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Be Part of the Green Transition

Virtual Forum with NBS Experts

How to measure the environmental impact of your NBS?
Nature4Cities Environmental assessment tools

Dr. Ozge Yilmaz

19-20th May 2020

How to measure the environmental impact of your NBS?

Urban Challenges	Climate	Environment	Resource	Social	Economy
Issues & Impacts	Water management and quality Climate issues	Air quality Biodiversity and urban space Soil management and quality	Resource efficiency	Urban planning and governance People security Environmental justice and social cohesion Public health and well-being	Green economy

Many nature-based solutions result in **multiple co-benefits** for health, the economy, society and the environment, and thus they can represent more efficient and cost-effective solutions than more traditional approaches.

? How to identify the environmental **benefits** of NBS?

? Are there any environmental **trade-offs**? How to identify and quantify these?

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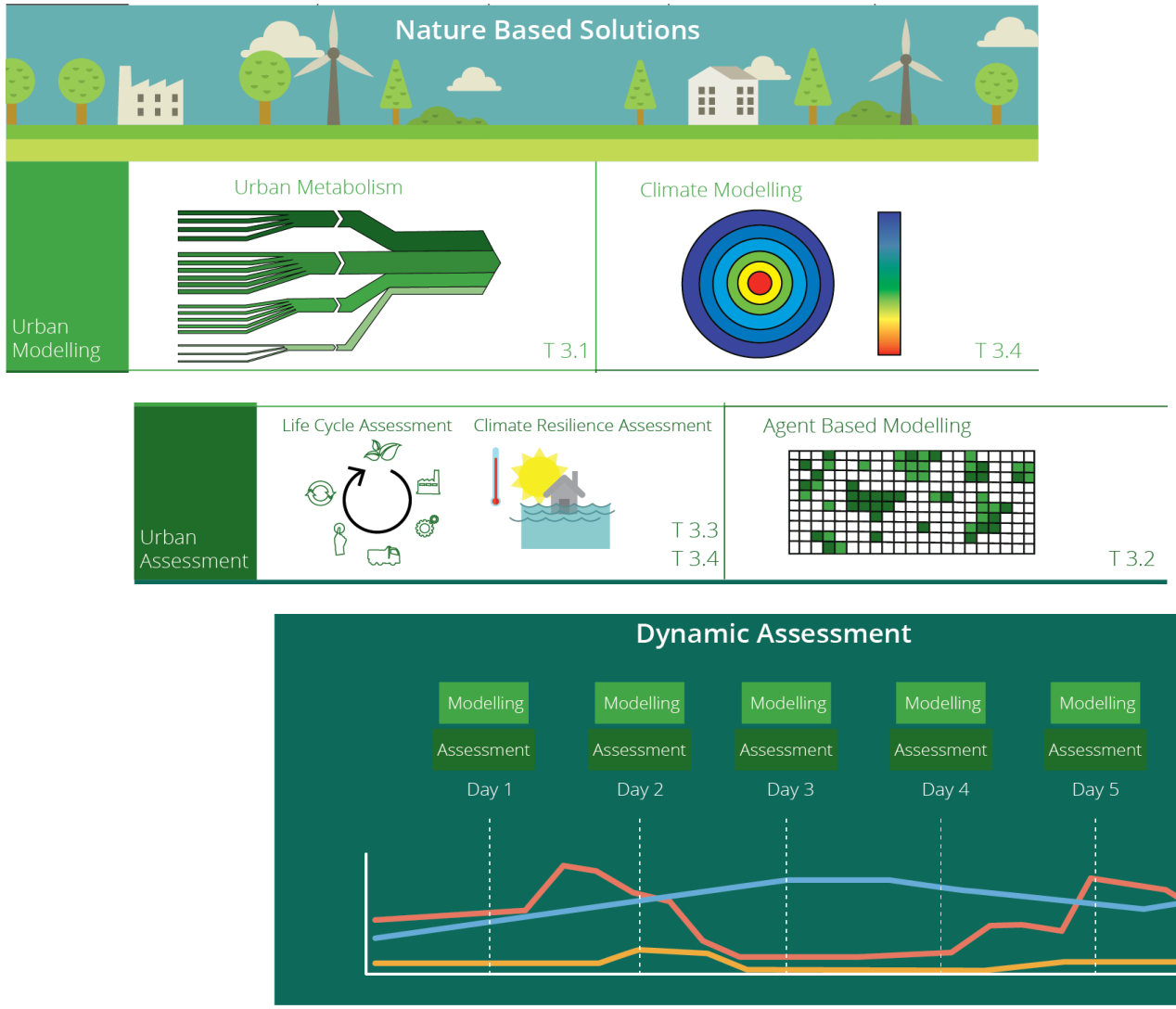
N4C Environmental Assessment Framework



The N4C environmental assessment framework is a collection of different modelling and assessment methodologies including

- ***Urban metabolism*** for conceptualization of the NBS projects
- ***Life cycle assessment (LCA)*** for quantification of benefits and trade-offs
- Guidance on ***climate resilience assessment models*** for proper estimation of climate impacts
- ***Agent based modelling*** to reveal potential links between NBS projects and policy making
- A ***dynamic assessment methodology*** developed to support temporal application fo the environmental assessment framework.

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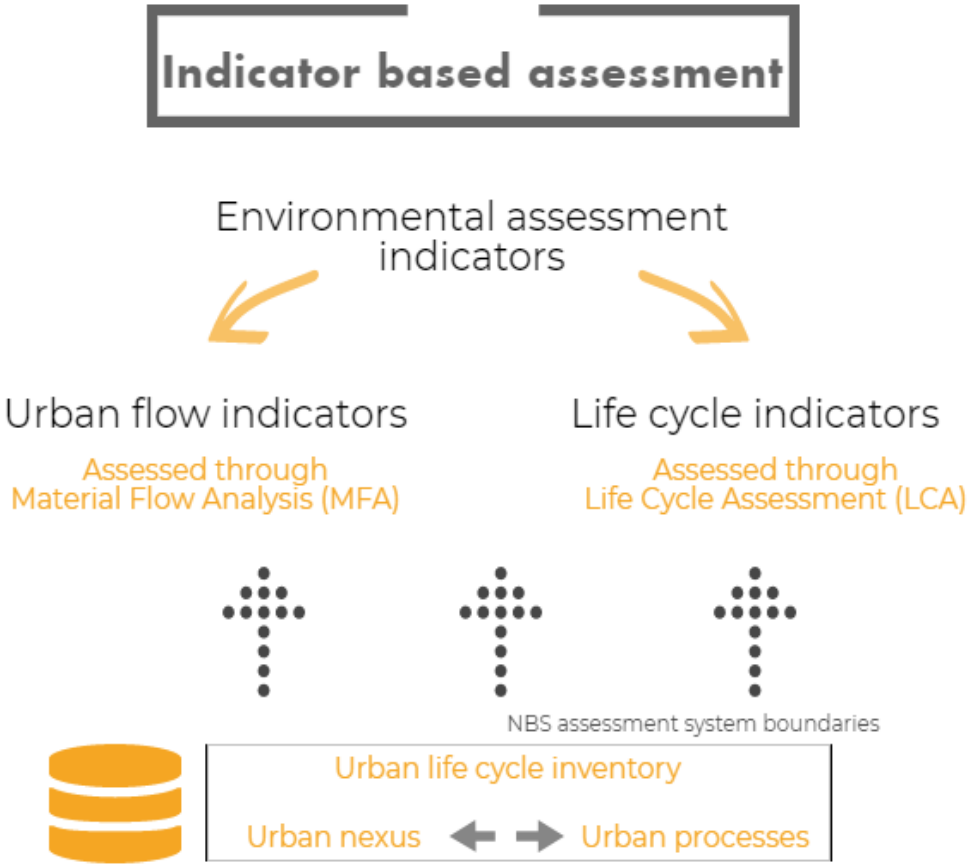
Urban flow and life cycle indicators

Urban flow indicators:

Determined in the form of headline indicators for various NBS projects to be quantified by analysis of urban nexus.

