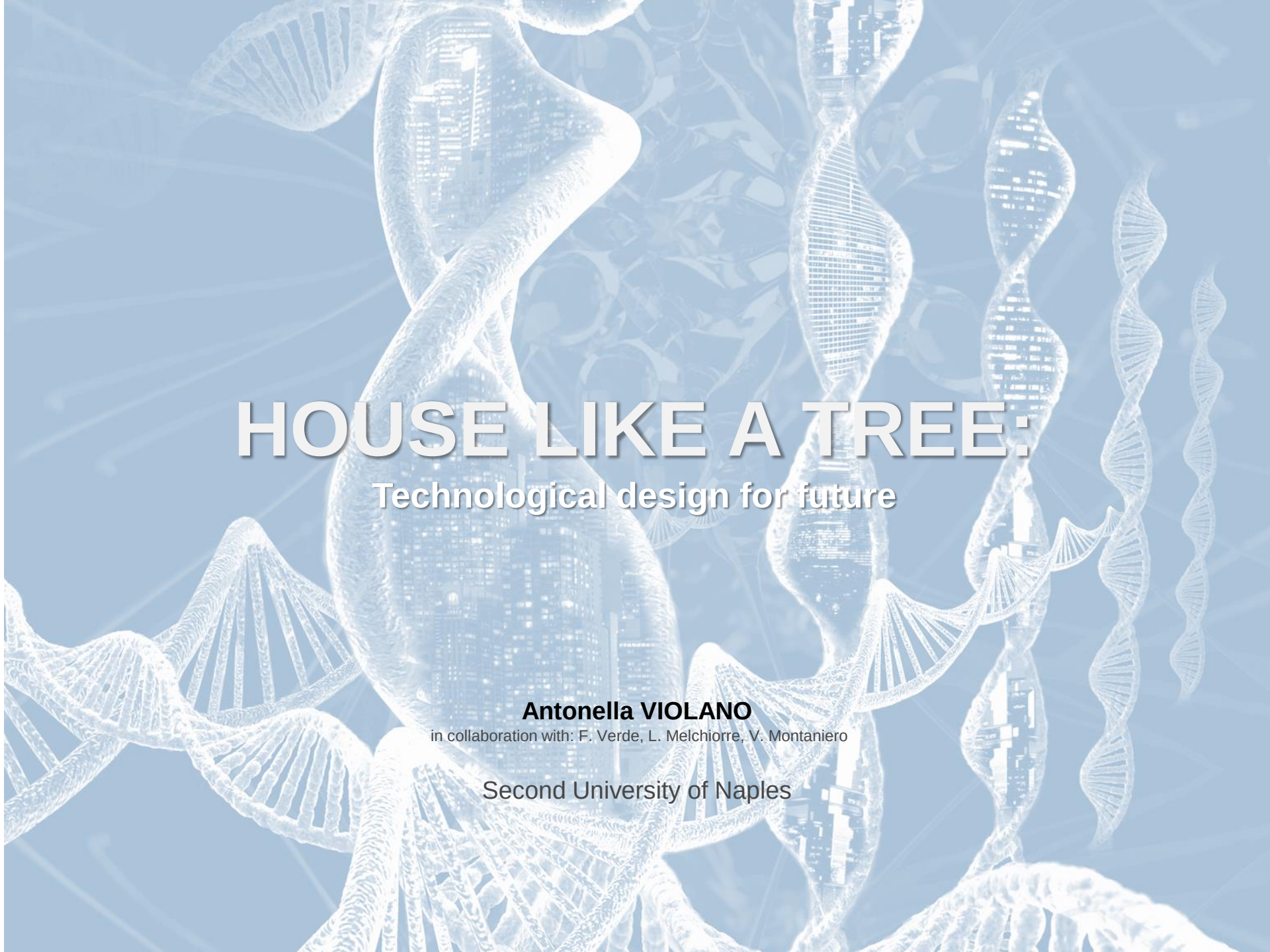


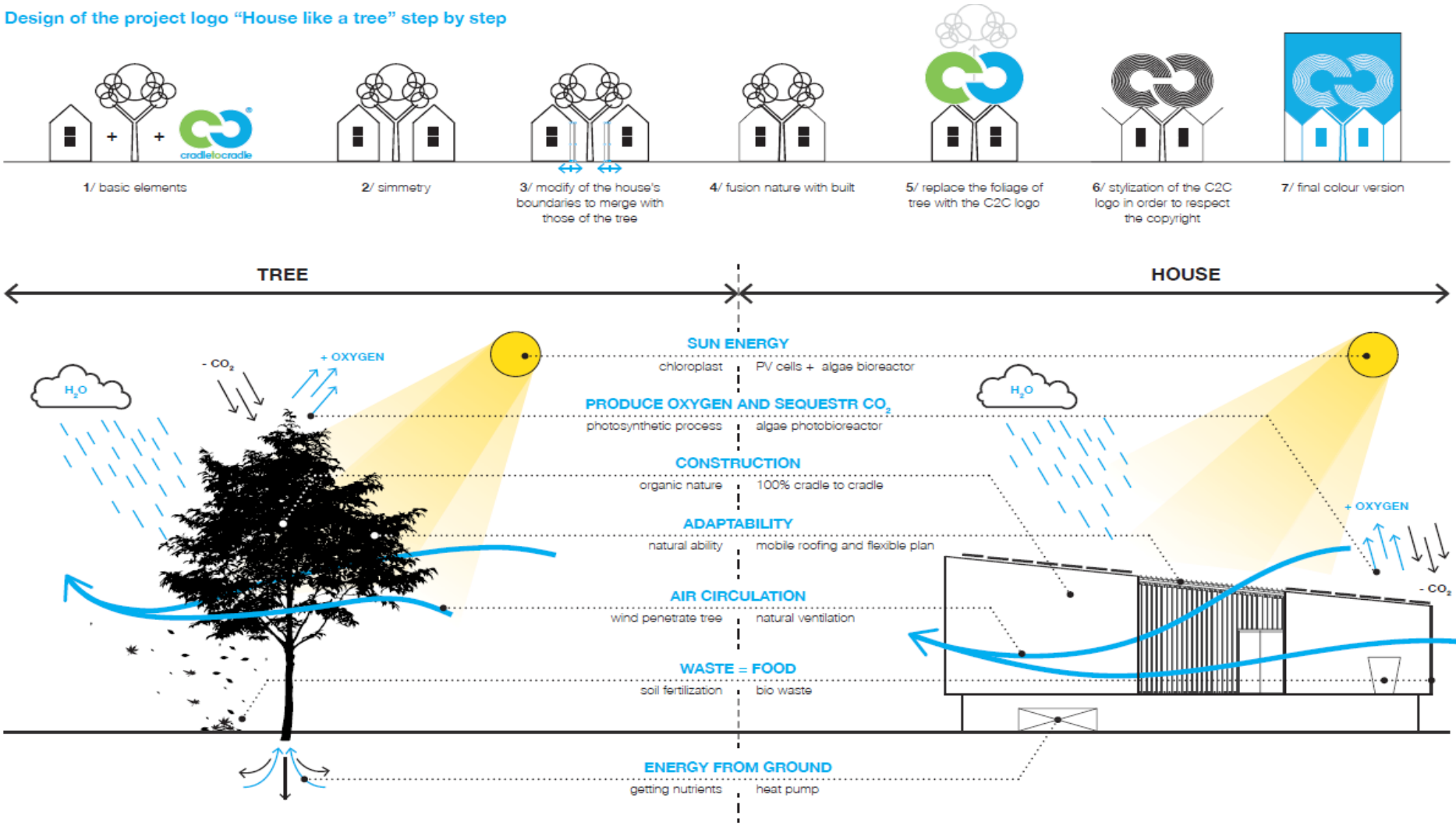
HOUSE LIKE A TREE:

Technological design for future

