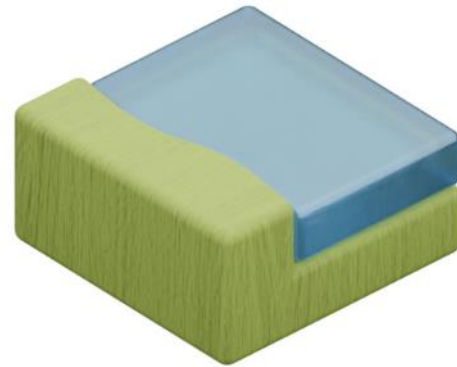


# Unlocking the potential of green roofs using an economic assessment: a study from different green roof projects in Czechia



**Marek Hekrle**

Jan Macháč

*Faculty of Social and Economic Studies*

*University of J. E. Purkyne*

*Usti nad Labem, Czech Republic*

# Unlocking the potential of green roofs...

- **COMMUNICATION IS THE KEY**
- **LEADING BY EXAMPLE AND (POLITICAL) COURAGE IS NECESSARY**
- **ECONOMIC ARGUMENT IS A STRONG ONE**
- **IT MAKES (ECONOMIC) SENSE TO SUPPORT GREEN ROOFS**

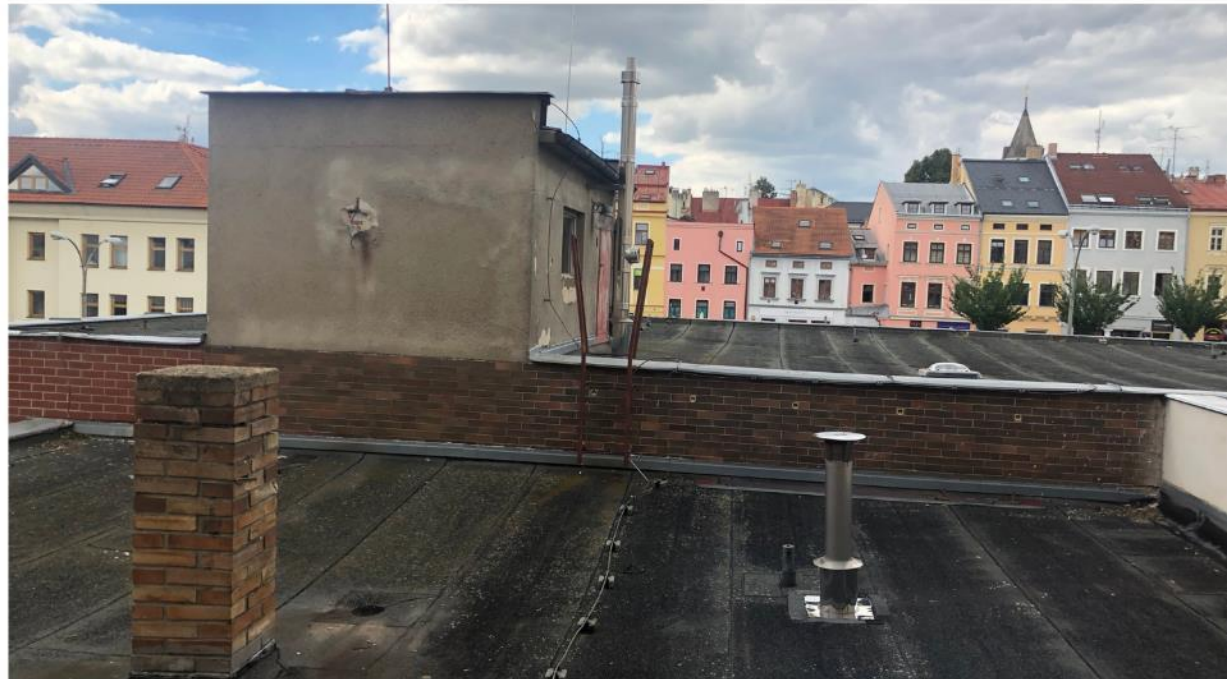
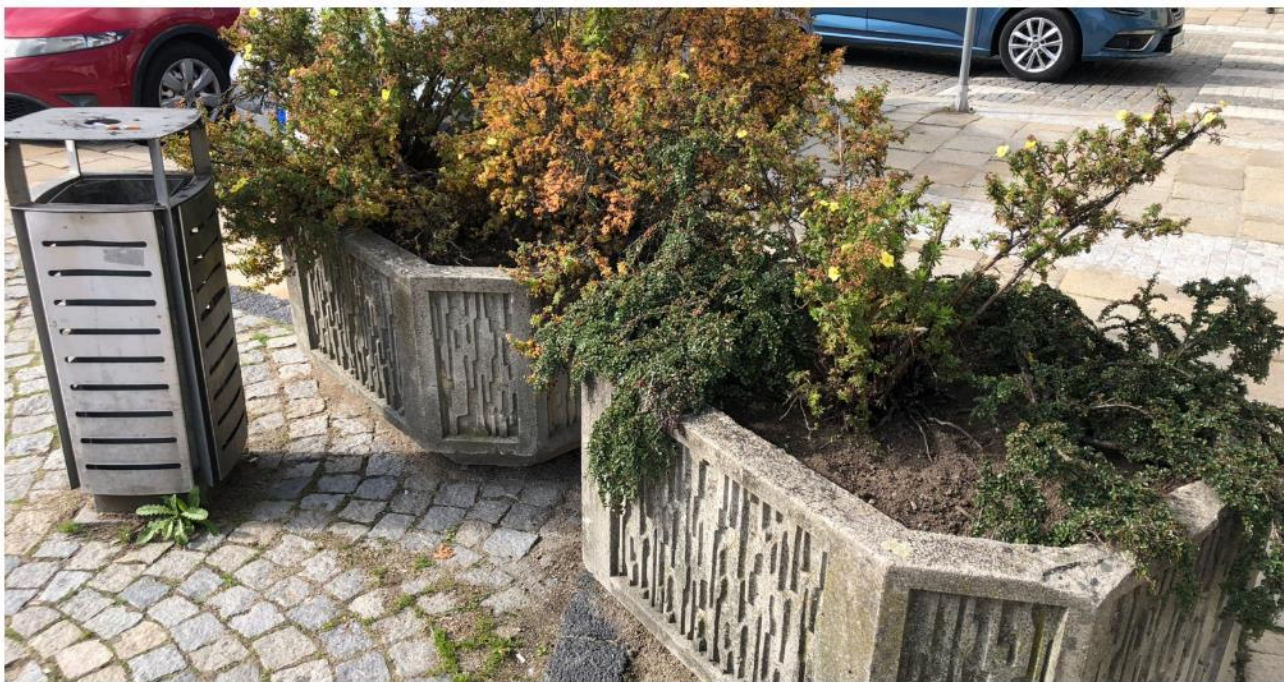


