URBAN GreenUP

D1.8: KPIs calculation tool and prioritization criteria

WP 1 , T1.6

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[1] PU = Public

PP = Restricted to other programme participants (including the Commission Services)

RE = Restricted to a group specified by the consortium (including the Commission Services)

CO = Confidential, only for members of the consortium (including the Commission Services)

Versions

Table 0-1: Table of contributions & versions of the deliverable

Version	Person	Partner	Date
v1	Kaan Emir	DEM	31.07.2020
v2	Esther San José Carreras, José Fermoso Domínguez	CAR	11.09.2020
v3	Magdalena Rozanska	ACC	15.09.2020
v4	Kaan Emir, Esra Demir, Baha Kuban	DEM	17.09.2020
v5	Alicia Villazán Cabero, Clare Olver	VAL, LIV	25.09.2020
v6	Kaan Emir	DEM	25.09.2020
v7	Tania Molteni, Benedetta Lucchitta	UBO	30.09.2020
v8	Kaan Emir	DEM	30.09.2020

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0 Abstract

The main purpose of this document is to explain KPI prioritization matrix which is a part of URBAN GreenUP's Scenarios Tool explained in D1.7. This matrix is directly related with action 2E of Re-naturing methodology given in table 1.1 of this document.

The following chapters is starting with introduction which includes 3 sections explaining the purpose and target groups, contribution of partners and relation between this document and other studies within this project.

In chapter 2, there are 3 sections. In first section a summary of previous studies connected with KPI selection and monitoring activities given by dividing the section into 4 subsections which are: List of KPIs, Selection criteria for KPIs, Barriers and Challenges on selection of KPIs, Questions to prioritize the KPIs. In this chapter the need for prioritization of KPIs is also explained. This chapter completed by evaluation of KPI prioritization matrix included in URBAN GreenUP's scenarios tool in detail.

The possible results, how to evaluate these results and visualization of results are explained within chapter 3.

The link between URBAN GreenUP's scenarios tool and the role of KPI prioritization matrix within this tool are investigated in detail under chapter 4.

This document completed with conclusions chapter which explains purposes of each chapter and main outputs.

1 Introduction

1.1 Purpose and Target Groups

The main purpose of this document is to explain KPI prioritization matrix which is a part of URBAN GreenUP's Scenarios Tool explained in D1.7. This matrix is directly related with action 2E of Re-naturing methodology given in table 1.1 of this document and has 2 main outputs as following:

- Output 1. Design monitoring program to track indicators to confirm progress (KPIs prioritization)
- Output 2 Define processes for review and adaptive management as milestones are met/missed and learnings are derived

The main target group of this report is city partners hence KPI prioritization process will be operated by them. Besides these partners, all partners related with design, implementation, maintenance and monitoring activities of NBS considered during the preparation of the document.

1.2 Contribution of Partners

Various partners of URBAN GreenUP project contributed to this document in different levels.

CAR and ACC directly contributed by preparing URBAN GreenUP's Scenarios Tool and Re-Naturing Methodology and explaining the links between those studies with KPI prioritization.

City partners directly contributed by sending inputs about their experiences on city related sections.

All other partners contributed by participating previous studies related with KPI selection and monitoring activities.

1.3 Relation to Other Activities in Project

URBAN GreenUP developed a systematic strategy to reach high level of impacts through the use of NBS. It aims to provide an integrated methodology to support the Urban Planning of NBS at the local city level, as a powerful strategy to contribute to increase sustainability, addressing a range of societal challenges. URBAN GreenUP introduces the concept of Renaturing Urban Planning, which incorporates NBS alongside the traditional urban planning aspects to generate a more sustainable approach to Urban Planning.

In parallel to traditional planning processes, the methodology supports cities in the direct implementation of one or more NBS in a specific area or across the city to address specific societal challenges in a more effective and ecologically sustainable way. This requires the proper monitoring and evaluation strategy for the NBS scenarios generated (this concept explained under chapter 4 of this document) and include the Key Performance Indicators, but also its prioritization criteria depending on different city diagnosis situation developed in previous step.

Table 1-1: Re-Naturing Methodology.

How to start?	1st. Understand your present	2nd. Choose your future aspirations	3rd. Integrate RUP and keep	"Renaturing Urban Plan"
A. Engage and Co-create	Action 1A. Identify and involve stakeholders	Action 2A. Prepare for co-delivery		**Chapter I.** Introduction to Re-naturing
B. Explore	Action 1B. Understand your "city" needs	Action 2B. Choose your "city" targets	Action 3B. Prepare RUP Plan integration into the Urban Plans of Local Municipality	**Chapter II.** City Targets
C. Diagnose	Action1C. Understand your "city" capacity	Action 2C. Evaluate NBS Scenarios and select one	Action 3C. Define list of NBS Projects and Actions	**Chapter III.** City NBS Adopted Scenarios
D. Visualize	Action 1D. Map challenges	Action 2D. Set spatial priorities for NBS	Action 3D. Prepare assessment of the Impact and Risk	**Chapter IV.** City Impact
E. Plan	Action 1E. Establish Baselines	Action 2E. Choose how success will be monitored	Action 3E. Prepare the Up-scale Plan	**Chapter V.** Monitoring Program and Action Plan
F. Inform	Action 1F. Promote the initiative	Action 2F. Publish the RUP	Action 3F. Define budget, roles and responsibilities	**Chapter VI.** Roles and Responsibilities
A. Engage and Co-create	Action 3A. Assess lessons learnt and validate the strategy			**Chapter VII.** Processes and reforms

In Action 2C, evaluating the NBS Scenarios, the supporting tool was created with aim to provide the user with a list of the best NBS for the needs, targets and capacities of the city (diagnosis/challenges/barriers/enablers). The analysis is completed with Action 2E where user choosing and adjusting the evaluation of NBS scenario. The main goal of this action is to help cities to choose and prioritize KPIs. In addition, with this action, a framework should be drawn on monitoring the results of NBSs to be implemented, taking into account the challenges and needs of the cities.

