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# Coast to Coast Climate Challenge & The European Science Network "Circular City"



VIA University College, Aarhus, Denmark  
19-20 September, 2022



## Added value of building integrated ecosystem services - Earth observation to support nature-based solutions



Rocío Pineda-Martos

Day 1  
Monday 19

C2C CC and The European Science  
Network Conference 2022



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# Nature-based solutions in the built urban environment: green roofs technologies

In the context of UGI, GRs are classified as NBS:

- Add natural features and processes;
- Locally adapted, resource-efficient, systemic interventions.

*Limitations need to be explored for design optimization  
Potential of GRs and other building-integrated systems*



European  
Commission

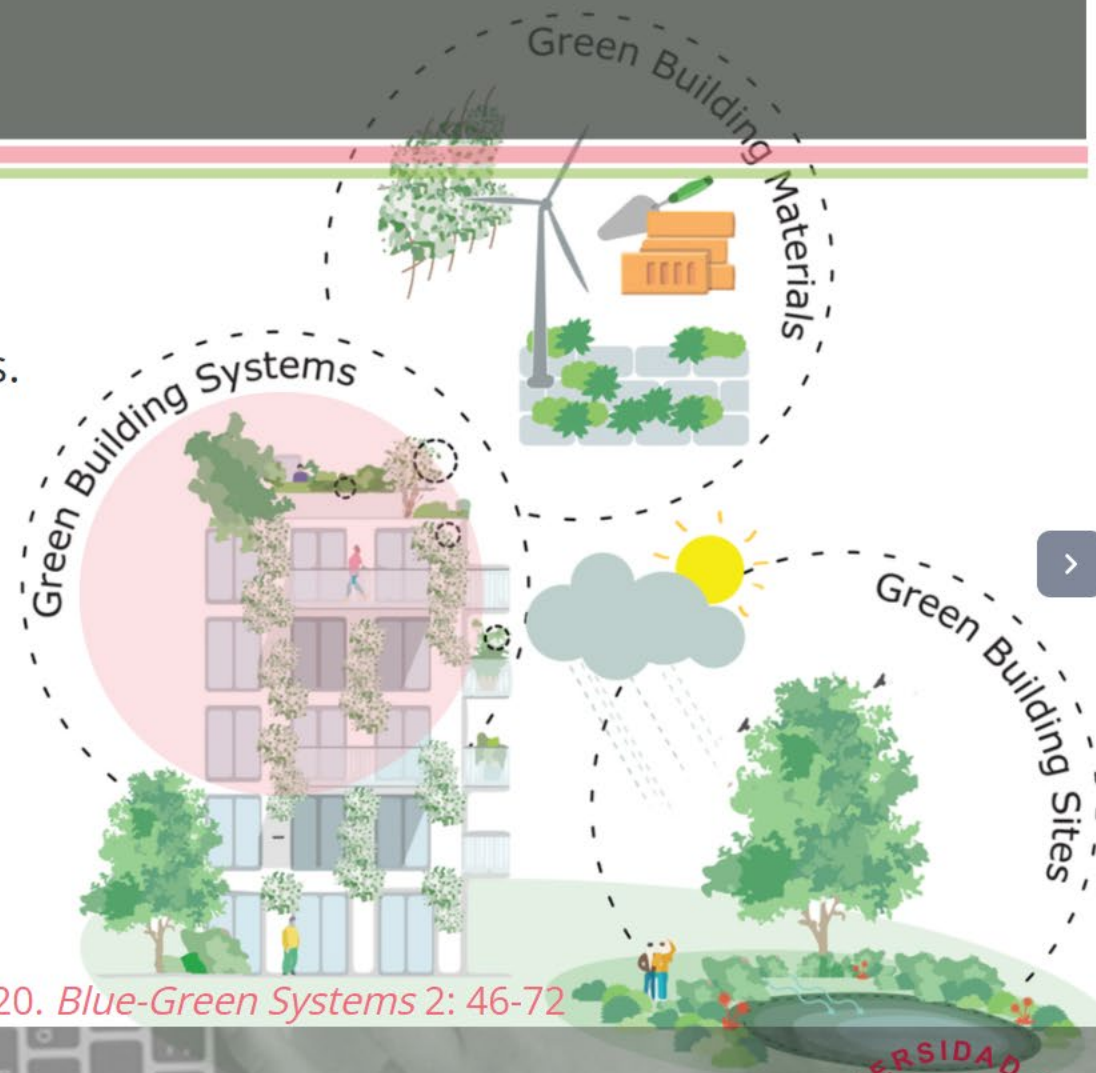
Sustainable use of land and  
NBS in cities

