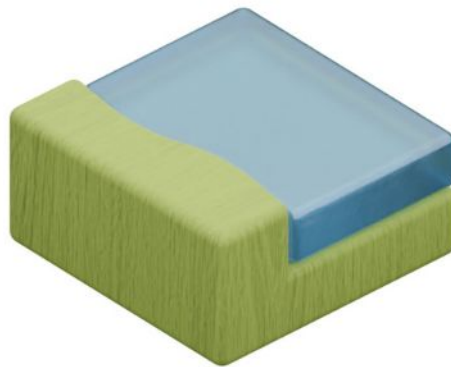


Cost-Benefit Analysis (CBA) as a tool to promote the development of more sustainable and resilient cities



Jan Macháč



Sustainable Population Consumption in a Post-Pandemic Economy. | 9. October 2024 | Ústí nad Labem

Platforma
pro zelenou
a modrou
infrastrukturu



T A
C R

This project is co-financed from the state budget
by the Technology Agency of the Czech Republic
within the ETA Programme.

www.tacr.cz/en

Visegrad Fund

UNIVERZITA J. E. PURKYNĚ V ÚSTÍ NAD LABEM
Fakulta sociálně ekonomická



About me

Environmental economist; researcher, analyst, project manager and university teacher

Field(s) of interest:

- Green and blue infrastructure
- Adaptation to climate change (floods and drought)
- Concept of ecosystem services
- Water management and disproportionate costs

Methods

- Cost-benefit analysis
- Valuation methods: e.g. Choice experiments
- Multi-criterial analysis
- Development of games
- ...

Platforma
pro zelenou
a modrou
infrastrukturu



Sponge Boost

Upscaling the natural sponge functions of freshwater ecosystems to deliver multi-benefit green deal solutions

Funded by the European Union

LAND4CLIMATE partners

Making better use of data to counter climate change

Huge quantities of environmental and meteorological data are already available both within public institutions and from open sources. But how to make sense of all the data to improve public responses to heatwaves, droughts, floods and reduce their impact on biodiversity? The Climate_CRICES project enhances the capacity of public authorities to manage climate change effects projected by the data. A dashboard visualises available data and will be further tested and rolled out to policy makers. In addition, a joint strategy developed by the project helps them to better use those data.

interreg-central.eu/projects/climate-crices

Co-funded by the European Union

Climate_CRICES

COUNTRIES & REGIONS

AUSTRIA	Burgenland
CROATIA	Grad Zagreb
CZECHIA	Severozápad
GERMANY	Sachsen
HUNGARY	Budapest Dél-Dunántúl
ITALY	Piemonte Veneto
POLAND	Dolnośląskie

2,29 million €
Project budget

9 Partners
3 Pilots

06.2024 Start date
11.2026 End date

80 % ERDF co-financing

Information based on application form | February 2024

Restoring urban streams to improve the micro climate in cities

Ecological restoration could help overheated cities with improving micro-climatic conditions and halting the decline of biodiversity. However, restoring green and blue nature corridors still lacks widespread acceptance among urban planners. The ReBioClim project addresses the many barriers and challenges for their nature-based solutions and strengthen the provision of sustainable biodiversity and ecosystem services. The partners focus on the re-establishment of urban streams. They analyse concrete challenges in four central European pilot areas, create and implement restoration plans, and produce a good-practice guide.

interreg-central.eu/projects/rebioclim

Co-funded by the European Union

ReBioClim

COUNTRIES & REGIONS

CZECHIA	Severovýchod Severozápad
GERMANY	Sachsen
NETHERLANDS	Zuid-Holland
POLAND	Wielkopolskie
SLOVAKIA	Bratislavský kraj Západné Slovensko

2,51 million €
Project budget

12 Partners
10 Pilots

06.2024 Start date
01.2027 End date

80 % ERDF co-financing

Information based on application form | February 2024



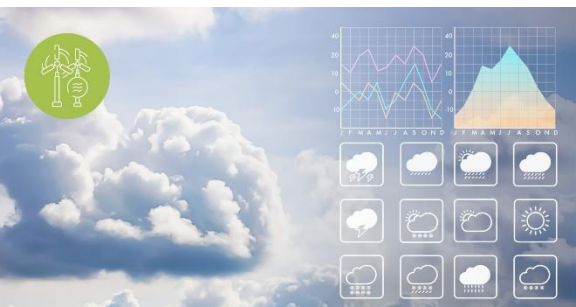
Sponge Boost

Upscaling the natural sponge functions of freshwater ecosystems to deliver multi-benefit green deal solutions

 **Funded by the European Union**




LAND4CLIMATE partners



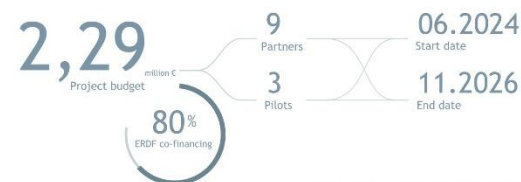
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interreg-central.eu/projects/climate-crices

 COUNTRIES & REGIONS

AUSTRIA
CROATIA
CZECHIA
GERMANY
HUNGARY
ITALY
POLAND



Information based on application form | February 2024

the micro climate in cities

Ecological restoration could help overheated cities with improving micro-climatic conditions and halting the decline of biodiversity. However, restoring green and blue nature corridors still lacks widespread acceptance among urban planners. The ReBioClim project addresses the many barriers and challenges for their nature-based solutions and strengthen the provision of sustainable biodiversity and ecosystem services. The partners focus on the re-establishment of urban streams. They analyse concrete challenges in four central European pilot areas, create and implement restoration plans, and produce a good-practice guide.

interreg-central.eu/projects/rebioclim

  **Co-funded by the European Union**

ReBioClim



COUNTRIES & REGIONS

CZECHIA: Severovýchod | Severozápad
GERMANY: Sachsen
NETHERLANDS: Zuid-Holland
POLAND: Wielkopolskie
SLOVAKIA: Bratislavský kraj | Západné Slovensko



