thegreenrevolution.it

Biotech contribution to the analysis of relevant NBS

STUDENTS :

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TUTORS : Geoffroy Séré, Christophe Schwartz, Catherine Sirguey

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   - Mushroom walls
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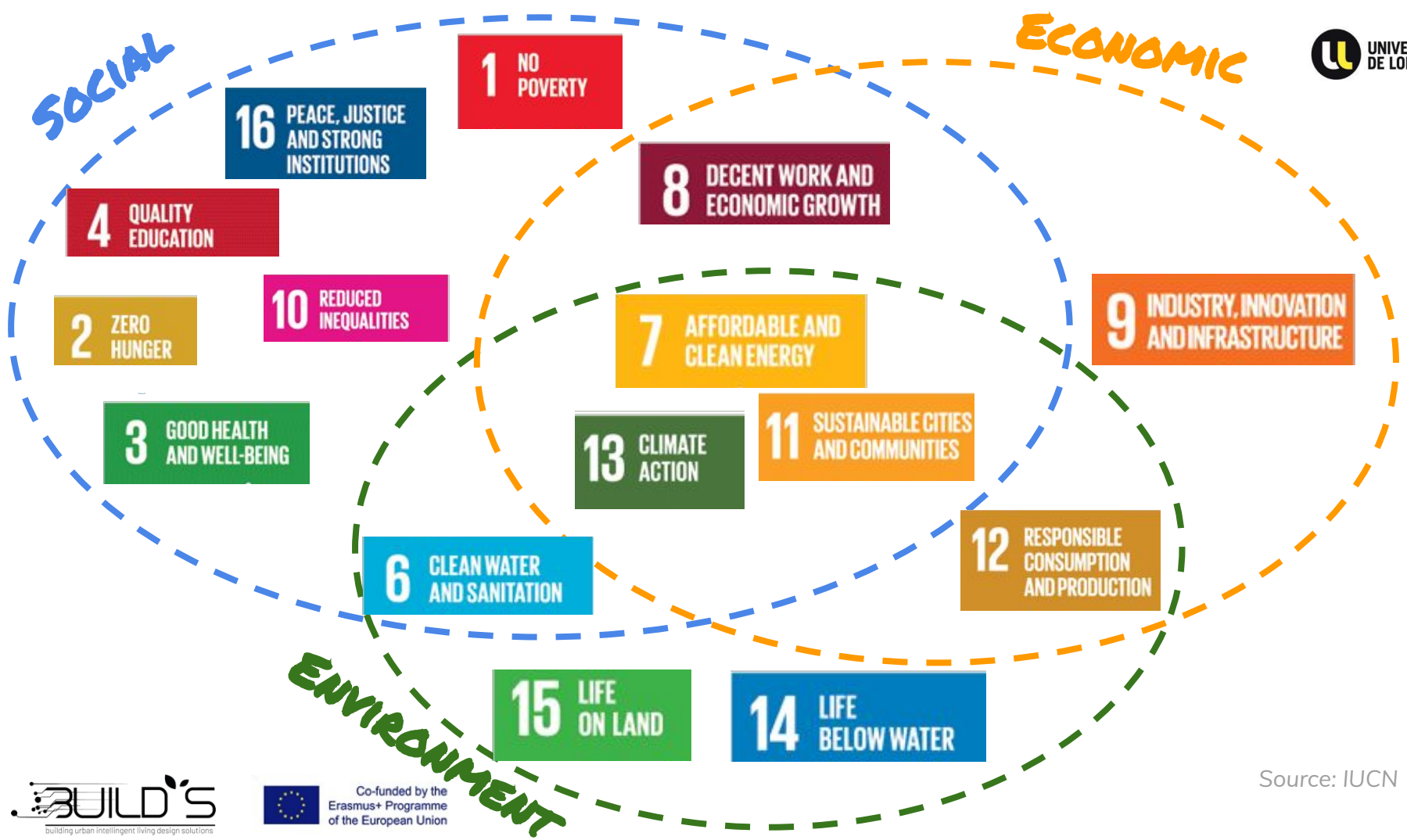
I. Introduction



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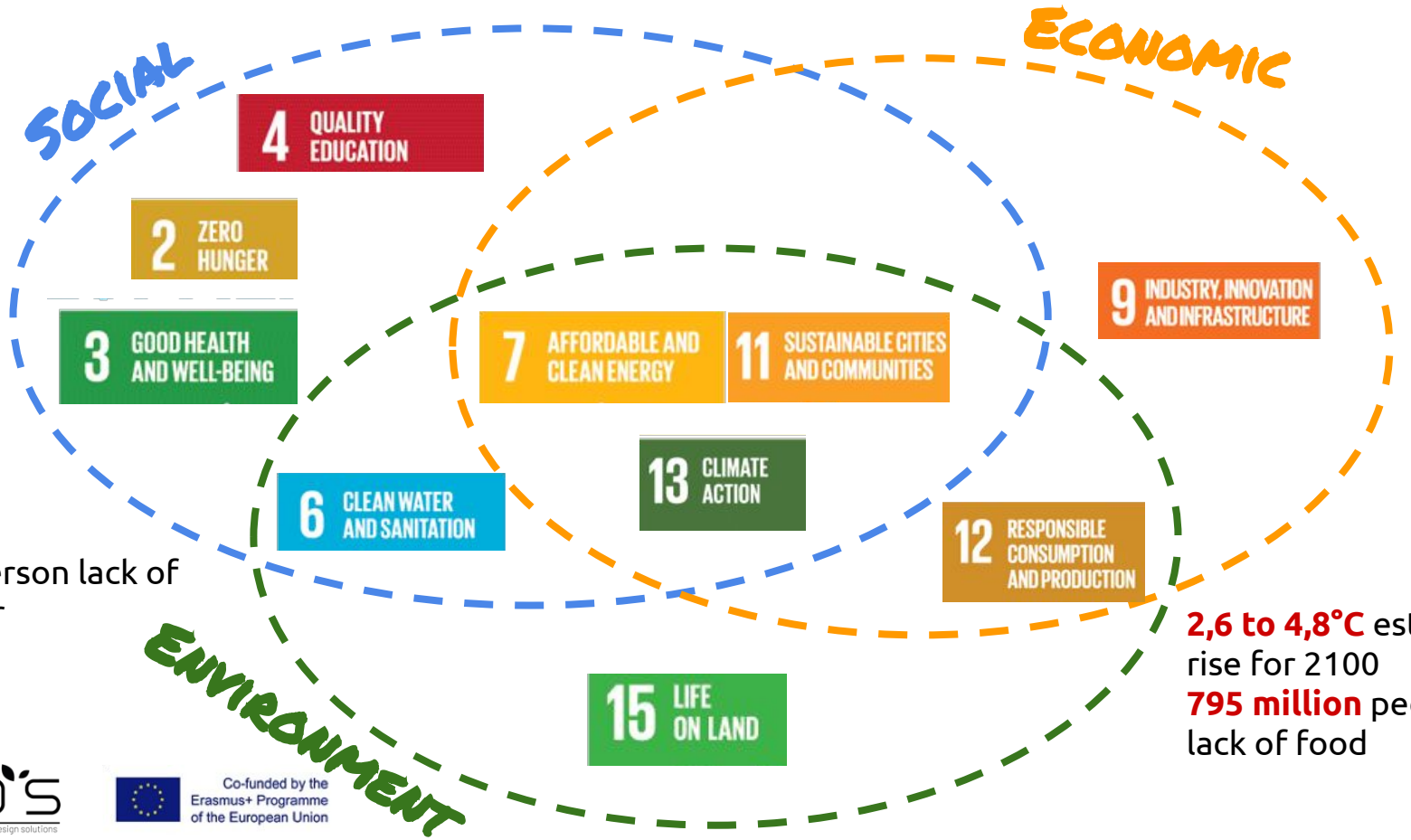
Source: IUCN

Main Challenges into cities we will focus on according to our examples



1 billion person lack of clean water

2,6 to 4,8°C estimated rise for 2100

795 million people lack of food

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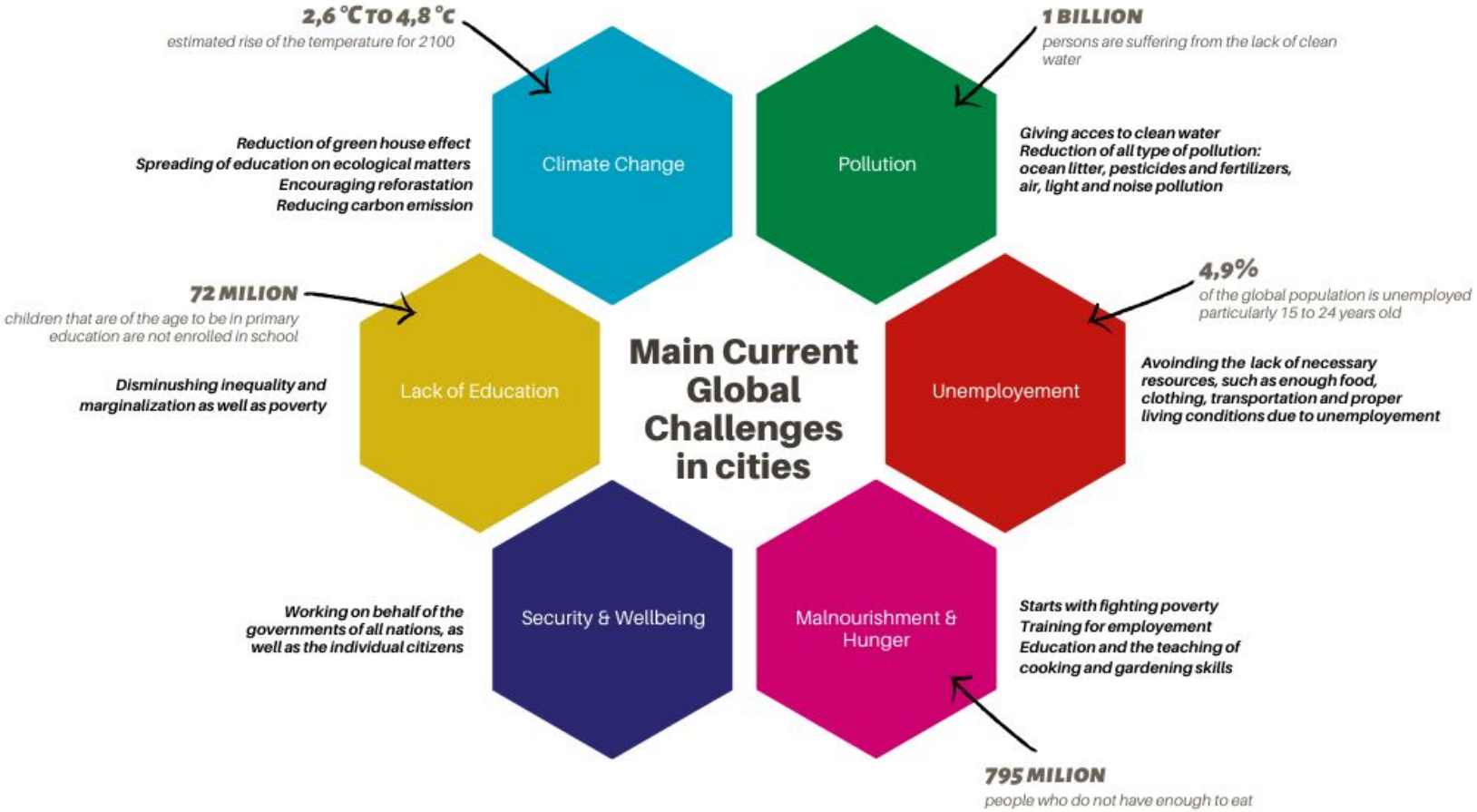

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Nature-based solutions

Actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing **human well-being** and **biodiversity benefits**.