A streamlined urban metabolism approach is adopted to determine the system boundaries for urban flow indicator assessment.



Life cycle indicators:

Determined by application of life cycle assessment (LCA) methodology.

Common system boundaries are used for both urban flow and life cycle indicators.

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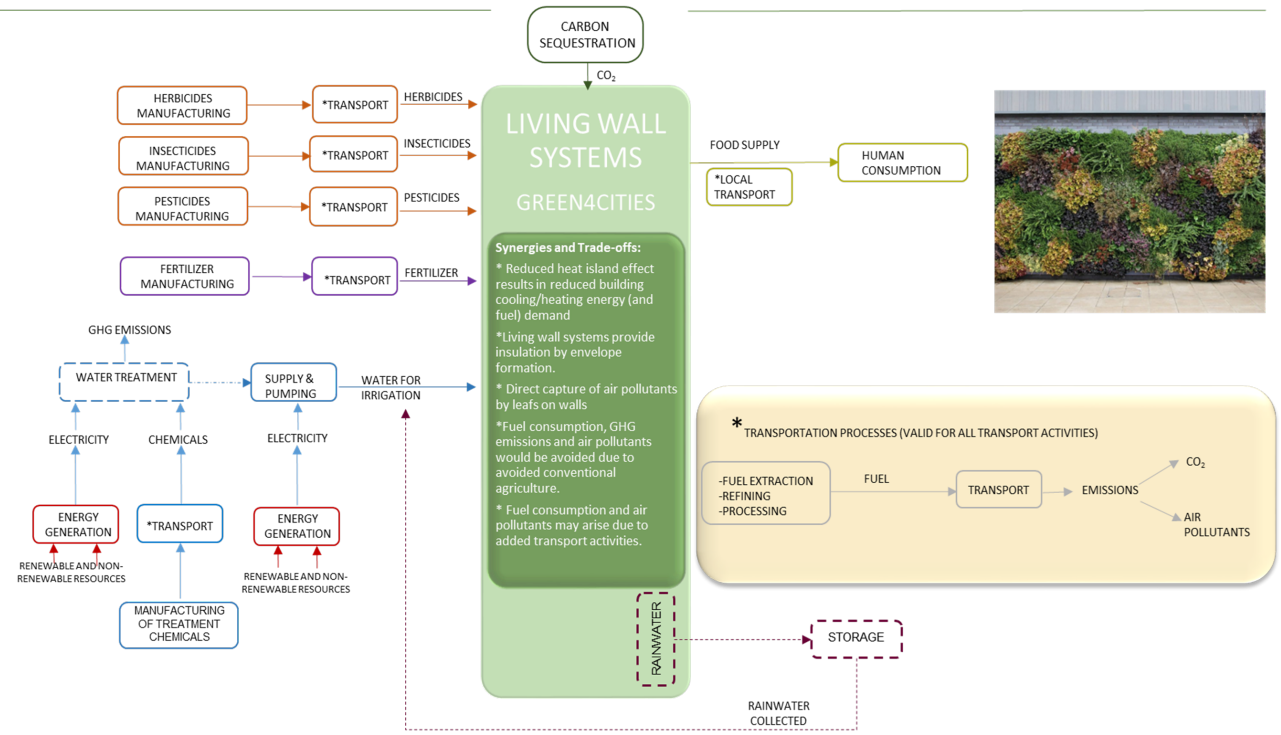
Urban flow indicators

Name of the NBS	Living wall systems Build or attached planter systems	
NBS Typology	Vertical structures "green walls and facades"	
Description		
Narrative impacts	Positive	Negative
Object scale	○ Nature and earth act as carbon sinks, ○ Capture of atmospheric CO2 during natural lighting hours ○ Reduced heating of walls, ○ Insulation, ○ Reduction in urban heat island effect: reduces energy needs in the building, ○ Fuel savings via the decreased heating/cooling energy demand ○ Storm/rain water runoff reduction (rain water is collected in a storage and then can be used for irrigation in living wall systems), ○ Low reduced common air quality index background levels	○ Possible resource consumption for maintenance including chemicals and irrigation water (if irrigation water cannot be supplied by rain/storm water collected)
Neighbourhood scale	CO2 capture, lower atmospheric CO2	
City scale	CO2 capture, lower atmospheric CO2,'limited impact, limited food production	

Indicator	Flows and applicable scales	Urban processes within the system boundaries	Operational cycle	Investment cycle	Unit of flow
Annual CO2 sequestration	Carbon sequestered (O, N)	Carbon uptake by plants		✓	kg CO2 eq/10 yrs, kg CO2 eq/100 yrs, kg CO2 eq per amount of biomass
Avoided GHG emissions	GHG emissions avoided (O, N)	All GHG emitting processes including combustion, Energy generation, Transportation		✓	kg CO2 eq/yr, kg CO2 eq/kg of product
Building energy needs	Energy demand for cooling (O) Energy demand for heating (O)	Energy generation, Electricity production from renewable sources, Electricity production from non-renewable sources	✓		J, MJ, MJ/yr, kWh, kWh/hr, kWh/d, kWh/yr
Common air quality index	Air pollutants removed (O, N)	Direct capture by leafs, NOx and PM capture		✓	µg/m3, mg/m3, kg/year
Cumulative energy demands	Energy demand for air treatment (O) Energy demand for cooling (O)	Energy generation, Electricity production from renewable sources, Electricity production from non-renewable sources	✓		J, MJ, MJ/yr, kWh, kWh/hr, kWh/d, kWh/yr



- Environmental benefits and trade-offs are identified for different NBS projects
- List of relevant urban processes and nexus are also determined
- Headline indicators for each NBS is selected

