

LANDSCAPE-BASED ENERGY TRANSITION

2025-2026 © UNIFI-DIDA Landscape Design Lab

Gabriele Paolinelli (coordinator) - Anna Lambertini, Tessa Matteini, Emanuela Morelli, Antonella Valentini (specialist staff) - Paolo Picchi (specialist expert fellow), Gaetano Calise, Marco Dettori (specialist fellow)

Each Landscape

of your Island is the greatest collective story of the relationships between communities and the places they live in. The landscape is always changing, its story is never-ending.

Landscapes are always contemporary as they record and reflect the changes of societies and environments. Therefore not only we do have to look at the nowadays energy transition with regard to landscapes but we can also imagine and express it through them.

Every landscape embodies renewable natural energies, as the sun and the wind. We can image a sustainable transition by planning and designing with regard to the specific features of every landscape. It means expressing the natural power of landscape.

We humans are natural beings and can take part in nature intelligent expressions. We can take part in the energy transition by evolving our critical thinking, aware that the transformation of renewable energy is not inherently sustainable, yet depending on how, where and how much.

Landscapes suggest what can be done with them rather than against them. Integrating renewable energy in the landscapes social-ecological systems seeks for the opportunity of change rather than escaping it.

With such an approach we can also protect every landscape from transformations to which it is unsuitable.

Thinking and acting with a landscape approach is not hiding or moving faraway transformations so to limit their visibility as much as possible. It concerns the need to find the right places, ways and weights of changes.

Being able to see the landscape changes, is having the ability to understand their social-ecological functions and aesthetics. It protects against financial-industrial colonization that supra-local authorities and energy companies sometimes try to overimpose.

Expressing the renewable energy embodied in the landscapes through proper transformations offers opportunities for the pursuit of a new aesthetic of sustainability. The energy transition is a chance to understand how we can adapt for living as guests of a beautiful world.



A new transition

In a world in transition the option of renewable energy is a factor of climate neutrality. It is by no means the only one, but it is an inevitable one. According to the article 5 of the Council of Europe Landscape Convention (2000), "Each Party undertakes: (...) to integrate landscape into its regional and town planning policies (...), as well as in any other policies with possible direct or indirect impact on landscape".

The CO2 PACMAN European Project aims to foster a landscape-based approach to the energy transition.

With regards to this goal, key topics and procedural steps frame a process of planning and designing to support decision making and implementation.

posters 02-03 LANDSCAPE FEATURES

The landscapes of the island of Crete are known and described. A brief survey of their most significant FEATURES regarding the energy transition is proposed.

poster 04 LANDSCAPE SUITABILITIES

Landscape features express different SUITABILITIES for using renewable energy technologies (RET). Screenings with regard to the sun and wind power are carried out per land use.

posters 05 LANDSCAPE SCENARIOS

Landscape suitabilities are framed in realistic hypothesis of current/ near future environmental social and economic processes in landscape SCENARIOS. Discussing and fine-tuning scenarios fosters communities engagement, supports shared decision-making, and contributes to achieving installed capacity targets. Three examples are proposed.

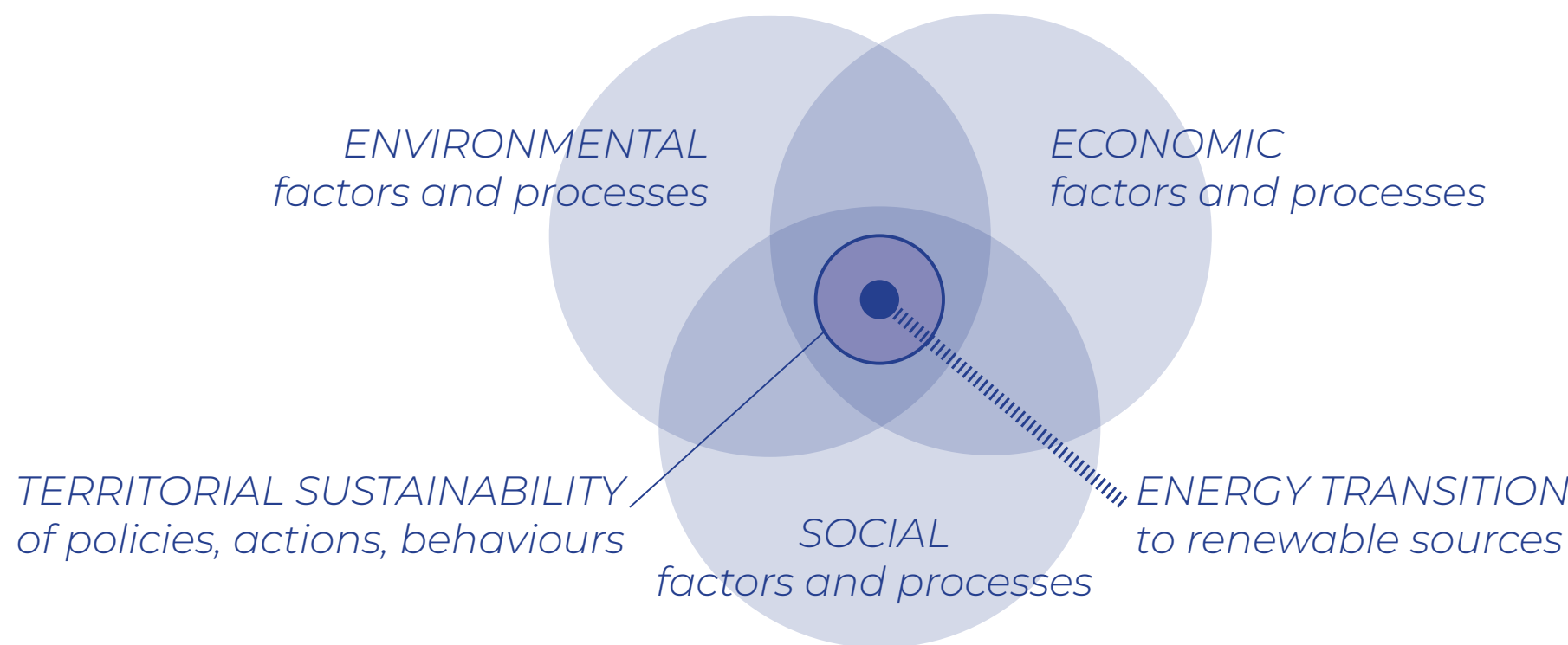
poster 06-08 LANDSCAPE CAPACITIES

From landscape scenarios, solar and wind energy potential analyses are conducted to determine landscape CAPACITIES, assessing the effective opportunities of different RET to generate additional benefits for habitats and local communities.

posters 09-11 LANDSCAPE DESIGN SAMPLES

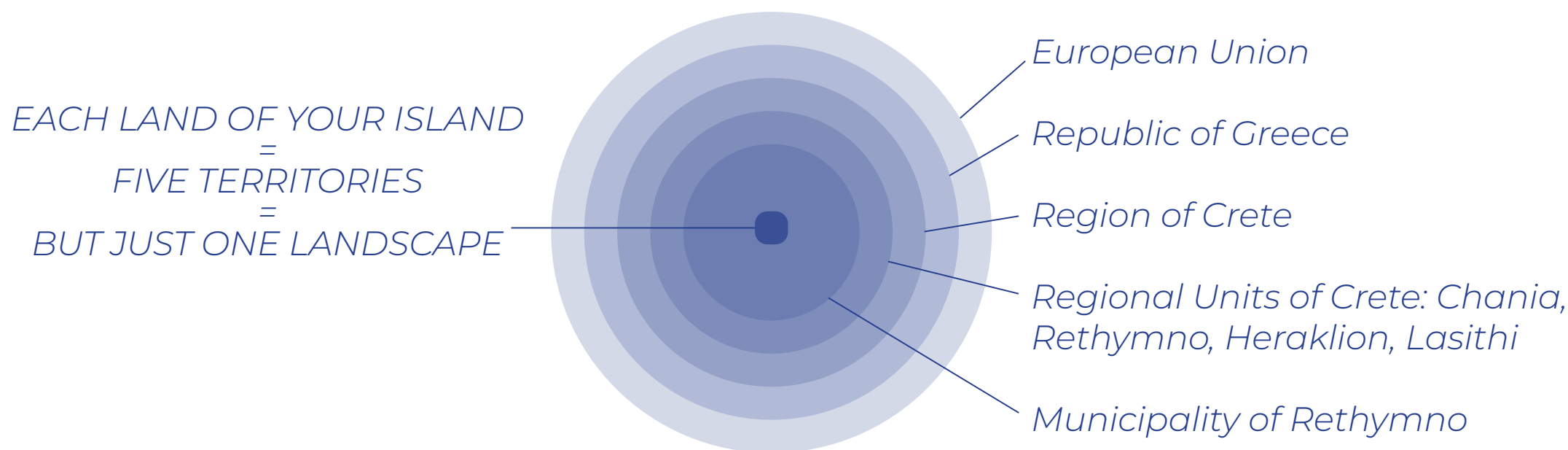
It's difficult for citizens to imagine and accept remarkable changes in their living environment. Showing how the changed landscape would look like supports people in raising their awareness and to express critical positions.

Sustainability and Territories



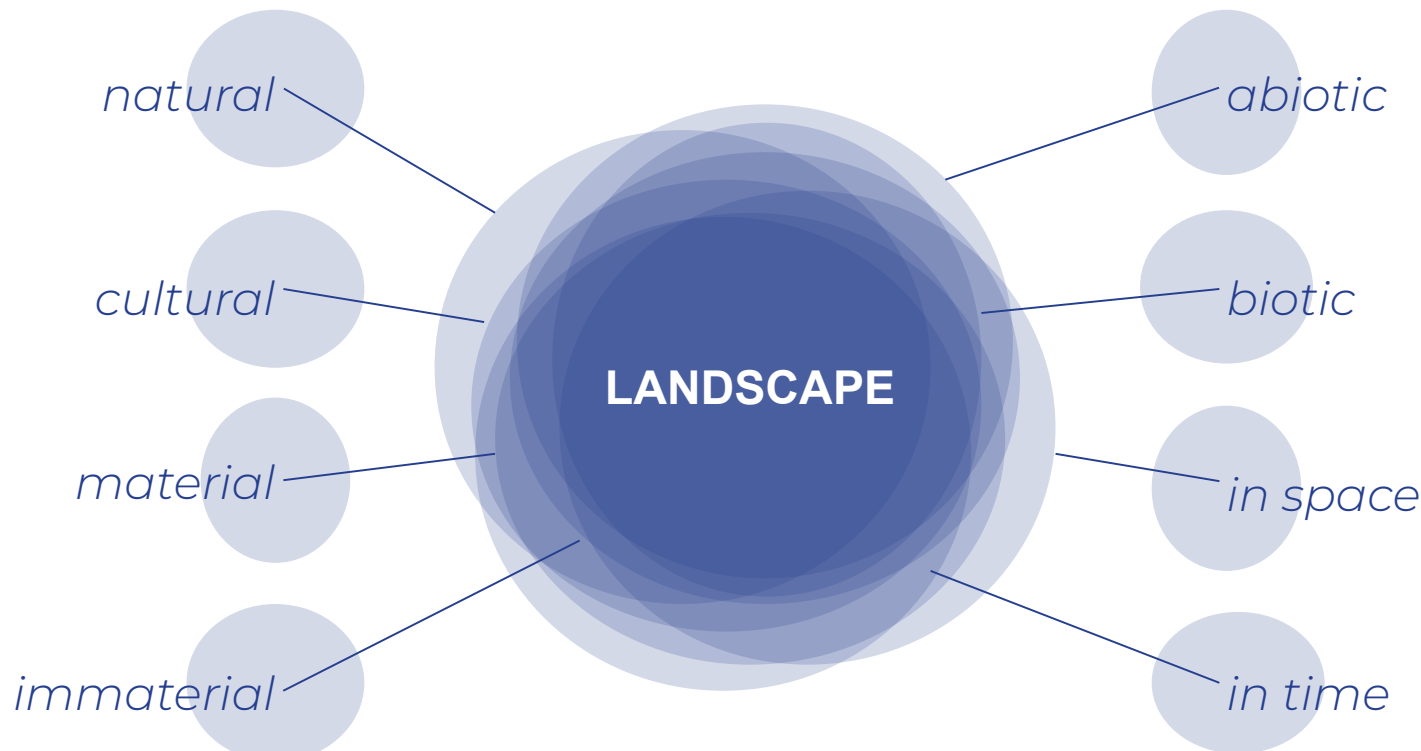
Crete Island All in One

a same unique landscape for five territories



Crete Island Landscapes

resultant of interaction between factors and processes



*Loving your Landscapes
is to care for their changes*

Would you like to take part in the Energy Transition for living on a Climate Neutral Island?