The information generated should allow the calculation for the KPI´s corresponding city baseline values (NBS based) and the level reached with respect to the targets defined. Thanks to monitoring procedures integrated to the City Urban Plans RUP, the scaling up to the city zones, districts, cities will be continuously improved.

Both actions than are interlinked and they are an important part of a holistic re-naturing methodology considered in URBAN GreenUP Project. The following deliverables are also helpful and extend the concept on prioritization of KPIs:

- *Deliverable 1.1 NBS Catalogue.*
- *Deliverable 1.2 Challenges Catalogue.*
- *Deliverables 2.2, 3.2 and 4.2 Baseline Definition by Zone and Challenge*
- *Deliverables 2.4, 3.4 And 4.4 Monitoring Program for Each City*
- *Deliverable 5.1 Technical KPIs definition*

- *Deliverable 5.3 City Diagnosis and Monitoring Procedures.*
- *Deliverable 1.7 NBS scenarios generation tool*

This holistic approach was validated thanks to the lessons learned, gathered in process of implementing NBS in the 'leading' cities of Liverpool (UK), Izmir (Turkey), Valladolid (Spain), and simultaneously validated in 'follower' cities of Mantova (Italy), Ludwigsburg (Germany), Medellin (Colombia), Changdu (China), and Quy Nhon (Vietnam).

2 KPI Prioritization for Nature Based Solutions

2.1 Summary of Challenges and KPIs

A brief subset of challenges in form of cards has been developed to form a catalogue, including their definition as well as key indicators and methods for assessing the possible impacts to be achieved through the use of nature-based solutions in cities in deliverable D1.2: Climate Change Challenge Catalogue. The catalogue is a part of the URBAN GreenUP methodology for the Renaturing Urban Planning concept (RUP) which incorporates urban planning aspects directly related with NBS as a part of the Sustainable Urban Planning (SUP). This methodology will support the direct implementation of one or a set of NBS in a specific area of the city to address specific challenges in a more effective way. It provides specific concepts definition and includes main NBS identified to deal with these challenges, as well as different key performance indicators defined to measure their impacts.

A set of Key Performance Indicators (KPI) which is described in D5.1 Technical KPIs definition and updated in D5.5: Technical KPI Definition (INTERIM II), were selected based on the Eklipse mechanism that show how the proposed actions and NBS will tackle the challenges that the project and each demonstration city is facing. These challenges and KPIs are specified in a summary below. Each epigraph is named after a challenge where the 29 related KPIs are fitted in. The Core KPI are divided by challenges : Challenge 1, climate mitigation & adaptation; Challenge 2, water management; Challenge 3, coastal resilience – there are no NBS planned to face this challenge in city demos, therefore it is not considered to be Core–; Challenge 4, green space management; Challenge 5, air quality; Challenge 6, urban regeneration; Challenge 7, participatory planning and governance; Challenge 8, social justice and social; Challenge 9: public health and well-being; Challenge 10, potential of economic opportunities and green jobs.

2.1.1 List of KPIs

In this section NBS vs. challenges and KPIs matches of 3 frontrunner cities are given in tables. These tables include the information from the interim report D5.9: NBS implementation conclusions and recommendations. Final NBS catalogue (Interim). Each city will evaluate the KPI codes and their final KPI list after 7th periodic meeting and 2nd review held between 28th and 30th of September 2020. These tables will be updated after this evaluation and updated tables will be given in D5.7 Data Collection Procedures.

The codes given in columns of tables below are described under chapter 3 of D5.5 Technical KPI Definition (Interim 2).

As an example: CH0101: Ton C02 CARBON REMOVED per Ha

- **Valladolid**

Table 2-1: NBS vs Challenge and KPIs match for Valladolid Subdemo A

VAL Subdemo A NBSs	CODE	CODE By CHALLENGE															
		CH1			CH2				CH4				CH5		CH6		CH9
		CH0101	CH0105	CH0107	CH0201	CH0204	CH0206	CH0218	CH0401	CH0403	CH0411	CH0412	CH0502	CH0507	CH0607	CH0901	CH0902
Re-naturing urbanization																	
Green route	Vac1								X	X	X			X	X		X
Arboreal Interventions	Vac2	X	X	X		X	X		X	X	X	X	X	X	X		X
	Vac3	X	X	X		X	X		X	X	X	X	X	X	X		X
Resting Areas	Vac6													X	X		
Water Interventions																	
SUDs	Vac8				X			X						X	X		
Singular GI																	
Pollinators	Vac19	X										X		X	X		
Cycle - Pedestrian Infrastructures	Vac15								X	X				X	X		X
Smart Soils	Vac16												X	X	X		
Vertical GI	Vac22		X	X					X	X	X	X	X	X	X	X	X

