REGREEN
NATURE-BASED SOLUTIONS

Fostering Nature-based Solutions for equitable, green and healthy urban transitions

Policy Recommendations

- Involve cities and regions directly as full partners in Research & Innovation Action projects to reap full benefits.

- Involve children in NbS and give them opportunities to be included in collective processes of developing and governing local NbS.

- Create the right enabling conditions - adequate funding, break down silos, foster policy champions, effective enforcement and take advantage of emerging opportunities.

- Involve diverse stakeholders in planning processes to facilitate the update of NbS and motivate collaboration.

- Make use of rapid assessment of NbS efficiency and scenarios to gain insights on potential of NbS at city-scale.4

- Apply localised and spatially explicit ecosystem service models combined with scenarios to upscale NbS implementation.

- Recognize the value of NbS impacts as more than an economic metric - include different forms of evidence of how people interpret, experience, perceive, and learn from NbS.

- Private entrepreneurs and investors need transparency, accountability, and clarity for what is defined as a sustainable investment.

*This brief provides information about the outcome of the REGREEN project.*

Urban Nature-based Solutions (NbS) such as street trees, parks, green roofs, lakes and rivers offer multifunctional solutions to major societal challenges, including reducing the risk of flooding, alleviating the impacts of heat waves, improving water quality, reducing noise pollution and enhancing health and well-being. But nature is under significant pressure in cities. Increasing land-take at the periphery of cities and densification within city boundaries coupled with climate extremes make cities increasingly vulnerable and unpleasant to live in. The European Nature Restoration Law seeks to reverse this trend to restore and protect i.a. urban ecosystems.

The H2020 REGREEN project aimed to promote urban liveability by systematically modelling the benefits of ecosystem services and biodiversity as the basis for NbS that can be widely deployed by public and private actors. Such NbS, underpinned by evidence-based tools, improved urban governance, and nature-based education and learning can enable urban planners and policy makers to meet contemporary and future challenges, such as climate change resilience, public health and well-being and social inclusion. Thereby REGREEN findings and insights can help accelerate the crucial transition toward equitable, green and healthy cities.

This policy brief provides key insights and recommendations from across the many fields of REGREEN, while a number of subsequent policy briefs offer a deeper look into specific topics. The REGREEN transition Handbook gives a comprehensive overview of key findings and outcomes[1].

Gonesse contructed wetland, Paris region, France © SIAH
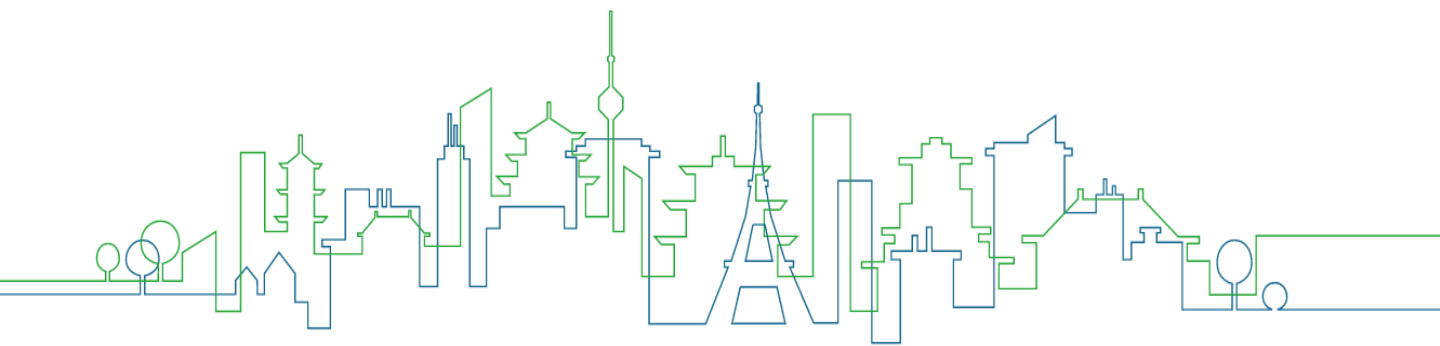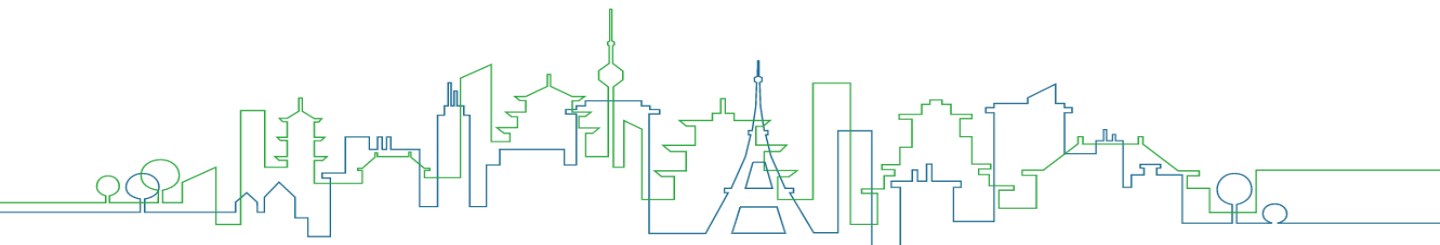
Kindergarten children 'investigating' nature © Lars Brundin

The importance of engaging cities and regions

The involvement of two municipalities (Aarhus, Denmark; Velika Gorica, Croatia) and one regional agency (Paris Regional Institute, France) in REGREEN has served as a catalyst for strategic shifts, capacity building of staff, wider stakeholder outreach and has also secured the mandate for further exploring and implementing NbS. The three cities differ widely in scale and complexity but share the same type of challenges and potentials. For REGREEN, the engagement with these cities has played a crucial role in contextualising and providing crucial insights across the different themes of REGREEN[2].

Nature-based learning and NbS

NbS have extensive educational potential that is not yet well developed. REGREEN has explored NbS as co-creative educational processes from kindergarten to youth, investigating collaborative learning opportunities in developing NbS locally and involving children, teachers and schools as active partners. Children risk being alienated from nature with the current reduced opportunity to experience biodiverse natural settings, the dominance of indoor activities and the general use of artificial materials and bright colours in playgrounds. Interactive walkable floormaps[3,4], citizen science on biodiversity for school children[5], play biotopes where children and biodiversity thrive[6] and digital educational tools of GREENOPOLIS[7] and field e-books for Eco-Explorers[8] have been developed and validated with schools through REGREEN.

Creating integrated governance contexts for NbS implementation

Conditions for successful NbS implementation can vary significantly across European cities due to contextual differences. Because NbS is complex and multi-functional, getting NbS from an idea-stage to actual implementation often requires integrated approaches that involves bringing together different sectors in local administrations each with their agenda and tradition. REGREEN found that enablers for local NbS implementation involve openness to collaborate with stakeholders, the presence of a policy champion within local government to influence and drive the processes, the ability to utilise emerging windows of opportunity and public awareness to speed up decision-making. Enablers also involve aligning NbS initiatives with government strategies to facilitate negotiations, effective enforcement of targets and regulations for green space and the availability of strategic and long-term funding [9,10].

Further reading

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Nature-based urban land use planning approaches

Slowing and ultimately stopping urban land take and developing NbS in urban environments need to become key strategies. Because of the complexity and multi-functionality of NbS, it is preferable, in addition to strategic planning, to facilitate a participatory process with stakeholders including government at different levels, semi-public organisations, businesses, non-governmental organisations, local community organisations and citizens more broadly and integrate NbS into urban planning documents. REGREEN investigated new approaches to reducing urban land take and new methods of integrating NbS in planning systems[11]. REGREEN also developed a highly topical approach and tool to identify potential for de-paving and guidance on re-greening strategies in cities that is now being put to use at regional level in Paris. The concept and approach are available in English[12], French, Danish and Croatian and the underlying concept is in principle replicable to all cities. REGREEN also explored the role of NbS on how to enhance urban-rural resilience. We focused on peoplesheds that concern patterns of human dwellings and mobility in the larger context of watersheds, airsheds, and naturesheds[13].

Urban drivers, pressures, and solutions

There is a lack of clear, collated information about the relative effectiveness of many types of urban NbS, which can hinder the uptake of NbS in cities. REGREEN has developed an internally consistent typology of NbS backed up by a summary of the evidence base for the ecosystem services that each NbS provides, considered as a quantity per unit area of NbS to allow for a direct comparison across NbS and ecosystem services[14]. The resulting matrix comprises nine main categories of NbS ranging from gardens and parks to linear features, NbS on infrastructure and water bodies. These NbS typologies are assessed for 11 different ecosystem services. NbS with more natural features have a high multi-functionality for regulating services and score highest for supporting biodiversity. This matrix helps planners make rapid decisions on which type of NbS are more multi-functional. It can also play a useful role in communication. Building on this typology, REGREEN developed different types of scenarios to represent NbS across the city for use with ecosystem service models to inform planning.

Object type	Object category	Food provision	Air pollution removal	Noise mitigation	Heat mitigation	Water quality mitigation	Water flow management	Maintaining carbon stocks	Supporting physical activity	Supporting social interactions	Restoring capacities	Supporting biodiversity
Gardens	Balcony	Low	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Low	High	Low
	Private garden	Medium	Low	Low	Medium	Medium	Medium	Low	Very high	Medium	Very high	High
	Shared common garden area	Medium	Low	Low	Medium	Medium	Medium	Low	Medium	High	Medium	Low
Parks	Pocket park	Low	Low	Low	Low	High	Medium	Low	Medium	Very high	High	Medium
	Park	Low	High	High	High	High	Medium	High	Very high	Very high	Very high	High
	Botanical garden	Low	High	Very high	Very high	High	Medium	High	Medium	High	Very high	Very high
	Heritage garden	Medium	Medium	High	High	High	Medium	Medium	Medium	High	Very high	High
	Nursery garden	Medium	Medium	Low	Low	High	Medium	Medium	Low	Medium	Medium	Low
Amenity areas	Sports field	Negligible	Low	Low	Low	Low	Low	Low	Very high	High	Medium	Negligible
	School yard	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Very high	High	Medium	Negligible
	Playground	Negligible	Negligible	Negligible	Negligible	Low	Low	Negligible	Very high	Very high	Medium	Negligible
	Golf course	Medium	Medium	Low	Low	Medium	Medium	Low	High	High	High	Medium
	Shared open space (e.g. square)	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Medium	Very high	Low	Negligible
Other public space	Cemetery	Negligible	Medium	Medium	Medium	Medium	Medium	High	Low	Low	Very high	High
	Allotment/other growing space	Very high	Medium	Low	Low	Negligible	Medium	Negligible	High	High	Very high	High
	City farm	Very high	Medium	Low	Low	Negligible	Medium	Negligible	Medium	Medium	High	Medium
	Adopted public space	Low	Medium	Low	Low	Low	Low	Negligible	Negligible	Low	Medium	Low
Linear features/routes	Street tree	Low	High	Low	High	Low	Low	Medium	Negligible	Low	High	Medium
	Cycle track (as green/blue corridor)	Low	Low	Low	Low	Low	Low	Low	Very high	Medium	High	Low
	Footpath (as green/blue corridor)	Low	Low	Low	Low	Low	Low	Low	Very high	Very high	High	Low
	Road verge	Low	Low	Low	Low	Medium	Medium	Low	Negligible	Negligible	Low	Low
	Railway corridor	Negligible	Very high	Very high	Very high	Low	Medium	High	Negligible	Negligible	Low	Very high
	Riparian woodland	Low	Very high	Very high	Very high	Very high	High	Very high	High	High	Very high	Very high
	Hedge	Low	Medium	Low	Low	High	High	Medium	Negligible	Negligible	Medium	Medium
Constructed GI on infrastructure	Green roof	Negligible	Low	Negligible	Low	Low	High	Low	Negligible	Negligible	Low	Low
	Green wall	Negligible	Medium	Medium	Low	Negligible	Low	Low	Negligible	Negligible	Medium	Low
	Roof garden	Medium	Medium	Low	Medium	Low	Low	Medium	Low	High	Very high	Medium
	Pergola (with vegetation)	Negligible	Medium	Low	High	Low	Low	Medium	Negligible	Low	High	Low
Hybrid GI (for water)	Permeable paving	Negligible	Negligible	Negligible	Negligible	High	High	Negligible	Low	Negligible	Negligible	Negligible
	Permeable parking/roadway	Negligible	Negligible	Negligible	Negligible	High	High	Low	Negligible	Negligible	Negligible	Negligible
	Attenuation pond	Negligible	Low	Low	Low	Very high	Very high	Medium	Negligible	Low	Medium	High
	Flood control channel	Negligible	Low	Negligible	Low	Low	Very high	Low	Negligible	Low	Negligible	Medium
	Rain garden	Low	Medium	Low	Low	High	High	Medium	Negligible	High	High	Medium
	Bioswale	Negligible	Medium	Low	Low	Medium	High	Medium	Negligible	Negligible	Low	Medium
Waterbodies	Wetland	Negligible	Medium	Low	Medium	Very high	Very high	Medium	Low	Medium	Very high	High
	River/stream	Low	Low	High	High	Medium	High	Low	Medium	High	Very high	High
	Canal	Low	Low	Low	Medium	Medium	Medium	Low	Medium	High	Very high	Low
	Pond	Negligible	Low	Low	Low	Low	High	Medium	Low	High	Very high	High
	Lake	Medium	Low	Medium	High	High	High	Medium	High	High	Very high	Very high
	Reservoir	Low	Low	Medium	Medium	Very high	High	Medium	High	High	Very high	Medium
	Estuary/tidal river	High	Low	High	High	High	N/A	Medium	Medium	High	Very high	High
	Sea (incl. coast)	High	Low	High	High	High	N/A	Very high	Very high	Very high	Very high	Very high
Other non-sealed urban areas	Woodland (other)	Low	Very high	Very high	Very high	High	High	Very high	High	High	Very high	Very high
	Grass (other)	Low	Low	Low	Low	Medium	Medium	Low	Very high	High	Medium	Medium
	Shrubland (other)	Low	Medium	Low	Low	High	High	Medium	Medium	Medium	High	High
	Arable agriculture	Very high	Medium	Low	Low	Negligible	Negligible	Negligible	Low	Negligible	Low	Low
	Sparsely vegetated land	Negligible	Negligible	Low	Negligible	Low	Low	Negligible	Medium	Medium	Medium	Low

Typology of NbS types and assessment of the challenges they help reduce[14].

