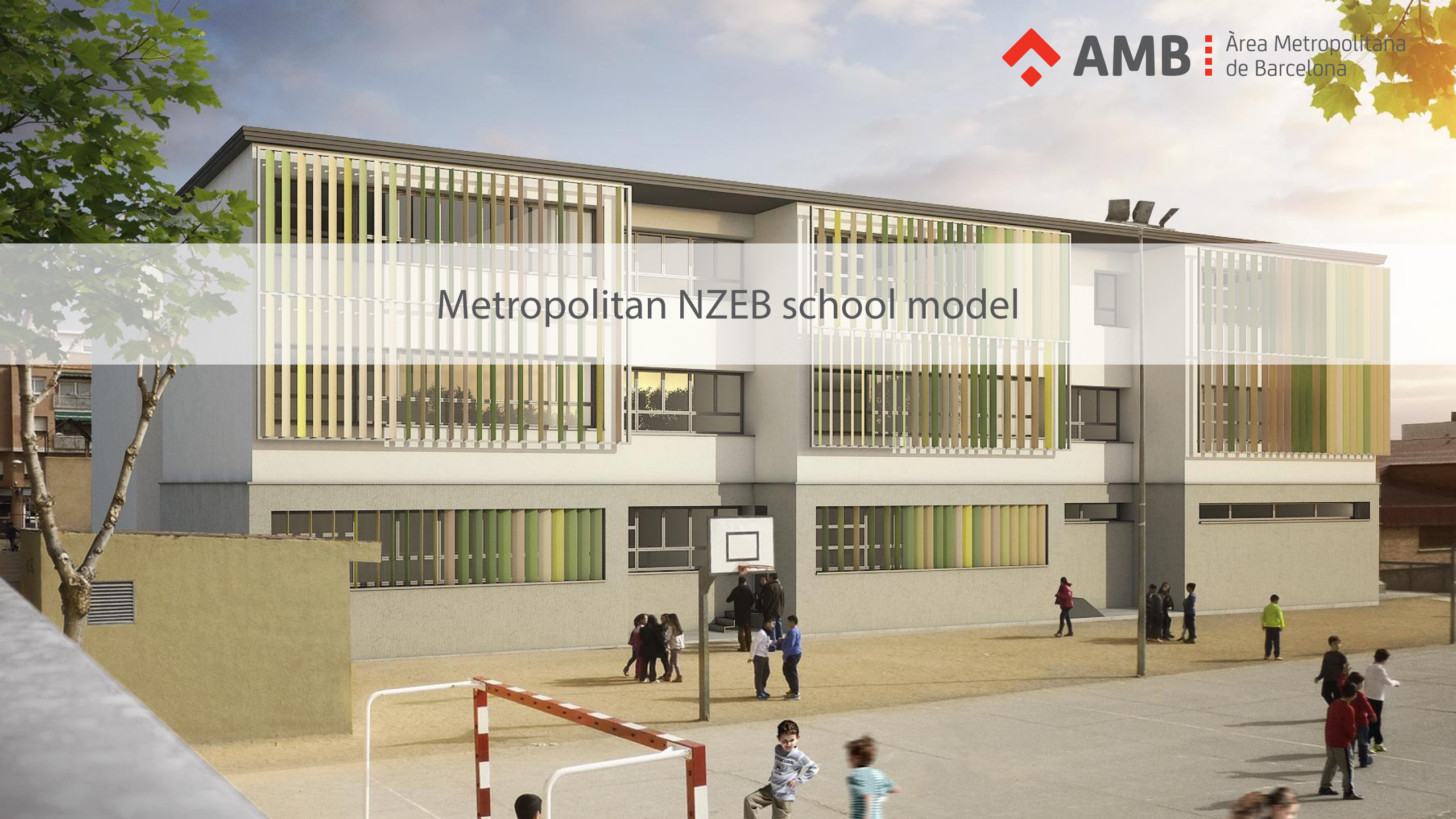
Metropolitan NZEB school model



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Responsibility and leadership from municipalities