Table 2-2: NBS vs Challenge and KPIs match for Valladolid Subdemo B

VAL Subdemo B NBSs	CODE	CODE By CHALLENGE															
		CH1			CH2			CH4				CH5			CH6	CH9	
		CH0101	CH0105	CH0107	CH0204	CH0206	CH0216	CH0401	CH0403	CH0411	CH0412	CH0502	CH0507	CH0515	CH0607	CH0901	CH0902
Re-naturing urbanization																	
Arboreal Interventions	Vac4	X	X	X	X	X		X	X	X	X	X	X		X		X
Singular GI																	
Pollinators	Vac20	X									X		X		X		
Smart Soils	Vac17											X	X		X		
Vertical GI	Vac23		X	X				X	X	X	X	X	X		X	X	X
	Vac24		X	X				X	X	X	X	X	X		X	X	X
	Vac25		X	X				X	X	X	X	X	X		X	X	X
Horizontal GI	Vac26				X	X	X	X	X				X		X		
	Vac27		X	X				X	X	X	X	X	X		X	X	X
	Vac28		X	X				X	X	X	X	X	X		X	X	X
	Vac29		X	X				X	X	X	X	X	X		X	X	X
Pollutants filter	Vac30											X	X	X	X		

Table 2-3: NBS vs Challenge and KPIs match for Valladolid Subdemo C

VAL Subdemo C NBSs	CODE	CODE By CHALLENGE																			
		CH1			CH2						CH4					CH5		CH6	CH8	CH9	CH10
		CH0101	CH0105	CH0107	CH0201	CH0204	CH0206	CH0210	CH0216	CH0218	CH0401	CH0403	CH0408	CH0411	CH0412	CH0502	CH0507	CH0607	CH0802	CH0902	CH1003
Re-naturing urbanization																					
Arboreal Interventions	Vac5	X	X	X		X	X				X	X		X	X	X	X	X		X	
Carbon capture	Vac7	X	X	X		X	X				X	X		X	X	X	X	X		X	
Water Interventions																					
SUDs	Vac9				X		X			X							X	X			
	Vac10				X		X			X							X	X			
Flood actions	Vac11				X		X	X		X				X			X	X		X	X
Water treatment	Vac12	X	X	X		X	X										X	X			
	Vac13				X		X		X					X			X	X		X	X
Green pavements	Vac14		X	X	X		X			X							X	X			
Singular GI																					
Pollinators	Vac19	X													X		X	X			
	Vac20	X													X		X	X			
	Vac21	X													X		X	X			
Smart soils	Vac18															X	X	X			
Urban farming	Vac31												X				X	X			X
	Vac32																X	X			X
	Vac33																X	X			X
Non technical interventions																					
Educational activities	Vac34																X	X	X		X
	Vac35																X	X	X		X
	Vac36												X				X	X	X		X

Table 2-4: NBS vs Challenge and KPIs match for Valladolid Non-technical actions

VAL NBSs Non technical interventions	CODE	CODE By CHALLENGE			
		CH5	CH6	CH8	CH10
		CH0507	CH0607	CH0802	CH1003
Engagement	Vac37	X	X	X	X
	Vac38	X	X	X	X
City coaching	Vac39	X	X	X	X
Support activities	Vac40	X	X	X	X
	Vac41	X	X	X	X
	Vac42	X	X	X	X

- **Liverpool**

Table 2-5: NBS vs Challenge and KPIs match for Liverpool Subdemo A

LIV Subdemo A NBSs	CODE	CODE By CHALLENGE													
		CH1		CH2		CH4			CH5			CH6	CH7	CH9	CH10
		CH0103	CH0107	CH0201	CH0218	CH0403	CH0411	CH0412	CH0502	CH0504	CH0507	CH0601	CH0704	CH0902	CH1003
Re-naturing urbanization															
Arboreal Interventions	Lac5	X	X		X	X	X							X	
	Lac6	X	X		X		X					X			
Green Route	Lac1					X	X		X	X				X	
Resting Areas	Lac-add1		X	X	X		X		X	X			X		X
Water Interventions															
Green pavements	Lac10	X	X	X	X		X					X	X		
Flood actions	Lac4														
SUDs	Lac8	X	X	X	X		X					X	X		
Singular GI															
Pollinators	Lac12	X	X	X	X		X	X				X			
	Lac13	X	X				X	X	X	X			X		
Smart Soils	Lac11														
Horizontal GI	Lac16	X	X	X			X					X			
	Lac-add2		X		X		X		X	X	X				

Table 2-6: NBS vs Challenge and KPIs match for Liverpool Subdemo B

LIV Subdemo B NBSs	CODE	CODE By CHALLENGE												
		CH1			CH2	CH4			CH5		CH6		CH7	CH9
		CH0103	CH0107	CH0110	CH0218	CH0403	CH0411	CH0412	CH0504	CH0507	CH0601	CH0607	CH0704	CH0902
Re-naturing urbanization														
Arboreal Interventions	Lac5	X	X		X	X	X							X
	Lac6	X	X		X		X				X			
Green Route	Lac2	X					X			X		X	X	X
Water Interventions														
Flood actions	Lac4													
Singular GI														
Pollinators	Lac13	X	X				X	X	X				X	
	Lac14	X			X		X		X					
Vertical GI	Lac15	X	X	X		X	X	X		X			X	