1/4

**COMMUNICATION IS THE KEY**











What's the difference?



# Benefits of urban nature

---

## Ecosystem services

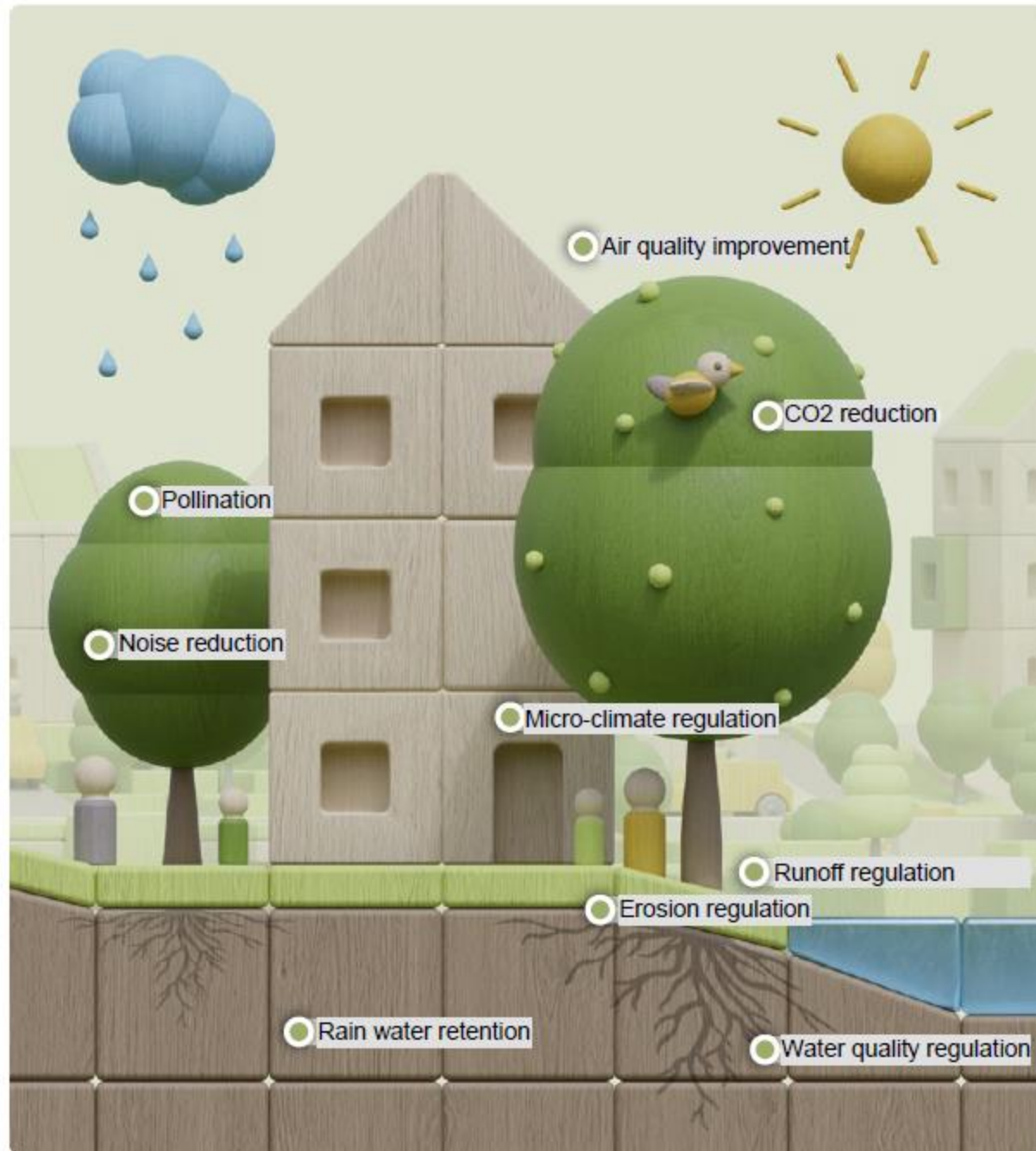
*...the benefits that people derive from functioning ecosystems. (Costanza et al., 2017)*