Source: IUCN

II. Diversity of solutions

Answer the issues of the cities

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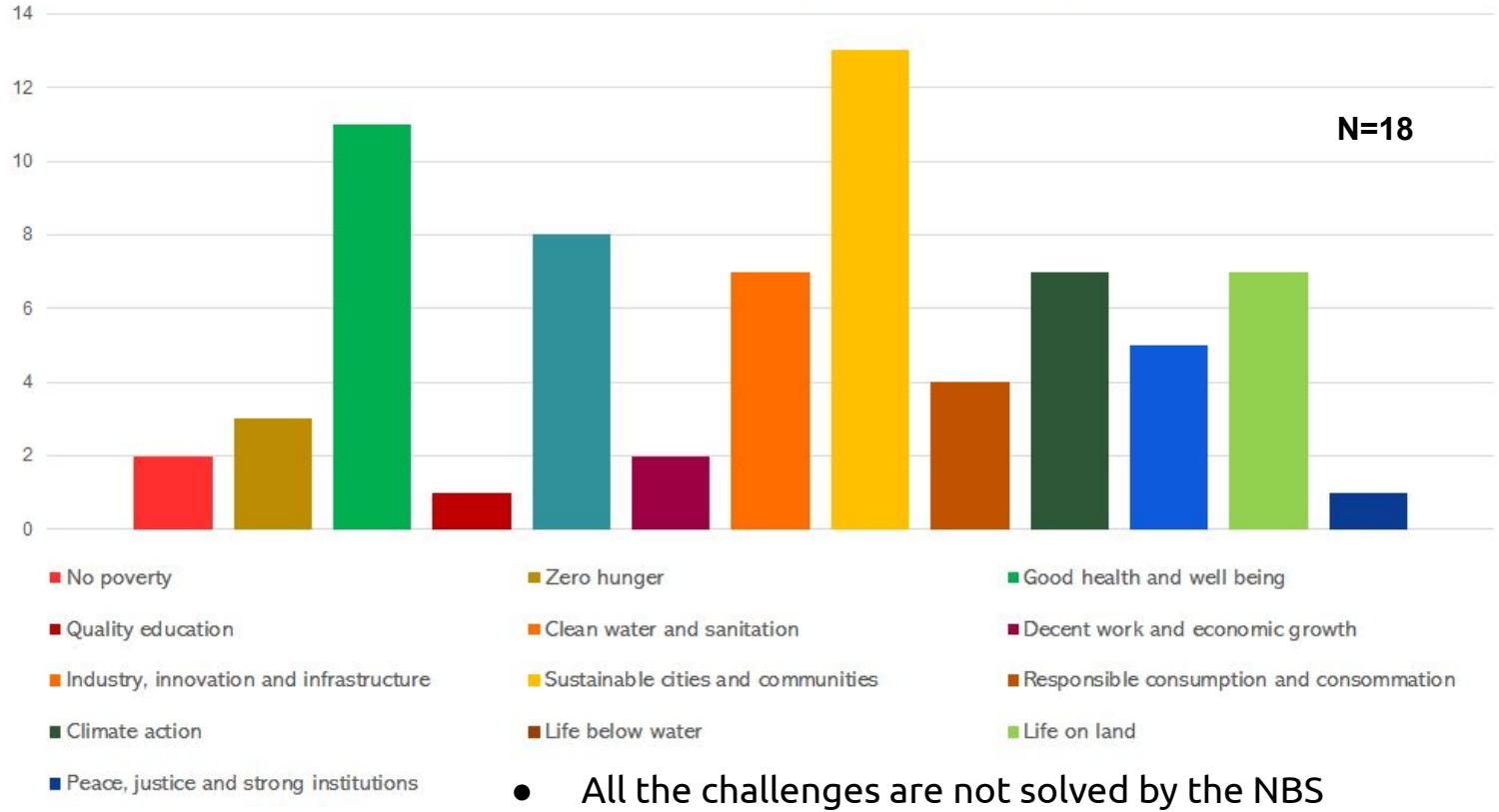
Number of NBS answering each UN challenges



- All the challenges are not solved by the NBS
- Some of them are represented a lot in the pool of NBS we choose

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III. Urban NBS case studies

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The biological approach for the analysis of an NBS example:

1. The concept
2. Ecology, biology : theoretical approach

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Ecological functions

Biological processes allowing the functioning and maintenance of the ecosystem

Ecocentric view

Source : E. Blanchart, S. de Tourdonnet, Lien entre Services Écosystémiques et Fonctions écologiques, UVED

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The biological approach for the analysis of an NBS example:

1. The concept
2. Ecology, biology: theory for ecological processes
3. Ecosystem services

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Ecosystem services

Human benefits from the biological processes

Anthropocentric view

Source : E. Blanchart, S. de Tourdonnet, Lien entre Services Écosystémiques et Fonctions écologiques, UVED

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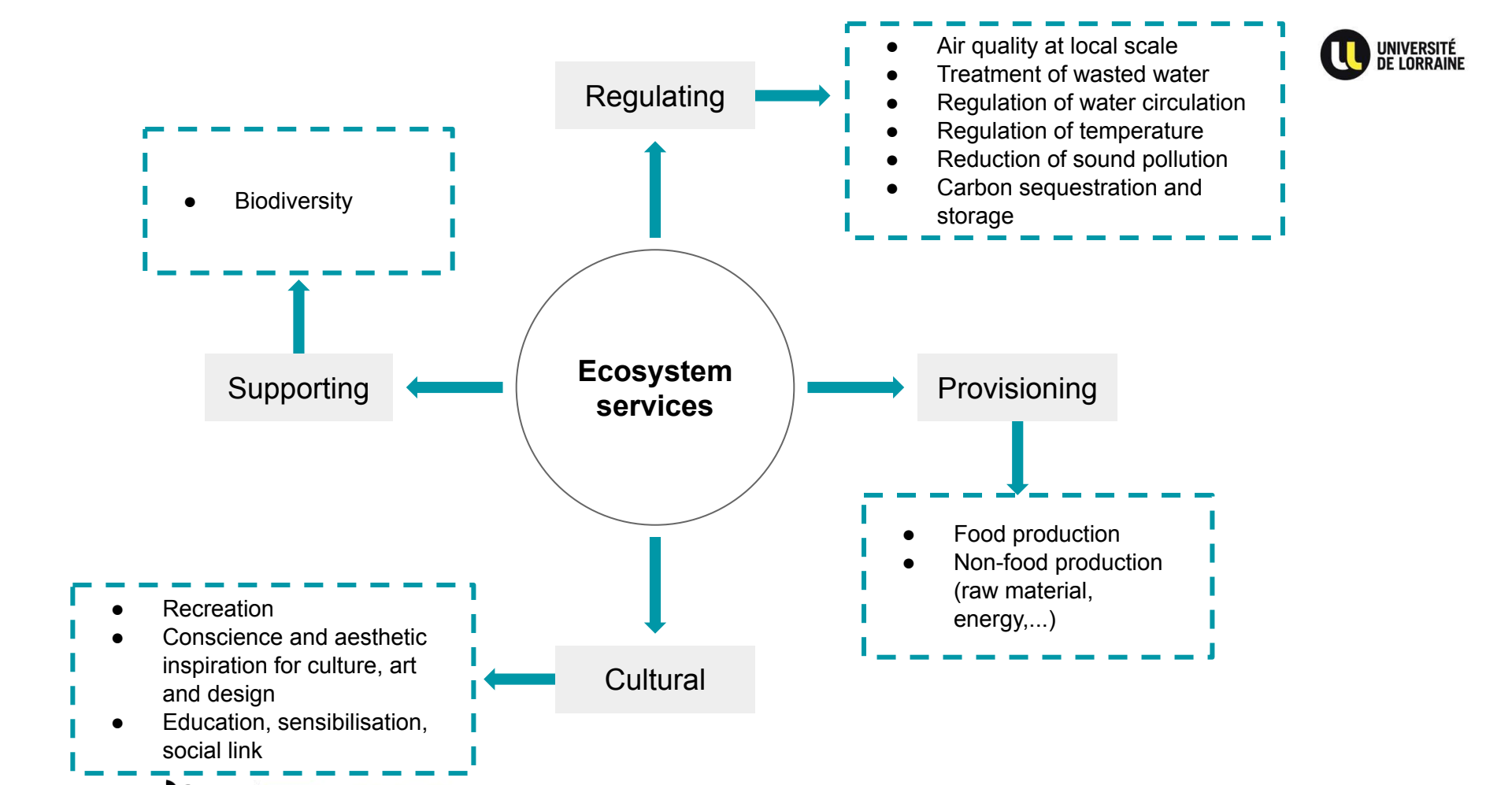

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Source : Adapted from MEA 2005

The biological approach for the analysis of an NBS example:

1. The concept
2. Ecology, biology: theory for ecological processes
3. Ecosystemic services
4. Limits & ways to improve
5. Biological rating

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The Nature-based solutions - biotech rating

Criteria		
	Rating	
Biological criteria		0 : Doesn't meet the criteria
Economical criteria		1 : Moderately meets the criteria
Social criteria		2 : Meets the criteria
Technical criteria		3 : Fully meets the criteria

- Easy way to “rate” the NBS we find regarding the purpose they can bring, how they bring it and the viability of the project
- Will be modified and improved while studying the different cases

https://forms.gle/pLcgdahpgpJJTgPQ9

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The Nature-based solutions - biotech rating

Criteria	
	Rating
Biological criteria	
System self sufficiency	
Answers the challenges	
Ressources consumption	
System lifetime	
Disturbances from nature (ex : allergies)	

Economical criteria	
Cost	
Maturity	

Social criteria	
Public utility	
Creation of social good	
Integration to urban area (aesthetic/disturbances)	

Technical criteria	
Maintenance	
Technicality	
Transposition (geographically)	
Transposition (scale)	
Material's type/type of resources used	

https://forms.gle/pLcgdahpgpJJTgPQ9

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VertEco

A green way to clean our water

Origin : France

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1. The concept

An indoor vertical constructed plant based wetland allowing to treat grey waters :

- Reducing drinking water consumption
- Using plants/microorganisms symbiosis
- With an aesthetic value
- Improving indoor environment

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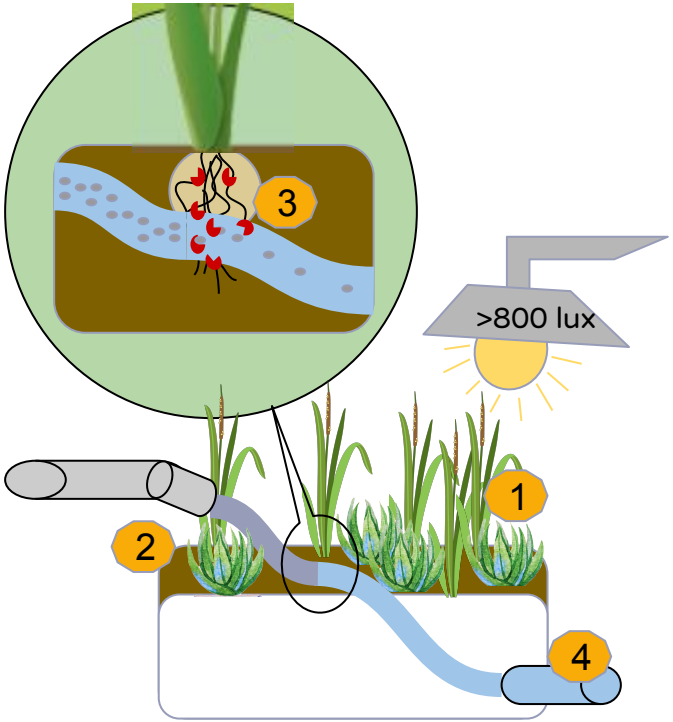
Source : VertECO presentation for demEAUmed innovations event

1. Growth of specific plants : marsh plants, graminoïds, tropical or subtropicals
2. Polluted water input : organic matter, NPK, micropollutants.
3. Treatment of the water by the microorganisms that live in the rhizosphere. Degradation of the suspended matter.
4. Output of the cleaned water

Water treatment by plants = Phytodepuration



Source : Alexandra Martin

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3. Ecosystem services & UN Sustainable Development Goals

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4. Limits & ways to improve

Limits

- Need a gardener to take care of the plants
- Big & heavy structure =>
  4 m & 1 500 kg/m3-water/day
- Doesn't treat all types of pollutants (heavy metals)

How to improve ?