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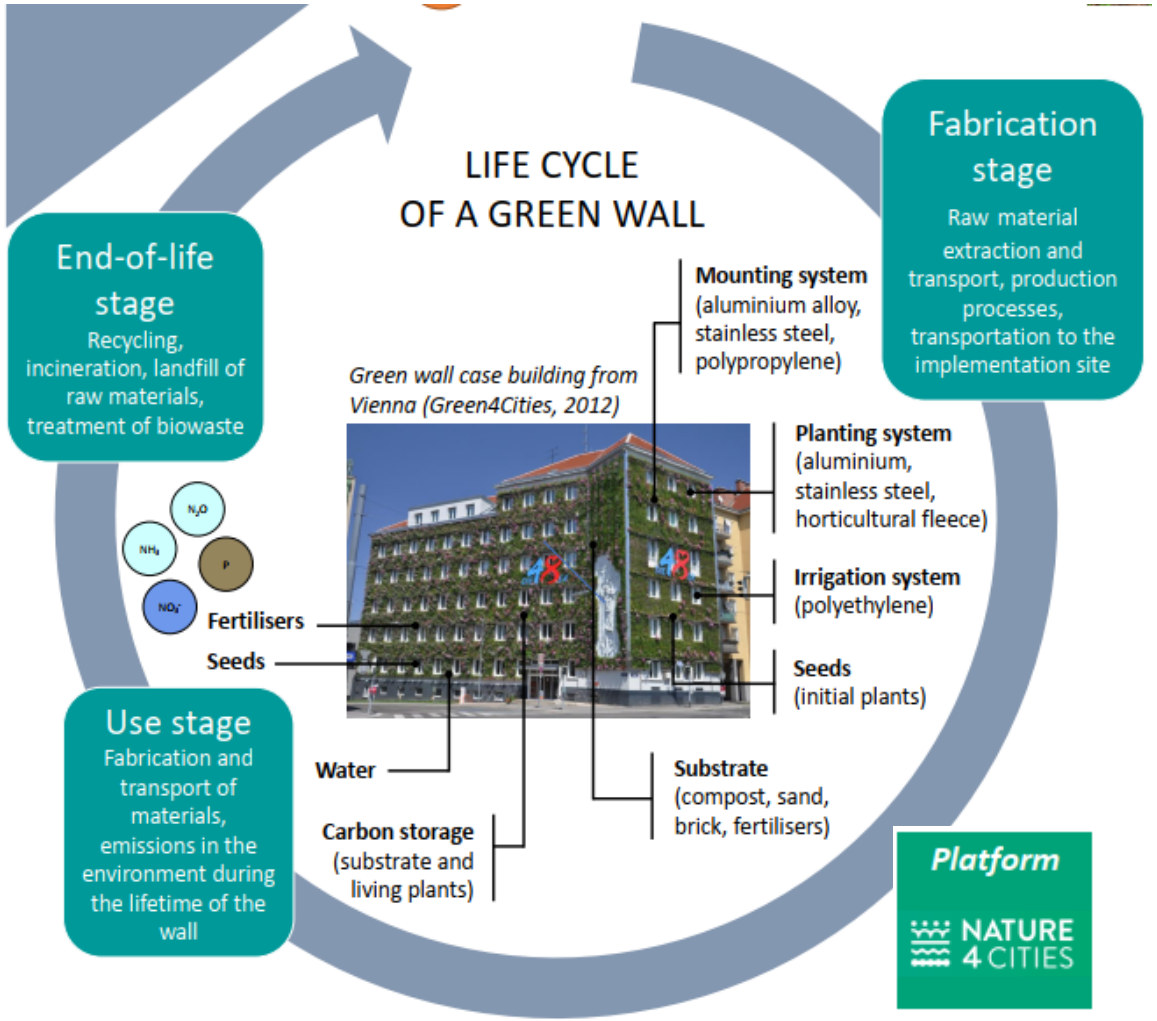
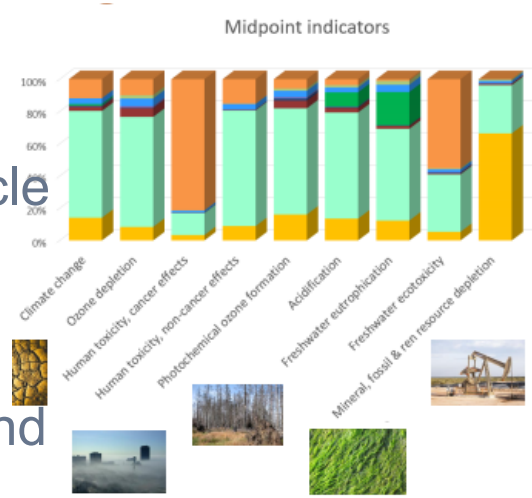
Life cycle assessment for NBS



Complementary detailed LCA specifically adapted to the requirements of a particular NBS case study (external service to the platform)



- Environmental assessment methodology based on life cycle thinking
- Generic Life Cycle Inventories for NBS based on expertise and literature
- LCI modelling of NBS – links with urban metabolism system boundaries
- Life cycle impact assessment for the NBS

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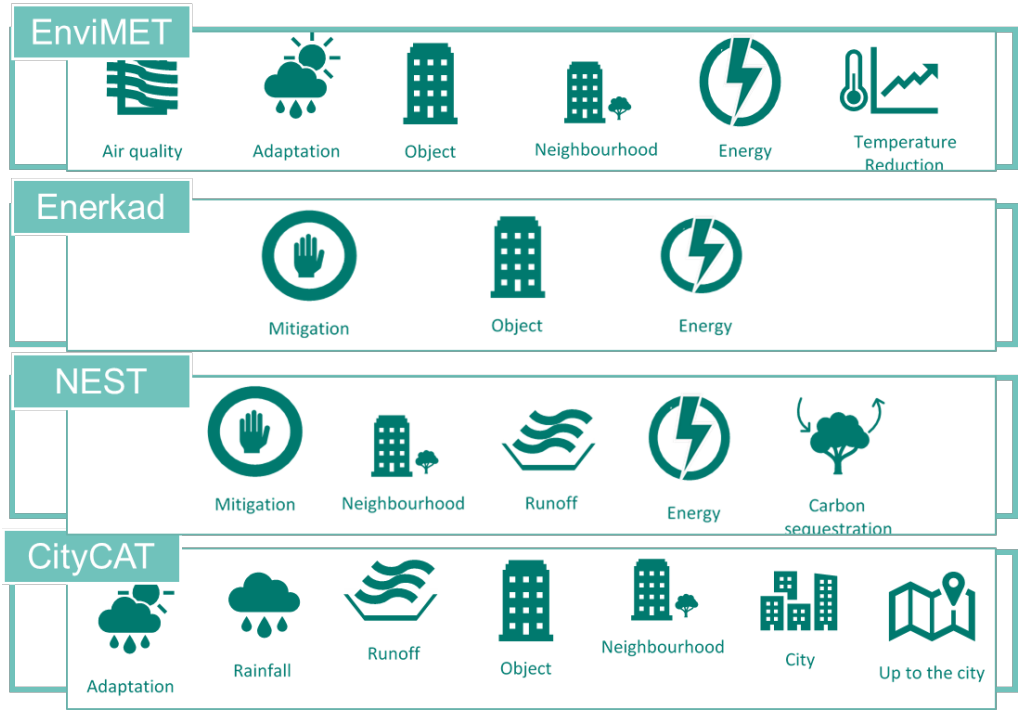
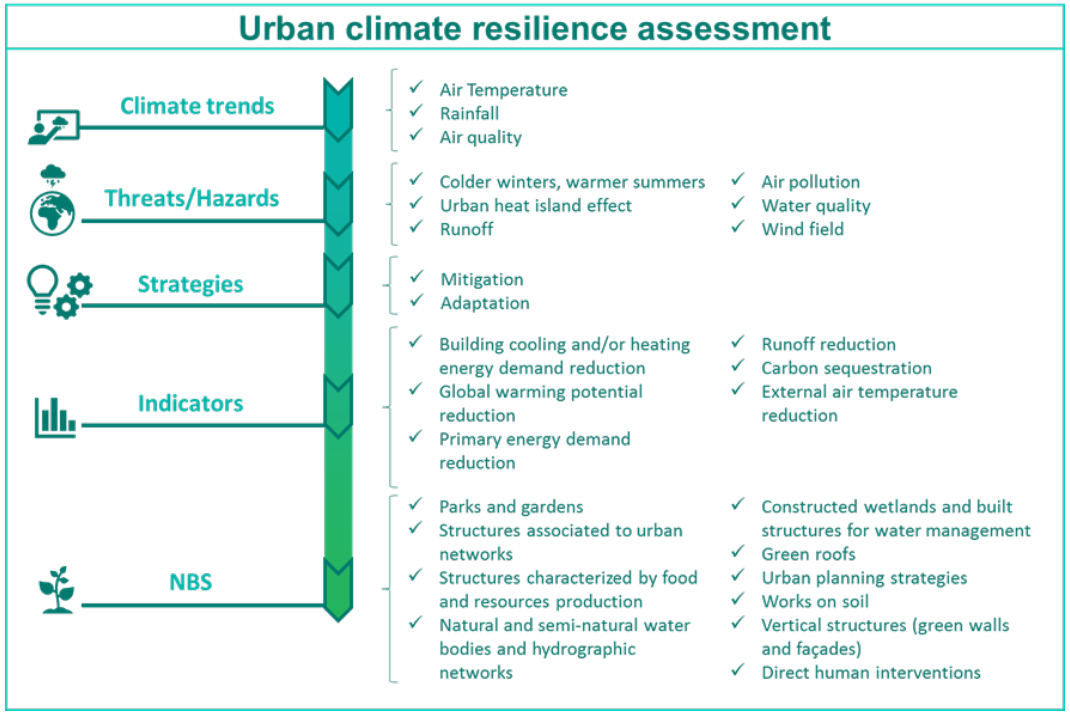
Climate resilience assessment

Different **climate resilience assessment methologies** surveyed considering links with NBS (factsheets prepared for each methodology)