- EU Biodiversity Strategy for 2030 (core part of the European Green Deal);
- Ecosystem services and Green Infrastructure;
- NBS.



\*UGI: urban green infrastructure; GRs: green roofs; NBS: nature-based solutions.

*Pearlmutter et al., 2020. Blue-Green Systems 2: 46-72*



# Research and Innovation on nature-based solutions and re-naturing cities: green roofs and societal challenges

The EU R&I policy agenda on 'NBS and Re-Naturing Cities':

- Position the EU as leader in 'Innovating with nature';
- Focus on new and innovative NBS to sustainable and resilient societies.

Key opportunities areas (Goals):

- G1: Enhancing **sustainable urbanisation**;
- G3: Developing **climate change adaptation and mitigation (CCAM)**;
- G4: Improving **risk management and resilience**.

Recommended R&I (NBS) Actions:

- Urban regeneration and well-being;
- Sustainable use of matter and energy;
- Insurance value of ecosystems;
- Carbon sequestration.



# Nature-based solutions: How we can use nature's own resources to tackle environmental challenges

CLIMATE CHANGE AND ENERGY

UNSUSTAINABLE & UNHEALTHY CITIES

DEGRADATION OF ECOSYSTEMS

## 1 INCREASE RESILIENCE

Green roofs can cool buildings in the summer and prevent heat loss in the winter

-10% energy use

European market for green roofs  
+ €380m sales  
+ 11m m<sup>2</sup> yearly

## FLOOD RISK REDUCTION

Green infrastructure can reduce flood risks

**Malmö, Sweden**

The city invested in sustainable urban regeneration, and installed green roofs and an open storm water system

-50% run-off ↓ less flood damage

-20% environmental impact

+50% biodiversity

## 2 DECREASE URBAN HEAT STRESS

Trees, green space and vegetation can attenuate urban heat stress and reduce temperatures by up to 13°C compared to full sunlight

pilot study in Manchester, UK

## IMPROVE AIR QUALITY

HEALTH AND WELL-BEING

Trees and green walls can halve the amount of health threatening particles in the air

10% more urban green space

can reduce health care and sick leave costs by €400m/year per 10m inhabitants



- Positive impact of UHI ameliorating.

\*UHI: urban heat island.

# Science for environment policy: how to improve knowledge on green roofs performance and implementation

Weak aspects regarding studies of GRs:

- *Gap of knowledge: quantifying system beneficial effects and characteristics;*
- *Specific case studies;*
- *Differences between GRs (i.e. size, type, vegetation, location, ...) not assessed;*
- *Improve knowledge on synergies resulting of GRs accumulation in the same area.*

ANCV, 2020. Wastewater treatment station of Alcântara, Lisbon, PT; PROAP (2005-2011).



# How do the Copernicus programme and its services contribute to the implementation of the EU Green Deal?

Copernicus is the European Union EO Programme in partnership with Member States:

- Play an essential role in monitoring the state of our planet environment.
- True ally in implementing the EU ambitious climate plan, thanks to the data it provides.
- UGI and specifically vegetated areas (GRs) have to be continuously monitored: optimal conditions for cover plants.

By monitoring our atmosphere and air pollutants, the Copernicus programme has an important role to play in achieving the goal of climate neutrality by 2050. \*EO: Earth observation.