Information based on application form | February 2024

Cities and Sustainable Population

Consumption

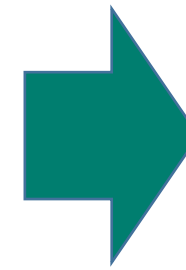


Cities and Sustainable Population Consumption



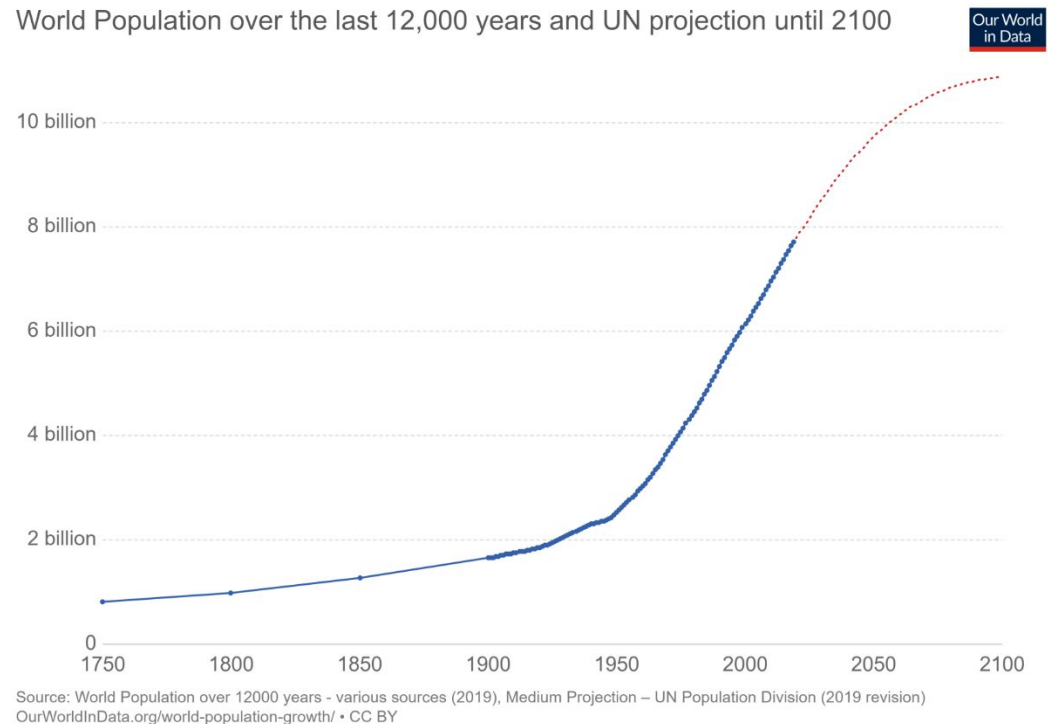
Cities and Sustainable Population

Consumption



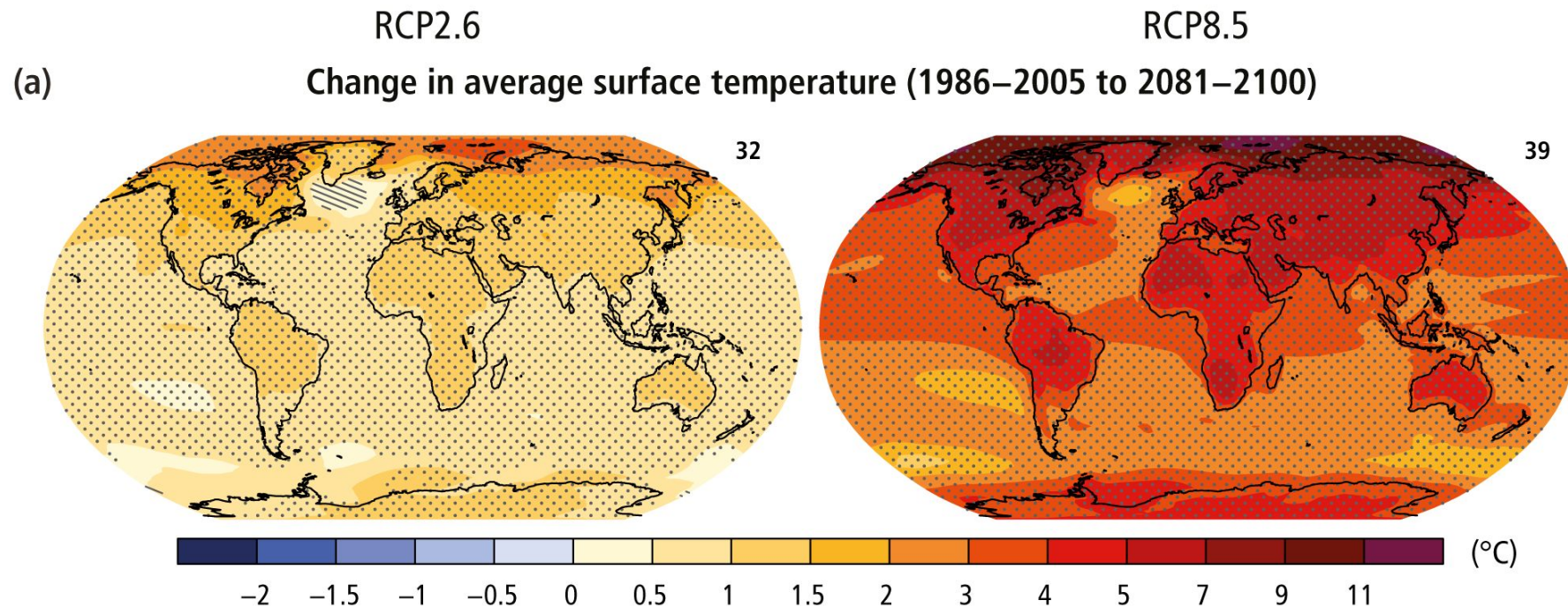
- **Quality of life (residents)**
- Creating the community
- Supporting economy

Current and future challenges for cities



Increase of the population
+
Urbanisation
=
Increase of population
living in cities
(urban growth)

Current and future challenges for cities



Source: IPCC, 2014



Sources: CNN (2024), Centre for Eastern Studies (2021), radio.cz (2024)