Table 2-7NBS vs Challenge and KPIs match for Liverpool Subdemo C

LIV Subdemo C NBSs	CODE	CODE By CHALLENGE												
		CH1		CH2		CH4			CH5			CH6	CH7	CH9
		CH0103	CH0107	CH0201	CH0218	CH0403	CH0411	CH0412	CH0502	CH0504	CH0507	CH0601	CH0704	CH0902
Re-naturing urbanization														
Arboreal Interventions	Lac5	X	X		X	X	X							X
Green Route	Lac1					X	X		X	X				X
	Lac3													
Carbon capture	Lac9													
Water Interventions														
SUDs	Lac8	X	X	X	X		X					X	X	
	Lac-add3						X	X						
Singular GI														
Pollinators	Lac13	X	X				X	X	X	X			X	
	Lac12	X	X	X	X		X	X				X		
Smart Soils	Lac11													
Horizontal GI	Lac-add2		X		X		X		X	X	X			
	Lac16	X	X	X			X					X		

Table 2-8: NBS vs Challenge and KPIs match for Liverpool Non-technical actions

LIV NBSs	CODE	CODE By CHALLENGE						
		CH5			CH6	CH7	CH8	CH9
		CH0502	CH0504	CH0507	CH0601	CH0704	CH0802	CH0902
Non technical interventions								
City coaching	Lac27					X	X	
Educational activities	Lac18				X	X		
	Lac19				X	X	X	
	Lac20				X	X	X	
Engagement	Lac21					X	X	
	Lac22				X	X	X	
	Lac23				X	X	X	
	Lac24					X	X	
	Lac25				X	X	X	X
	Lac26				X	X	X	
Support activities	Lac28					X	X	
	Lac29					X	X	

	Lac30					X	X	
Pollutants filter	Lac17	X	X	X		X		

- **Izmir**

Table 2-9: NBS vs Challenge and KPIs match for Izmir Subdemo A

IZM Subdemo A NBSs	CODE	CODE By CHALLENGE					
		CH1				CH4	CH5
		CH0103	CH0107	CH0201	CH0218	CH0403	CH0504
Re-naturing urbanization							
Arboreal Interventions	Iac3			X	X		
Resting areas	Iac4	X	X	X		X	X
Singular GI							
Smart Soils	Iac10	X	X		X		
Horizontal GI	Iac14	X		X	X		X
	Iac15			X	X		
	Iac16	X		X	X		X

Table 2-10: NBS vs Challenge and KPIs match for Izmir Subdemo B

IZM Subdemo B NBSs	CODE	CODE By CHALLENGE								
		CH1	CH2		CH4			CH5	CH8	CH10
		CH0101	CH0215	CH0216	CH0408	CH0411	CH0412	CH0504	CH0802	CH1003
Water Interventions										
SUDs	Iac6		X				X	X		
Singular GI										
Pollinators	Iac11						X			
Urban farming	Iac17			X	X				X	X
	Iac18	X								
Smart soils	Iac9	X								
Non Technical Interventions										
Educational Activities	Iac20					X			X	
	Iac21								X	
	Iac22								X	
Engagement	Iac24								X	X
	Iac25								X	X
	Iac26								X	

Table 2-11: NBS vs Challenge and KPIs match for Izmir Subdemo C

IZM Subdemo C NBSs	CODE	CODE By CHALLENGE											
		CH1				CH2	CH4				CH5	CH6	CH9
		CH0101	CH0103	CH0105	CH0107	CH0215	CH0403	CH0407	CH0411	CH0412	CH0504	CH0601	CH0902
Re-naturing urbanization													
Green route	Iac1	X	X				X	X	X		X		X
Arboreal interventions	Iac2	X	X	X	X	X						X	
Carbon capture	Iac5	X	X				X					X	
Water Interventions													
Flood actions	Iac7						X						X
Green pavements	Iac8			X	X	X							
Singular GI													
	Iac12									X	X		
Vertical GI	Iac13									X			
Non Technical Interventions													
Educational Activities	Iac19												

2.1.2 Selection criteria for KPIs

In this subsection selection criteria for KPIs of each frontrunner city of URBAN GreenUP explained and previous deliverables that cities told the story behind KPI selection referred.

- **Valladolid**

Details of KPI selection process for NBSs in Valladolid can be found in D2.4: Monitoring program to Valladolid.For each KPI, the document describes the rationale for measuring the indicator, including associated literature that suggests why it may be important and/or relevant. The monitoring procedures are then outlined in general terms, with respect to the methods and approaches appropriate for each discipline. To allow for these disciplinary differences, the document is divided into two parts, with the first outlining biophysical monitoring procedures and the second part outlining socio-economic monitoring procedures. Each section concludes with a plan for management and sharing of the data generated over the course of the URBAN GreenUP project and beyond.