*...benefits that nature may provide for humans. (Nesshöver et al., 2017).*

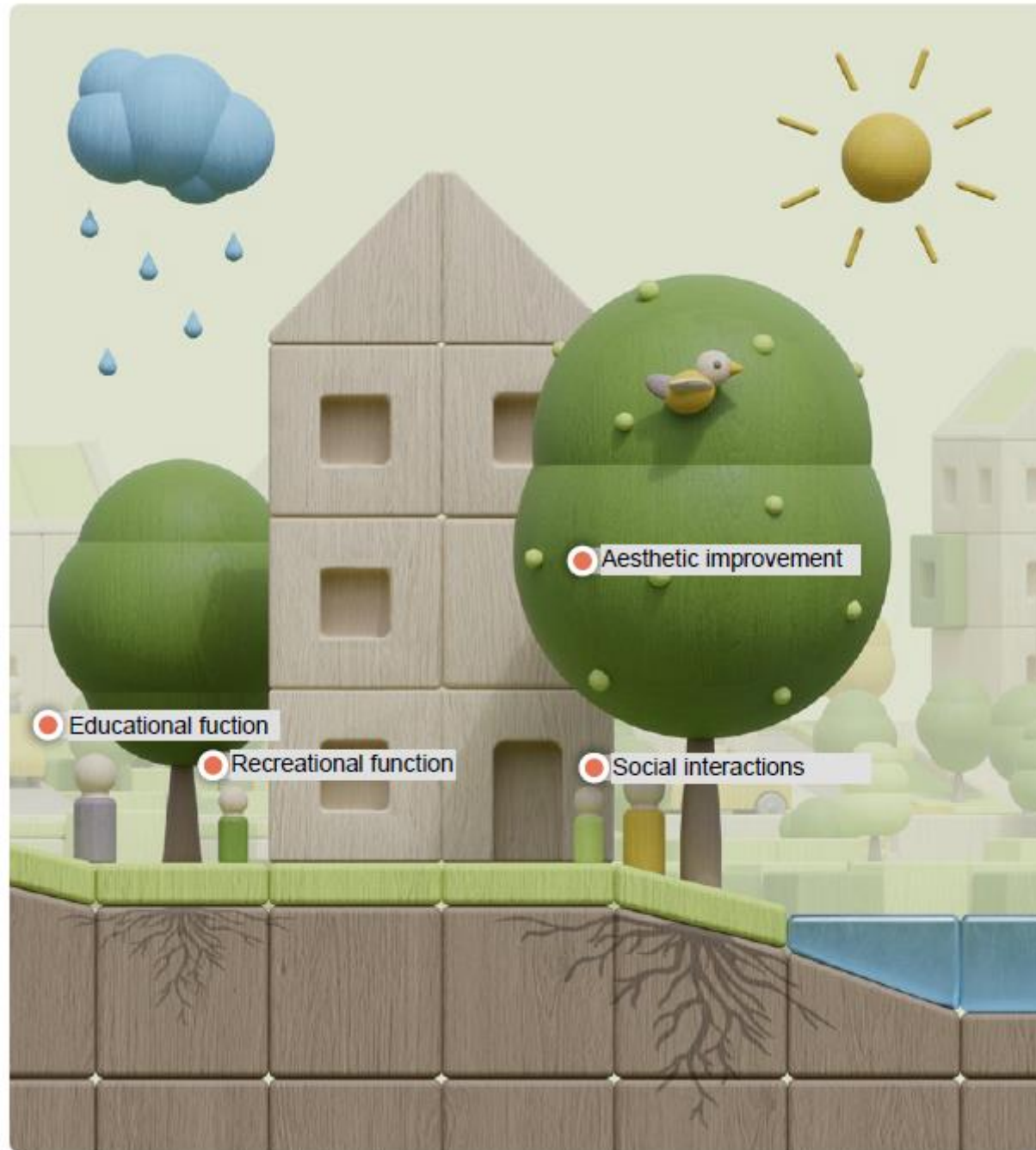
*...benefits that directly or indirectly contribute to human well-being. (TEEB, 2010)*