- Use human care independant plants to decrease the need for maintenance
- Use less heavy & spacious substratum or hydroponics system
- Use hyperaccumulating plants to treat the water for heavy metals
- Inoculate bacteria to enhance the efficiency of the system

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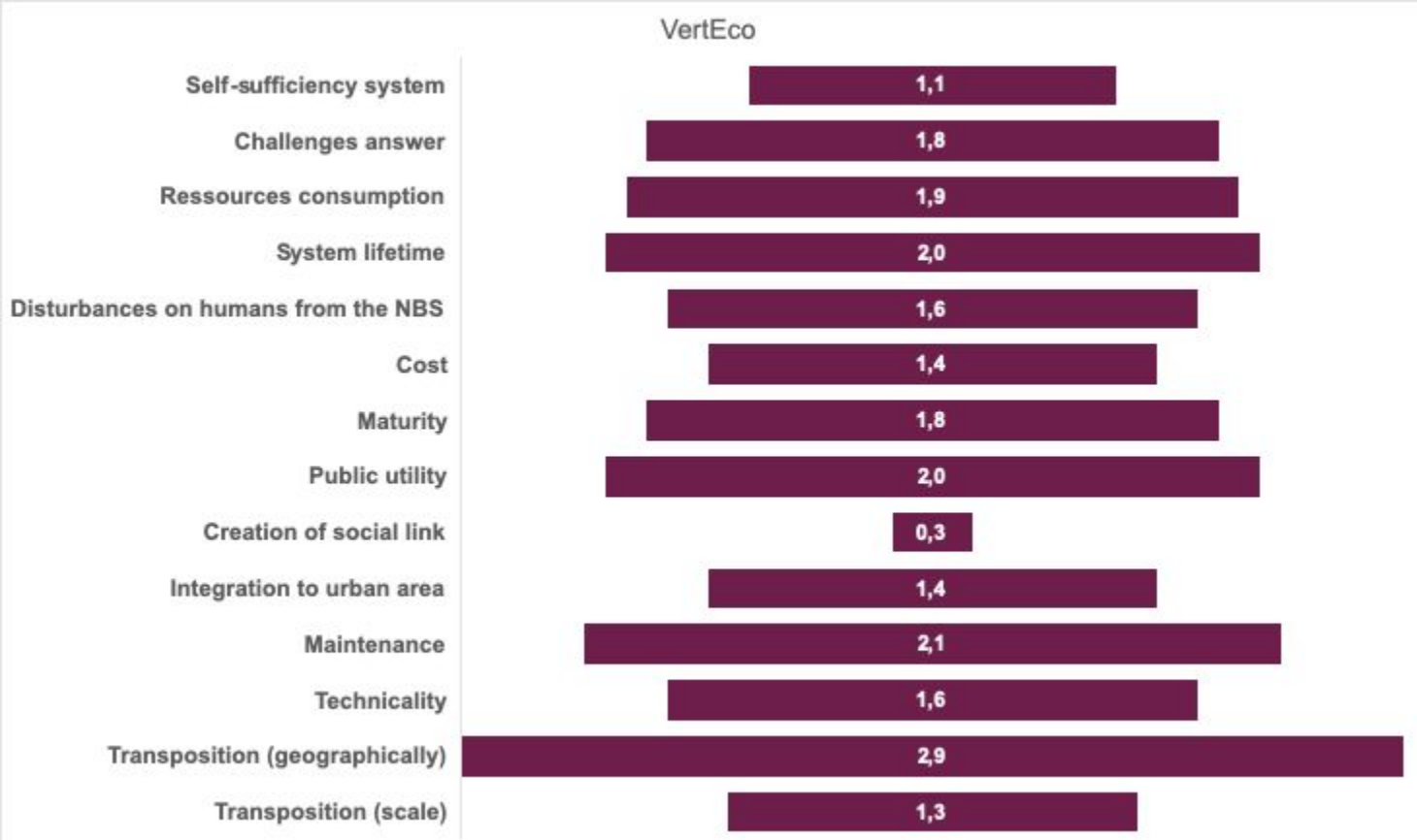
5. NBS rating



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Source : http://www.naturabee.com

Natura bee

Biodiversity into cities

Origin : France

Co-funded by the Erasmus+ Programme of the European Union

1. The concept : Bringing more bees into cities

Team building and **environmental friendly project**

Urban Beekeeping

Since 2013 implement hives in firms and communities

- Unite people around a commun and responsible project
- Bring out work areas
- Raise awareness towards biodiversity issues
- Harvest honey on site
- Low tech

Workers' well-being

Biodiversity

Installation

Training

Maintenance

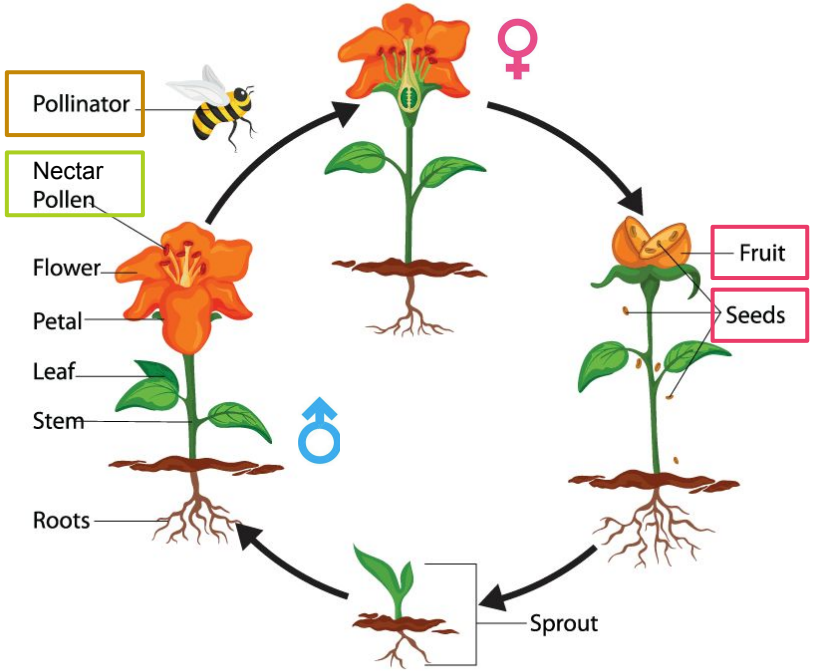
organic product

Harvest

Source : naturabee.com

No bees - No seeds

- **75%** of main subsistence crops are pollinated by animals
- **85%** of flowering plants are biotically pollinated
- **9.5%** of the value of world agricultural production



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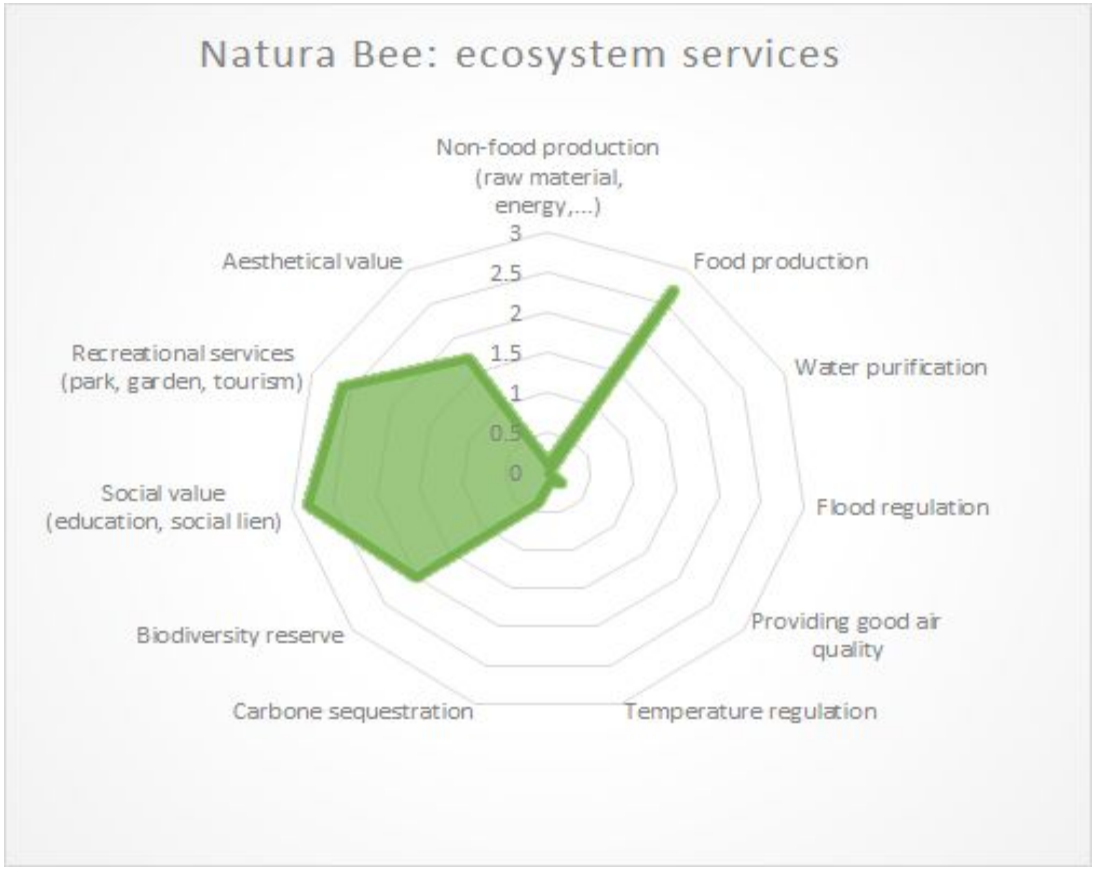
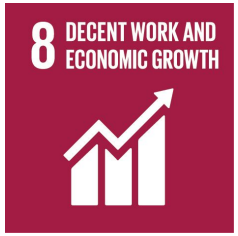
Source : Ollerton, J., Winfree, R. & Tarrant, S. - Klein, A.-M. et al. - Gallai et al. 2009
http://natureworkspark.org

3. Ecosystem services & UN Sustainable Development Goals





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4. Limits & ways to improve

Limits

- **15%** of pollination by the honey bee - domestic
- **80%** of pollination by wild insects
- Competition for food resources with wild bees
- Allergic

How to improve ?

- Better control on size and area of honey bees' hives
- Encourage food resources and habitat for wild bees to increase biodiversity
- Build insect hotels to increase biodiversity
- Increase awareness

"If wild pollinator declines continue, we run the risk of losing a substantial proportion of the world's flora."