Current and future challenges for cities



Drought



Floods



Biodiversity
loss



Quality of air



Drinking water

SUSTAINABLE DEVELOPMENT GOALS



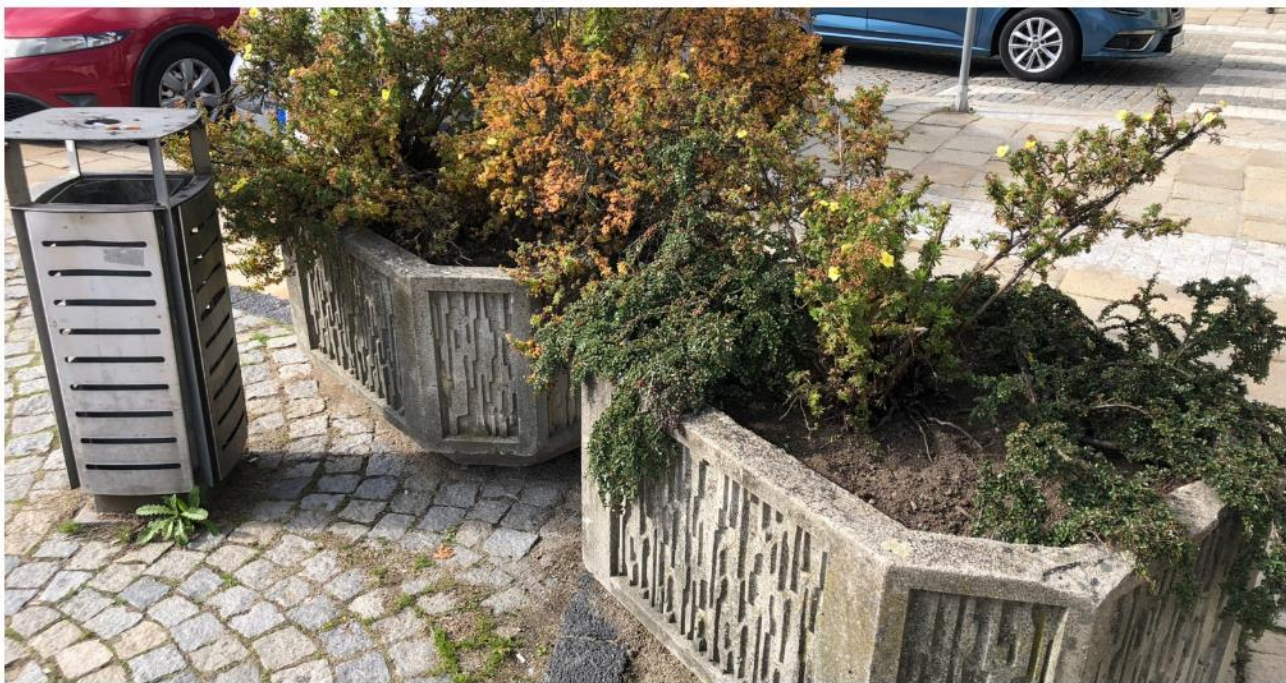
Blue and green infrastructure



Positive change:

- Society-wide awareness of the elements is increasing
- Interest in obtaining multiple types of benefits simultaneously
- Knowledge and experience of designers and implementers is increasing
- Financial availability (there are a number of subsidy titles)





Blue and green infrastructure



Some problems persist:

- Often implemented only on a limited scale
- Benefits are not included in decision making

Status quo = loss of many opportunities

1. CITY - an opportunity for a living centre
2. STREETS - an opportunity to take greenery as a neighbour
3. PARKING - an opportunity to end the asphalt desert
4. NEIGHBOURHOOD - an opportunity for better living
5. PARK - an opportunity to have your favourite place
6. BUILDINGS - an opportunity to place greenery even in the built-up area
7. COURTYARD of the house - an opportunity for a garden instead of weeds or asphalt
8. WATERCOURSES AND AREAS - an opportunity to revive them

ECOSYSTEM SERVICES

1. Provisioning

Thanks to blue-green infrastructure, we have the opportunity to utilize resources such as wood, biomass, and fruit.

2. Regulating

The existence of blue-green infrastructure regulates aspects such as noise pollution, air quality, and water flow.

3. Cultural

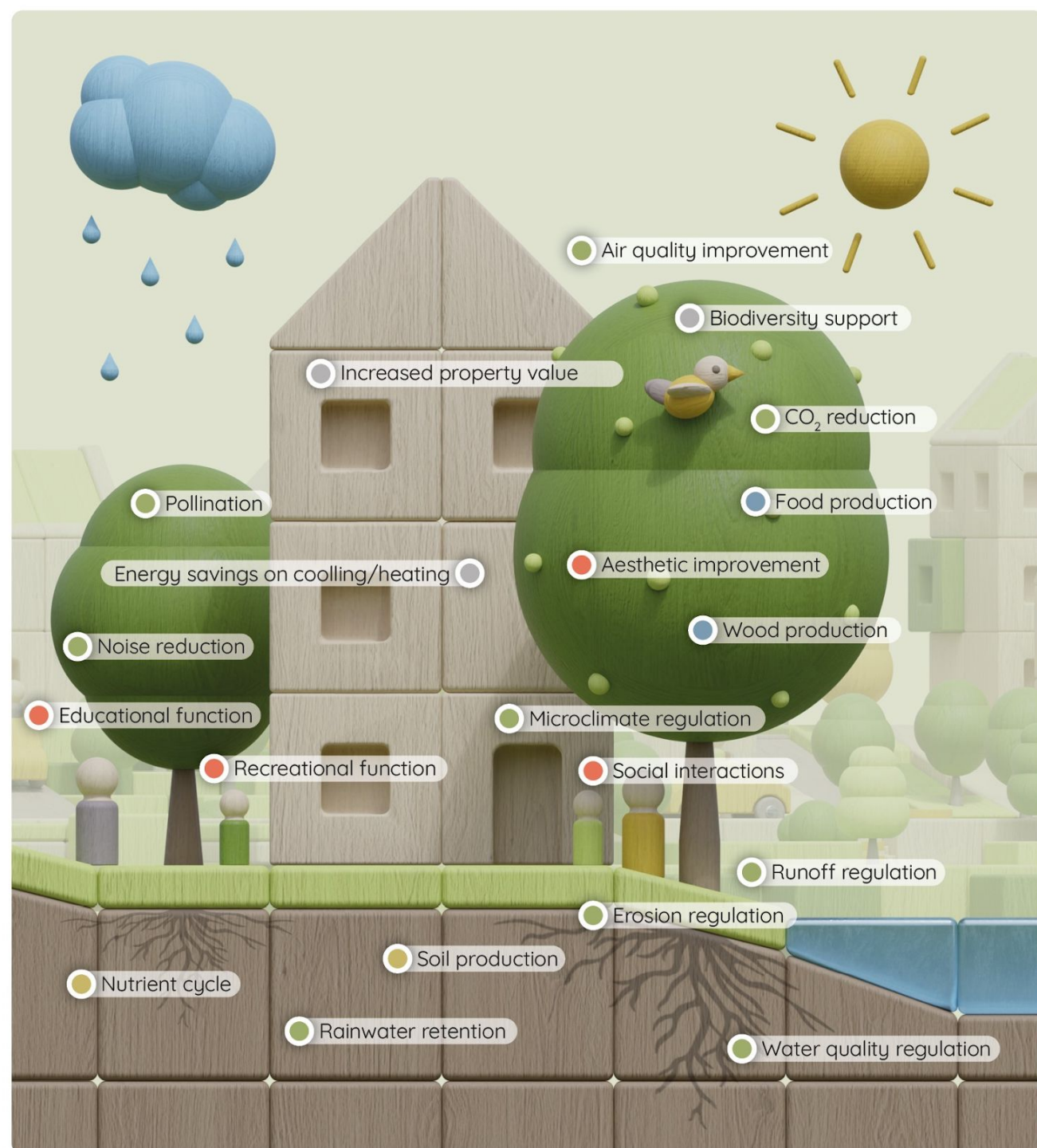
The presence of blue-green infrastructure provides opportunities for activities like recreation, aesthetic experiences, and socialization.