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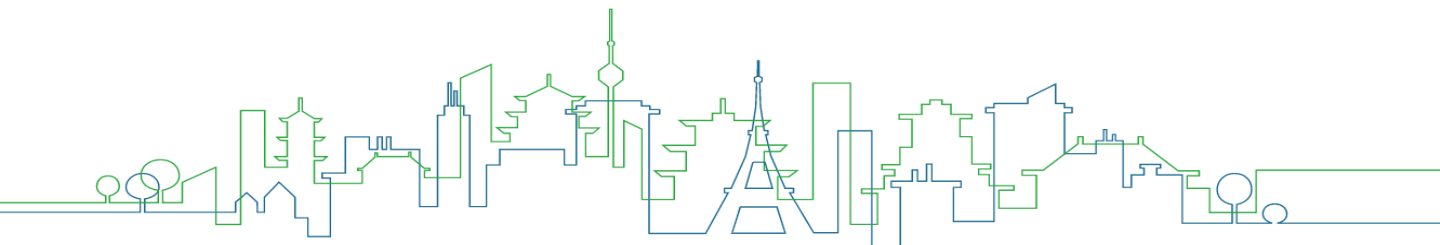
Mapping urban ecosystem services and targets

With the requirements to map ecosystem services and set targets for increasing green infrastructures in European cities and towns under the European Nature Restoration Law, Member States and local authorities need to understand the spatial and temporal dynamics of urban ecosystems. REGREEN developed tools and guidelines for mapping and modelling procedures to allow for transferability and replicability[15] and mapped land-cover/land-use across spatial scales and over time at high resolution[16-18]. These were enriched by land-cover scenarios until 2030[19]. The mapping has allowed cities to deepen the understanding of residential structures, socio-demographics and equity in relation to existing urban nature and provided the baseline for ecosystem models and economic valuation of NbS. REGREEN elaborated a typology of target values for various environmental pressures and developed a synthesis of cross-sectoral potential target values, including barriers and constraints in achieving them, which is of direct relevance for all cities in Europe[20].

Modelling ecosystem services and use of scenarios

Decision-makers also need accurate assessments of the benefits of NbS in absolute terms and tailored to the local context when planning for implementation of urban green and blue spaces. REGREEN has developed six improved ecosystem models that provide locally-relevant calculations of benefits, taking into account local pressures, people who may benefit and the type of NbS. The six models show how NbS can help address the challenges of reducing air and noise pollution[21], alleviate Urban Heat Islands[22], reduce water flow under extreme precipitation[23], improve water quality[24], and maintain or increase biodiversity. REGREEN combined the models with scenarios of large-scale NbS implementation, aggregating the findings of multiple benefits of NbS. The models provide maps and summary metrics, showing where urban pressures are greatest and what impact different levels and types of NbS intervention may have. The models are integrated into the City Explorer Toolkit, with the first online version created in REGREEN for the city of Aarhus, Denmark.

Wellbeing values of NbS

NbS are most often undervalued because assessments lack the full range of social, environmental and health benefits of NbS into account in decision-making. The multiple functions of NbS and the different environmental, social and economic impacts (depending on location and socio-demographics) make valuation of NbS particularly complex. REGREEN has demonstrated the importance of understanding NbS benefits from multiple perspectives[25] and has taken a complex systems thinking approach[26,27], which can help strengthen arguments for the implementation of NbS and avoid sub-optimal or even harmful implementation.

Business model development & decision-support

Investments in NbS needs to accelerate and increase manyfold. Governments at different levels, private companies and financial institutes can benefit from collaborating on developing sustainable business models for NbS. REGREEN has elaborated an overall approach for developing sustainable business models and three concrete business model approaches for inspiration including a public-private driven model, a commercially driven consultancy model and a citizen driven model[28]. A Decision Support Tool gathers foundational knowledge from REGREEN and guides different types of stakeholders through the process of designing, implementing and delivering NbS[29].

Further reading

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High resolution land cover
Multiple use cases, different data sets, comparable results
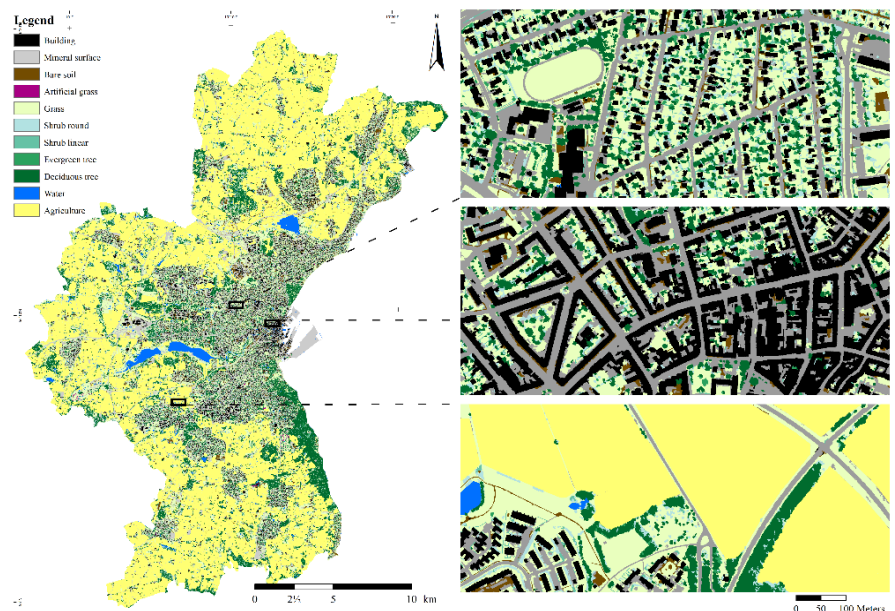
Recommendations for mapping

- High resolution layers provide insights into understanding residential structures; structural urban biodiversity; and the distribution of smaller green elements both on private and public grounds.

- High resolution land cover analysis offers multiple usages and serves to localise NbS, assess status quo, and provides basic information for ecosystem service modelling.

- Make use of available city data.

- Applicable to many urban areas.

- Spatial resolution can be resized dependent on pinpointed research, needs at the planning level, and visualisation demands.

This brief provides information about the outcome of high-resolution mapping of land cover at all the three European urban living labs in the REGREEN project.
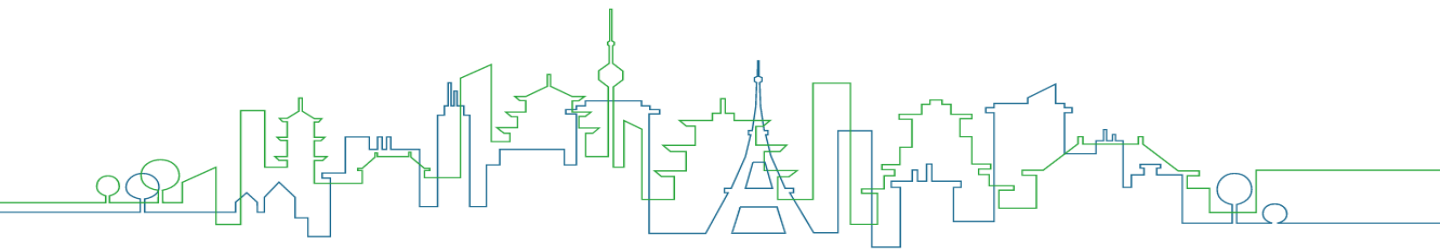
Why high resolution land cover (HRLC)?

Very high resolution dataset of the urban structure, including different "land-cover" and "land-use" classes down to functional urban area types and single elements such as trees and buildings. The mapping is supposed to

- Deepen the understanding of the residential structures in urban areas

- Facilitate the comparisons between the different cities

- Serve as an input for models (e.g. noise)

- Be used to link other data in the same spatial dimension, such as information gathered from questionnaires and simple point data like biodiversity and prevailing species and types

- Enhance knowledge on social demographic and social economic implications of residents for various pressures at allocated hotspots

Legend
- Building
- Mineral surface
- Bare soil
- Artificial grass
- Grass
- Shrub round
- Shrub linear
- Evergreen tree
- Deciduous tree
- Water
- Agriculture

0 2½ 5 10 km

0 50 100 Meters

High-resoultion land-cover for Aarhus municipality
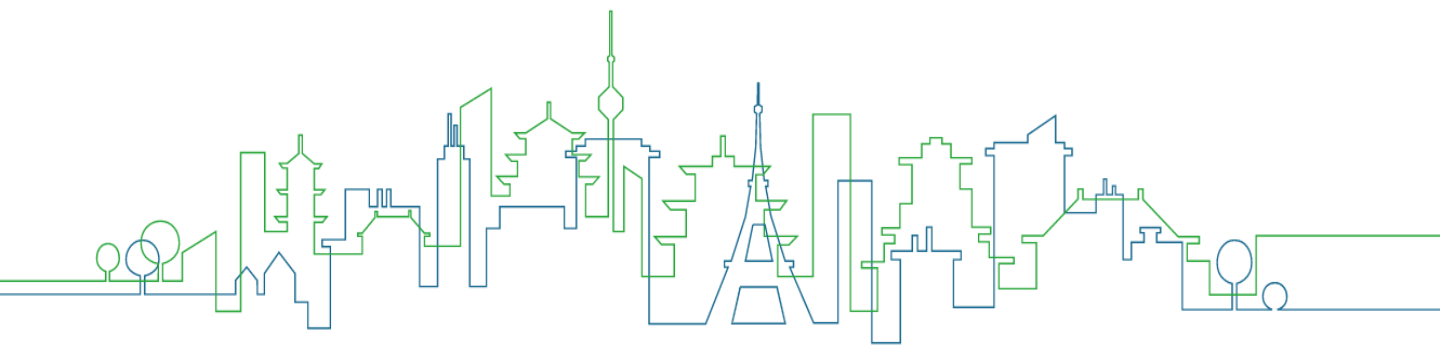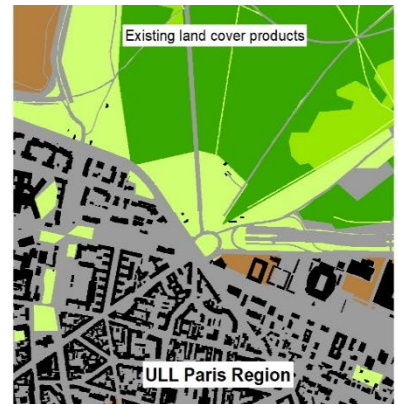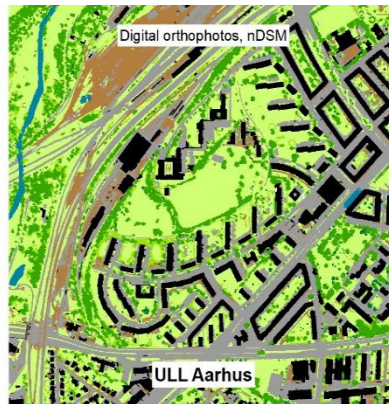
Legend				
Harmonised classes	Mineral surface	Bare soil	Grass	Tree	Agriculture
	Building	Artificial grass	Shrub	Water	

Comparing different land-cover products

Background

The high-resolution land-cover (HRLC) map is supposed to bridge gaps in the existing datasets. It aims to provide the highest possible resolution of land cover for a given urban area. The mapping approach is object-based, using remotely sensed datasets to derive objects that closely resemble real-world objects, such as roads and buildings. The input data was provided by the European Space Agency, national orthophotos and various existing land cover and land use products. Mapping relied heavily on test sites and ground truthing by local partners, with a strong emphasis on providing detailed information on land cover for the entire urban area regardless of property status.

Need

The high-resolution land cover (HRLC) product is essential for local decision-making and enhancing knowledge on socio-demographic and socio-economic implications of residents for various environmental pressures and needs:

- Detailed information on land cover as input for ecosystem service models such as heat, water-related issues and human wellbeing.

- Environmental challenges in urban environments for different societal groups

- Social inequality

- Policymakers can identify areas that require more resources and attention.

- Policymakers can make informed decisions about resource allocation and management.

- HRLC may be overlaid over walkable floor maps for visualising land cover status quo and scenarios.

- Identification of hotspots where urban development is putting pressure on environment and residents,

- Allowing for targeted interventions.

Its advantages

All of the above dimensions are mapped regardless of property status, which distinguishes them from more conventional municipal datasets. Here, green infrastructure on private property is assessed and considered when planning new interventions. Mapping of urban morphology enables to assess potentials for green roofs. Where urban development is putting pressure on the environment of residents, the targeted interventions are spatially allocated.

