CASE STUDY BOOKLET

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Mapping green infrastructures and their ES in Antwerp

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ESMERALDA partner: Vlaamse Instelling Voor Technologisch Onderzoek N.V. (VITO)

Case Study Coordinators: Inge Liekens & Steven Broekx

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Enhancing ES mapping for policy and decision making

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CASE STUDY FACTSHEET

Mapping green infrastructures and their ES in Antwerp

WS7_cs2a

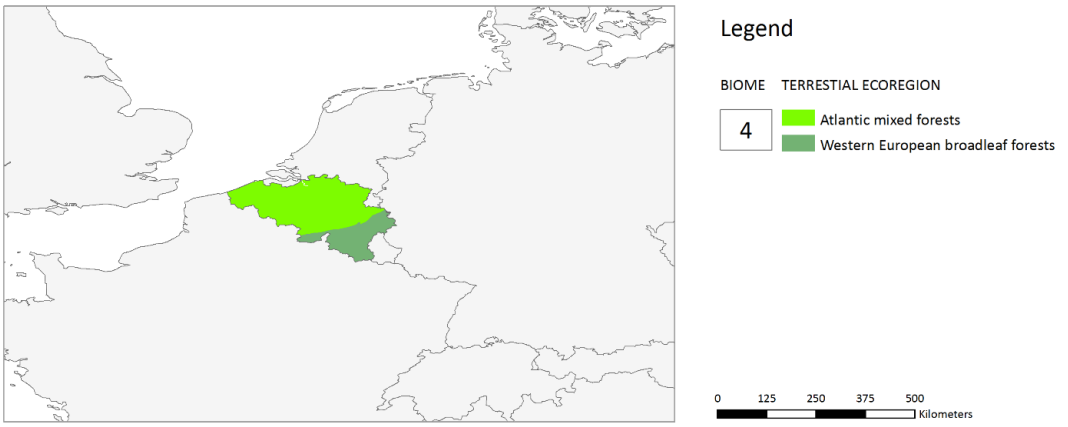
NAME AND LOCATION OF STUDY AREA	City of Antwerp
COUNTRY	Belgium

STATUS OF MAES IMPLEMENTATION

Stage 1	Stage 2	**Stage 3**

BIOMES IN COUNTRY

1 Tropical & Subtropical Moist Broadleaf Forests	**4 Temperate Broadleaf & Mixed Forests**
5 Temperate Conifer Forests	6 Boreal Forests/Taiga
8 Temperate Grasslands, Savannas & Shrublands	11 Tundra
12 Mediterranean Forests, Woodlands & Scrub	13 Deserts and Xeric Shrublands
14 Mangrove	



case study outline

SCALE	national	sub-national	**local**	
AREAL EXTENSION	**Ca. 200 km²**			

THEMES

nature conservation	climate, water and energy	marine policy	natural risk
urban and spatial planning	**green infrastructures**	agriculture and forestry	business, industry and tourism
health	ES mapping and assessment		

ECOSYSTEM TYPES

urban	cropland	grassland	woodland and forest
heatland and shrub	sparsely vegetated land	wetlands	rivers and lakes
marine inlets and transitional waters	coastal	shelf	open ocean

1. Overview of the study area

Antwerp is the second largest city in Belgium. It has 517 000 inhabitants and a surface of 204.5 km². The city is a mix of a highly urbanized central area, with a clear shortage of available green space, some larger important conservation areas at the borders of the city, and an industrial harbour area. The tidal river Scheldt, which runs through the city, and neighbouring wetlands are also important ecosystems.

The city has the ambition to become more green (see Figure 1). To achieve this purpose, a masterplan on green and blue infrastructure was developed, focusing on five "park-regions". The master plan includes large-scale restoration projects (e.g. *parkspoor Noord*: transform former railway station to urban park; *park groot Schijn*: restore a green-blue corridor and connect a large nature area to the city) and small-scale initiatives such as garden streets, green facades and urban farming. Beside this citywide strategic plan, nine local green plans at district level and one for the harbour area are currently under development or planned.