The identification of monitoring indicators in Valladolid has evolved from the first selection of indicators to the present. In an initial phase on 2017, a series of indicators were identified from the list included in the Eklipse methodology which could be of interest for the Valladolid demo. However, with the development of the project, limitations have been identified in order to obtain reliable data to calculate these KPIs. This has meant that some KPIs have been changed for others more appropriate to real needs.

- **Liverpool**

To establish the parameters of the URBAN GreenUP delivery and monitoring protocols, the Liverpool project team have drawn on the Eklipse documents in developing its KPIs. This has led to the development of set of KPIs that: 1) Are relevant to our interventions; 2) Can be robustly and consistently measured; and 3) Aligns with the human and financial resources available for the project. These criteria are comparable to the areas of concern and subsequent investigation that would be used by any city interested in evaluating the efficiency and effectiveness of their investment in NBS. Based on these criteria, the Liverpool project team have developed a list of KPIs in table 1 of D3.4: Monitoring program to Liverpool that will be used to develop a baseline and to monitor post-intervention effectiveness or change.

To establish the parameters of the URBAN GreenUP delivery and monitoring protocols, the Liverpool project team drew upon the Eklipse documents in developing its KPIs. This has led to the development of set of KPIs that:

1) Were relevant to our interventions;

2) Could be robustly and consistently measured; and

3) Aligned with the human and financial resources available for the project.

In short, the key aim was to identify which KPIs best quantified the impacts of NBS which are hypothesised to have multiple benefits, so we wanted to measure multiple axes. Throughout the decision-making process Liverpool team maintained the principles of identifying KPIs that could be monitored effectively, and were repeatable and at reasonable cost.

In reality Liverpool team had to balance the ideal and practical workarounds about when and where to monitor, and allow time for slow-acting effects. Through discussion the Liverpool partners agreed the KPIs that were able to be evidenced at a frequency ideally tailored to natural range of variability and appropriate to the NBS installed.

Details of KPI selection process for NBSs in Liverpool can be found in D3.4: Monitoring program to Liverpool.

- **Izmir**

Izmir team decided that each KPI requires a clear and simple protocol, in order to arrive at an effective and comparable monitoring program. By protocol we mean every step from recording raw data (or obtaining it from publicly available sources), through any data processing and modelling that may be necessary, to the final KPI, which can be reported.

Each protocol will typically include:

- Whether the KPI is directly measured or modelled based on e.g. a map.
- The choice of sensor or measuring instrument and why that was chosen (if needed).
- Which NBS the KPI is relevant to (although in some cases some KPIs are best measured across a whole demo area or whole city and not attributable to individual NBS interventions).
- When (frequency and duration) and where (extent and placement relative to NBS) measurements are made.
- Method to be followed by the measurer, if not automated.

- Method for data post-processing and modelling, software, if relevant, including GIS methods.
- For core KPIs, Izmir team will also contrast *minimum* standards for the protocol and *desirable* standards, which would lead to better data if time and resources allow.

D4.4: Monitoring program for Izmir outlines the monitoring protocols proposed for the City of Izmir URBAN GreenUP interventions, following Task 4.6: Development of the monitoring programme, and in line with the higher order principles outlined in D5.3: City Diagnosis and Monitoring Procedures. Key information about the City of Izmir, the rationale for developing the interventions and their locations are provided in the diagnosis and baseline reports (i.e. D4.1: Report on the Diagnosis of Izmir and D3.2: Baseline Document for Izmir). These provide an important contextual basis for this monitoring protocol, which focuses only on the principles and procedures of the biophysical and social monitoring.

2.1.3 Barriers and Challenges on selection of KPIs

Front-runner cities of the project have suffered from the similar barriers and challenges and the same questions have raised for each of them. Due to these common issues in this sub section the barriers and challenges on selection of KPIs explained in an integrated text for all of the cities.

First challenge each city faced with is related with issues in when and where to monitor and to find the ideal and practical workarounds. Cities answered these questions as following:

When: ideally before and after and allowing time for slow-acting effects. Frequency ideally tailored to natural range of variability (e.g. no need to monitor every day if change slow; no need to monitor in winter if summer is when effects occur. However, monitoring before and after intervention should use the same time schedule). Workarounds might include using different baseline data sources.

Where: at relevant NBS and/or close to relevant NBS where effects are hypothesised to reach; Sampling and representativeness; ideally sample control sites in BACI design. Workarounds might include taking an arbitrary sample instead of a random sample (e.g. a bus route).

Selection of important KPIs matters for city and further projects is the other challenge for cities. It is critical that to select the KPIs directly related with main challenges of the city like heat island effect, air pollution, carbon sequestration etc. According to this selection and possible results cities will plan future projects and this makes the selection important for future.

Regarding this selection cities considered 10 Challenges of the Eklipse Methodology and adaptation of previous selection with this methodology was another barrier for cities.

Besides the Eklipse Methodology cities have considered NBSs going to be implemented in the city to eliminate some KPIs and decide the best options.

Availability and accessibility to baseline data was another barrier that made a considerable effect on selection of KPIs. The main goal by implementing NBS within cities to investigate their positive effects in the future and if the baseline data is not available or accessible this creates a huge problem for cities to overcome. This situation occurs with several KPIS, and an example in

case of Valladolid demo given as following. Energy efficiency KPIs, such as "*Energy and carbon savings from reduced building energy consumption*" will be calculated at the Green Roof and the Green Wall. They are expected to be calculated through several methodologies, some of the including direct measurement and some others considering its estimation from building energy consumptions. The second methodology is defined to compare energy consumptions before and after NBS implementation in buildings. However, data of the historical energy consumption of the market and the commercial building in which NBS are installed is not available and, when available, it is not detailed enough.