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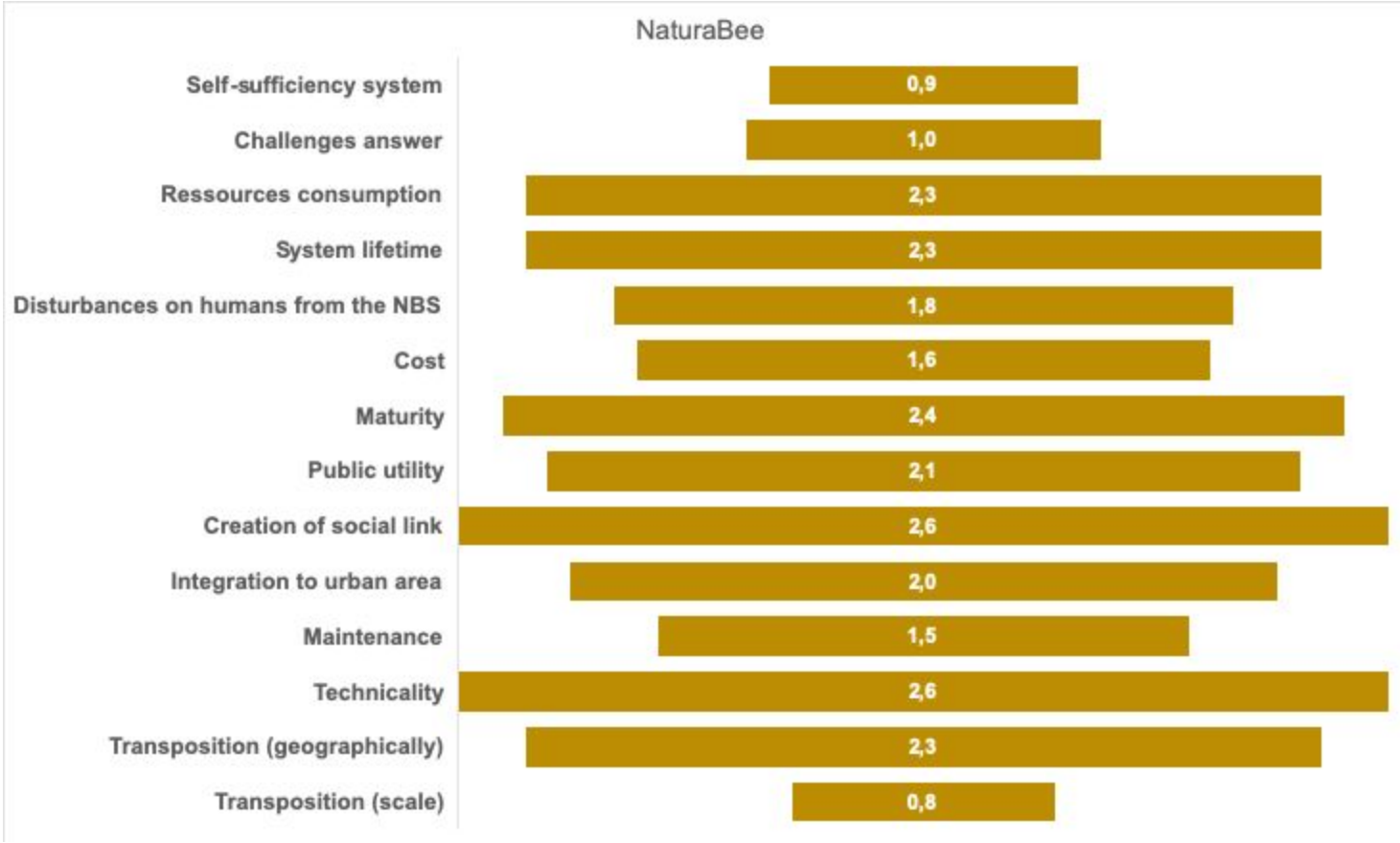
5. NBS rating


NaturaBee
Self-sufficiency system
0,9
Challenges answer
1,0
Ressources consumption
2,3
System lifetime
2,3
Disturbances on humans from the NBS
1,8
Cost
1,6
Maturity
2,4
Public utility
2,1
Creation of social link
2,6
Integration to urban area
2,0
Maintenance
1,5
Technicality
2,6
Transposition (geographically)
2,3
Transposition (scale)
0,8

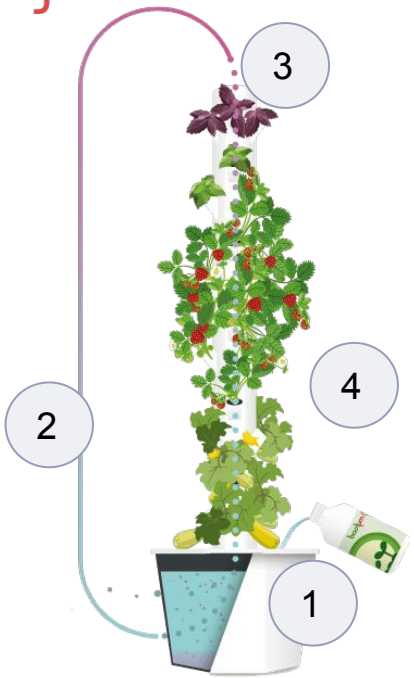
Source : https://myfood.eu/fr/notre-technologie/aerospring/

Myfood

Cultivate in town

Origin : France

1. The concept : Connected vertical hydroponic agriculture



Source: myfood.com

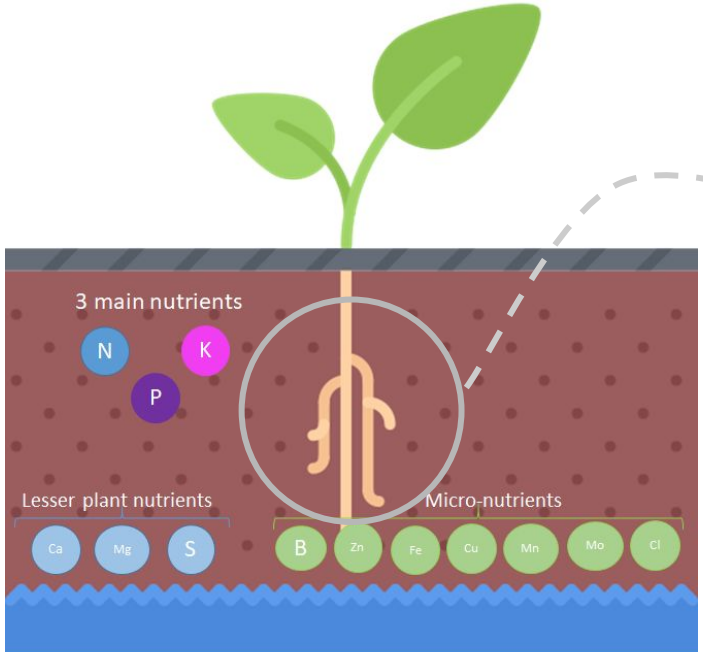
Innovative technology: the aerospring. Allowing anyone to grow vegetables without any soil and limiting the consumption of drinking water and inputs.

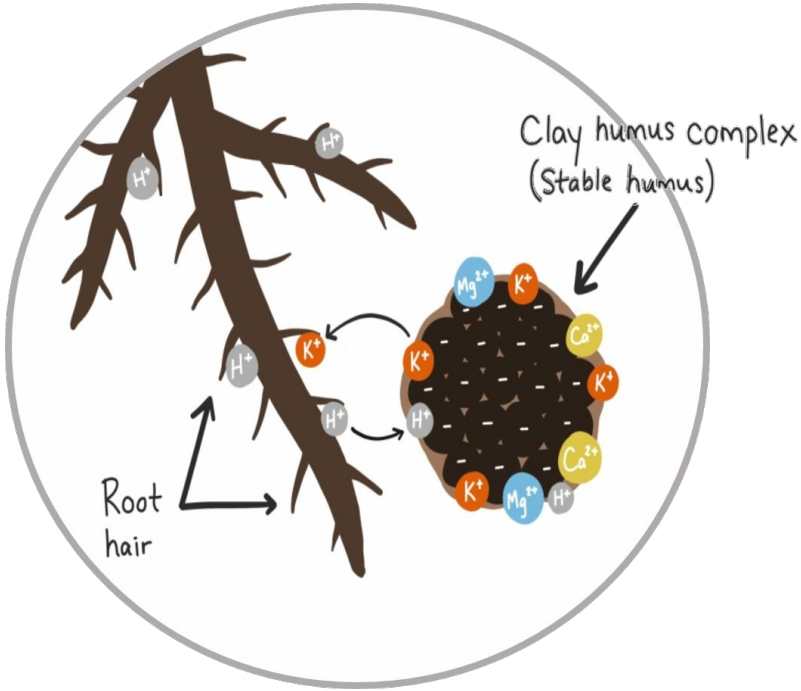
- 1: Using organic manure directly in the water to feed the plants
- 2: Water circulation from the basin to the culture tower thanks to a pump
- 3: Closed system continuous irrigation of the plants
- 4: Roots grow in a neutral matrix

Space efficiency Water efficiency Electricity efficiency

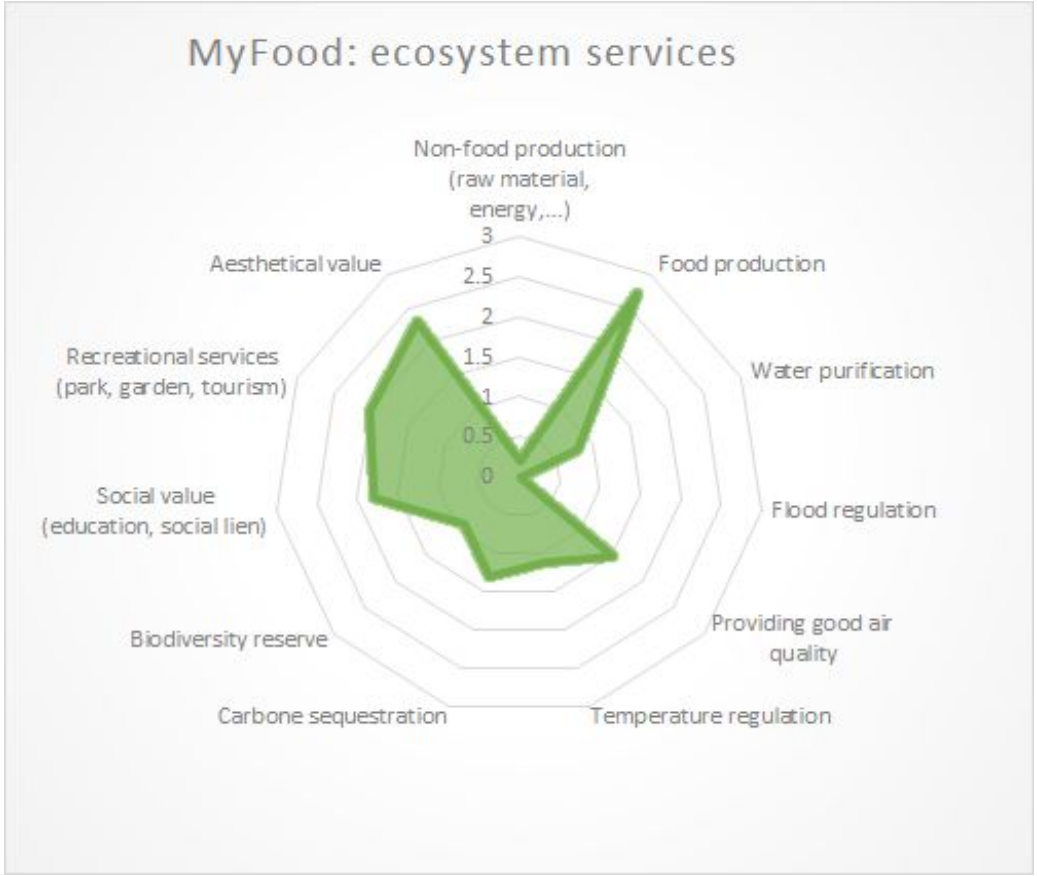
Optimized management: All installation are equipped with connected equipment to follow information about pH, temperature.

Source : myfood.eu


3 main nutrients
N
K
P
Lesser plant nutrients
Ca
Mg
S
Micro-nutrients
B
Zn
Fe
Cu
Mn
Mo
Cl


Clay humus complex
(Stable humus)
Root
hair

3. Ecosystem services & UN Sustainable Development Goals



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4. Limits & ways to improve

Limits

- Difficult management of the nutritional solution
- Nutrient deficiency and accumulation of sulphate
- Growth of algae and quick spreading of pests
- Even if it is in closed circuit, needs of intrants

How to improve ?