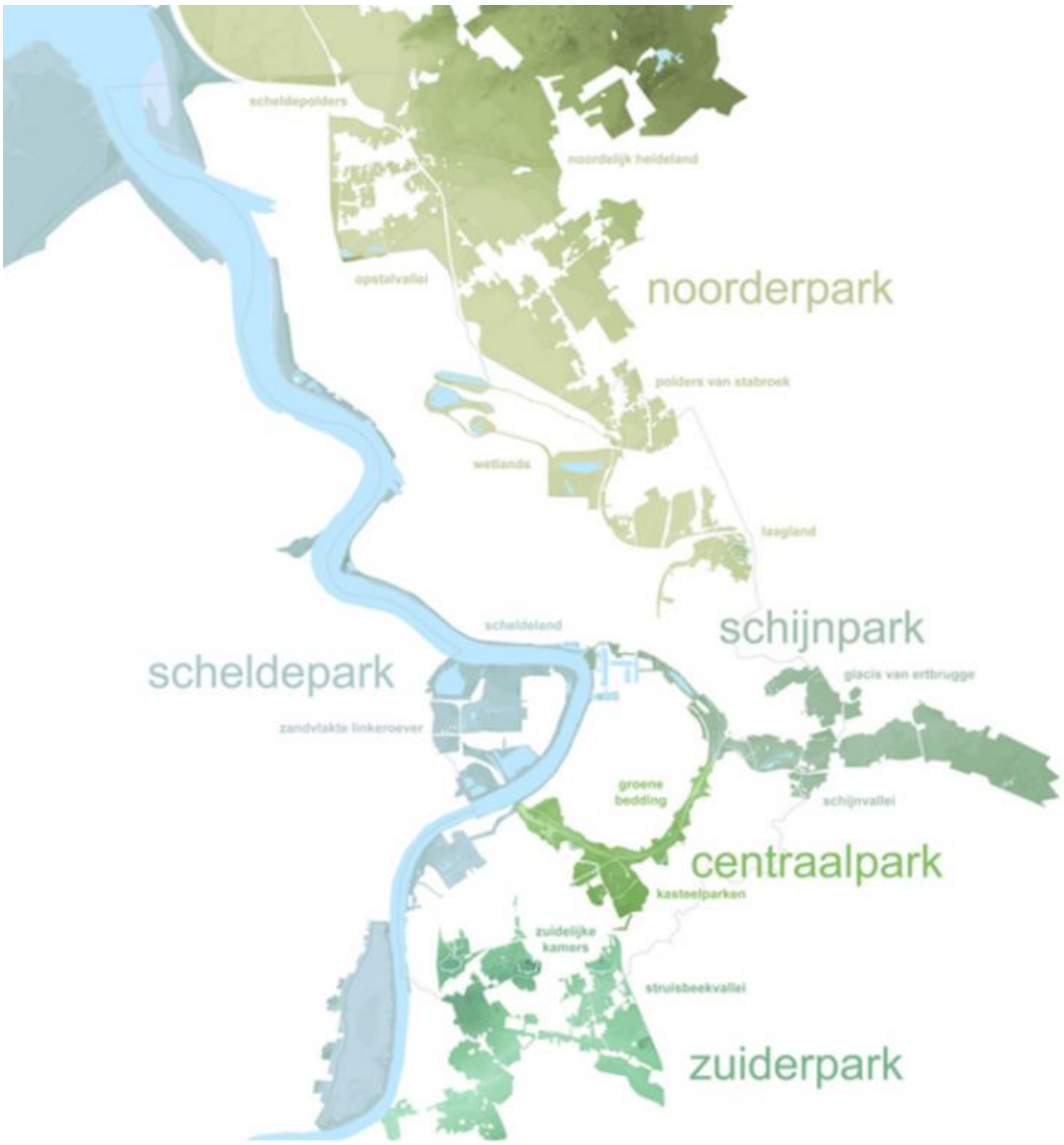


Figure 1: Key park regions and corridors in the Antwerp green masterplan

2. Questions and Themes

Establishing win-win situations for different topics simultaneously with green and blue infrastructure is a key ambition of the city and its strategy. Mapping and assessing the impacts of green infrastructure will help to achieve this. For this purpose, the city developed the ***Antwerp Greentool***, which contains different ES maps and integrated assessment tools (see https://groentool.antwerpen.be/). It is only available in Dutch but "gebiedsanalyse" is self-explanatory.