Decision support guidelines have been created with the aim of helping the municipalities in identifying and deciding between all the existing methods and tools to analyze the climate resiliency of cities and the NBS

Tools with high applicability potential identified

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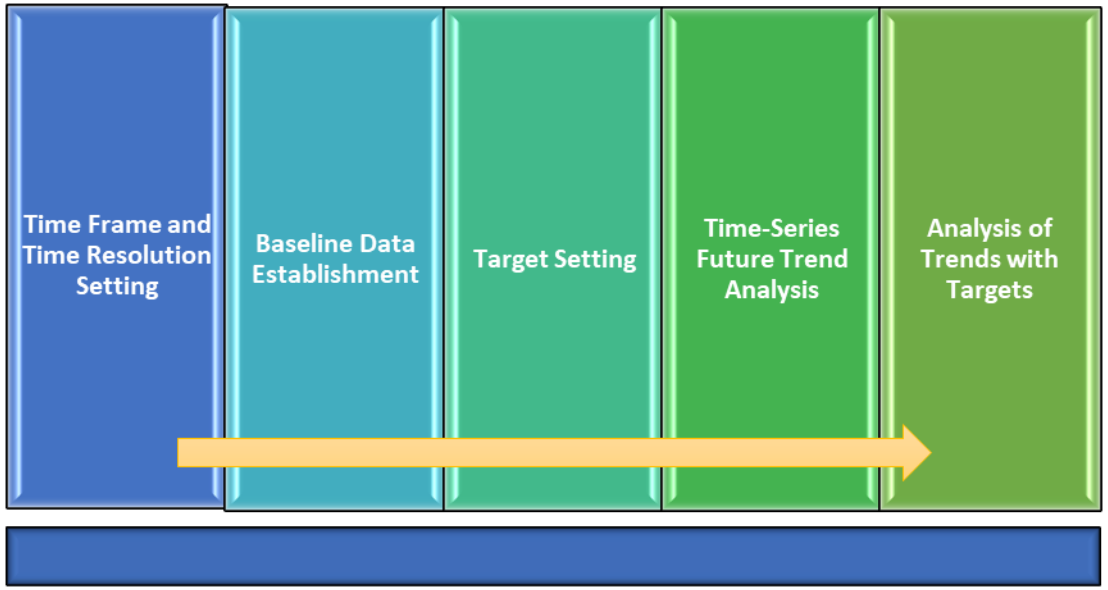
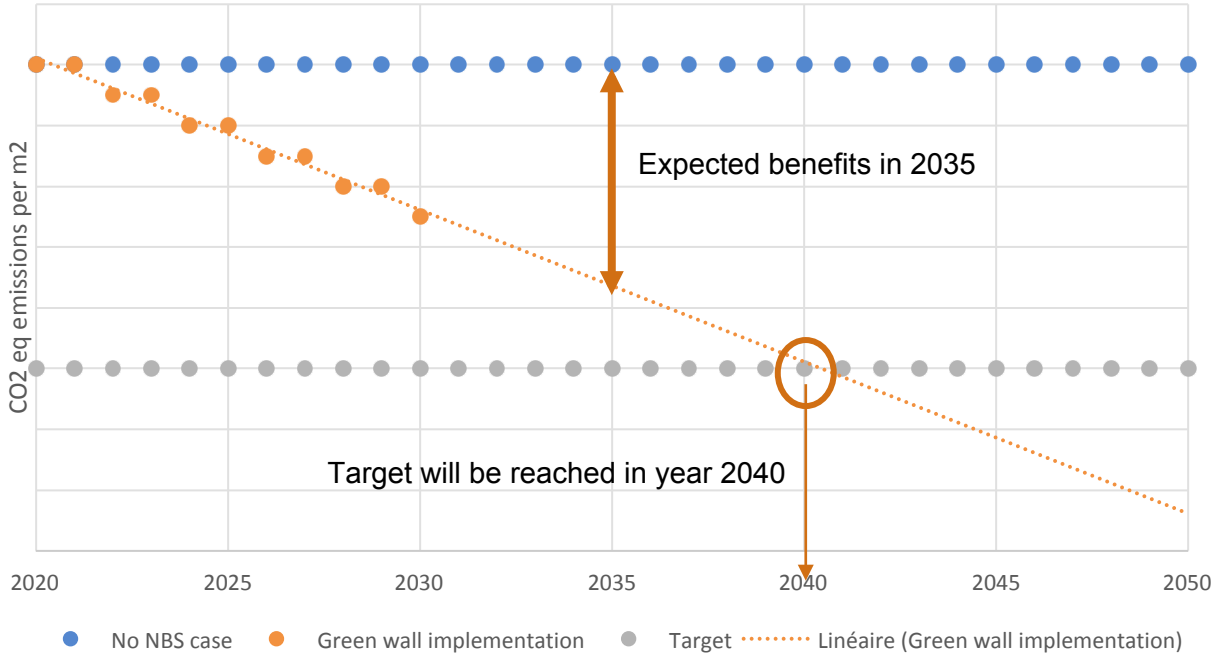
Dynamic environmental assessment of NBS

Dynamic Assessment Methodology





Cities are always transforming...

Dynamic assessment, supported by continuous monitoring, will help to change from reactive to pro-active evaluation and action building of the urban landscape transformation

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Agent Based Modelling to provide higher policy relevance

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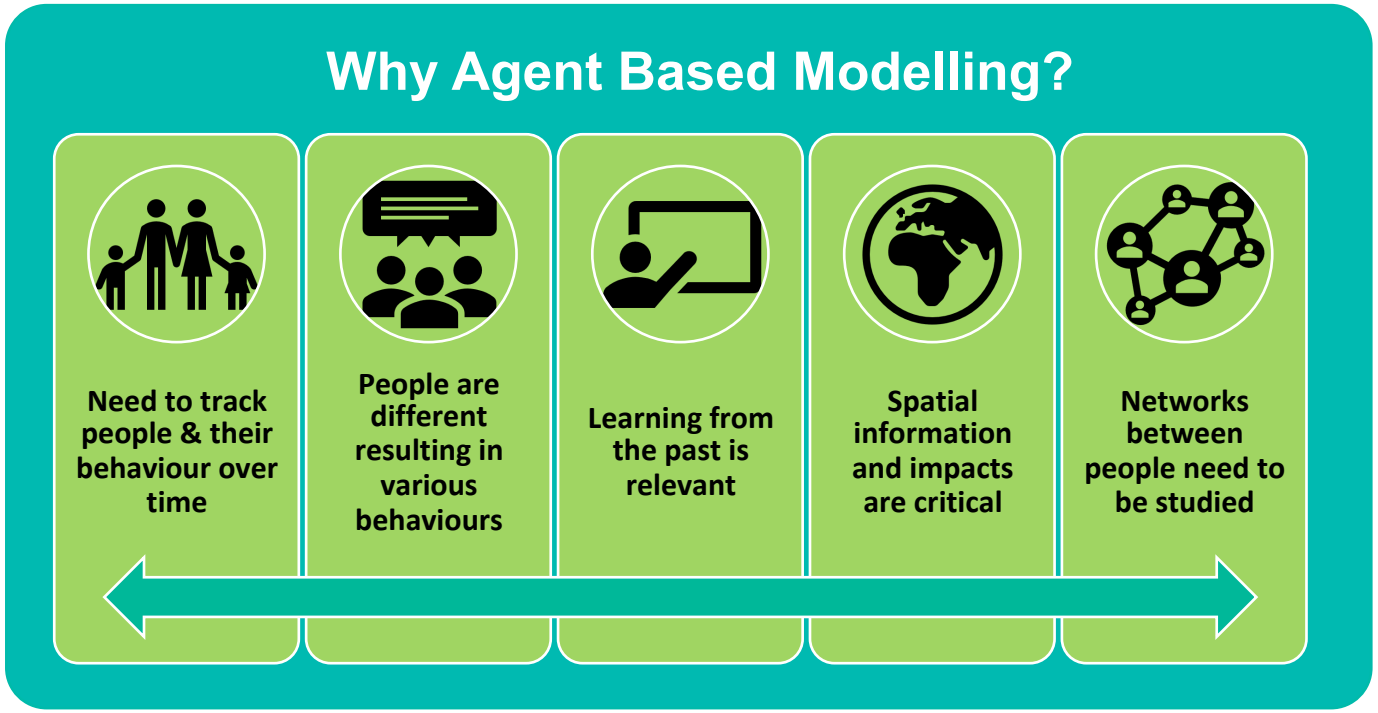
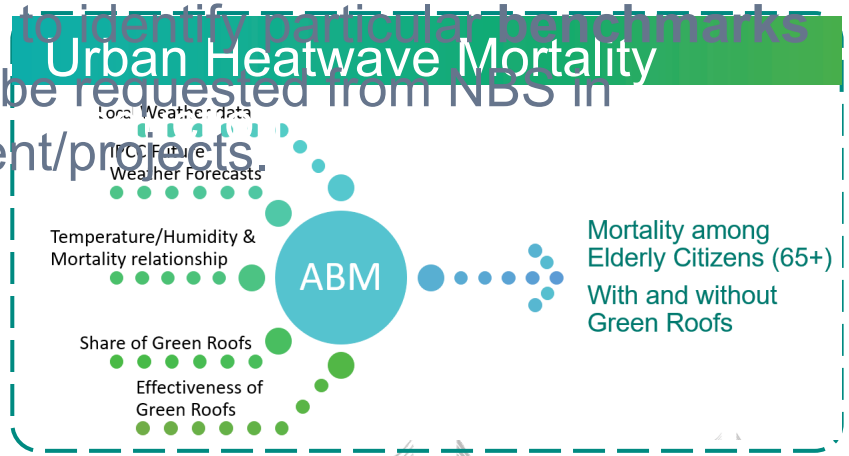
ABM can provide insights for NBS yet the direct link to policy making and planning needs further evaluation. Agent-Based-Modelling can help to understand **upscaling of NBS solutions** to larger areas of the city for particular challenges (heat-waves, flooding) and particular needs (socio-economics/well-being) .