The Island I would like Lab
Crete - Greece 28-30 April 2026



CO2 PACMAN

Interreg
Euro-MED



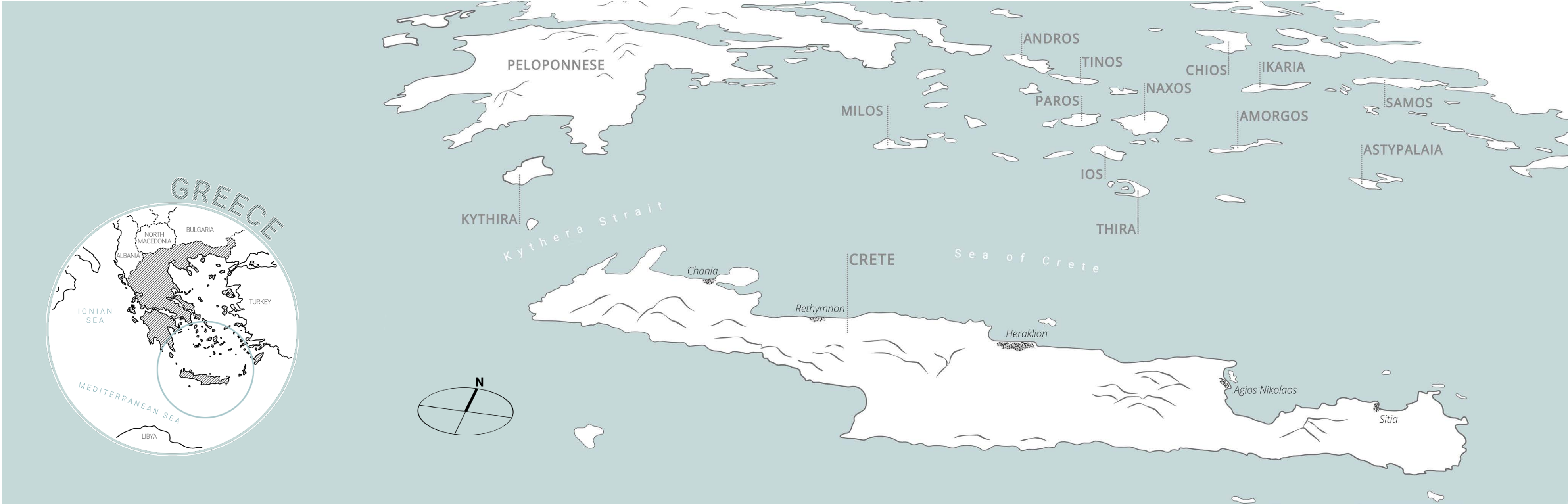
Co-funded by
the European Union

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SOUTHERN AEGEAN ARCHIPELAGO

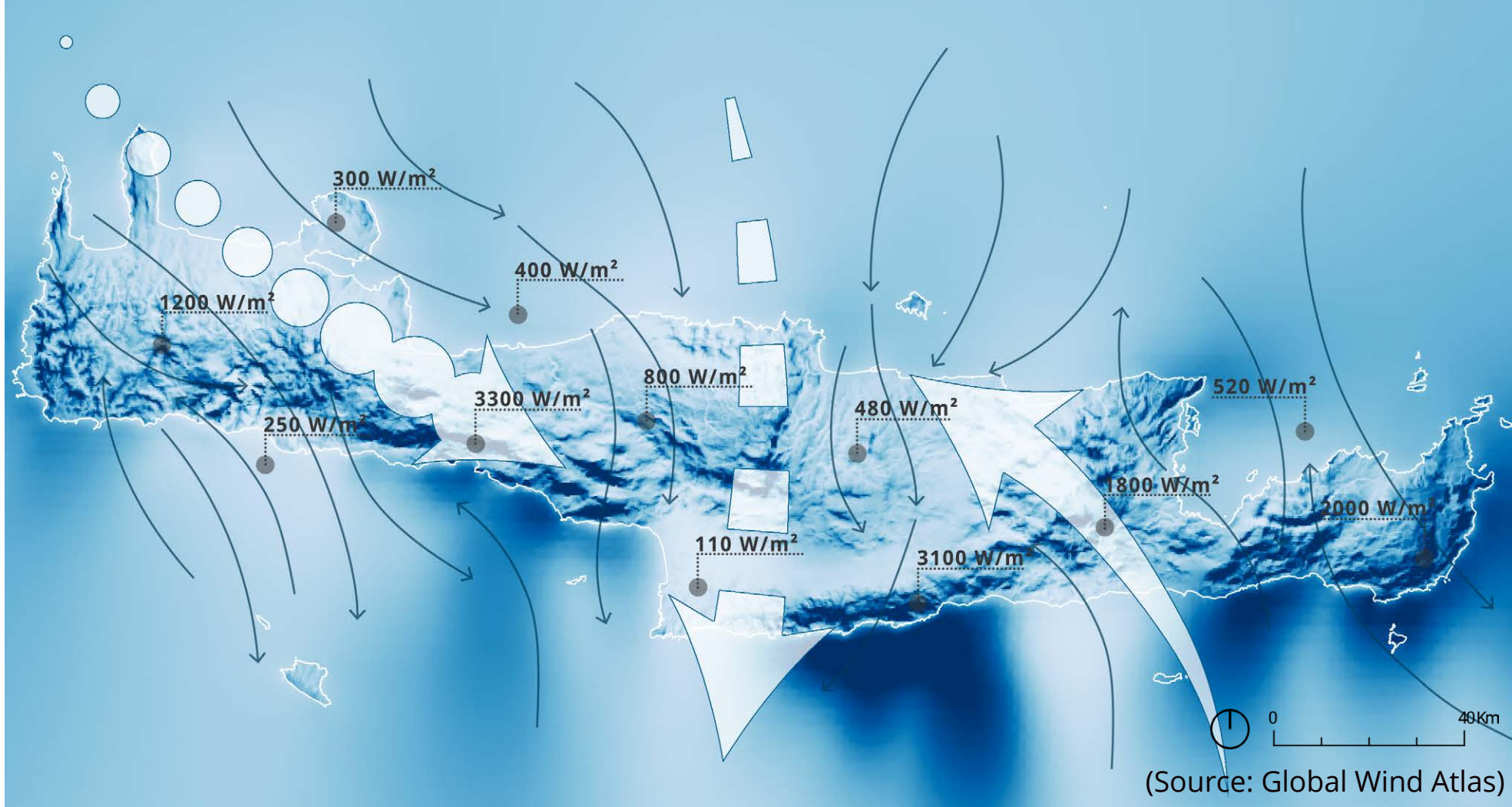


THE ISLAND OF CRETE



THE ENERGY OF LANDSCAPE

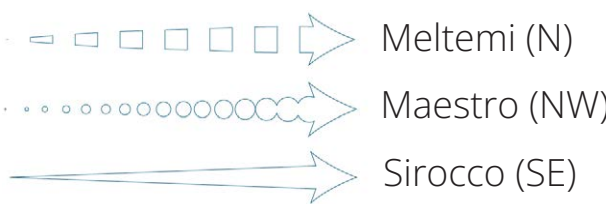
WIND ENERGY



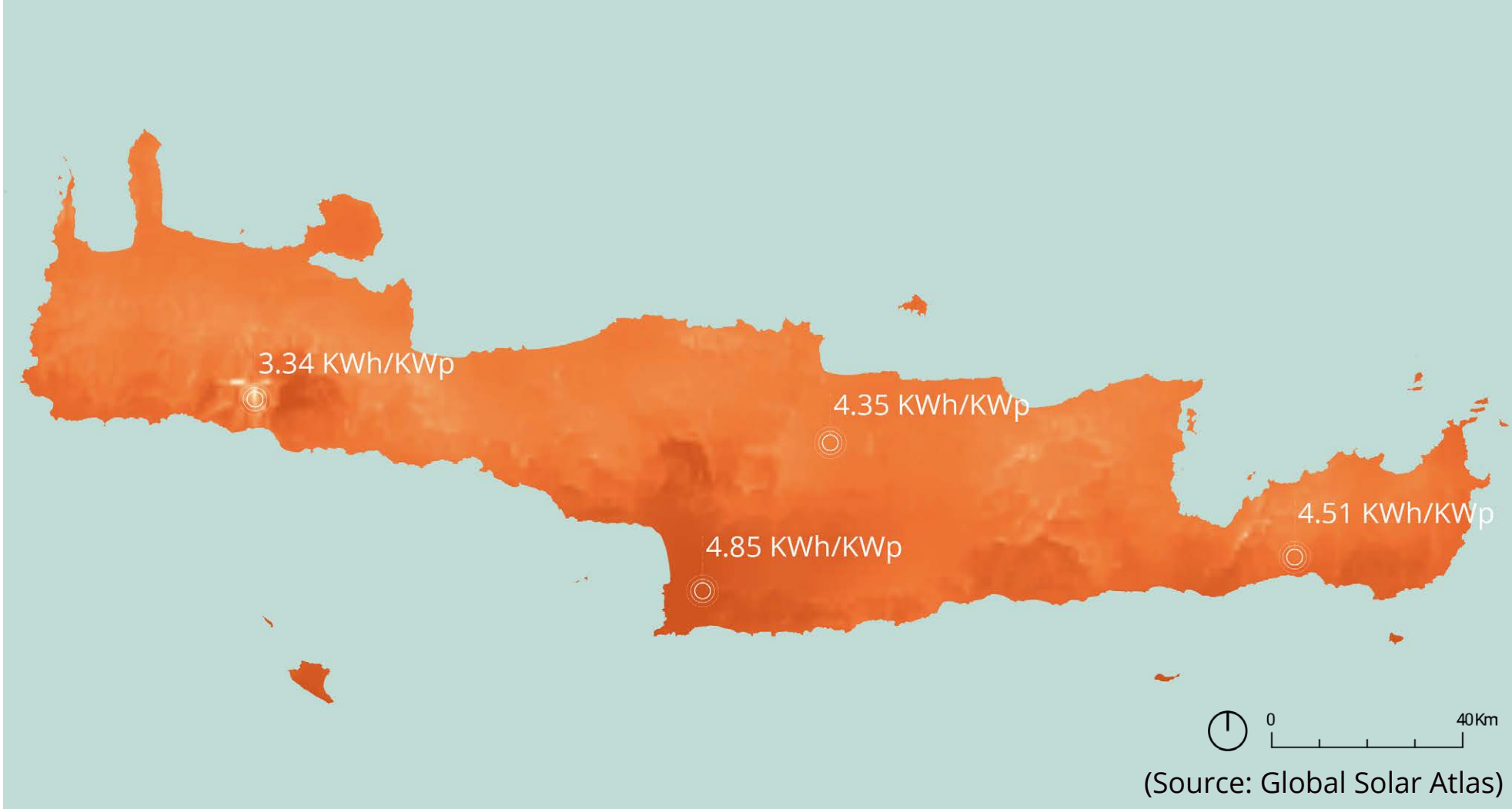
Average density of wind potential W/m^2



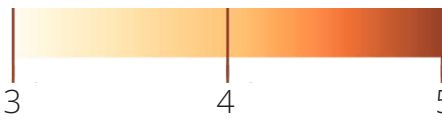
Main winds



SOLAR ENERGY



Photovoltaic power output - kWh/kWp



CRETE ISLAND - CROATIA

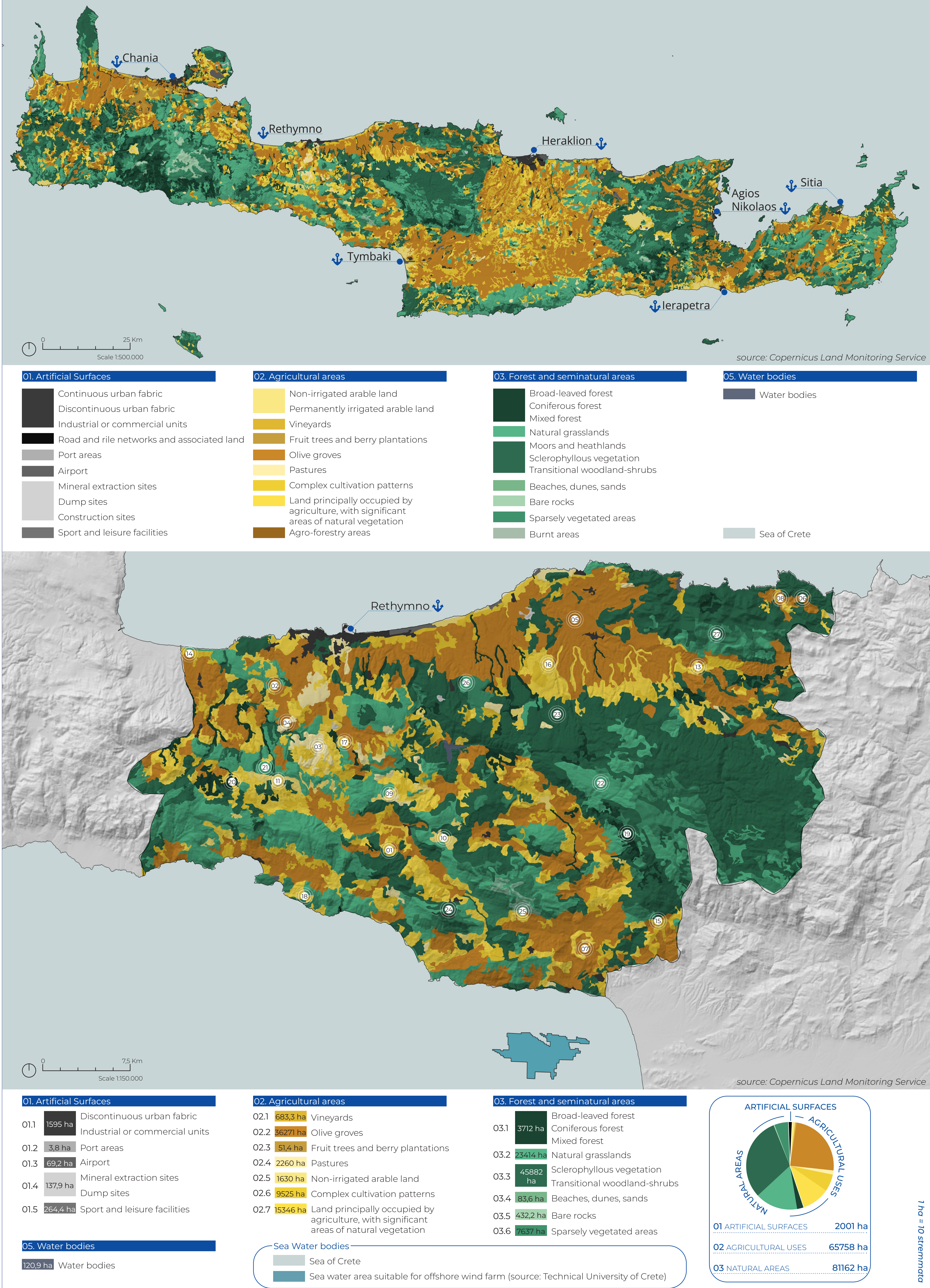
LANDSCAPE FEATURES



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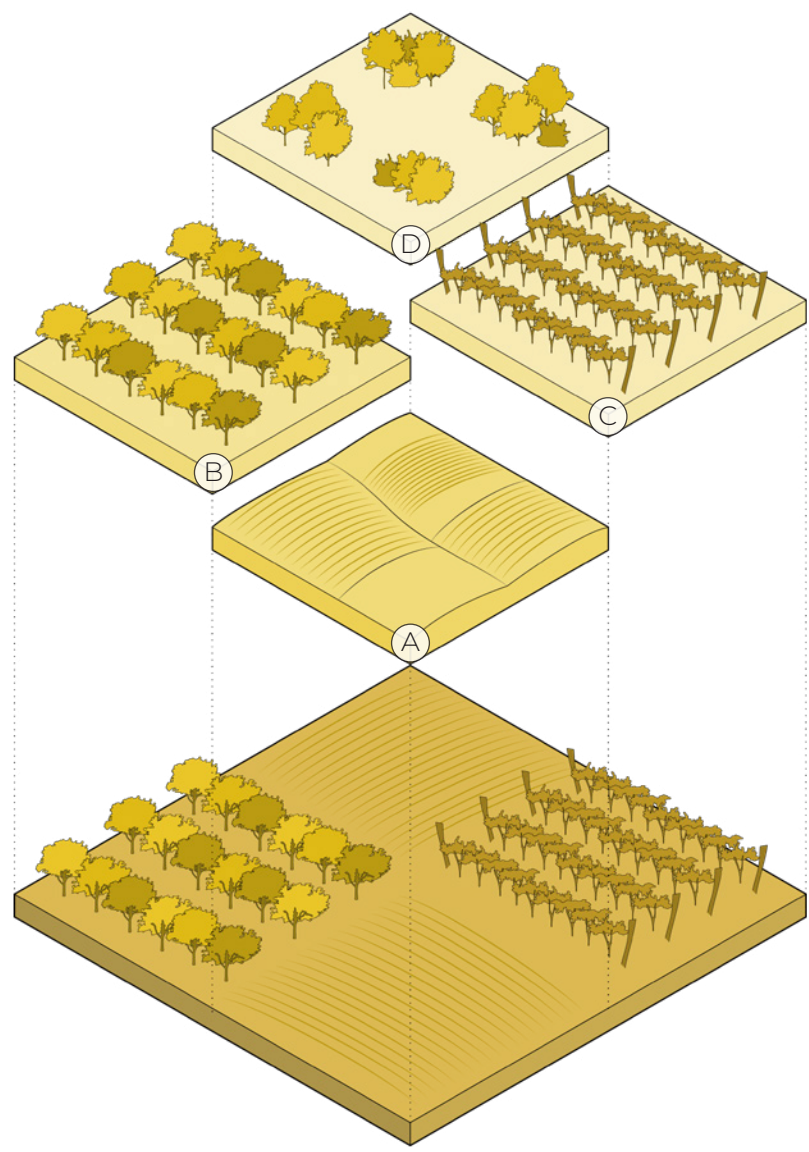
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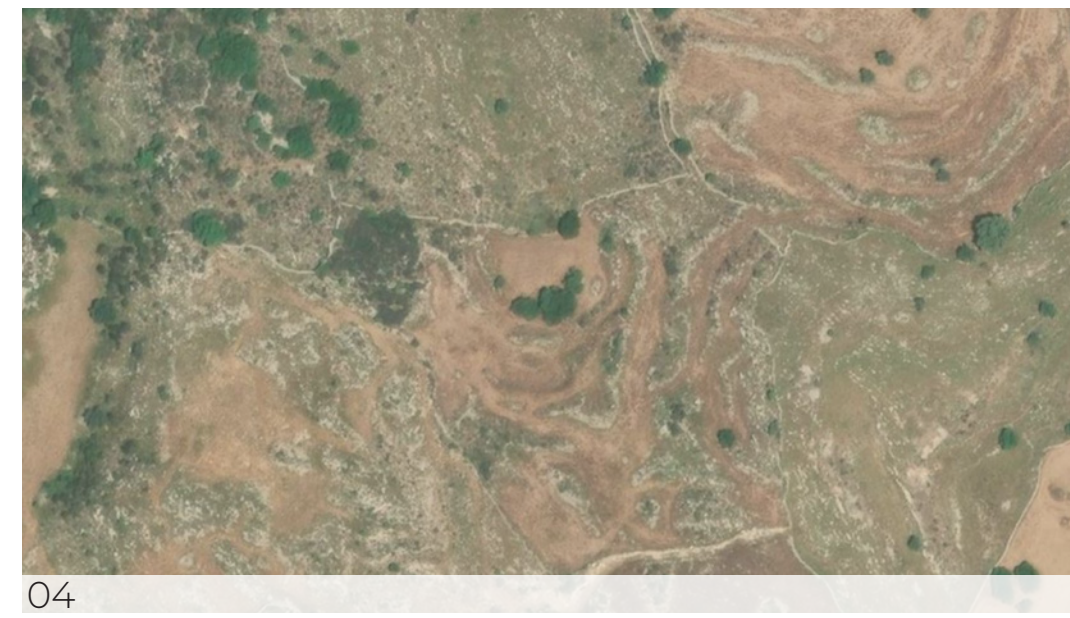
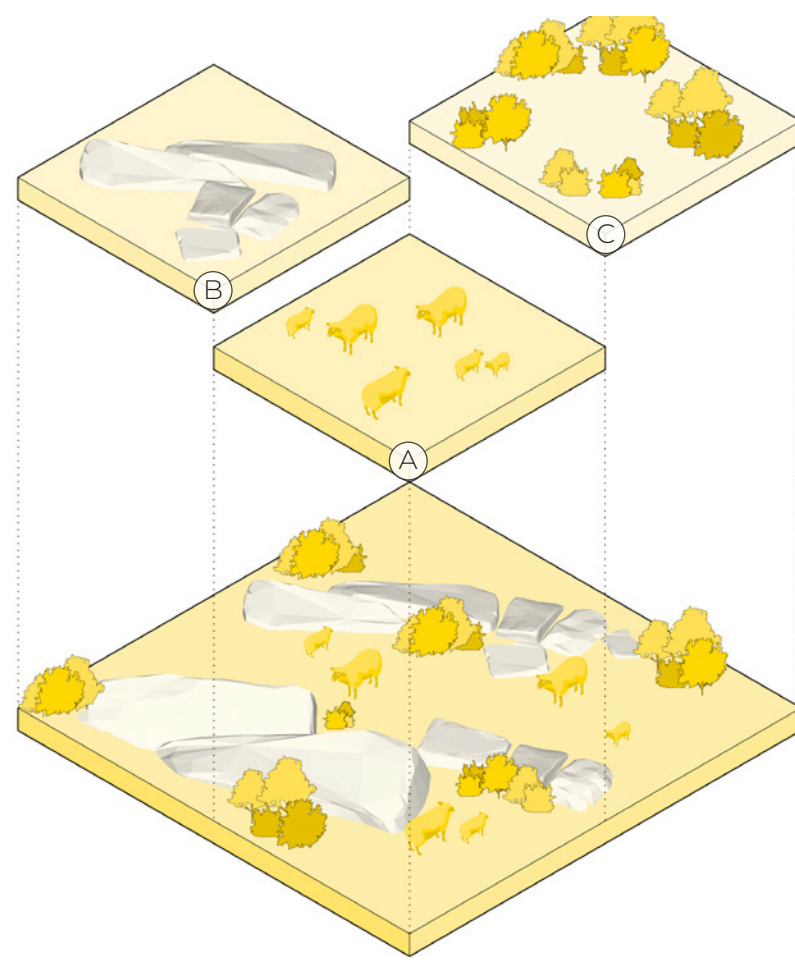
02.1 VINEYARDS

- (A) Agricultural crops
- (B) Linear olive groves
- (C) Vineyards
- (D) Spontaneous vegetation