The infographic is divided into two vertical panels. The left panel, labeled 'from GREY.', features icons for CO<sub>2</sub> clouds, industrial buildings, a factory, and a classical building. The right panel, labeled 'to GREEN.', features icons for a satellite, solar panels, a house with solar panels, a train, and a tree. Below the panels, there are logos for the European Commission and Copernicus, along with the hashtags #EUGreenDeal and #EUClimateLaw. A spiral notebook and a pen are visible in the foreground.

- First #EUClimateLaw, a crucial proposal under the #EUGreenDeal

# The 'Fifth Façade Project' (PQAP, Projeto Quinto Alçado do Porto) - Jardim das oliveiras: Porto's urban rooftop garden



Pearlmutter et al., 2020. *Blue-Green Systems 2*: 46-72

\*ANCV - Associação nacional de coberturas verdes



ANCV  
Municipality of Porto

## Innovative consultancy project

### Objectives:

- Enhancing sustainable urbanization;
- Restoring ecosystems and functions;
- Developing climate change mitigation and adaptation;
- Improving risk management and resilience;
- NBS for increasing sustainable use of matter and energy.



*To define models in order to include UGI (GRs) into urban planning, environmental and green spaces strategy of the city*

Oppla: Open platform EU Repository of NBS ([oppla.eu](https://oppla.eu))



# Technical innovation on nature-based solutions practices in urban areas: from theory to practice (PQAP) - GRs

General characteristics of the project:

- Effort to improve an area in decline in the historical Center of Porto - city oldest area;
- Urban regeneration project of 5000 m<sup>2</sup>; 4500 m<sup>2</sup> - GR;
- Three levels structure.
  - GR (top-most level);
  - Planted with olive trees ('Porta do Oliva').



*NBS for increasing the sustainable use of matter and energy*



Van Rompaey, 2019. ThinkNature Summer School; Crete, GR



Praça de Lisboa - CMP, Câmara Municipal do Porto (2013)





# Earth observation to support nature-based solutions: urban green management with near-real time geodata



In the framework of Copernicus programme:

- Solid databases of in-situ and EO-based measurements;
- Potential for data harmonization and standardization.

Cloud-based platforms, such as **Google Earth Engine**:

- Centralized access to data and information;
- Processing tools of unprecedented computing and modelling capabilities.

Somarakis *et al.*, 2019 (Eds.) *ThinkNature nature-based solutions handbook*  [platform.think-nature.eu](https://platform.think-nature.eu)

## Environmental and socioeconomic NBS impact assessment

- Digital tree inventory;
- Renaturing our cities;
- The Internet of Nature.

### Green city watch - Taking nature online

- Greener, smarter cities using geospatial AI and data-driven urban ecology.



\*AI: artificial intelligence.

# Satellite remote sensing approaches and future perspective in urban planning for green and smart cities

NDVI is primarily sensitive to chlorophyll contributions and vegetation structure \*.

NDVI interannual variations response to water deficits and enhancements, particularly in sparsely vegetated regions \*.

< The impact of cloud contamination affects the NDVI.

NDVI can be obtained at management level spatial resolutions:

- Derived at the field level (~30 m - Landsat) and S2, with revisit times of the order of days.

*Lack of previous research with space-based observations focused on GRs characterization*

*(\*) Joiner et al., 2018. Remote Sensing of Environment 219: 339-352*

- Remote sensing techniques accompanied by *in situ* observations about changes in rooftops use enable to methodically assess the overtime status of urban GRs.
- Advances will be of assistance to get better knowledge on urban systems and, potentially having an advantage to NDVI and UGI status monitoring.

GRs can provide the foundations towards meeting several SDGs (2030 Agenda)



Background picture: the green roof lab  
Instituto Superior de Agronomia  
Universidade de Lisboa, PT (2020)

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  - **URSUS-DM**, Nuevos desarrollos en minería de datos para su utilización en la sostenibilidad urbana.
    - 🌐 <http://wp.iaia.lcc.uma.es/nuevos-desarrollos-en-mineria-de-datos-para-su-utilizacion-en-la-sostenibilidad-urbana/>

Upcoming remote sensing analysis are trending to include indicator sets as an automated and standardized method to accurately track vegetation status on multi-temporal images of UGI.



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Thanks!

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