This provides insights into:

- Parcel based population aggregation
- Access to "UGS" (calculations)
- Structural biodiversity (patch connectivity, metrics)

Additional material

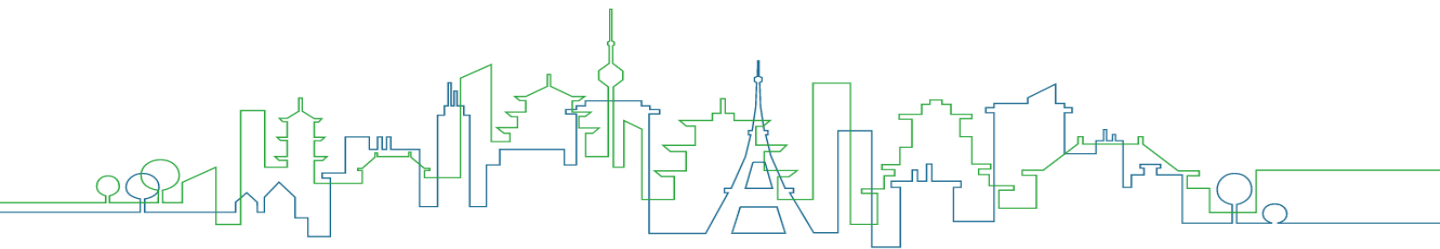Knopp, J. M. (2021). High-resolution land cover 2015, Aarhus, Denmark.
https://zenodo.org/record/5215792

Knopp, J. M. (2021). High-resolution land cover 2016, Velika Gorica, Croatia.
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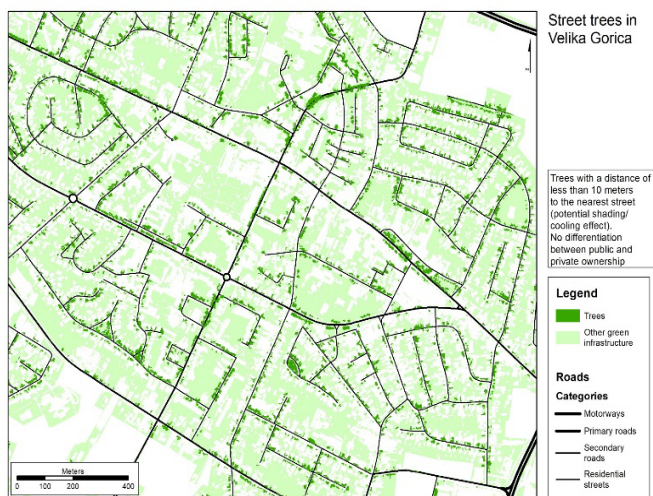
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Impact

Overall, the HRLC product has a significant impact on users, providing them with scientifically validated information to make decisions about the urban environment and to quantify land cover. Visualisation also helps to raise awareness towards social inequality in a spatial context. It enables stakeholders to make evidence-based decisions on hotspots that require more resources and attention.

Capturing the canopy area of street trees in Velika Gorica

Approach

For Paris Region, the various datasets are combined into a single product. To accomplish this, data types are converted to raster, and merged with rulesets, where priority is given to the highest resolution or thematic content. In addition, overlapping data was combined to represent the 3rd dimension within the datasets. Some datasets are only available for limited areas within the Ile- de- France region. The datasets used in the production of this map were *MosPlus 2017-81*, *Cadastre Verte* (green cadastre), *hauteur vegetation* (vegetation height), *Copernicus* (small and woody features, street tree layer) and the *densibati* dataset (estimation of residents per building).
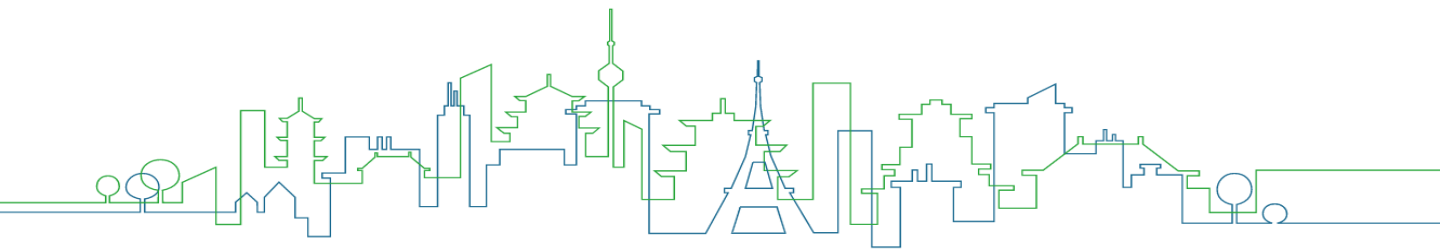
For Grad Velika Gorica, the input data are acquired from ESA and enable an object-based image analysis (OBIA) based on very high-resolution satellite imageries. OBIA involves aggregating individual pixels in remotely sensed datasets to derive objects that resemble real-world objects. The method was applied to both Aarhus Municipality and Grad Velika Gorica. Currently using commercial software, the approach can also be transferred into open-source software to strengthen the transferability and repeatability of the mapping effort.

For Aarhus Municipality, the approach used for the HRLC product is object-based image analysis (OBIA), which involves aggregating individual pixels in remotely sensed datasets to derive objects that resemble real-world objects. The method was applied to both Aarhus Municipality and Grad Velika Gorica. Currently using commercial software, the approach can also be transferred into open-source software to strengthen the transferability and repeatability of the mapping effort.

Building and land-use type influencing the vegetation distribution on parcels

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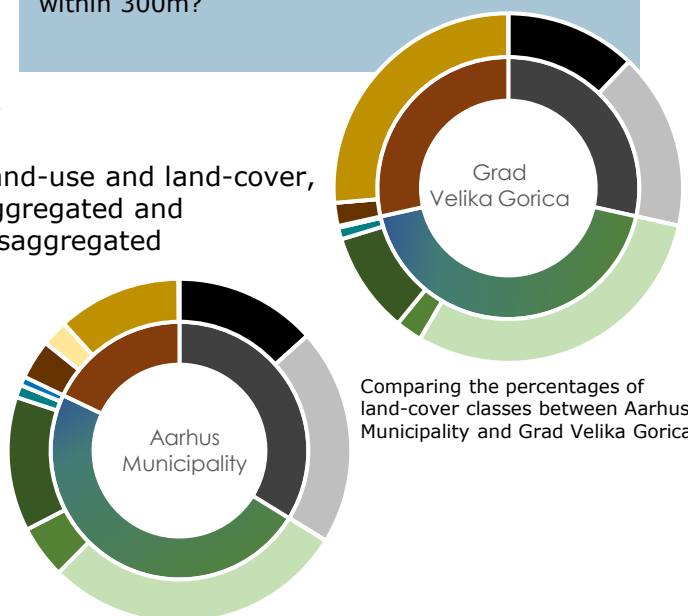NATURE-BASED SOLUTIONS

Results

The HRLC project has so far provided valuable insights into land cover and land use in urban environments. It has identified hotspots where urban development is putting pressure on the environment and residents, allowing for targeted interventions, such as the planning of new green roofs, street trees or urban (pocket) parks.

The project has also provided valuable information on the socio-demographic and socio-economic implications of residents for various pressures, enabling policymakers to address social inequality through e.g., access to urban green spaces. The effort has once more exemplified the importance of detailed land-cover and land-use information in urban planning and management.

As an example, the structural biodiversity on private grounds can be mapped and linked to the estimated number of residents per building. Furthermore, street trees can be extracted from the HRLC to provide insight into canopy cover along streets, proving shade and cooling.

Do you know that...

… the highest spatial resolution achieved was for Aarhus Municipality by using orthophotos?

… private green spaces contribute around 32% of vegetation of Grad Velika Gorica and Aarhus Municipality?

… bi-temporal satellite imagery and aerial photographs were used to delineate evergreen and deciduous trees?

… 2% of the urban footprint of Paris Region are waterbodies and courses, with Aarhus Municipality and Beijing being closer to 1%

… only 7% of Grad Velika Gorica are covered by parks, but 75% of residents have access to one within 300m?

Land-use and land-cover, aggregated and disaggregated

⬛ Building	🟩 Grass	🟦 Water
⬜ Mineral surface	🟩 Shrub	🟫 Bare soil
🟪 Artificial grass	🟩 Deciduous	🟨 Agriculture extensive
🟩 Evergreen		🟨 Agriculture temporary
🟩 Tree		🟫 Agriculture permanent
⬛ Built and sealed	🟩 Green blue infrastructure	🟫 Agriculture and barren

Grad Velika Gorica

Aarhus Municipality

Comparing the percentages of land-cover classes between Aarhus Municipality and Grad Velika Gorica

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Using dasymetric mapping
What is the socio-spatial distribution like in your city?

Policy Recommendations

- Localise socio-demographic data by means of dasymetric mapping

- Use available socio-economic data to derive advanced knowledge on socio-spatial differentiation in your city

- Identify hotspots for interventions, taking into account people's livelihoods.

- Implement nature-based solutions in neighbourhoods with socially weaker groups

- Co-create green spaces with socially exposed groups based on dasymetric mapping

This brief provides information about the incorporation of socio- economic data into spatial assessment of NBS. The outcome serves to provide equity in access to urban green spaces

Mapping socio-economic variables and attribute them to individual houses is of great spatial knowledge for stakeholders. Dasymetric mapping is the tool of choice applied in the REGREEN project.
It can make for a more comprehensive approach when studying access to green spaces.

Why dasymetric mapping?

- Increased understanding of the of the service areas of green spaces

- Deeper look into topics such as disadvantage and social equity

What is the benefit?

It helps cities advance their strategies for implementing nature-based solutions with their accompanying ecosystem services on neighbourhood level in a more just way.
Workflow and associated results comprise

- Parcel information

- Building footprints

- Gridded population data and socio-economic variables
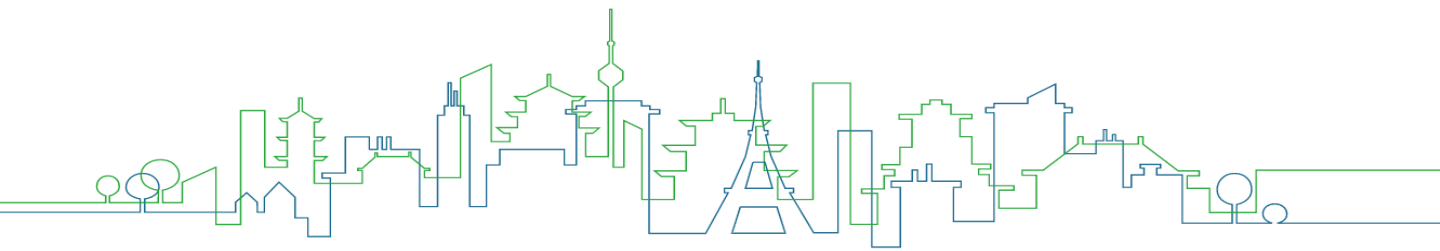
- Location of urban green spaces

Relevance

Dasymetric mapping is vital tool for cities where localised information about their citizens and their socio-economic status is not available (see maps on next page).
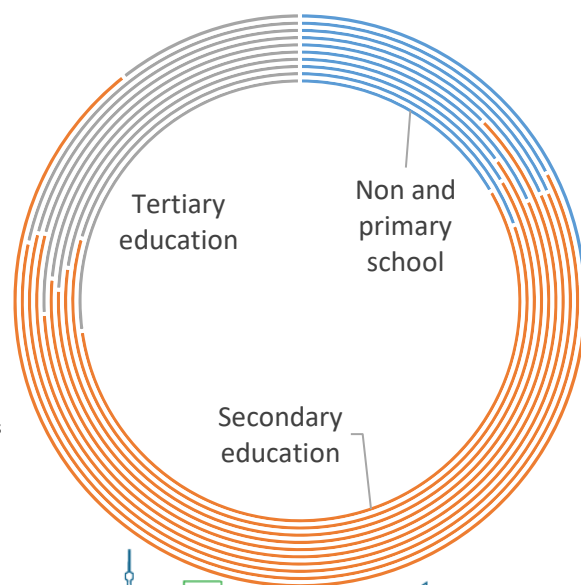
Example for the distribution of education levels in a service area of ten different parks

Tertiary education

Non and primary school
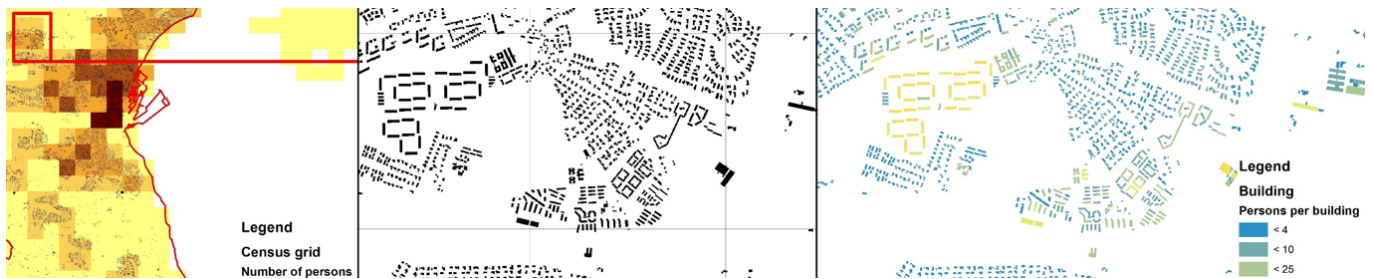
Secondary education
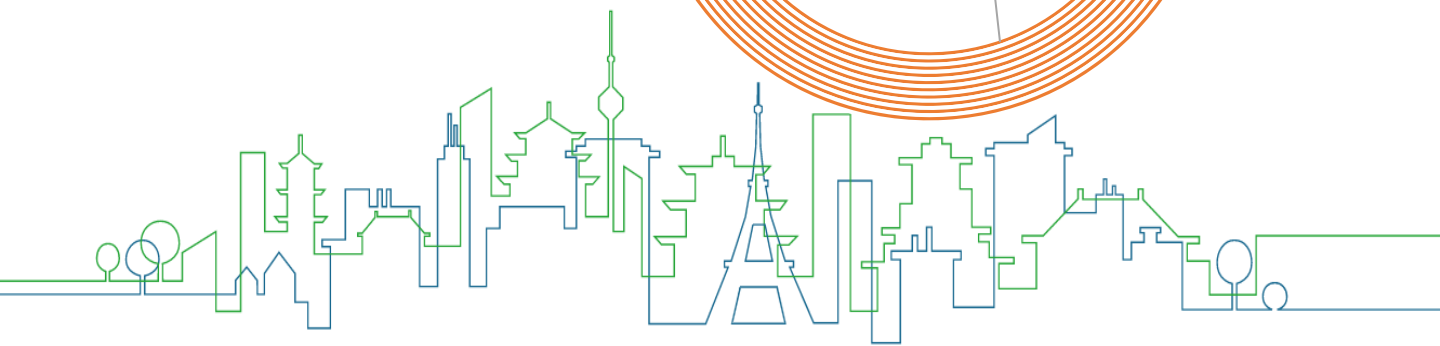
It is based on the assumption that data distributed over a given area may only be existent in certain places, i.e. citizens within the municipal boundaries of a city have a place of residence. By assuming this relationship, the number of residents per city, district or statistical grid cell can be redistributed into individual houses, either by type, area or cubic volume of a given building. This approached is visualised within the graphic below, which shows gridded population data, building footprints and remapped residents per building.