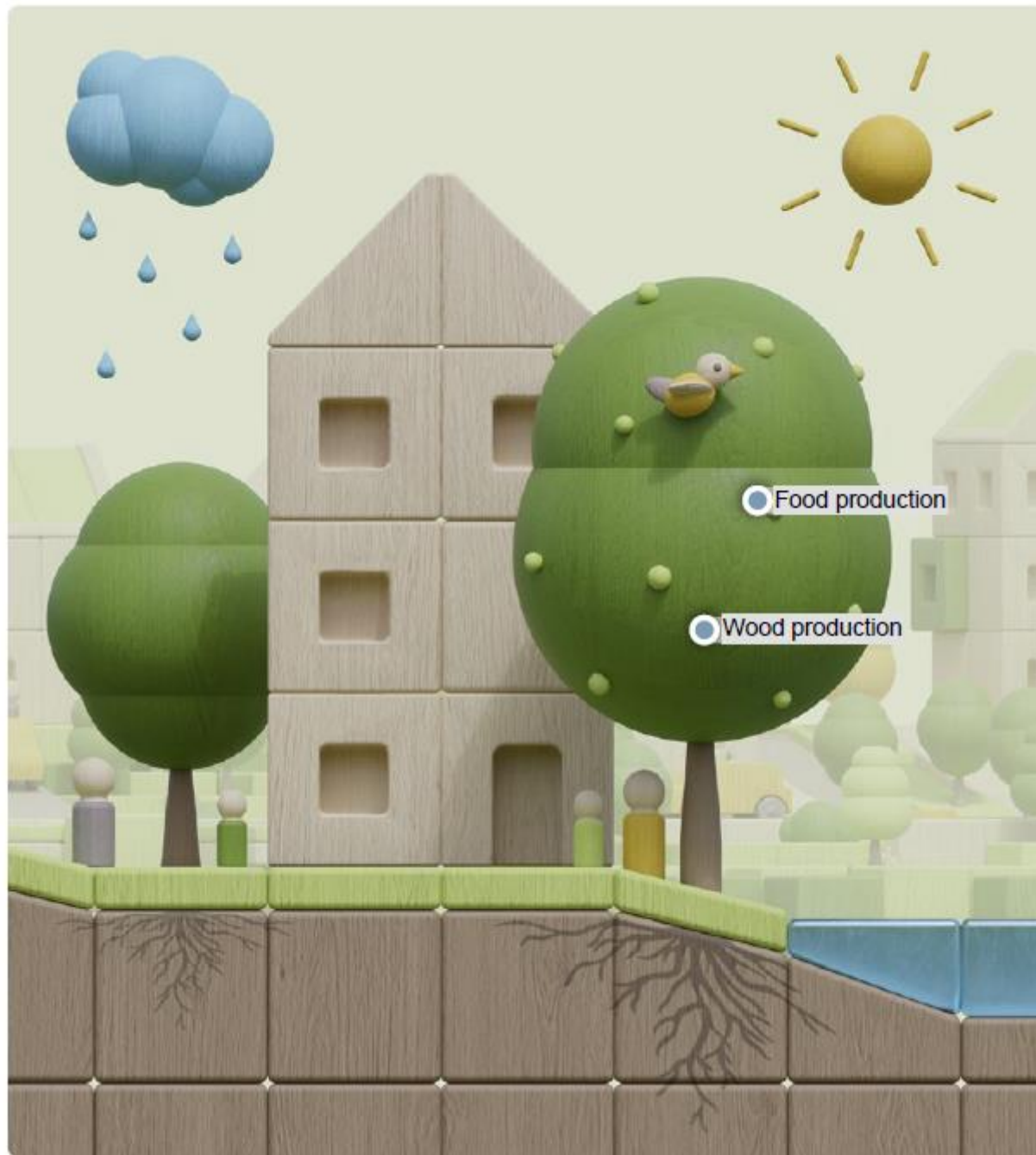
# Regulating services



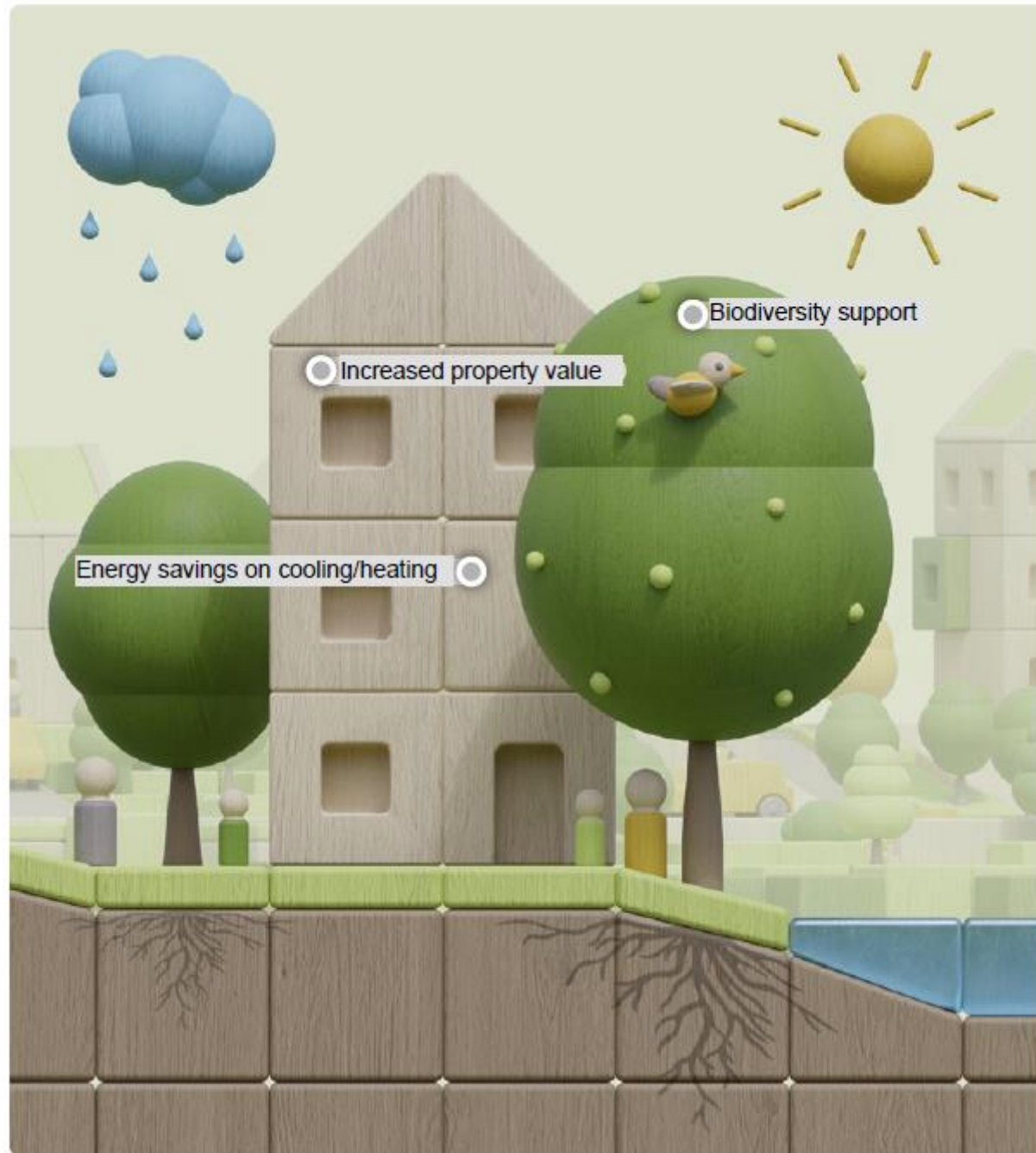
# Cultural services

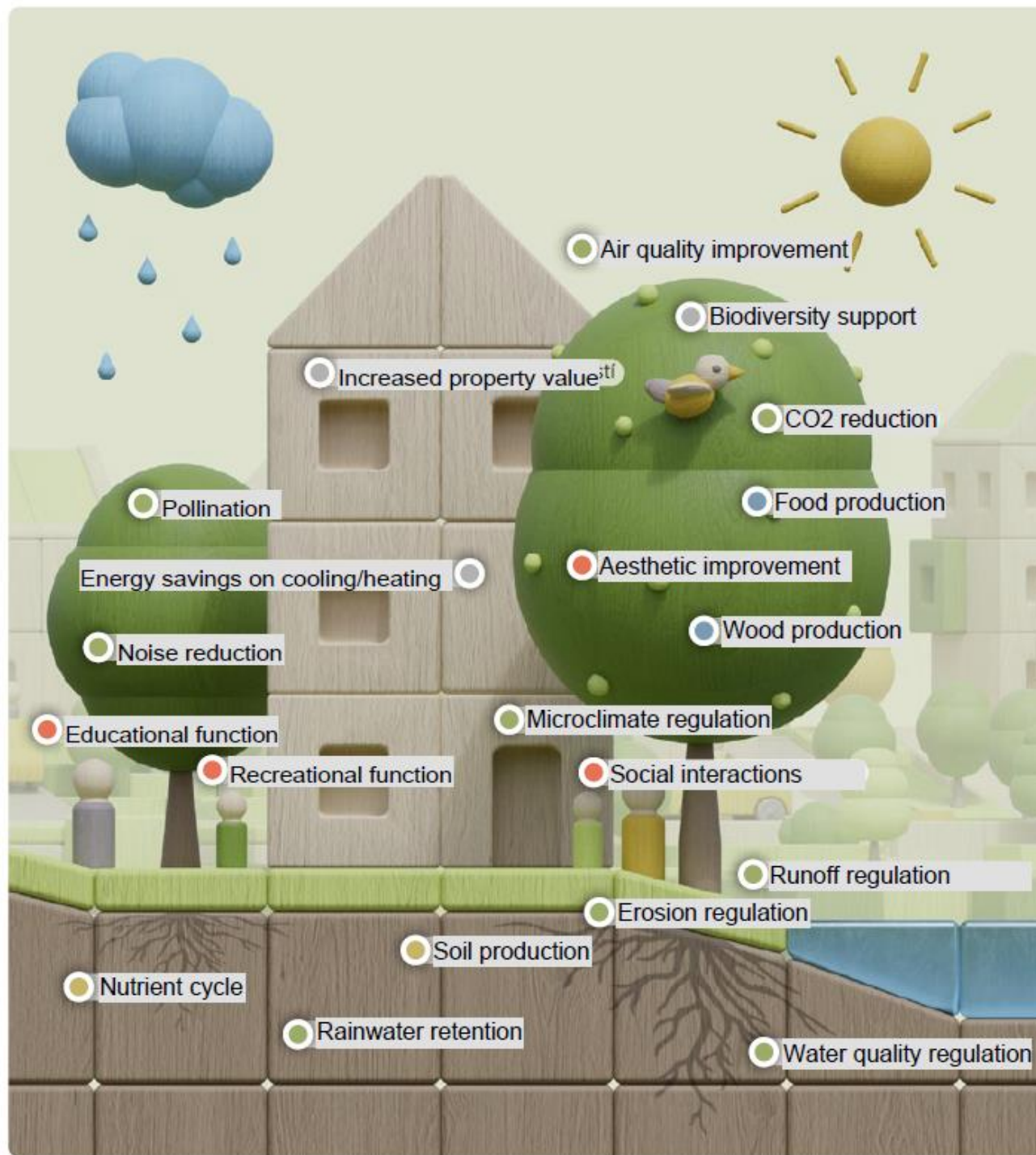


# Provisioning services



# Other benefits





2/4

**LEADING BY EXAMPLE AND  
(POLITICAL) COURAGE IS  
NECESSARY**



# Our team

---

## Where:

Jan Evangelista Purkyně University in Ústí nad Labem, Czech Republic

## What:

Methods of **environmental economics**

Scientific and application projects

Nature-based solutions and ecosystem services

Waste and water management



# 'Our' experimental green roof

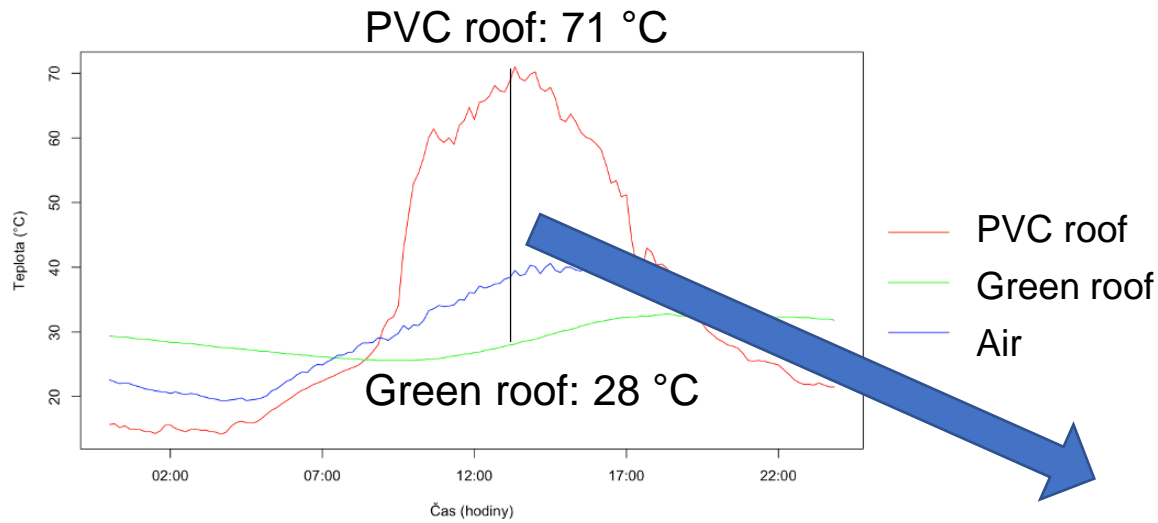
- roof on the building of the Faculty, building from 1986
- green roof as a part of reconstruction
- 125 m<sup>2</sup> extensive green roof
- substrate thickness of 8-10 cm
- mainly sedum plants
- **surface temperature sensors**





# 'Our' experimental green roof

Hottest day in 2022 (40 °C):



**43 °C temperature difference**  
**between green and reference roof**  
**(PVC roof)**

3/4

**ECONOMIC ARGUMENT IS A  
STRONG ONE**



# Economic value of green roofs

---

## Common barriers limiting the practical implementation of GRs:

- Concerns about the long-term costs and economic feasibility of GR
- A lack of information regarding GR benefits



Demand for a reliable **ECONOMIC ASSESSMENT** that includes the quantification of the costs and benefits of real case studies



# Economic assessment of green roofs

---

**Application of economic methods to express the societal costs and benefits of green roofs (including ecosystem services)**



**Cost-benefit analysis (CBA)** – certified methodology (Macháč et al.; 2019)

- Monetary valuation of particular benefits (and costs)
- Comparison of benefits and costs over the life cycle of the green roofs
- Raises awareness about the usefulness of different actions