- Recycling the solution thanks to a closed circuit
- Implement antagonistic micro-organism

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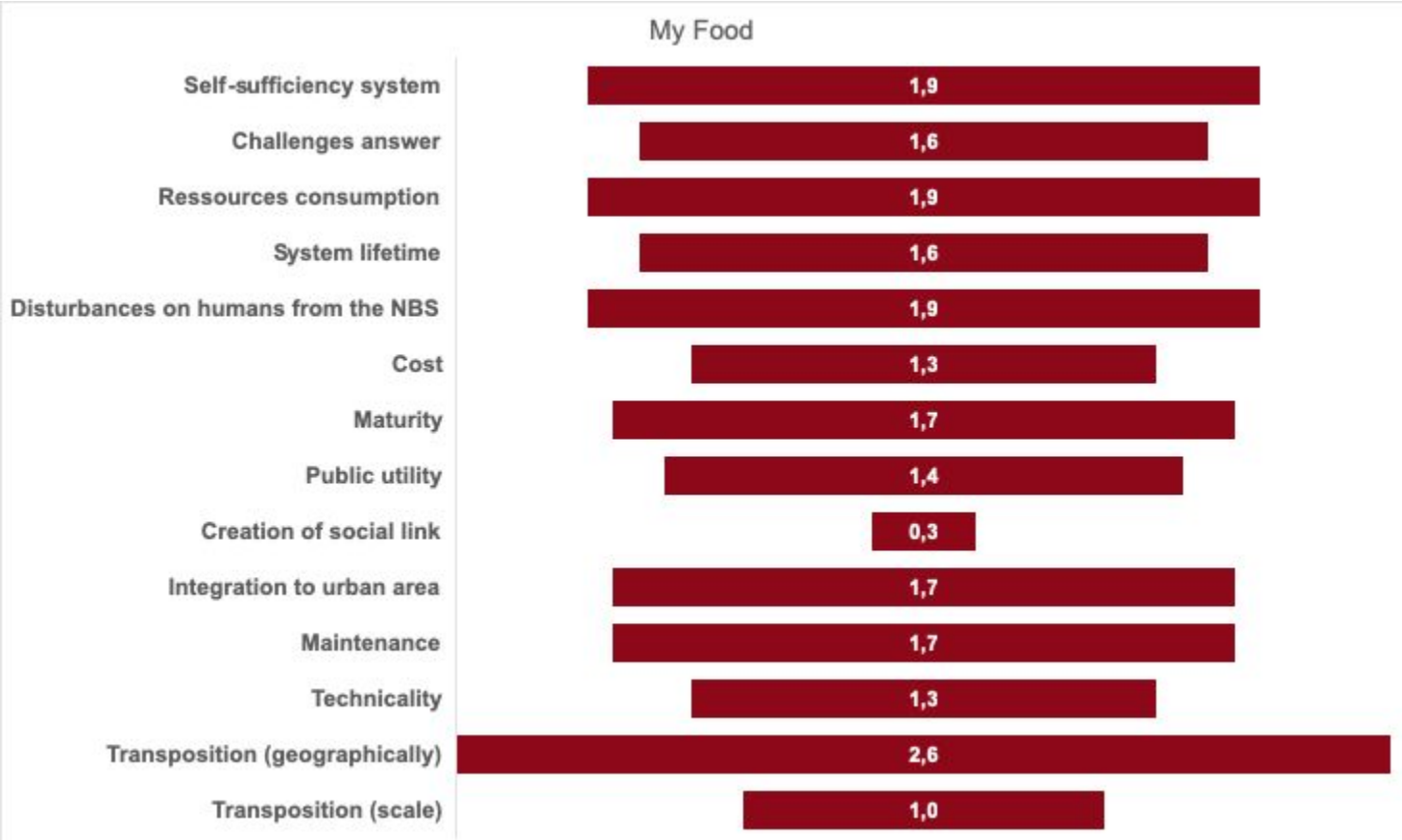
5. NBS rating



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Source : https://www.urbancanopee.com/notre-solution-pour-la-planete/

UrbanCanopee

Deploying plant canopies in the city

Origin : France

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1. The concept

The structure :

- Lightweight, adaptable and flexible
- Made of composite materials
- Modular and reversible
- Possible to connect several structures together to increase the area of shaded surface

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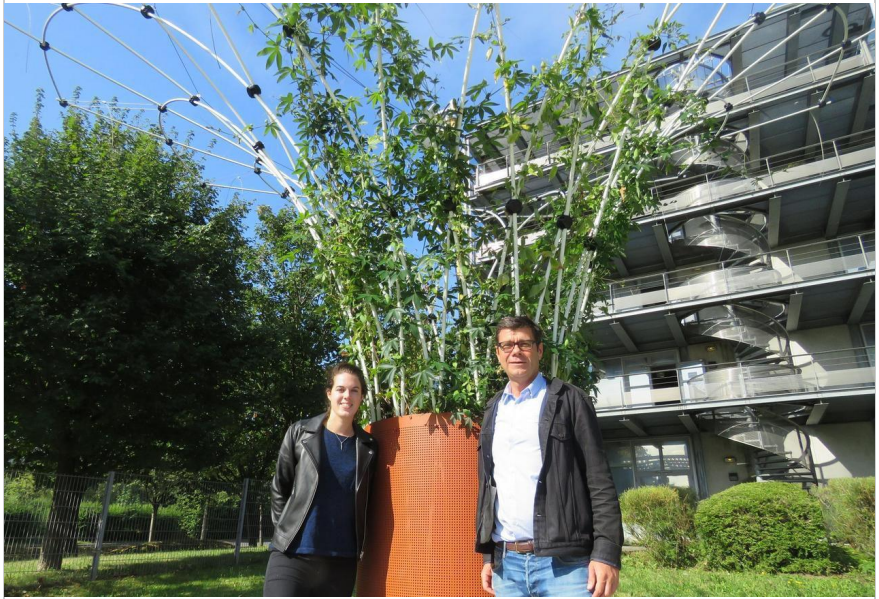
1. The concept

The plants :

- Grafted on the structure
- Climbing plants which provide freshness from the shade
- Limit greenhouse gas emissions
- Reduce the risk of flooding
- 9 climbing plants (Akebia, Clematis, Hydrangea, Jasmine, Bignone, Hops, Rosebush, Passiflore, Virginia Creeper)



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1. The concept

The Sensopee System :

- Pot containing a specific substrate and a water storage, combined with sensors. Allows to develop and implement an irrigation algorithm with distance monitoring.

- Thanks to the data collected, maintenance is reduced and the system transmits data back to a central point : temperature, hygrometry, diverse particles, biodiversity.

- Allows the canopy to be completely independent for its water and electricity needs.

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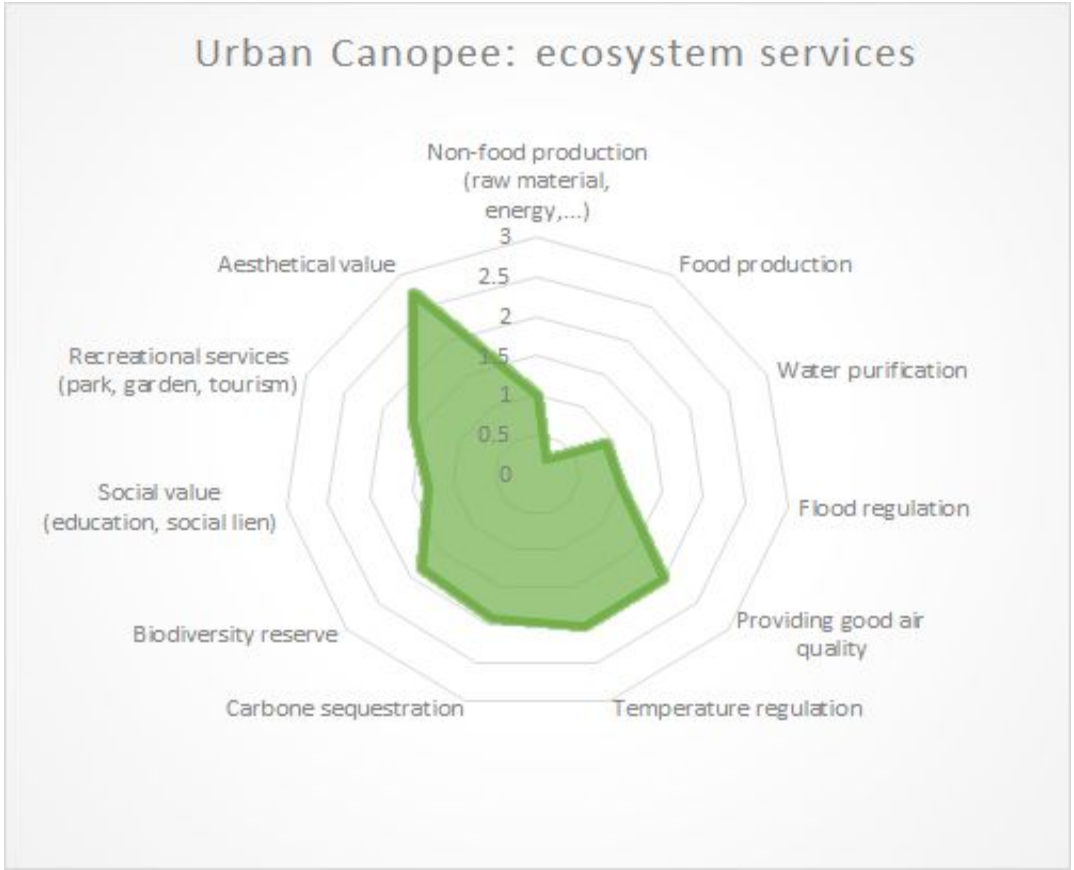
3. Ecosystem services & UN Sustainable Development Goals



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Limits

- Big structure => big amount of water
- 9 different climbing plants not all from France
- Composite structure with plastic

How to improve ?

- Use more sustainable materials or recycled plastic
- Use local plants

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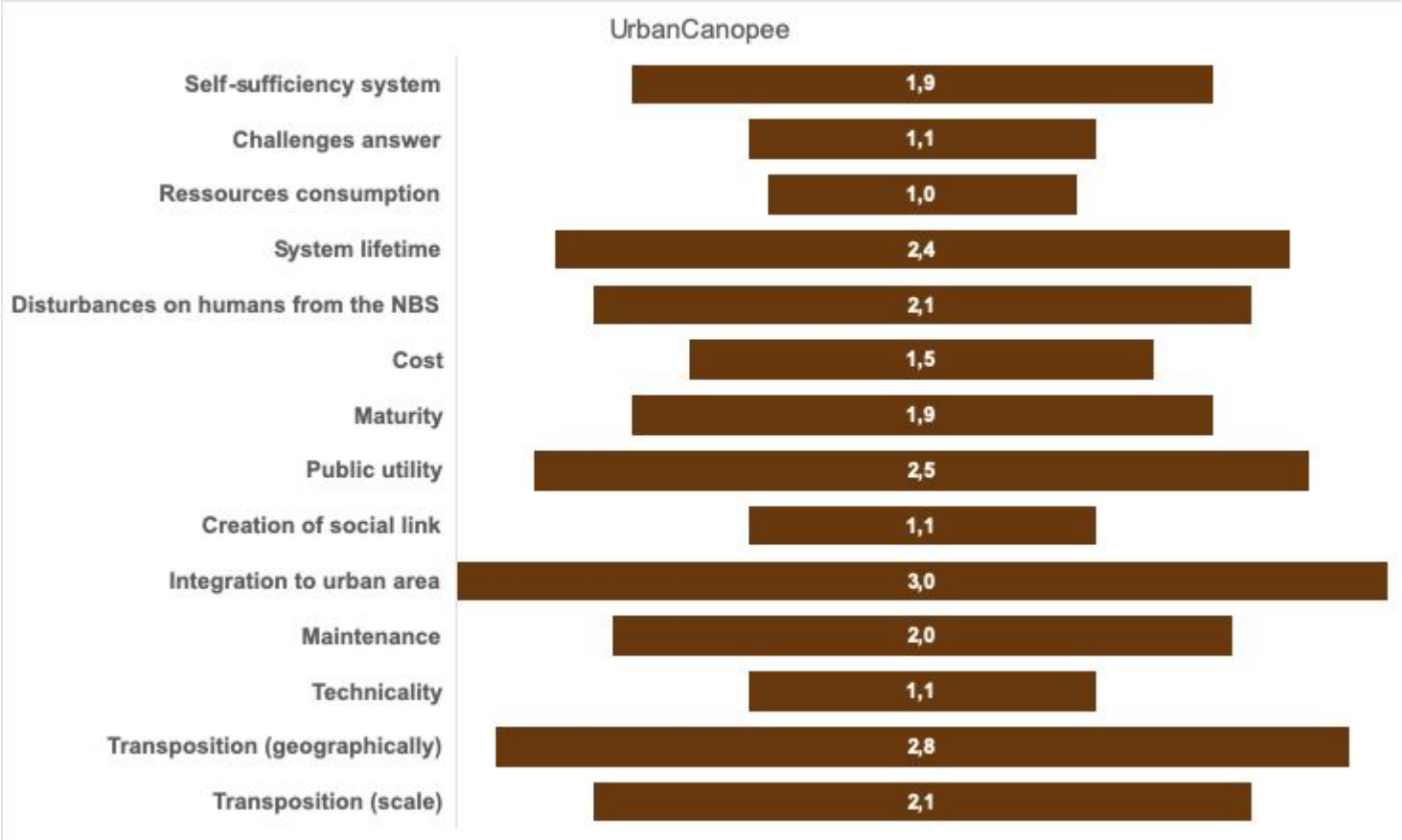
5. NBS rating