Need

Socio-economic variables refer to the social and economic characteristics of a population. They include indicators like income levels, employment rates, education levels, and housing conditions. These variables can significantly shape the potential accessibility of urban ecosystem services, such as clean air, water, and green spaces. For instance, residents living in poverty may have less access to these services due to lack of resources or opportunities.

The service area of parks assumes a certain distance residents are willing to travel to access. This is usually 300 to 500 meters. Access to larger parks might have a greater distance. The influx area may either be calculated by a network analysis, i.e. routing of residents along streets and pathways, or a simple Euclidian distance as an approximation.

Do you know that...

… residents living in poverty may have less access to urban ecosystem services?

.. the distance people are willing to travel to parks varies greatly depending on age and income group?

…the UN SDG (11.7) sets the target of creating equity in access to green infrastructure?

Approach

In this order, the steps include the following Identification of suitable existing parks

- Identification of suitable sites for new interventions
- Filtering by UGS area, distance assume which people are willing to travel
- Service area, either by linear distance or through routing and network analysis
- Analysis of the residents affected/ in need

Results

Detailed mapping for the city districts and their residents helps to identify potential hotspots. This is an important step in planning new green and blue infrastructure.

Legend
Census grid
Number of persons

Legend
Building
Persons per building
< 4
< 10
< 25

Stepwise dasymetric mapping for Aarhus

Authors

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Ecosystem services modelling

Policy Recommendations

- Models can give locally-relevant information on the benefits of nature-based solutions

- This information is specific to each local context in a city (not a generic value)

- Model outputs are real numbers (not just a score from high to low), and are particularly useful when combined with socio-economic data to make decisions on green and blue space planning

This brief provides information about the outcomes of REGREEN research on using ecosystem services models to calculate the many benefits from urban green and blue space.

Why modelling?

Decision-makers need accurate information on the benefits that urban Nature-based Solutions can provide, which are specific to their city. REGREEN has created new models which address this need, and help them make the right planning decisions to address urban challenges in a sustainable way.

Need

City officials need accurate assessments of the benefits that nature-based solutions (NbS) provide, to help with planning decisions on green and blue space in cities, like parks, street trees, rivers or other natural features. A challenge is that many existing sources of information fail to meet their needs for a number of reasons. Some give only relative scores for benefit (low to high), rather than actual numbers (change in pollution concentration, degrees Celsius of cooling, etc.); many are based on simple look-up tables which assume that a tree provides the same benefit regardless of where it is planted, but the reality is very different. There is a need for improved ecosystem service models which provide locally-relevant calculations of benefit which take into account local pressures, the type of NbS and the people who will benefit from it.

Approach

In REGREEN, teams of specialists worked with city representatives to develop new spatial ecosystem services models. These models incorporate key ecological and environmental processes into simpler versions which can be run relatively quickly in GIS software, but which take account of local context. New models were developed (Fig. 1) which show how NbS can help to address the following urban challenges:

- Reducing air pollution
- Reducing man-made noise
- Urban cooling
- Reducing water flow under high rainfall
- Improving water quality
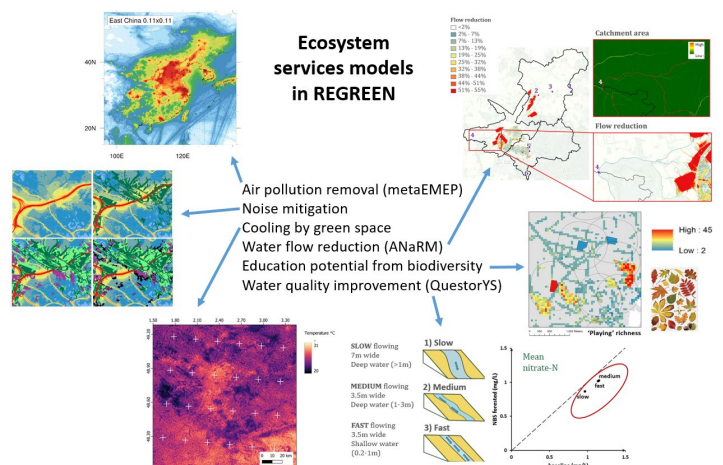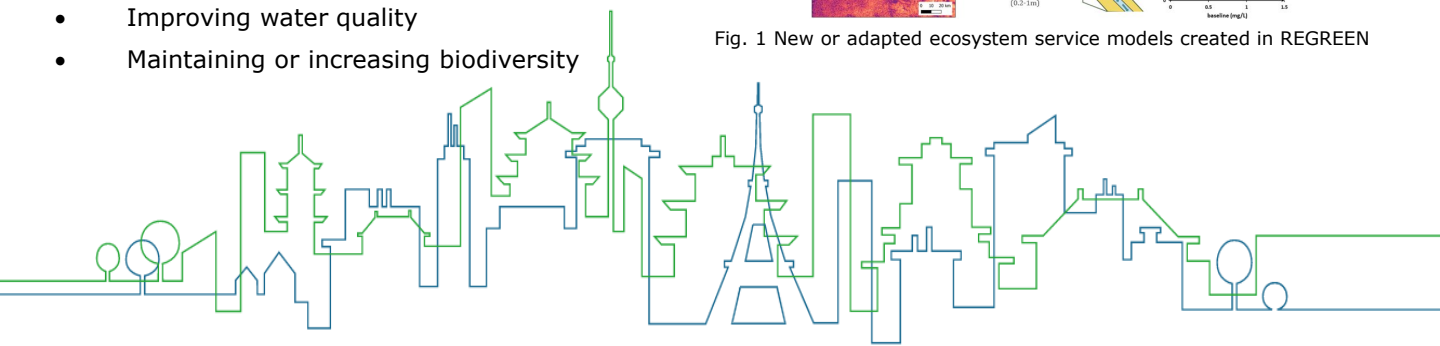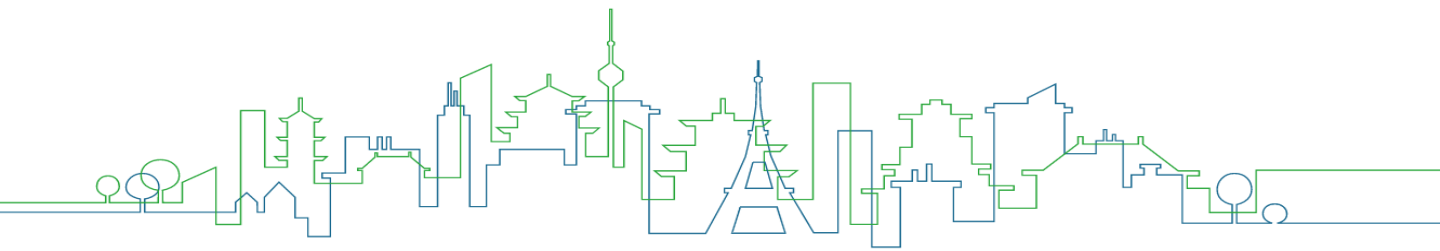- Maintaining or increasing biodiversity

Fig. 1 New or adapted ecosystem service models created in REGREEN

Results

The models can produce maps and summary metrics, and support further analysis, which are useful for city decision makers, citizens and researchers. Models can show where urban pressures are greatest, and where NbS provide benefits to society (Fig. 2).
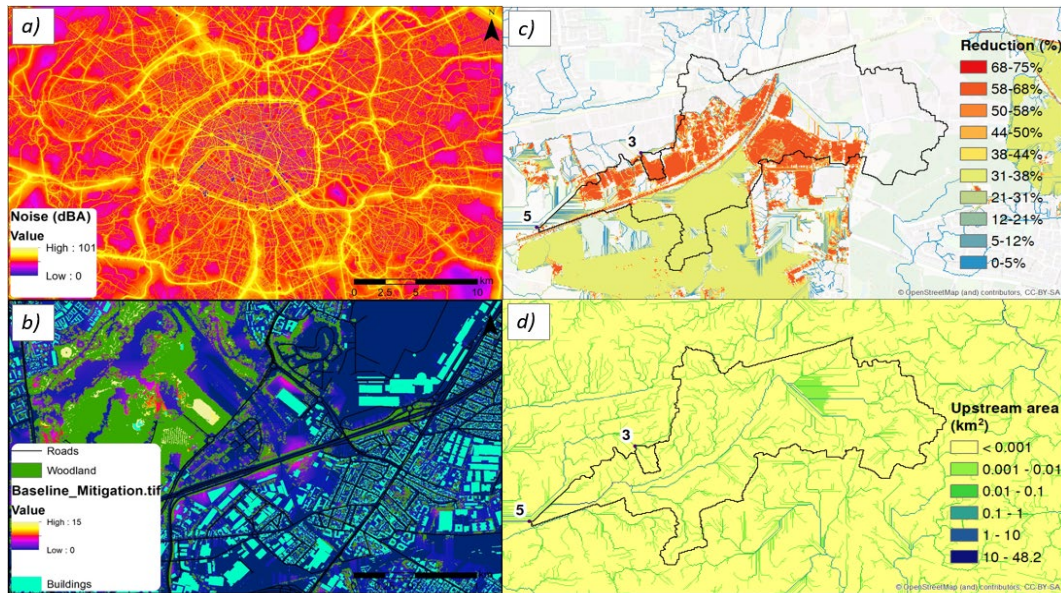

Fig. 2 Examples of ES models showing a) noise levels in Paris, b) mitigation of noise by urban trees, c) water flow models showing % runoff reduction and d) stream flows benefitting from new tree planting.

Looking at models together with social data can identify areas where NbS can help reduce social and health inequalities. For example, poorer neighbourhoods in Paris experience higher air pollution levels, but urban trees benefit these neighbourhoods more than they do in wealthier communities (Fig. 3).

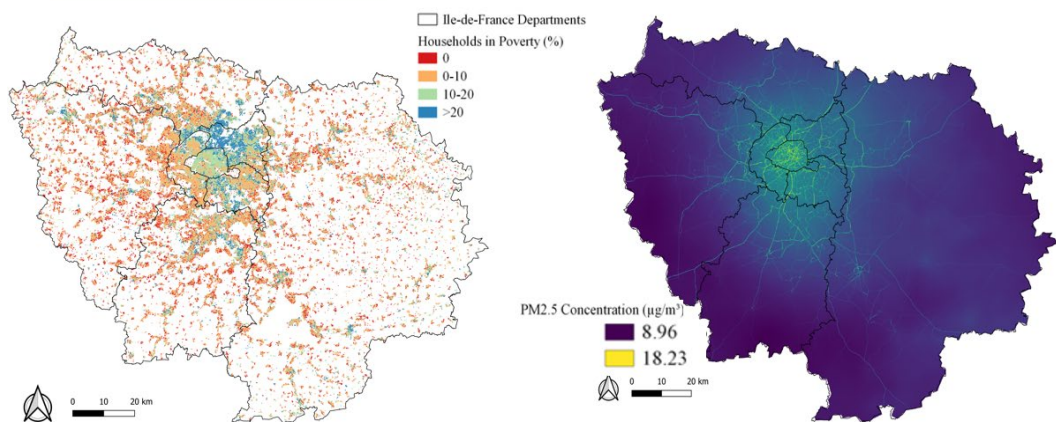|		Background PM2.5	Effect of Urban Trees
Households in Deprivation (%)	Total Population	Baseline (µg/m³)	Δ Concentration (µg/m³)
0	558,400	10.7	-0.21
> 0 & ≤ 10	4,411,169	12.0	-0.26
>10 & ≤20	4,287,820	12.9	-0.23
≥20	2,740,053	12.5	-0.22

Fig. 3 Trees help address social inequalities in Paris, by removing more air pollution in poor areas compared with more wealthy neighbourhoods.