# Why economic assessment?

---

- **It provides arguments of an economic nature**
  - Communication with **public**
    - promoting benefits using monetary expression
    - justifying the costs of measures
  - Negotiation with **stakeholders**
    - e.g., with developers
  - Setting **policies** to support measures
    - e.g., to compensate positive externality

4/4

IT MAKES (ECONOMIC) SENSE  
TO SUPPORT GREEN ROOFS



# Economic value of real-case green roofs

- Three case studies – three green roof projects installed on different types of buildings

**PUBLIC POLICLINIC**



**RESIDENTIAL FLATS**



**SINGLE-FAMILY HOUSE**



Application of **Czech CBA approach** to assess the economic value of GRs

# First case – GR\_public

---

- **Public building**
- Extensive GR, 360 m<sup>2</sup>
- Financed by **municipality**
- Sedum and grass vegetation
- The space under the roof is rented as commercial space
- Some offices have sight of the green roof
- **Main motivation:** improving the building's energy performance and adapting to climate change





# Second case – GR\_flats

---

- **Residential and commercial building**
- Extensive GR, 639 m<sup>2</sup>
- Financed by a **private development company**
- Sedum and grass vegetation
- The space under the roof is rented as commercial space
- GR is visible from some private flats in the higher building
- **Main motivation:** ambition to offer a more sustainable and attractive form of residential housing



# Third case – GR\_house

---

- **Single-family residential house**
- Extensive GR, 125 m<sup>2</sup>
- Financed by **private individual**
- Sedum and grass vegetation
- **Main motivation:** ambition to architecturally improve the appearance of the house



# Cost inputs to CBA

## Costs of green roofs



COSTS			GR_public	GR_flats	GR_house
Installation costs	one-off (1st year)	€/m <sup>2</sup>	30	58	43
Maintenance costs	annual (every year)	€/m <sup>2</sup>	0.40	0.93	0.57

### Data used to monetise the costs:



data available







consultations with the building owners or managers

# Benefit inputs to CBA



## Data used to monetise the benefits:

BENEFITS		€/m <sup>2</sup>	GR_public	GR_flats	GR_house	
Rainwater runoff regulation	annual (every year)	€/m <sup>2</sup>	0.27	0.29	0.29	 rainwater retention capacity + data on precipitation episodes + prices of wastewater treatment
Energy savings on heating and cooling	annual (every year)	€/m <sup>2</sup>	1.71	2.18	1.49	 expected insulation + prices of heating supply
Interior noise reduction	one-off (1 <sup>st</sup> year)	€/m <sup>2</sup>	12	12	12	 level of noise reduction + price of technical insulation with similar effect
Increased insulation lifespan	periodic (30 <sup>th</sup> )	€/m <sup>2</sup>	14	14	14	 price of insulation replacement

# Benefit inputs to CBA



BENEFITS			GR_public	GR_flats	GR_house
<b>Air quality improvement</b> (absorption of NO <sub>2</sub> , SO <sub>2</sub> , O <sub>3</sub> and PM <sub>10</sub> )	annual (every year)	€/m <sup>2</sup>	0.11	0.11	0.11
<b>CO<sub>2</sub> reduction</b>	annual (every year)	€/m <sup>2</sup>	0.002	0.002	0.002

## Data used to monetise the benefits:



studies about the pollutant removal capacity + prices of similar measures with the same effect



studies about the CO<sub>2</sub> absorption capacity + price of carbon dioxide equivalent in the EU ETS

# Benefit inputs to CBA



GR\_public GR\_flats GR\_house

BENEFITS			GR_public	GR_flats	GR_house	
Aesthetic improvement to the building with a GR	Increased property value	one-off (1st year)	€/m <sup>2</sup>	-	-	237.81
	Increased rent in the building	annual (every year)	€/m <sup>2</sup>	0.50	0.75	-
Aesthetic improvement to surrounding buildings	Increased property values of surrounding buildings that overlook the GR	one-off (1st year)	€/m <sup>2</sup>	-	275.62	-
	Increased rent in surrounding buildings that overlook the GR	annual (every year)	€/m <sup>2</sup>	8.32	-	-

## Data used to monetise the benefits:



review of property prices and rent percentage increases + local market prices

# CBA results

---

- Economic value of assessed green roofs in 40-year lifespan:



---

	<i>GR_public</i>	<i>GR_flats</i>	<i>GR_house</i>
<b>COSTS (€)</b>	<b>13 234.77</b>	<b>47 589.26</b>	<b>6 528.02</b>
<b>BENEFITS (€)</b>	<b>77 474.56</b>	<b>209 548.50</b>	<b>35 232.85</b>
<b>Difference (€)</b>	<b>+ 64 239.78</b>	<b>+ 161 959.24</b>	<b>+ 28 704.83</b>

---

# CBA results

---

- Economic value of assessed green roofs in 40-year lifespan:



---

	<i>GR_public</i>	<i>GR_flats</i>	<i>GR_house</i>
<b>Net present value (NPV) (€/m<sup>2</sup>)</b>	<b>178.44</b>	<b>253.46</b>	<b>229.64</b>
<b>Benefit-cost ratio (BCR)</b>	<b>5.85</b>	<b>4.40</b>	<b>5.40</b>
<b>Payback period (years)</b>	<b>2</b>	<b>1</b>	<b>1</b>