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Escola Margalló, Castelldefels

		kWh/m².a
	483	
m²	2.700	146
año	1997	

Escola El Garrofer, Viladecans

		kWh/m².a
	483	
m²	3.300	89
año	1974	

Escola Cascavell, Sant Adrià del Besòs

		kWh/m².a
	245	
m²	2.700	98
año	1980	

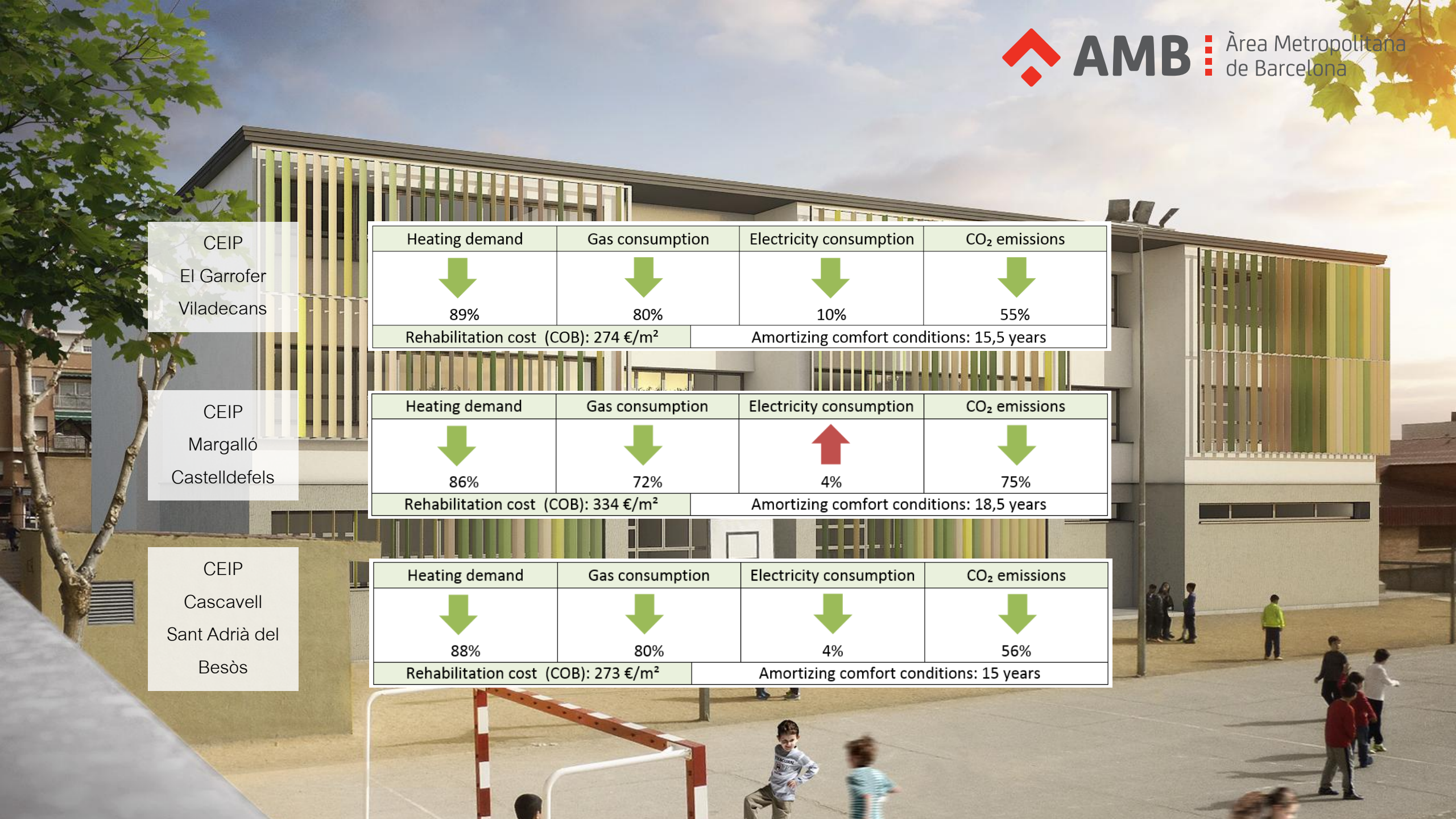
4500
4000
3500
3000
2500
2000
1500
1000
500
0
CO2 (ppm)
90
80
70
60
50
40
30
20
10
0
Tª (ºC)
H.R. (%)
Nivells de CO2 (ppm)
Temperatura interior (ºC)
Humitat relativa (%)

a) **Passivhaus adapted to the Mediterranean**

b) Passivhaus certificate

c) B certificate

Certification criteria		Requirements
Heating	Heating demand	≤ 15 kWh/m²·year
	Heating loads	≤ 10 W/m²
Cooling	Overheating frequency (26ºC)	≤ 10 %
Primary Energy	*(heating, cooling, SHW, ventilation, lighting, electric appliances)*	≤ 120 kWh/m²·year
Air tightness	*Blower Door* n_{50} results	1,0 renovations/h