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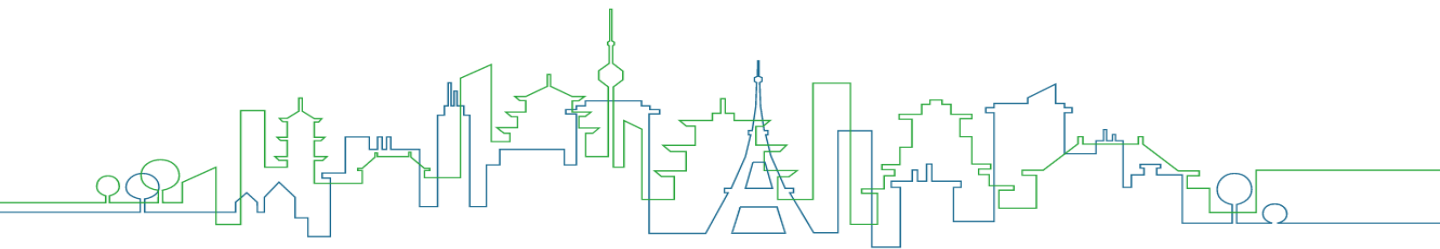
Integrated analysis

Developing scenarios which explore city plans, or future policy guidelines such as the 3-30-300 rule, is a powerful tool for decision-makers. These can be used in new model runs to see the multi-functional benefits for many different challenges (Fig. 4)
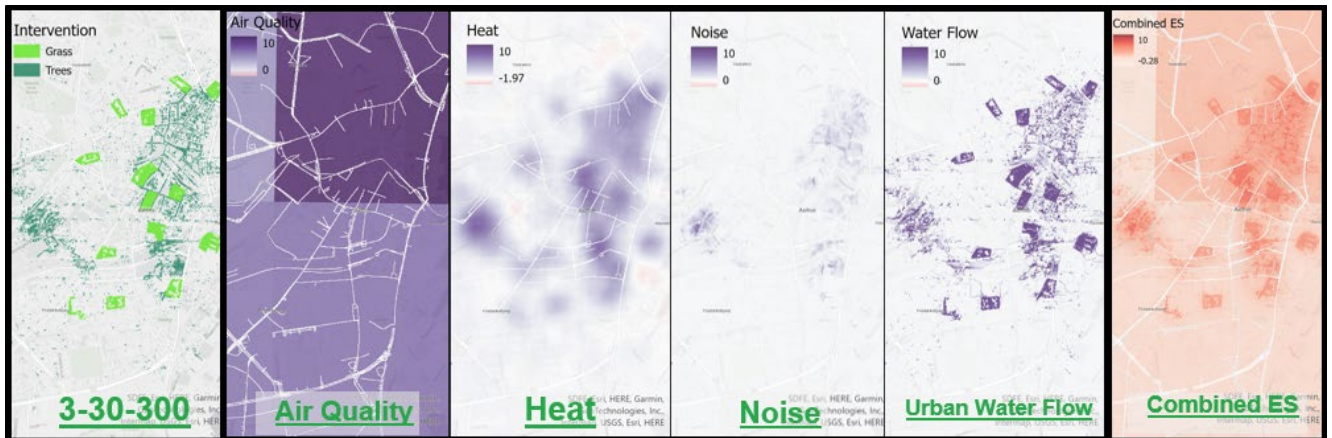

Fig. 4 Evaluating the 3-30-300 rules using four models (air quality, heat, noise and water flow), showing central part of Aarhus. Last panel shows combined results of all models.

Metrics

Detailed model results can be summarised into key metrics for each city. These city-tailored results allow Municipal officials to make future decisions using the efficiency metrics for very rapid estimates of benefit without re-running the models (Tab. 1). Note that these may be very different for each city.
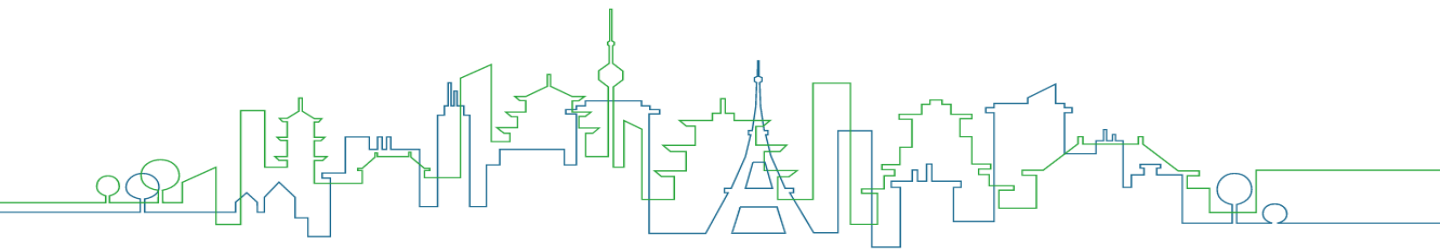
Theme	Metric	Aarhus	Paris	Velika Gorica
Pressure	Average PM2.5 concentration (ug/m3 - modelled)	8.520	9.410	18.380
Area of NBS (trees)	Tree cover (ha) - current urban trees	1,688	54,216	20
	Tree cover (%) - current urban trees	10.36	18.79	1.74
Total service provided	Total quantity of PM2.5 pollution removed (kg)	5,986	295,410	31
	Average PM2.5 concentration change (ug/m3)	-0.035	-0.182	-0.004
	Average percentage change in PM2.5 concentration (%)	-0.41	-1.93	-0.02
Efficiency	Pollutant removed per ha (kg/ha)	3.5	5.4	1.5
	Concentration change per 10% urban trees	-0.034	-0.097	-0.020
	% concentration change per 10% urban trees	-0.401	-1.029	-0.110
Population affected	Urban population	130,172	6,599,815	4,259
	Peri-urban population	23,982	614,995	29,339

Tab. 1 Summary metrics with example shown for air pollution removal, giving metrics for each city.

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Impact

The models produce maps and summary metrics which are useful for city decision makers and citizens as well as researchers. They can be used to show what existing street green and blue space like street trees, grassland or ponds do to improve quality of life of city residents. They help city officials plan the best locations for new NbS, and which type of NbS to choose when solving particular problems.

Findings from the modelling in REGREEN have been used to change planning policies on new construction in Velika Gorica, inspired by the hot-day temperature mapping. The proportion of green space required in new construction has been increased from 25% to 33%. The models are being used to evaluate the benefits of NbS plans in Aarhus, and to make the economic case for new schemes.

Do you know that…

… descriptions of some of the models can be found in the following papers:

Noise: Fletcher et al. (2022)
https://doi.org/10.3390/su14127079
Water flow: Miller et al. (2023)
https://doi.org/10.1016/j.landurbplan.2023.104737
Water quality: Hutchins et al. (2019)
https://doi.org/10.1016/j.jenvman.2023.119950
Air quality: Harrison et al. (2023)
https://doi.org/10.1016/j.envsoft.2023.105821
Heat: Bird et al. (2022)
https://doi.org/10.3390/atmos13071152

… some of these models are being incorporated into the City Explorer Toolkit
https://www.ceh.ac.uk/city-explorer

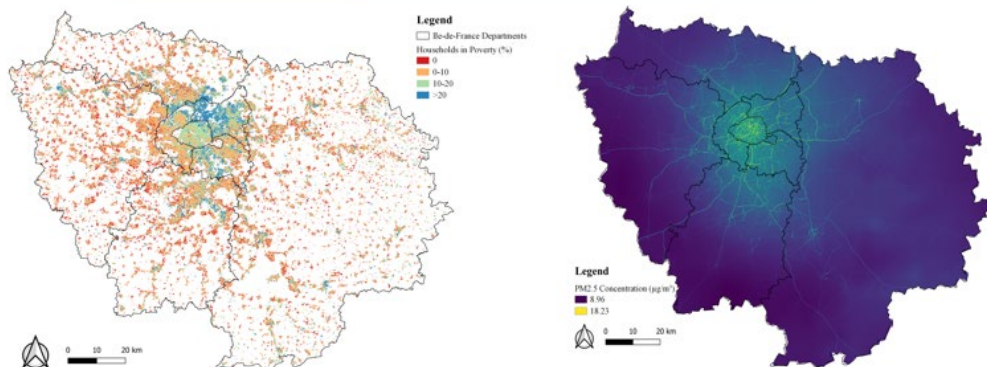| Households in Deprivation (%)	Total Population	Background PM2.5 Baseline (µg/m³)	Effect of Urban Trees Δ Concentration (µg/m³)
0	558,400	10.7	-0.21
> 0 & ≤ 10	4,411,169	12.0	-0.26
>10 & ≤20	4,287,820	12.9	-0.23
≥20	2,740,053	12.5	-0.22

Fig. 5 Urban trees can help reduce inequality. Poorer neighbourhoods in Paris experience worse air pollution (middle column of table) BUT trees in these areas remove more pollution than they do in more wealthy neighbourhoods (right hand column).

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Mixed-method integration of evidence and valuation findings

Policy Recommendations

- 'Value' should be recognised as more than an economic metric and different forms of evidence about how people experience, interpret, and perceive NbS produced and used

- NbS are complex and plural types of evidence are needed to fully understand what works, where and for whom

- Different audiences will need and respond to different types of value and evidence

This brief provides information about the outcomes of REGREEN research on assessing the wellbeing values of NbS

Nature Based Solutions (NbS) are often undervalued because the range of values (e.g. social, environmental, health) are not taken fully into account. Valuing benefits properly is required in order to inform decision-making, especially with increasing pressure on our urban areas. A key challenge is it is much simpler to articulate and monetise the value of development of housing and other built infrastructure compared to the complexity and multiple functions of and responses to nature.

Different forms of evidence, individually and in combination, can reveal if and how an NbS action had the intended impact, clarifying who or what benefited, to what degree, and in what ways. Additionally different audiences need, and will respond to, different types of evidence.

The health and wellbeing values of NbS are significant, and through REGREEN we have demonstrated the importance of understanding these values from multiple perspectives. Monetary values are crucial and often are the primary driver of decision-making. However, other approaches add important dimensions to our understanding, provide opportunities for local citizens to be involved, and ultimately result in better, more sustainable decisions.

UNDERSTANDING THE MULTIPLE VALUES OF NATURE BASED SOLUTIONS

WHY DO WE VALUE?

Nature based solutions (NBS) have wide-ranging benefits for communities, human health and the environment.

Holistically valuing all the benefits (and disbenefits) can inform decision making. Each of the approaches used here contributes to the collective valuation of nature-based solutions in urban areas.

1

SYSTEMS THINKING THROUGH CAUSAL LOOP DIAGRAMS

Using a systems thinking approach, we reviewed existing evidence and consulted stakeholders on NBS in urban areas to develop our causal loop diagrams. They visualise the outcomes, feedback loops, and unexpected consequences of NBS on communities.

Here's an example that looks at the links between street trees and mental health:
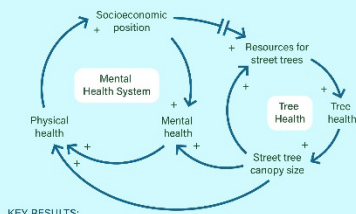
KEY RESULTS:

The health of the street trees is important – maintenance is needed to ensure they reach the age and size when the benefits to mental health are realised.

Communities that don't experience benefits may be less likely to advocate for future investment in street trees, ultimately leading to increased inequalities.

2

ON-SITE ECOLOGICAL EXPERIENCES SURVEY

Ecological momentary assessments engage with in-the-moment experiences, behaviours, and moods of people as a means of valuing NBS.

People surveyed within the green spaces were most often local individuals using it to travel through.

>75%
OF PARTICIPANTS FELT HAPPY AND CALM IN THEIR GREEN SPACE

3

PHOTO-ELICITATION WITH COMMUNITY GROUPS

Photo-elicitation uses photographs to prompt discussions to uncover information, feelings, and memories about NBS.
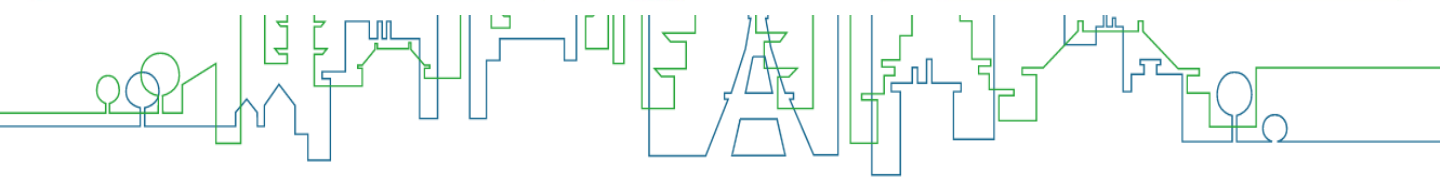
"That experience [moving around in the city] is enhanced by the existence of trees, and you can follow the seasons, when you can see that new leaves are coming out, you can see birds' nests in the trees."
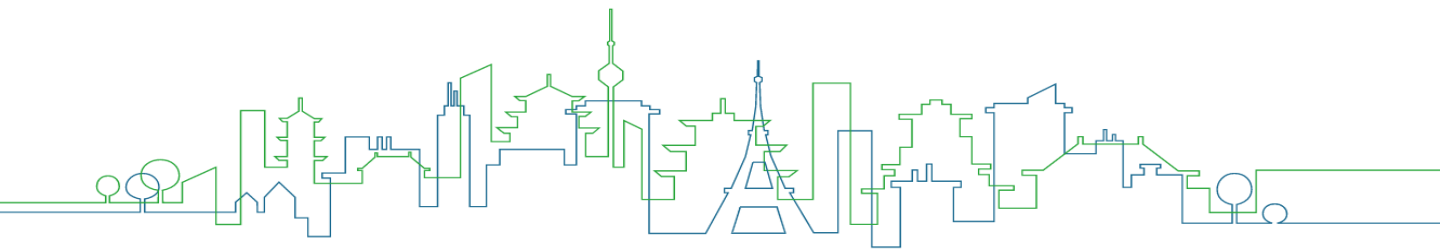(AARHUS)

"I remember the whole community gathered to plant these trees. I still remember that planting... When I think about it now, it still keeps my heart warm and I'm proud."
(VELIKA GORICA)

4

DELIBERATIVE VALUATION

Deliberative valuation utilises small groups of citizens who discuss and choose between NBS scenarios and their costs to inform the economic valuation of NBS benefits in urban areas.
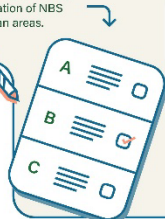
This method helps understand preferences and guide environmental policy and decision-making.

CITIZENS ARE WILLING TO PAY FOR A
12%
TREE CANOPY COVER INCREASE

5

ECOSYSTEM SERVICE VALUATION

Ecosystem service valuation assigns measurable economic value to the processes through which nature contributes to human well-being.

Our work valued the cooling effect of green spaces for Paris residents and the associated reduced risk of mortality.

Mean temperature

Distance from green space

57%
OF PEOPLE IN CENTRAL PARIS LIVED CLOSE ENOUGH TO GREEN SPACES TO BENEFIT FROM COOLING EFFECTS

Relevance

Different audiences require different forms of evidence to inform their decision making about NbS. Further, collecting information on how values differ between communities or stakeholders can inform NbS strategy elsewhere.