UrbanCanopee
Self-sufficiency system
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1,1
Integration to urban area
3,0
Maintenance
2,0
Technicality
1,1
Transposition (geographically)
2,8
Transposition (scale)
2,1

Source : Buildup.eu

The BIQ House

Produce energy with algae

Origin : Germany

Co-funded by the Erasmus+ Programme of the European Union

1. The concept : Produce renewable energy

Hamburg, 2013
SolarLeaf system
Project cost: 5 M €

129 bioreactors measuring 2.5m x 0.7m

15 residential units

Provides around ⅓ of the total heat demand of the BIQ house

200 m² of facade covered by SolarLeaf panels

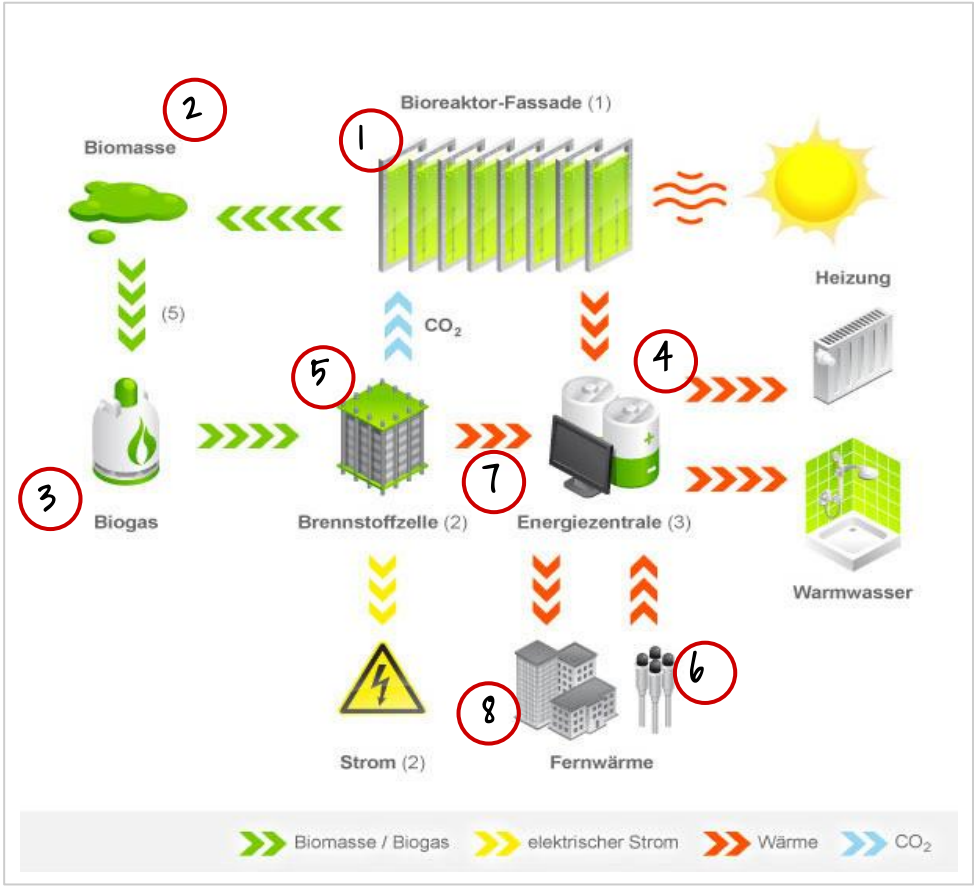
30 KWh/m2.year

Source : urbanews.fr

Co-funded by the Erasmus+ Programme of the European Union

1. The concept : Produce renewable energy

1. Bioreactor façade
2. Algae Biomass
3. Biogas
4. Heat
5. Gas burner
6. Boreholes for storage
7. Control center
8. District heating system



Source : urbanews.fr

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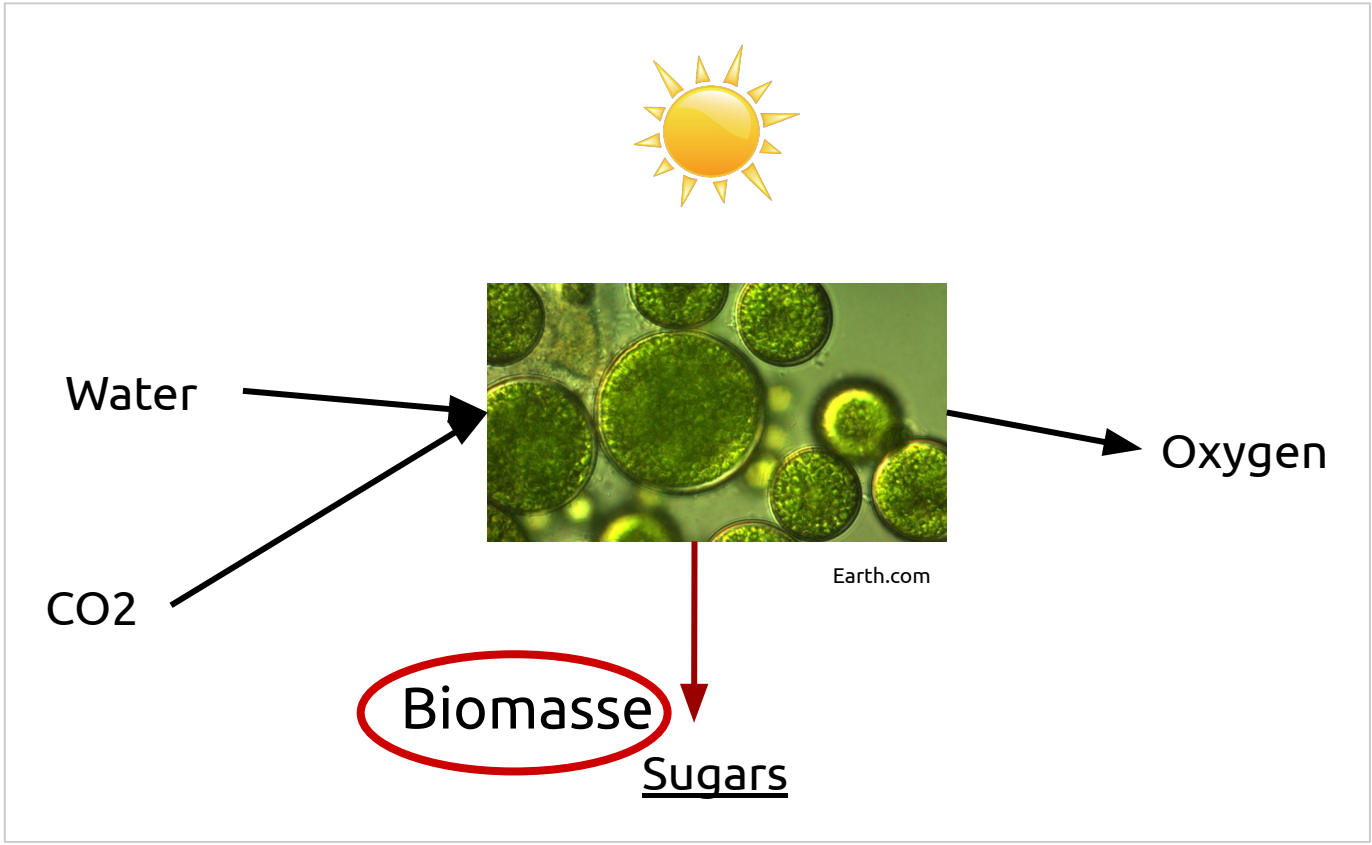

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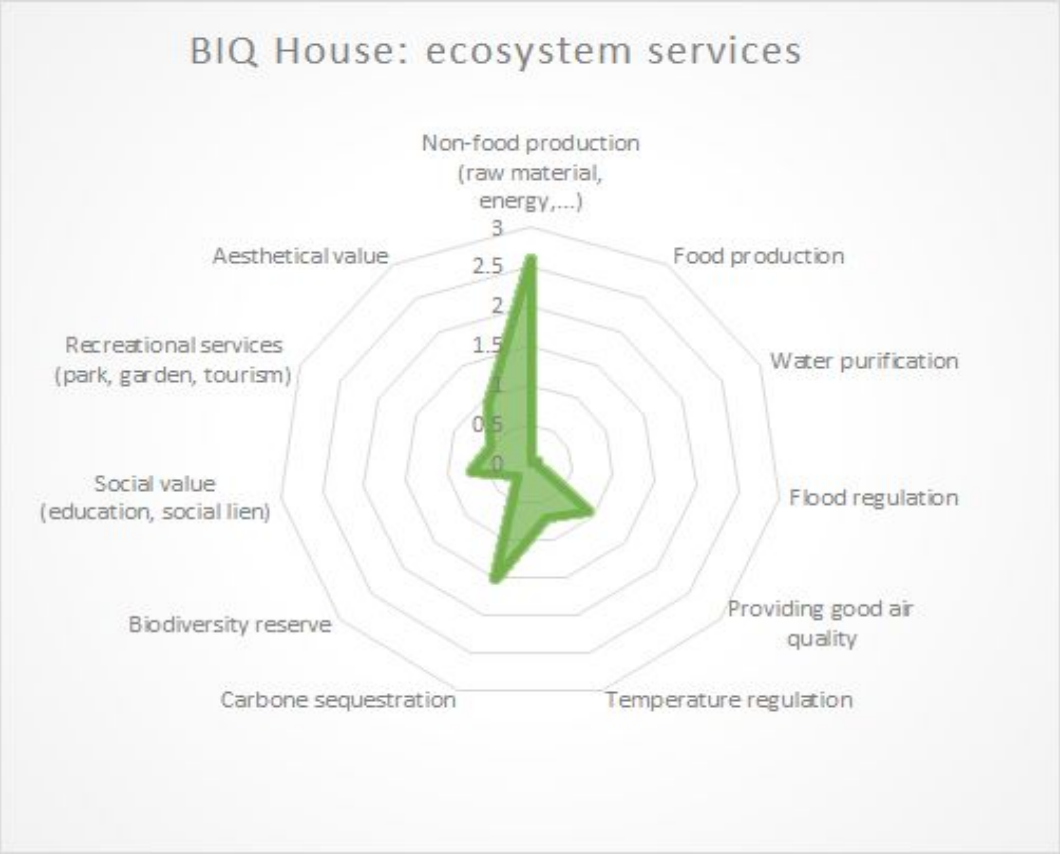
3. Ecosystem services & UN Sustainable Development Goals



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4. Issues & ways to improve

Limits

- Efficiency of the SolarLeaf system:
  - conversion of light to biomass 10%
  - conversion of light to heat 38%
- For comparison:
  - Photovoltaic systems efficiency: 12-15%
  - Solar thermal systems: 60-65%

How to improve ?