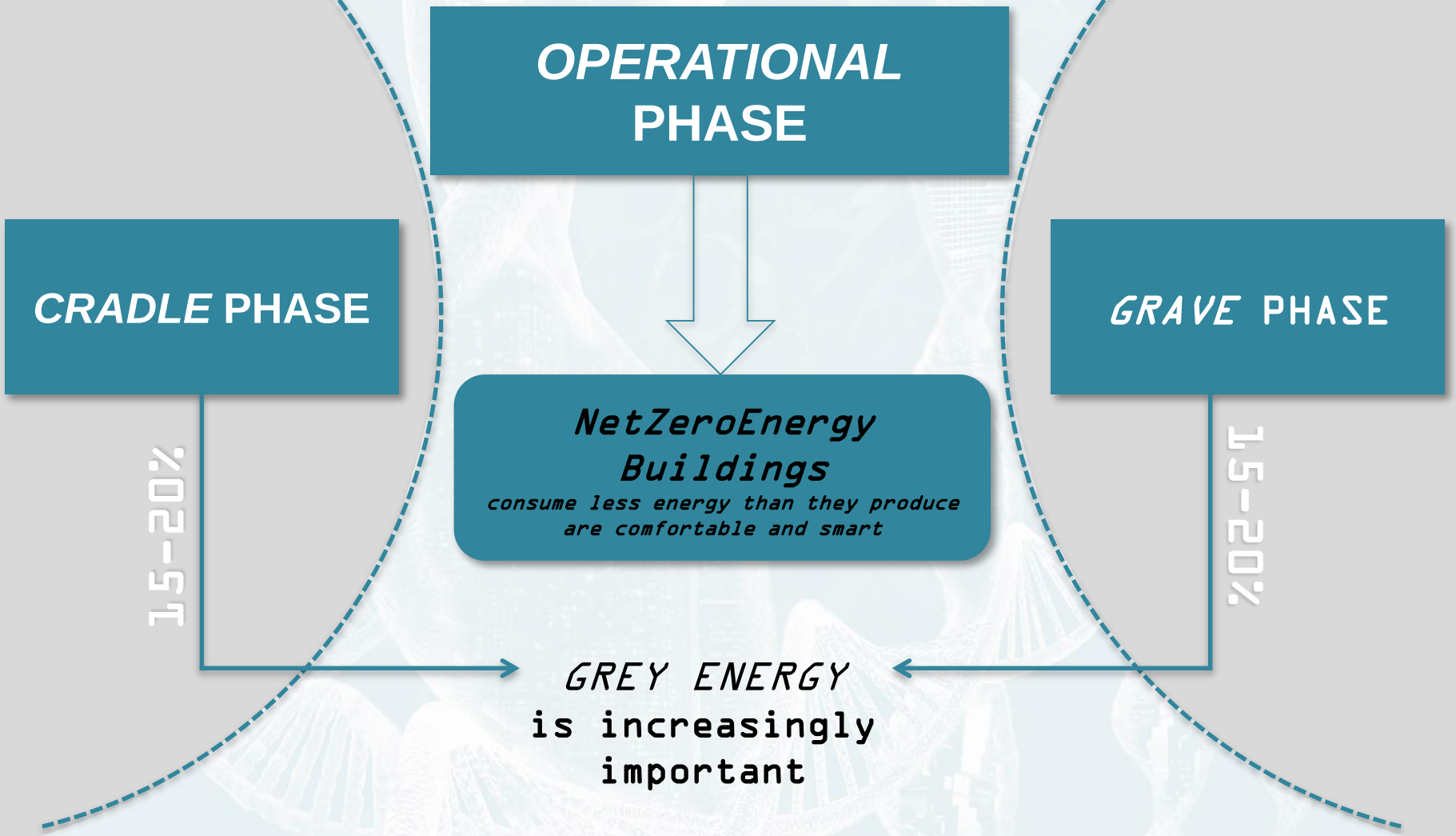
Antonella VIOLANO
in collaboration with: F. Verde, L. Melchiorre, V. Montaniero