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CEIP El Garrofer Viladecans

Heating demand	Gas consumption	Electricity consumption	CO_2 emissions
↓ 89%	↓ 80%	↓ 10%	↓ 55%
Rehabilitation cost (COB): 274 €/m²		Amortizing comfort conditions: 15,5 years	

CEIP Margalló Castelldefels

Heating demand	Gas consumption	Electricity consumption	CO_2 emissions
↓ 86%	↓ 72%	↑ 4%	↓ 75%
Rehabilitation cost (COB): 334 €/m²		Amortizing comfort conditions: 18,5 years	

CEIP Cascavell Sant Adrià del Besòs

Heating demand	Gas consumption	Electricity consumption	CO_2 emissions
↓ 88%	↓ 80%	↓ 4%	↓ 56%
Rehabilitation cost (COB): 273 €/m²		Amortizing comfort conditions: 15 years	

AMB
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de Barcelona
Great replication potential
Great energy improvement potential
NZEB awareness
Thermal and air quality comfort

AMB Àrea Metropolitana de Barcelona

Municipal NZEB refurbishment strategies
BadiaNZEB 2025?

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Define and test a comprehensive NZEB refurbishment model at city/neighborhood scale

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BadiaNZEB 2025?
From a socioeconomic stigma to a paradigmatic low carbon project

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1. NZEB definition & timeline

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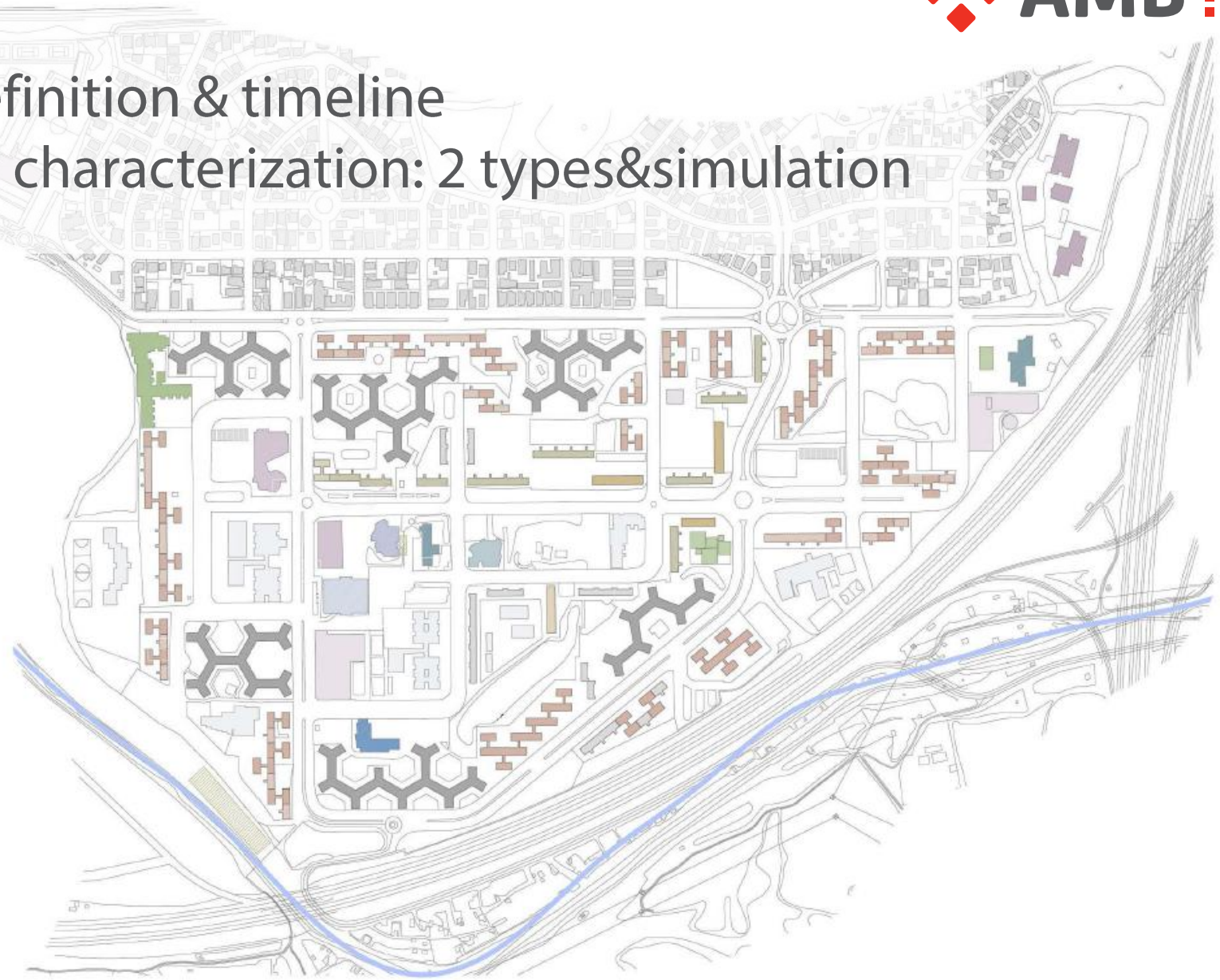
2. Building characterization: 2 types&simulation