Other examples occur with the limited availability of economic data disaggregated at the building or street level of detail that URBAN GreenUP NBS monitoring requires. Economic data exists at the city level or at the macro level.

During the KPI selection process cities have considered legal barriers as well. The owner of data is one of the main topics. To have a sustainable monitoring process, cities should have been sure the institution or person which is the owner of the data or the land that measurement will continue would give necessary access.

Another legal barrier related with monitoring was permissions on measurements. In this case, as an example, Izmir team have to solve the legal constraints related with ownership and flight permits of drones to start and continue drone-based monitoring activities.

The definition and distribution of monitoring responsibilities between partners and third parties in some cases were another challenge for cities. The availability of economic and human sources is another barrier to be solved by considering the responsibilities.

The barriers and challenges on selection of KPIs during decision making and monitoring processes can be diversified with more examples. Cities will reveal more examples in chapter 4: Success Stories – Failures - Barriers and Boundaries on data collection - COVID Effect in D5.7: Data collection procedures.

2.1.4 Questions to prioritize the KPIs

In this section the list of questions and their explanations to better understand the prioritization process is given in table Table 2-12.

This list of questions was prepared by considering questions presented in Coaching and Mentoring workshop organized on 12th of May 2020 during 6th periodic meeting of the project. To expand the question list and to make the questions well targeted, the feedbacks from partners of front runner cities and follower cities have been considered.

Table 2-12: List of questions for prioritization criteria

List of Questions	Comments / Explanations
Q1 - Is the methodology/KPI credible?	Who uses this method? Is it recognized as best practice or widely accepted/used in decision making or compliance monitoring?
Q2 - Is it practical, reliable and replicable?	Can one/two people do this quickly and accurately?

Q3 - Does other similar data exist for comparison and benchmarking?	Here or in other comparable cities or partner cities. Are there accepted thresholds?
Q4 - Does it offer good value for time/money invested?	Can we get results quite quickly? Are consumables and parts affordable? Is it resource efficient?
Q5 - Will it further our understanding / add value to the NBS solutions? How much does it tell the story of the NBS solutions?	Is it meaningful? Is it appropriate? Is it understandable? Is it convincing?
Q6 - Do we have the expertise/software/time to make the analysis?	Can this be done in-house? Is there a training need?

2.2 The need for Prioritization of KPIs

Depending on the user community, NBS are shaped as ecosystem-based adaptation (EbA), Green Infrastructure (GI), ecosystem-based Disaster Risk Reduction (EcoDRR), or Natural Water Retention Measures (NWRM). They all deliver multiple benefits, based on the assumption that ecosystems, if in healthy condition, deliver at the same time important services for human well-being and address economic, social, and environmental targets, including climate change adaptation and mitigation and biodiversity conservation, enhancement, and restoration.

NBS can be defined as "solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience". NBS bring together established ecosystem-based approaches, such as 'ecosystem services', 'green-blue infrastructure', 'ecological engineering', 'ecosystem-based management' and 'natural capital' with assessments of the social and economic benefits of resource-efficient and systemic solutions that combines technical, business, finance, governance, regulatory and social innovation (European Commission, 2015). NBS, therefore, are directly relevant to several policy areas and through their systemic nature interact with many others, such as land use and spatial planning. NBS are also seen as open innovations that require engagement with multiple actors, providing co-benefits that bridge social and economic interests and as thus, can stimulate new green economies and green jobs.

The assessment of environmental impacts was in many cases restricted to single challenge areas (e.g., biodiversity, ecosystems) and rarely addressed cross-sectoral impacts (e.g., links between biodiversity, and the economy). Moving to solution implementation requires decision-making toolkits that simplify and systematize the monitoring and evaluation of co-benefits in decision support; processes for reflecting, connecting and investigating, modelling and exploring, doing and suggesting solutions; and supporting multi-dimensional communication networks for delivering co-benefits in real-world contexts.

NBS implementation requires political, economic and scientific challenges to be addressed simultaneously by several actor groups. Practitioners need to consider elements of urban management, biodiversity, governance and social innovation within a socio-ecological system, and to integrate diverse types and systems of knowledge and values for NBS design and

implementation so as to be socially comprehensible and acceptable to a range of stakeholders[2]. Both monetary and non-monetary values need to be considered in this process given that economic valuation alone misses nuances in socio-cultural valuation.

When prioritising actions, planners need to minimise the use of 'hard adaptation measures' that are often associated with high costs, inflexibility and conflicting interests. The type of data available for monitoring and assessing actions may influence the types of actions to be considered for NBS design and implementation.

2.3 KPI Prioritization Tool

In this section all elements (NBSs, challenges, KPIs, questions, valuation etc.) of the tool and their roles in the tool are explained.