Second University of Naples

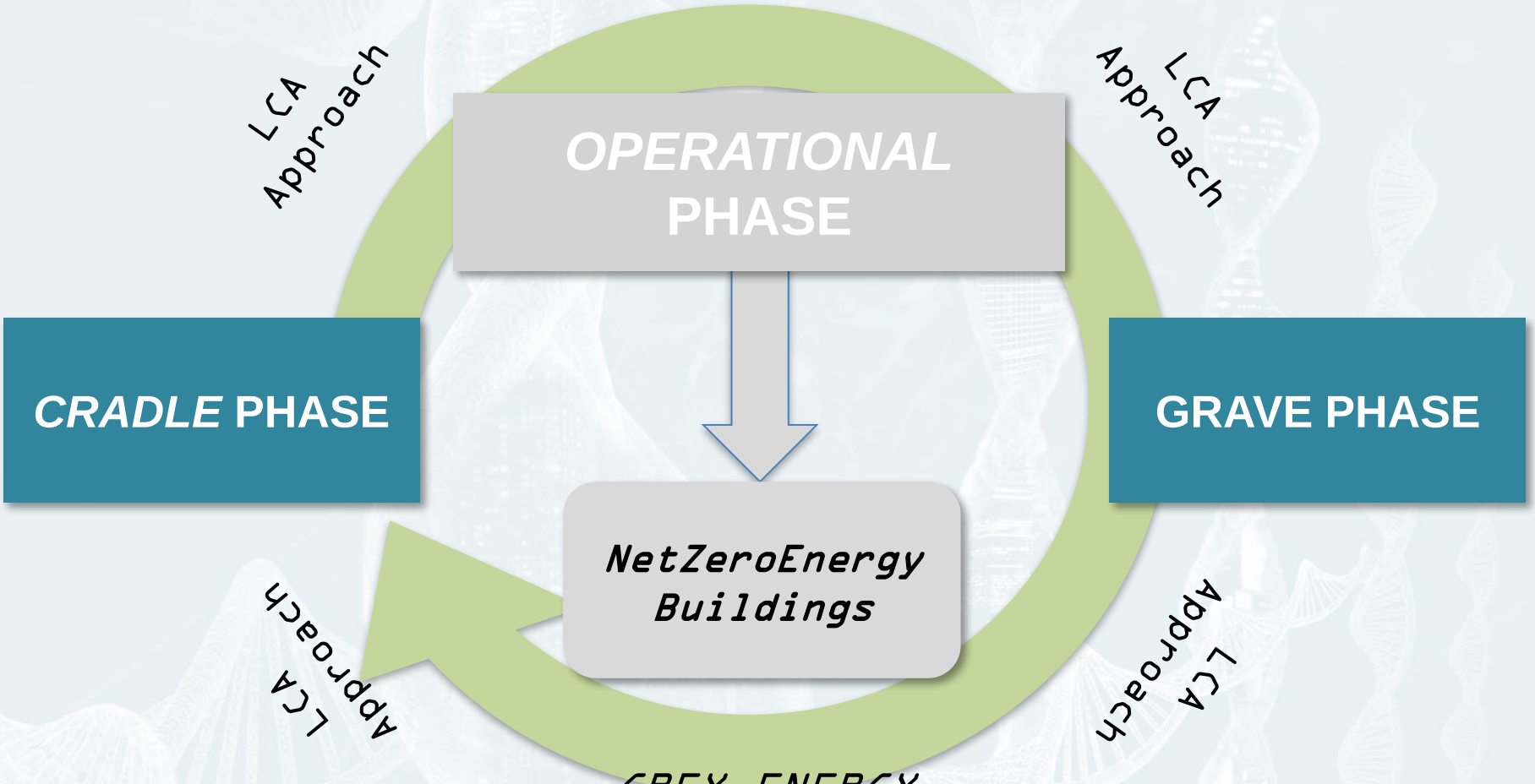
The design is not only a process but a “place” of reciprocal relationship