The objective of the *Greentool* is to inspire spatial planners and city officials to take smart and green measures when developing urban locations. For this purpose, it provides different sorts of information:

1) General Insights into the advantages of including vegetation and water bodies in urban developments (literature review). The degree of positive impact of various 'smart' measures can be seen on the following environmental factors:
   - Air quality
   - Heat Stress
   - Noise
   - Water management
   - Nature and Biodiversity
   - CO2-capture
   - Recreation
   - …

2) An overview of the existing environmental quality is provided allowing the existing environmental challenges to be identified (pressure maps).
- The effects of a large database of green and blue measures can be performed for each topic (expert based evaluations).
- Suggestions of interesting measures to users for locations of their interest
- The measures are applicable on different scales: street level up to city wide
- Analysis is based on cartographic information:

3) Maps presenting the impact of possible measures

The tool can be applied to benchmark sites owned by city authorities, support management plans and can be made mandatory for urban development plans to ensure spatial planners take into account environmental challenges and liveability.

The tool is inspirational. The idea is to supply easily available information (it should not take more than 1 hour), to non-expert users.

3. Stakeholders' Involvement

The development of the tool and all maps was done in close cooperation with the city authorities (department sustainable city, with focus on energy and environment). During the project, other departments such as the biodiversity department and the spatial planning department were consulted. Generally, the tool supports the development of local green plans, which involves the consultation of local citizens.

4. Initiating Mapping and Assessment

4.1. Identification and mapping of ecosystem type

The major ecosystem type is "Urban". Other important habitats include forests, wetlands and grasslands. A lot of effort was invested in setting up a suitable typology of urban green infrastructure and developing a map of the current situation (see Table 1). This is based on existing morphological classifications of land use maps, green management, green infrastructure (example categories are green roofs intensive, extensive; semi-hardened surface; tree rows; SUDs; grassfield; hedges and shrubs; coniferous – broadleaved forest. We also provide 12 inspirational street images from Antwerp or other cities to roughly estimate the impact of combined measures (see examples in Figure 2).

Table 1: Typology of urban green infrastructure applied for Antwerp

Level 1	**Level 2**	**Level 3**
Green roofs	Extensive Green roofs	
	Semi intensive green roof	
	Intensive green roof	
Pavements	Closed pavements	
	Semi-hardened pavement	
	Open pavements (soil, woodchips, broken fractions)	
Water and Humid Vegetation	Water	
	Humid vegetation	
	Suds	
Open vegetation	Bare soil	
	Flower meadow and herbaceous vegetation	
	Grass field, lawn	
	Heathland	
	Private gardens (low vegetation)	
	Agricultural landuse	Community gardens/kitchen garden
		Other agricultural landuse
Bushes, hedges and woodsides		
Forest	Deciduous forest	Tree height <6m; 6-12m; >12m
	Coniferous forest	Tree height <6m; 6-12m; >12m
	Mixed forest	Tree height <6m; 6-12m; >12m
	Forest edge vegetation	Tree height <6m; 6-12m; >12m
City trees	Deciduous trees	Tree height <6m; 6-12m; >12m
	Coniferous trees	Tree height <6m; 6-12m; >12m
	Mixed trees	Tree height <6m; 6-12m; >12m
	Orchard	
Facades and walls	Green walls	
Build surface		

Street typology 1: Garden street Antwerp

Street typology 2: Copenhagen water street

Figure 2. Examples of inspirational street typology

4.2. Assessing ecosystem conditions

Condition indicators:

- Land cover map taking into account a tree inventory and the presence of green roofs (proportions of land use)
- Biodiversity: identification of key protected areas and corridors.

Pressure indicators:

- air quality (yearly average concentrations EC, Nox, PM10, PM2,5 in µg/m³)
- noise hindrance (dB)
- urban heat (radiation temperature during a heat event in °C)
- flood risk pluvial flooding (risk: non critical risks < T 20years; low critical T 20 years; highly critical T 5 years; very critical T 2 years)
- areas with shortage local green (m² of green area per inhabitant)

4.3. Selecting Ecosystem Services

The ES were selected based on expert knowledge and relevance for the city authorities. Table 1 lists the selected ES, classified using the CICES v4.3 (2013) classification, and related assessment method categories.