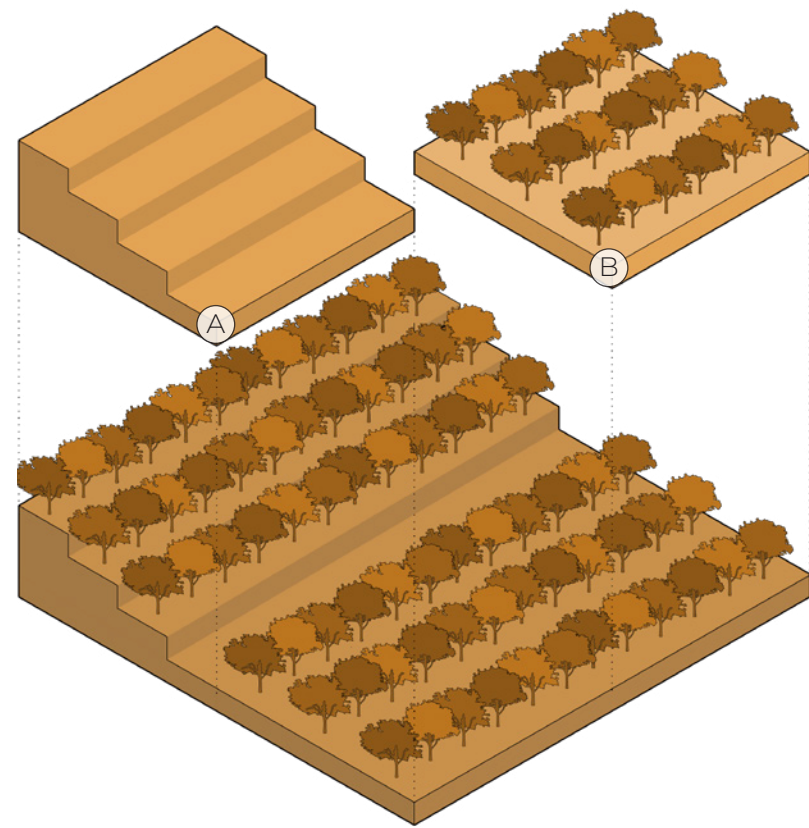
02.4 PASTURES

- (A) Pastures
- (B) Bare rocks
- (C) Spontaneous vegetation



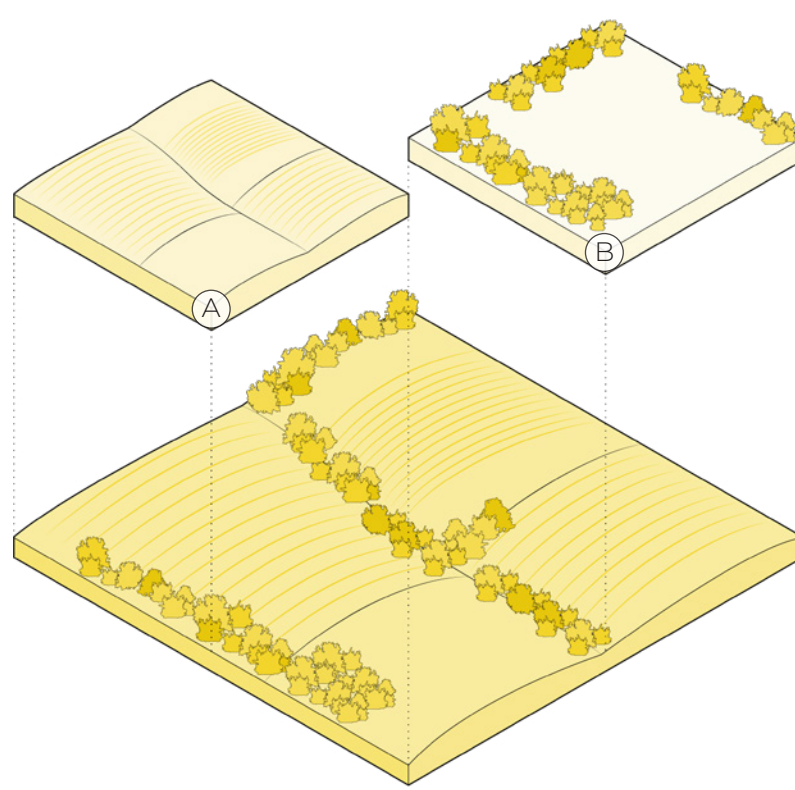
02.2 OLIVE GROVES

- (A) Terrace systems
- (B) Linear olive groves

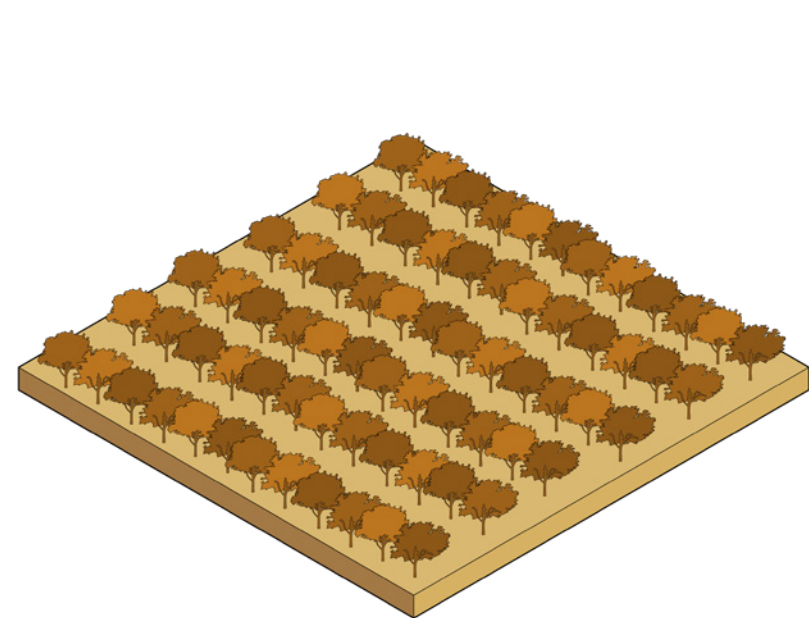


02.5 NON-IRRIGATED ARABLE LAND

- (A) Agricultural crops
- (B) Perimeter hedges



02.3 FRUIT TREES AND BERRY PLANTATIONS



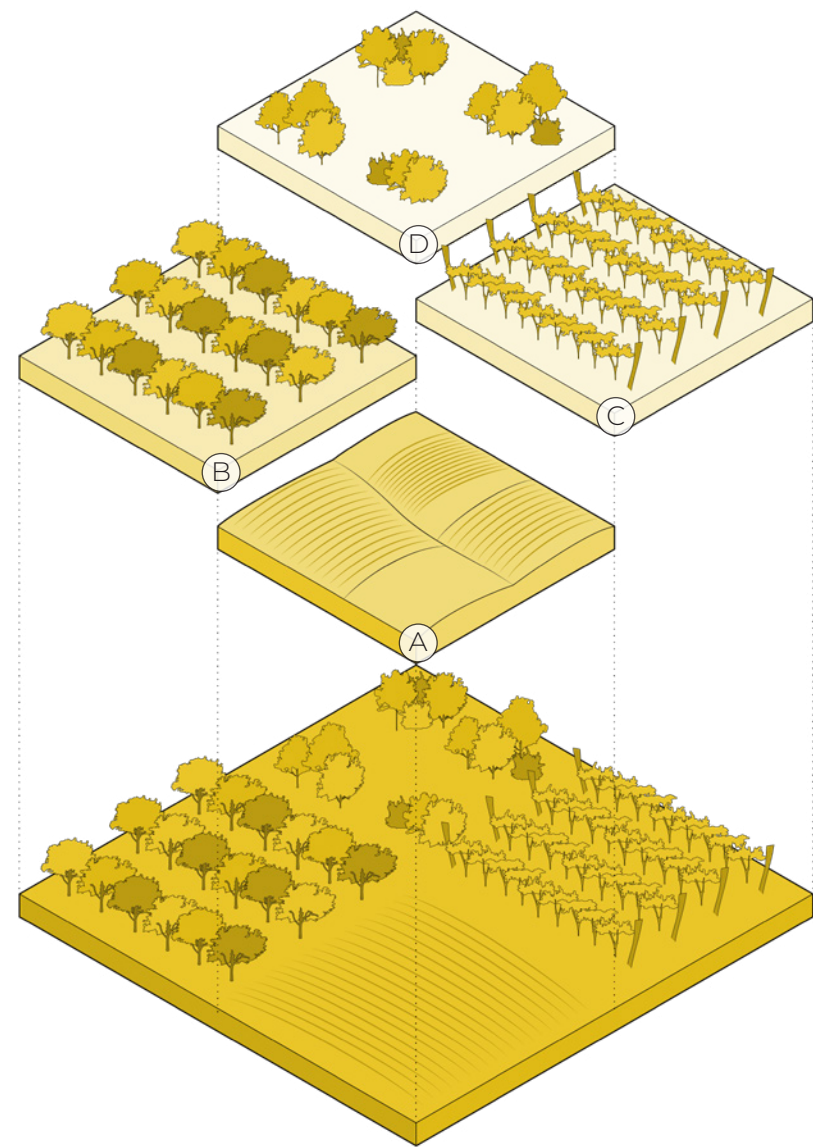
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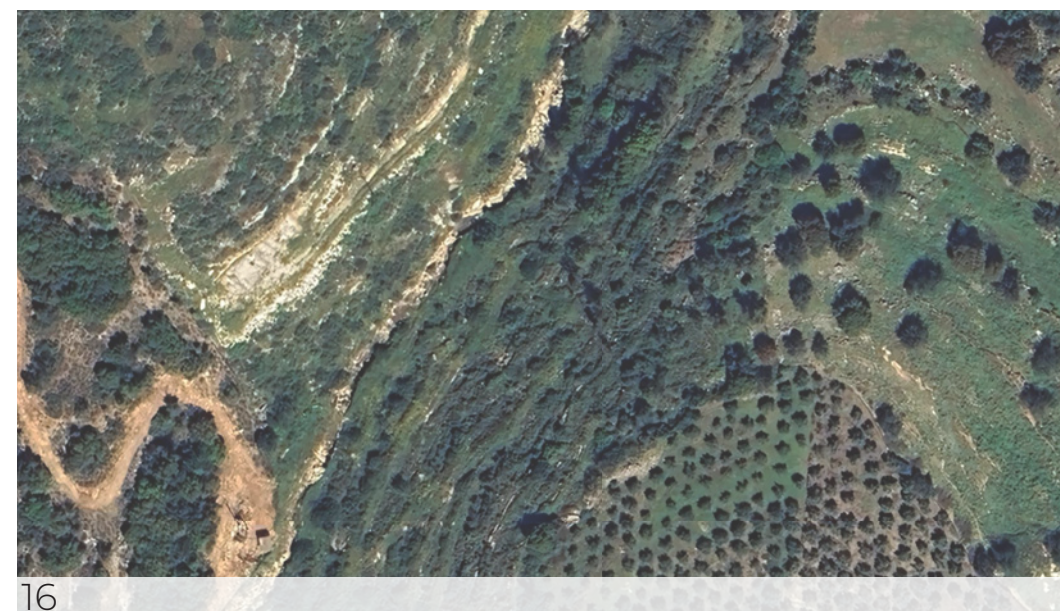
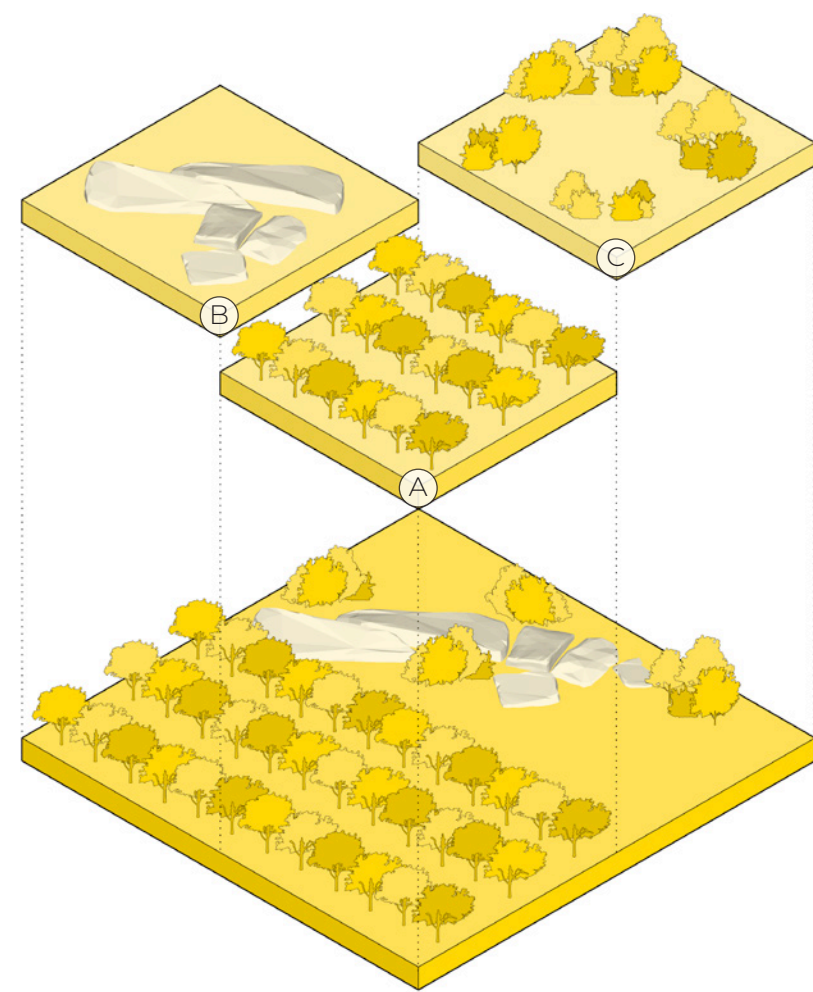
02.6 COMPLEX CULTIVATION PATTERNS

- (A) Agricultural crops
- (B) Linear olive groves
- (C) Vineyards
- (D) Spontaneous vegetation

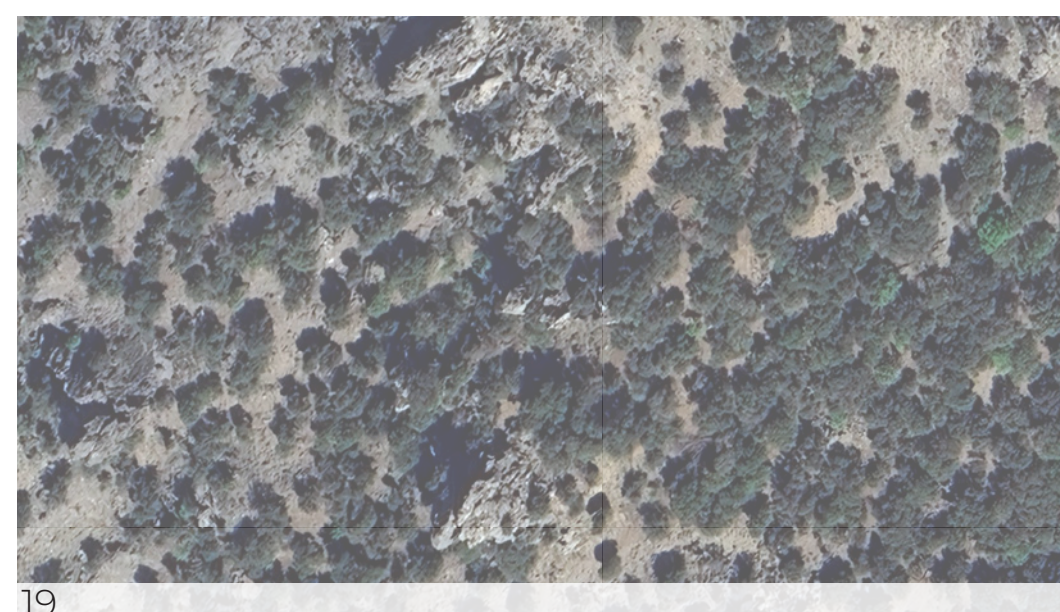
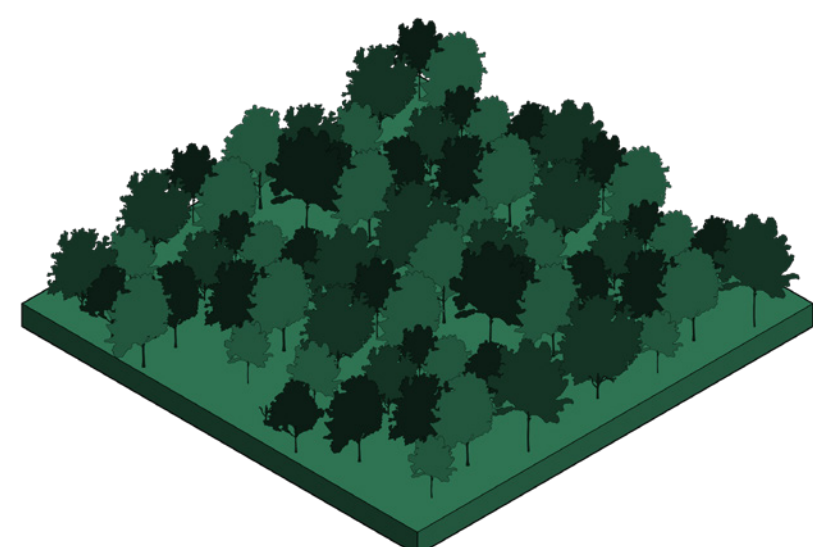