Current approach (cradle-to-grave)

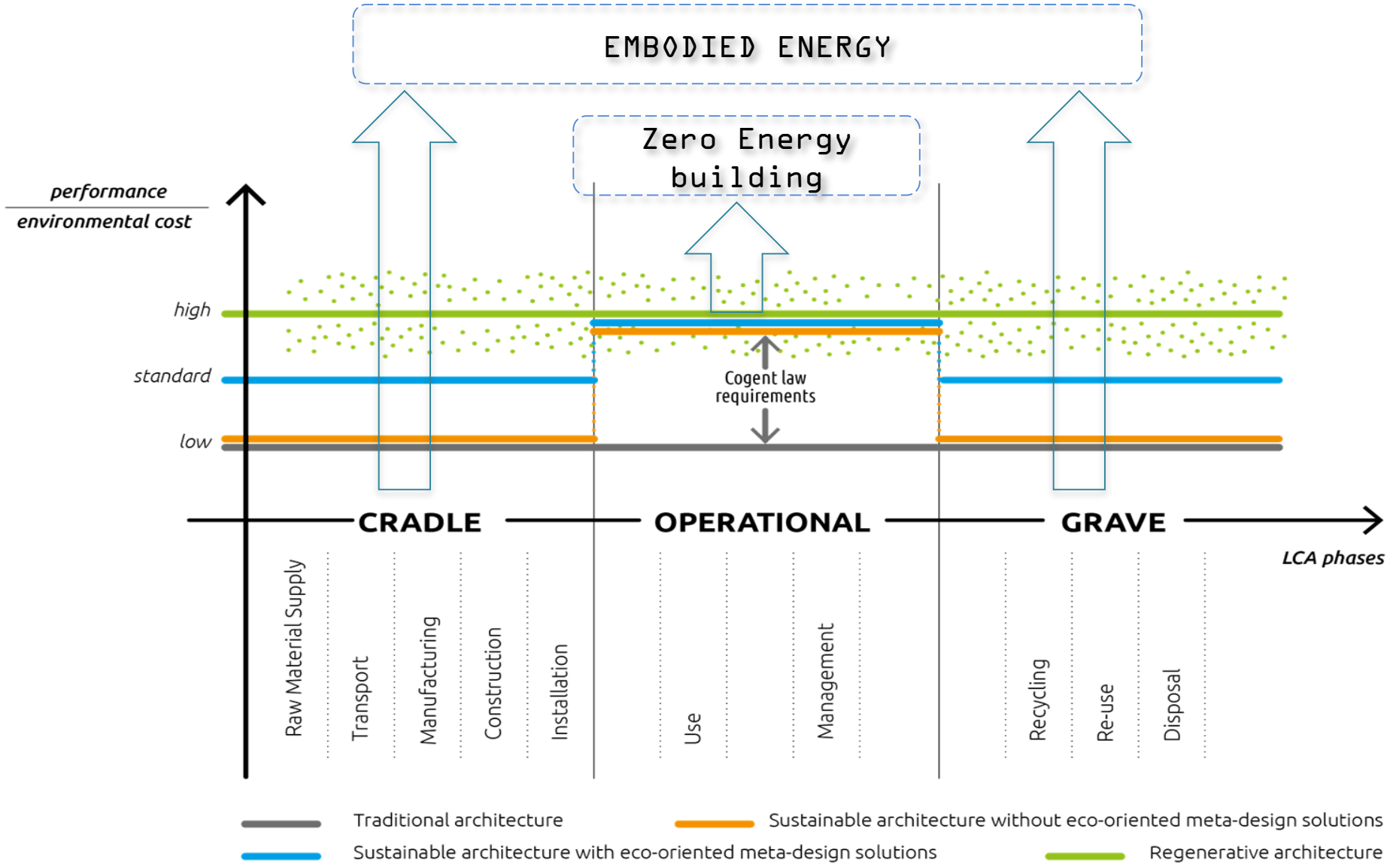


The new approach (cradle to cradle - C2C)