- Use more sustainable materials or recycled plastic
- Improve aesthetic appearance for a better acceptance

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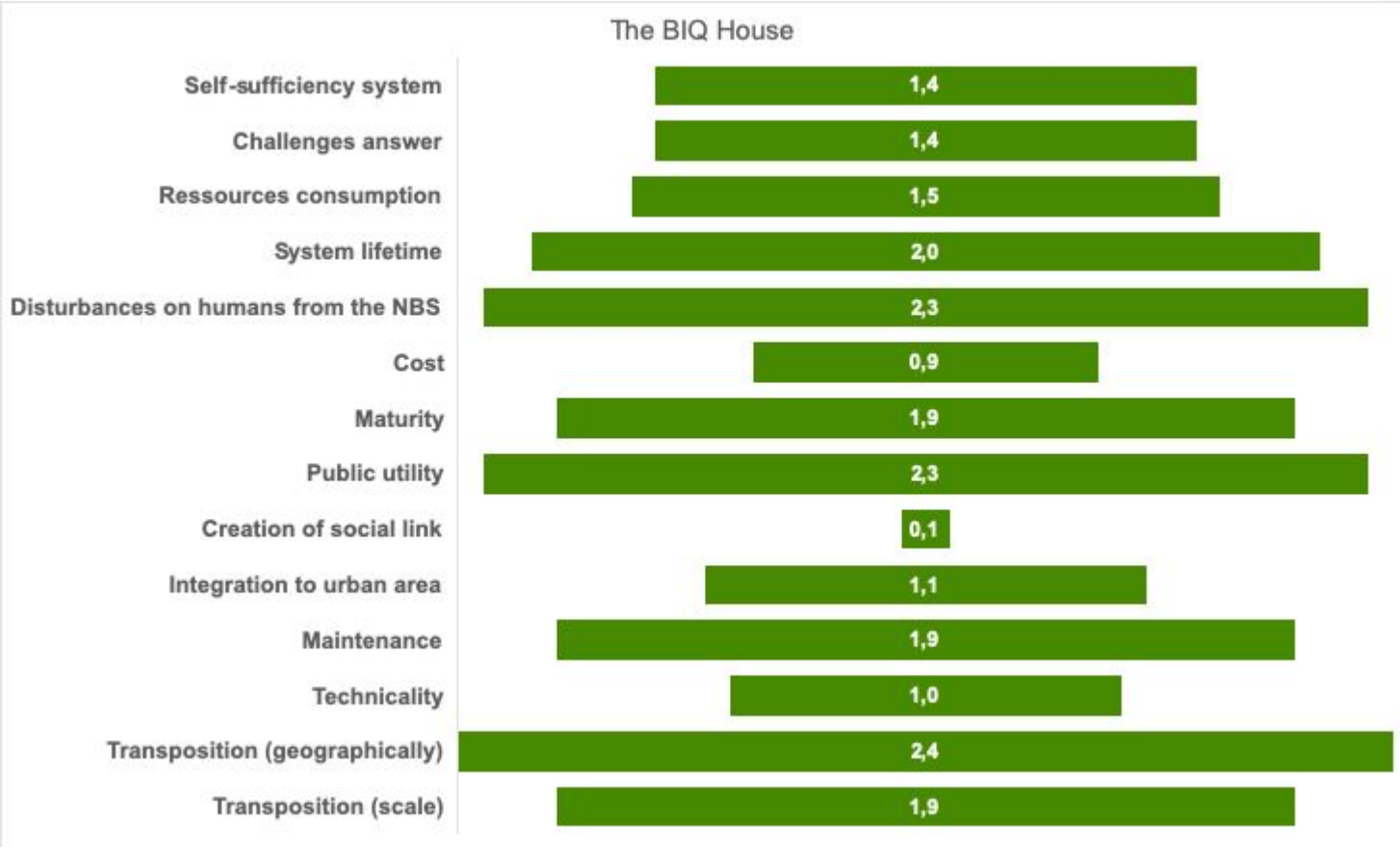
5. NBS rating



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Source : http://bocage-urbain.com

Bocage Urbain

Manage the rain mimicking a bocage

Origin : France

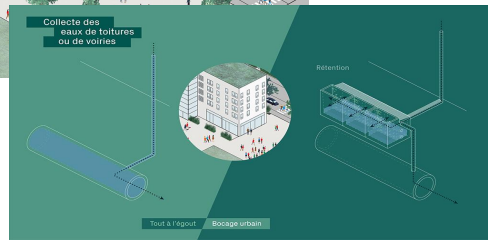
Co-funded by the Erasmus+ Programme of the European Union

1. The concept

Plants trees and plants in cities

Collects rainwater

Reorganizes the circulation



Grows in specific modules thanks to the rainwater

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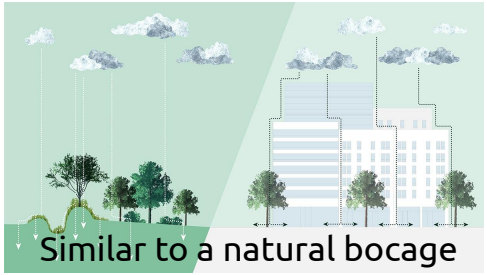
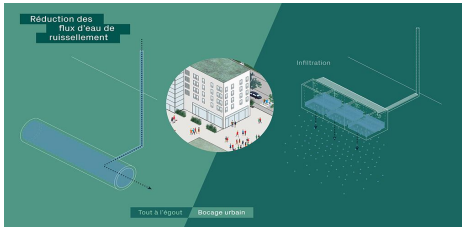
Source : http://bocage-urbain.com



Similar to a natural bocage

EVAPOTRANSPIRATION



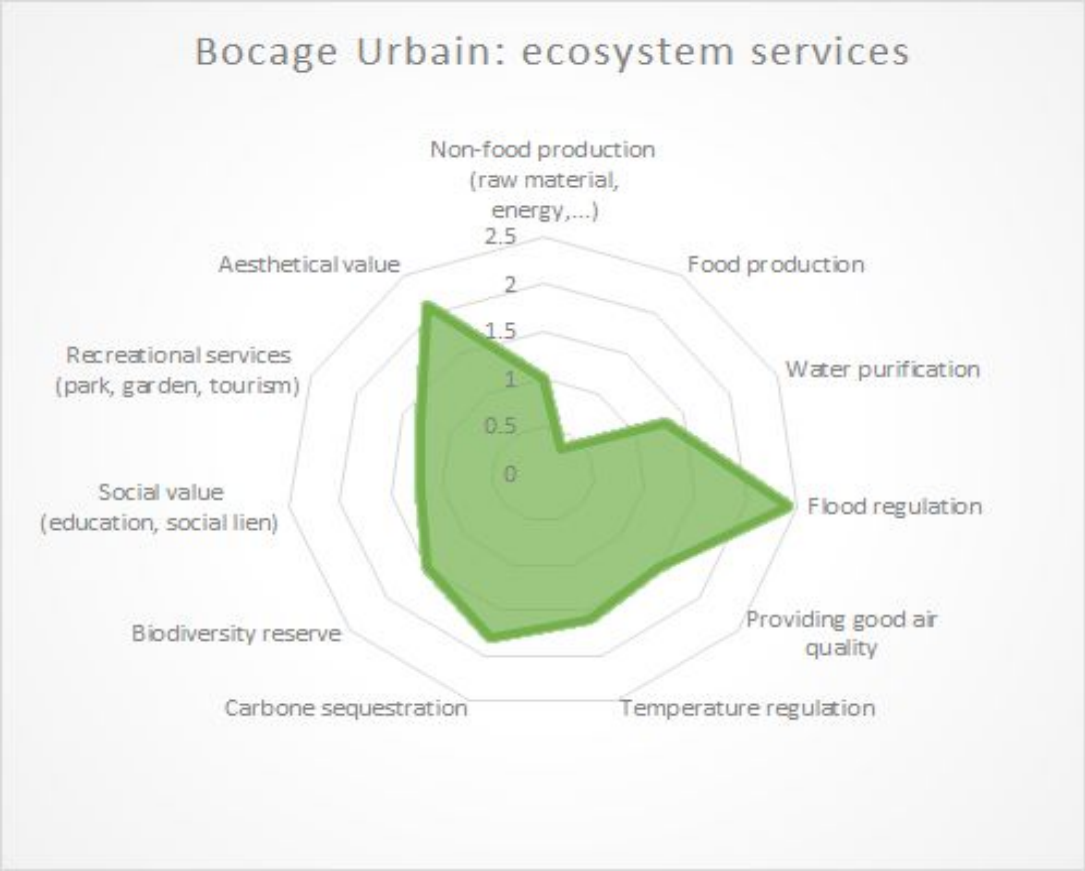
Water regulation

Reduce the heat by the evaporation

Attract biodiversity

Water need coming from rains

3. Ecosystemic services & UN Sustainable Development Goals



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4. Limits & ways to improve

Limits

- Need a gardener for the cut
- Reorganisation of the city and the underground
- Plants growing in a restrictive space
- Space competition in the city
- Not directly link to the real soil
- Polluted water
- Sealing because of waste

How to improve ?

- Use more independant plants to reduce the need for maintenance
- Use phytodepuration plants/microorganisms to filter the water
- Imagine an aquaponic/food production system
- Extent the access to the soil
- Method to pick up the waste to prevent sealing

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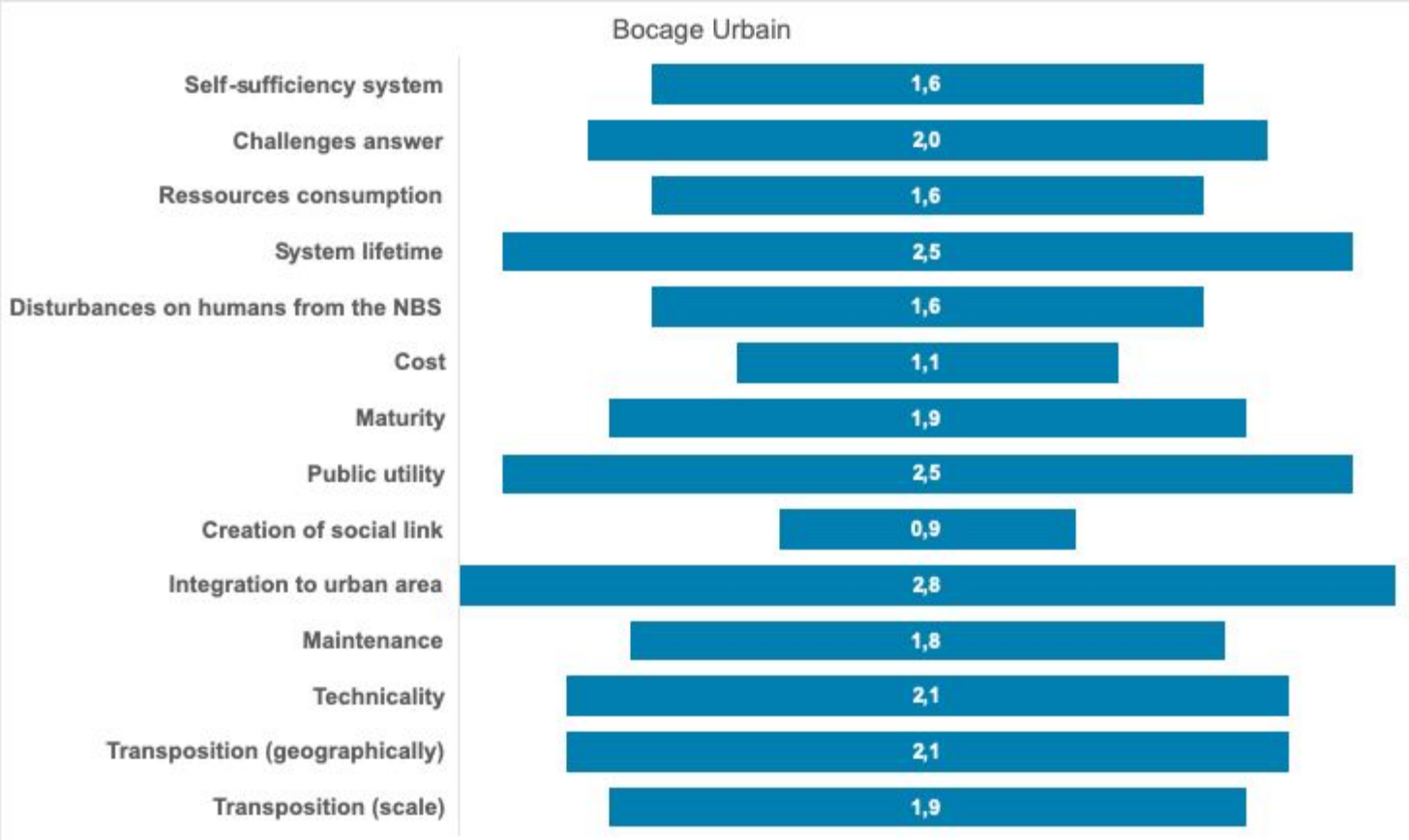
5. NBS rating



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Mushroom walls

Grow mushrooms in cities

Origin : Spain

Source : Alexandra MARTIN photos

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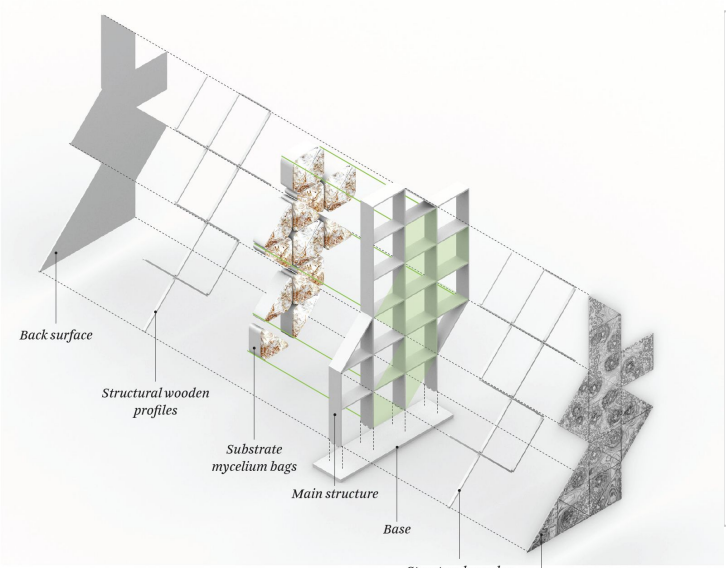
1. The concept

The goal : Create a wall in which you can grow mushrooms.
This wall will be used to build an entire structure.