4. Supporting

Blue-green infrastructure has a long-term impact, for example, on soil formation, nutrient cycling, and water regulation in nature.

OTHER BENEFITS

Beyond ecosystem services, additional benefits include an increase in biodiversity and property values.



Blue and green infrastructure

- Some problems persist:
 - Often implemented only on a limited scale
 - Benefits are not included in decision making
 - LACK OF COMPREHENSIBLE ARGUMENTS

Blue and green infrastructure

- Some problems persist:
 - Often implemented only on a limited scale
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 - LACK OF COMPREHENSIBLE ARGUMENTS

And to be able to respond to:

- *"Why do we have to spend so much money on....?"*
- *"I want a measure that is visible!"*
- *"I understand that, but how do we explain it to the voters?"*
-

Blue and green infrastructure

- Some problems persist:
 - Often implemented only on a limited scale
 - Benefits are not included in decision making
 - LACK OF COMPREHENSIBLE ARGUMENTS

„Much of the sustainable rainwater management measures that make sense are often invisible things. Or things that are hard to explain or present to people. There isn't some nice easy-to-understand material for that.“

And to be able to respond to:

- *"Why do we have to spend so much money on....?"*
- *"I want a measure that is visible!"*
- *"I understand that, but how do we explain it to the voters?"*
-

How to get an economic
argument?

Economic assessment



- monetary valuation of specific benefits (and costs)
- comparison of discounted benefits and costs of measures
- financial and socio-economic feasibility

Jan Macháček
Lenka Dubová
Jiří Louda
Marek Hekrl
Lenka Zajíčková
Jan Brabec

Institute for Economic and Environmental Policy | Ústí nad Labem, 2019



IEP Institute for Economic and Environmental Policy



Economic assessment

Methodology for Economic Assessment of Green and Blue Infrastructure in Human Settlements

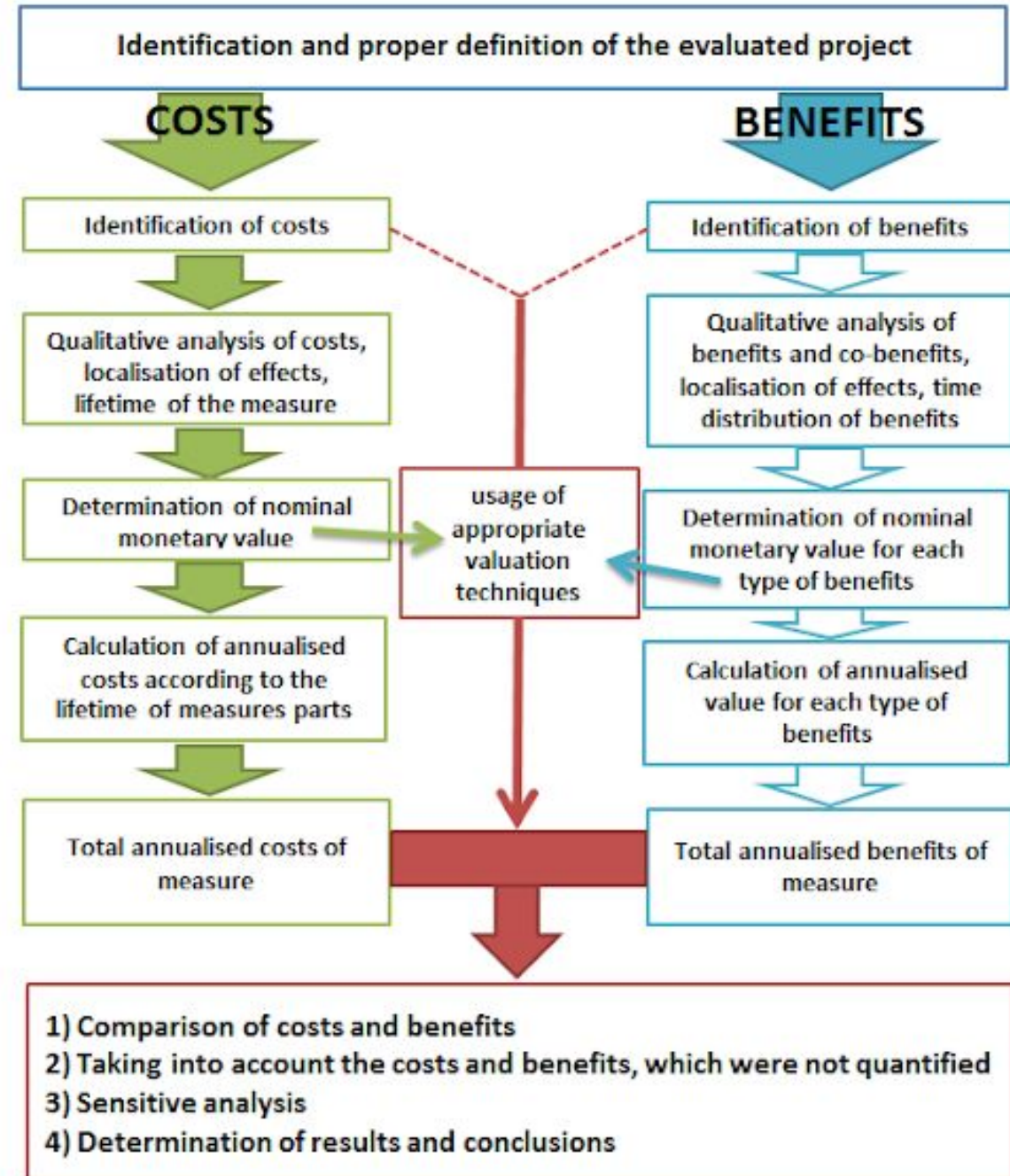
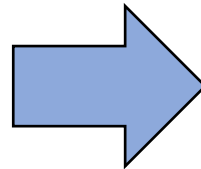