Need

Producing and using different types of evidence of the value of NbS facilitates an understanding of the complexities of NbS. NbS are multi-functional, with complex environmental, social and economic impacts. Actively working to develop, assess, and communicate a broad, mixed value and evidence base enhances our understanding of the potential or realised multifunctionality and co-benefits of NbS. Better understanding of this complexity can help strengthen arguments for the implementation of NbS.

Using constrained types of values and evidence in decision making limits the effectiveness of the NbS implementation, delivery, and function and risks severe unintended consequences including wasted resources, or even harm to individual or communities.
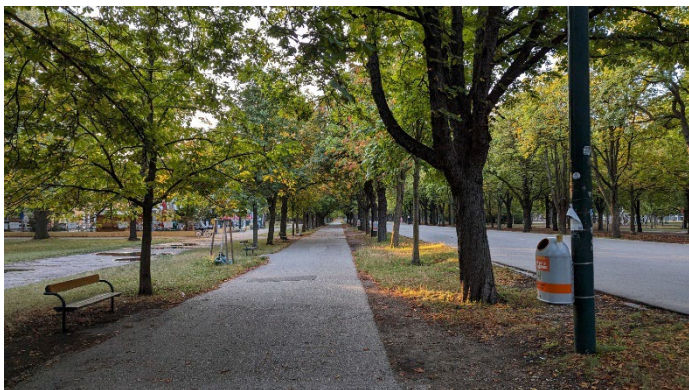
Street trees are an important NbS with multiple wellbeing-related values © B.W. Wheeler

Do you know that...

Different types of value include:

- **numerical data**, such as quantifying health impacts through mortality or hospital admission rates.
- **monetary values**, which may be ascribed using various methods, and are often considered useful due to policy/decision-making relevance and potential utility as a comparable quantity.
- **qualitative evidence**, which can help reveal, in more depth and in citizens' own words, values such as perceptions, aims and intentions, and their experiences.
- **cultural evidence**, which can come in the form of, for example, texts, images or performances, can reveal values held by communities.
- **evaluative evidence**, which can take numerical, economic, qualitative or many other forms, can reveal if an action (such as an NbS) had the intended consequences. Evaluations may indicate who or what benefited, to what degree and in what ways.

Approach and results

Through REGREEN we used a range of different methods to assess the values of NbS:

- Theory building and complex systems were used to understand the multiple outcomes, feedback loops, and unexpected consequences of implementation of street trees.
- Ecological momentary assessment was used to document the experiences, behaviours, and moods of people in urban parks in three of the Urban Living Labs.
- Photo-elicitation captured the responses of community groups to green space, specifically street trees.
- Deliberative valuation was used to explore people's perceptions and preferences regarding ecosystem services and subsequent benefits, and disbenefits of NbS.
- Ecosystem service valuation demonstrated the potential of public green spaces in Paris in terms of their cooling effect on nearby residents and the associated reduced risk of heat related mortality.

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Barriers and enablers in local NbS governance in Europe

Policy Recommendations

- NbS offer multifunctional solutions to major climate and environmental challenges e.g. flooding, heat effects, water quality, health and wellbeing.

- NbS uptake requires resources, political support and alignment with strategic priorities. Key enablers for NbS update include:

- Ensure openness to working across policy areas / silos and with wider stakeholders

- Foster policy champions within local governments and actors to enable collaboration across science-policy-practice boundaries

- NbS requires adequate and longer term funding

This brief provides information about the outcomes of REGREEN research on governance barriers and enablers in three European Urban Living Labs (Aarhus, Paris Region & Velika Gorica).

Nature-Based Solutions (NbS) target and can address major challenges of our time – climate change, disaster risk reduction, food and water security, human health, biodiversity, sustainable development etc. (https://www.iucn.org/our-work/nature-based-solutions).

NbS are on national and local agendas in the EU. However, despite often being very beneficial to society when implemented, it can be difficult at local level to move NbS beyond the idea stage. NbS ideas require time and resources invested in them, along with adequate political and institutional support, to move them from the idea stage to policy/decisions and implementation.

NbS agenda-setting and decision-making often demand more integrated approaches to local policy-making than other types of policy solutions, since these solutions are complex and multi-functional. NbS are therefore often designed and negotiated across different sectors in local administration which may otherwise be compartmentalized, each in their silo and with different agendas.

In the Horizon 2020 project REGREEN, governance barriers and enablers in NbS governance in urban areas in Europe and China were analysed through case studies in Aarhus (DK), Beijing (CN), Ningbo (CN), Paris Region (FR), Shanghai (CN), and Velika Gorica (HR). Below, we present findings from the European cases.

Depaving, Paris Region © Yann Laurent (Grandin et al. 2022)

The Bièvre restored at Igny, Paris Region © Hervé CARDINAL, SIAVB (Grandin et al. 2022)
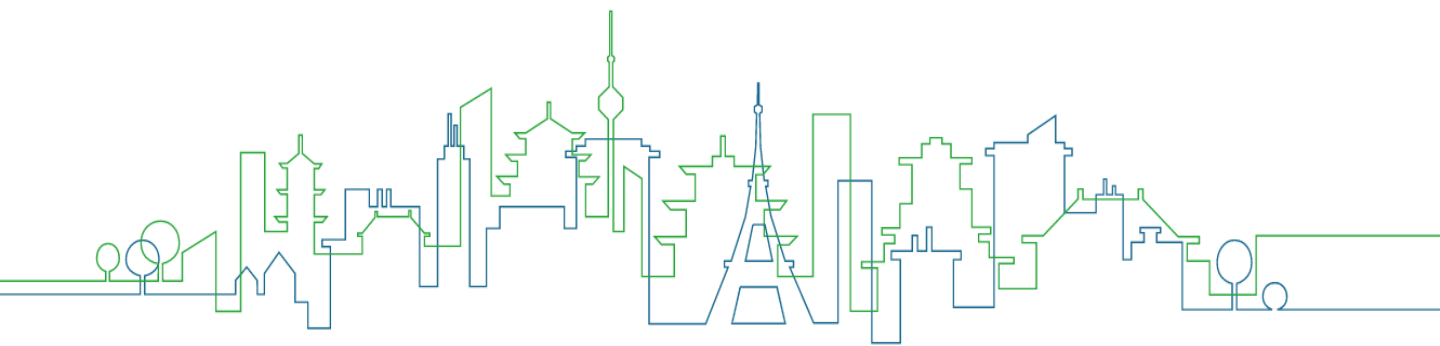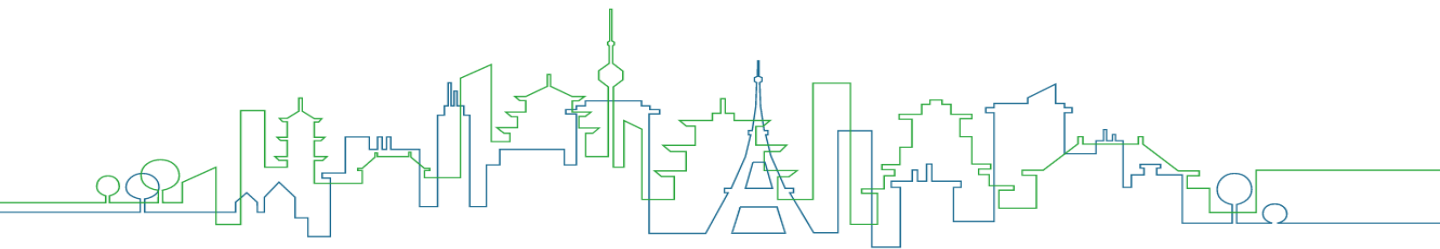
Relevance and need

Increasingly, urban governance and planning studies have focused on the inclusion of urban nature as part of the solution to a wide array of problems. Consequently, there is a need to understand barriers and enablers for NbS uptake.

Approach

We used document analysis, qualitative interviews with stakeholders, and walkable floormap policy workshops. During the analysis of the data we drew on the concept of networked 'governance architectures' – paying attention to institutional structures, cultures and practices and acknowledging the role of non-governmental stakeholders and networks in policy making.

Discussion, Aarhus Municipality floormap,
© Anders Branth Pedersen

Do you know that...

… the REGREEN project used walkable floormaps (see photo below) to facilitate discussions between different offices in local administration in the European cases. See also policy brief #9 "Meeting on the map".

As part of the REGREEN work package on 'Governance and Planning of Urban Nature-Based Solutions', 'guidelines for urban and territorial NbS land use planning', were developed – https://doi.org/10.5281/zenodo.10707827

Enablers for successful local NbS implementation in Europe

A number of differences were identified in the three European ULLs, but common NbS enablers found include:

- openness to transversal and collaborative interaction with stakeholders, especially with those who are likely to maintain and use green/blue spaces
- existence of a policy champion entrepreneur (e.g. within local government) having the power/ability to influence decision-making and/or implementation
- involvement of boundary actors with expertise and ability to fulfill a role as coordinators or advisors
- external policy drivers in combination with public awareness (creating windows of opportunity). Policy drivers can both be sudden (e.g. flooding events or deaths during heatwaves) or gradual (e.g. increasing average temperatures)
- coherence of NbS initiatives with government strategies – this tends to be connected to availability of funding
- adequate enforcement of targets and regulations for green space to avoid land take as part of urbanization
- availability of funding – preferably strategic and long-term.

If enablers are not present, their absence may instead constitute barriers for local NbS uptake.

Authors

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Knowledge co-production in the Urban Living Labs

Recommendations for policy

- Through an ULL approach with particular collaboration between researchers and public administrations, knowledge is contextualised and shapes project details to ensure local relevance.

- Participating in knowledge co-production provides public administrations with a mechanism for raising awareness of NbS within the organisation and on a political level.

- In order for the produced knowledge to have an impact in the organisation communication targeting the practice is essential. This needs to be tailored for the stakeholders with regards to communication style, language and medium.

This brief provides information about the outcome of REGREEN research on the process of knowledge co-production that took place in the European Urban Living Labs.

Urban Living Labs (ULLs) are lifted forward as an approach that explores in real-time society-science interfaces and function as arenas for learning as they allow to test novel processes, actor constellations and practices that otherwise may not unfold. A common element for these projects are that they apply transdisciplinary approaches, in which knowledge co-production takes place across disciplines and sectors, integrating more than academic expertise and highlighting practice-based knowledge. Research methods are often of explorative and experimental character and aim at long-term strategies and solutions. Learning and reflexivity are core objectives and qualities of an ULL to detect mechanisms that are scalable and transferable.

Urban Living Labs within REGREEN

Central to the REGREEN project was the use of Urban Living Labs (ULLs), three in Europe (Aarhus, Paris Region and Velika Gorica) and three in China (Beijing, Ningbo and Shanghai). The Chinese ULLs differed from the European ULLs due to its lack of direct involvement of public administrations. The European ULLs were represented by two municipality organisations (Aarhus Municipality and Velika Gorica Municipality) and one regional think tank (Paris Region). Within the project the ULLs had a central role as an arena for co-creation of knowledge involving local citizens, schools, businesses, organisations and public administrations. Within the ULLs different approaches, methods and tools were developed and applied that could be integrated into decision support systems, guidelines and standards for developing and deploying urban NbS at a systemic and strategic level.

A training workshop for technicians has been run by IPR at all three European ULLs
© Marc Barra
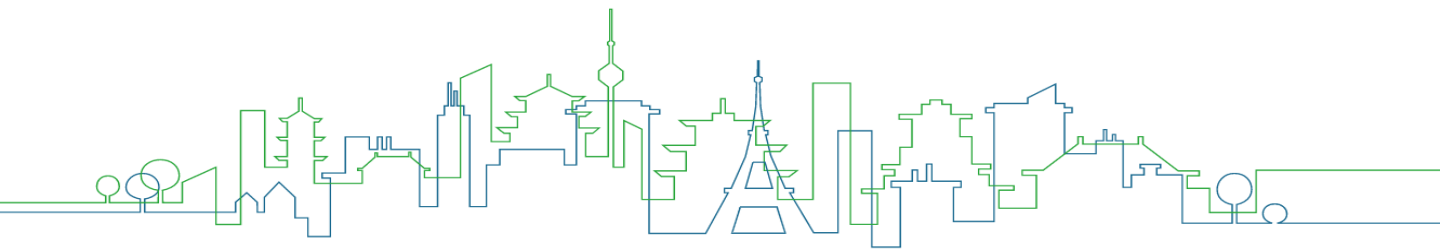
Approach

In order to analyse the knowledge co-production taken place within the REGREEN project we carried out document analysis to explore the involvement of the three European ULLs within the different tasks. We also carried out semi-structured interviews with the local contact persons for all three ULLs to understand the role of the public administrations within the knowledge co-production process and how the project has influenced their respective organisation.

Training session, Vesterbro Torv, Aarhus © Signe M. Iversen

Do you know that...

… for Aarhus municipality REGREEN has provided an opportunity to increase the political awareness of NbS but also to increase the general awareness of NbS within the organisation.

... in Velika Gorica the knowledge producded within REGREEN has been put into action through the comprehensive plan and the three programs (Clean air, Climate change and Environmental protection).

… in Paris Region the depavement strategy developed within REGREEN has moved into planning and policies on a municipal level.

Knowledge co-production within the European ULLs

The key outcomes of the study are summarised as follows:

- Public administrations took on different roles with regards to knowledge co-production for the different tasks. This ranged from providing local data sets, contextualised task, towards driving activities that could directly feed into policy and planning documents.
- An important component of the knowledge co-production from the perspective of the public administrations was the peer-to-peer knowledge exchange. This was facilitated through organised meetings between the ULL contact persons, field visits during the project meetings on site as well as the training workshop developed and run by the Paris Region ULL.
- All three European ULL recognised the importance of REGREEN for raising political and broader awareness of NbS within their respective organisations. This was facilitated through the contact persons for each ULL engagement and communication with a wider set of stakeholders possible through the ULL. Important here was also the project meeting on site in each ULL which allowed members of staff from the organisation to partake and meet the members of the consortium.
- The public administrations benefited in different ways depending on the status of on-going work with NbS. For Paris region and Aarhus municipality the new knowledge provided by REGREEN has at large fed into on-going work and policies. In the municipality of Velika Gorica the knowledge produced have allowed new policies and programs to be developed in support of NbS.