02.7 LAND PRINCIPALLY OCCUPIED BY AGRICULTURE, WITH SIGNIFICANT AREAS OF NATURAL VEGETATION

- (A) Linear olive groves
- (B) Bare rocks
- (C) Spontaneous vegetation

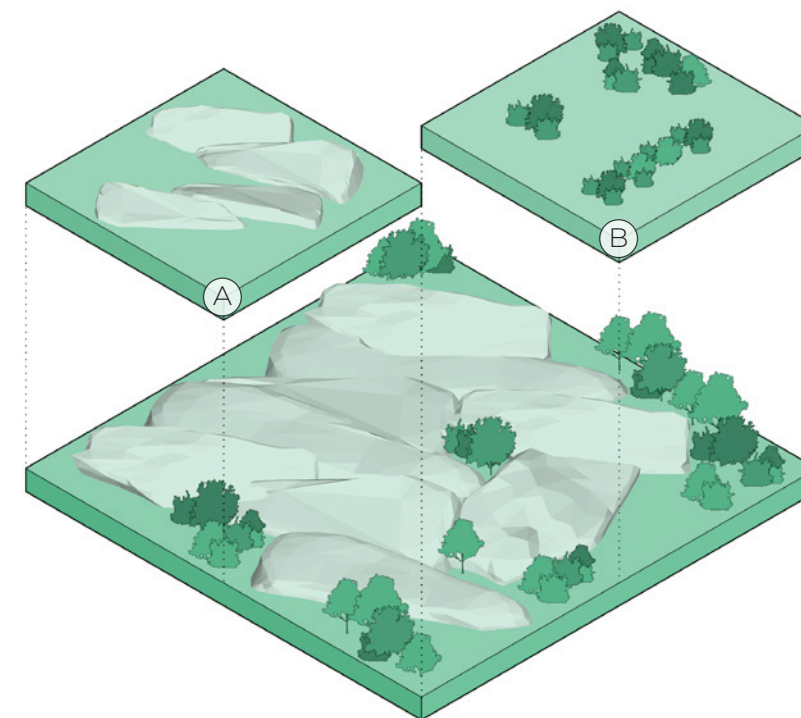


03.1 FORESTS



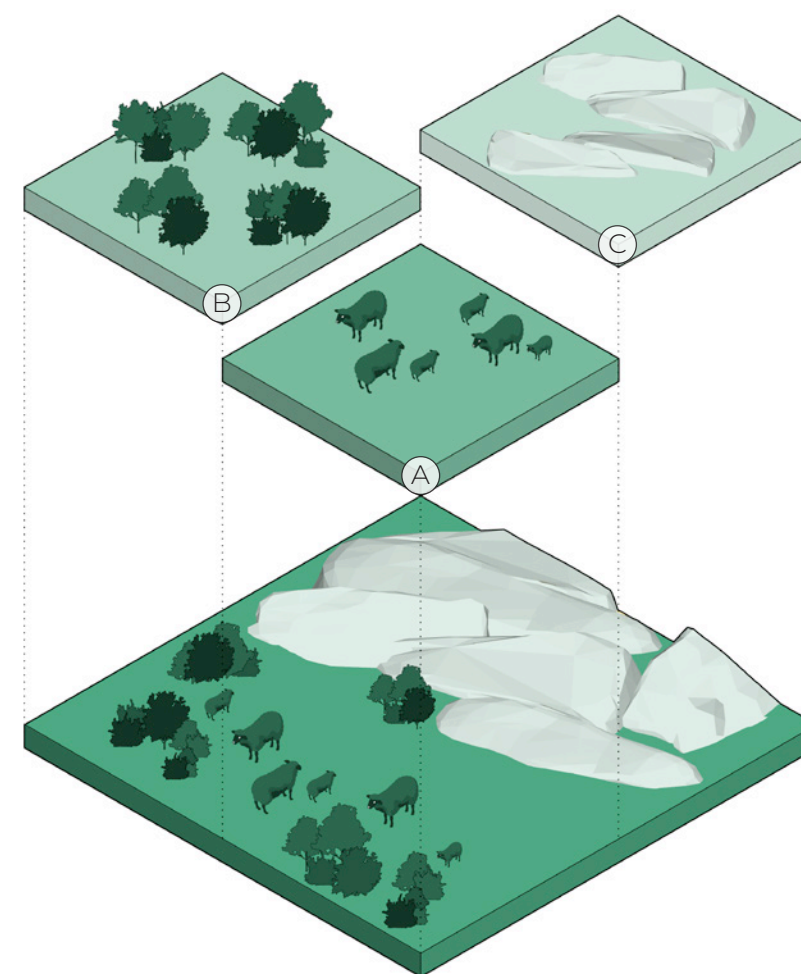
03.2 NATURAL GRASSLANDS

- (A) Bare rocks
- (B) Herbaceous cover

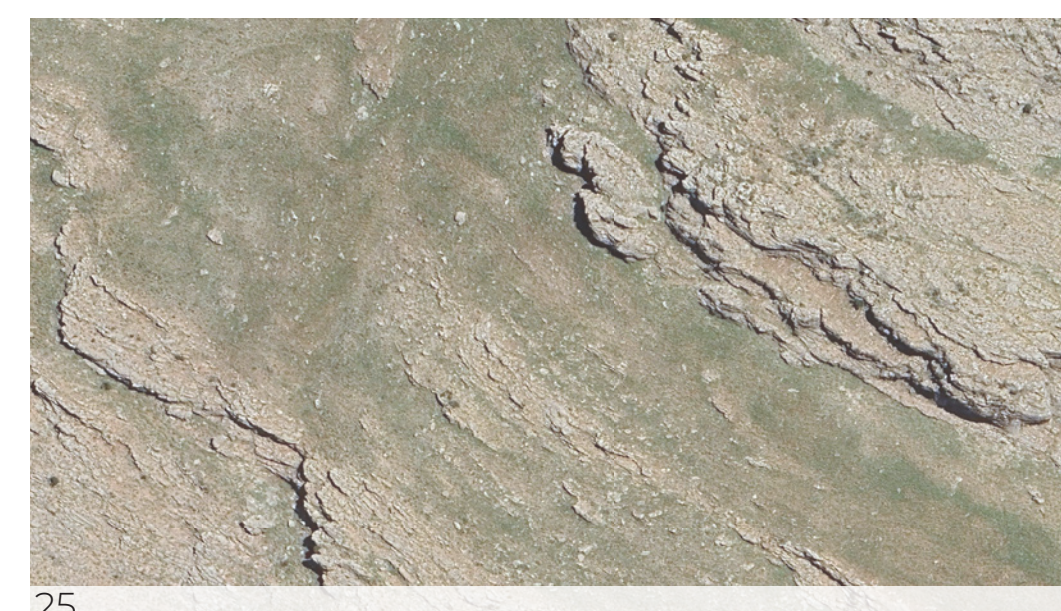
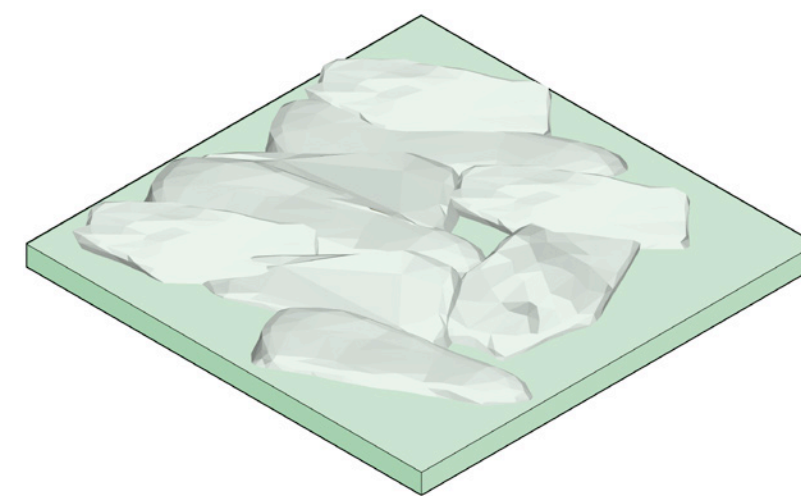


03.3 WOODLAND-SHRUBS

- (A) Pastures
- (B) Spontaneous vegetation
- (C) Bare rocks

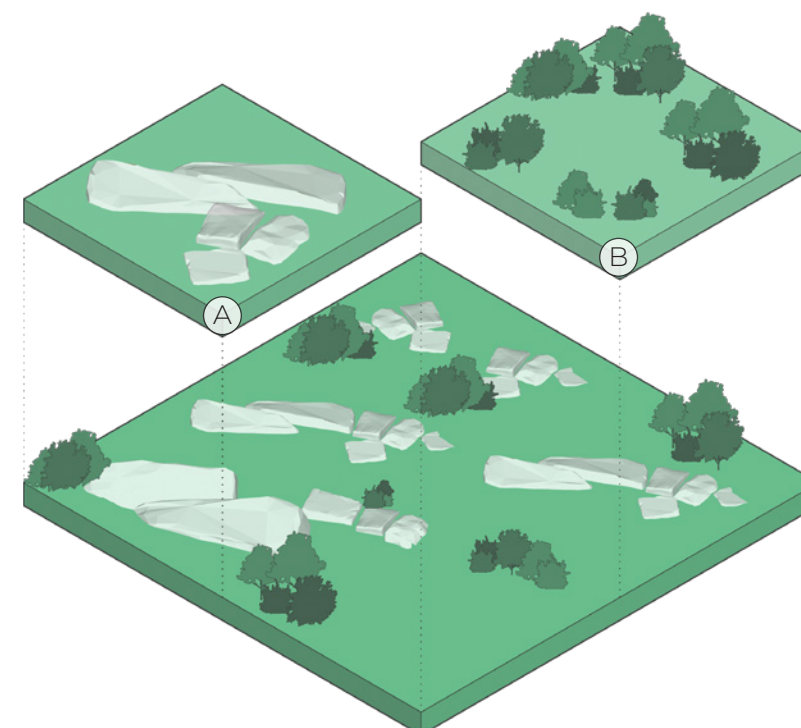


03.4 BARE ROCKS



03.5 SPARSELY VEGETATED AREAS

- (A) Bare rocks
- (B) Spontaneous vegetation

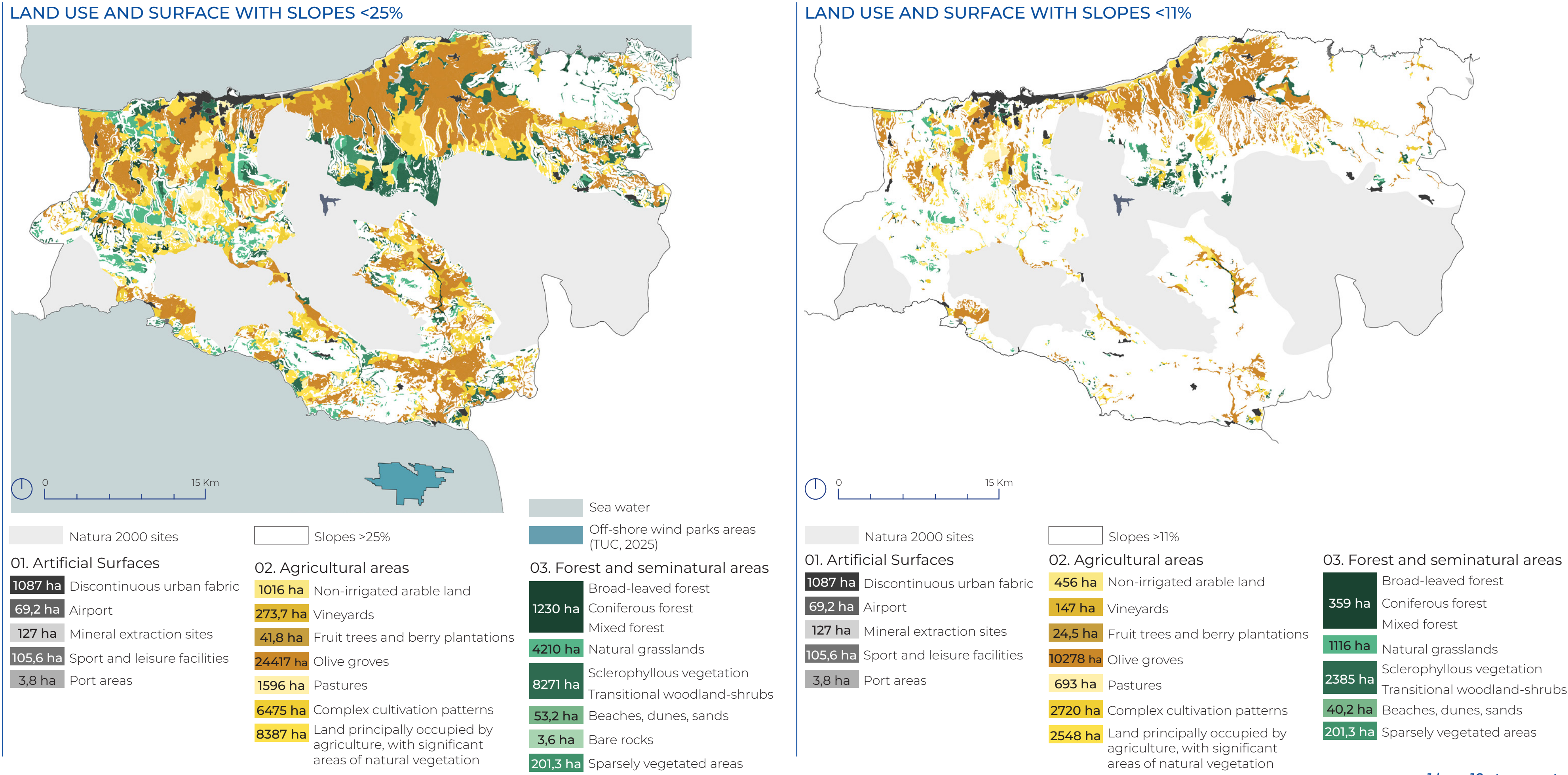


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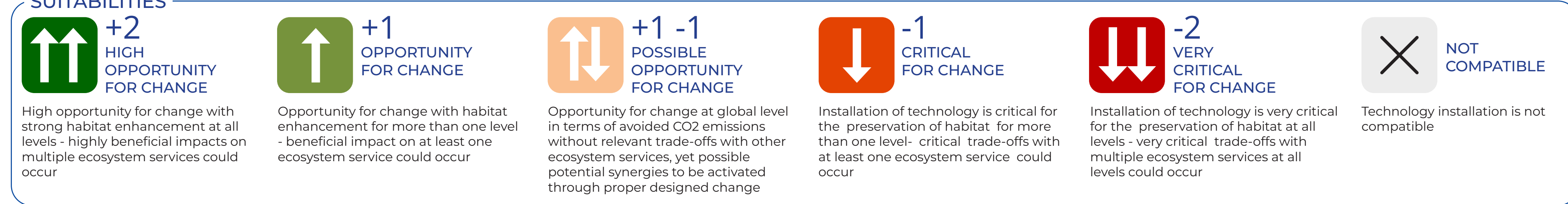
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TOPOGRAPHY BASED LANDSCAPE SUITABILITY PER LAND SLOPE DEGREE - TECHNOLOGIES REQUIRE SLOPES <25%



EXPERT BASED LANDSCAPE SUITABILITY PER LAND USE - NATURA 2000 SITES EXCLUDED



ONSHORE LAND USES		Agrivoltaic systems with monoaxis trackers 4 meters elevated from the ground and bifacial modules.	Agrivoltaic greenhouses, 30% shading on tomatoes and peppers	Photovoltaic modules on green roofs, pergolas and facades	Floating Photovoltaics on inland sweet water	Solar thermal systems on roofs	Onshore Wind parks by 10 MW wind turbines	Building-scale closed heat-cold pumps and storage	OFFSHORE SEA USES	Offshore Wind parks by 10 MW wind turbines
01. Artificial Surfaces	Continuous and Discontinuous urban fabric/Industrial or commercial units	×	↑↑	↑↑	×	↑↑	×	↑↑	sea water	
	Road and rile networks and socciated land	×	×	×	×	↑↑	×	↑↑	naval routes	↓↓
	Port areas	×	×	↑↑	×	↑↑	×	↑↑	marine transportation	↓↓
	Airport	×	×	↑↑	×	↑↑	×	↑↑	cable-ducts	↕
	Mineral extraction site /Dump sites	×	×	×	×	×	↕	×	marine ecosystems	↑
02. Agricultural areas	Sport and leisure facilities	×	×	↑↑	×	↑↑	×	↑↑	Routes for birds' migrations	↓↓
	Non irrigated arable land and permanently irrigated arable land	↑↑	↑↑	×	×	×	↕	×	commercial fishing	↓↓
	Fruit trees and berry plantations	↑↑	↑↑	×	×	×	↕	×	off-shore wind parks areas (TUC, 2025)	↑↑
	Vineyards	↕	↑↑	×	×	×	↓↓	×		
	Olive groves	↕	↑↑	×	×	×	↓↓	×		
	Pastures	↑	↑↑	×	×	×	↕	×		
	Complex cultivation patterns	↑↑	↑↑	×	×	×	↓↓	×		
03. Forest and seminatural areas	Land principally occupied by agriculture, with significant areas of natural vegetation	↑↑	↑↑	×	×	×	↓↓	×		
	Agro-forestry areas	×	×	×	×	×	↓↓	×		
	Broad-leaved forest / Coniferous forest / Mixed forest	×	×	×	×	×	↓↓	×		
	Natural grassland	×	×	×	×	×	↕	×		
	Moors and heathlands / Sclerophyllous vegetation / Transitional woodland-shrubs	×	×	×	×	×	↓↓	×		
	Beaches, dunes, sands	×	×	×	×	×	↓	×		
	Bare rocks	×	×	×	×	×	↓	×		
	Sparsely vegetated areas	×	×	×	×	×	↓	×		
	Burnt areas	×	×	×	×	×	↓↓	×		
	Water bodies	×	×	×	↑	×	↕	×		



337,2 MW
TARGETED
INSTALLED
CAPACITY

2.953.926
MWh
Energy share required
for carbon neutrality

504.586
CO2 Ton. avoid

373
km² of forest

276.578
Families

01 WOULD YOU LIKE TO COOL DOWN YOUR CITY WHILE GENERATING SOLAR ENERGY AND ENHANCING NATURE?

The scenario, in line with blue economy local strategies the scenario supports the cooling of large park areas in urban areas by integrating Photovoltaics Modules in Natura Based Solutions. A centralized action by the Municipality and co-financed by local enterprises can enhance the urban micro-climate of vast not shaded parking areas in Rethymno by shading those thanks to a system of photovoltaic pergolas integrated to new space for natural habitat providing shelter to the public areas. Additional natural habitat can be developed in suburban agriculture areas in proximity of the coastline and the river courses. There a decentralized and cooperative action by farmers and Energy Communities can support the conversion of plastic tunnels for vegetables production into more energy efficient agrivoltaic greenhouses, making more room available for river natural courses and natural habitat along the coastal line. Further decentralized and cooperative action by tourism entrepreneurs and Energy Communities can sustain the implementation of innovative Building Integrated Photovoltaics (roofs, facades) and heat and cold geothermal pumps for tourism receptivity structures along the coast line.