GREY ENERGY
is increasingly important

Integrating the building in the life cycle of the ecosystem


EMBODIED ENERGY
Zero Energy building
performance
environmental cost
high
standard
low
Cogent law requirements
CRADLE
OPERATIONAL
GRAVE
LCA phases
Raw Material Supply
Transport
Manufacturing
Construction
Installation
Use
Management
Recycling
Re-use
Disposal
Traditional architecture
Sustainable architecture without eco-oriented meta-design solutions
Sustainable architecture with eco-oriented meta-design solutions
Regenerative architecture

Genetic engineering

Biotechnology

Electrical engineering

Biophysics

Synthetic biology

will be able to imagine and build new living systems (which display functions that do not exist in nature) for useful purposes

Architectural

fields

Building

BIO-SENSORS

Es.. microbes that change color when detecting toxins or find and heal cracks in concrete

Energy

BIO-FUELS

derived from converting of readily available solar energy and natural or waste materials

Environment

BIO-REMEDIATION

based on the design and modification of microorganisms such as fungi or bacteria to eliminate toxic substances and pollutants from soil or contaminated water

The grown materials applications in architecture

GROWN MATERIALS

the **biotic-processed** that collects the materials generated by an actively participation of living organisms in the process of creating the final product

the **biotic-processing** that collects the materials in which the living organisms are integrated into the final product to extend the service life.