The **isolation of particular parameters and the flexibility to change them** and see how it affects the results delivers critical insights. Especially, to identify particular benchmarks that could be requested from NBS in procurement/projects.



Improved toolkits and integration of experts within the policy domain is needed for ABM to be useful within policy-making for NBS, given the challenges today in building such models and interpreting the results usefully.

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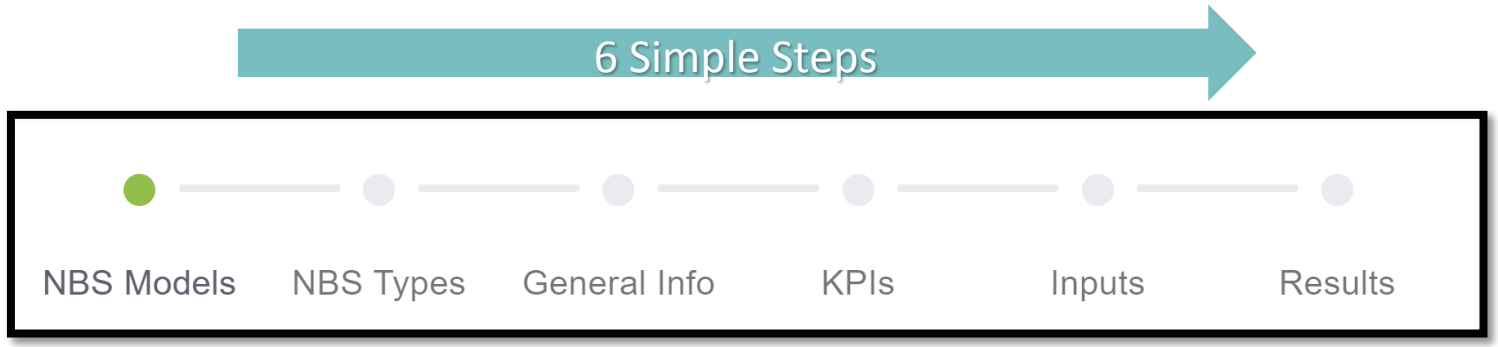
Common Environmental Assessment Tool

EPESUS (Material Flow Analysis=MFA)	S-LCA (Simplified Life Cycle Assessment)
❑ Annual CO_2 Sequestration ❑ Avoided GHG Emissions ❑ Energy Efficiency ❑ Food Production Variability ❑ Raw Material Efficiency ❑ Other Relevant Indicators	❑ Midpoint Impact Categories ❑ Endpoint Impact Categories

Assessment Path for NBS Environmental Performance Evaluation



presented by

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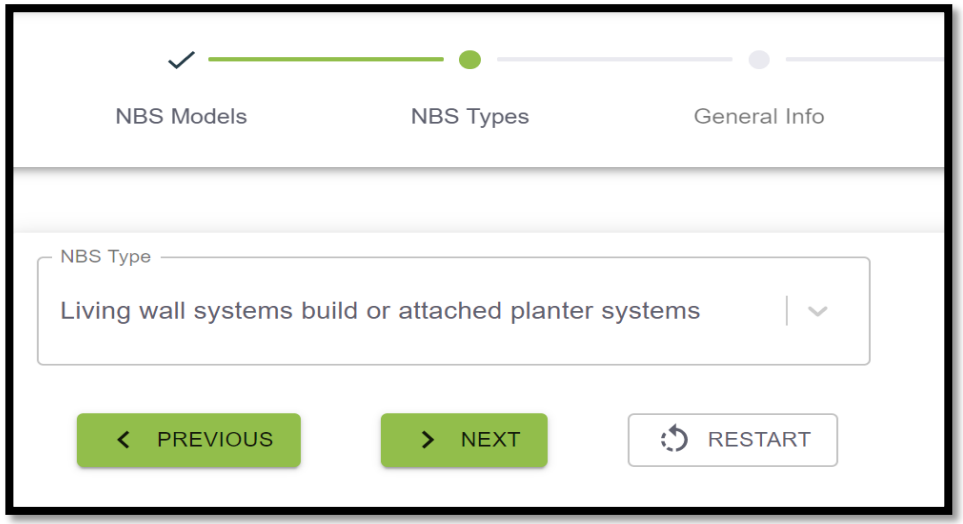
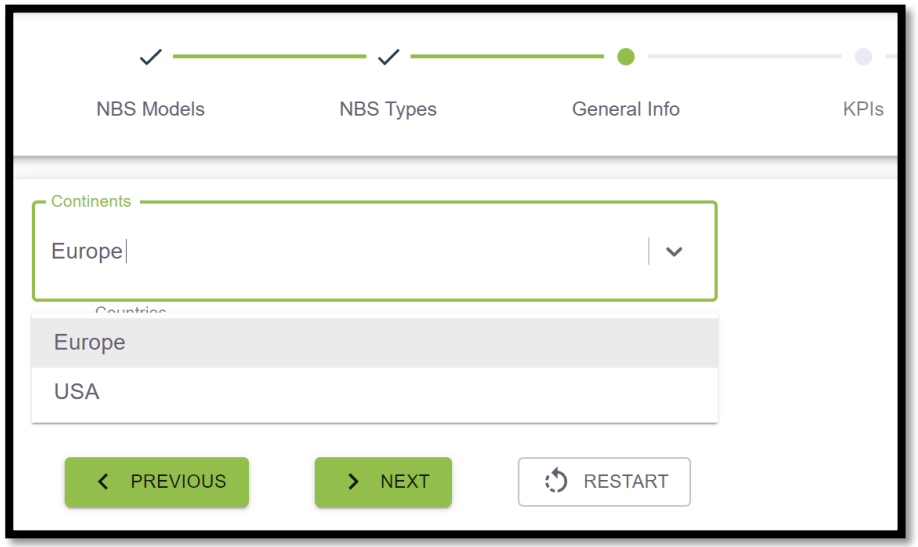
Common Environmental Assessment Tool Steps