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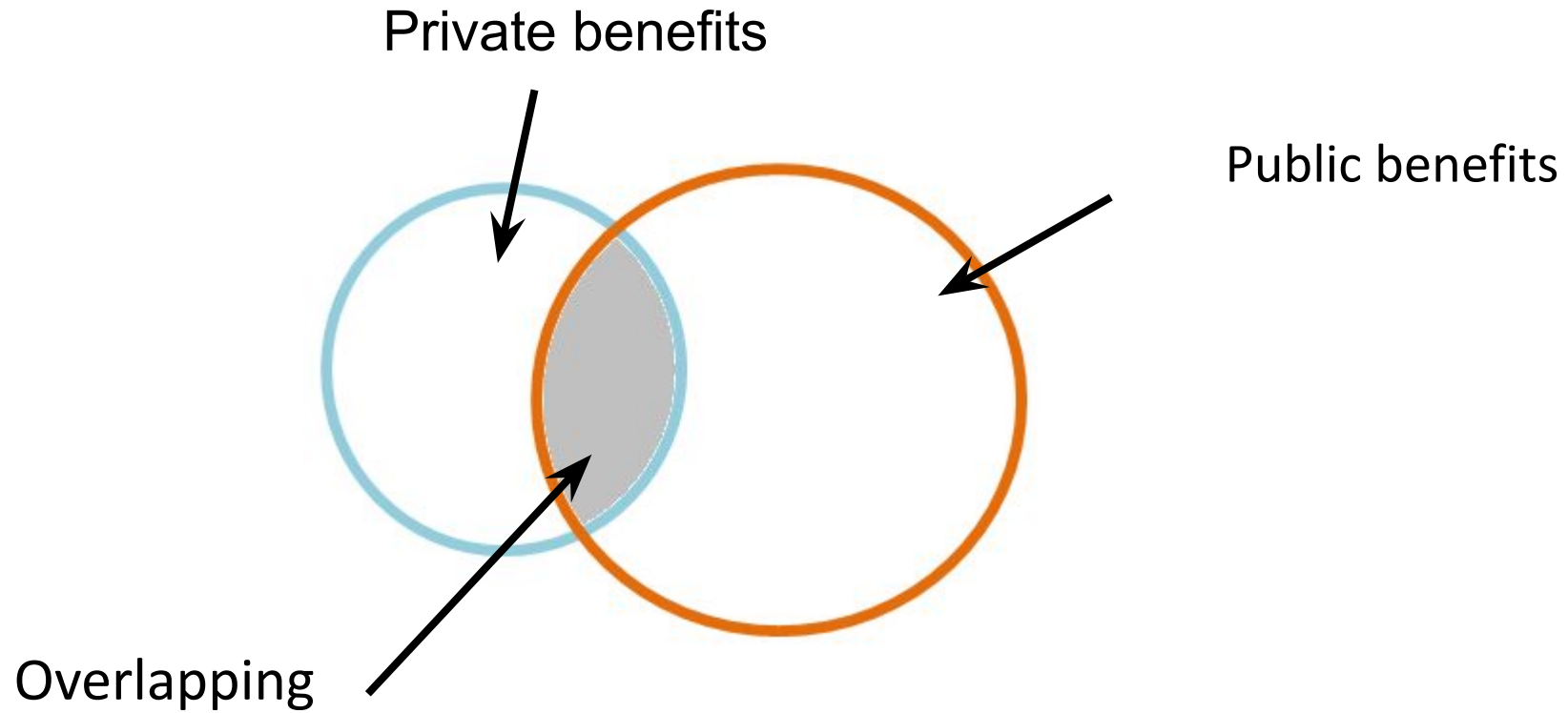
Institute for Economic and Environmental Policy | Ústí nad Labem, 2019