Bacteria-based materials

BioMason

Bio-On

Bio cement

Fungi-based materials

Ecovative

Algae based materials and systems

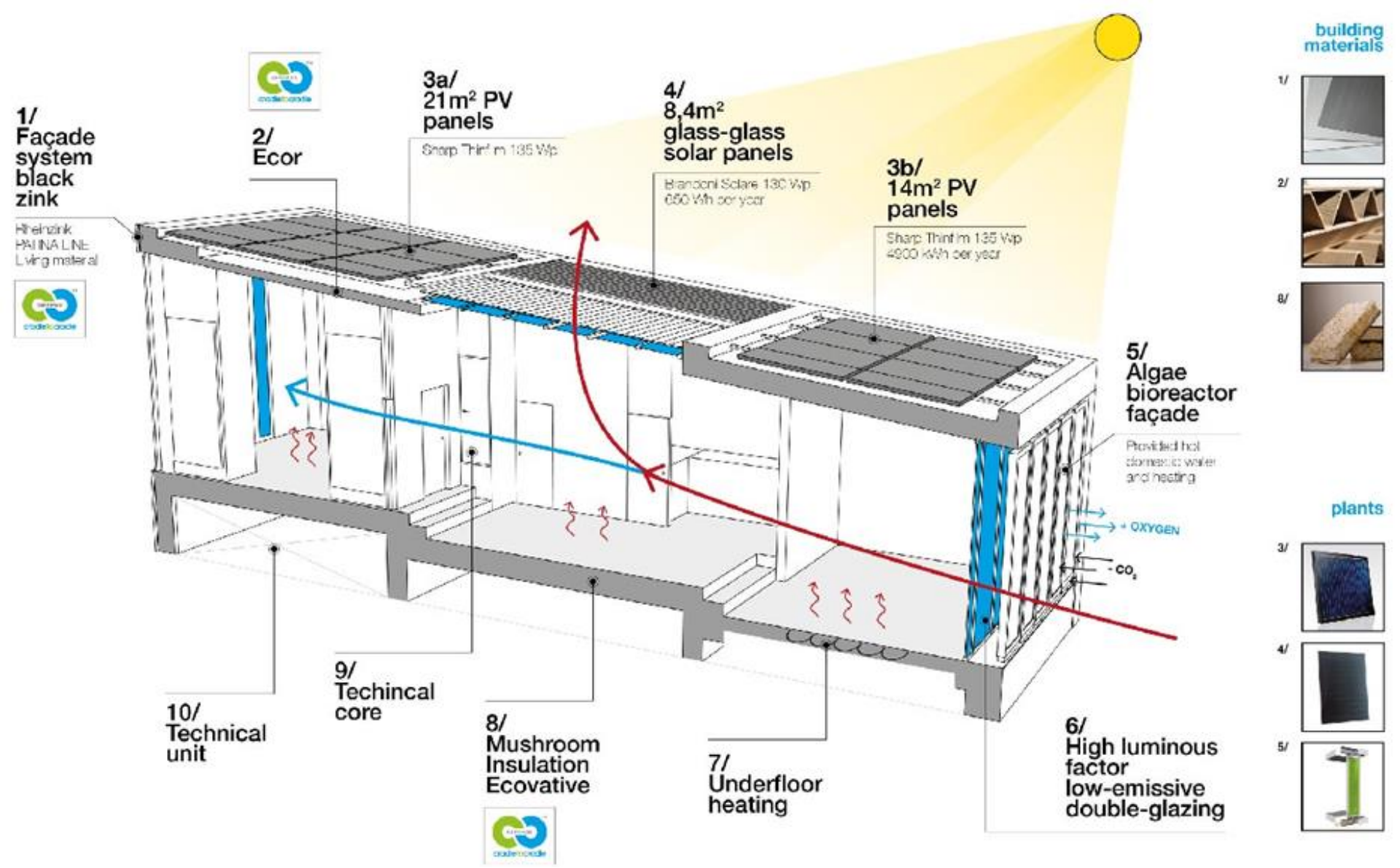
EdiMare

Urban algae façade

SolarLeaf

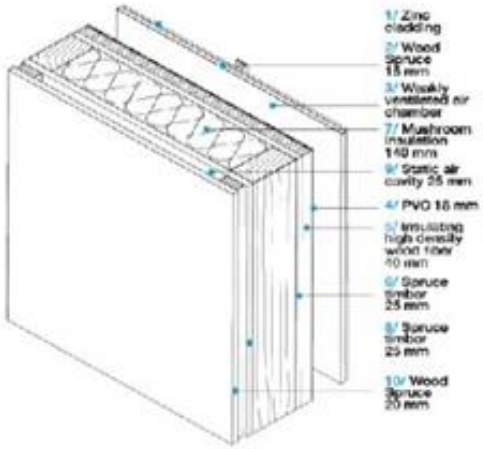
The role of the microorganism ends at the time when the construction product is made.

microorganisms co-evolve with the building and their living process continue during the operational phase


1/
Façade system black zink
Rheinzink PATINA LINE Living material
2/
Ecor
3a/
21m² PV panels
Sharp Thin f m 135 Wp
4/
8,4m² glass-glass solar panels
Brandoni Solare 130 Wp
650 kWh per year
3b/
14m² PV panels
Sharp Thin f m 135 Wp
4900 kWh per year
5/
Algae bioreactor façade
Provided hot domestic water and heating
+ OXYGEN
- CO_2
6/
High luminous factor low-emissive double-glazing
7/
Underfloor heating
8/
Mushroom Insulation Ecovative
9/
Techincal core
10/
Technical unit
building materials
1/
2/
8/
plants
3/
4/
5/

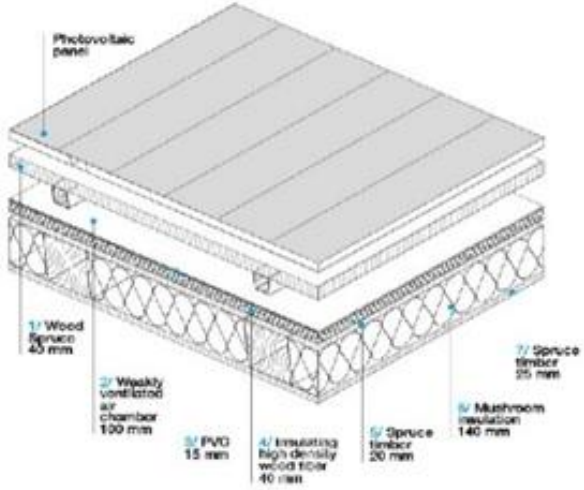
External wall

Total layers	10
Total thickness	392,8 mm
Thermal resistance	5,7094 m²K/W
Thermal transmittance	0,1751 W/m²K
Attenuation	0,1647
Time shift (ext-int flux)	12h 35'



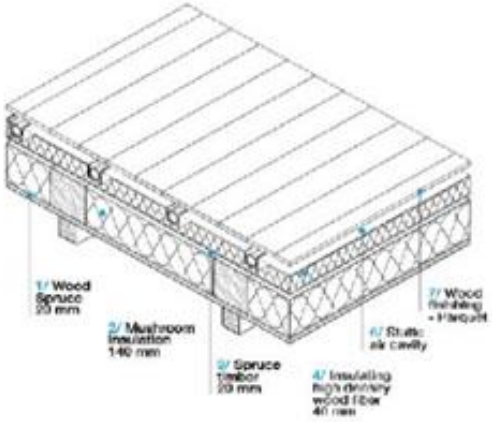
Living area roof

Total layers	7
Total thickness	361,5 mm
Thermal resistance	5,5158 m²K/W
Thermal transmittance	0,1813 W/m²K
Attenuation	0,2518
Time shift (ext-int flux)	11h 14'



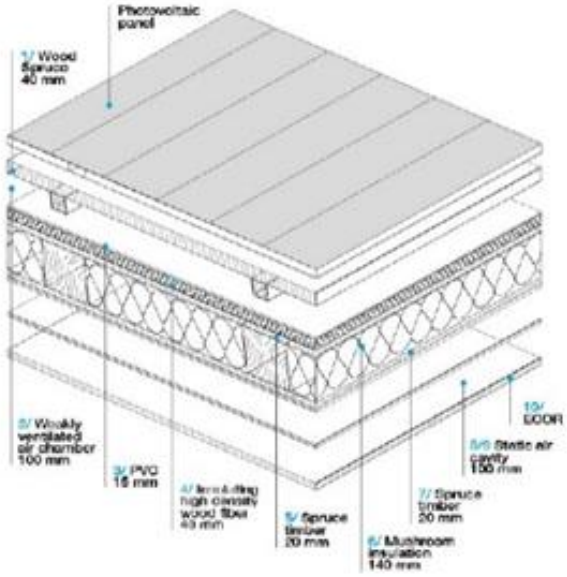
Floor

Total layers	7
Total thickness	261 mm
Thermal resistance	5,8175 m²K/W
Thermal transmittance	0,1719 W/m²K
Attenuation	0,2648
Time shift (ext-int flux)	9h 48'