Step-1: Select NBS Model



Step-2: Select NBS Type



Step-3: Choose NBS location

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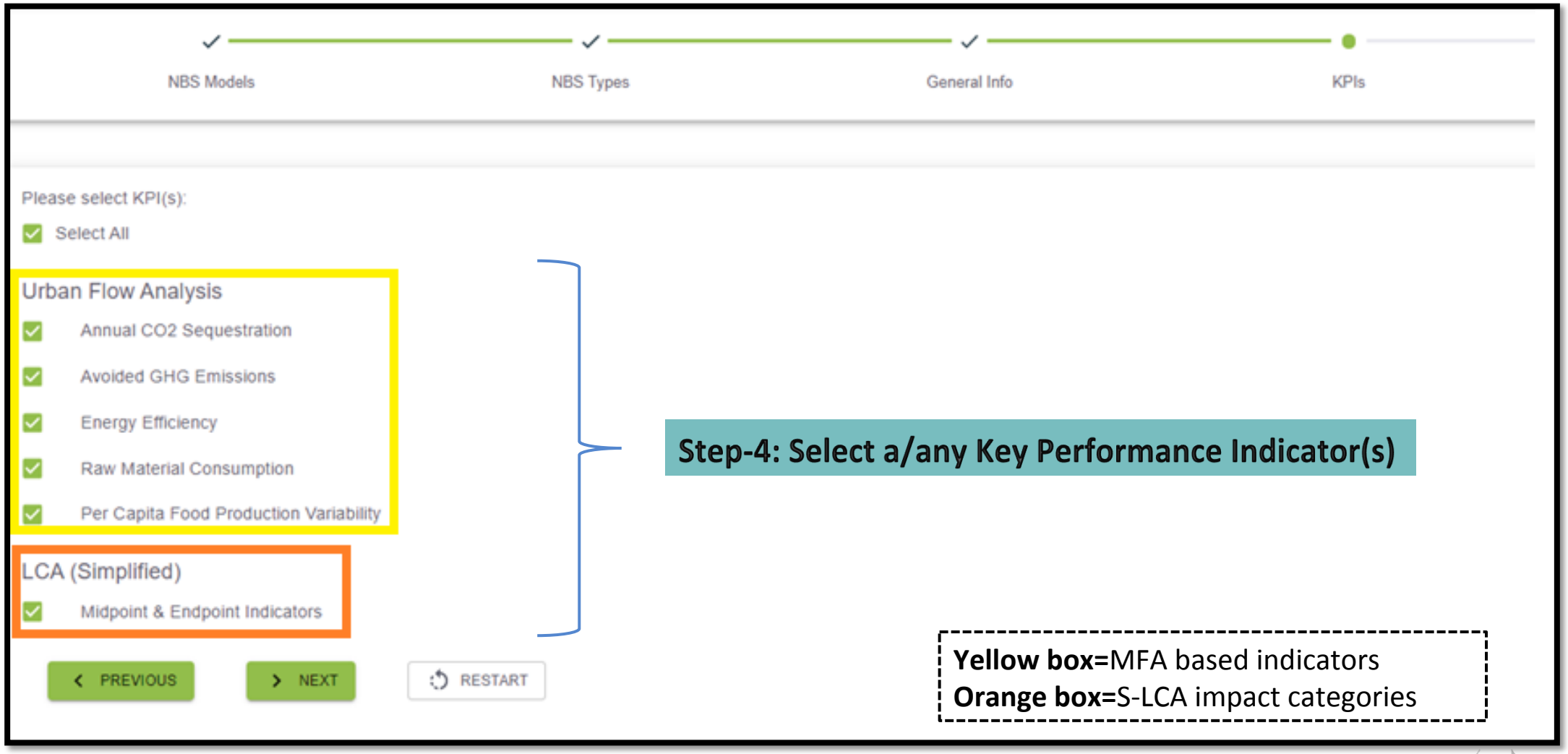
Common Environmental Assessment Tool Steps



Step-4: Select a/any Key Performance Indicator(s)

Yellow box=MFA based indicators
Orange box=S-LCA impact categories

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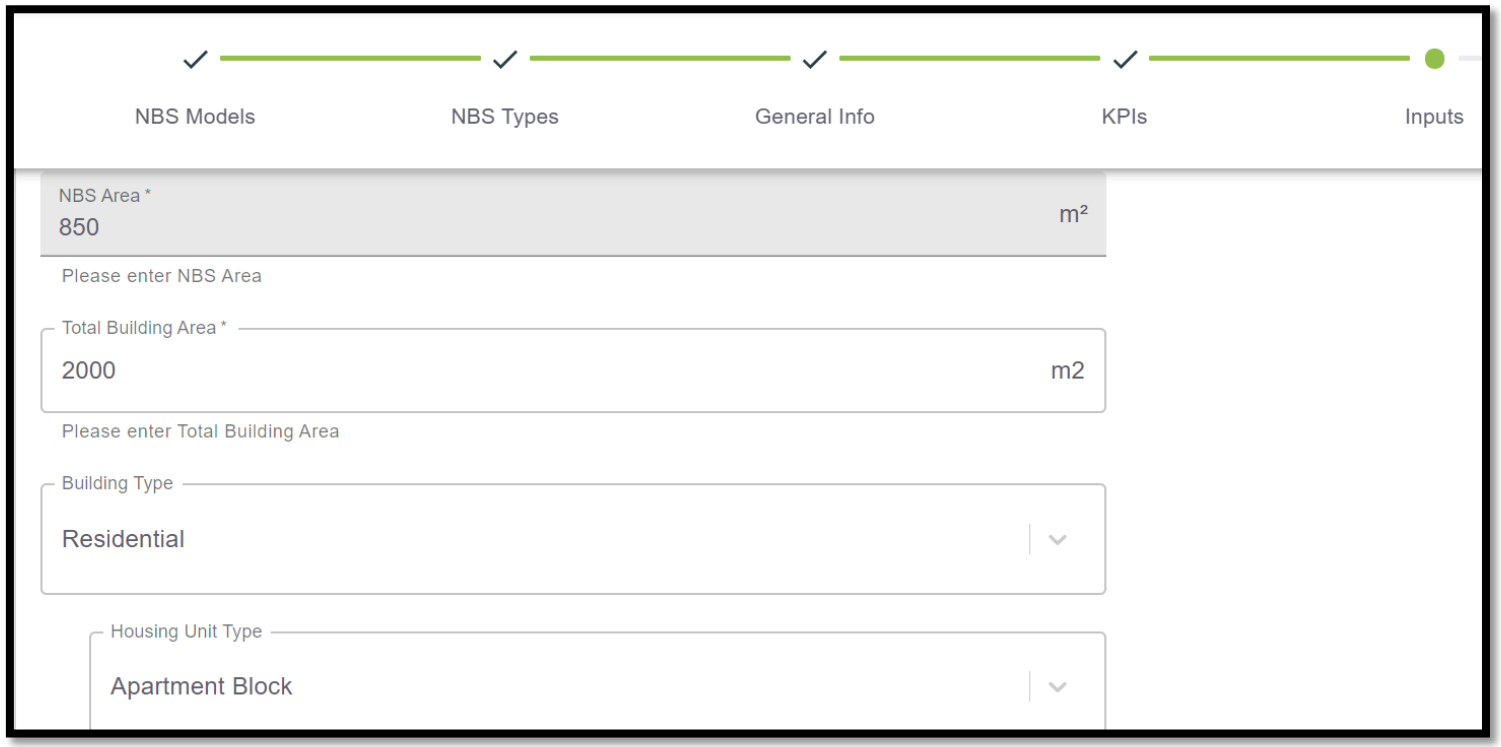