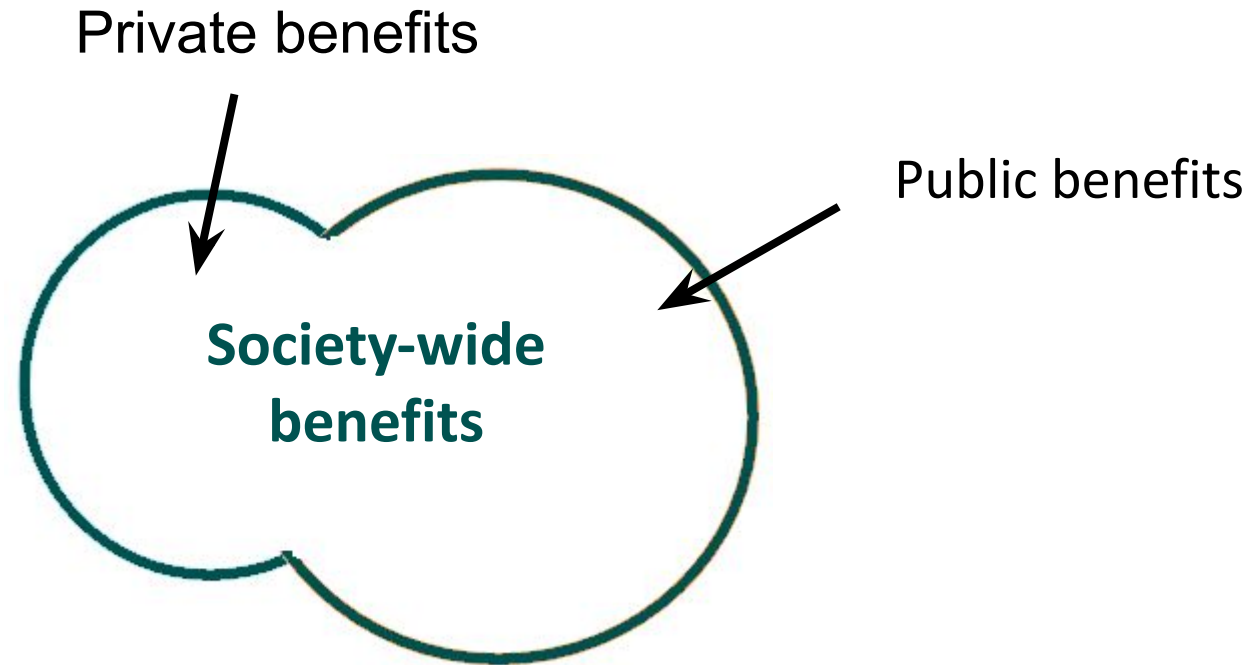
IEEP
Institute for Economic
and Environmental Policy



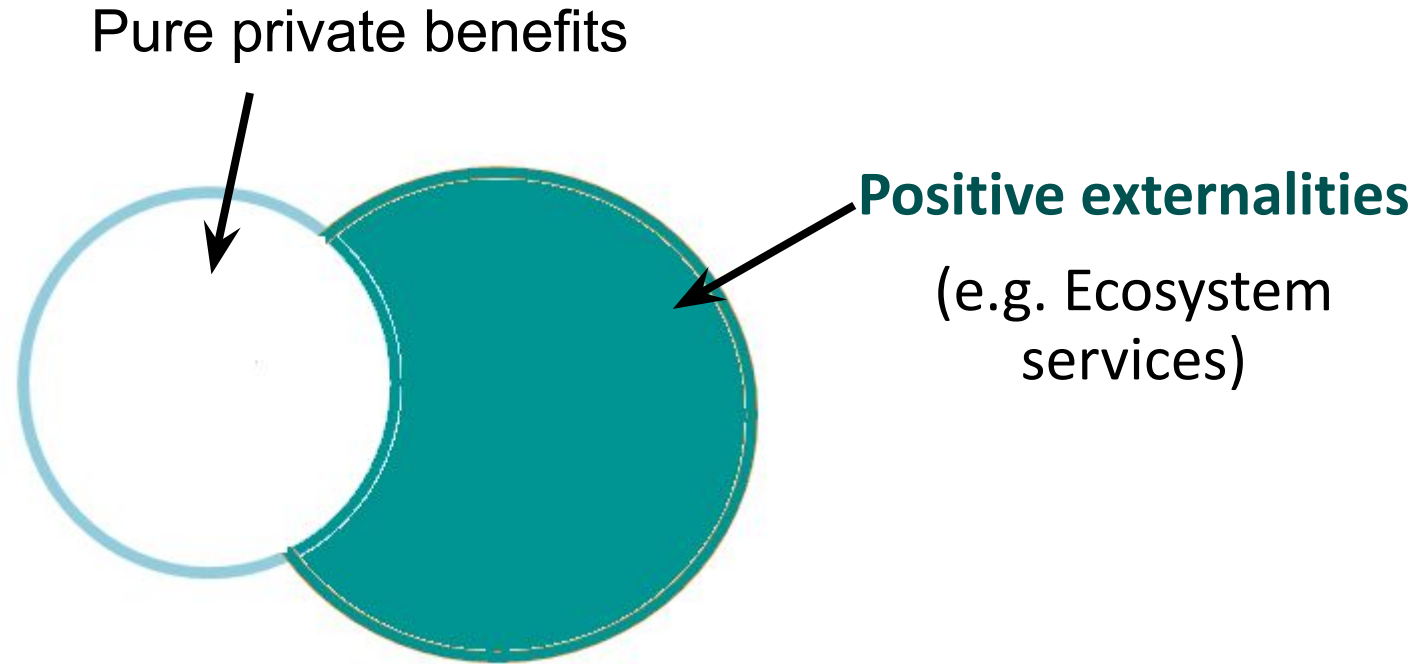
Provided Benefits and Ecosystem services



Provided Benefits and Ecosystem services



Provided Benefits and Ecosystem services



From an economic point of view, did it make sense to build a rain garden, green roof or to green the tramway?





Rain garden at the crossroads (Roudnice nad Labem)


- an area of 75 m²
- part of the overall revitalisation of the street
- water collection from the road
- supported by gravel base, perennials and shrubs



Photo: Markéta Šindlarová, 2022

Services and benefits provided

	rate of provision	monetised
Regulační	Water retention <input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Reduce rainwater runoff to the sewer <input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Flood protection <input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Water quality improvement <input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Regulation of erosion (water/wind) <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Local climate regulation <input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Air quality regulation <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Carbon storage <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Noise reduction <input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Pollination <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	

Zásobovací	Crop and food production <input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Water production <input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Production of wood and other biomass <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
Kulturní	Increase in aesthetic value <input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Recreational functions <input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Socializing function <input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Educational function <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
Biodiverzita	Habitat creation and biodiversity support <input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
Ostatní	Value of surrounding properties <input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	

Results - societal costs and benefits

- comprehensive society-wide economic assessment







Time horizon (25 years)	
Total present value of COSTS	14,600 EUR
Total present value of BENEFITS	18,040 EUR
APPRECIATION of 1 invested EUR	1,2 EUR
RETURN of investment	1 year



Greening of the tram line (Ústí nad Labem)

- roof on the building of the Faculty, building from 1986
- green roof as a part of reconstruction
- 125 m² extensive green roof
- substrate thickness of 8-10 cm
- mainly sedum plants