Night area roof

Total layers	10
Total thickness	581,5 mm
Thermal resistance	6,1835 m²K/W
Thermal transmittance	0,1617 W/m²K
Attenuation	0,1492
Time shift (ext-int flux)	13h 17'



	Criteria	Range
PRODUCTION	Raw material supply	1. From no renewable source and low availability 2. From no renewable source and high availability 3. From no renewable source with low regenerative potential 4. From renewable source with high regenerative potential 5. From waste of renewable/not renewable materials
	Transport [Distance/ Availability]	1. Maximum distance and minimum availability 2. Maximum distance and medium availability 3. Medium distance and medium availability 4. Minimum distance and high availability 5. No distance and maximum availability
	Manifacturing [Complexity manufacturing process / Source supply]	1. High complexity in manufacturing process / High source supply 2. Medium complexity in manufacturing process / High source supply 3. Medium complexity in manufacturing process / Medium source supply 4. Minimum complexity in manufacturing process / Medium source supply 5. Minimum complexity in manufacturing process / Minimum source supply
CONSTRUCTION	Transport to site	1. International distance 2. National distance 3. Regional distance 4. Local distance 5. No distance (grown in site)
	Construction / Installation process [Waste/Source supply]	1. Maximum waste / Maximum source supply 2. Medium waste / Medium source supply 3. Minimum waste / Medium source supply 4. No waste / Minimum source supply 5. Auto-construction
OPERATION	Use [Reactivity]	1. Keeping unchanged intrinsic properties 2. Reacting modifying the surrounding environment properties 3. Reducing the energy demand without energy production 4. Not reducing the energy demand but producing energy 5. Reducing the energy demand and producing energy
	Management [Manteinance of performances during time]	1. High intervention need to keep unchanged its performances during time 2. Medium intervention need to keep unchanged its performances during time 3. Low intervention need to keep unchanged its performances during time 4. To keep unchanged its performances without maintenance 5. Auto-management (regenerative behaviour)
END OF LIFE	Recycling / Re-use	1. No re-use / No recycling 2. Partial re-use / Partial recycling 3. No re-use / Recycling 4. Re-use / No recycling 5. Re-use / Recycling
	Disposal	1. 100% disposal (special waste) 2. 100% disposal (ordinary waste) 3. Partial disposal 4. Biological decomposition 5. Re-inserting in the LCA

RESEARCH COMPARES

- **bio-based materials**
  grown materials
- **natural materials**
- **traditional materials**

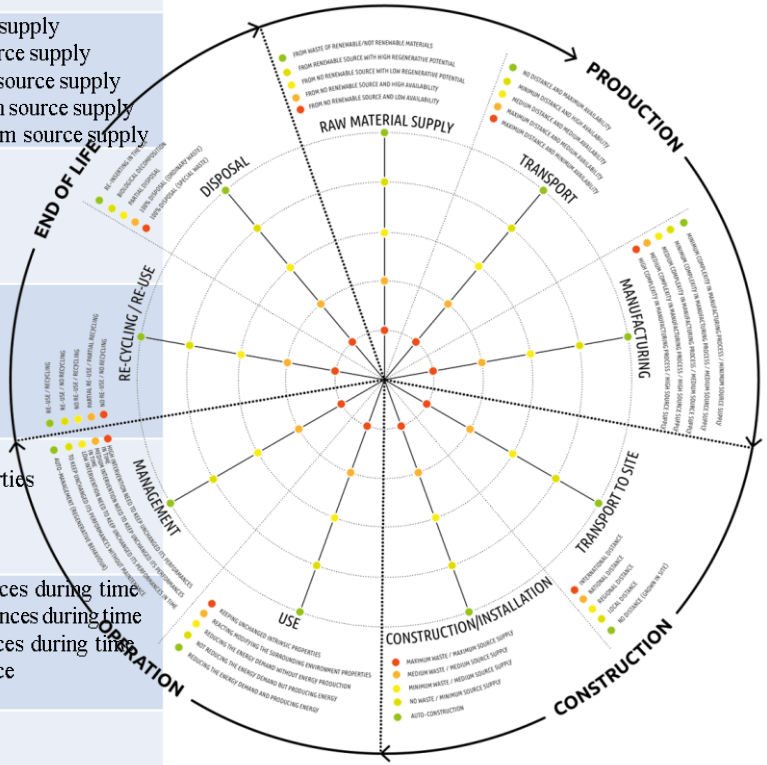
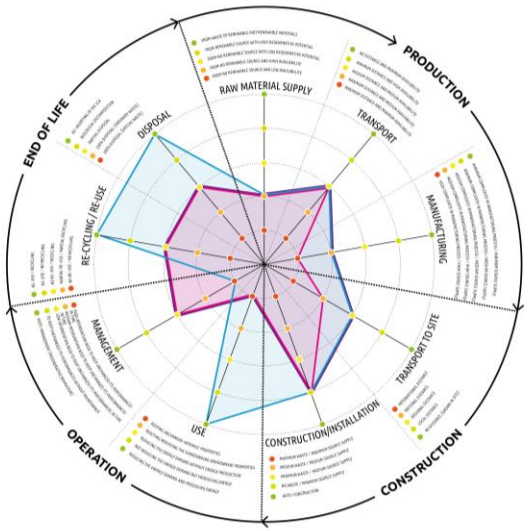
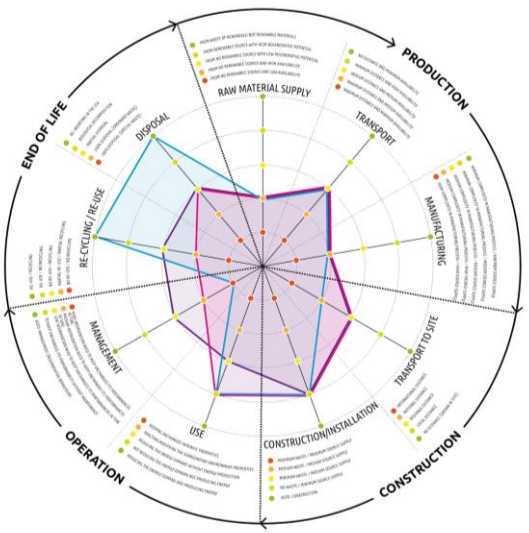