Table 2. Overview of the ES and related mapping and assessment methods in the Antwerp case study

Ecosystem Service selected for mapping and assessment	B	S	E
2.3.5.1 Global climate regulation by reduction of greenhouse gas concentrations	X		
2.3.5.2 Micro and regional climate regulation	X		
2.1.2.3 Mediation of smell/noise/visual impacts	X		
2.1.2.1 Filtration/sequestration/storage/accumulation by ecosystems*	X		
2.2.2.1 Hydrological cycle and water flow maintenance	X		
3.1.1.2. Physical use of land- /seascapes in different environmental settings*	X		

* ES selected for further discussion during ESMERALDA workshops 7 in Trento;
B = biophysical methods; S = socio-cultural methods; E = economic methods.

5. Methods for ES mapping and assessment

5.1. Biophysical methods for ES mapping and assessment

An expert based scoring table was applied to map the impact of measures (tier 1). This was combined with outcomes from process based models for modelling pressures (tier 3 for noise, urban heat island effect, air quality, risk for pluvial flooding; tier 1 for recreation) to identify interesting locations for green infrastructure.

Impact calculation:

*impact_measures = pressure * (impact_score measure – impact_score existing situation)*

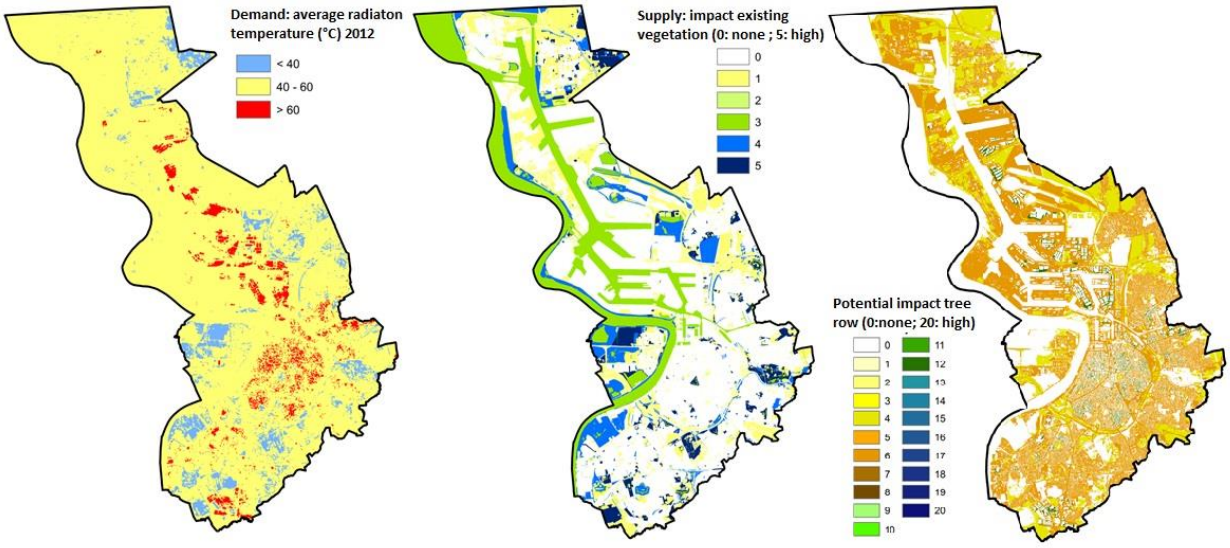


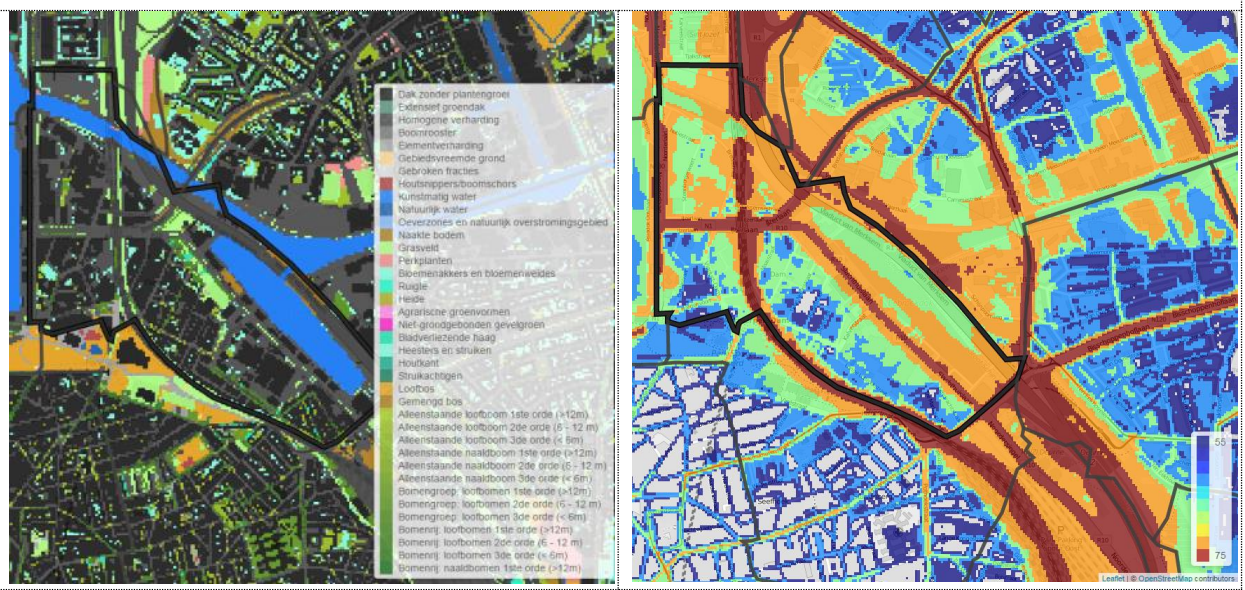
Figure 3: ES maps for heat stress in Antwerp. Supply from existing vegetation and water is scored from none (0) to maximal (5). Based on a heat map of the city and population densities the demand is mapped leading to zones with varying degrees of impact vegetation. Taking into account the current supply and demand, the potential for green measures is calculated, and scored from no potential (0) to maximal potential (20).

5.2. Integration of ES mapping and assessment results

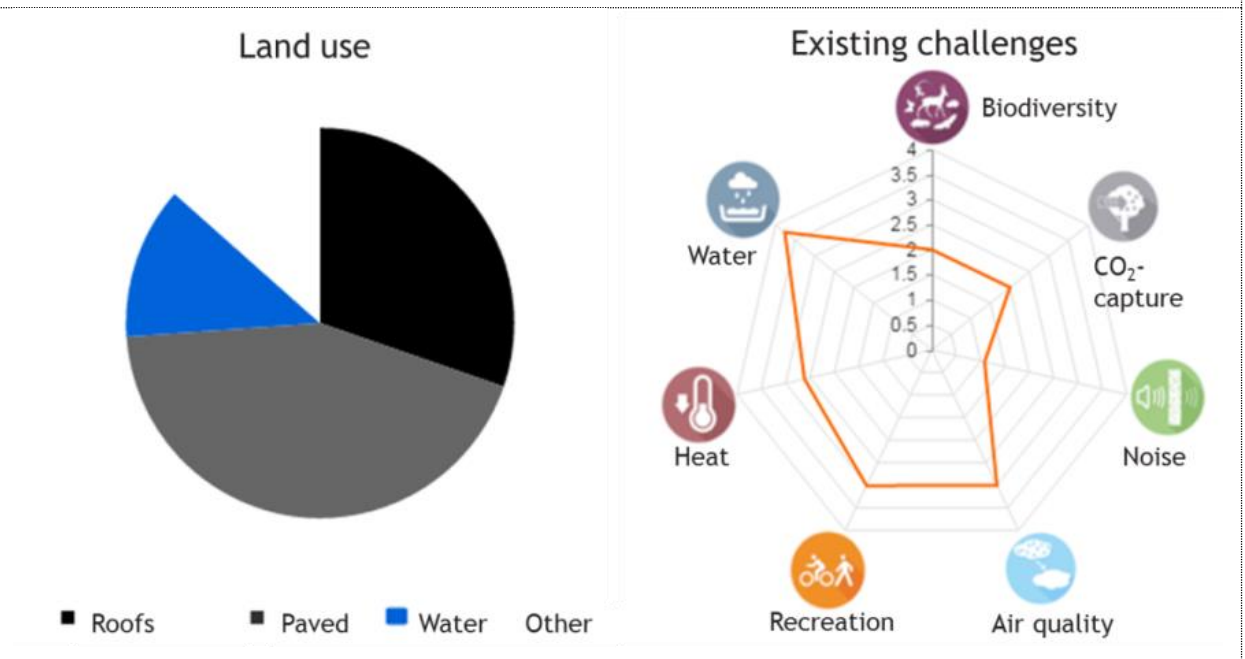
To allow an easy overview on the condition (land use distribution, pressures), the *Greentool* allows users to select an area and get a quick overview (star diagram) of all the pressures. This information, in combination with other data such as the presence of buildings, **street canyons**, open spaces to assess the suitability of the area to implement specific measures, allows to assess the impact of specific types of measures.