ACTORS

- Municipality
- Energy Communities
- Small and medium-sized enterprises, single or in partnership

LAND USE

- Continuous and Discontinuous Urban Fabrics, industrial and commercial units
 - Port areas
- IN LARGER CITIES

RET

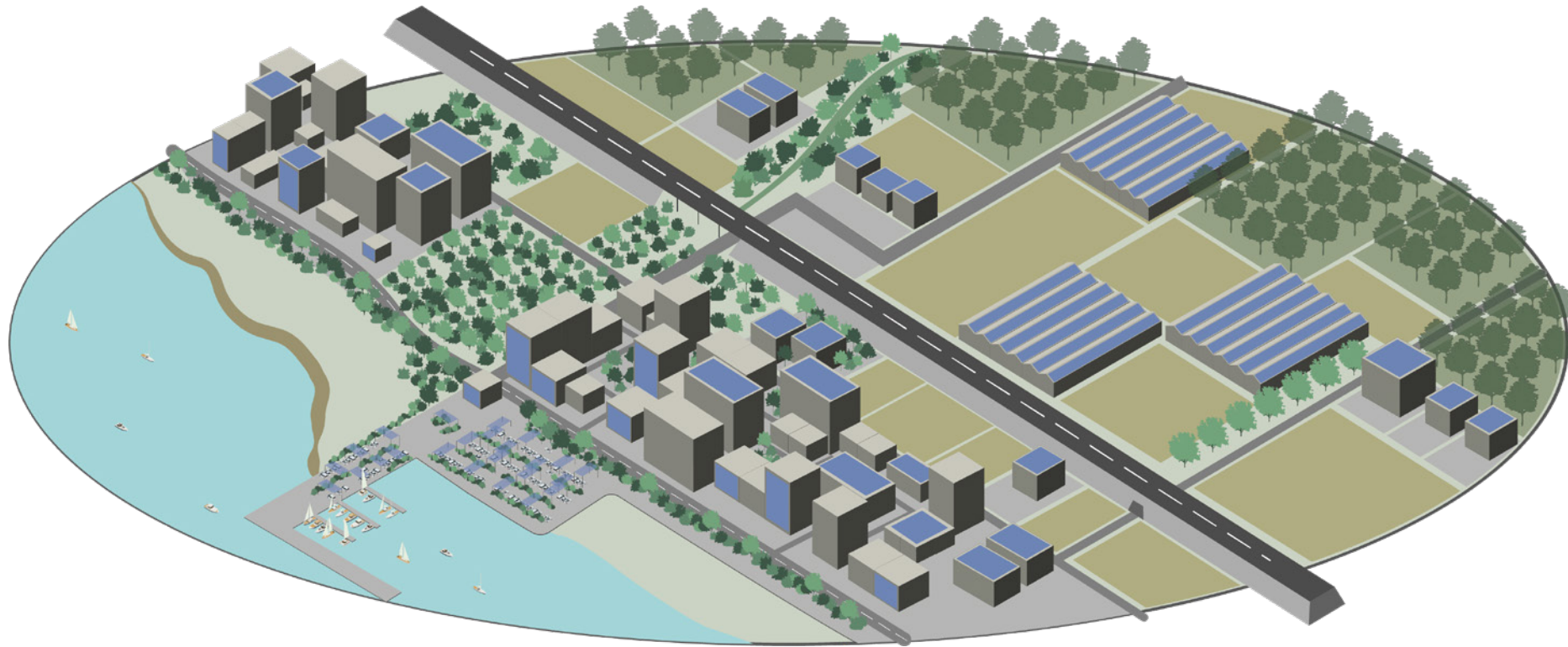
- PV pergolas on Port area
- Agrivoltaic greenhouses, 30% shading on tomatoes and peppers;
- Photovoltaic modules on green roofs and facades
- Building-scale closed heat-cold pumps and storage

SCALE

< 1 MW
installed capacity
units in network

POLICY

Strong Public Subsidies for Energy Communities and to farmers to switch from plastic tunnels to closed agrivoltaics (<40% contribution to the sustained costs and < 1, 2 euros/kWh electricity price)



02 WOULD YOU LIKE TO ENHANCE THE SEA AND THE LAKES NATURAL HABITAT WHILE GENERATING WIND AND SOLAR ENERGY?

The scenario foresees the sweet and sea water bodies capability to integrate floating PVs in the inland sweet water bodies and off-shore wind turbines in the open sea. The capability is assumed to be high according to specific energy plants design prototypes capable to enhance sweet and sea water natural habitat. The inland floating PV system can be combined with new floating vegetated islands sustaining niches for inland plants and animal species reproduction. The off-shore wind turbines floating platforms sustain niches for sea plant and animal species reproduction by avoiding fishing in the area and incorporating Artificial-Reef structures. Those initiatives foresee developers and investors and function through compensative measures plus energy justice tools, like proposing co-ownership and lower tariffs to local population. With regards to inland floating PVs the ratio is to invest in planting 1 ha of floating vegetated island each 10 MW of installed capacity, for a total of 5% of water surface covered by the integrated system. For the off-shore the compensative measure consists in investing in the adoption of artificial reef experimental technologies in the floating basement.

ACTORS

- Industry, Developers and Investment Funds in co-ownership with locals

LAND USE - WIND

- Sea of Crete

LAND USE - PV

- Sweet water bodies

RET

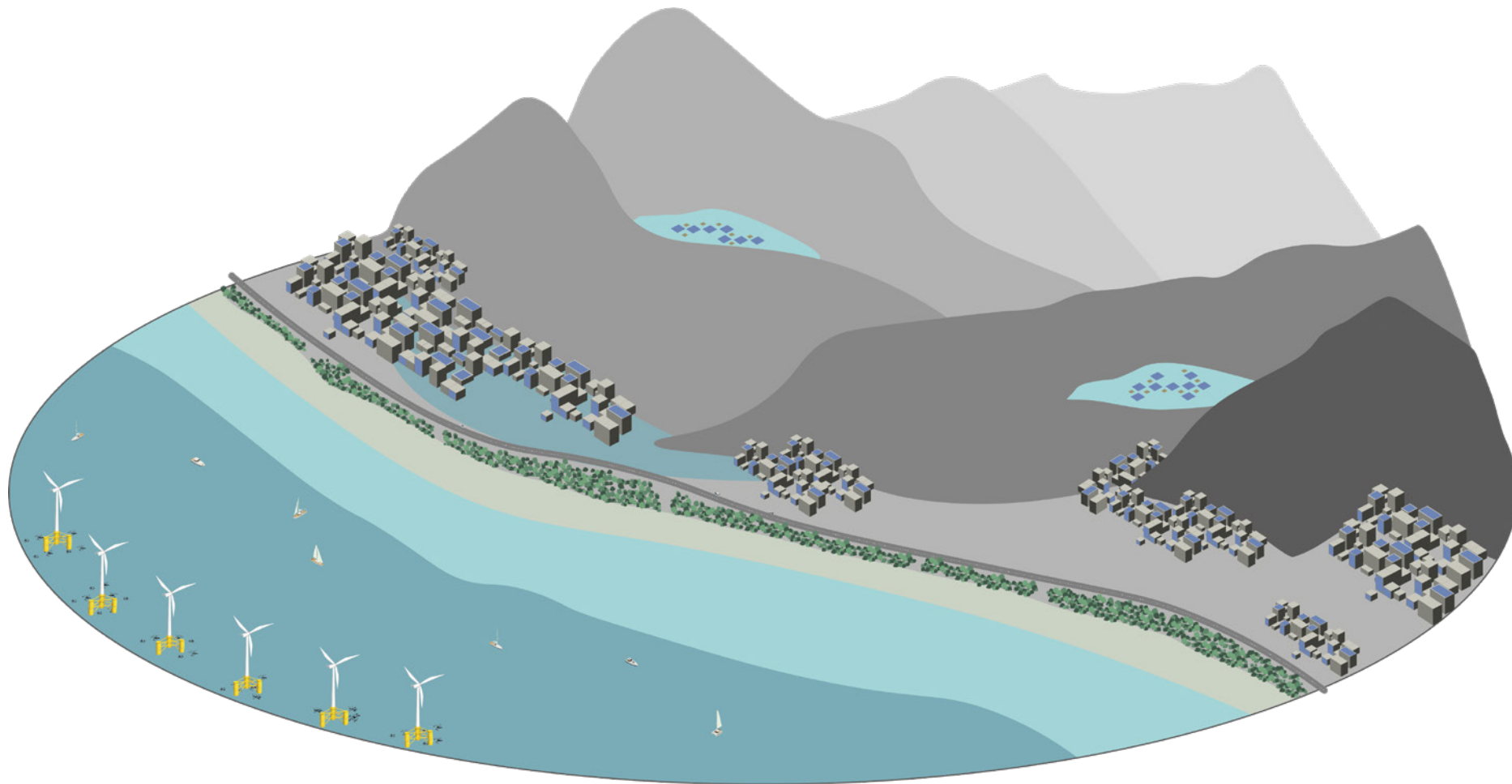
- Floating PV systems covering up to 5% to the water surface
- Wind turbines by 10 MW each nominal power on floating basements

SCALE

>10 MW
for floating PV systems
>100 MW
for off-shore wind farms

POLICY

Strong regulations for project quality standards and co-ownership



03 WOULD YOU LIKE TO SUSTAIN INNER AGRICULTURE AND NATURAL HABITAT WHILE GENERATING RENEWABLE ENERGY?

In the local LEADER program rural areas are defined as plagued by a multitude of problems such as low economic activity, lack of attractive employment opportunities, skills shortages, insufficient investment in infrastructure and lack of basic and social support services. Agrivoltaic system in the inner non irrigated arable land can support the switch from a poor input and output agriculture towards a more competitive agriculture, irrigated through watering precision systems. Tomatoes and peppers production currently cultivated in plastic tunnels closer to the coast could be more sustainably and effectively cultivated in open agrivoltaic systems to sustain a reborn of inner agriculture. This scenario would require strong economic subsidies (up to 40% of sustained costs) to newborn cooperatives by young farmers and guaranties for the access to local credit. The generated energy can supply the inner villages and make them autonomous while contributing to the island decarbonization and strengthening the inner socio-economic capacity to start sustainable development.

ACTORS

- Farmers Cooperatives in public-private partnership with inner Municipalities

LAND USE

- Non-irrigated arable land;
- Complex cultivation patterns;
- Land principally occupied by agriculture, with significant areas of natural vegetation

RET

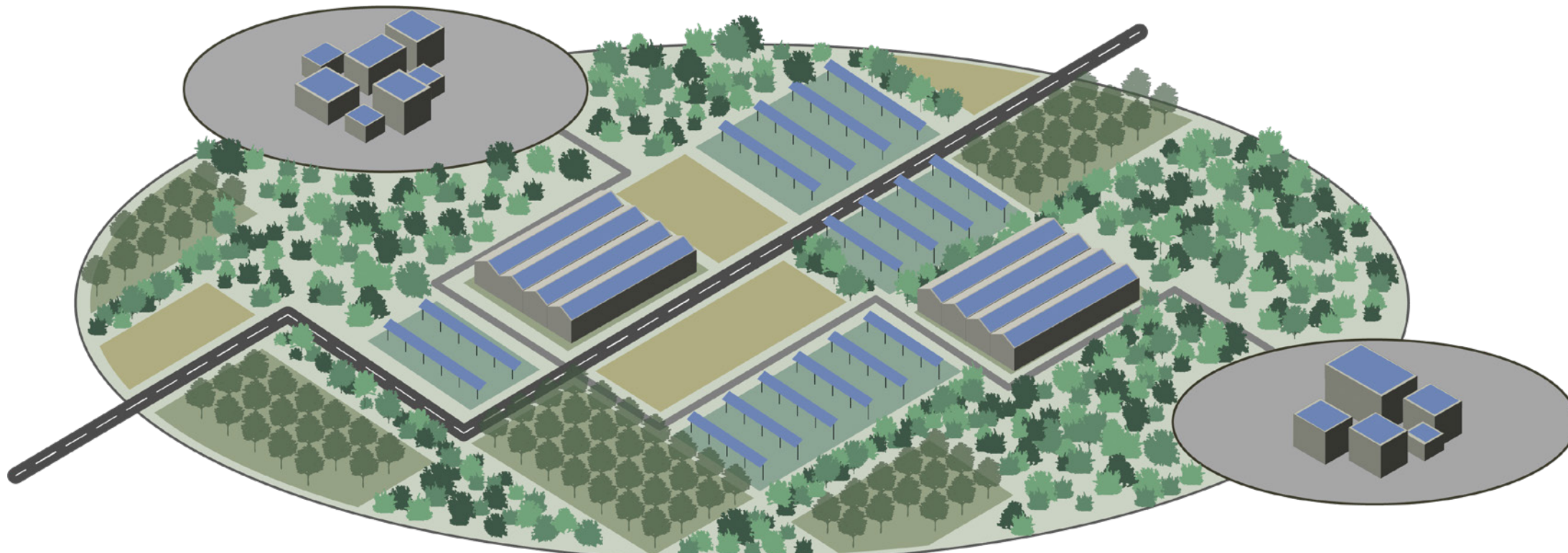
- Agrivoltaic systems with monoaxis trackers 4 meters elevated from the ground and bifacial modules;
- Agrivoltaic greenhouses, 30% shading on tomatoes and peppers;

SCALE

<1 MW
unit with 0,5kW/ha
installed capacity

POLICY

Strong Subsidies to Farmers cooperatives to switch from non-irrigated crops to agrivoltaic irrigated crops (<40% contribution to the sustained costs and < 1, 2 euros/kWh electricity price)



WOULD YOU LIKE TO SUSTAIN SUSTAINABLE AGRICULTURE AND NATURAL HABITAT WHILE GENERATING RENEWABLE ENERGY?

Agrivoltaic greenhouses, 30% shading on tomatoes and peppers

Photovoltaic modules on green roofs, pergolas and facades

Solar thermal systems on roofs

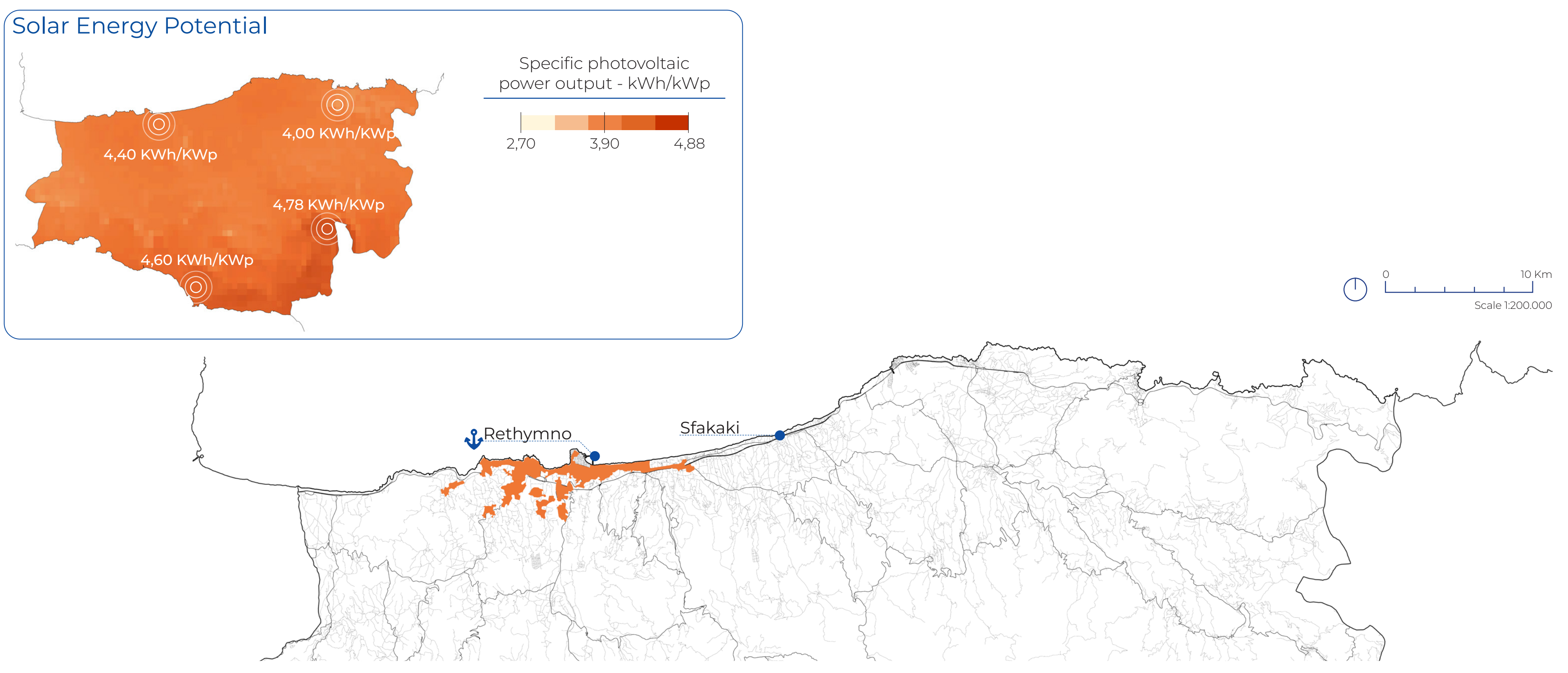
Building-scale closed heat-cold pumps and storage