Exploded isometric diagram of the final prototype

Developpement of mycelium on different substrates, placed in the wall.

Few holes for the fruits growth.

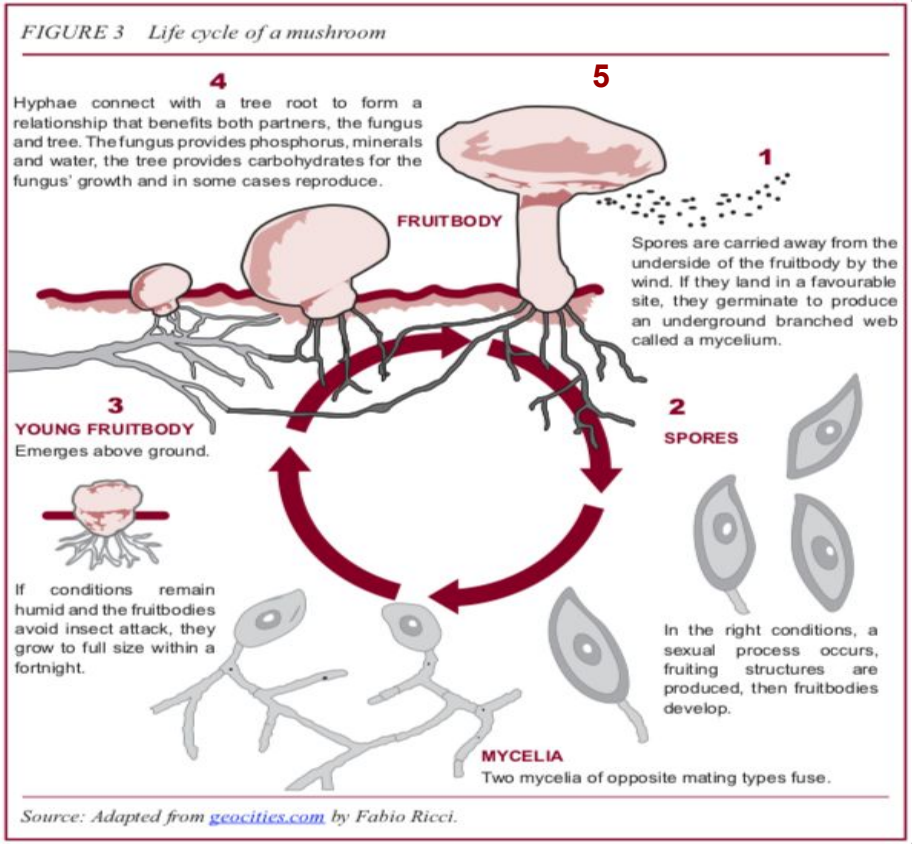
Providing food for the population.

Co-funded by the Erasmus+ Programme of the European Union

Source : Chiara's presentation, IAAC

2. Ecology, biology: theory for ecological processes

1. **Inoculation**
2. **Development of the mycelium**
3. **Fusion of mycelia of opposing mating type**
4. **Fructification**
5. **Harvest**



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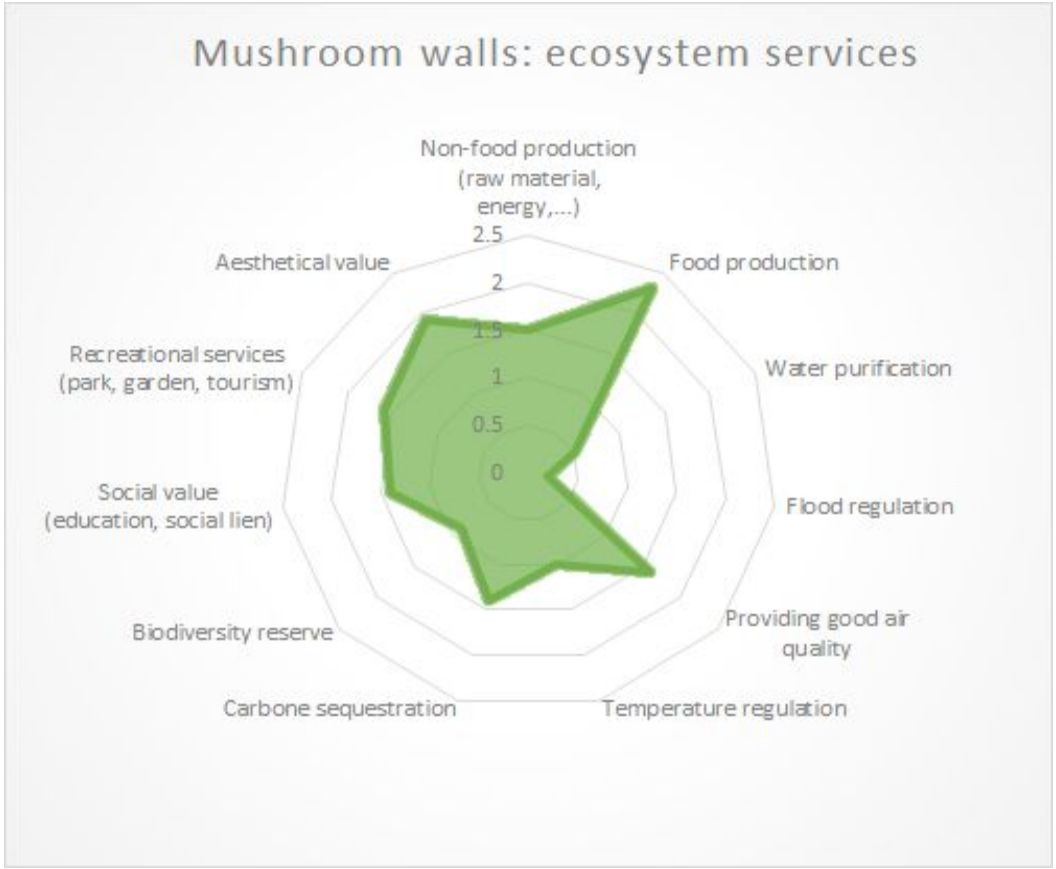
3. Ecosystem services & UN Sustainable Development Goals



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4. Limits & ways to improve

Limits

- Biodiversity, but not so much
- Needs a lot of care
- Mushrooms can degrade the wooden structure
- Use of substratum

How to improve ?

- Leave space for other species of mushrooms or other type of plants to create more biodiversity
- Find a way to close the cycle to decrease the need for care
- Close the structure to avoid contamination to other places in the city
- Use the sawdust created by the making of the structure

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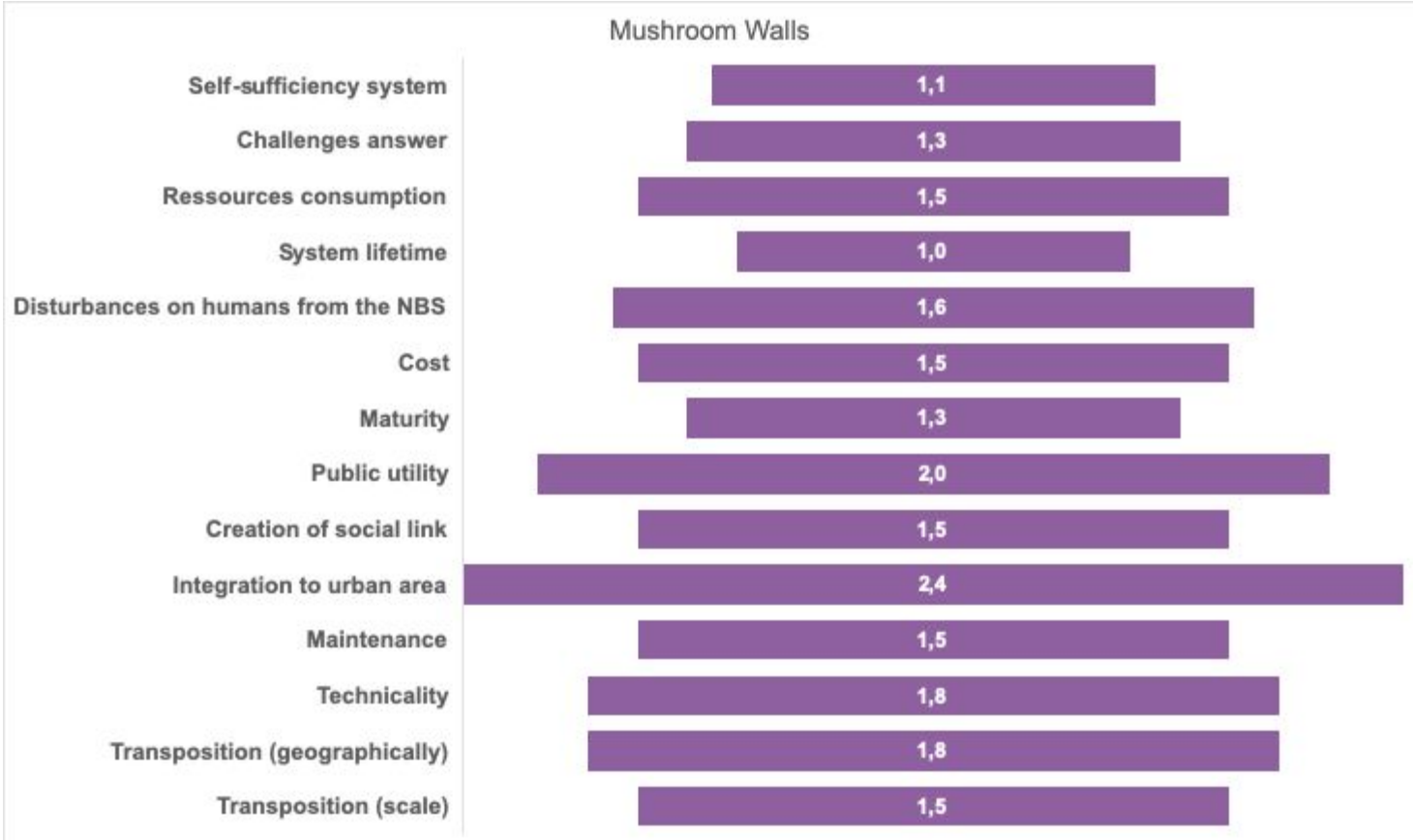
5. NBS rating



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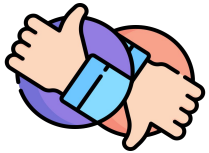
IV. Conclusion

We showed you 5 examples of NBS
→ but there are plenty of them
→ Applying NBS at different scales and for different purposes
→ imagination is the only limit

All of them = answering to the need of bringing back nature into cities and providing sustainable services to citizens (ecosystemic services)



We presented a way to rate these kind of projects not to say they are good or not but to show there is a way to improve them.

We are working on these solutions since April 2019, finding their advantages and boundaries but we particularly focus on the agronomic and environmental point of view

NBS and Sustainable Development Goals = multidisciplinary and complex challenges

To make this project concrete, strong and relevant, we need you
we need to build an us

So, let’s BUILD the solutions together

UN Sustainable Development Goals

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