Services and benefits provided

	rate of provision	monetised	
Regulační	Water retention	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Reduce rainwater runoff to the sewer	<input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Flood protection	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Water quality improvement	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Regulation of erosion (water/wind)	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Local climate regulation	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Air quality regulation	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Carbon storage	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Noise reduction	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Pollination	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	

Zásobovací	Crop and food production	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Water production	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Production of wood and other biomass	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
Kulturní	Increase in aesthetic value	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Recreational functions	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Socializing function	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Educational function	<input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
Biodiverzita	Habitat creation and biodiversity support	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Value of surrounding properties	<input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
Ostatní	Energy savings for heating/cooling	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Lifetime extension of insulation	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	

Results - societal costs and benefits

- comprehensive society-wide economic assessment



Time horizon (25 years)	
Total present value of COSTS	7,680 EUR
Total present value of BENEFITS	9,800 EUR
APPRECIATION of 1 invested EUR	1,3 EUR
RETURN of investment	14 years






Greening of the tram line (Ostrava)


- Revitalisation of the rail belt
- Dry-loving vegetation cover (sedum plants)
- Motivation: a number of aspects - noise and dust reduction, HDV and microclimate improvement
- 654 m long part



Photo: Magistrát města Ostravy, 2021

Services and benefits provided

	rate of provision	monetised	
Regulační	Water retention	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Reduce rainwater runoff to the sewer	<input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Flood protection	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Water quality improvement	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Regulation of erosion (water/wind)	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Local climate regulation	<input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Air quality regulation	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Carbon storage	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	
	Noise reduction	<input type="radio"/> <input checked="" type="radio"/> <input checked="" type="radio"/>	
	Pollination	<input type="radio"/> <input type="radio"/> <input checked="" type="radio"/>	

Zásobovací	Crop and food production	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
	Water production	<input type="radio"/> <input type="radio"/> <input type="radio"/>	
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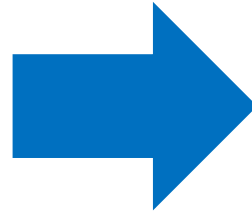
Results - societal costs and benefits

- comprehensive society-wide economic assessment



Time horizon (25 years)	
Total present value of COSTS	467,280 EUR
Total present value of BENEFITS	678,360 EUR
APPRECIATION of 1 invested EUR	1,5 EUR
RETURN of investment	12 years

How to find out preferences?

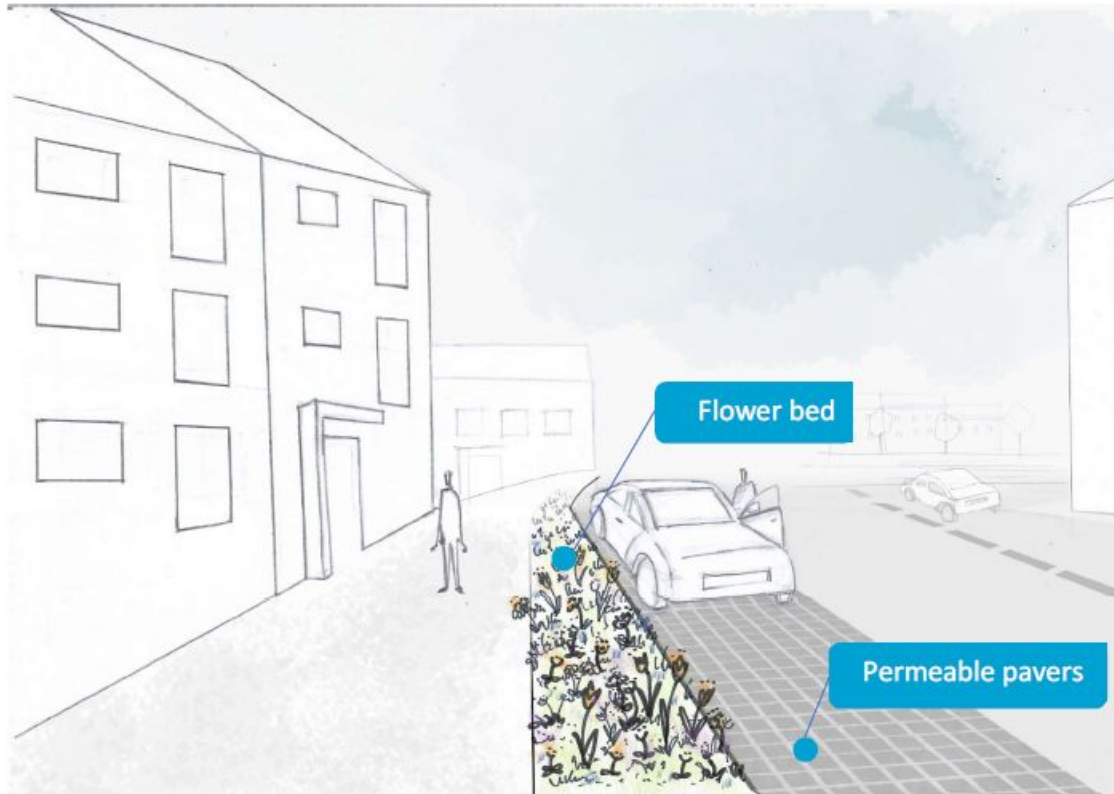




Results

Litoměřice			Prague	
Score	NBS	Rank	NBS	Score
8.73	Trees	1	Trees	9.07
7.96	Retention ponds	2	Retention ponds	8.50
7.57	Flower beds	3	Flower beds	8.32
7.41	Green roofs	4	Green roofs	7.95
7.05	Biosolar roofs	5	Biosolar roofs	7.48
7.00	Bushes	6	Bushes	7.39
6.74	Lawn	7	Lawn	7.37
6.44	Constructed wetlands	8	Green tram tracks	7.36
6.39	Green façades	9	Constructed wetlands	6.60
6.10	Green tram tracks	10	Green façades	6.43
5.14	Swales	11	Swales	5.87
4.84	Polders	12	Polders	5.47