CONTINUOUS AND DISCONTINUOUS URBAN FABRIC/INDUSTRIAL OR COMMERCIAL UNITS

ROAD AND RAIL NETWORK AND ASSOCIATED LAND

PORT AREAS

LANDSCAPE SOLAR CAPACITIES



SOLAR GREENHOUSES

CLEAN ENERGY

RENOVATION

AGRICULTURE

WATER SAVING

@LeGreenhouse

@Insolight

BUILDING INTEGRATED PV / HEAT-COLD PUMPS

CLEAN ENERGY

COMMUNITY

PROSUMER

RENOVATION

Architectural integration Photovoltaics

PHOTOVOLTAIC MODULES ON PERGOLAS

CLEAN ENERGY

COMMUNITY

LANDMARK

WATER SAVING

Kendeda building, Atlanta

EXPO 2020, Dubai

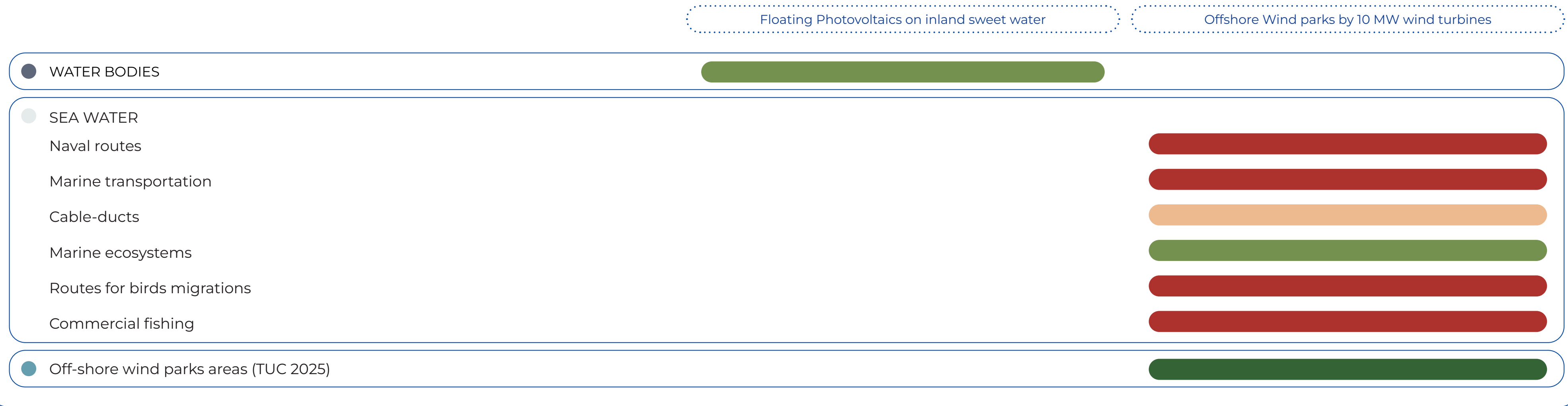
FLORIADE exhibition hall, Netherlands

LANDSCAPE-BASED ENERGY TRANSITION

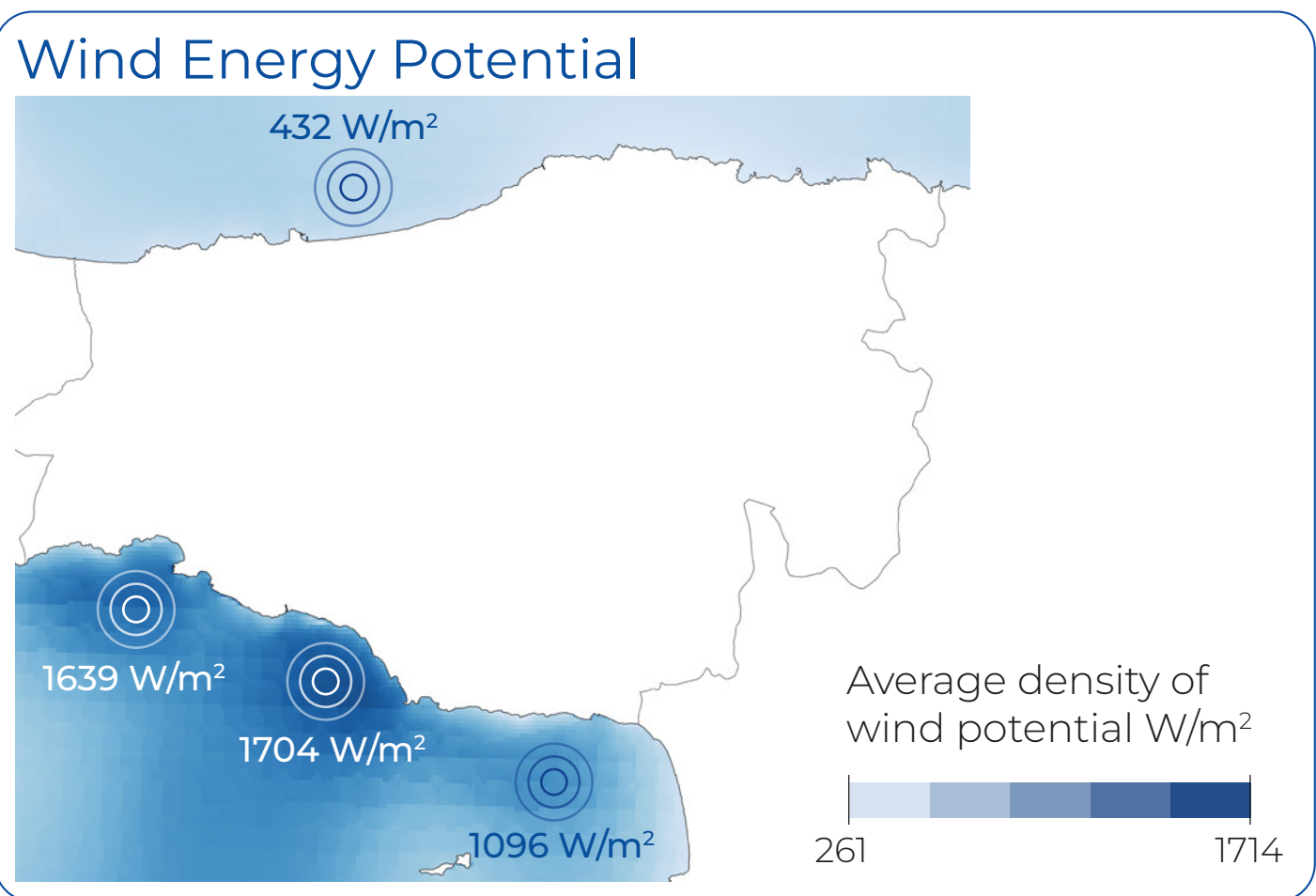
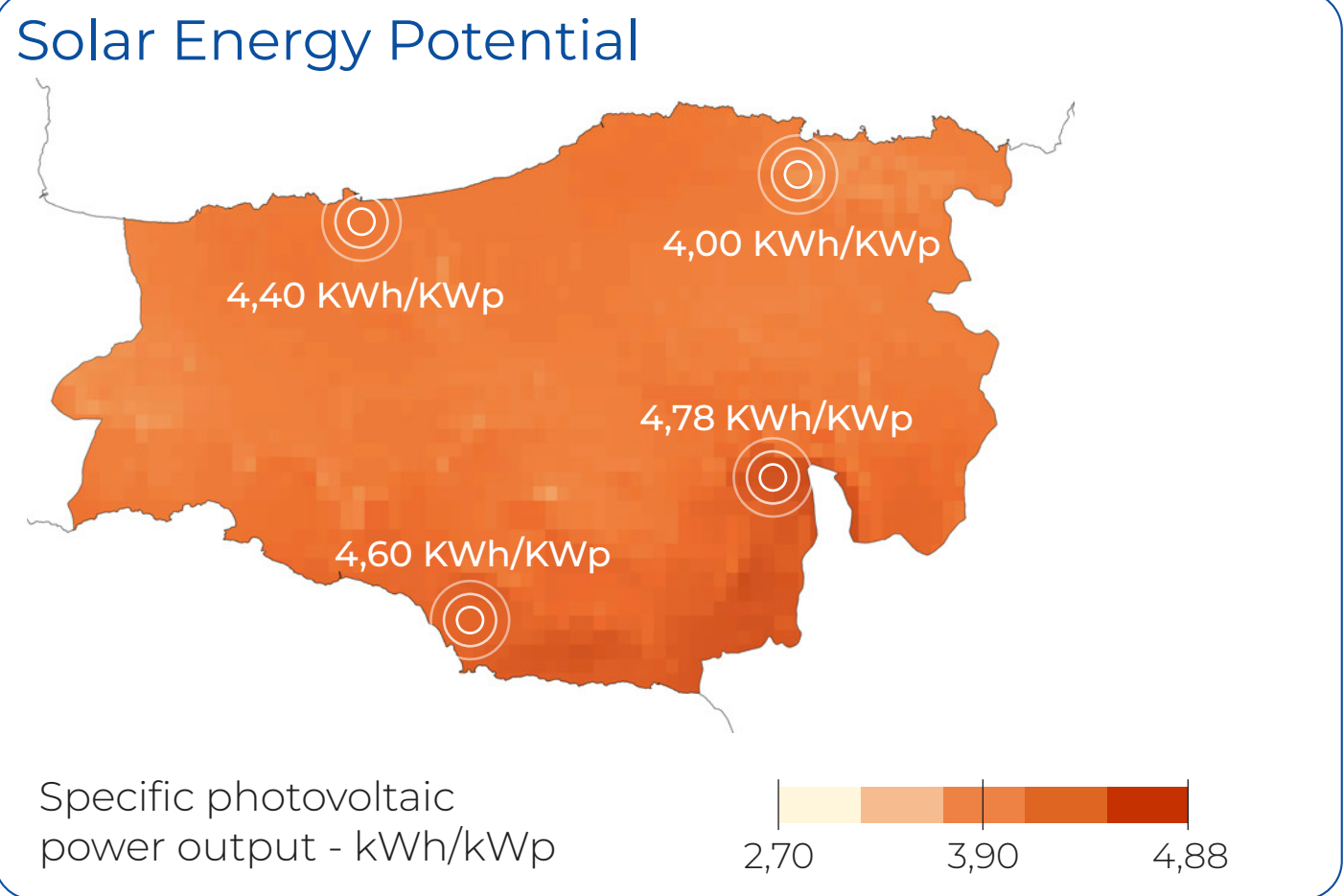
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WOULD YOU LIKE TO ENHANCE THE SEA AND THE LAKES NATURAL HABITAT WHILE GENRATING WIND AND SOLAR ENERGY?



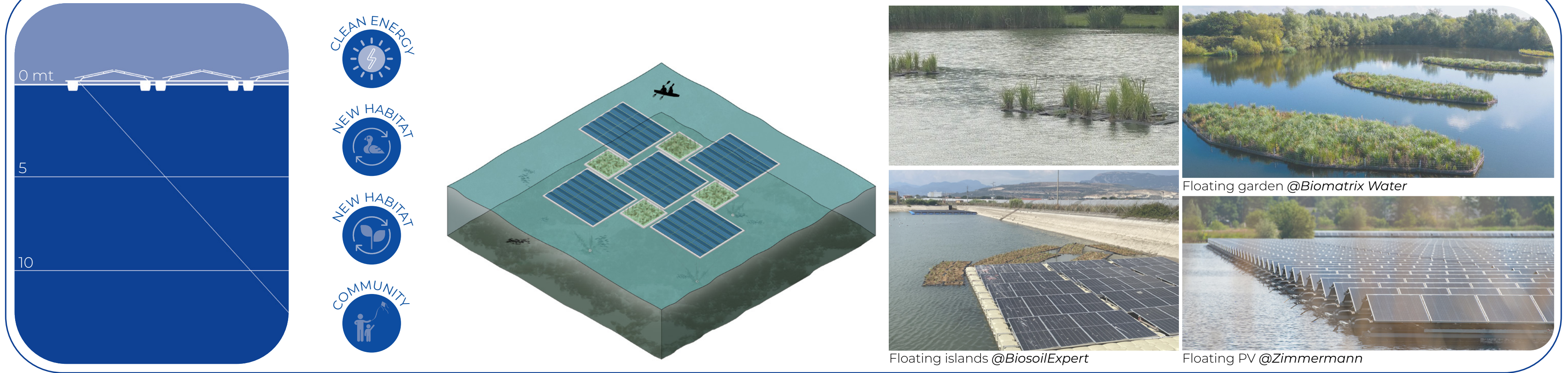
LANDSCAPE SOLAR CAPACITIES



OFFSHORE WIND FARM



FLOATING PHOTOVOLTAIC SYSTEM



WOULD YOU LIKE TO COOL DOWN YOUR CITY WHILE GENERATING SOLAR ENERGY AND ENHANCING NATURE?

Agrivoltaic systems with monoaxis trackers 4 meters elevated from the ground and bifacial modules

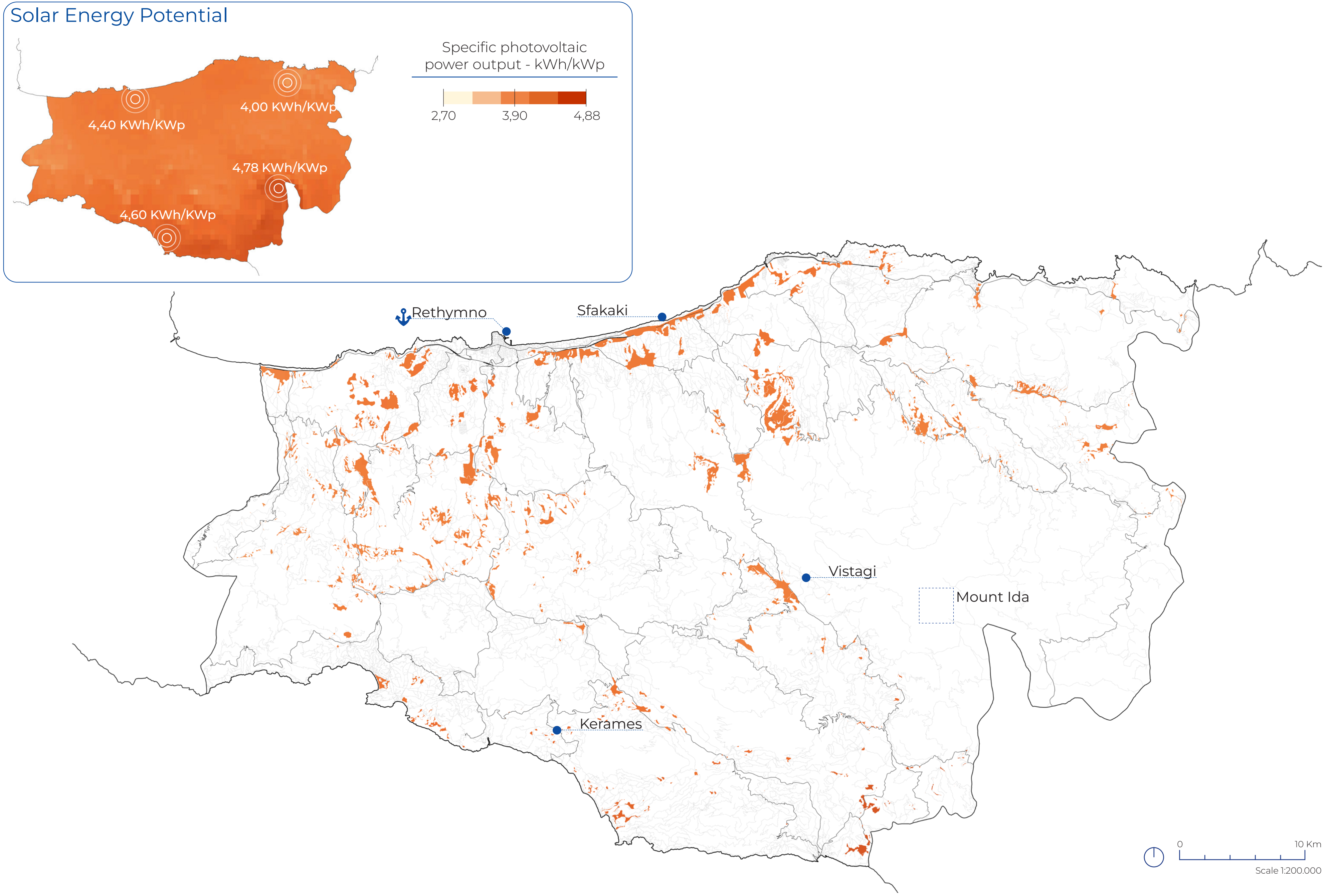
Agrivoltaic greenhouses, 30% shading on tomatoes and peppers