---



# Unlocking the potential of green roofs...

---

- **COMMUNICATION IS THE KEY**

- Multiple ecosystem services - an opportunity to increase wellbeing

- **LEADING BY EXAMPLE AND (POLITICAL) COURAGE IS NECESSARY**

- Good implementation of pilot measures leads the way for future projects

- **ECONOMIC ARGUMENT IS A STRONG ONE**

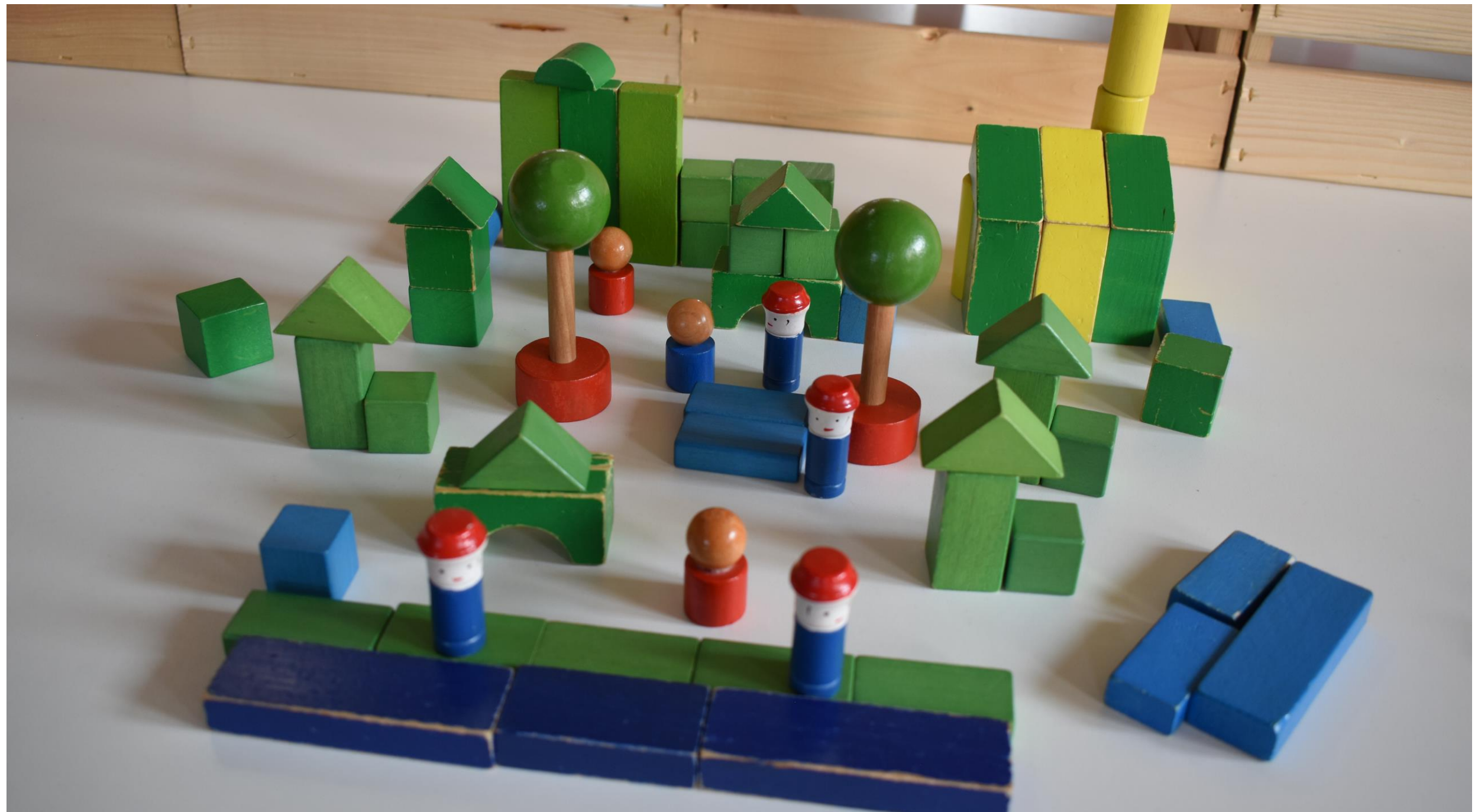
- Green roofs (and all nature-based solutions) provide benefits which can be expressed in monetary terms

- **IT MAKES (ECONOMIC) SENSE TO SUPPORT GREEN ROOFS**

- The benefits over the lifetime can range up to hundreds of euros per square metre of green roof







# Thank you.

Marek Hekrle  
[marek.hekrle@ujep.cz](mailto:marek.hekrle@ujep.cz)

Jan Macháč  
[jan.machac@ujep.cz](mailto:jan.machac@ujep.cz)

[www.ieep.cz](http://www.ieep.cz)



[bit.ly/RG\\_Marek](https://bit.ly/RG_Marek)