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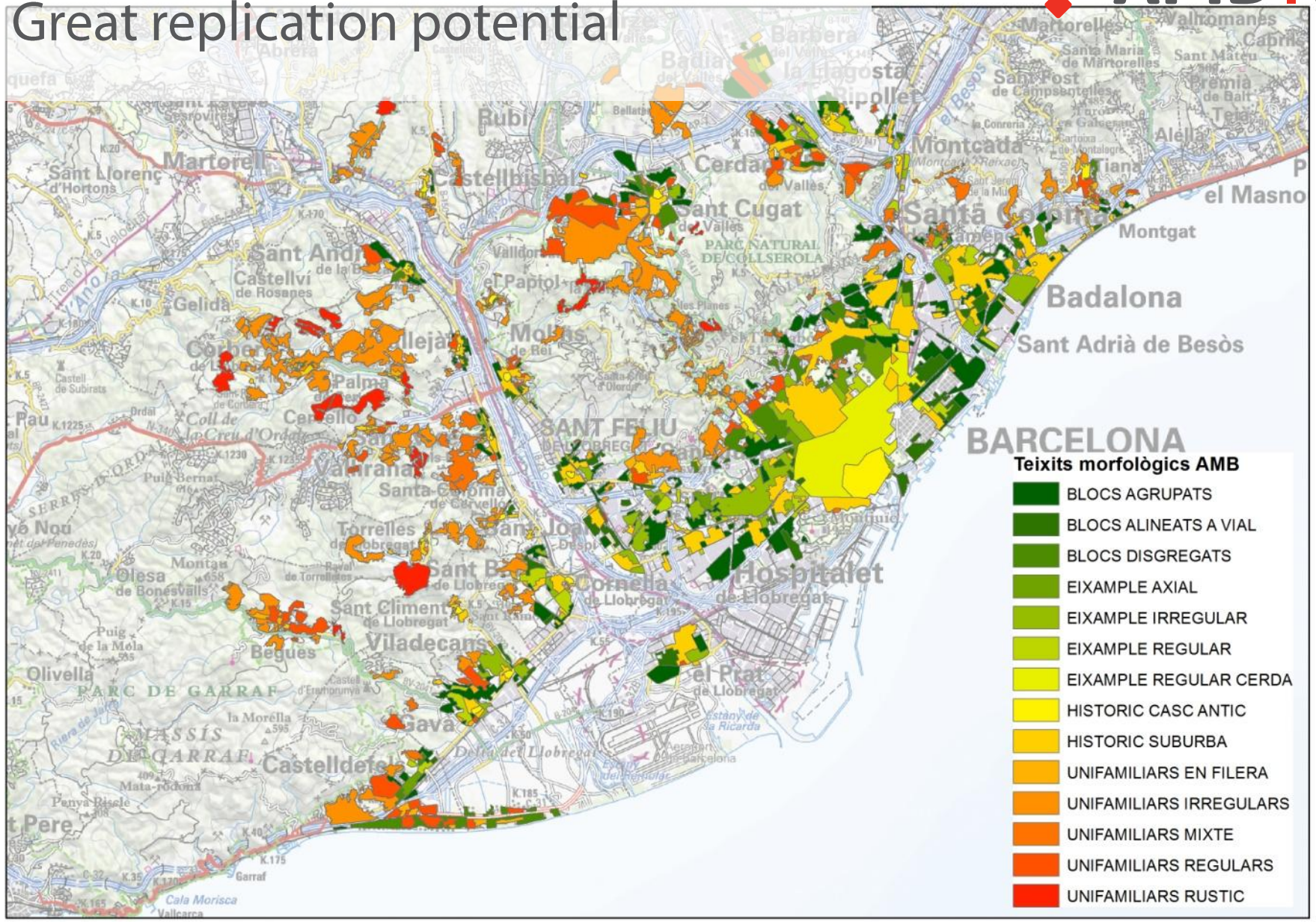
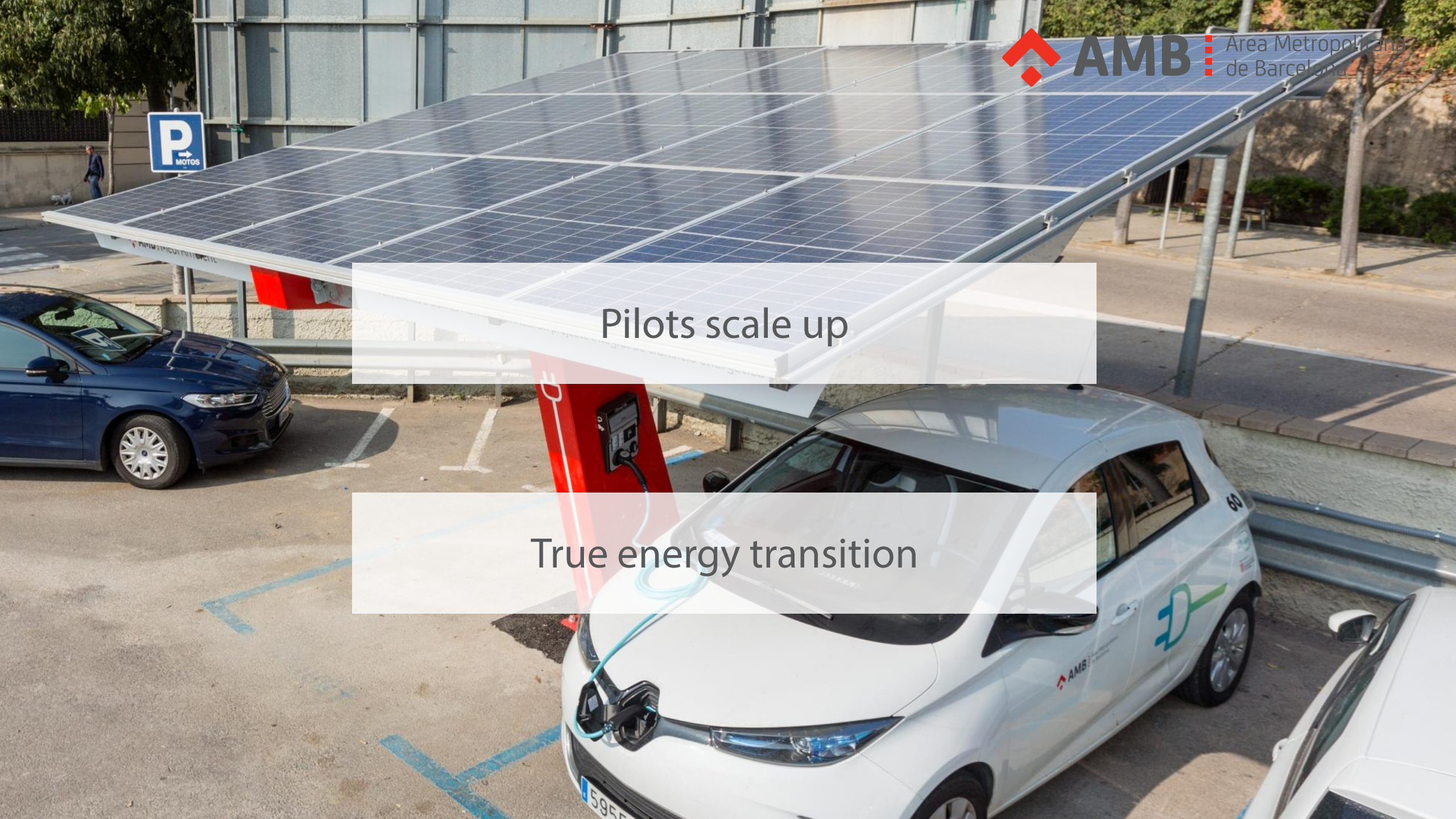
1. NZEB definition & timeline
2. Building characterization
3. Master Plan: rehabilitation + fuel poverty+ business model
   - Financing alternatives
   - PPP alternatives

Great replication potential

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Pilots scale up
True energy transition

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Energy Transition at Barcelona Metropolitan Area

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IESE Energy Club 9-11/11/2016