NON IRRIGATED ARABLE LAND AND PERMANENTLY IRRIGATED ARABLE LAND

COMPLEX CULTIVATION PATTERNS

LAND PRINCIPALLY OCCUPIED BY AGRICULTURE; WITH SIGNIFICANT AREAS OF NATURAL VEGETATION

LANDSCAPE SOLAR CAPACITIES



SOLAR GREENHOUSES

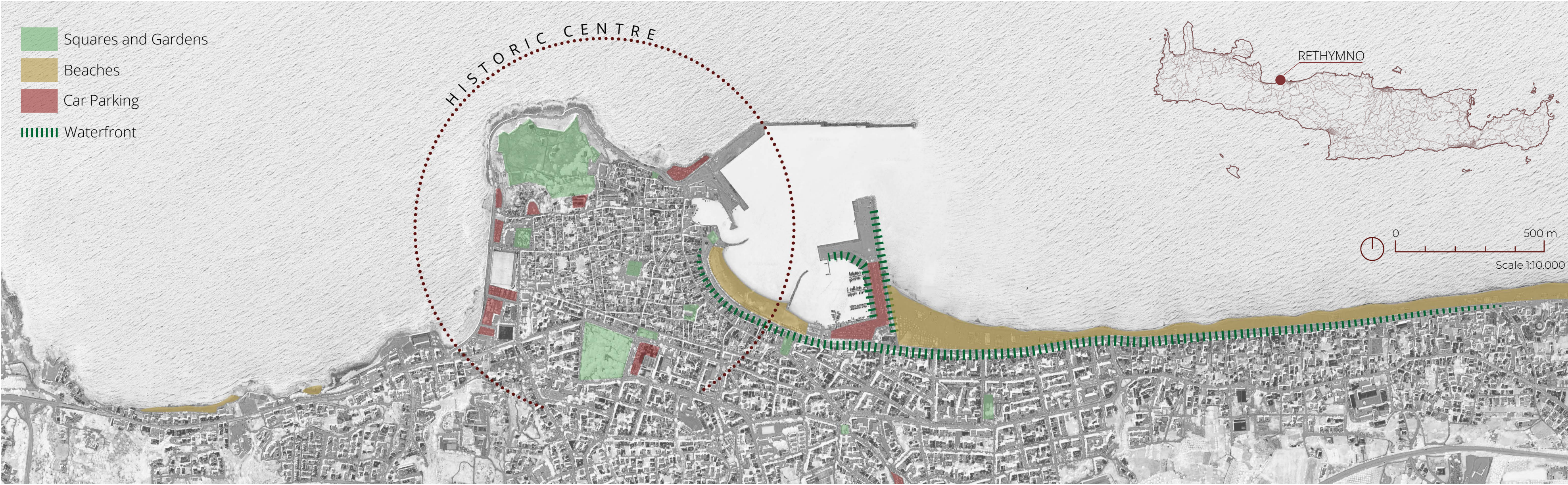
AGRIVOLTAIC SYSTEM

LANDSCAPE-BASED ENERGY TRANSITION

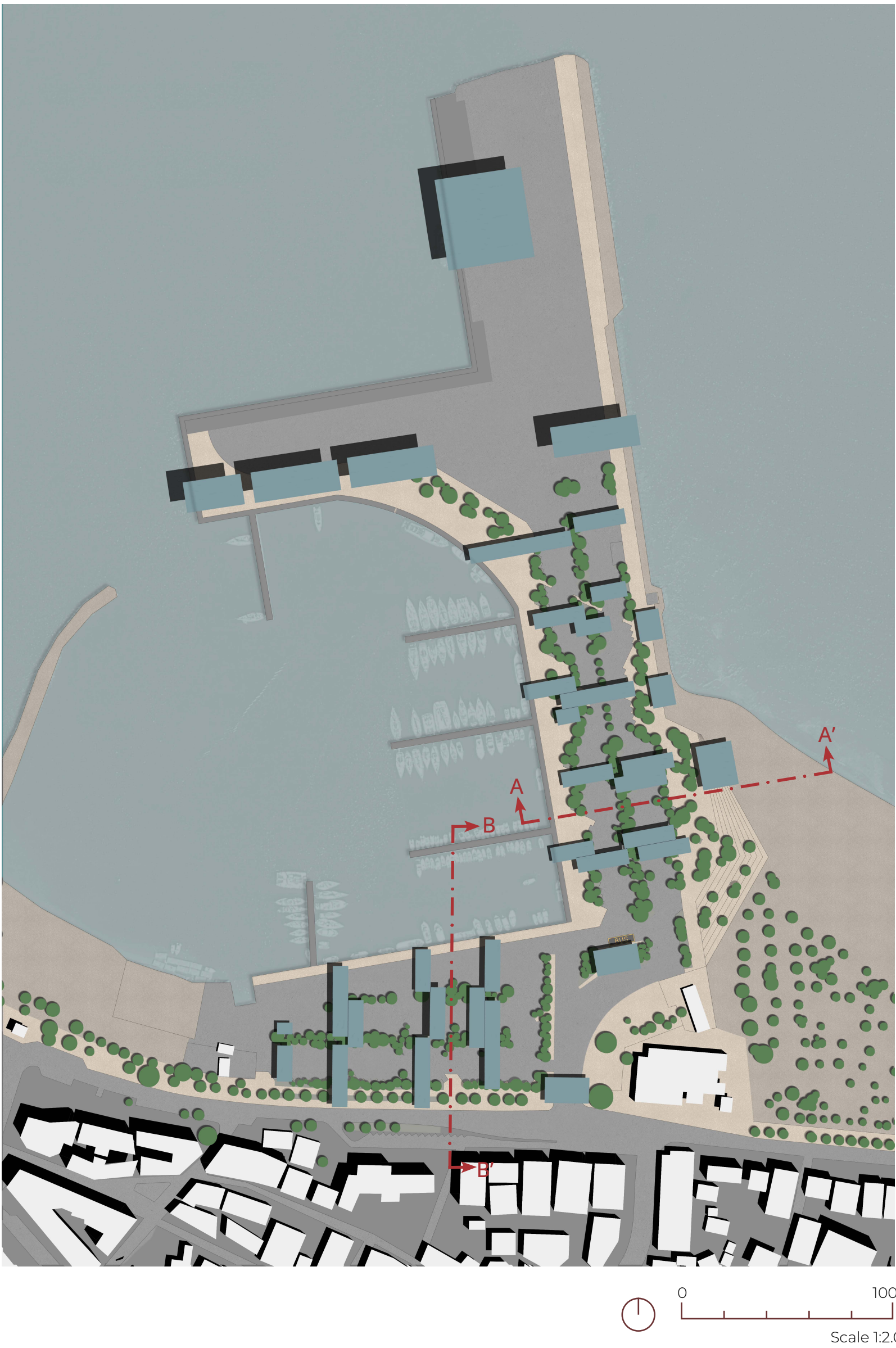
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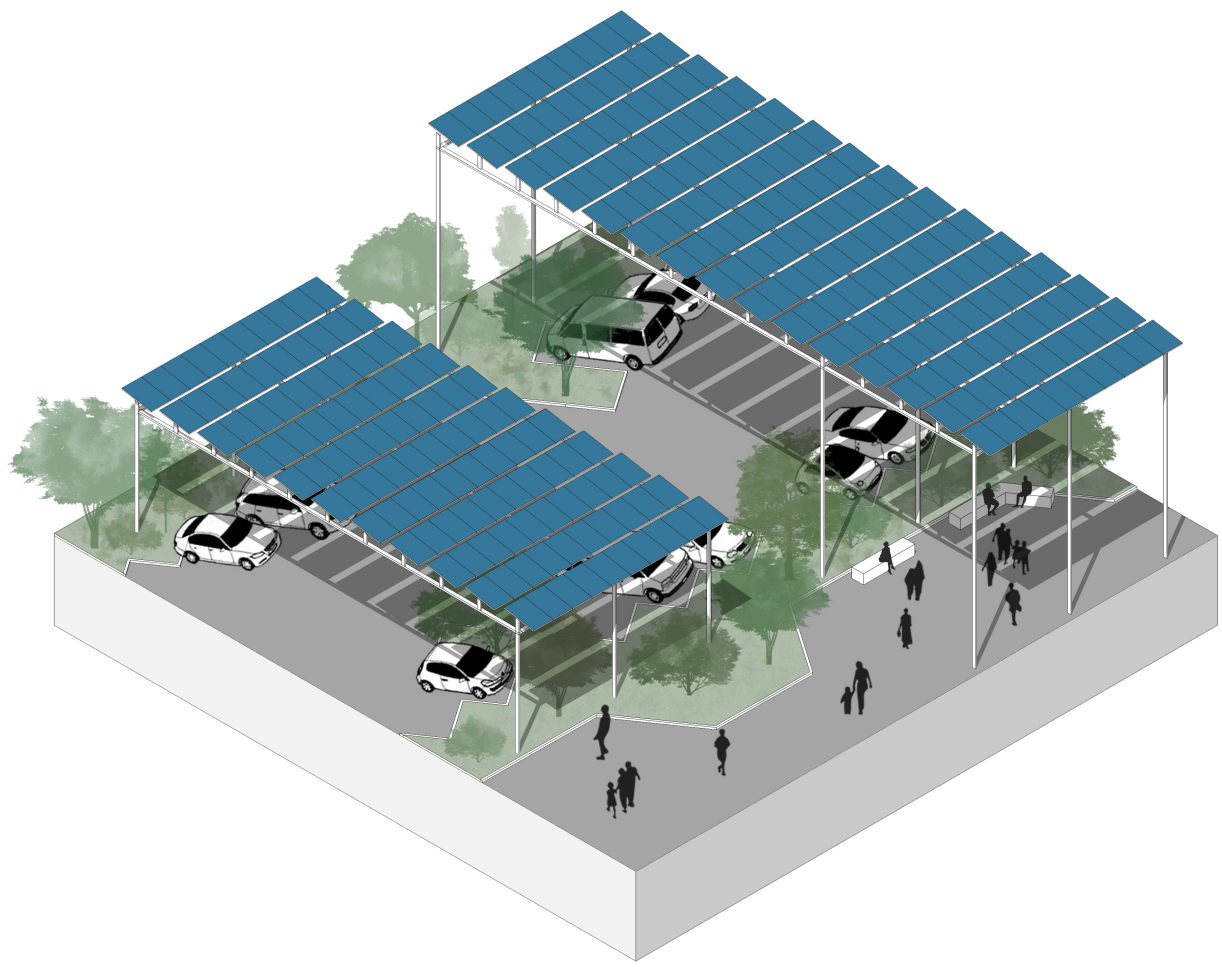
OPEN SPACES SYSTEM



PLANIVOLUMETRIC



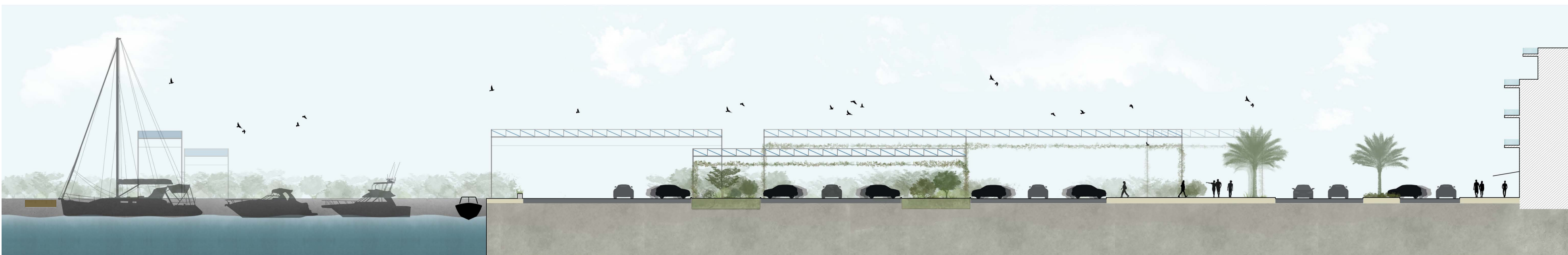
PV surface
9500 m²
Installed capacity
13,3 mW

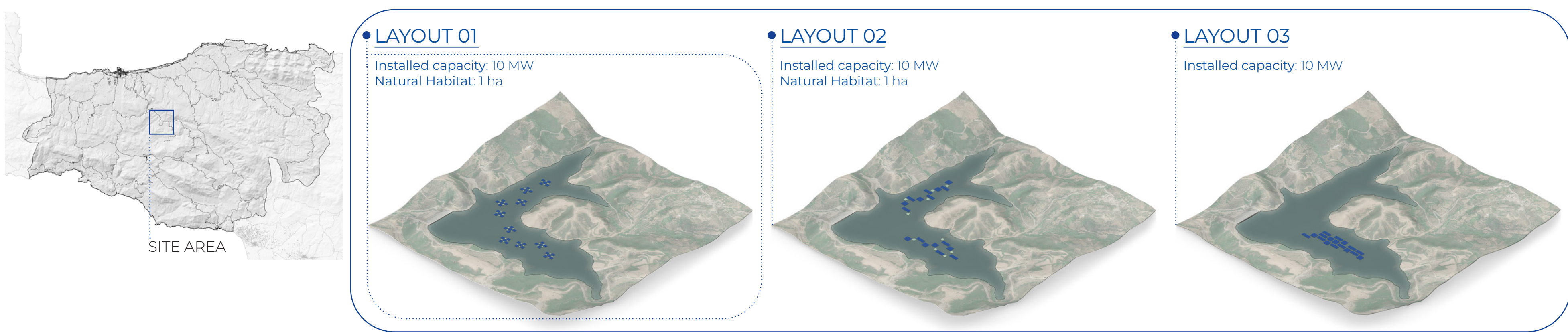


Section A-A'