5.2.1. Applying the Greentool

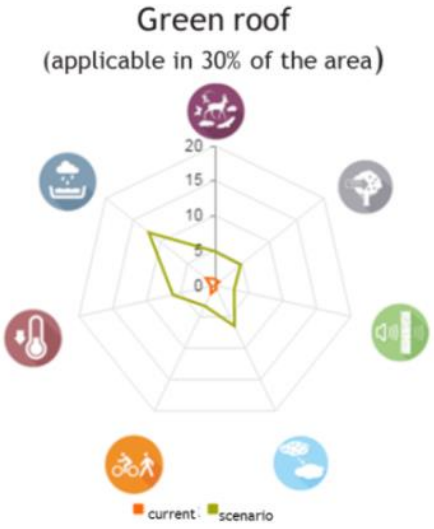
Step 1: Select an urban area in an interactive map: noise map with noise levels in dB and selection of an area (left) and land use - buildings, infrastructure, vegetation, water etc. (right).

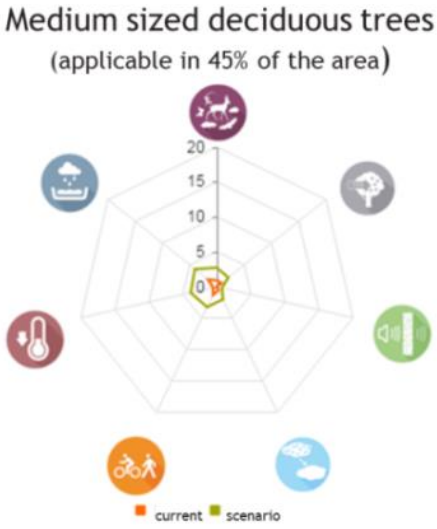


Step 2: Analyse current situation for selected area: land use composition - existing pressures



Step 3: Assess the suitability and impact to install specific types of green infrastructure in this area





6. Implementation

General feedback of users given on the existing methodologies is that a quick feedback on identification of the pressures in the selected area is very relevant and of high added value. Impact calculation of the measures and top five list of most suitable measures could improve.

The general challenge remains on improving the usability of maps and assessments for selecting suitable building blocks for local green plans.

General expert question: Is it sufficiently credible? Yes/no? Where do you see major knowledge gaps and challenges for further improvement? How to bridge the gap with spatial planners?

This general question is split into the following five groups of specific questions found in annex:

- Typology
- Selection of indicators
- Impact calculation
- Integrated assessment
- Communication of results and use

7. References & Annexes

References

https://groentool.antwerpen.be

https://www.natuurwaardeverkenner.be/

Annexes

Table 3: Biophysical ranges as a baseline for expert based evaluation of impact green infrastructure

Score	Heat stress reduction	Air quality improvement	Noise buffer	kg C seq. per year per m²	Recreation & Amenity
5	-2°C	> 15% improvement local air quality	>=10 dBA	0.79 - 1.18	High visibility and a lot of evidence positive impact on amenity, recreation
4	-1.5°C	> 10%	>=5 en <10 dBA	0.74 - 1.08	High visibility and some evidence positive impact
3	-1°C	> 5%	>=3 en <5 dBA	0.45 - 0.79	Average visibility (low vegetation), some evidence positive impact
2	-0.5°C	> 1%	>=1 en <3 dBA	0.40 - 0.74	Low visibility, some evidence positive impact
1	-0.5 tot 0°C	< 1% improvement	>0 en <1 dBA	0.05 - 0.40	Low visibility, very little evidence positive impact
0	no impact	no improvement	0 dBA	< 0.05	No impact
-1		negative	< 0dBA	n.a.	n.a.