In the KPI prioritization process, the challenges defined by the EKLIPSE methodology, re-adapted in URBANGreenUP T1.2-D1.2 and identified for each city on earlier studies of the project, will be listed. For each challenge listed, the KPIs previously determined in WP5 monitoring studies will appear in the next column. Then, the cities will match those KPIs with NBSs which are being implemented in their demo sites and listed in the top two rows of the matrix. Taking into consideration the results of this output and the pre-determined prioritization questions, a score between 1 and 5 will be assigned to each KPI to determine the priority of this KPI for each NBS. The list of the questions and their explanations are given in the table in section 2.1.4 Questions to prioritize the KPIs.

The output of this entire process will reveal a result similar to the example table below.

Table 2-13: An example of output of prioritization matrix

				NBS_LEVEL1	Green route	Arboreal interventions
				NBS_LEVEL2	Cycle and pedestrian green route	Shade trees
CH	**Challenge Name**	**KPI**	**KPI name**	**Question**	**Score**	**Score**
01	Climate mitigation & adaptation	CH0101	Ton C02 CARBON REMOVED per Ha	01	2	1
01	Climate mitigation & adaptation	CH0101	Ton C02 CARBON REMOVED per Ha	02	3	4
01	Climate mitigation & adaptation	CH0101	Ton C02 CARBON REMOVED per Ha	03	5	0
01	Climate mitigation & adaptation	CH0101	Ton C02 CARBON REMOVED per Ha	04	4	4
01	Climate mitigation & adaptation	CH0101	Ton C02 CARBON REMOVED per Ha	05	1	4
01	Climate mitigation & adaptation	CH0101	Ton C02 CARBON REMOVED per Ha	06	5	2
Average score KPI:CH0101					3.33	2.5

[2] Raymond C. "A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas",

As seen in the bottom row of the table above, the average value will be determined as a result of the scoring for 6 questions. Scoring will be made by project teams of each city by internal discussions. Based on these averages, the city's KPI prioritization will be visualized as follows via the spider diagram given in section 3.1.

3 Expected Results and Advantages of Prioritization Tool (DEM)

3.1 Expected Results

It is necessary to visualize the results from scoring and all other inputs to explain prioritization better to users of the matrix. A diagram will be helpful to show all KPIs and their prioritization for a specific NBS.

The figure below visualizes the results of scoring obtained by answering 6 questions described above.

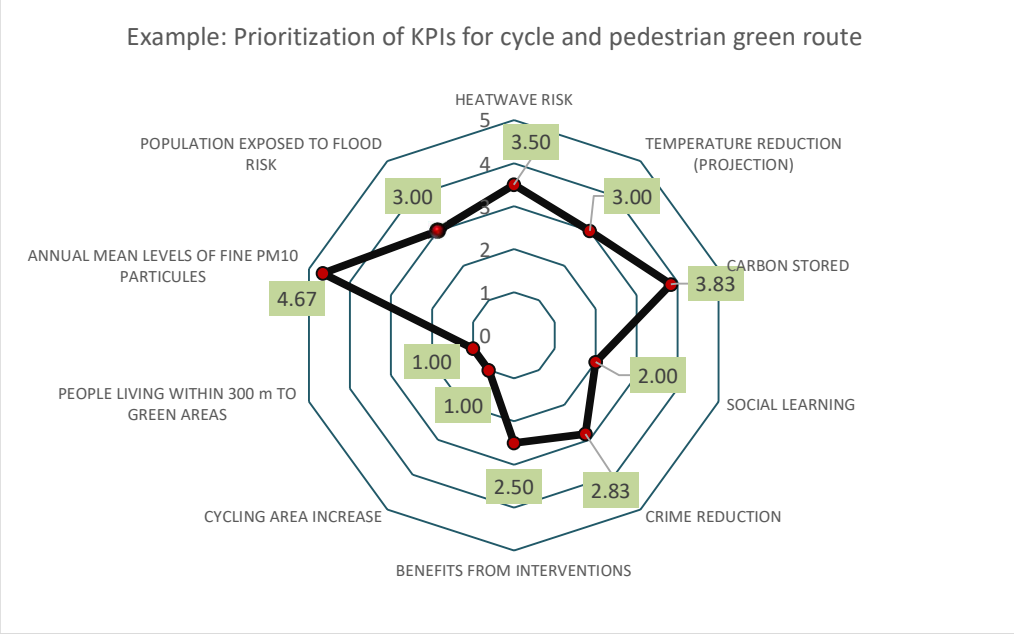

Figure 3-1: A diagram to visualize the results of prioritization process

Users can see the average scores and ranking of each KPI for a specific NBS. According to previous experiences of Izmir demo team of the project, priority ranges are determined and interpreted as follows:

Between 1.00 and 2.50; minor priority

Between 2.50 and 3.75 medium priority

Between 3.75 and 5.00 high priority

About these ranges there will be discussions with other project teams and the final decisions will be adapted to the matrix. These ranges are necessary to make the results visual with another option besides the diagrams. 3 colour code will be used in the matrix to explain priorities to users:

- Red for minor priority

- Yellow for medium priority

- Green for high priority

An example for this method can be seen in Figure 3-2 below.