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REGREEN
NATURE-BASED SOLUTIONS

A methodology for identifying areas with high renaturation potential

Policy Recommendations

- Renaturing is often confused with desealing, which involves restoring the permeability of topsoil, often using porous drainage pavements.

- Renaturing involves restoring the entire ecosystem (soil, flora and fauna)

- Renaturing relies on knowledge of ecology and awareness of all levels of biodiversity (genetic, specific and ecological).

- Involving the community in renaturing projects helps residents to accept them and make them their own, ensuring their long-term success.

This brief provides information about a methodology for helping the identification of mineralised sites that could be used for renaturation operations.

All cities, decisions makers, urban planners, NGOs etc. can use this approach. It has been developed to be replicable for different urban contexts and cities. Just follow the step-by-step method. The criteria and data used in the methodology may be enriched or supplemented according to the issues of the local context and to the data available. The online publication of interactive maps can be done with many GIS tools: arcGIS, QGIS, etc.

Why a methodology for renaturing?

Our cities are full of areas that have been concreted or asphalted over and where nature could potentially return and flourish. We propose a method that will help local authorities:

- to target urban areas where renaturing represents a key strategy.
- to identify mineralised sites that could be used for renaturation operations.

Before and after opening up the river in a densely built-up area of Sarcelles (Paris Region, France). © SIAH Croult et Petit Rosne.

Impact

Many applications can be derived from this analysis. At their own level, local authorities can use it as inspiration to work towards the No Net Land Take objective and define "areas to be renatured" in their urban planning documents. In addition, the application of the methodology can encourage local authorities to implement more coherent renaturation strategies for their entire territory. The method can also feed the "Avoid, Reduce, Compensate" sequence and help project developers to identify mineralized sites that can accommodate compensatory measures, thus contributing to a higher gain.
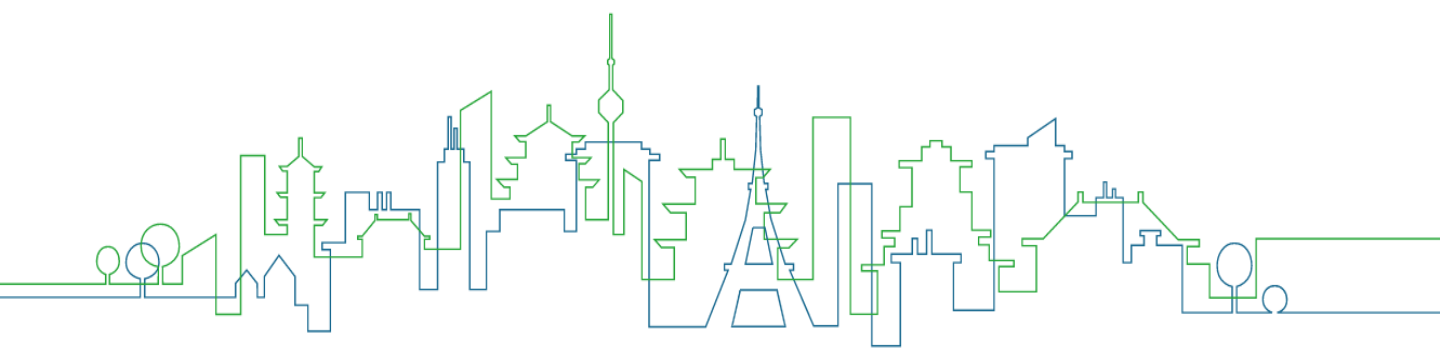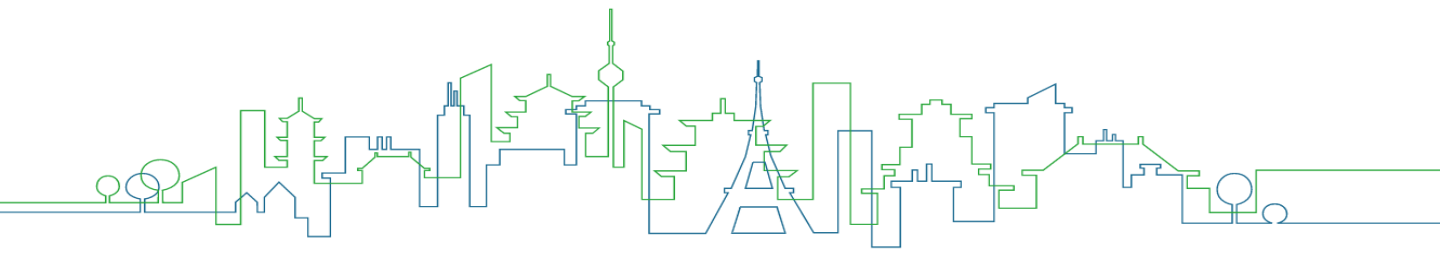
Approach

The method described here is based on three key challenges that make it possible to locate these urban areas:

- Restoring biodiversity on targets areas that are deficient in terms of biodiversity, by studying the size of green spaces; the type of plant cover; the presence of rare habitats; and ecological connectivity.

- Adapting to climate change on target areas exposed to climate risk: river flooding, runoff and urban heat islands.

- Improving human health and the living environment on targets areas that are vulnerable because of lack of green spaces, air pollution and health problems relating to urban heat islands.

This first step makes it possible to identify areas where the potential for renaturing is high, but it does not pinpoint sealed sites that could be renatured. To do this, potentially desealable/renaturable sites (school playgrounds, car parks, areas of waste ground, public squares, etc.) were listed based on the land use classification guidelines.

Results

The Regreen method has been applied at the scale of the Paris Region. It helps local authorities to map areas at risk on a scientific basis and to identify mineralised sites that could be used for renaturation operations. The methodology makes it possible to estimate the amount of potentially desealable and renaturable land. All the results are available online in the form of interactive maps.

Do you know that...

… the REGREEN project published the guide Renaturing cities: method, examples and recommendations in English, French, Danish and Croatian

You will learn about where and how to restore nature in cities. This guide will be a useful tool with the forthcoming EU regulation on nature restoration.
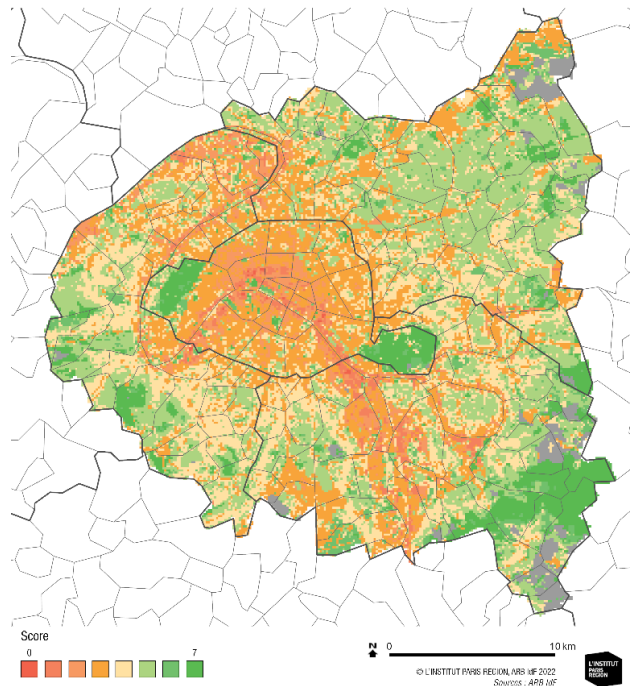
Overall map of exposure to the effects of climate change for Paris and the inner suburbs. The higher the level of renaturation required, the lower the score (red) © Institut Paris Region

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REGREEN
NATURE-BASED SOLUTIONS

Nature-based solutions business development and business models

Policy Recommendations

- To foster private investment in NbS, entrepreneurs need transparency, accountability, and clarity for what is defined as a sustainable investment.

- „Encourage rather than punish": Regulations, policies, and financing instruments should build up frameworks that give advantages to sustainable businesses.

- An experienced coordinator, early planning, and organisation, especially of long-term maintenance, are particularly important for public-private models.

- A commercially driven consultancy model needs to specialise in a niche with a clear value proposition.

- For a citizen driven model, it is crucial to integrate local, cultural specifics, or identity into the project so that people want to be a part of it and feel it is a project that belongs to them.

This brief provides information about the outcome of REGREEN research on NbS business development and business models.

To limit global warming, halt biodiversity loss, stop land degradation, and achieve sustainable development goals, investments from the public and private sectors in NbS have to increase massively. The awareness of the need to act —for governments, private companies, and financial institutes— is rising, also that NbS are essential and suitable to meet these challenges. But the speed of action is too slow, and especially investments in the private sector have to increase massively.

Why business models and NbS?

The business model concept is a potential planning tool to clarify:
- What is the value proposition of the planned enterprise or project?
- What is important for finding investment?
- What are suitable ways to engage the right stakeholders?
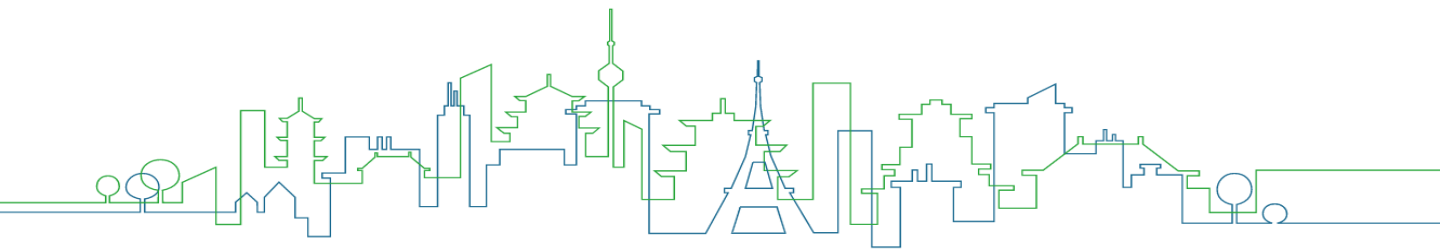- How to get a project started?

Business models are for the public and private sector. There is no strict separation, and hybrid models with flexible, adjusted elements are also possible.

Sustainable business models and NbS share the fact that both take a holistic approach to addressing future challenges. Non-monetary value, social embedding, and long-term character are categories to be considered.
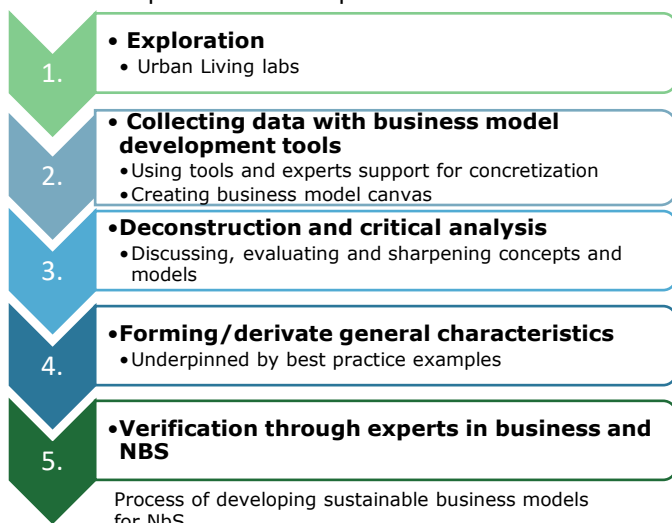

Urban Farming Graz, Austria, © JOANNEUM RESEARCH Life
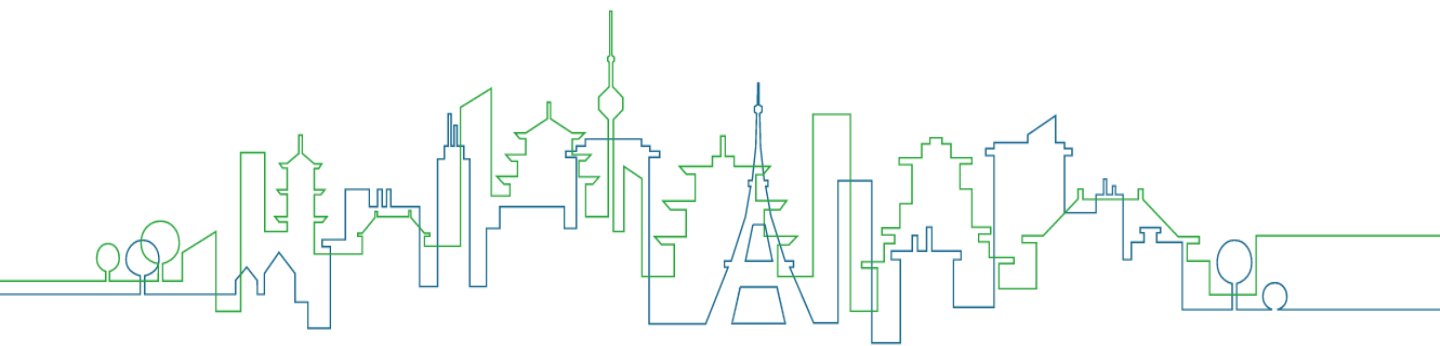
Approach

The research process of developing sustainable business models and their overall economic embedding in the REGREEN project can be described as an iterative process with a focus on keeping the balance between theoretical inputs and practical experiences. It is possible to read the procedure described below as a description of our research approach in the Prospectus for NbS business investment as well as potential steps for imitation in the development of a NbS business model, especially in the first phase of development.