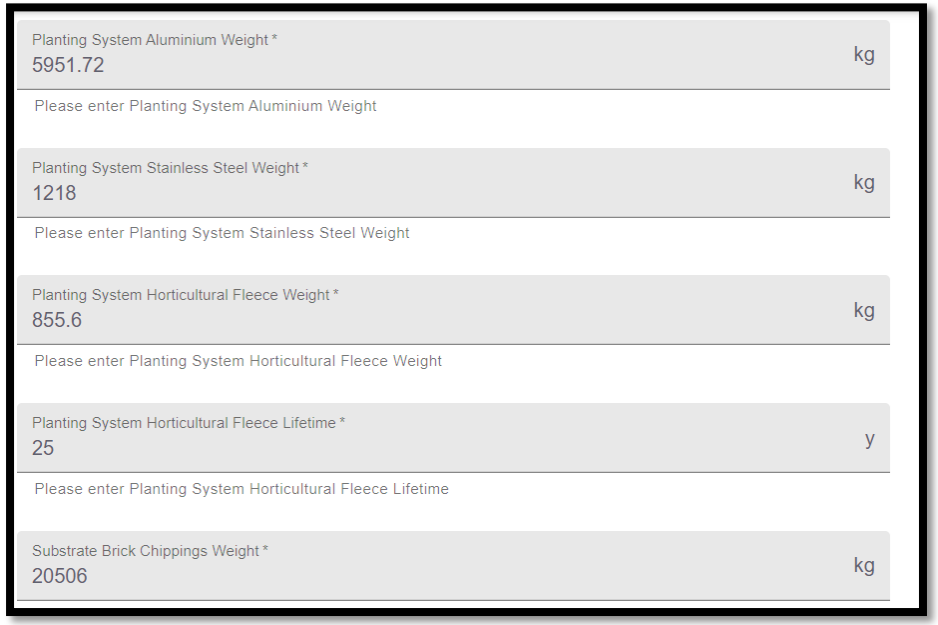

Step-5: Enter required inputs for final step (Default values are already given)

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Common Environmental Assessment Tool Results Page

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Platform

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NBS Models ✓ — NBS Types ✓ — General Info ✓ — KPIs ✓ — Inputs ✓ — Results ●

Assessment Report

NBS: Green Wall
Type : Living wall systems build or attached planter systems
NBS Area: 850 m²
NBS Service Life: 40 years
Continent: Europe
Country: Belgium
Buiding Type: Residential
Buiding Unique Type: Apartment Block
Heating Method: Natural Gas
Report Creation Time: Fri, 15 May 2020 08:49:31 GMT

KPI	Unit	Value	Comment
Annual CO2 Sequestration	kg CO2/year/NBS Area(m2)	4568.96	
Avoided GHG Emissions (NBS Implemented against Baseline)	kg CO2e/year	-1644.32	
Avoided GHG Emissions (Grey Solution against Baseline)	kg CO2e/year	-1500.85	
Avoided GHG Emissions (NBS Implemented against Grey Solution)	kg CO2e/year	143.47	

Step-6-a: Viewing Assessment Results

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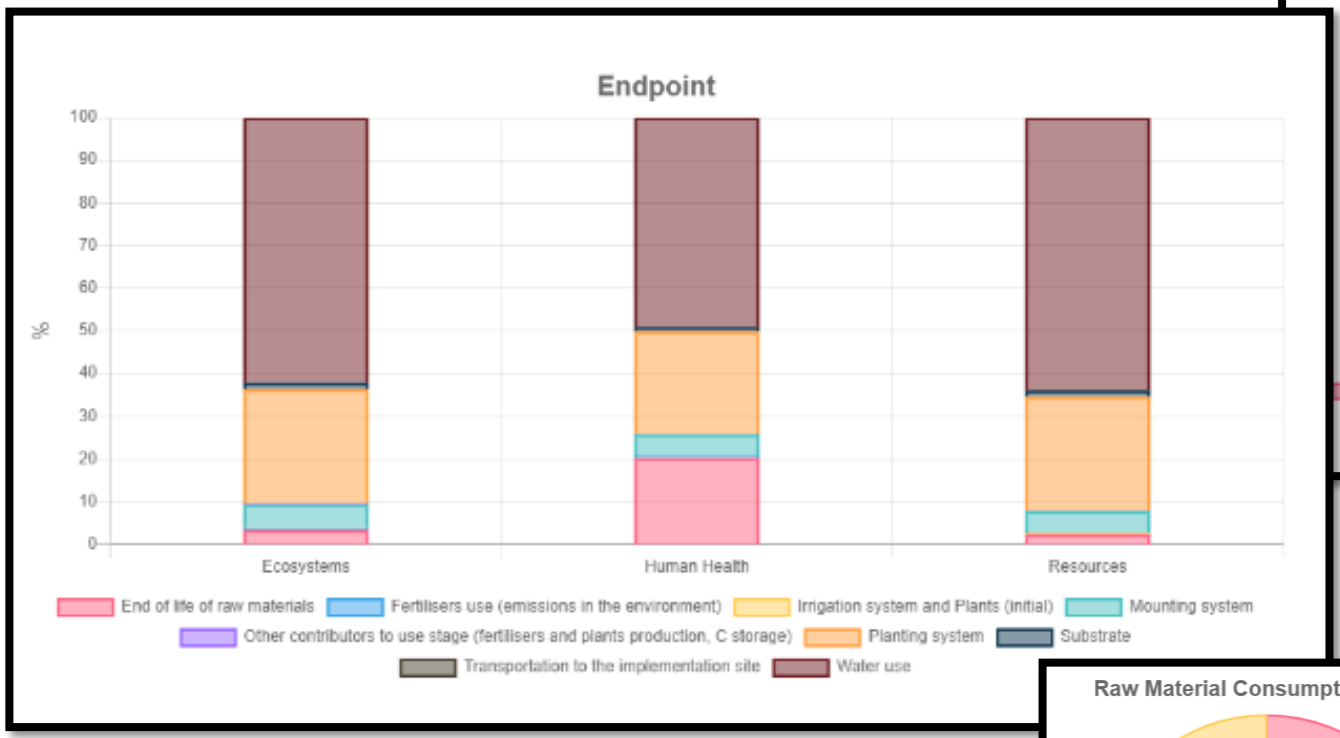
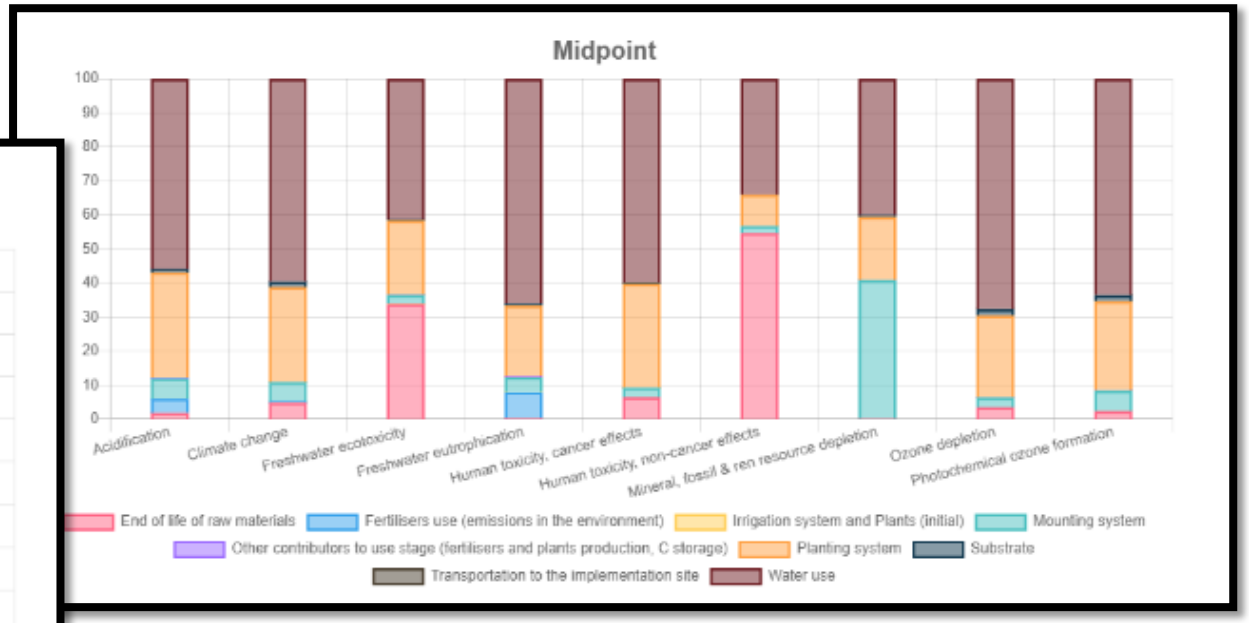
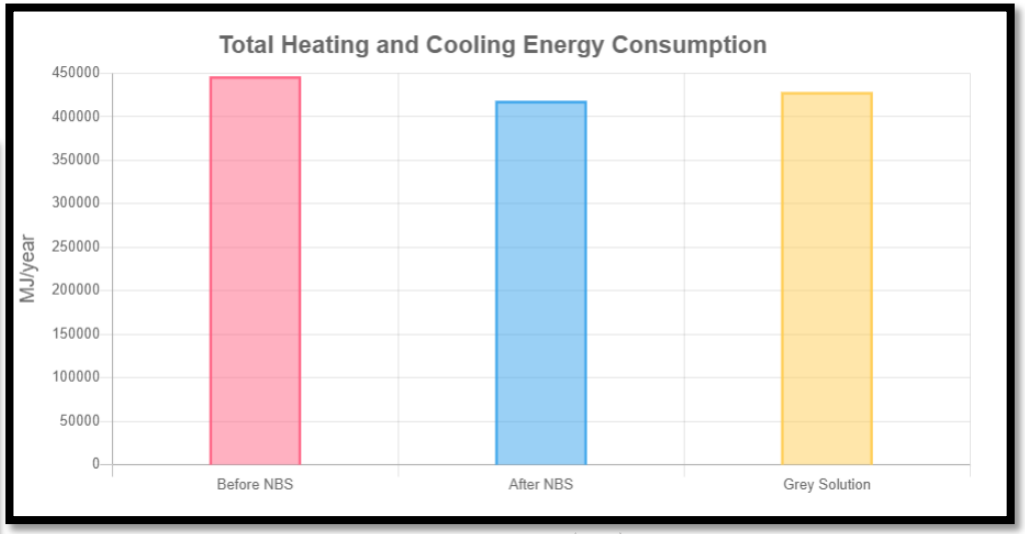
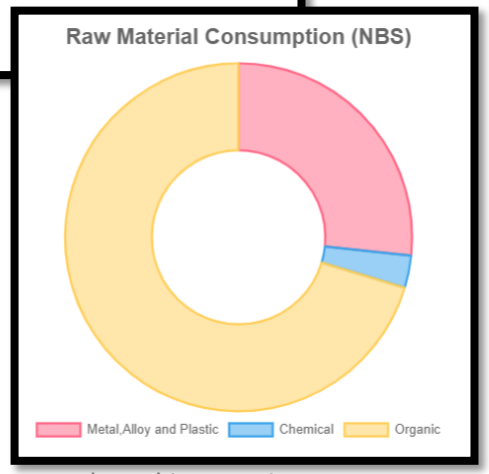
Common Environmental Assessment Tool Results Page