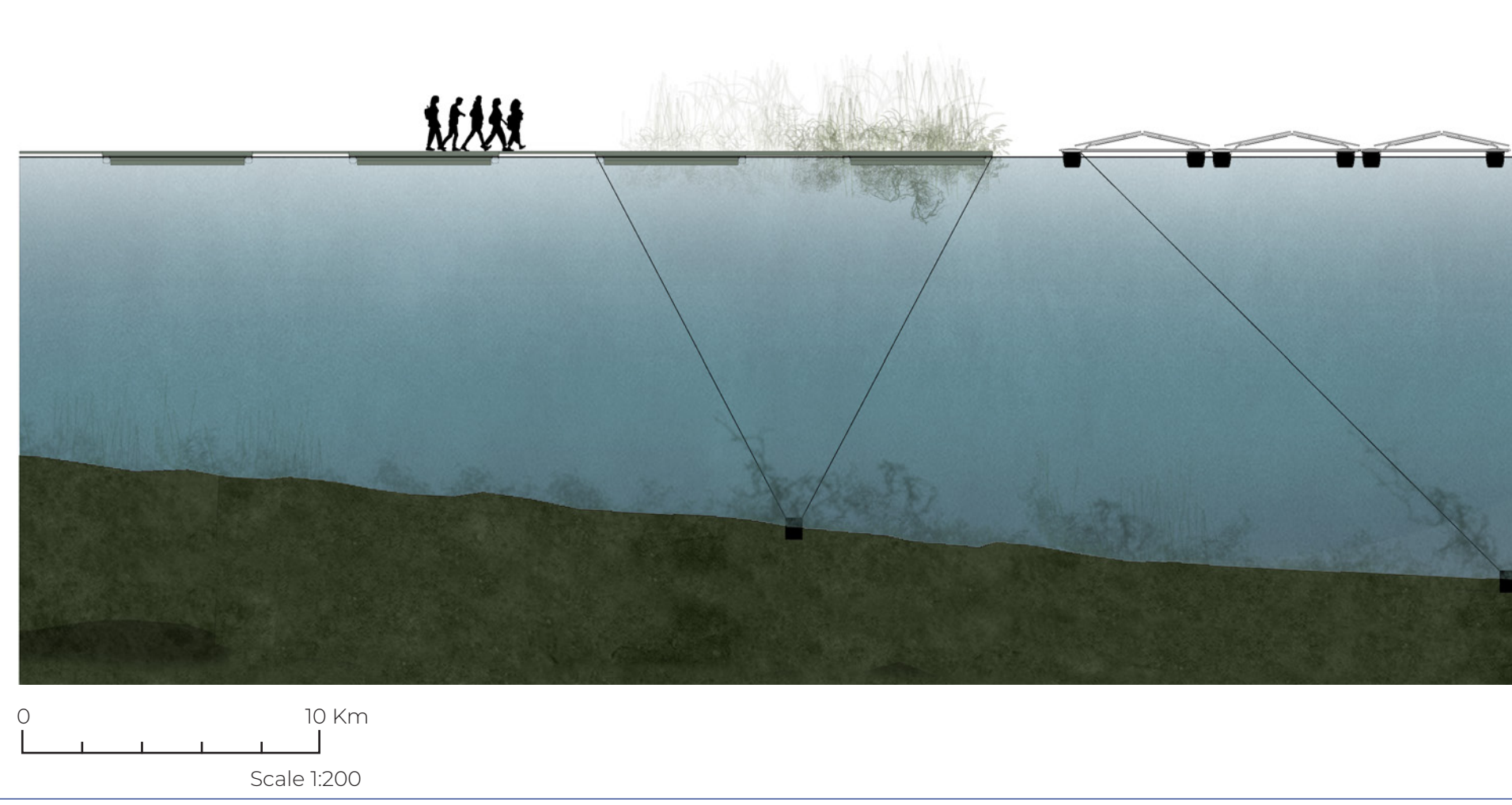
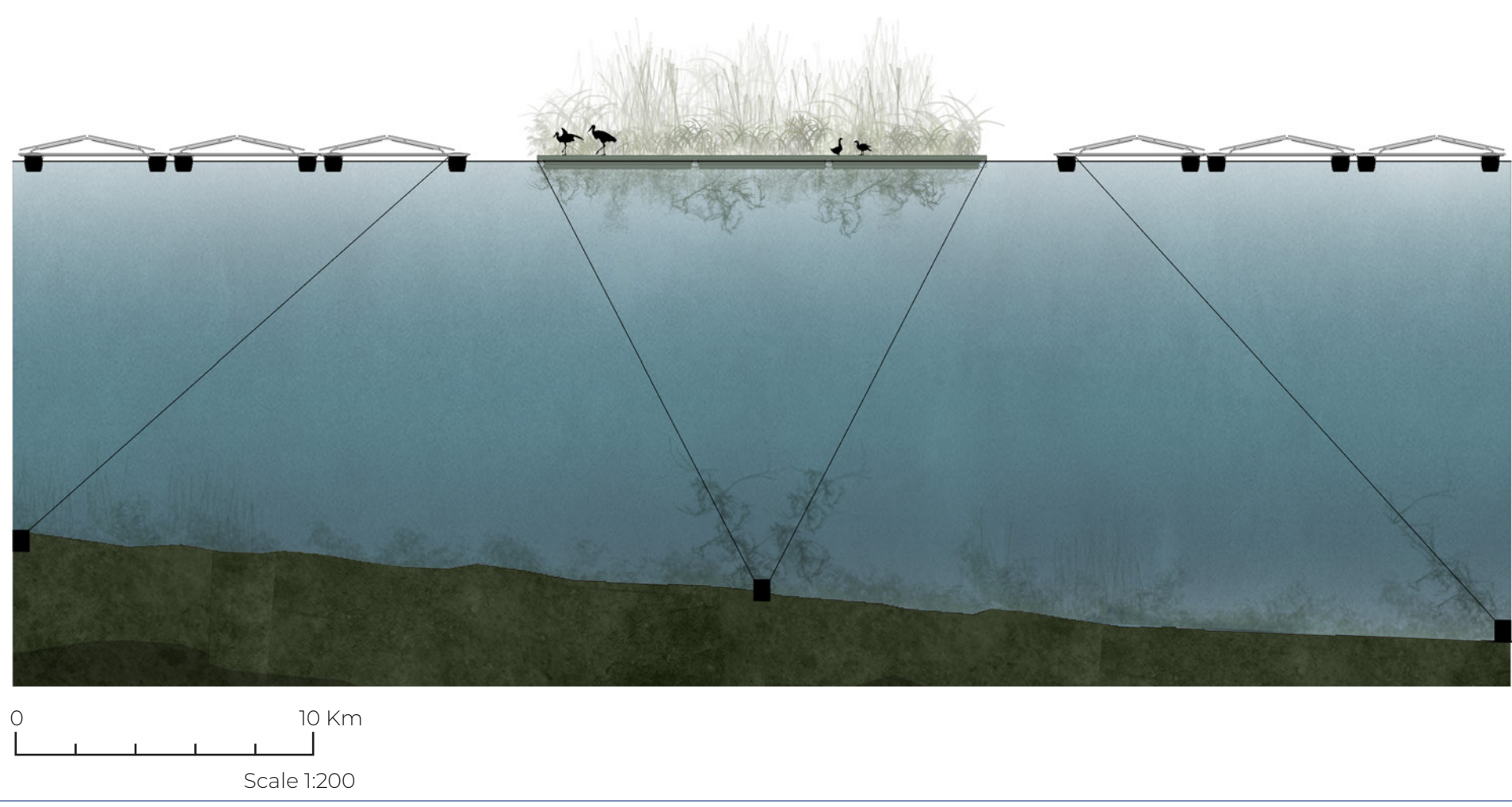
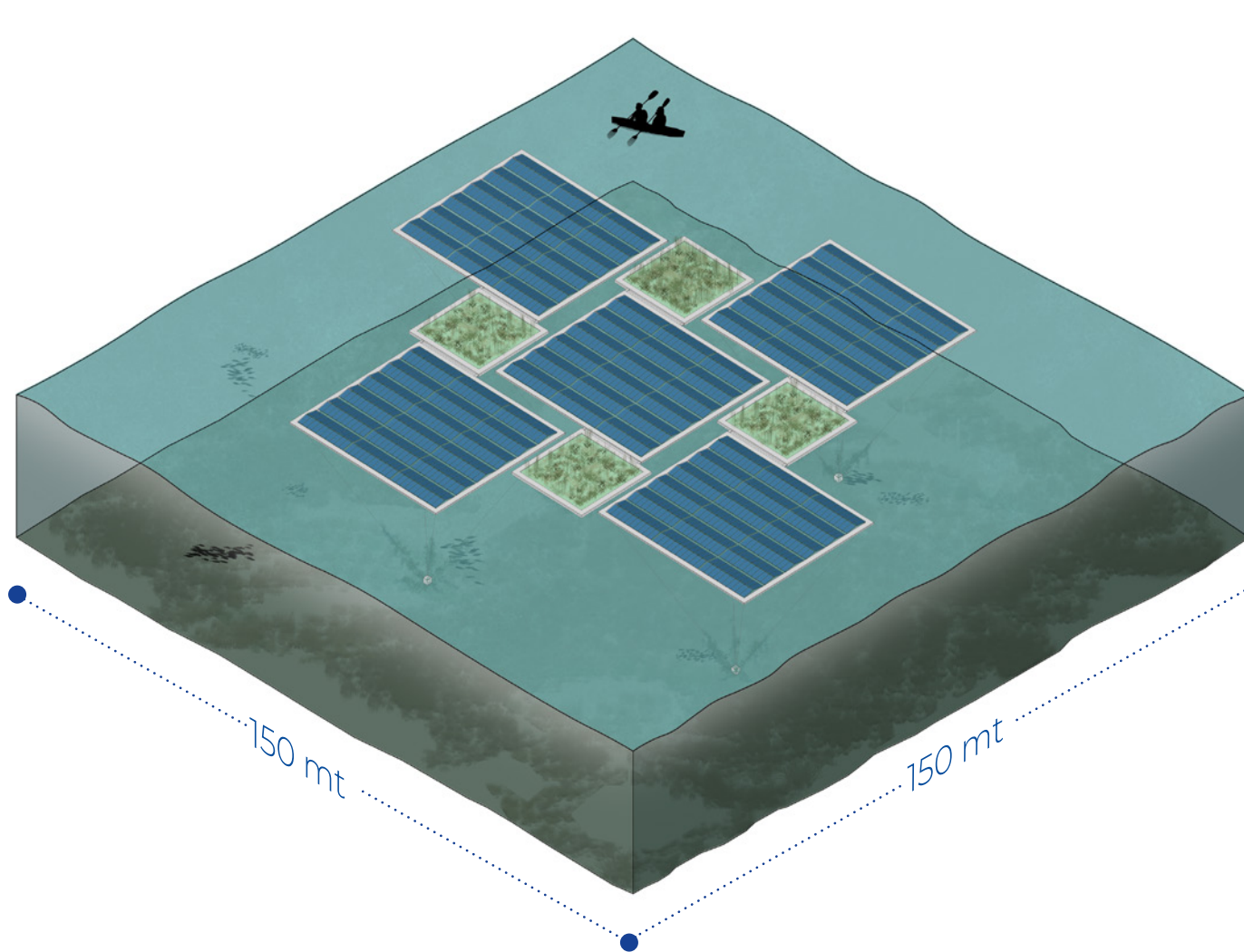
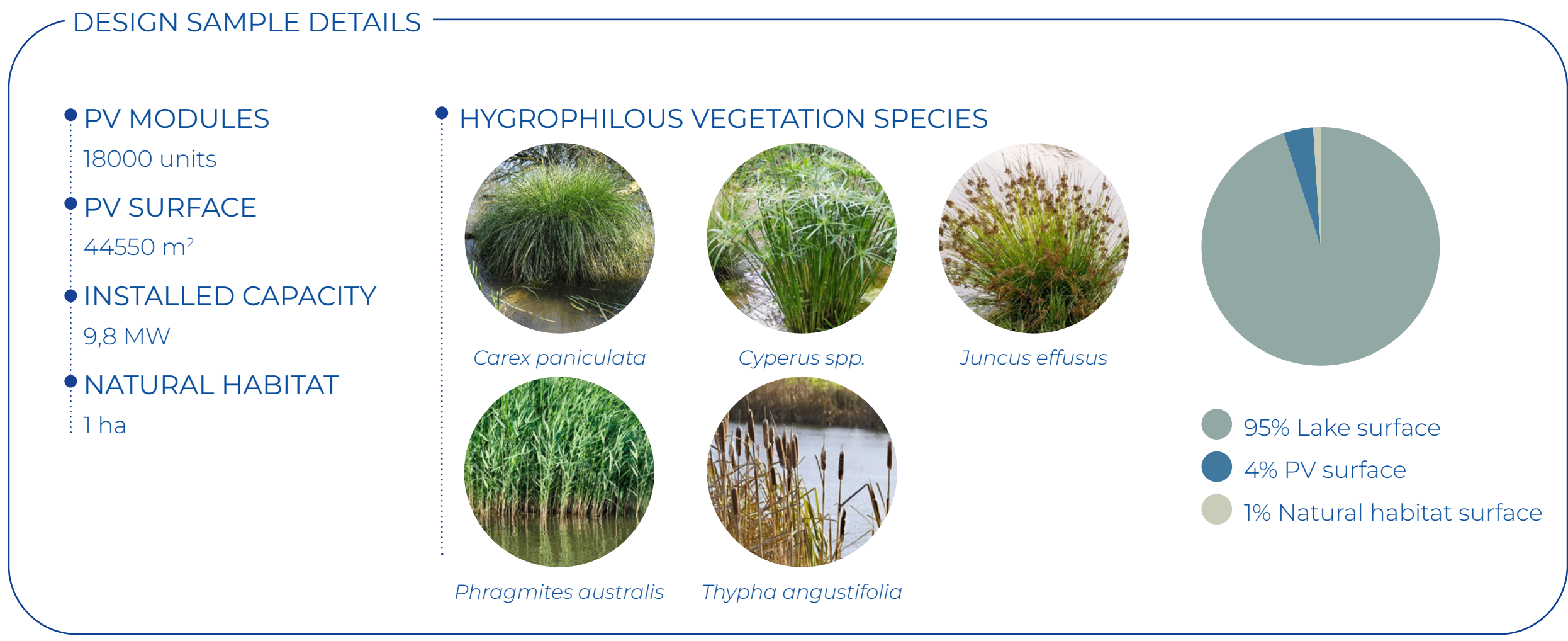
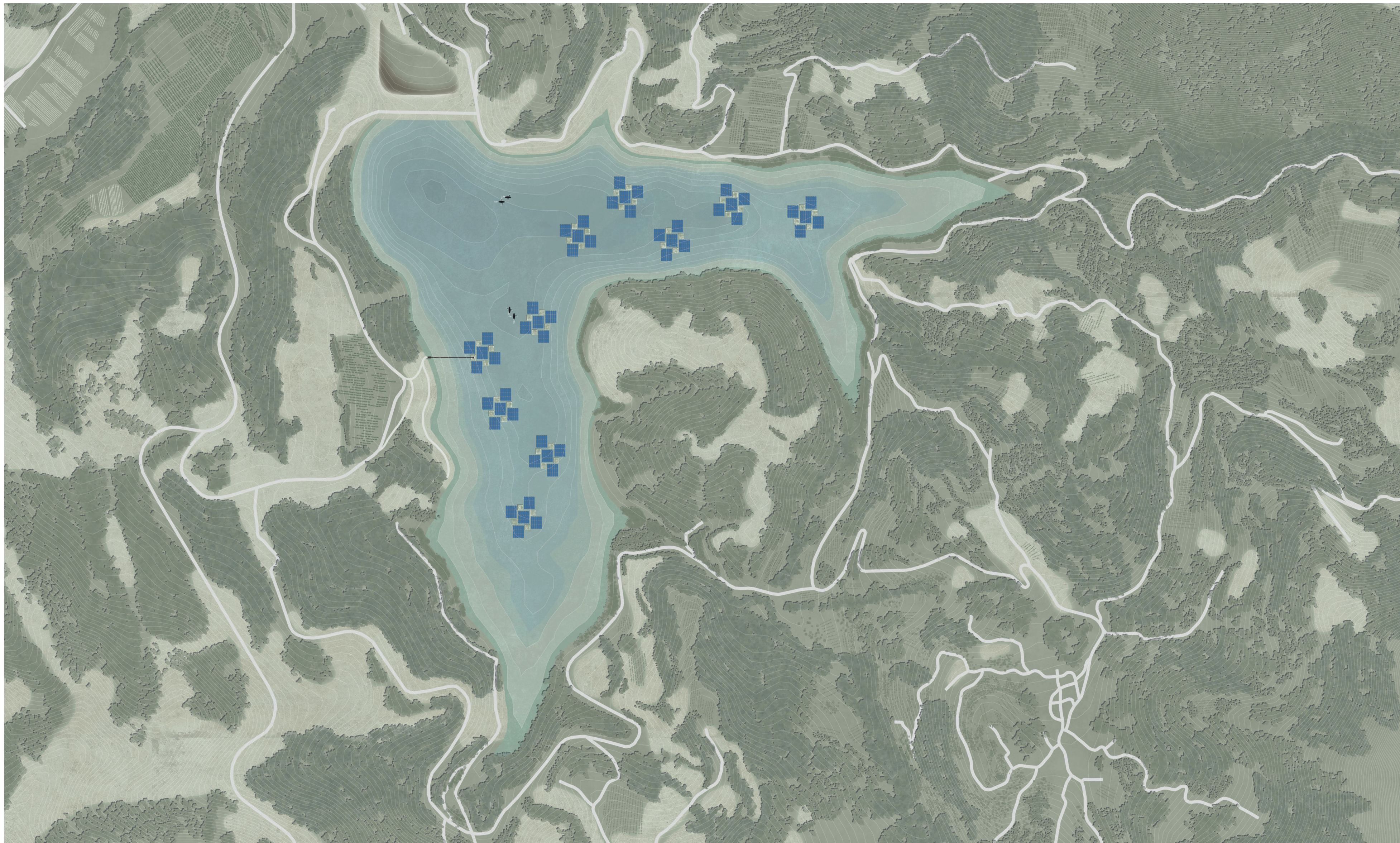


Section B-B'





DESIGN PROTOTYPE FOR FLOATING PHOTOVOLTAIC SYSTEMS - LAYOUT 01



LANDSCAPE-BASED ENERGY TRANSITION

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The Ρέα wind park is interpreted as a tribute to Rhéa, Titan Mother of Zeus and visible from the mount Ida in the form of a huge embrace to the mount and the cave where the Mother of Olympics protected Zues from Chrones. The wind park is composed by **12 turbines** as much as the Olympics that were generated since then.

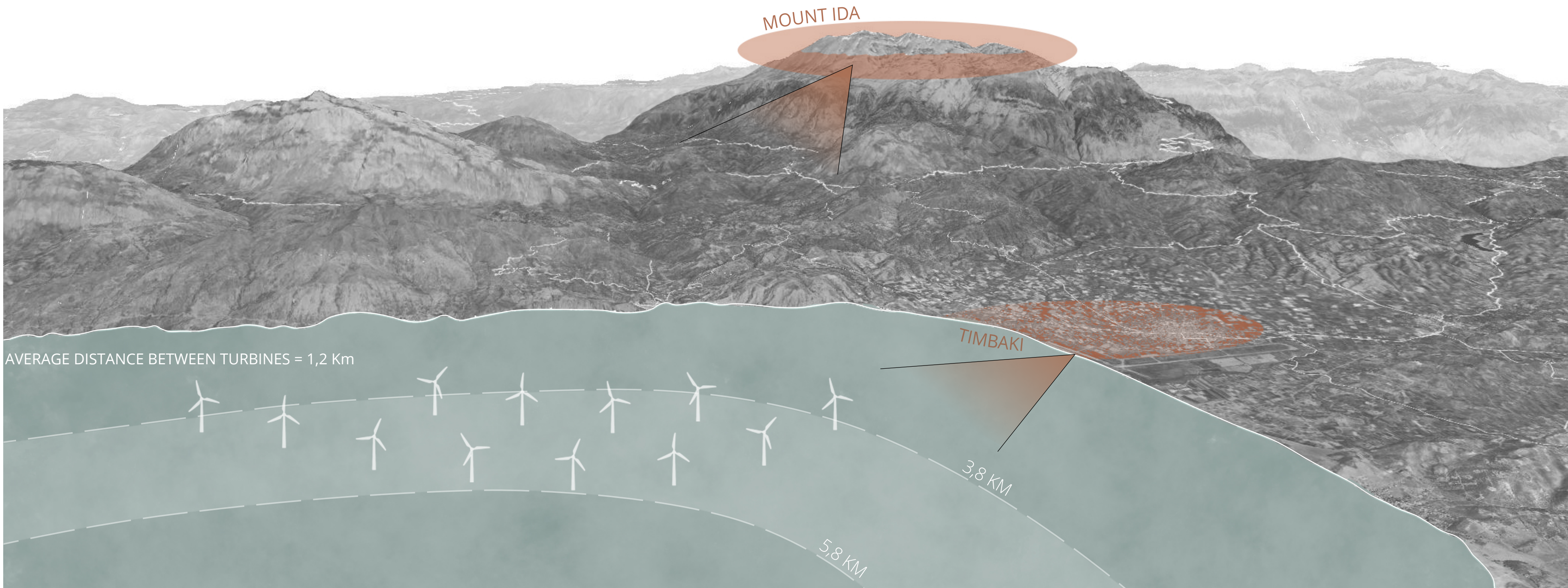
«τῷ δὲ σπαργανίσασα μέγαν λίθον ἐγγυάλιξεν/Οὐρανίδῃ μέγ' ἄνακτι, θεῶν προτέρῳ βασιλῆϊ»

« Then she gave him, wrapped in swaddling clothes, a large stone,/ to the son of Uranus, the great lord, the first king of the gods.»
(Esiodo, Teogonia, 485-6; traduzione di Graziano Arrighetti)



Galerie mythologique, tome 1 d'A.L. Millin

DESIGN PROTOTYPE FOR Ρέα OFFSHORE WIND PARK



VIEW FROM MOUNT IDA



VIEW FROM TIMBAKI SEAFRONT



TECHNICAL SECTION

SCALE REPRESENTATION OF A SEA PORTION WITH ONE OF THE 12 FLOATING WIND TURBINES