				NBS_LEVEL1	Green route	Arboreal interventions
				NBS_LEVEL2	Cycle and pedestrian green route	Shade trees
CH	Challenge Name	KPI	KPI name	Average Score		
01	Climate mitigation & adaptation	CH0101	Ton C02 CARBON REMOVED per Ha		2.166666667	1.5
01	Climate mitigation & adaptation	CH0102	Ton C02 CARBON REMOVED per year		2.833333333	2.5
01	Climate mitigation & adaptation	CH0103	CARBON STORED		3	2.833333333
01	Climate mitigation & adaptation	CH0105	TEMPERATURE DECREASE		2	2.666666667
01	Climate mitigation & adaptation	CH0106	TEMPERATURE REDUCTION (PROJECTION)		2.666666667	2.5
01	Climate mitigation & adaptation	CH0108	HEATWAVE RISK		0	4.333333333

Figure 3-2: Visualization of the results of prioritization process by colour codes

Cities should put high priority KPIs at the forefront to allocate resources. Evaluation of the results of these prioritized KPIs will play a key role to understand the project outcomes.

3.2 Advantages of the Tool

The main advantage of the ToolUGU which explained under chapter 4 of this document and the matrix for KPI prioritization is avoiding time and work loss during decision making process of KPI selection.

By using this matrix, users will face less barriers and challenges which listed and explained in detail under subsection 2.1.3 Barriers and Challenges on selection of KPIs. By considering those barriers and challenges with using this matrix users can overcome these with less effort.

One of the other important advantage is the tool will allow users to better evaluate and understand which KPIs suit their priorities about their city in terms of design, implementation and monitoring of NBSs.

By answering the questions defined in subsection 2.1.4 and will be used for scoring of KPIs users will find answers to the possible future challenges before they spend time on their monitoring studies. They will evaluate the credibility of methodology, reliability and replicability of KPIs, sustainability of monitoring, investments on monitoring, benchmarking possibilities, ownership of necessary sources etc.

Visualized results will give better evaluation and understanding chance to the users. Also by using those visuals users may explain their approach to other city partners who might involve implementation and monitoring activities during further projects.

4 Linking KPI Prioritization to URBAN GreenUP's Scenarios Tool

ToolUGU which has been defined under chapter 3 of D1.7 will offer a set of solution using NBS to specific city challenges following the user's requirements. The tool will generate one or several NBS scenarios integrating the knowledge developed in URBAN GreenUP about NBS and challenges (deliverable 1.1 and 1.2), existing barriers, boundaries and enablers (deliverable 1.5) and collecting user requirements and actuation characteristics following the framework defined in the city diagnosis and baseline definition process (deliverables 1.3 and 1.4).

In order to clarify concepts, a **scenario** is defined as a set of NBS selected to respond to the city challenges under a determined city context including physical, environmental and socioeconomic characteristics and taking into account existing barriers and boundaries. This context and boundary conditions are defined by a previous city/area diagnosis. This scenario could be generated for a specific street, neighbourhood, area or city.

NBS scenarios will be the result of the user interaction with ToolUGU. The user will examine the NBS scenario characteristics (NBS included, links to document and implementation guides, recommended KPIs to assess the impact…) and will decide if it is adequate according to its expectations or if another iteration is needed. Task 1.6 was planned with two complementary and simultaneous sub-task:

- T1.6.1 NBS scenarios generation tool
- T1.6.2 KPIs calculation prioritization criteria

Both tasks are complementary to build ToolUGU. Relationships **NBS / Challenges** and **NBS / Barriers and boundaries** (this also includes enablers) are collected from previous information generated within the Project. This information serves to filter in some way user requirements and select the best NBS to face up the challenges identified by the user and its context.

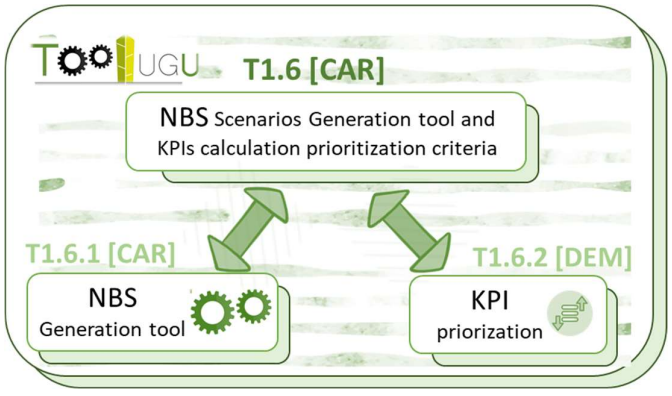

Figure 4-1: Sub-tasks included in task 1.6.

The link between KPIs prioritization and NBS Scenarios Generation Tool is explained in more detail under section 2.2.2 of D1.7.

5 Conclusions

In this document, the whole story behind KPI selection, the final list, selection criteria, barriers and challenges during decision making process and questions to evaluate KPI selection and prioritization explained in connection with each other by collecting experiences of all frontrunner cities of URBAN GreenUP project.

ToolUGU and its relation with KPI prioritization matrix are evaluated and described by considering the definition of Task 1.6: NBS scenarios generation tool and KPIs calculation prioritization criteria.

The KPI prioritization matrix described by explaining all its components (NBSs, challenges, KPIs, questions, scoring, possible results and visualization of results). Advantages of using this matrix is investigated to make users better understand the necessity behind this study.

The previous experiences, feedbacks and current approaches of all frontrunner and follower cities within the project used during building the structure and detailing contents under chapters of the document.