Diagram of transparent envelope



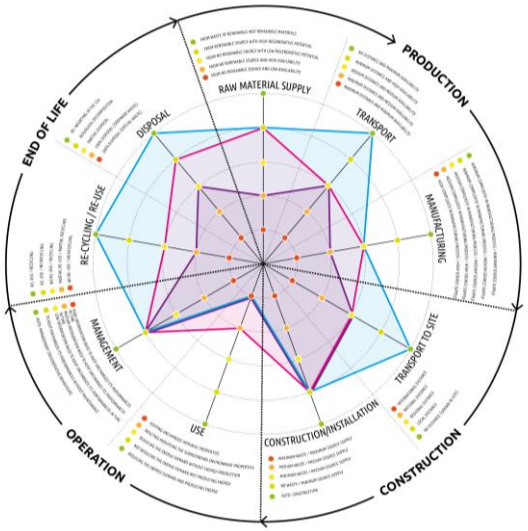
GROWN SYSTEM		BIO-INSPIRED SYSTEM		TRADITIONAL SYSTEM	
Bioreactor façade	30	Homeostatic façade	21	Energy-efficient glass	19

Diagram of plant systems



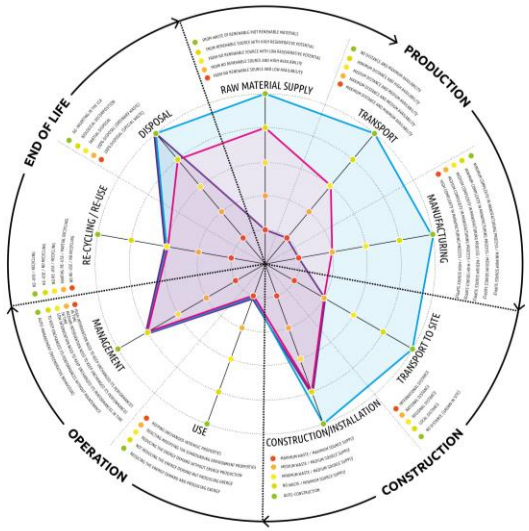
GROWN SYSTEM		BIO-INSPIRED SYSTEM		TRADITIONAL SYSTEM	
Bioreactor system	29	Solar glass	24	Tradional boiler	26

Diagram of opaque envelope



GROWN MATERIAL		NATURAL MATERIAL		TRADITIONAL MATERIAL	
Bacteria-based brick	46	Hemp-lime brick	31	Clay brick	22

Diagram of insulation materials



GROWN MATERIAL		NATURAL MATERIAL		TRADITIONAL MATERIAL	
Fungi-based insulation	52	Cork insulation	25	EPS insualtion	17

"Understanding how objects and Nature work means to recognise and to understand the many ways in which man-made systems interact with natural ones, which implies what I call ecological intelligence".

Daniel Goleman

Sustainability will never achieve its needs if we do not change our behaviour, culture and way to work.
… this is the new frontier of architecture
… this is the mental and behaviour innovation that asks to the technicians:

let us cultivate ecological intelligence
let us change our way to design!

Nature always wins