STREET A



Increased price of rent

47 EUR/month

STREET B



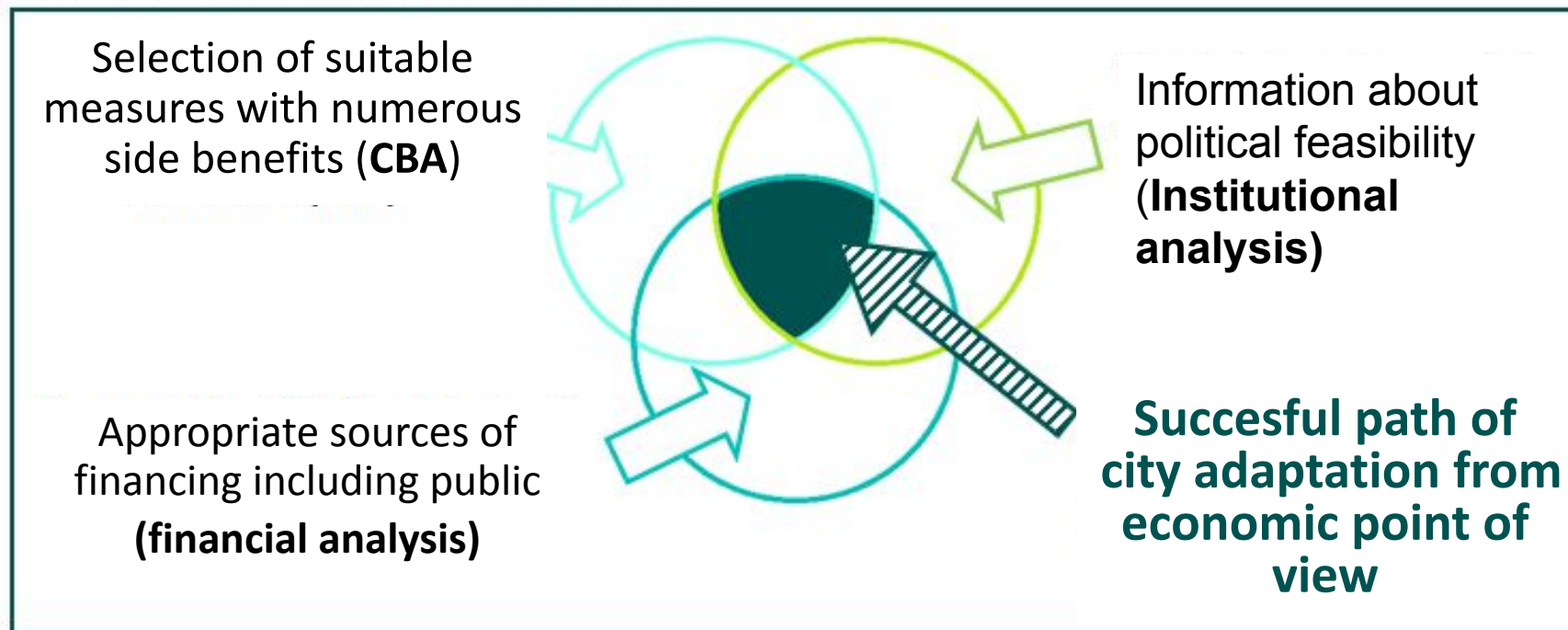
Increased price of rent

95 EUR/month

How to find out preferences?

Attribute	Mean	Median	Standard deviation
Prague			
➡ Green roof	-145.2	-18.1	327.0
➡ Green façade	65.4	2.4	198.2
➡ Grassy strip	89.7	4.5	242.8
➡ Flower bed	-99.8	-7.2	247.5
➡ Grass paving	-24.4	-0.3	161.7
➡ Permeable pavers	-76.7	-1.9	293.2
Litoměřice			
➡ Green roof	-3.9	-3.2	2.6
➡ Green façade	2.7	1.8	3.9
➡ Grassy strip	3.4	2.3	3.8
➡ Flower bed	-3.4	-2.8	2.3
➡ Grass paving	-0.9	-0.6	3.9
➡ Permeable pavers	-2.7	-1.7	7.2

Conclusion



Conclusion

COMMUNICATION IS THE KEY

Multiple ecosystem services - an opportunity to increase wellbeing



IT MAKES (ECONOMIC) SENSE TO SUPPORT GBI

Ecosystem services typically exceed the implementation and maintenance costs many times over the lifetime of the measures



ECONOMIC ARGUMENT IS A STRONG ONE

An economic assessment can be used to evaluate the benefits of measures in relation to the costs.



- ☐ Economic assessment should be part of the projects

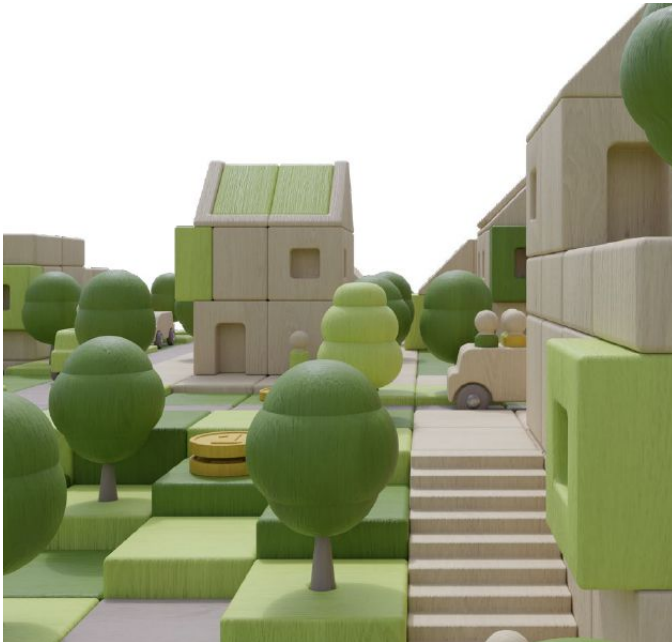
More tips and tricks





FURTHER EXAMPLES
available at www.IEEP.cz

Blue-green cities for a better life...



Ing. Jan Macháč, Ph.D. - machac@ieep.cz

www.ieep.cz

www.e-academia.eu

Thank you for your attention.

Sustainable Population Consumption in a Post-Pandemic Economy. | 9. October 2024 | Ústí nad Labem

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UNIVERZITA J. E. PURKYNĚ V ÚSTÍ NAD LABEM
Fakulta sociálně ekonomická