Step-6-b: Viewing Assessment Results

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Decision support guidelines for climate resilient cities and NBS

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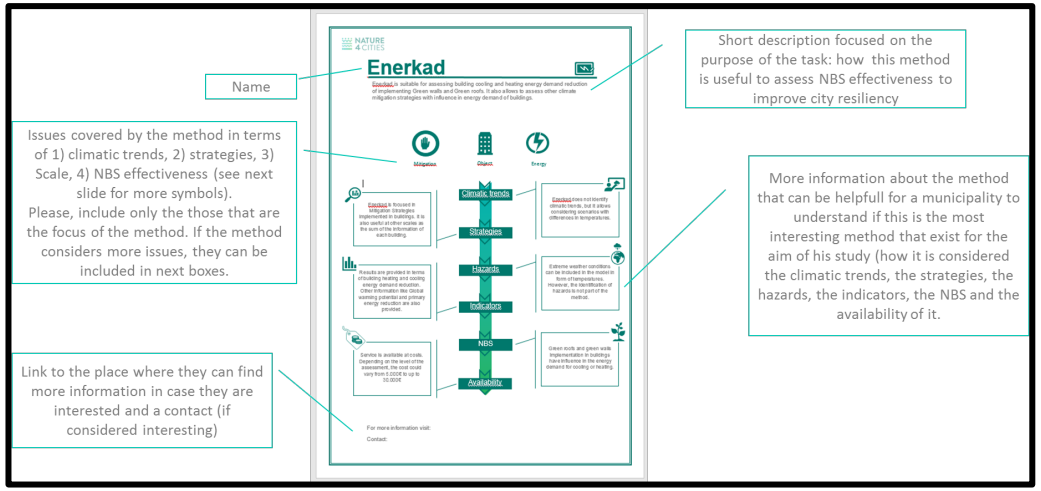
Platform NATURE 4 CITIES

1. Do you want to assess climate trends that could affect your city?
2. Which kind of threats/impacts do you want to consider?
3. Which strategy do you want to implement?
4. Which kind of outputs do you want to obtain?
5. Which indicators do you want to take into account?
6. At what scale do you want to work?
7. Are you interested in specific NBS?
8. Availability
9. Budget

City | NBS | Adaptation | Mitigation

Design Builder	DesignBuilder is a software tool used for energy, carbon, lighting and comfort measurement and control. It aims at providing high quality, comfortable buildings that also comply with building regulations, minimise upfront costs to the client, optimise on-going energy costs and reduce environmental impact. It combines advanced energy simulation with the fastest modelling technology, which enables to include green solutions (e.g. green roofs), to support in the estimation of energy demand and consumption based on external temperatures and on desired internal thermal comfort.
IVAVIA (Impact and Vulnerability Analysis of Vital Infrastructure and built-up Areas)	Impact and Vulnerability Analysis of Vital Infrastructure and built-up Areas (IVAVIA) is a risk analysis methodology (in the SoA is defined as tool) that helps cities in understanding cause-effect relationships of climate change, identifying geographical risk and vulnerability hotspots, assessing the demographic, economic and local impact of climate change now and for the future. Green infrastructure is one of the factors that determines coping capacity and thus affects vulnerability.
PLINIVS models	PLINIVS models are the models developed by PLINIVS Study Centre of University of Naples Federico II for different purposes under various studies. Main models and tools focus on seismic, volcanic, landslide impact simulations and economic impacts of natural hazards. It allows risk assessment and decision support.
Soil and Water Assessment Tool (SWAT)	SWAT (Soil and Water Management Tool) is a small watershed to river basin-scale model to simulate the quality and quantity of surface and ground water and predict the environmental impact of land use, land management practices and climate change. SWAT is widely used in assessing soil erosion prevention and control, non-point source pollution control and regional management in watersheds.
US EPA Storm Water Management Model (SWMM)	EPA's Stormwater Management Model (SWMM) is used for single event or long-term simulations of water runoff and quality in primarily urban areas.
Rayman	Rayman is developed to calculate short wave and long wave radiation fluxes affecting the human body. The model considers complex building structures and the clouds and is suitable for the analysis of the effect of various planning scenarios on thermal comfort in different micro to regional scales.

Step-1: Express your interest by answering 9 questions



Step-2: Viewing a summary of preselected methods

Step-3: Viewing forms with more information about preselected methods

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Thank you for your attention!

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