Table 4: Impact scores major types green infrastructure elements (expert based)

Green infrastructure element	Heat	Air quality open	Air quality canyon	Air quality buffer	Noise	Carbon seq.	Biodiversity	Water	Amenity and recreation
Extensive Green roofs	1	0	0	0	4	1	1	3	0
Semi intensive green roof	2	1	1	1	4	2	2	3	1
Intensive green roof	3	2	2	2	4	3	3	4	1
Closed pavements	0	0	0	0	-1	0	0	0	0
Grass dales	1	0	0	0	2	0	2	2	0
Broken fractions	1	0	0	0	1	0	0	3	0
Wood chips	1	0	0	0	2	0	0	3	0
Water	3	0	0	0	-1	0	4	5	4
Humid vegetation and wetlands	4	0	0	0	1	1	5	4	3
SUDS	2	0	0	0	0	1	3	5	3
Bare soil	1	0	0	0	0	0	1	3	2
Grass field	1	0	0	0	2	1	3	5	3
Flower meadow	1	0	0	0	3	1	5	5	3
Heathland	1	0	0	0	3	1	5	5	3
Agriculture	1	0	0	0	3	1	3	5	3
Green walls	1	1	1	1	3	1	1	1	2
Hedges	2	1	-1	1	3	2	1	4	3
Shrubs	2	1	n.a.	2	2	2	4	5	4
Deciduous forest	5	3	n.a.	5	4	5	4	5	5
Forestedge vegetation	1	1	n.a.	1	2	2	5	5	5
City tree deciduous(>12m)	2	2	-1	2	1	4	4	4	4
City tree deciduous (6 - 12 m)	1	1	-1	2	1	3	4	3	3
City tree deciduous (< 6m)	1	1	-1	2	1	2	3	3	3
Biodiversity friendly building elements	0	0	0	0	0	0	4	0	0

Specific expert questions to be discussed during workshop:

a) Typology of green (land cover map):

Expert questions:

- Do you have suggestions on how we can incorporate tree canopy data and information of private gardens? What are suitable data layers and methodologies?
- How to deal with two-dimensional information? (tree crown versus soil coverage, green walls)
- Scale: what is an appropriate scale for the line of questioning? Is 10x10m sufficiently detailed?

b) Indicator selection

Expert questions:

- Are the applied indicators suitable for the objective of the tool?
- Do you see important topics missing?
- Are the applied indicators good to assess the pressures for the different topics? Do you have alternative suggestions?
- Does including biophysical, social and economic valuation add value to the evidence base for the decision making process? If yes, how and how to approach this?

c) Impact calculation

Large simplification of impact calculation due to lack of knowledge and calculation complexity. Assessment of quantitative impacts of process-based models is not an option (scenarios). Biophysical (e.g. tonnes), social and economic valuation was not expressed as a need by the users.

Expert questions:

- Impact calculation depends heavily on the local pressure in the existing methodology (cell values). Is this problematic? Do you know methodologies to overcome these problems? And do you have good examples? (E.g., distance decay functions)
- Can/should we standardize scores based on the importance of the impact? (e.g. in terms of health)
- Diversity on impact of measures can be large between different species (e.g. tree species). Is credible information available on this? Where can we find this information?
-

d) Prioritization of measures / integrated assessment

The star diagram is used to demonstrate the integrated impact on different topics.

Expert questions:

- What your feeling is about these star diagrams? Does it answer the need of the tool?
- Do you see possible improvements? Do you have inspirational examples?

e) Communication of results and use

The tool is intended to be used on a voluntary basis. As many small projects are happening where it is not feasible to do detailed model calculations/scenario analysis on specific topics, this tool can serve as an explorer to assess small-scale impacts of urban greening. Additionally, it needs to help to identify priority areas on a city scale. Inspiration is an important key word. Not decision.

Target audience: city administrations, consultancies, urban planners, citizen organizations.

Multi-scale application:

- Project level/street level: Design book management of public spaces – can a sustainability check be built in the building code to underpin selection of measures?
- City level: where are the top five locations to install green roofs?
- What is the contribution of projects, specific measures, to sustainable development goals?

Time foreseen for use: the idea is that the user gets feedback within 1 hour.

Expert questions:

- Does the intended use corresponds with the tool set up? Do you see issues?
- Do you see other potential uses to support decision-making?
- Do you have other examples where similar tools are used in a similar context?
- How to improve usability? How to improve the process organization and the inclusion of the tool / maps in this?
- What can we learn from social valuation/participatory techniques in this perspective?