1.
- **Exploration**
  - Urban Living labs

2.
- **Collecting data with business model development tools**
  - Using tools and experts support for concretization
  - Creating business model canvas

3.
- **Deconstruction and critical analysis**
  - Discussing, evaluating and sharpening concepts and models

4.
- **Forming/derivate general characteristics**
  - Underpinned by best practice examples

5.
- **Verification through experts in business and NBS**

Process of developing sustainable business models for NbS

Three models

The three REGREEN business model approaches are based on actual business model cases with which our partners in the ULLs have gained experience. The models were further developed with the help of a business model canvas and in discussions.

Public private driven model

Brings together private and public interests. There is a share of responsibility and risks for NbS in financing, implementation, and maintenance.

Do you know that...

… in REGREEN, two more distinct initiatives adress business-related aspects?

The Decision Support Tool (DST) introduces users to NbS, offering foundational knowledge from the REGREEN project. It simplifies complex information and empowers users to replicate successful NbS actions.

https://nature-solutions.eu/decision-support-tool/

The Start-up accelerator programmes facilitate and provide professional advisory to SME by promoting innovation, knowledge sharing, and collaboration among stakeholders.
Tedeschini, F. (2023). Report on start-up accelerator programme
https://doi.org/10.5281/zenodo.10607886

Commercially driven consultancy model

The knowledge-based consultancy is flexible with regard to individual possibilities and needs. It needs a financial value creation in a sustainable and responsible way, and NbS could be a niche or extension of the portfolio of an existing enterprise.

Citizen driven model

This model is characterised by bottom-up initiatives and local stakeholders, which needs a group of like-minded people to bring in time, manpower, and knowledge. Its advantage is the greater commitment due to personal involvement and co-creation with citizens.

For more on the NbS market, corporate investment, and the three NbS business models:

Ellmer, H.-P, et al. (2023). Prospectus for Nature-based solutions business investment.
https://doi.org/10.5281/zenodo.10607872

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REGREEN
NATURE-BASED SOLUTIONS

Meeting on the map:

Innovative platform for stakeholder learning, dialogue and engagement with nature-based solutions (NbS)

Policy Recommendations

Schools

- Offer walkable floor maps to schools for free and involve teachers in the designing process.

- Invite schools to participate in local dialogues and collaboration on NbS

- Help schools overcome obstacles to using walkable floor maps for learning projects and for engaging in local dialogue.

Governance

- Offer IWF to local government departments for display and use to foster dialogue with public and private actors on NbS policy innovation and implementation.

- Invite politicians, policy makers across policy sectors and stakeholders to jointly use IWF to enhance and deepen dialogue on urban challenges, local areas and communities, explore multiple benefits of NbS opportunities and how to overcome current challenges and constraints.

- Offer IWF as platform for innovative policy design and policy learning.

This brief provides information about the outcome of cross-disciplinary research and development work on the use of walkable floor maps as an interactive educational platform.

Why NbS?

NbS are actions to protect, sustainably manage and restore natural and modified ecosystems in ways that effectively and adaptively address societal challenges. By providing both human well-being and biodiversity benefits, and offering multiple other services such as climate adaptation, they are crucial to resilient and sustainable cities.

Why dialogue?

Establishing NbS calls for a high degree of participation, engagement and understanding from a range of public and private actors. Dialogue is an absolute prerequisite because problems cannot be solved unilaterally.
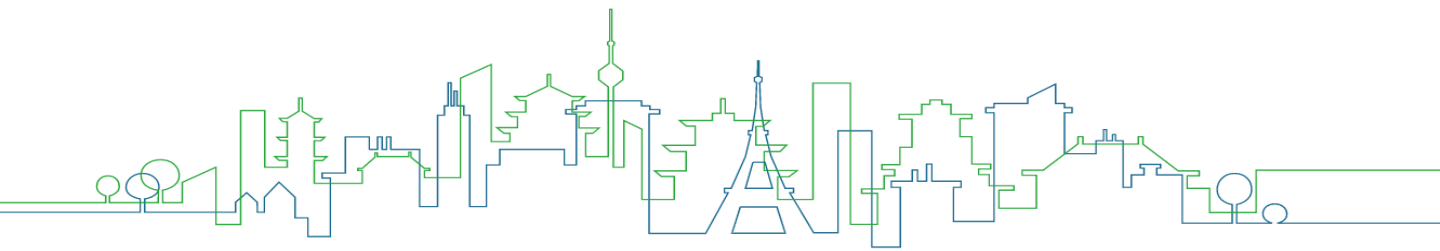
Why maps?

Interactive Walkable Floor Maps (IWFs) provide a platform for learning and a meeting point for dialogue. They consist of a high-resolution image (red, green and blue; RGB) and additional material. For floor installation, they are printed on a large (up to 5 x 8 m) sheet of resistant material that tolerates being walked on. Unlike other tools, IWFs enable spatial identification and collaborative dialogue through tactile and kinaesthetic interaction with the map.

The map's sheer size supports understanding of large-scale contexts while the refined resolution captures important details.

Aarhus policy workshop, © A.B. Pedersen
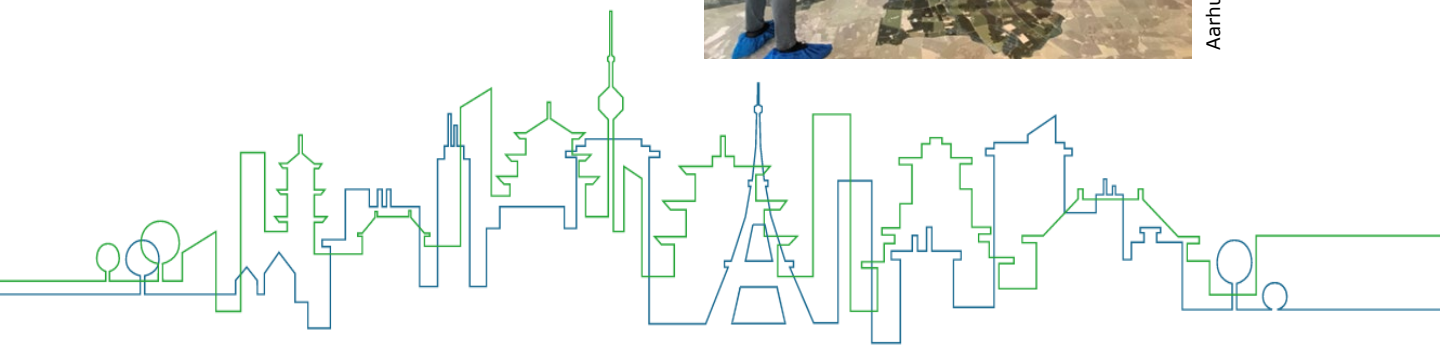
Children interacting with the IWF, © J. Læssøe

Educational platform for children's engagement with NbS

Need

The aim of NbS is to create sustainable living conditions for future generations. However, these future generations are often merely informed about plans drawn up by others to change their local environment. It is imperative that we find ways to enable young people to participate in processes of sustainable change and to engage in developing quality NbS, ways that also promote learning, develop democratic action competence, offer hope for the future, and enhance local identity.

Research

REGREEN collaborated with teachers in three European cities to find ways of applying interactive walkable floormaps (IWFs) to foster learning about local NbS through practical exercises. Collaboration showed that IWFs afford a wide range of opportunities for action-oriented learning. They facilitate exploration of local climate-related problems and encourage children to reflect on and develop ideas for local NbS. Adding their findings to the floormaps using QR-codes, post-its, or by drawing on overlaid transparencies, allows children to engage in dialogue and co-learning with local experts and authorities. IWFs also provide a platform for urban planners to integrate the perspectives of young people on sustainable urban futures.

Findings

We explored the educational potential of IWFs and barriers to their use.

Barriers: Teachers have limited time for preparation in general, which leaves little time for incorporating new pedagogical approaches. School organisation and structure, rigid national curricula, children's sociopsychological problems, and poor in-service training opportunities are among the many impeding factors.

Potentials and examples: Teachers experimented with walkable floor maps by adding floor map activities to current lesson plans in compliance with the curriculum. Using the maps as point of departure, students explored a variety of environmental issues. They biked around the city, registered dangerous sections on the IWF and suggested changes. Using the map for city planning, they compiled a list of improvements and best placements for new schools, parks, green areas, and lakes etc. Others used the map to explore their local area, its nature, daily life and history, transferring their new knowledge to the IWF with QR-codes and by drawing on large overlaid transparencies. These thematic IWFs were then presented to the town mayor at a public school event.

Children and their parents on the IWF, © J. Læssøe

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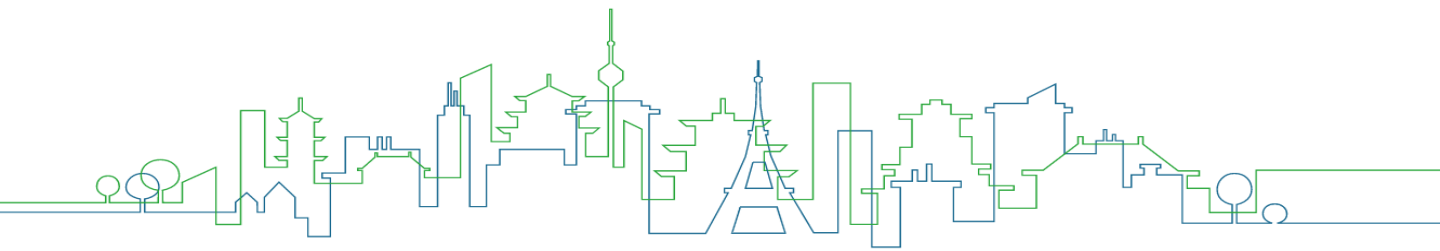NATURE-BASED SOLUTIONS

Learning and engagement – promoting participation and democratic decision making

Responding to our pressing climate and environmental challenges requires innovation, joined-up thinking and working across sectors rather than policy siloing. NbS are well-suited for cross-sectoral and innovative implementation. If we are to foster policy innovation and change, then engagement and dialogue with policy makers and stakeholders is needed.

Paris Region policy workshop, Aulnay-sous-Bois, 2022, © C. Petersen

As part of REGREEN we used our innovative IWFs to facilitate engagement, dialogue and stimulate learning with key policy makers (e.g. local government), children and stakeholders in three European Urban Living Lab case studies (one policy workshop in each).

We found IWF to be a useful and promising tool to promote dialogue, social interaction and stimulate learning among policy makers across policy sectors – e.g. environmental, plannining, education and social work – on and about the maps. Specifically, they offer

- Opportunities for dialogue and asking questions.
- Visual kinaesthetic learning – moving around the map.
- Pinpointing opportunities, challenges and constraints on the IWF.
- Revealing cross-cutting multi-functions of specific NbS interventions - and potential conflicts on urban nature
- Greater spatial contextualisation of discussions
- Enables highlighting of connectivity aspects, barriers etc. (opportunities/challenges).

Additional material

Banzhaf, E., Anderson, S., Læssøe, J., Jensen, A. & Iversen, S. (2021). Walkable floor maps, REGREEN 3rd Newsletter, Dec. 2021.

Conclusions

Use of IWF with policy makers and stakeholders offers

- Contextualised dialogue and policy learning amongst policy makers and stakeholders in the local area
- Opportunities to explore NbS potential and constraints, question current approaches and to 'think outside the box'
- Potential pathways to policy change

Aarhus policy workshop, © A.B. Pedersen

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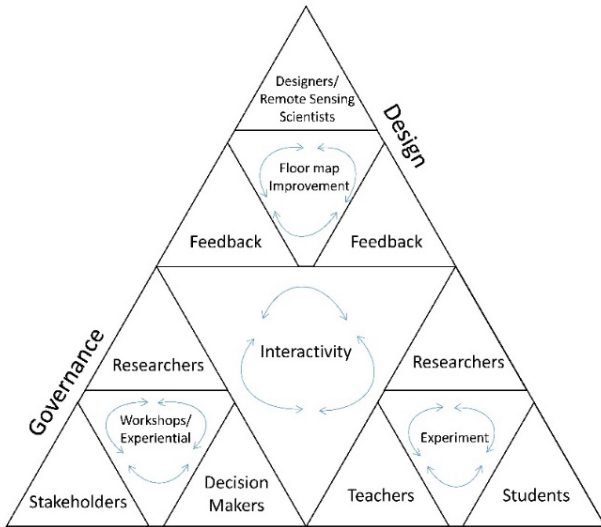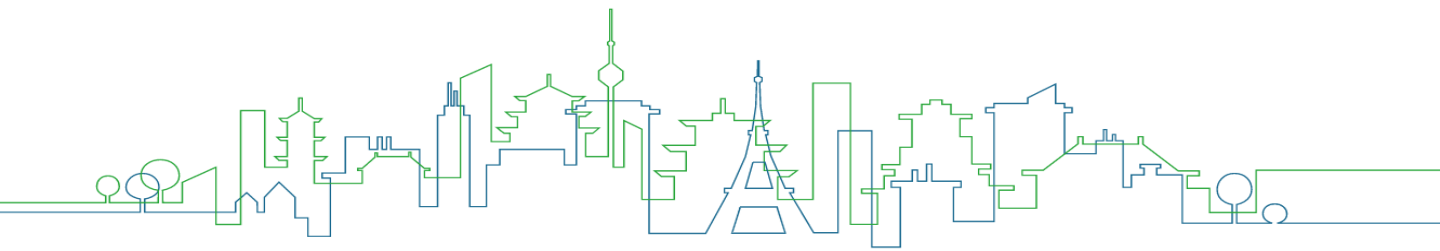
Interactive, interdisciplinary workflow, S. Elze

Do you know that…

… in the REGREEN project, the IWFs were part of the development and testing of tools to understand the benefits and values from NbS and their services. They formed an overarching tool encompassing mapping, governance and educational learning. Their resounding success in REGREEN is due to strong cooperation with the urban living labs in all three countries.

IWF in the aula of Eugen-Kumicic school © J. Læssøe

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